

**Cessna®**  
**MODELS'**  
**1967**

**310 L**

**and 1968**

**310-N**

**FOREWORD**

This Service Manual contains factory recommended procedures and instructions for ground handling, servicing and maintaining the Cessna 310 aircraft. Where specific reference is made to the 310 aircraft in this Service Manual this reference applies to 310L and 310N type certificated aircraft. Besides serving as a reference for the experienced mechanic, this Service Manual also covers step-by-step procedures for the less experienced mechanic. This Service Manual should be kept in a handy place for ready reference. If properly used, it will better enable the mechanic to maintain the Cessna 310 aircraft and thereby, establish a reputation for reliable service.

The information in this Service Manual is based on data available at the time of publication, and is supplemented and kept current by Service Letters and Service News Letters published by Cessna Aircraft Company. These are sent to all Cessna Dealers so that they have the latest authoritative recommendations for servicing Cessna airplanes. Therefore, it is recommended that Cessna owner's utilize the knowledge and experience of the factory-trained Dealer Service Organization.

In addition to the information in this Service Manual, a group of vendor publications are available from the Cessna Customer Services Department which describe complete disassembly, overhaul and parts breakdown of some of the various vendor equipment items. A listing of the available publications is issued periodically in Service Letters.

**•SERVICE MANUAL**

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CESSNA AIRCRAFT COMPANY • WICHITA, KANSAS

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**NOVEMBER 1967**

## CESSNA 310 Service Manual 1967 thru 1968

### REVISION INFORMATION - 01/08/2002

This product is sold "as is". The end-user is responsible for determining the accuracy of the information provided by this product and for obtaining any revision(s) affecting the information provided by this product. The user should contact the aircraft manufacturer for revision information. The following information is provided for your convenience. It is believed to be accurate however the accuracy of the following information is not guaranteed.

The original date of this service manual is November 1967.

No changes or revisions have been incorporated into the 1967-1968 Cessna 310 service manual on this .pdf file.

The service manual **does not include** the following revision(s):

Temporary Revision Number 1, dated April 16, 1993

The reason for the revision:

- Added FAA approval statement to Title page.
- Corrected figure 1-6 for bolt removal during lubrication of landing gear actuator.
- Added inspection time limits for emergency exit window.
- Relocate oxygen system component inspection time limits from Section 12 to Section 2.
- Corrected flap actuator and gearbox overhaul time limits.
- Corrected engine compartment rubber hose replacement time limits.

Temporary Revision Number 2, dated November 12, 1993

The reason for the revision:

- Corrected inspection time limits for emergency exit window.
- Corrected overhaul time limits for landing gear.
- To add nose landing gear trunnion pivot bearing lubrication.

Temporary Revision Number 3, dated June 15, 1999

The reason for the revision:

- Added inspection time limits/replacement of check valve manifold.

Temporary Revision Number 4, dated December 15, 1999

The reason for the revision:

- Revised propeller mounting nut torque information.

**End of revision information.**

INSERT LATEST CHANGED PAGES. DESTROY SUPERSEDED PAGES

**LIST OF EFFECTIVE PAGES**

NOTE: The portion of the text affected by the current change is indicated by a vertical line in the outer margin of the page.

TOTAL NUMBER OF PAGES IN THIS PUBLICATION IS 518 CONSISTING OF THE FOLLOWING:

\* The asterisk indicated pages changed, added or deleted by the current change.

# TABLE OF CONTENTS

| SECTION |                                                           | PAGE |
|---------|-----------------------------------------------------------|------|
| 1       | GENERAL INFORMATION .....                                 | 1-1  |
| 2       | GROUND HANDLING, SERVICING AND INSPECTION .....           | 2-1  |
| 3       | AIRFRAME .....                                            | 3-1  |
| 4       | LANDING GEAR AND BRAKE SYSTEM .....                       | 4-1  |
| 5       | CONTROL COLUMN,<br>AILERON AND TRIM CONTROL SYSTEMS ..... | 5-1  |
| 6       | ELEVATOR AND TRIM CONTROL SYSTEMS .....                   | 6-1  |
| 7       | RUDDER AND AND TRIM CONTROL SYSTEMS .....                 | 7-1  |
| 8       | FLAP CONTROL SYSTEM .....                                 | 8-1  |
| 9       | ENGINE .....                                              | 9-1  |
| 10      | PROPELLER SYSTEM .....                                    | 10-1 |
| 11      | FUEL SYSTEM .....                                         | 11-1 |
| 12      | INSTRUMENT AND RELATED SYSTEMS .....                      | 12-1 |
| 13      | UTILITY AND OPTIONAL SYSTEMS .....                        | 13-1 |
| 14      | ELECTRICAL SYSTEMS .....                                  | 14-1 |
| 15      | ELECTRONICS SYSTEMS .....                                 | 15-1 |
| 16      | STRUCTURAL REPAIR .....                                   | 16-1 |



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## SECTION 1

## GENERAL INFORMATION

## Table of Contents

|                                            | Page |
|--------------------------------------------|------|
| GENERAL DESCRIPTION . . . . .              | 1-1  |
| PRINCIPAL DIMENSIONS . . . . .             | 1-1  |
| ACCESS AND INSPECTION PROVISIONS . . . . . | 1-2  |

## GENERAL DESCRIPTION.

The Model 310 is an all-metal, low-wing, twin-engine aircraft built by the Cessna Aircraft Company of Wichita, Kansas. The aircraft is powered by two continental six-cylinder horizontally-opposed, fuel-injection IO-470-VO engines driving constant-speed, all-metal, full-feathering propellers. Flight adjustable trim tabs are located on the right elevator, left aileron and rudder. The split-type wing flaps are electrically operated. The aircraft is equipped with fully retractable, electrically operated, tricycle-type landing gear.

## PRINCIPAL DIMENSIONS.

|                                      |             |
|--------------------------------------|-------------|
| GROSS WEIGHT . . . . .               | 5200 Pounds |
| EMPTY WEIGHT (approximate) . . . . . | 3125 Pounds |
| USEFUL LOAD . . . . .                | 2017 Pounds |

## MAXIMUM BAGGAGE:

|                                 |                 |
|---------------------------------|-----------------|
| Wing Lockers . . . . .          | 120 Pounds Each |
| Cabin Baggage Section . . . . . | 200 Pounds      |

ENGINES: Continental IO-470-VO, 6-Cylinder, Opposed,  
Fuel Injected, Wet Sump

|                                           |          |
|-------------------------------------------|----------|
| Spark Plugs . . . . .                     | SL-300A  |
| Magnetos (Bendix) LH . . . . .            | S6RN-201 |
| (Bendix) RH . . . . .                     | S6RN-205 |
| (See Section 9 for Engine Specifications) |          |

## PROPELLERS:

|                                         | (2 Blades Standard) | (3 Blades Optional) |
|-----------------------------------------|---------------------|---------------------|
| McCaughey . . . . .                     | D2AF34C81/84JF-3    | D3AF-32C80/82NC-4   |
| Propeller Governor (Woodward) . . . . . | 0750101-69          | 0750101-69          |
| Diameter . . . . .                      | 81.00 Inches        | 78.00 Inches        |
| Blade Angles                            |                     |                     |
| Low Pitch Angle . . . . .               | 12.8° ± 0.2°        | 12.5° ± 0.2°        |
| Blade Latch Angle . . . . .             | 14.5° ± 0.5°        | 14.0° ± 0.5°        |
| Feathered Angle . . . . .               | 82.6° ± 0.4°        | 81.3° ± 0.4°        |

BATTERIES: . . . . . 0511319-201

## FUEL CAPACITY:

|                                         |                    |
|-----------------------------------------|--------------------|
| Main Tanks (each wing) . . . . .        | 51.0 U.S. Gallons  |
| Usable (each wing) . . . . .            | 50.0 U.S. Gallons  |
| Auxiliary Tanks (each wing) . . . . .   | 20.50 U.S. Gallons |
| Usable (each wing) . . . . .            | 20.00 U.S. Gallons |
| Wing Locker Tanks (each wing) . . . . . | 20.30 U.S. Gallons |
| Usable (each wing) . . . . .            | 20.00 U.S. Gallons |



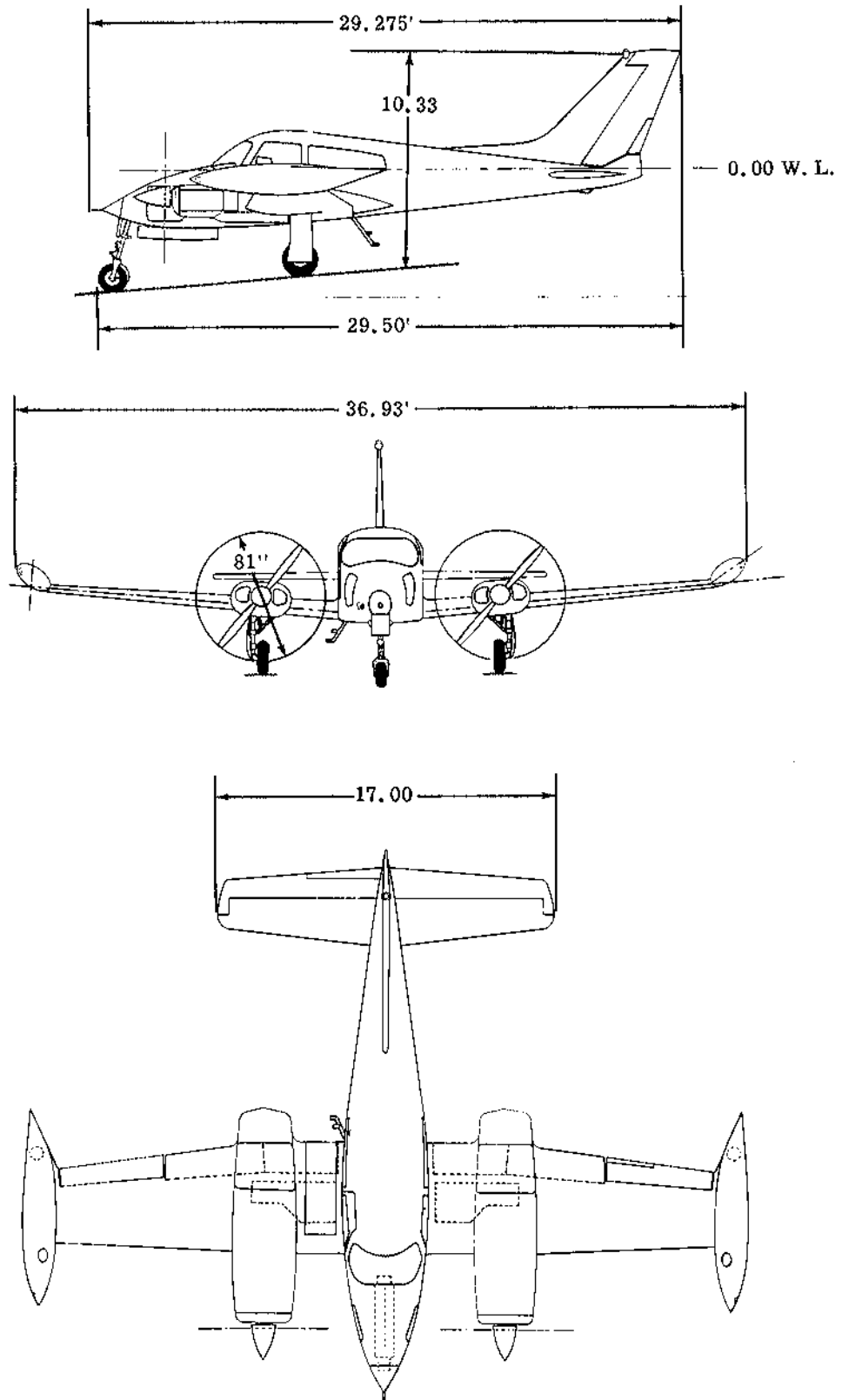


Figure 1-1. Three View 310L and 310N Aircraft

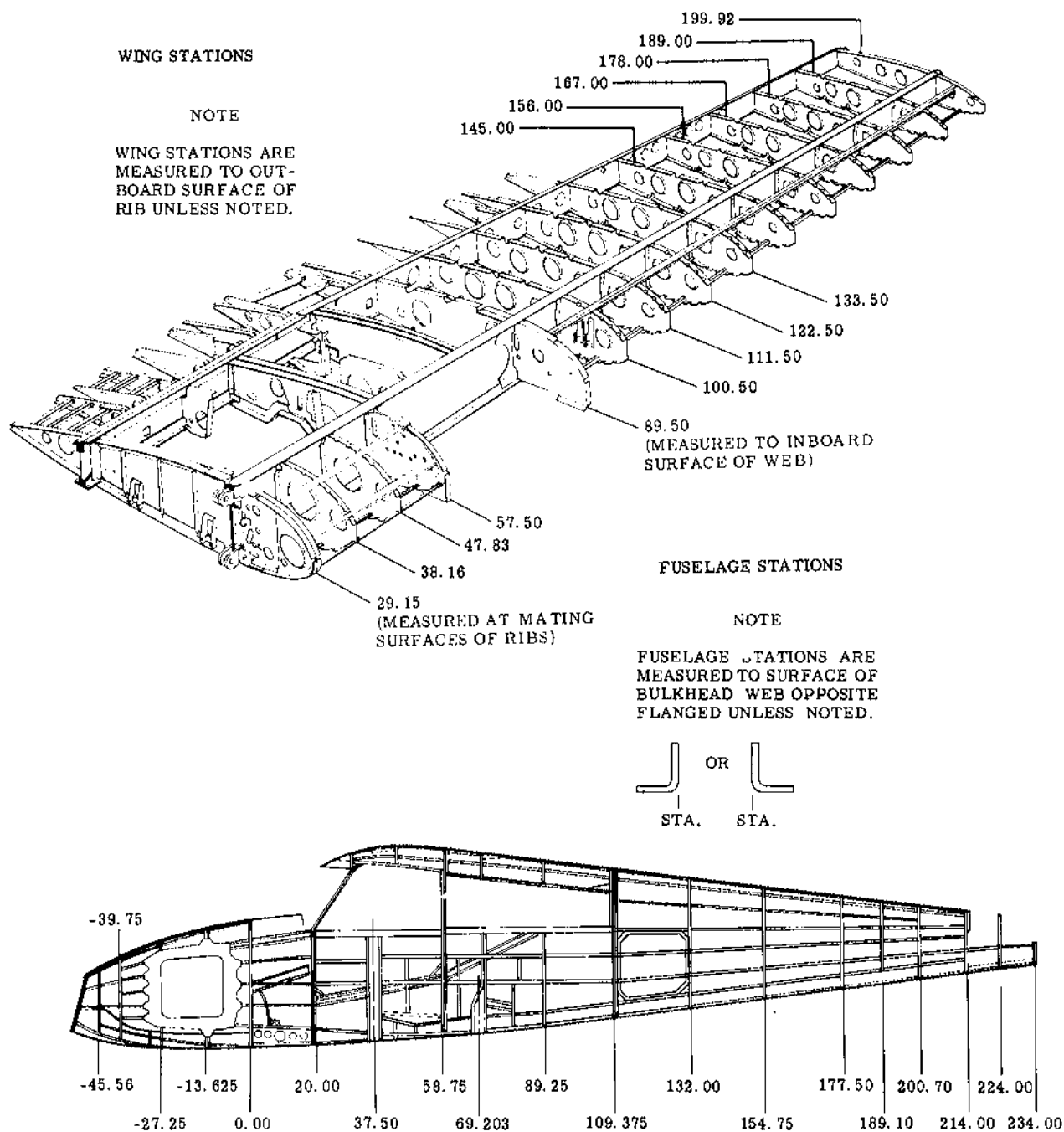


Figure 1-2. Station Diagrams (Sheet 1 of 2)

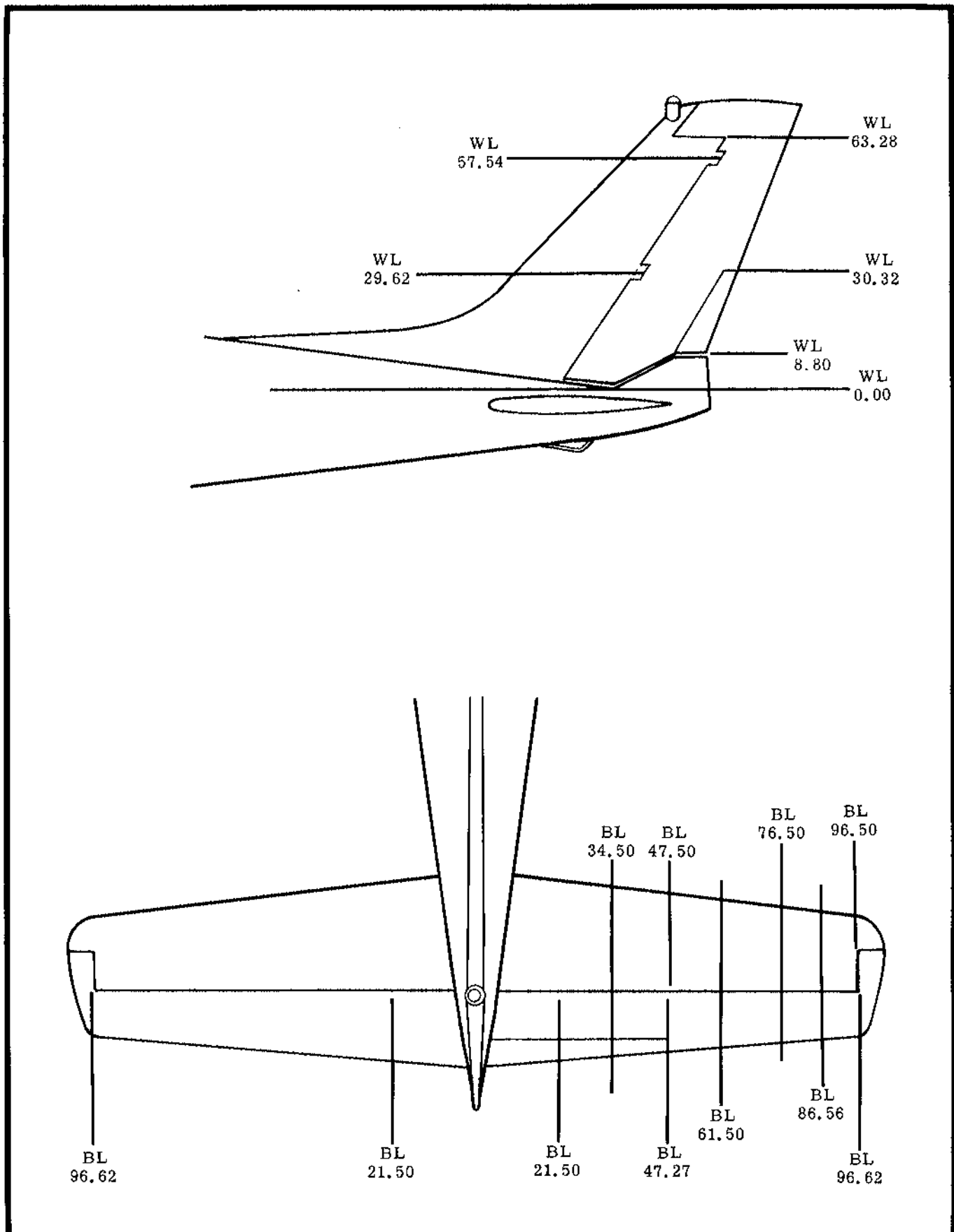
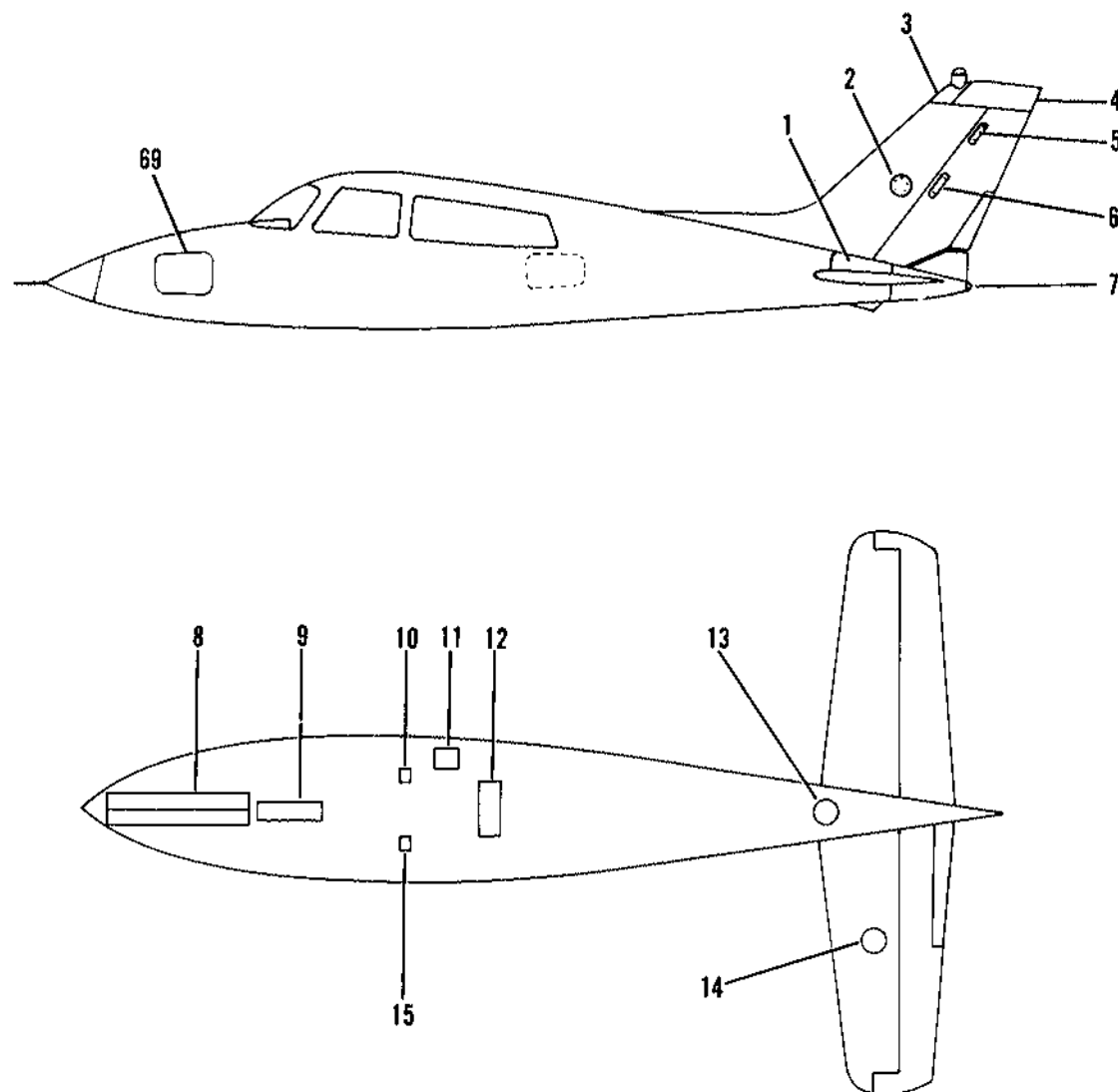
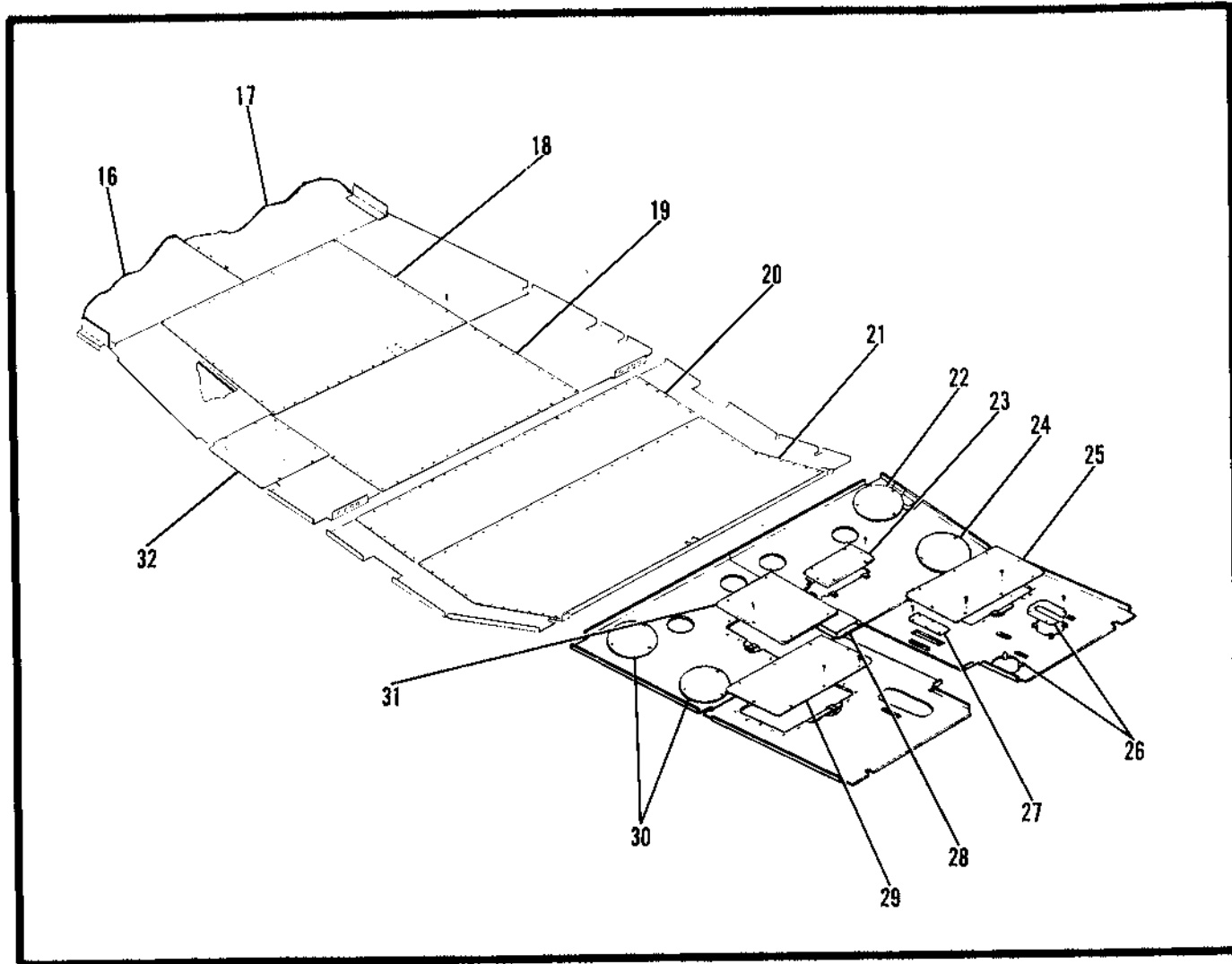


Figure 1-2. Station Diagrams (Sheet 2 of 2)



- |                                |                                 |
|--------------------------------|---------------------------------|
| 1. Stabilizer Fairing          | 11. Nose Gear Bellcrank Access  |
| 2. Rudder Trim Access          | 12. Flap Motor Access           |
| 3. Fin Tip                     | 13. Elevator Bellcrank Access   |
| 4. Rudder Tip                  | 14. Elevator Trim Access        |
| 5. Upper Rudder Access         | 15. Lower Spar Cap Access (RH)  |
| 6. Lower Rudder Access         | 16. Baggage Floor (RH)          |
| 7. Stinger Assembly            | 17. Baggage Floor (LH)          |
| 8. Nose Gear Door              | 18. Center Floorboard (Aft)     |
| 9. Control Cable Access        | 19. Center Floorboard (Forward) |
| 10. Lower Spar Cap Access (LH) | 20. Interspar Floorboard (Aft)  |

Figure 1-3. Inspection Plates and Access Panels (Sheet 1 of 3)



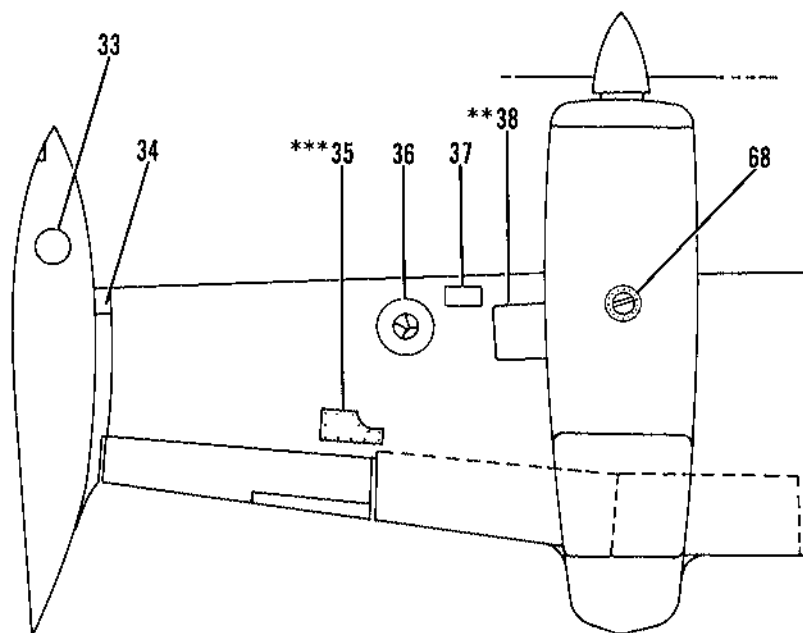
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|-----------------------------------------------|---------------------------------------------|
| 21. Interspar Floorboard (Forward)            | 45. Fuel Line Access                        |
| 22. Deice Line Access                         | 46. Fuel Strainer and Selector Valve Access |
| 23. Aileron Cable Access                      | 47. Fuel Line Access                        |
| 24. Deice Line Access                         | 48. Fuel Line Clamp Access (Inboard)        |
| 25. Brake Line Access                         | 49. Aileron Bellcrank Access                |
| 26. Master Cylinder Access                    | 50. Fuel Line Clamp Access (Outboard)       |
| 27. Elevator Trim Tab Pulley Access           | 51. Tie Down Ring Access                    |
| 28. Cover (Engine Controls)                   | 52. Leading Edge Access                     |
| 29. Rudder Cable Access                       | 53. Fuel Line Access                        |
| 30. Inspection Plate (Selector Valve Control) | 54. Main Fuel Tank Access                   |
| 31. Elevator Bellcrank Access                 | 55. Fuel Vent Line Access                   |
| 32. Retractable Step Access                   | 56. Rear Spar Access                        |
| 33. Main Tank Filler                          | 57. Inboard Wing Access                     |
| 34. Main Tank Gap Fairing                     | 58. Aileron Trim Access                     |
| 35. Aileron Bellcrank Access                  | 59. Plug Button (Aileron Trim)              |
| 36. Auxiliary Tank Filler                     | 60. Aileron Trim Pulley Access              |
| 37. Fuel Selector Valve Access                | 61. Plug Button (Outboard Flap)             |
| 38. Battery Access                            | 62. Outboard Flap Access                    |
| 39. Main Gear Door (Inboard)                  | 63. Aileron Cable Stops Access              |
| 40. Main Gear Door Access                     | 64. Auxiliary Power Plug                    |
| 41. Engine Controls Access                    | 65. Plug Button (Inboard Flap)              |
| 42. Heater Pump and Filter Access             | 66. Flap Bellcrank Access                   |
| 43. Vacuum Line Access                        | 67. Main Gear Door (Outboard)               |
| 44. Oil Sump Drain Plug                       | 68. Wing Locker Tank Filler (Optional)      |
|                                               | 69. Nose Access Door                        |

Figure 1-3. Inspection Plates and Access Panels (Sheet 2 of 3)



## NOTE

LH wing shown, RH is similar except as noted.



- \*LH Wing Only
- \*\*Battery and Fuel Quantity Sending Unit on LH Wing,  
Fuel Quantity Sending Unit on RH Wing
- \*\*\*LH Wing Only on Optional Wing
- \*\*\*\*LH Wing Only on Standard Wing

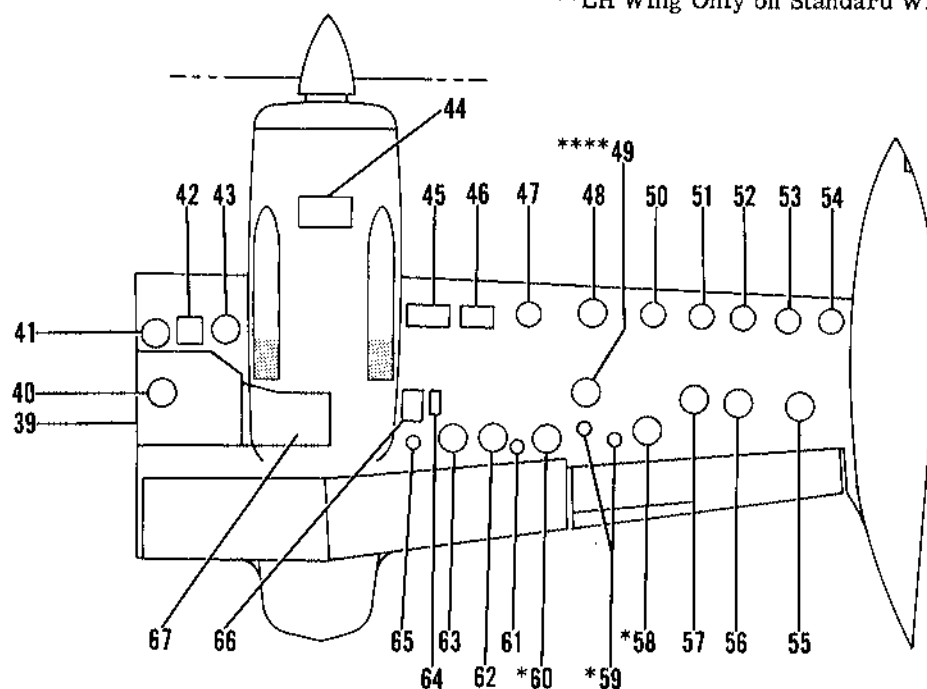


Figure 1-3. Inspection Plates and Access Panels (Sheet 3 of 3)



FINISH &amp; TRIM

SEAT UPHOLSTERY

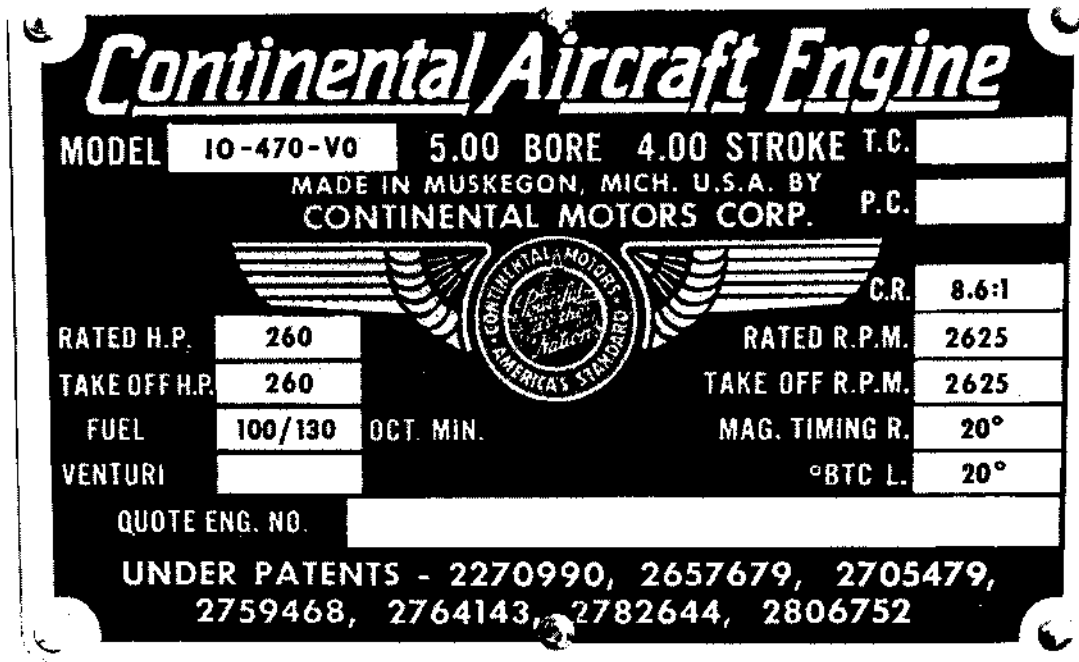


Figure 1-4. Serial Numbers and Identification Plates

TORQUE VALUES IN POUND-INCHESFINE THREAD SERIES

| BOLT SIZE<br>(See Note 1) | STANDARD TYPE NUTS<br>(See Note 2) |                                              | SHEAR TYPE NUTS<br>(See Note 4) |                                              |
|---------------------------|------------------------------------|----------------------------------------------|---------------------------------|----------------------------------------------|
|                           |                                    | Alternate<br>Values<br>AN310<br>(See Note 4) | MS20364, AN320<br>AN316, AN7502 | Alternate<br>Values<br>AN320<br>(See Note 4) |
| 10-32                     | 20-25                              | 20-28                                        | 12-15                           | 12-19                                        |
| 1/4-28                    | 50-70                              | 50-75                                        | 30-40                           | 30-48                                        |
| 5/16-24                   | 100-140                            | 100-150                                      | 60-85                           | 60-106                                       |
| 3/8-24                    | 160-190                            | 160-260                                      | 95-110                          | 95-170                                       |
| 7/16-20                   | 450-500                            | 450-560                                      | 270-300                         | 270-390                                      |
| 1/2-20                    | 480-690                            | 480-730                                      | 290-410                         | 290-500                                      |
| 9/16-18                   | 800-1900                           | 800-1070                                     | 480-600                         | 480-750                                      |
| 5/8-18                    | 1100-1300                          | 1100-1600                                    | 660-780                         | 660-1060                                     |
| 3/4-16                    | 2300-2500                          | 2300-3350                                    | 1300-1500                       | 1300-2200                                    |
| 7/8-14                    | 2500-3000                          | 2500-4650                                    | 1500-1800                       | 1500-2900                                    |
| 1-14                      | 3700-5500                          | 3700-6650                                    | 2200-3300                       | 2200-4400                                    |
| 1-1/8-12                  | 5000-7000                          | 5000-10000                                   | 3000-4200                       | 3000-6300                                    |
| 1-1/4-12                  | 9000-11000                         | 9000-16700                                   | 5400-6600                       | 5400-10000                                   |

COARSE THREAD SERIES

| BOLT SIZE<br>(See Note 1) | STANDARD TYPE NUTS<br>(See Note 3) | SHEAR TYPE NUTS<br>MS20364, AN320, AN316 |
|---------------------------|------------------------------------|------------------------------------------|
| 8-32                      | 12-15                              | 7-9                                      |
| 10-24                     | 20-25                              | 12-15                                    |
| 1/4-20                    | 40-50                              | 25-30                                    |
| 5/16-18                   | 80-90                              | 48-55                                    |
| 3/8-16                    | 160-185                            | 95-100                                   |
| 7/16-14                   | 235-255                            | 140-155                                  |
| 1/2-13                    | 400-480                            | 240-290                                  |
| 9/16-12                   | 500-700                            | 300-420                                  |
| 5/8-11                    | 700-900                            | 420-540                                  |
| 3/4-10                    | 1150-1600                          | 700-950                                  |
| 7/8-9                     | 2200-3000                          | 1300-1800                                |
| 1-8                       | 3700-5000                          | 2200-3000                                |
| 1-1/8-8                   | 5500-6500                          | 3300-4000                                |
| 1-1/4-8                   | 6500-8000                          | 4000-5000                                |

## NOTES:

- (1) AN3, AN23, AN42, AN173, MS20004, NAS334, NAS464 Series bolts; AN502, AN503, NAS220 and NAS517 Series Screws.
- (2) AN310, AN315, AN345, AN362, AN363, MS20365, AN366, "EB", "1452", "Z1200," "UWN" and other self-locking nuts.
- (3) AN310, AN340, MS20365, AN366 and other self-locking anchor nuts.
- (4) When using AN310 and AN320 castellated nuts where alignment between bolt and cotter pin holes is not reached using normal torque values, use alternate torque values or replace nut.

These torque values are recommended for all procedures contained in this book except where other values are stipulated.

Figure 1-5. Torque Values

## SECTION 2

**GROUND HANDLING, SERVICING AND INSPECTION**

## Table of Contents

|                                                 |      |                                              |       |
|-------------------------------------------------|------|----------------------------------------------|-------|
| GENERAL DESCRIPTION . . . . .                   | 2-1  | Flap System . . . . .                        | 2-13  |
| GROUND HANDLING . . . . .                       | 2-1  | Engine Assembly . . . . .                    | 2-13  |
| Towing . . . . .                                | 2-2  | Engine Oil Pressure System . . . . .         | 2-13  |
| Wing Walk and Wing Walk Areas . . . . .         | 2-2  | Engine Mounts . . . . .                      | 2-13  |
| Taxiing . . . . .                               | 2-2  | Engine Oil Filter Servicing . . . . .        | 2-13  |
| Minimum Turning Radius . . . . .                | 2-2  | Control Quadrant . . . . .                   | 2-14  |
| Parking . . . . .                               | 2-5  | Magnetos . . . . .                           | 2-14  |
| Tie-Down . . . . .                              | 2-5  | Ignition Cables . . . . .                    | 2-14  |
| Jacking . . . . .                               | 2-5  | Propellers . . . . .                         | 2-14  |
| Hoisting . . . . .                              | 2-5  | Induction Air Filter . . . . .               | 2-15  |
| Leveling . . . . .                              | 2-5  | Fuel-Air Control Unit . . . . .              | 2-15  |
| Outside Storage . . . . .                       | 2-6  | Fuel Manifold . . . . .                      | 2-15  |
| Short Term Storage . . . . .                    | 2-6  | Fuel Discharge Nozzles . . . . .             | 2-16  |
| Extended Storage . . . . .                      | 2-6  | Fuel Selector Valve and Strainer . . . . .   | 2-16  |
| Restoring Aircraft to Service . . . . .         | 2-7  | Fuel Selector Valve Control System . . . . . | 2-16  |
| PAINTING . . . . .                              | 2-7  | Vacuum System . . . . .                      | 2-16  |
| Preparation . . . . .                           | 2-7  | Pitot Static System . . . . .                | 2-16  |
| CLEANING, INSPECTION, REPAIR                    |      | Heater . . . . .                             | 2-16  |
| AND SERVICING . . . . .                         | 2-8  | Oxygen . . . . .                             | 2-16  |
| Windshield and Windows . . . . .                | 2-8  | Surface Deice . . . . .                      | 2-16  |
| Cabin Door . . . . .                            | 2-8  | Propeller Unfeathering System . . . . .      | 2-16  |
| Baggage Door . . . . .                          | 2-8  | Battery . . . . .                            | 2-16A |
| Seats . . . . .                                 | 2-8  | Battery Box . . . . .                        | 2-16A |
| Seat Belts . . . . .                            | 2-9  | Shock Strut Servicing . . . . .              | 2-16A |
| Upholstery . . . . .                            | 2-9  | Miscellaneous Service Items . . . . .        | 2-16B |
| Carpet . . . . .                                | 2-9  | Cold Weather Servicing . . . . .             | 2-16B |
| Wing . . . . .                                  | 2-9  | Fuel System Servicing . . . . .              | 2-16B |
| Fuselage Stinger . . . . .                      | 2-10 | Fuel System Drains . . . . .                 | 2-16B |
| Landing Gear Actuator . . . . .                 | 2-10 | Defueling . . . . .                          | 2-16B |
| Emergency Manual Extension System . . . . .     | 2-10 | EXTERNAL POWER RECEPTACLE . . . . .          | 2-16B |
| Main and Nose Landing Gear Assemblies . . . . . | 2-10 | SPECIAL TOOLS AND EQUIPMENT . . . . .        | 2-16B |
| Torque Links . . . . .                          | 2-11 | INSPECTION . . . . .                         | 2-16B |
| Main and Nose Gear Rigging Inspection . . . . . | 2-11 | Movable Parts . . . . .                      | 2-16C |
| Nose and Main Gear Retracting Linkage . . . . . | 2-11 | Engine Compartment Hoses . . . . .           | 2-16C |
| Nose Gear Shimmy Dampener . . . . .             | 2-11 | Fluid Lines and Hoses . . . . .              | 2-16C |
| Nose Wheel Steering System . . . . .            | 2-12 | Metal Parts . . . . .                        | 2-16C |
| Nose and Main Wheels and Tires . . . . .        | 2-12 | Wiring . . . . .                             | 2-16C |
| Brake System Plumbing . . . . .                 | 2-12 | Bolts in Critical Area . . . . .             | 2-16C |
| Brake Assemblies . . . . .                      | 2-12 | Filter, Screens and Fluids . . . . .         | 2-16C |
| Master Cylinders . . . . .                      | 2-13 | Aircraft File . . . . .                      | 2-16C |
| Control Column . . . . .                        | 2-13 | COMPONENT LOCATION CHART . . . . .           | 2-17  |
| Aileron and Trim Systems . . . . .              | 2-13 | INSPECTION CHART . . . . .                   | 2-18  |
| Elevators and Trim Systems . . . . .            | 2-13 | OVERHAUL AND REPLACEMENT . . . . .           | 2-21  |
| Rudder and Trim Systems . . . . .               | 2-13 | SERVICE CHART . . . . .                      | 2-22  |
| Rudder Pedal Assembly . . . . .                 | 2-13 | LUBRICATION DIAGRAM . . . . .                | 2-25  |

**GENERAL DESCRIPTION.**

This section contains routing servicing and maintenance procedures that are most frequently encountered. Frequent reference to this section will aid maintenance personnel by providing information on ground handling and emergency procedures, daily periodic servicing procedures, and airframe maintenance and lubrication. When any system or unit requires service or maintenance, other than the routine procedures as outlined in this section, refer to the section applicable to that system or unit.

**GROUND HANDLING.**

The following precautionary measures should be taken when handling the aircraft on the ground:

- Control surfaces shall not be locked while towing or taxiing the aircraft.
- Do not set parking brake if brakes are overheated.

When operating the engines, observe the following:

- Remove all towing equipment.
- Head aircraft into wind and chock wheels.

- c. Remove all control locks.
- d. All personnel, work stands and equipment shall be clear of danger areas.
- e. Parking brake set.
- f. Position nose wheel exactly fore and aft when running engines at high RPM.

#### Towing.

A tow bar, located in the baggage compartment, is provided for ground movement of the aircraft. The tow bar, which engages spacers on the nose gear at the lower torque link, is used to guide the aircraft manually. The nose gear will caster a maximum of 55 degrees to either side of center.

#### CAUTION

When towing the aircraft, the 55 degree limit shall be strictly observed, as the nose gear and/or steering mechanism will be damaged if turned beyond the 55 degree stops.

Be sure parking brake is released and external rudder gust lock is removed before towing. Never push, pull or lift aircraft by the ailerons, elevators, flaps, nacelles or unsupported skin between wing ribs.

Power towing is not recommended. However, aircraft can be power towed to move aircraft over soft or muddy ground or in emergencies by attaching a rope harness to the main landing gear. Do not power tow aircraft with towing vehicle attached to nose gear or the tail skid. When power towing, station a crew member in the aircraft to apply brakes in case of emergency. Use extreme caution to avoid jerky motions, as serious structural damage can result.

#### Wing Walk and Wing Walk Areas.

A non skid-surfaced wing walk, located along the inboard side of the right wing, will allow freedom of passage without damaging the wing finish. The entire inboard wing section from the cabin out to the engine nacelle is reinforced to withstand weight pressures up to 500 pounds. The inboard section of the left wing from the cabin out to the left engine is also reinforced, but precautions should be taken if the left inboard edge of the wing must be used for passage. When it is necessary to walk on the left inboard areas, be sure to cover the surfaces of the wing in order to prevent damaging the wing finish.

#### Taxiing.

Before attempting to taxi the aircraft, ground person-

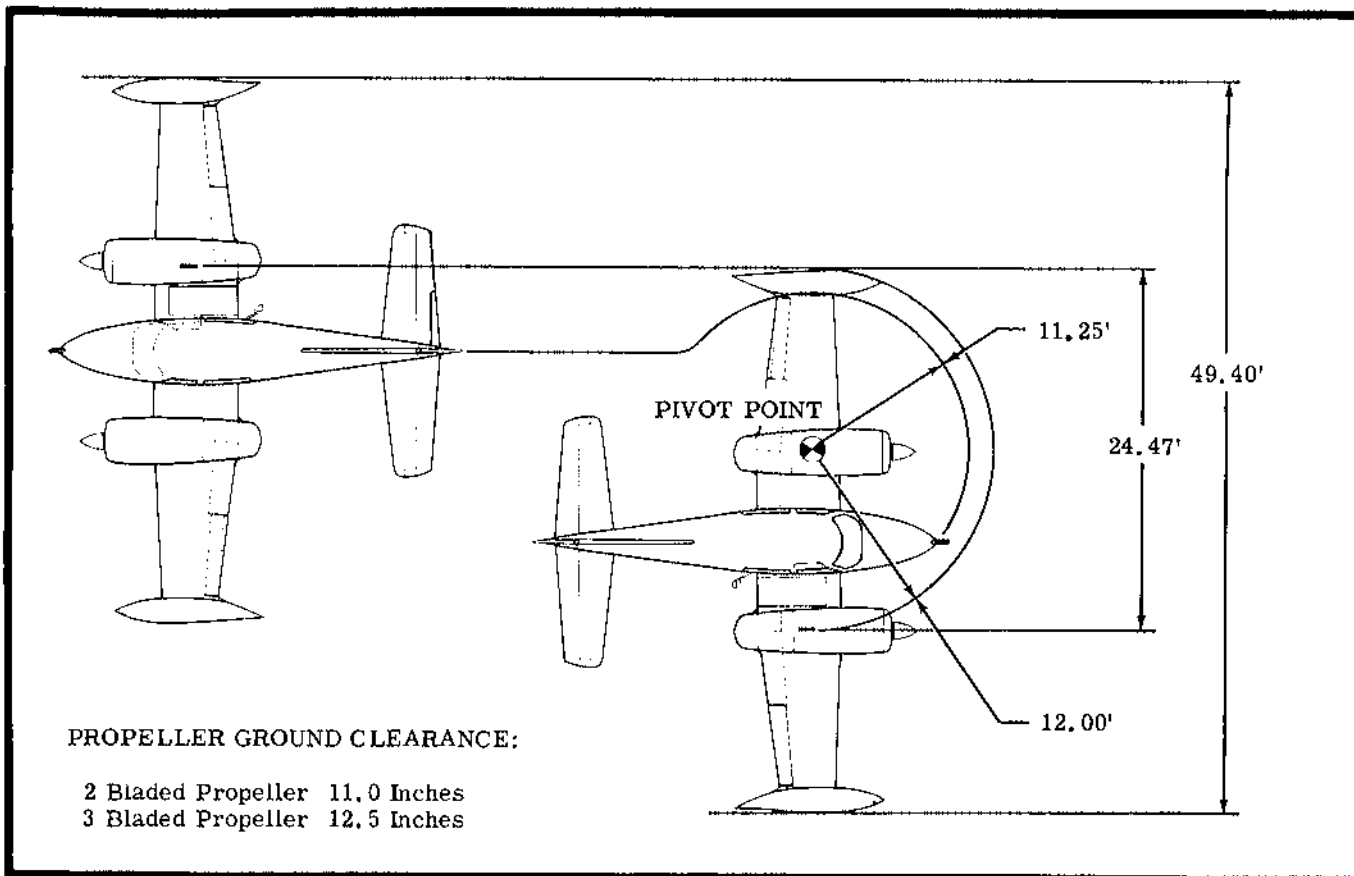


Figure 2-1. Minimum Turning Radius

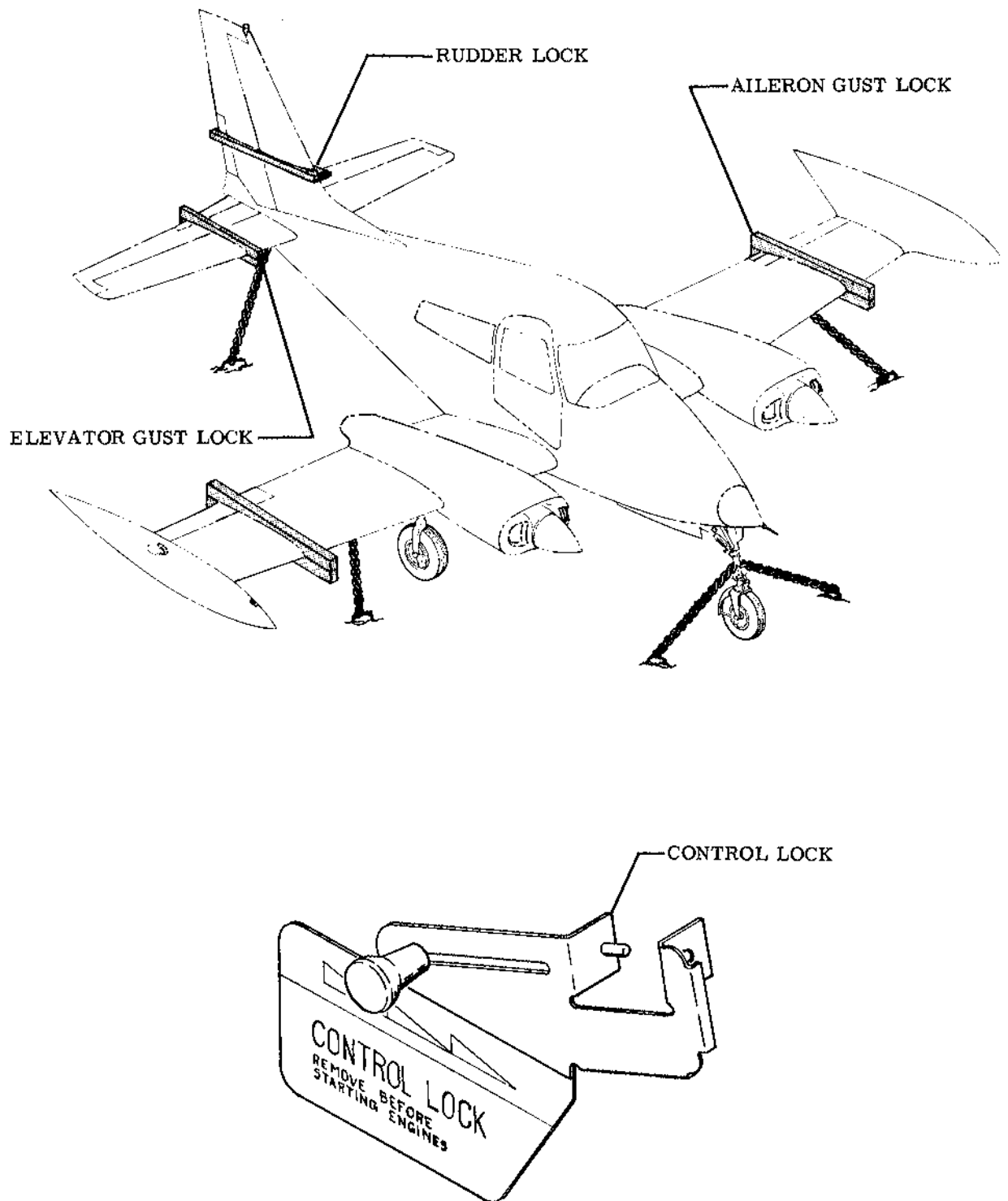


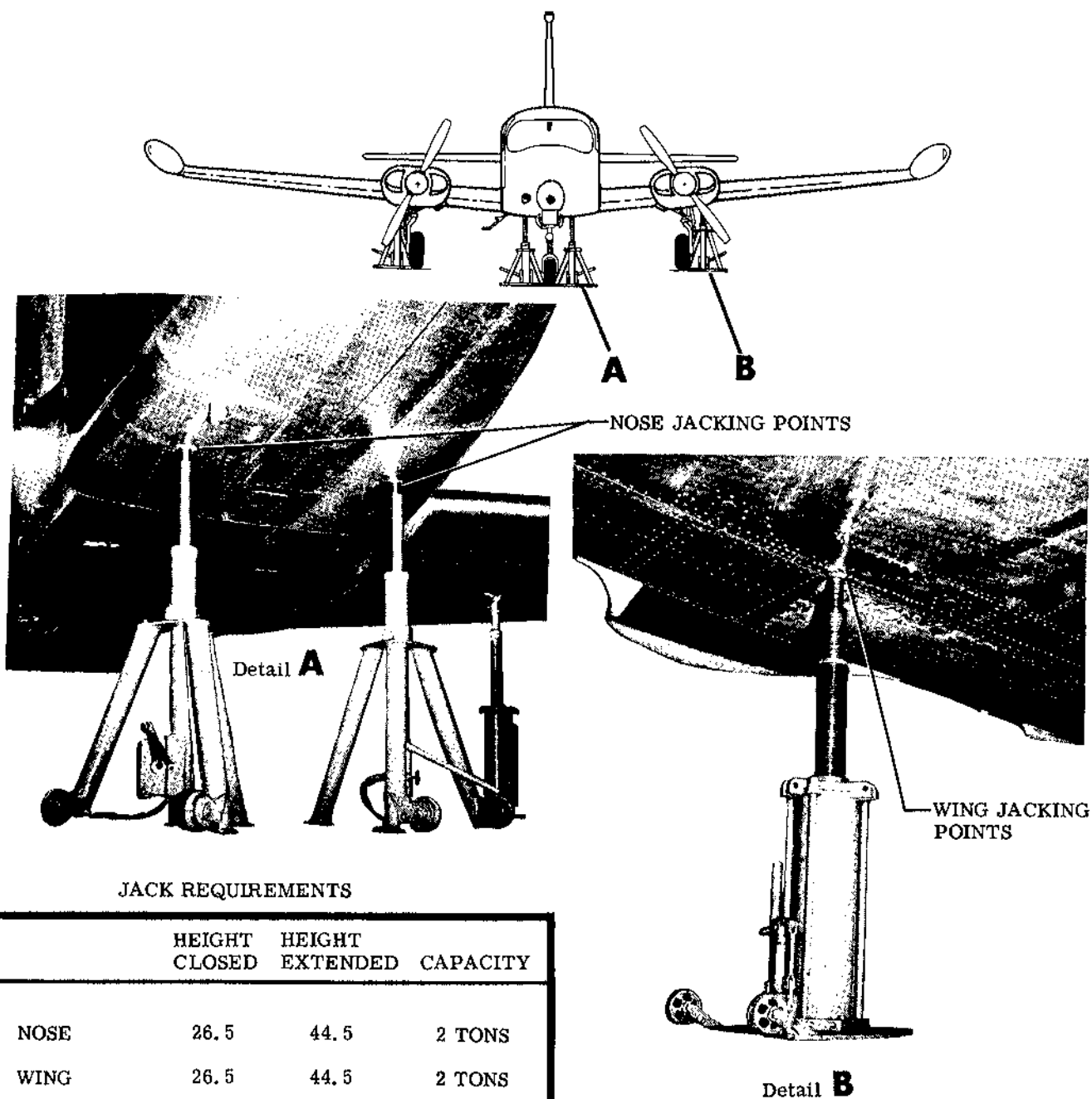
Figure 2-2. Tie-Down and Control Lock

NOTE

FOR LANDING GEAR REMOVAL AND MAINTENANCE, USE ALL FOUR JACKING POINTS.  
FOR REMOVAL OF MAIN WHEELS, WHEEL JACKING LUGS MAY BE USED.  
FOR REMOVAL OF NOSE WHEEL, THE TWO NOSE JACKING POINTS MAY BE USED.

CAUTION

PLACE WEIGHTS IN NOSE SECTION OF FUSELAGE TO PREVENT AIRCRAFT FROM TIPPING BACKWARD WHEN NOSE IS RAISED. TO PREVENT POSSIBLE STRUCTURAL DAMAGE, APPLY EQUAL FORCE WITH NOSE JACKS.



JACK REQUIREMENTS

|           | HEIGHT<br>CLOSED | HEIGHT<br>EXTENDED | CAPACITY |
|-----------|------------------|--------------------|----------|
| NOSE      | 26.5             | 44.5               | 2 TONS   |
| WING      | 26.5             | 44.5               | 2 TONS   |
| WHEEL LUG | 11               | 18                 | 2 TONS   |

Figure 2-3. Jacking

nel should be checked out by qualified pilots or other responsible personnel. When it is determined that the propeller blast area is clear, apply power to start the taxi roll and perform the following checks:

- a. Taxi forward a few feet and apply brakes to determine their effectiveness.
- b. While taxiing, make slight turns to determine the effectiveness of the nose gear steering.
- c. Minimum turning distance must be strictly observed when taxiing the aircraft close to buildings or other stationary objects.
- d. Do not operate the engine at high RPM when taxiing over ground containing loose stones, gravel or any loose material that may cause damage to the propeller blades.

#### Parking.

- a. When parking the aircraft, head into the wind and set parking brake.

#### CAUTION

Do not set parking brake when the brakes are overheated, or during cold weather when accumulated moisture may freeze the brakes.

- b. Install internal control lock. Install pitot tube cover and place chocks under all wheels. In parking the aircraft, it is also important to turn the nose gear to its full limit, either right or left, if external rudder lock is not available. This will place the rudder bellcrank against the stop and hold it there with spring tension from the nose gear steering mechanism.

#### Tie-Down.

Tying-down the aircraft should be accomplished in anticipation of light winds or anytime the aircraft is to be left outside for lengthy periods, such as overnight. Tie-down as follows:

- a. Head aircraft into the wind if possible.
- b. Set parking brake and install control lock.

#### CAUTION

Do not set parking brake when the brakes are overheated or during cold weather when accumulated moisture may freeze the brakes.

- c. Set trim tabs to neutral, so tabs fair with control surfaces.
- d. Install external gust locks on rudder, elevator and aileron (one each wing) as shown in figure 2-2.

#### NOTE

If external rudder gust lock is not available, turn nose wheel to extreme right or left position.

- e. Secure chains or manila rope, of 700 pounds or more tensile strength, to tie-down fittings under wings and secure other end to ground anchor.
- f. Tie a manila rope around the nose gear, above

torque link, and secure the outer end to a ground anchor.

- g. Tie a manila rope or chain to tailcone bumper and secure other end to a ground anchor.
- h. Install pitot tube cover.

#### Jacking.

Four jack points, two on underside of the fuselage just aft of the nose wheel well, and one on the lower surface of each wing just aft of the main gear attach points, are provided on the aircraft. One jacking point is provided on each main gear for wheel removal and maintenance. See figure 2-3 for jacking procedures.

#### NOTE

Special two-ton tripod jacks, ideally suited to the 310, can be supplied by Cessna Service Parts Department. Four jacks are required to raise the aircraft.

#### Hoisting.

The 310 may be lifted by four hoisting lugs and a sling. These may be fabricated from any suitable material capable of sustaining a 5200 pound load. Each lug may be attached to the upper bolt which secures the front wing spar to the fuselage spar, and the upper bolt at the rear wing spar attaching point. Access to the wing spar bolts is gained by removing the wing fillet between the fuselage and each wing. Each lug may be temporarily attached to the upper bolt on each wing for hoisting purposes only. The forward spar bolts are located directly in line with the aircraft center of gravity, so the sling should be positioned accordingly. Position a man at both the nose gear and the tail cone section of the aircraft to assure that it stays level while hoisting.

#### NOTE

After removing lugs, torque front spar nuts to  $60 \pm 5$  foot-pounds, and rear spar nuts to  $175 \pm 15$  inch-pounds.

#### Leveling. (See figure 2-4.)

To attain level flight attitude, inflate the main gear struts to their maximum extension, completely deflate the nose gear strut and adjust the nose wheel tire pressure until the aircraft is level. Position a spirit level, at least four feet in length, on the upper edge of the outside doubler between Stations 40 and 50, outside the pilot's window. To level the aircraft laterally, center the level on the outside skin along the rear spar. Inflate or deflate the main gear tires until aircraft is level. The alternate method for leveling the aircraft longitudinally is to hold a spirit level of appropriate length against the baggage door upper sill. If jacks are available, it will not be necessary to adjust struts or tire pressures to level the aircraft.



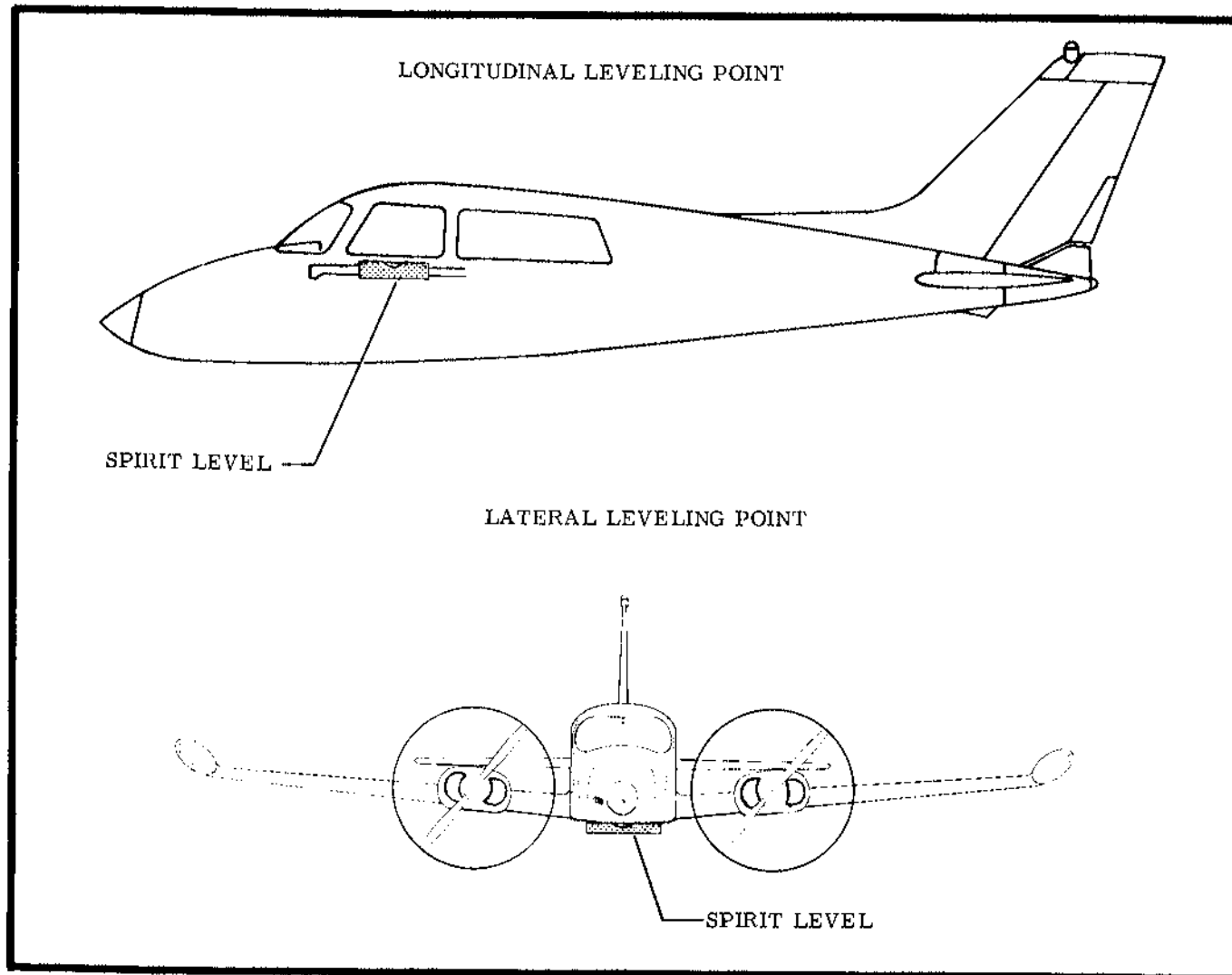


Figure 2-4. Leveling

#### Outside Storage.

For outside, short term, storage of the aircraft:

- a. Tie-down the aircraft in accordance with the tie-down procedure.
- b. If local conditions (dust or snow) exist, take normal aircraft precautions, such as plug air vents, exhaust outlets and any other vents.

#### Short Term Storage.

For short term storage of aircraft, thirty days or less, the following procedures should be followed:

- a. Start and run engines once every week until oil temperature is within normal operating limits.
- b. After oil is at normal operating temperature, exercise propellers to circulate the oil within the propeller dome.
- c. Rotate wheels every two weeks.

#### Extended Storage.

The various conditions will alter the extended hangar

storage, but the normal extended hangar storage precautions are as follows:

- a. Engines:
  1. Start engine and run until oil temperature is within normal operating limits.
  2. Stop engine, drain oil sump, and replace oil filter.
  3. Fill the engines with preheated (225°F) corrosion preventive oil (Continental recommends Cosmoline No. 1223).
  4. Operate engines five minutes at 1200-1500 RPM with 215°-225°F oil temperature.

#### NOTE

Do not operate the engines at more than 1500 RPM when engines are filled with corrosion preventive oil.

5. Stop engines, drain preserving oil from engines, and replace sump plug.
6. Remove spark plugs and spray corrosive preventive oil into upper and lower spark plug holes.

7. Replace lower spark plugs or install solid plugs.
8. Install dehydrator plugs in upper spark plug holes.

9. Cover spark plug cable terminals and all other engine accessory vents and openings with a vapor proof covering material.

10. Attach a warning on throttle controls and propeller to the effect that engines are preserved and **DO NOT TURN PROPELLERS.**

b. Airframe:

1. Lubricate the aircraft.

2. Lubricate lightly the propeller blades, all flight controller surface hinge pins, bearings, bellcranks, chains, control rods and quadrants with corrosion preventive oil.

3. Coat the extended portion of the landing gear shock struts with light weight oil.

4. Either place the aircraft on jacks to relieve pressure on tires or rotate wheels every 30 days to change support points and prevent flat spotting the tires.

5. Fill fuel tanks with gasoline.

6. Cover all aircraft internal vents and air inlets.

7. Inspect for corrosion at least once a month.

c. Battery:

1. Remove from aircraft and service periodically.

2. Check battery box for corrosion and neutralize if required.

### Restoring Aircraft to Service.

If the proper procedures were followed for extended storage, the aircraft should require the following service.

a. Airframe:

1. Remove all covers from vents and air inlets.

2. Clean aircraft if required.

3. Lubricate the aircraft.

4. Check the brake cylinders, struts and shimmy dampener.

5. Drain a small amount of fuel from all fuel lines and check for water sediment.

b. Battery:

1. Check battery, charge if necessary.

2. Install battery.

c. Engines:

1. Remove all vents and opening covers installed.

2. Remove oil sump drain plugs.

3. Remove plugs from spark plug holes in all cylinders. Rotate engines by hand to remove corrosion preventive oil from cylinders.

### CAUTION

Ignition switches must be in the OFF position when rotating the propellers by hand.

4. Install recommended spark plugs which have been properly cleaned and gapped.

5. Remove and replace oil filter element.

6. Install the oil sump drain plugs and fill oil sump with recommended oil.

7. Check propellers for freedom of operation.

8. Perform complete ground runup check on engines.

### PAINTING.

#### NOTE

All Model 310's are painted with Enmar 82B series vinyl enamels.

#### Preparation.

Thoroughly clean all surfaces, beyond area to be painted with Turco 800 or Enmar 3094 thinner. Extreme care should be taken to remove all letters, grease, bugs, etc. Mask off stripe areas to be painted carefully; see that all tapes are firmly adhered to metal to prevent ragged edges. Class "A" wrapping paper and thinner proof masking tape should be used to cover the plexiglass area. This will prevent damage from solvent and thinner vapors. (Newspapers will not provide adequate protection.) Extreme care should be taken to assure that no oil seepage occurs from seams, splices, or rivet heads.

#### CAUTION

Metallic paper, metal, metal foil or metal of any kind should never be used as a paint spray mask on heated windshields.

#### Primer - Mixture and Application.

#### NOTE

Mix EX2016G primer only in quantities required for use within six hours and then only in stainless steel bucket provided.

a. Mix equal parts of EX2016G primer and T6070 diluent and stir thoroughly.

b. Apply EX2016G primer in a well broken up, wet, even coat. If primer has to be sanded, sand and re-prime. Sanding breaks film, resulting in poor adhesion.

#### NOTE

On all leading edge surfaces, apply cross coat, wet and even, of EX2016G primer.

c. Clean equipment immediately after use and under no consideration use EX2016G primer that has been mixed longer than six hours.

#### Preparation of 82B Series Vinyl Enamel Colors.

Thoroughly mix and stir in original container and make sure all pigments are in solution. Thin required amount of vinyl color with T-1866A vinyl thinner in a 1:1 ratio. Mix thoroughly and strain into either a cup or pressure pot.

## Application of 82B Series Vinyl Colors.

### NOTE

If vinyl is to be applied from pressure pot, do so under the following conditions: pressure of 10 pounds on the pot. Regulate gun pressure at gun with test gage to 25 pounds, using gun with FX needle and fluid tip, with fan set wide open and yield two turns open. If cups are used, set gun at 30 pounds with EX needle and fluid tip, fan set one turn open and yield wide open.

- a. Apply first coat even and wet; second and third coats in same manner.
- b. Check carefully before second and third coats for defects and correct them before final coats.
- c. On second and third colors, mask off and lightly sand with 400 grit sandpaper the painted surfaces of previous color that is in area to be painted.

### NOTE

On all leading edges, apply a fourth coat. After finishing each color coat, burn down with T-1411 burn-down thinner. Remove all masking from painted surfaces after each color application. If you have a Heat Room, turn up the heat and dry paint at temperatures of 125° to 145° F, for at least three hours. Heat will give a good reflow on vinyl paint.

## CLEANING, INSPECTION, REPAIR AND SERVICING.

### Windshield and Windows.

- a. Cleaning.
  1. Remove dust and dirt from the panels by washing with a solution of mild soap and warm water.
  2. Dissolve grease and oil deposits with either kerosene or Aliphatic Naphtha, Specification TT-N-95 (Type II only). Apply this solvent with either a soft, grit-free cloth, chamois, sponge or with bare hands. Bare hands are the most satisfactory applicators, as they are least likely to produce scratches.

### CAUTION

Do not use any solvent except those specified in step 2., above, as many chemical solvents will soften or craze the surface of the plastic. Cleaning sprays and other cleaning solutions prepared for use on cellulose-nitrate and cellulose-acetate base plastics often contain ingredients harmful to acrylate plastic, which is the material used in this aircraft. Even a light coat of salt spray or dust should not be wiped off when dry, as small hairline scratches will result when gritty particles are rubbed over the surface. Always flush the surface first with clean water or soap solution. Finally, rinse generously with clean water.

### b. Inspection.

1. Refer to Section 3 and inspect all windows and windshield in accordance with Plastic Windows Inspection Criteria.

### c. Repair and Servicing.

1. After cleaning plastic window surfaces, allow to dry, then wax to give surface a maximum transparency.
2. Minute hairline scratches can often be removed by rubbing with commercial automobile body cleaner. Apply the cleaner with a soft, dry, clean cloth or imitation chamois or flannel.
3. If repair to plastic window surfaces becomes necessary, refer to Section 16 and repair them in accordance with Repair of Plastic Window Surfaces.

### Cabin Door.

#### a. Cleaning.

1. Clean the cabin door and latching mechanisms by wiping with a suitable cloth.
2. Remove accumulations of grease from cabin door parts by using a suitable solvent and wipe clean with a cloth.

#### b. Inspection.

1. Make a visual inspection of component parts for excessive wear, metal breaks and improper threads.
2. Operate door and observe for proper function of component parts.

#### c. Repair and Servicing.

1. Refer to Section 3, replace components which show evidence of excessive wear.
2. Refer to Lubrication Diagram, figure 2-9, and service components as shown.
3. To aid the door seal to slip into the groove, lubricate with DC4 compound or equivalent.

### Baggage Door.

#### a. Cleaning.

1. Clean upholstery panel with a suitable commercial upholstery cleaner.
2. Clean latch assembly, cylinder assembly and door assembly with suitable solvent and wipe dry with cloth.

#### b. Inspection.

1. Make a visual inspection of latch and cylinder assemblies for excessive wear or binding.

#### c. Repair and Servicing.

1. Refer to Section 3, replace components which show evidence of excessive wear.
2. Refer to Lubrication Diagram, figure 2-9, and service component parts as shown.

### Seats.

#### a. Cleaning.

### NOTE

Cleaning fluids used on fabrics having a naphtha base are recommended for use in cleaning fabric covered seats.

**CAUTION**

Never use anything except a mild soap solution on leather and vinyl covered seats. Solvents and cleaners will damage, discolor and shorten the life of the seats.

1. Clean fabric covered seats as follows:
  - (a) Carefully brush off and vacuum all loose particles of dirt.
  - (b) Wet a small, clean cloth with cleaning solution and wring out thoroughly. Then open the cloth and allow a small part of the fluid to evaporate.
  - (c) Pat the spot lightly with the cloth, but do not rub it. Repeat this procedure several times, using a clean part of the cloth each time.

**NOTE**

Patting the spot lightly will prevent its spreading and is less likely to leave a ring.

- (d) Moisten another piece of cloth and allow to evaporate until barely damp. Now pat the spot lightly, working from the outside in toward the center.

**CAUTION**

Do not use too much fluid. Seat cushions are padded with foam rubber, and since volatile cleaners attack rubber, these pads may be damaged if the material gets soaked with the cleaner.

- (c) Brush again to remove any more particles which have become loosened.
2. Clean vinyl or leather seats as follows:
  - (a) On vinyl or leather seats, use a mild soap solution and sponge to remove dirt from seats; wipe dry with a clean damp cloth.
- b. Inspection.
  1. Inspect the front seats for binding on seat rails.
  2. Inspect for proper functioning of adjusting handles and tilting mechanism.
  3. Seat belts for proper security.
  4. If electrically operated seats are installed (optional equipment), actuate switches and observe for smooth operation.
- c. Repair and Servicing.
  1. Refer to Section 3, replace components which show evidence of excessive wear or binding.
  2. Lubricate seat base rolls with oil as required.
  3. Wax seat rails with automotive wax to reduce friction between seat rollers and seat rails.

**Seat Belts.**

- a. Cleaning.

Courtesy of Bomar Flying Service  
[www.bomar.biz](http://www.bomar.biz)

**NOTE**

Seat belts should be removed from the aircraft to clean.

1. Clean seat belts using a suitable solvent or mild soap solution.

**CAUTION**

Never use thinner or strong solutions on seat belts. See Seat Belt Inspection procedure before reinstalling seat belts in aircraft.

- b. Inspection.
  1. Inspect webbing material for fraying.
  2. Inspect seat belt installation for security.

**Upholstery.**

- a. Cleaning.
  1. The upholstery can be cleaned with a noninflammable solvent while installed in the aircraft. Spots or stains can be removed by following the procedure for cleaning the seats (fabric), as outlined in this section.
- b. Inspection.
  1. Inspect upholstery for general condition and wear. Observe areas where chafing from other equipment might occur thus damaging the upholstery panels.

**Carpet.**

- a. Cleaning.
  1. Use a small whisk broom to loosen dirt; then vacuum the carpet. The more difficult spots or stains can be removed by using a noninflammable dry-cleaning fluid. General care of the carpet is the same as the care of the carpets in your home.
- b. Inspection.
  1. Inspect carpet for excessive wear and security to the floorboard.

**Wing.**

- a. Cleaning.
  1. Clean the wing as follows:
    - (a) Use a suitable solvent to remove all grease and dirt from nacelle area and landing gear area.

**CAUTION**

Never use gasoline, paint thinners, or Ketone to remove grease. These are highly inflammable and fire could result.

- (b) After washing area with suitable solvent, wash the remaining solvent off with soap and water and allow to air dry.
- (c) The wing can be cleaned with any good aircraft cleaner and wax.
- b. Inspection.
  1. Inspect wing fume proofing materials as follows:
    - (a) Fume proofing materials have been incorporated into the wing areas for the purpose of containing carbon monoxide (CO<sub>2</sub>) fumes.

Containment of carbon monoxide fumes is accomplished by various sealants, boots, and patches strategically placed within the wing area. Sealants are used throughout the engine nacelle area for both fire proofing and fume proofing. Boots are used to seal the main landing gear door hinges and main landing gear torque tubes. Small patches are used in the corners of the main gear wheel well, over lightening holes in trailing edge of wing at the root rib, along the edges of the wing fittings on the outboard side of root rib, and over the lightening holes just forward of the flaps. Sponge rubber insulation is placed between corrugated web and wing spars in the wheel well area.

### CAUTION

When fume proofing materials, as described above, have been damaged or removed, immediate replacement is required.

2. See Inspection Chart for periodical inspection requirements.

c. Repair and Servicing.

Refer to Lubrication Diagram, figure 2-9, for servicing requirements.

### Fuselage Stinger.

a. Cleaning.

1. Clean the fuselage stinger with suitable solvent and wipe with a cloth.

b. Inspection.

1. Inspect for loose rivets, stiffeners and doublers.

2. Inspect fiberglass for cracks.

c. Repair and Servicing.

1. If cracks are found in fiberglass, repair in accordance with Section 16.

2. Replace or secure loose rivets.

### Landing Gear Actuator.

a. Cleaning.

1. Clean external parts of landing gear actuator assembly and reduction gear by wiping with a clean cloth.

2. Dampen cloth with a suitable cleaning solvent to remove oil or grease accumulations.

b. Inspection.

1. Inspect assemblies externally for visible damage such as cracks, nicks, dents and scratches. Check upper and lower bellcranks and splines on the protruding portions of sector shaft for visible damage.

2. Refer to Inspection Chart, figure 2-7, for additional periodical inspection requirements.

c. Repair and Servicing.

1. Refer to Lubrication Diagram, figure 2-9, and service components as shown.

2. Disassembly of the landing gear actuator assembly or reduction unit for repairs are not recommended.

### NOTE

Landing gear actuator may be disassembled to lubricate gears only.

### Emergency Manual Extension System.

a. Cleaning.

1. Clean all components with suitable solvent.

b. Inspection.

1. Inspect miter gears and sprocket for visible damage such as chipped or broken teeth, nicks, dents, cracks or deep scratches.

2. Inspect all bolt and pin holes for elongation.

3. Inspect around all welds for cracks.

4. Refer to Inspection Chart, figure 2-7, for additional periodical inspection requirements.

c. Repair and Servicing:

1. Refer to Lubrication Diagram, figure 2-9, and service components as shown.

### Main and Nose Landing Gear Assemblies.

a. Cleaning.

1. Clean all metal parts with suitable solvent.

### CAUTION

If metal parts are not to be assembled immediately, coat with system hydraulic fluid to prevent rusting. Before assembly it will be necessary to again clean with solvent.

2. Clean all O-rings and seals with system hydraulic fluid.

b. Inspection.

1. Inspect all components for excessive wear, cracks, dents, nicks, and scratches.

2. Inspect outer barrel of the lower strut assembly for any defects that may damage seals.

3. Refer to Inspection Chart, figure 2-7, for additional periodical inspection requirements.

c. Repair and Servicing.

1. Repair of main landing gear is limited to replacement of parts, smoothing out of minor scratches, nicks and dents and repainting of areas where paint has chipped or peeled.

2. Refer to Lubrication Diagram, figure 2-9, and service components as shown.

1. Repair of main landing gear is limited to replacement of parts, smoothing out of minor scratches, nicks and dents and repainting of areas where paint has chipped or peeled.
2. Refer to Lubrication Diagram, figure 2-9, and service components as shown.

#### Torque Links.

- a. Cleaning.
  1. Clean torque link assemblies with a suitable solvent and wipe clean with a clean cloth.
- b. Inspection.
  1. Refer to Inspection Chart, figure 2-7, for periodical requirements.
- c. Repair and Servicing.
  1. Repair of torque link assemblies is limited to replacement of parts, smoothing out of minor scratches, nicks, and dents and repainting of areas where paint has chipped or peeled.
  2. Refer to Lubrication Diagram, figure 2-9, and service components as shown.

#### Nose and Main Gear Retracting Linkage.

- a. Cleaning.
  1. Clean linkage components with cloth saturated with suitable cleaning solvent.

#### CAUTION

Do not clean sealed bearings or needle bearings which do not have provisions for lubrication.

- b. Inspection.
  1. Refer to Inspection Chart, figure 2-7, for periodical inspection requirements.
- c. Repair and Servicing.
  1. Repair of main landing gear retracting linkage is limited to replacement of parts, smoothing out of minor nicks, dents, and scratches and repainting of areas where paint has chipped or peeled.
  2. Refer to Inspection Chart, figure 2-7, remove and dye check nose gear uplock torque tube for cracks. If no cracks are visible, replace torque tube.
  3. Refer to Lubrication Diagram, figure 2-9, and service components as shown.

#### Nose and Main Landing Gear Rigging Inspection.

Inspect the nose and main landing gear rigging at each 100 Hour Inspection as follows:

- a. Jack the aircraft in accordance with Jacking Procedures.
- b. Operate gear through one complete cycle and visually inspect nose and main gear doors for operation, proper fit and other damage.
- c. Disconnect nose and main gear doors.
- d. Inspect drive tubes, idlers, trunnions and wheel well area for bends, nicks, looseness, wear and other damage.

#### NOTE

If any part of the landing gear system is questionable, do not hesitate to reject it.

- e. (See Section 4) Inspect main gear downlocks for proper tension (40 to 60 pounds).
- f. Inspect main gear uplock for proper engagement.
- g. (See Section 4) Inspect nose gear downlocks for proper tension (45  $\pm$  15 pounds).
- h. Inspect nose gear uplocks for proper engagement and tension (100  $\pm$  20 pounds).
- i. Disconnect main drive tubes and check gear for free fall. Gear should free fall into down and lock position.
- j. Check main gear doors for proper tension (35  $\pm$  0, -35 pounds).
- k. Check operation of emergency extension system.
- l. Check landing gear actuator for security.
- m. Check up and downlock safety switches for proper adjustment and security.
- n. Remove aircraft from jacks.

#### Nose Gear Shimmy Dampener.

- a. Cleaning.
  1. Clean all metal parts with suitable solvent.
  2. Clean all O-rings and seals with clean system hydraulic fluid.

#### CAUTION

If metal parts are not to be assembled immediately, coat with system hydraulic fluid to prevent rusting. Before assembly, it will be necessary to again clean with suitable solvent.

- b. Inspection.
  1. Refer to Inspection Chart, figure 2-7, for periodical inspection requirements.
- c. Repair and Servicing.
  1. Repair of shimmy dampener is limited to replacement of parts, smoothing out of minor nicks, scratches, and dents and repainting of areas where paint has chipped or peeled.
  2. Refer to Lubrication Diagram, figure 2-9, and follow this procedure to fill the shimmy dampener:
    - (a) Using the tow bar, turn the nose wheel strut to the extreme left position against the 55-degree stop. This will place the shimmy dampener piston to the rear of the cylinder and eliminate the possibility of entrapped air in the cylinder.
    - (b) Remove the filler plug and fill with hydraulic fluid.
    - (c) Replace filler plug and turn nose wheel strut through its entire travel several times.
    - (d) Return strut to the extreme left position against the 55-degree stop.
    - (e) Remove filler plug and add whatever fluid is needed to fill the cylinder.
    - (f) Replace and safety filler plug.

### Nose Wheel Steering System.

- a. Cleaning.
  1. Clean metal parts with suitable solvent.
  2. Wipe cables and pulleys with a clean dry cloth.
- b. Inspection.
  1. Refer to Inspection Chart, figure 2-7, for periodical inspection requirements.
- c. Repair and Servicing.
  1. Repair of components in the nose gear steering system is limited to replacement of parts.
  2. Refer to Lubrication Diagram, figure 2-9, and service system components as shown.

### Nose and Main Wheels and Tires.

- a. Cleaning.
  1. Clean all metal parts with suitable solvent.
  2. Clean felt seals and bearing cones by washing in suitable solvent and dry thoroughly.
- b. Inspection.
  1. Inspect wheel castings for cracks, nicks, dents, scratches and corrosion.

#### NOTE

Replace castings which show evidence of cracks or heavy corrosion. See step c., for servicing castings which show evidence of light corrosion.

2. Inspect disc drive keys for damage, looseness, and excessive wear.
3. Inspect bearing cups for visible damage and wear.

#### NOTE

Do not remove bearing cups unless replacement is required.

4. Inspect bearing cones for visible damage and wear.

#### NOTE

If more than the usual number of takeoffs and landings are made or the aircraft is operated in dusty areas, it is recommended that cleaning and lubrication of wheel bearings be accomplished at each 100-hour inspection.

5. Inspect retainers and snap rings for damage and distortion. Straighten or replace as necessary.
6. Inspect the tire for breaks, cuts, foreign objects imbedded in tread, and flat spots and/or exposed cords.

#### CAUTION

Breaks, flat spots, exposed cords and cuts that damage cords are cause for immediate rejection of tire. Should there be any doubt about a tires reliability, don't hesitate to reject it.

7. Refer to Inspection Chart, figure 2-7, for periodical inspection requirements.

#### c. Repair and Servicing.

1. Slightly corroded areas on wheel castings can be repaired as follows:
  - (a) Clean affected area thoroughly.
  - (b) Repaint with two coats of zinc chromate primer on area which has had the protective coating removed.
  - (c) Finish coat casting with two coats of aluminum lacquer.
2. Replace bearing cones with applicable grease as shown in Lubrication Diagram, figure 2-9.
3. Replace damaged keys and tighten loose keys
4. Lubricate felt seal with light oil.

### Brake System Plumbing.

- a. Cleaning.
  1. Clean hydraulic components with clean system hydraulic fluid or denatured alcohol.
- b. Inspection.
  1. Inspect fittings for damaged threads and deformed flares on ends of tubing; lines for cracks, dents, deep scratches, flattened bends, and signs of chafing at points of wear; hose for swelling, cracking, abrasions through protective plies and leaks.
  2. Refer to Inspection Chart, figure 2-7, for periodical inspection requirements.
- c. Repair and Servicing.
  1. Repairs to brake system plumbing should be made in accordance with best shop practice, using standard parts and procedures, and conducted in compliance with applicable regulations.
  2. Service system as shown in Lubrication Diagram, figure 2-9.

### Brake Assemblies.

- a. Cleaning.
  1. Wash metal parts in suitable solvent.
  2. Wash O-rings with clean system hydraulic fluid or denatured alcohol.
  3. If required, clean brake linings with carbon tetrachloride.
- b. Inspection.
  1. Inspect metal parts for wear and thread damage.
  2. Inspect brake disc for "dishing" in excess of .0625 inch or if keyways are worn to a size in excess of 1.188 inches.
  3. Inspect disc drive keys for wear, and minimum width of 1.116 inches.
  4. Inspect cylinder walls for corrosion, pitting and scoring.
  5. Refer to Inspection Chart, figure 2-7, for periodical inspection requirements.
- c. Repair and Servicing.
  1. Replace worn or damaged parts.
  2. Polish out minor nicks using 400 grit wet-or-dry sandpaper with system hydraulic fluid.
  3. Replace brake lining at each engine overhaul or when wear approaches limits described in Section 4, Replacement of Brake Linings.

## Master Cylinders.

- a. Cleaning.
  1. Clean all metal parts in suitable solvent.
  2. Clean O-ring seals with clean system hydraulic fluid or denatured alcohol.
- b. Inspection.
  1. Inspect metal parts for wear and thread damage.
  2. Inspect cylinder walls for corrosion, pitting and scores.
  3. Inspect O-ring seal and O-ring portion of lock-o-seal for swelling, chipping or other evidence of damage.
  4. Refer to Inspection Chart, figure 2-7, for periodical inspection requirements.
- c. Repair and Servicing.
  1. Replace master body when damage to cylinder wall is found.
  2. Repairs to master cylinder components are not recommended, only replacement of defective parts.
  3. Refer to Lubrication Diagram, figure 2-9, and service as shown.

Control Column. (Refer to Inspection Chart, figure 2-7, and Lubrication Diagram, figure 2-9.)

Aileron and Trim Tab Systems. (Refer to Inspection Chart, figure 2-7, and Lubrication Diagram, figure 2-9.)

Elevator and Trim Systems. (Refer to Inspection Chart, figure 2-7, and Lubrication Diagram, figure 2-9.)

Rudder and Trim Systems. (Refer to Inspection Chart, figure 2-7, and Lubrication Diagram, figure 2-9.)

## Rudder Pedal Assembly.

- a. Cleaning.
  1. Clean component parts with suitable solvent.
- b. Inspection.
  1. Inspect all components for visible damage such as dents, cracks and broken welds.
  2. Inspect all bearings for scoring, binding, and excessive wear.
  3. Inspect all pin and bolt holes for elongation.
  4. Refer to Inspection Chart, figure 2-7, for periodical inspection requirements.
- c. Repairs and Servicing.
  1. Repair rudder pedal assembly by replacing defective parts only.
  2. Refer to Lubrication Diagram, figure 2-9, and service as shown.

Flap System. (Refer to Inspection Chart, figure 2-7, and Lubrication Diagram, figure 2-9.)

Engine Assembly. (Refer to Section 9, Continental Maintenance and Overhaul Manual, Inspection Chart, figure 2-7, for repair, servicing and overhaul.)

## Engine Oil Pressure System.

- a. Cleaning.
  1. Clean line assemblies and fittings with suitable solvent.
- b. Inspection.
  1. Start and run engine for a few moments observing oil pressure gage for fluctuations.
  2. Shutdown engine and inspect oil pressure lines and fittings for leaks.
- c. Repair and Servicing.
  1. Servise oil pressure system as follows:
    - (a) With all connections tightened, start engine and allow time for the engine pumps to fill the oil pressure lines.
    - (b) After a positive indication of oil pressure has been noted, loosen the hose fittings on the rear of the engine gage units and allow a few drops of oil to leak from the fittings. This will bleed the trapped air from the lines and provide an accurate oil pressure indication.

Engine Mounts. (Refer to Inspection Chart, figure 2-7.)

## Engine Oil Filter Servicing. (See figure 2-5.)

- a. Installation and Inspection.
  1. Inspect filter case by placing a straight edge on the washer seat surface. If any distortion or out-of-flat condition (greater than .010 inch) is observed, replace filter case (8). Replace filter case (8) when conditions indicate that the case may have been dropped, over-pressured or over-torqued.
  2. Lubricate gasket (6) furnished with filter element kit with a light coat of engine oil or general purpose grease. This procedure will allow the gasket to move freely and seat properly.

## NOTE

Install only the .090 inch thick gasket (6).

3. Assemble new cover gasket (4) on cover (5), turn cover (5) so that it is facing downwards. If gasket (4) falls off, replace the gasket and repeat test. If gasket falls from cover (5), replace cover.
4. Assemble bolt (10) and washer (9) through case (8) and filter element (7). Position case (8) so that element (7) is facing upwards, then assemble gasket (6) and cover (5) onto bolt (10).
5. Inspect the adapter gasket seat for possible gouges, excessive scratches, wrench marks or other types of mutilation. If defects are found, replace the adapter.
6. Inspect threaded hole in the center of the adapter gasket seat. If the hole is off center more than .030 inch, replace adapter.
7. Install the case (8) on adapter (3), but DO NOT



allow gasket (4) to make contact with gasket seat. Hold case (8) to prevent it from turning, torque filter bolt (10) 15 to 18 foot-pounds (180 to 216 inch-pounds).

#### NOTE

If torque wrench is not available, tighten bolt 1-3/4 turns after gasket (4) snugs against the seat in adapter (3).

8. Refill engine with proper grade and quantity of oil. Start engine and check for leaks after the engine has warmed properly, cycle through at least one high power setting.

9. If gasket (4) protrudes more than twice as much on one side as on the other, the gasket has become unseated during assembly. This condition indicates that either the cover or adapter are faulty and should be replaced.

10. Recheck filter bolt torque and safety wire the filter assembly.

#### Control Quadrant.

##### a. Cleaning.

1. Clean all metal parts in a suitable solvent and allow to air dry.

##### b. Inspection.

1. Inspect all parts for evidence of cracking and excessive wear.

2. Inspect the racks and ratchet stops on the mixture levers for broken teeth and excessive wear.

##### c. Repair and Servicing.

1. Replace racks, ratchet stops, and ratchet stop springs if worn or too weak to insure positive locking.

2. Lubrication of control quadrant is not recommended; however, the control quadrant pedestal does require lubrication. (Refer to Lubrication Diagram, figure 2-9.)

Magnetos. (Refer to Section 9 and Inspection Chart, figure 2-7.)

Ignition Cables. (Refer to Section 9 and Inspection Chart, figure 2-7.)

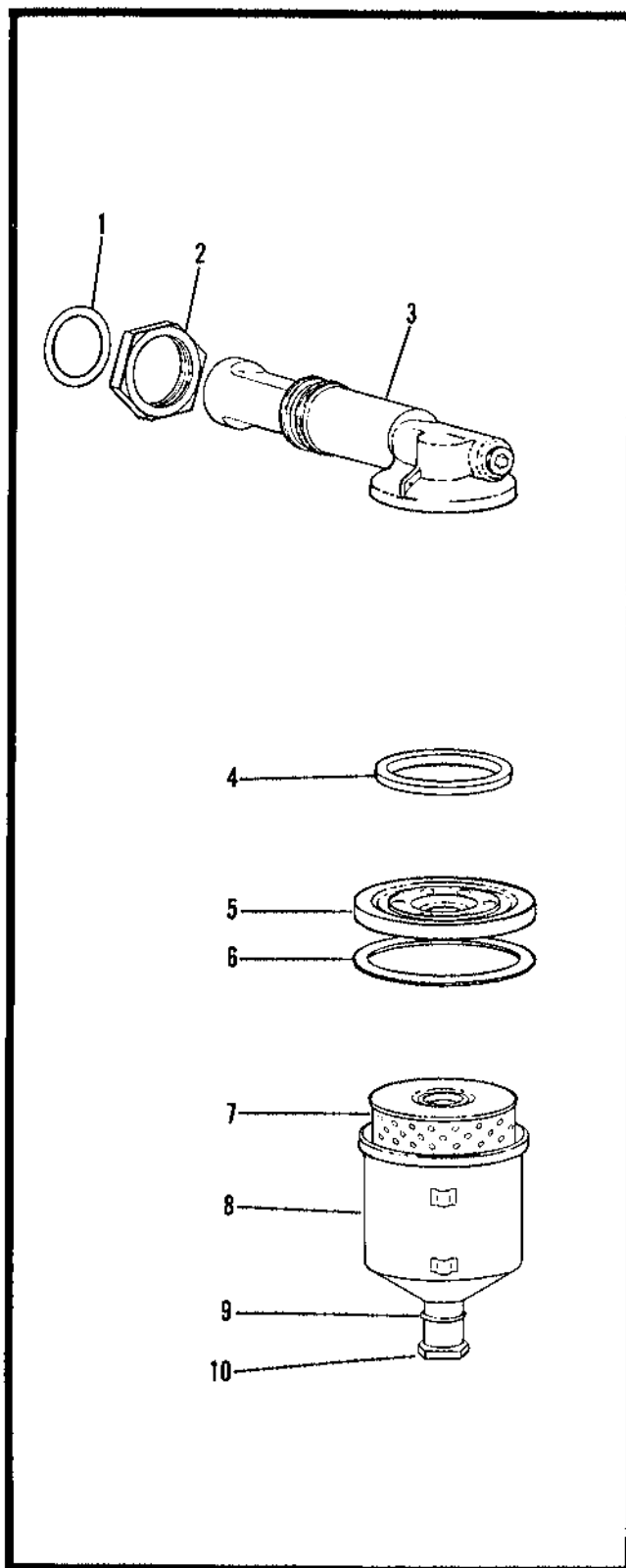
#### Propellers.

##### a. Cleaning.

1. Clean all metal parts in a mixture consisting of 1/3 lubricating oil, Specification MIL-L-6082, Grade 1030, and 2/3 solvent, Federal Specification P-S-661. Clean small, highly finished parts separately, exercising care not to cause damage, particularly to working surfaces.

#### NOTE

Inside diameter of counterweight halves and ferrule groove in which they mount, must be free of all oil. Use solvent only - not the mixture - to clean these surfaces. Should cleaning mixture or other lubricant acci-



- |                     |            |
|---------------------|------------|
| 1. Packing          | 6. Gasket  |
| 2. Adapter Nut      | 7. Element |
| 3. Adapter Assembly | 8. Case    |
| 4. Gasket (Cover)   | 9. Washer  |
| 5. Cover            | 10. Bolt   |

Figure 2-5. Oil Filter Assembly

dentally come into contact with these surfaces, clean thoroughly prior to reassembly.

2. Clean non-metallic parts (except gaskets, packings and seals) by wiping with a soft, lint-free cloth dampened with cleaning mixture.

3. Heavy and tightly adhering deposits may be removed with a soft brush.

### CAUTION

Under no circumstances are any parts to be cleaned with a steel, other metal, or hard bristle brush, or tool of any type.

4. After cleaning, allow parts to air dry, or remove excess mixture with a gentle stream of clean, dry compressed air. Keep nozzle well away from parts.

5. Protect parts from collecting dust and dirt during storage and handling for overhaul. It is recommended that small parts be kept in transparent plastic bags.

6. Parts which are to be coated with dry film lubricant are to be cleaned with ethyl acetate immediately prior to application of lubricant (refer to McCauley Industrial Corporation's Service Manual).

b. Inspection.

1. Refer to Inspection Chart, figure 2-7, and McCauley Industrial Corporation's Service Manual.

c. Repair and Servicing.

1. Any repairs should be made in accordance with best shop practices as outlined in McCauley Industrial Corporation's Service Manual and FAA Regulations.

2. Refer to McCauley's Industrial Corporation's Service Manual and lubricate only on reassembly.

Induction Air Filter. (Refer to Inspection Chart, figure 2-7.)

On aircraft 310L0001 to 310N0001, the induction air filter should be serviced in accordance with instructions stamped on the bottom of the filter. Filters should be serviced every 50 hours of engine operation or more often under dusty conditions. Clean the air intake box with a suitable solvent, and inspect for cracks or dents. Minor cracks in the air intake box may be stop drilled. In cases of continued or severe cracking, replace air intake box.

On aircraft 310N0001 and On, the induction air filters should be cleaned every 50 hours, or more often under dusty conditions and replaced every 1000 hours. Under extremely dusty conditions, daily maintenance of the filter is recommended. One method is to use dry compressed air at not over 100 PSI and blow through the filter. Blow from the inside to outside to remove dirt and dust. At 50 hour intervals clean the filter as follows:

a. Remove the filter from the canister.

b. Slightly rap the filter to remove heavy dirt accumulations.

c. Wash thoroughly, using a mild detergent, non-sudsing soap and water solution.

d. Rinse filter with a stream of water until water is clear.

e. Dry thoroughly using dry compressed air. Air pressure should not exceed 100 PSI.

f. Check filter for holes or damage.

g. Install the filter in the canister and safety.

### Fuel-Air Control.

a. Cleaning.

1. Remove the fuel strainer and clean the screen in fresh cleaning solvent. Reinstall and safety.

b. Inspection.

1. Check control connections, levers, and linkage for security of attaching parts, for safing and lost motion due to wear.

2. Check the air control body for cracks and the fuel-air control unit for overall condition.

3. Refer to Inspection Chart for interval of inspection.

### Fuel Manifold.

a. Hold the top cover down against internal spring until all four attaching screws have been removed, then gently lift off the cover. Use care not to damage the spring-loaded diaphragm below it.

b. Remove the upper spring and lift the diaphragm assembly straight up.

### NOTE

If the valve attached to the diaphragm is stuck in the bore of the body, grasp the center nut and rotate and lift at the same time to work gently out of the body.

### CAUTION

Do not attempt to remove needle or spring from inside valve. Removal of these items from the valve will disturb the 4 PSI factory calibration.

c. Remove the flushing plug located opposite the inlet fitting.

### CAUTION

The filter screen is a tight fit and may be damaged if removal is attempted. It should be removed only if a new screen is to be installed.

d. Using clean gasoline, flush out the chamber below the screen.

e. Flush above the screen and inside the center bore making sure that outlet passages are open. Use only a gentle stream of compressed air to remove dust and dirt and to dry.

f. Replace flushing plug.

g. Clean the diaphragm valve, top cover and springs in the same manner.

h. Carefully replace diaphragm and valve in manifold body. Check that valve works freely.

i. Place upper spring in position.

j. Align mounting holes in body, diaphragm and top cover locating the small vent hole in the cover to the

side. Hold the cover down against the spring while installing and tightening all four attaching screws. Safety the screws.

#### Fuel Discharge Nozzles.

a. Cleaning.

1. To clean fuel discharge nozzles, immerse in fresh cleaning solvent.

#### CAUTION

Do not use a wire brush or other sharp metal objects to clean orifices. This will damage orifice.

b. Inspection.

1. Inspect the fuel discharge nozzle for damaged orifice, dirt and foreign objects.
2. Refer to Inspection Chart for interval of inspection.

#### Fuel Selector Valve and Strainer.

a. Cleaning.

1. Fuel selector valve handles - OFF.
2. Drain excess fuel from sediment bowl with quick-drain.

#### CAUTION

The fuel selector valve should always stop in a detent position, never intermediate. If the fuel selector stops in an intermediate position, the controls are improperly rigged and should be rigged in accordance with Section 11.

3. Remove the lower access cover plate.
  4. Remove the eight screws securing sediment bowl to bottom of selector valve and remove bowl and filter assembly.
  5. Clean filter in fresh solvent and air dry.
- b. Inspection.
1. Inspect quick-drain valve, gasket, filter and fuel selector for nicks, dents, scratches, dirt accumulation and other foreign matter.
  2. Refer to Inspection Chart for interval of inspection.

#### Fuel Selector Valve Control System.

a. Cleaning.

1. Clean the fuel selector valve with a suitable solvent, wipe clean with a dry cloth.
- b. Inspection.
1. Inspect fuel selector valve control system for binding of control, travel, proper operation, excessive wear, safing and detent position.

#### Vacuum System.

a. Cleaning.

1. The vacuum system may be cleaned by immers-

ing lines and hoses in dry cleaning solvent, and dried with filtered dry compressed air.

2. Wipe exterior of lines and hoses with a clean, dry cloth.

3. Replace the vacuum system filter. Do not attempt to clean.

4. Remove the relief valve screen and submerge in suitable solvent. Allow to soak or wash until all foreign particles are dislodged.

5. Clean relief valve if required by washing in suitable solvent and drying with filtered dry compressed air.

b. Inspection.

1. Inspect the vacuum system for scratches, chips, nicks, dents, deformed tubes, sharp bends, dirt, proper operation and correct vacuum indication.

2. Refer to Inspection Chart for inspection intervals.

#### Pitot Static System.

a. Cleaning.

1. Immerse lines in dry cleaning solvent.
2. Dry lines with filtered compressed air.
3. Wipe exterior of lines with a clean, dry cloth.

b. Inspection.

1. Inspect lines for cracks, chafing and abrasions.

#### Heater.

Refer to Inspection Chart and Cessna Heater and Components Service/Parts Manual for cleaning and inspection of heater system.

#### Oxygen System.

Refer to Inspection Chart and Section 13 for cleaning and inspection of oxygen system.

#### Surface Deice.

Refer to Inspection Chart and Section 13 for cleaning and inspection of surface deice system.

#### Propeller Unfeathering System.

a. Cleaning.

1. Clean accumulator with suitable solvent.
  2. Wipe hoses and accumulator with a clean cloth.
- b. Inspection.

1. Inspect hose assemblies for chafing and fittings for tightness.

2. Inspect accumulator for security in mounting brackets.

3. Always inspect filler valve after charging for leaks.

c. Repair and Servicing.

1. Repairs to propeller unfeathering system are limited to replacement of components.

## CAUTION

Always release system pressure by placing propeller control in unfeathered position and release accumulator pressure through filler valve, before disconnecting hose between accumulator and governor or removing accumulator.

## 2. Service accumulator as follows:

- (a) Place propeller control in the unfeathered position before charging the accumulator to prevent the possibility of oil under pressure being trapped in the accumulator.
- (b) Although the accumulator will function properly when charged with air, dry nitrogen gas is recommended to minimize corrosion.
- (c) Either too much pressure or not enough pressure in the accumulator will reduce efficiency of the unfeathering system. With a normal amount of friction within the propeller, optimum pressure is approximately 110 psi. A range of 100-125 psi is acceptable.

## Battery.

## a. Cleaning.

1. Clean batteries with a mild solution of bicarbonate of soda (baking soda) and water to remove acid corrosion.
2. Rinse with clear water and sponge off excess water and allow batteries to dry.

## CAUTION

Take special precautions to insure that battery cell filler caps are tight before cleaning the battery. Entrance of soda water into battery cells will neutralize the cell electrolyte.

3. Clean battery terminals as needed with a wire brush to brighten the terminals for good electrical contact.
- b. Inspection.
  1. Check battery case for possible cracks and deterioration.
  2. Check electrolyte for specific gravity as follows:
    - (a) Using a hydrometer, check specific gravity for a reading of 1.250 to 1.280, corrected to temperature.
    - (b) Check that specific gravity of the electrolyte does not vary more than .025 between cells.
    - (c) Should a greater variation exist, battery should be slow charged and retested.

## CAUTION

Remove batteries from aircraft when charging the batteries. Do not use external power generators for charging purposes.

3. Refer to Inspection Chart, figure 2-7, for periodical inspection.

## Battery Box.

## a. Cleaning.

1. Battery lead should be cleaned with a strong solution of bicarbonate of soda (baking soda) and water.
2. Clean hard deposits of spilled acid and corrosion products using a wire brush.
3. When all foreign materials have been removed from the box, flush it thoroughly with clean water.

## CAUTION

Do not allow acid deposits to come in contact with skin or clothing. Serious acid burns may result unless the affected area is washed immediately with soap and water. Clothing will be ruined upon contact with battery acid.

## b. Inspection.

1. Inspect the cleaned battery box for physical damage and for areas lacking proper acid proofing. Badly damaged or corroded boxes should be replaced.
2. Inspect surrounding areas of wing adjacent to battery box for damage and corrosion.

## c. Repair.

1. Boxes requiring acid proofing should be painted inside and out with TT-L-54 Enmar Acid Proof Black lacquer.

## NOTE

It is recommended that the bottom of the battery box compartment cover and the battery box supports be painted with acid proof lacquer.

## Shock Strut Servicing.

## a. To fill the main landing gear shock struts, the following procedures:

1. Completely deflate the strut by loosening valve body (2-1/2 turns maximum).
2. With strut fully compressed, remove valve and fill with hydraulic fluid, MIL-H-5606.
3. Stroke strut slowly 3 times (minimum).
4. Top off fluid with strut compressed.
5. Replace air valve and inflate to extend strut as follows:
  - (a) 320 PSI with tire clear of ground.
6. When aircraft is on ground, empty except with full fuel and oil, service strut to approximately 3.00 inches extension until it can be serviced by jacking the aircraft and servicing strut according to step 5.
- b. To fill the nose gear shock strut, use the following procedures:
  1. Completely deflate the strut by depressing the valve core.
  2. With strut fully compressed, remove valve and fill with hydraulic fluid, MIL-H-5606.
  3. Stroke strut slowly 3 times (minimum).
  4. Top off fluid with strut compressed.
  5. Replace air valve and inflate to extend strut as follows:
    - (a) Inflate strut until extension is 1.25 inches with aircraft at gross weight.

### Miscellaneous Service Items.

a. Cold Weather Servicing. If the aircraft is to be used frequently in extremely cold weather, the oil should be drained while the engine is hot and stored in a dry warm place until needed for next flight. If desired, the oil may be heated before it is poured into the engine for the next flight.

b. Draining Oil. Drain the oil system on each engine as follows:

1. Start engine and run until oil temperature is within normal operating limits.
2. Stop engine and open oil drain access.
3. Remove drain plug and allow sump to completely drain.
4. Install drain plug and close oil drain access.

### WARNING

When preheating the oil, do not allow the temperature of the heated oil to rise above 121°C (250°F). Heating the oil above this temperature may cause a flash fire. Just before shutting down the engine in cold weather a quart of gasoline may be added to the oil in the sump to dilute the oil for the next

c. Fuel System Servicing. The standard fuel system is comprised of two main tanks. Each main tank has a total capacity of 51 U.S. gallons of which 50.5 U.S. gallons are usable. Optional fuel systems include two auxiliary tanks with a total capacity of 20.5 U.S. gallons each tank of which 20 U.S. gallons are usable and two wing locker fuel tanks (optional) with a total capacity of 20.3 U.S. gallons each tank of which 20 U.S. gallons are usable. This provides a total usable fuel capacity of 181 U.S. gallons.

### NOTE

Fuel servicing rates on some ground servicing equipment may tend to exceed the aircraft's fuel system intake rate, thus creating several false "Full" indications. A slower fueling rate is therefore recommended.

d. Fuel System Drains. The fuel system has incorporated eight drain valves which must be drained before the first flight each day to check for water or sediment. Two fuel selector valves and two crossover drain valves are drained by pushing up on the valve stem. The fuel selector valve is located inboard of nacelles and forward of the gear doors in the leading edge, while the crossover drain valves are located in the aft end of the main tanks. To drain the main tank, engage screwdriver (with shank removed), furnished with the aircraft, and push up. Fuel will flow through the hollow handle of the screwdriver. The auxiliary or optional tanks drain valves are located outboard of the nacelle and forward of flaps.

e. Defueling. The defueling procedures given pertain to the right wing. The procedure is the same for the left wing. A standard defueling truck or defueling pump is necessary to defuel the aircraft.

### CAUTION

During all defueling, tank purging and tank repair operations, the aircraft must be located a safe distance from other aircraft and buildings. Fire fighting equipment must be available. Two ground wires from different points on the aircraft to separate approved grounding stakes shall be used to prevent accidental disconnecting of one ground wire.

1. Turn off all electrical power.
2. Turn fuel select valve handles off.
3. Remove fuel filler cap and insert defueling tube.
4. Remove as much fuel as possible through the filler.
5. Cut safety wire and remove drain valves from bottom side of wing and drain remaining fuel in a clean, open container. Use defueling pump to remove fuel from container.
6. Drain right- and crossover drain line at wing gap area.

### WARNING

Residual fuel accumulation in the wing is a fire hazard. Use care to prevent the accumulation of such fuel.

### EXTERNAL POWER RECEPTACLE.

An external power receptacle is provided in the left wing below and slightly to the rear of the batteries to permit the use of 24 volt DC external power source for cold weather starting and for lengthy ground tests of the electrical system. A spring-loaded access door covers the receptacle opening in the wing when the receptacle is not in use.

### SPECIAL TOOLS AND EQUIPMENT.

The relative simplicity and easy accessibility of 310 components eliminate the use of many special tools. In most cases, the well equipped shop will find it necessary to employ only the following special tools which are available through the Cessna Service Parts Department.

| Part No.     | Nomenclature                                         |
|--------------|------------------------------------------------------|
| 4939-30      | Tripod Jack                                          |
| SE709        | Filter Adapter Wrench                                |
| SK320-2      | Unmetered Fuel Pressure Test Hookup                  |
| 0800007-3    | Screwdriver                                          |
| SE716        | Inclinometer                                         |
| C173001-0101 | Towing Bar - Light Duty                              |
| SE608        | Motor Mount Wrench (for use with 0851559 lockwasher) |
| 0800161-2    | Propeller Wrench                                     |

### INSPECTION.

To avoid repetition throughout the inspection, general

points to be checked are given below. In the inspection, only the items to be checked are listed and details as to how to check, or what to check for, are excluded.

Check as Applicable:

**MOVABLE PARTS** for lubrication, servicing, security of attachment, binding, excessive wear, safeting, proper operation, proper adjustment, correct travel, cracked fittings, security of hinges, defective bearings, cleanliness, corrosion, deformation, sealing, and tensions.

**ENGINE COMPARTMENT HOSES** for leaks, cracks, chafing, kinks, deterioration, security, heat hardness, obstructions and foreign matter. The hoses and wire bundles in the heat areas close to the exhaust should be inspected for heat hardness, cracking, flexibility and security during regular engine inspection. (See Inspection Chart for interval.)

**FLUID LINES AND HOSES** for leaks, cracks, dents, kinks, chafing, proper radius, security, corrosion, deterioration, obstructions and foreign matter.

**METAL PARTS** for security of attachment, cracks, metal distortion, broken spot-welds, corrosion, condition of paint and any other apparent damage.

**WIRING** for security, chafing, burning, defective insulation, loose or broken terminals, heat deterioration and corroded terminals.

**BOLTS IN CRITICAL AREA** for correct torque in accordance with torque values given in the chart in Section 1, when installed or when visual inspection indicates the need for a torque check.

**FILTERS, SCREENS AND FLUIDS** for cleanliness, contamination, and/or replacement at specified intervals.

**Aircraft File:**

There are miscellaneous data, information and licenses that are a part of the aircraft file. See Inspection Chart, figure 2-7.

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| COMPONENT                                                   | LOCATION                                                                                  |
|-------------------------------------------------------------|-------------------------------------------------------------------------------------------|
| Alternate Static Source . . . . .                           | Mounted on parking brake support bracket                                                  |
| Alternator Diode Assembly . . . . .                         | Inboard LH engine nacelle below alternator emergency field fuse                           |
| Alternator Emergency Field Fuse . . . . .                   | LH engine nacelle inboard of starter solenoids                                            |
| Alternator Field Fuses and Emergency Field Switch . . . . . | Below main circuit breaker panel on alternator emergency switch and circuit breaker panel |
| Alternator Overvoltage Relay . . . . .                      | Mounted on forward side of front spar beneath copilot's seat                              |
| Ammeter Shunt . . . . .                                     | LH junction box                                                                           |
| Autopilot Pressure Switches . . . . .                       | Inboard RH and LH engine nacelle on elbow fitting                                         |
| Autopilot Solenoid Valve . . . . .                          | Mounted on canted bulkhead in engine nacelle (inboard RH, outboard LH)                    |
| Auxiliary Pump Relay . . . . .                              | Wing root (LH and RH)                                                                     |
| Auxiliary Pump Resistor . . . . .                           | Wing root (LH and RH)                                                                     |
| Battery Solenoid . . . . .                                  | Left engine nacelle, RH side of aft firewall                                              |
| Cigar Lighter Fuse and Resistor . . . . .                   | Forward of instrument panel LH side 0.00 bulkhead                                         |
| Cylinder Head Temperature Bulb . . . . .                    | Under Number 4 cylinder each engine                                                       |
| Deice Control Box . . . . .                                 | Forward of instrument panel (on RH panel brace)                                           |
| Deice Control Switch . . . . .                              | Glare shield switch panel                                                                 |
| Deice Pressure Switch . . . . .                             | Under cabin floorboards aft of front spar (LH side)                                       |
| Deice Timer (Propeller) . . . . .                           | Upper shelf (LH nose)                                                                     |
| Dual Unit Stall and Gear Warning Flasher . . . . .          | Forward of instrument panel center of 0.00 bulkhead                                       |
| External Power Receptacle . . . . .                         | Under side of left wing outboard of nacelle                                               |
| Flap Position Transmitter . . . . .                         | Under floorboards aft of rear spar                                                        |
| Flight Hour Recorder Actuator Switch . . . . .              | Belly of aircraft forward of front spar                                                   |
| Fuel Pressure Relay . . . . .                               | Wing root (LH and RH side)                                                                |
| Fuel Selector and Strainer . . . . .                        | Outboard of each engine nacelle in leading edge                                           |
| Heater Filter and Solenoid . . . . .                        | Wing root (RH wing)                                                                       |
| Heater Igniter Plug . . . . .                               | Located in heater combustion chamber                                                      |
| Heater Fuel Shutoff Valve . . . . .                         | RH wing root                                                                              |
| Landing Gear Actuator and Motor . . . . .                   | Between front and rear spar under floorboard (LH side)                                    |
| Landing Gear Down Switch . . . . .                          | Top of landing gear actuator                                                              |
| Landing Gear Relays . . . . .                               | Beneath floorboards aft of landing gear actuator                                          |
| Landing Gear Safety Switch . . . . .                        | Main landing gear strut (LH)                                                              |
| Landing Gear Up Switch . . . . .                            | Top of landing gear actuator                                                              |
| Left Junction Box . . . . .                                 | Behind left upholstery panel forward of front spar in cabin area                          |
| Nose Gear Down Switch . . . . .                             | Attached to nose gear drag brace                                                          |
| Oil Dilution Solenoid . . . . .                             | On firewall in each engine nacelle                                                        |
| Oil Temperature Bulb . . . . .                              | In crankcase of each engine just below oil cooler                                         |
| Outside Air Temperature Bulb . . . . .                      | Located in nose air inlet duct                                                            |
| Oxygen Regulator . . . . .                                  | Mounted on oxygen bottle in nose compartment                                              |
| Peak Voltage Suppressor . . . . .                           | Mounted on parking brake support bracket                                                  |
| Pitot Static System Sump . . . . .                          | Mounted on aft side of rear cabin bulkhead in static line                                 |
| Propeller Synchronizer Actuator . . . . .                   | Mounted in RH nacelle on center of canted bulkhead                                        |
| Propeller Synchronizer Control Box . . . . .                | On fuselage forward of instrument panel RH side                                           |
| Propeller Unfeathering Accumulator . . . . .                | Mounted on side of engine mount structure                                                 |
| Right Junction Box . . . . .                                | Behind right upholstery panel forward of front spar in cabin area                         |
| Starter Solenoids . . . . .                                 | Mounted on firewall in left engine nacelle                                                |
| Starting Vibrator . . . . .                                 | LH panel brace forward of instrument panel                                                |
| Tip Tank Vent Heaters . . . . .                             | On vent line below each tip tank                                                          |
| Tow Bar . . . . .                                           | Stored in right wing baggage nacelle.                                                     |
| Vacuum System Filter . . . . .                              | Forward of instrument panel on 0.00 bulkhead (LH side)                                    |
| Voltage Regulators . . . . .                                | Beneath copilot's seat                                                                    |
| Windshield (Heated) Relay . . . . .                         | Upper shelf (LH nose)                                                                     |
| Windshield (Heated) Control . . . . .                       | Upper shelf (LH nose)                                                                     |
| Wing Locker Transfer Pump . . . . .                         | Mounted on rib outboard of engine nacelle                                                 |

Figure 2-6. Components Location Chart



|                                                                                                                                                             | 50 | 100 | As<br>Reqd. |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------|----|-----|-------------|
| <b>PROPELLER</b>                                                                                                                                            |    |     |             |
| 1. Blades - Check for nicks, cracks, scratches and blade angles                                                                                             | ★  |     |             |
| 2. Propeller Cylinder - Check allen screws for security                                                                                                     | ★  |     |             |
| 3. Bulkhead - Check for cracks and security on crankshaft                                                                                                   |    | ★   |             |
| 4. Dowel Pins - Check for looseness                                                                                                                         | ★  | ★   |             |
| 5. Propeller and Governor - Check for oil leaks                                                                                                             |    | ★   |             |
| 6. Deice System Electrical Leads - Check for condition and security                                                                                         |    | ★   |             |
| 7. Deice System Brushes - Check for wear and seating (see Section 13)                                                                                       |    | ★   |             |
| 8. Propeller Spinners - Wash, check for cracks and fractures                                                                                                |    | ★   |             |
| <b>ENGINE GROUP</b>                                                                                                                                         |    |     |             |
| <b>CAUTION</b>                                                                                                                                              |    |     |             |
| Ground magneto primary circuit before working on the engine.                                                                                                |    |     |             |
| 1. Engine Overhaul - (See Continental Motors Corporations' Maintenance and Overhaul Manual)                                                                 |    |     | A           |
| 2. Cowling - Wash, check for cracks and fractures                                                                                                           |    | ★   |             |
| 3. Induction Air Filter - Clean.                                                                                                                            |    |     | B           |
| 4. Magneto - Check timing, breaker gap and security (see Section 9)                                                                                         |    | ★   |             |
| 5. Engine Compartment - Visually check for condition, oil leaks, fuel leaks, etc.                                                                           | ★  |     |             |
| 6. Engine Oil and Filter - Change oil and filter element (C294505-0102)                                                                                     |    |     | B           |
| 7. Plugs - Clean and rotate (top to bottom, bottom to top)                                                                                                  | ★  |     |             |
| 8. Exhaust System - Check for condition, cracks and security (see Section 9)                                                                                | ★  |     |             |
| 9. Firewall and Nacelle Structure - Check for condition                                                                                                     |    | ★   |             |
| 10. Engine Mounts - Check for condition and security                                                                                                        |    | ★   |             |
| 11. Induction Manifold - Check connections for condition and security                                                                                       |    | ★   |             |
| 12. Engine Controls - Check for travel and security                                                                                                         |    | ★   |             |
| 13. Engine Wire Bundle - Check for condition and security                                                                                                   |    | ★   |             |
| 14. Alternator - Check brushes, brush leads, bearings and commutator                                                                                        |    |     | C           |
| 15. Fuel, Autopilot and Vacuum Pumps - Condition and security                                                                                               |    | ★   |             |
| 16. Deice Filter (Optional Equipment) - Clean                                                                                                               |    | ★   |             |
| 17. Ignition Cables - Check for condition and security                                                                                                      |    | ★   |             |
| 18. Engine Compartment Hoses (Fuel, Oil, Vacuum, etc.) - Check for deterioration, cracks and condition                                                      |    | ★   |             |
| <b>FUEL SYSTEM</b>                                                                                                                                          |    |     |             |
| 1. Sediment Bowl - Drain                                                                                                                                    |    |     | D           |
| 2. Fuel Strainer - Clean                                                                                                                                    |    | ★   |             |
| 3. Tip Tanks (Main) - Check for leaks, security and cracks around welds                                                                                     |    |     | D           |
| 4. Boost Pumps (Auxiliary) - Check for leaks at mounting and security                                                                                       |    | ★   |             |
| 5. Transfer Pumps (Optional) - Check for leaks and security                                                                                                 |    | ★   |             |
| 6. Tip Tank Vent Lines - Check for obstructions                                                                                                             |    |     | D           |
| 7. Plumbing - Check for leaks, condition and security                                                                                                       |    | ★   |             |
| 8. Selector Valve - Feel for detents through 270°, check linkage, bearings and pins for condition and security (see Section 11 for additional requirements) |    | ★   |             |
| 9. Selector Valve - Perform an Operational Check in accordance with Section 11                                                                              |    |     | C           |
| 10. Heater Fuel Filter - Check filter for cleanliness and plumbing for leaks                                                                                |    | ★   |             |
| A - Every 1200 hours                                                                                                                                        |    |     |             |
| B - Every 50 hours or sooner when local dust conditions exist                                                                                               |    |     |             |
| C - Every 500 hours                                                                                                                                         |    |     |             |
| D - Daily                                                                                                                                                   |    |     |             |

Figure 2-7. Inspection Chart (Sheet 1 of 4)

|                                                                                                                                                                                                   |                                                                                                                                                                                    | 50 | 100 | As<br>Reqd. |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|-----|-------------|
| <b>LANDING GEAR</b>                                                                                                                                                                               |                                                                                                                                                                                    |    |     |             |
| 1.                                                                                                                                                                                                | Main Landing Gear Actuator - Check for condition and security                                                                                                                      |    | ★   |             |
| 2.                                                                                                                                                                                                | Main and Nose Gear Drive Tubes and Idler Mechanism - Check for condition                                                                                                           |    | ★   |             |
| 3.                                                                                                                                                                                                | Wheel Well Mechanisms - Check for condition                                                                                                                                        |    | ★   |             |
| 4.                                                                                                                                                                                                | Torque Links - Check for excessive wear and condition                                                                                                                              |    | ★   |             |
| 5.                                                                                                                                                                                                | Nose Gear Steering Mechanism - Check cables and bearings for condition                                                                                                             |    | ★   |             |
| 6.                                                                                                                                                                                                | Shimmy Dampener - Check for condition and fluid                                                                                                                                    |    | ★   |             |
| 7.                                                                                                                                                                                                | Brake Linings - Check for wear                                                                                                                                                     |    | ★   |             |
| 8.                                                                                                                                                                                                | Wheel Bearings - Check for condition and repack                                                                                                                                    |    |     | E           |
| 9.                                                                                                                                                                                                | Tires - Check for general condition                                                                                                                                                |    | ★   |             |
| 10.                                                                                                                                                                                               | Brakes - Check for operation and fluid level                                                                                                                                       |    | ★   |             |
| 11.                                                                                                                                                                                               | Parking Brake - Check mechanism for condition and operation                                                                                                                        |    | ★   |             |
| 12.                                                                                                                                                                                               | Main Gear Trunnion - Check roll pin in pivot shaft for looseness                                                                                                                   |    | ★   |             |
| 13.                                                                                                                                                                                               | Main Landing Gear Safety Switch - Packed with DC4 Dow-Corning Silicone Grease                                                                                                      |    | ★   |             |
| <b>NOTE</b>                                                                                                                                                                                       |                                                                                                                                                                                    |    |     |             |
| The following items are to be checked with aircraft on jacks.                                                                                                                                     |                                                                                                                                                                                    |    |     |             |
| 14.                                                                                                                                                                                               | Safety Switch - Check for operation (gear extended)                                                                                                                                |    | ★   |             |
| 15.                                                                                                                                                                                               | Gear Indicator Light and Warning Horn - Check for operation (gear extended and retracted)                                                                                          |    | ★   |             |
| 16.                                                                                                                                                                                               | Gear Retraction Linkage - Check for excessive wear, nicks, dents and scratches                                                                                                     |    | ★   |             |
| 17.                                                                                                                                                                                               | Gear Retraction - Check operation with doors connected and disconnected                                                                                                            |    | ★   |             |
| 18.                                                                                                                                                                                               | Manual Gear Extension System - Check linkage for operation and condition                                                                                                           |    | ★   |             |
| 19.                                                                                                                                                                                               | Nose and Main Gears - Check operation for clearance (gear retracted and extended) - Check rigging in accordance with Section 2                                                     |    | ★   |             |
| 20.                                                                                                                                                                                               | Gear Down Lock - Check mechanism for positive lock                                                                                                                                 |    | ★   |             |
| 21.                                                                                                                                                                                               | Cabin Step System - Check for proper operation and condition                                                                                                                       |    | ★   |             |
| 22.                                                                                                                                                                                               | Nose Gear Steering Yoke - Check for operation as follows:                                                                                                                          |    | ★   |             |
| a.                                                                                                                                                                                                | With gear retracted, lower gear until nose strut is approximately 30° aft of vertical position. At this point, the nose wheel is free to rotate in either direction to its limits. |    |     |             |
| b.                                                                                                                                                                                                | Turn nose wheel to extreme right position and deflect left rudder pedal. This places the roller cam at the extreme edge of the steering yoke.                                      |    |     |             |
| c.                                                                                                                                                                                                | Continue lowering of the gear. Nose wheel should straighten by time nose strut locks down.                                                                                         |    |     |             |
| d.                                                                                                                                                                                                | Retract gear and repeat steps (a, b, and c) in opposite direction.                                                                                                                 |    |     |             |
| 23.                                                                                                                                                                                               | Nose Gear Uplock Torque Tube - Dye check                                                                                                                                           |    |     | F           |
| 24.                                                                                                                                                                                               | Landing Gear Actuator - Check gear operation for excessive wear                                                                                                                    |    |     | F           |
| <b>NOTE</b>                                                                                                                                                                                       |                                                                                                                                                                                    |    |     |             |
| If indications of wear exist, remove the gearbox cover, clean out all the hard and old grease and inspect. Repack the gearbox with low temperature aircraft lubricating grease and install cover. |                                                                                                                                                                                    |    |     |             |
| <b>AIRFRAME</b>                                                                                                                                                                                   |                                                                                                                                                                                    |    |     |             |
| 1.                                                                                                                                                                                                | Exterior and Interior - Check for loose bolts, nuts, rivets, broken spot-welds or any apparent damage                                                                              | ★  |     |             |
| 2.                                                                                                                                                                                                | Wing Spar Fittings - Check bolts for security                                                                                                                                      |    |     | G           |
| E - First 100 hours and 500 hours thereafter                                                                                                                                                      |                                                                                                                                                                                    |    |     |             |
| F - Every 1200 hours                                                                                                                                                                              |                                                                                                                                                                                    |    |     |             |
| G - Check torque first 100 hours, then every 100 hours thereafter check for security but DO NOT TORQUE.                                                                                           |                                                                                                                                                                                    |    |     |             |

Figure 2-7. Inspection Chart (Sheet 2 of 4)

|                                                                                                                                                                                                                                                                                                | 50 | 100 | As<br>Reqd. |   |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|-----|-------------|---|
| AIRFRAME (CONTINUED)                                                                                                                                                                                                                                                                           |    |     |             |   |
| 3. Wing Wheel Well and Root Rib - For condition and security of fume proofing materials                                                                                                                                                                                                        |    |     | C           |   |
| 4. Tip Tank Fittings - Check bolts for security                                                                                                                                                                                                                                                |    | ★   |             |   |
| 5. Vertical and Horizontal Stabilizers - Check bolts for security                                                                                                                                                                                                                              |    | ★   |             |   |
| 6. Baggage Doors - Check for condition and Operation                                                                                                                                                                                                                                           |    | ★   |             |   |
| 7. Cabin Door - Check for condition and operation                                                                                                                                                                                                                                              |    | ★   |             |   |
| 8. Windshield and Windows - Check for condition                                                                                                                                                                                                                                                |    | ★   |             |   |
| 9. Seats and Seat Belts - Check for condition and security                                                                                                                                                                                                                                     |    | ★   |             |   |
| 10. Vacuum System Filter - Replace                                                                                                                                                                                                                                                             |    | ★   |             |   |
| 11. Instruments - Check for condition and markings                                                                                                                                                                                                                                             |    | ★   |             |   |
| 12. Oxygen System - Check masks, hoses and for pressure                                                                                                                                                                                                                                        |    | ★   |             |   |
| 13. Surface Deice - Check plumbing and boots for condition and security                                                                                                                                                                                                                        |    | ★   |             |   |
| 14. Placards and Decals - Check for presence and legibility                                                                                                                                                                                                                                    |    | ★   |             |   |
| 15. Exterior Surfaces - Clean                                                                                                                                                                                                                                                                  |    | ★   |             |   |
| 16. Upholstery Trim, Windshield and Windows - Clean                                                                                                                                                                                                                                            |    | ★   |             |   |
| 17. Nose Ram Air - Check clamps and hoses to heating and ventilating system for condition and security                                                                                                                                                                                         |    | ★   |             |   |
| 18. Heater - Check for condition, security, fuel leaks, loose connections, clamps and attaching points (see Heater Service and Parts Manual)                                                                                                                                                   |    | ★   |             |   |
| OXYGEN SYSTEM                                                                                                                                                                                                                                                                                  |    |     |             |   |
| 1. Oxygen System - Check for pressure                                                                                                                                                                                                                                                          |    | ★   |             | H |
| 2. Oxygen Masks and Hoses - Check condition and clean                                                                                                                                                                                                                                          |    | ★   |             |   |
| 3. Oxygen Cylinders ICC-3HT (Refer to Section 13 for Hydrostatic Testing)                                                                                                                                                                                                                      |    |     |             |   |
| VACUUM SYSTEM                                                                                                                                                                                                                                                                                  |    |     |             |   |
| 1. Filter Replacement                                                                                                                                                                                                                                                                          |    | ★   |             |   |
| 2. Relief Valve - Check                                                                                                                                                                                                                                                                        |    | ★   |             |   |
| DEICE SYSTEM                                                                                                                                                                                                                                                                                   |    |     |             |   |
| 1. Deice System - Check for leaks                                                                                                                                                                                                                                                              |    | ★   |             |   |
| 2. Deice Boots - Check condition and security                                                                                                                                                                                                                                                  |    | ★   |             |   |
| 3. Deice Filter - Clean                                                                                                                                                                                                                                                                        |    | ★   |             |   |
| PITOT STATIC SYSTEM                                                                                                                                                                                                                                                                            |    |     |             |   |
| 1. Sump - Check for cracks, dents and leaks                                                                                                                                                                                                                                                    |    | ★   | I           |   |
| 2. System - Check for leaks                                                                                                                                                                                                                                                                    |    | ★   |             |   |
| 3. Altimeter - Inspect per FAR Part 43, Appendix E, by authorized repair station                                                                                                                                                                                                               |    |     |             |   |
| FLIGHT CONTROL SYSTEM                                                                                                                                                                                                                                                                          |    |     |             |   |
| 1. Aileron - Check hinge, bellcrank, linkage and bolt for condition, operation and security                                                                                                                                                                                                    |    | ★   | F           |   |
| 2. Aileron Trim Tab - Check for condition, security and hinge safety                                                                                                                                                                                                                           |    | ★   |             |   |
| 3. Aileron and Trim Tab - Check for travel and stops for security                                                                                                                                                                                                                              |    | ★   |             |   |
| 4. Aileron Trim Tab Actuator - Check linkage for condition and security                                                                                                                                                                                                                        |    | ★   |             |   |
| 5. Aileron and Aileron Trim Cables - Check for tension, fraying and turnbuckle security                                                                                                                                                                                                        |    | ★   |             |   |
| 6. Flaps - Check linkage, bellcranks, pulleys and cables for condition, tension and security                                                                                                                                                                                                   |    | ★   |             |   |
| 7. Flap Motor and Position Indicator - Check for travel, condition and security                                                                                                                                                                                                                |    | ★   |             |   |
| 8. Flap Actuator Gears - Check for indications of excessive wear. If indications of wear exist, remove and disassemble actuator assembly, clean out all the hard and old grease, inspect and repair as necessary. Repack gear-box with low temperature aircraft lubricating grease and install |    |     |             |   |
| C - Every 500 hours                      H - Every 3 years<br>F - Every 1200 hours                    I - Every 2 years                                                                                                                                                                        |    |     |             |   |

Figure 2-7. Inspection Chart (Sheet 3 of 4)

|                                                                                                                                                                                                                                                                            | 50 | 100 | As<br>Reqd. |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|-----|-------------|
| <b>FLIGHT CONTROL SYSTEM (CONTINUED)</b>                                                                                                                                                                                                                                   |    |     |             |
| 9. Elevator and Rudder - Check hinges, hinge bolts, trim tabs and trim tab actuators for condition, movement and security                                                                                                                                                  |    | ★   |             |
| 10. Elevator and Rudder - Check linkage, bellcrank, cables, pulleys and turn-buckles for condition, movement, tensions, fraying and security                                                                                                                               |    | ★   |             |
| 11. Elevator and Elevator Trim - Check for proper travel                                                                                                                                                                                                                   |    | ★   |             |
| 12. Rudder and Rudder Trim - Check for proper travel                                                                                                                                                                                                                       |    | ★   |             |
| 13. Rudder Torque Tube - Check for operation and security                                                                                                                                                                                                                  |    | ★   |             |
| 14. Autopilot (Optional Equipment) - Check cables, attachments, pulleys and turnbuckles for tension, condition, operation and security                                                                                                                                     |    | ★   |             |
| 15. Control Column - Check for condition and security                                                                                                                                                                                                                      |    | ★   |             |
| 16. Trim Control Knobs - Check for operation and security                                                                                                                                                                                                                  |    | ★   |             |
| 17. Push-Pull Rods - Check for operation                                                                                                                                                                                                                                   |    | ★   |             |
| <b>ELECTRICAL SYSTEM</b>                                                                                                                                                                                                                                                   |    |     |             |
| 1. Junction Box and Circuit Breaker Panel - Check wiring and terminals for condition and security                                                                                                                                                                          |    | ★   |             |
| 2. Pedestal and Instrument Panel - Check wiring and terminals for condition and security                                                                                                                                                                                   |    | ★   |             |
| 3. Regulators - Check for wiring and terminals for condition and security                                                                                                                                                                                                  |    | ★   |             |
| 4. Switches - Check for security and interference                                                                                                                                                                                                                          |    | ★   |             |
| 5. Landing Gear Relay and Limit Switch - Check wiring and terminals for condition and security                                                                                                                                                                             |    | ★   |             |
| 6. Flap Limit Switch and Motor - Check wiring and terminals for condition and security                                                                                                                                                                                     |    | ★   |             |
| 7. Wing and Fuselage - Check wiring bundle for condition and security                                                                                                                                                                                                      |    | ★   |             |
| 8. Battery - Check electrolyte and general condition and security                                                                                                                                                                                                          |    | ★   |             |
| 9. Battery Cables - Check for corrosion, condition and security                                                                                                                                                                                                            |    | ★   |             |
| 10. Instrument and Interior Lights - Check lights for operation                                                                                                                                                                                                            |    | ★   |             |
| 11. Radio and Navigation System - Check for condition and security. (Note evidence of water, if present, check ram air hoses.)                                                                                                                                             |    | ★   |             |
| <b>POST INSPECTION</b>                                                                                                                                                                                                                                                     |    |     |             |
| 1. Correct all discrepancies, replace all fairings, doors and access hole covers                                                                                                                                                                                           |    |     |             |
| 2. Ground check engine, check ignition drop, alternator charging rate, oil pressure and general operation of components.                                                                                                                                                   |    |     |             |
| <b>AIRCRAFT FILE</b>                                                                                                                                                                                                                                                       |    |     |             |
| 1. There are miscellaneous data, information and licenses that are a part of the aircraft file. The following is a checklist for that file. In addition, a periodic check should be made of the latest Civil Air Regulations to insure that all data requirements are met. |    |     |             |
| a. To be displayed in the airplane at all times:                                                                                                                                                                                                                           |    |     |             |
| (1) Aircraft Airworthiness Certificate (Form FAA-1362B).                                                                                                                                                                                                                   |    |     |             |
| (2) Aircraft Registration Certificate (Form FAA-500A).                                                                                                                                                                                                                     |    |     |             |
| (3) Airplane Radio Station License (Form FCC-404, if transmitter installed).                                                                                                                                                                                               |    |     |             |
| b. To be carried in the airplane at all times:                                                                                                                                                                                                                             |    |     |             |
| (1) Weight and Balance, and associated papers (latest copy of the Repair and Alteration Form FAA-337, if applicable).                                                                                                                                                      |    |     |             |
| (2) Aircraft Equipment List.                                                                                                                                                                                                                                               |    |     |             |
| c. To be made available upon request:                                                                                                                                                                                                                                      |    |     |             |
| (1) Aircraft Log Book.                                                                                                                                                                                                                                                     |    |     |             |
| (2) Engine Log Book.                                                                                                                                                                                                                                                       |    |     |             |
| <b>NOTE</b>                                                                                                                                                                                                                                                                |    |     |             |
| Cessna recommends that these items, plus the Owner's Manual and the "Cessna Flight Guide" (Flight Computer) be carried in the aircraft at all times.                                                                                                                       |    |     |             |

Figure 2-7. Inspection Chart (Sheet 4 of 4)

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| OVERHAUL AND REPLACEMENT CHART |                                                                              | Overhaul | Replace |
|--------------------------------|------------------------------------------------------------------------------|----------|---------|
| <b>PROPELLER</b>               |                                                                              |          |         |
| 1.                             | Propeller (see McCauley Maintenance and Overhaul Manual)                     | B        |         |
| 2.                             | Governor (see Woodward Overhaul Manual)                                      | B        |         |
| 3.                             | Accumulator, Unfeathering (see Woodward Overhaul Manual)                     | B        |         |
| <b>ENGINE GROUP</b>            |                                                                              |          |         |
| 1.                             | Engine (see Continental Motors Engine Overhaul Manual)                       | B        |         |
| 2.                             | Magneto (see Bendix Magneto Overhaul Manual)                                 | B        |         |
| 3.                             | Alternator (see Cessna Alternator Service/Parts Manual)                      | B        |         |
| 4.                             | Vacuum Pump (Wet)                                                            |          | B       |
| 5.                             | Vacuum Pump (Dry)                                                            |          | B       |
| 6.                             | Fuel Pump                                                                    |          | B       |
| 7.                             | Tachometer Generator                                                         |          | B       |
| 8.                             | Starter                                                                      |          | B       |
| 9.                             | Engine Compartment Fuel Hoses                                                |          | B       |
| 10.                            | Engine Compartment Oil Hoses                                                 |          | B       |
| 11.                            | Engine Compartment Pneumatic Hoses                                           |          | B       |
| 12.                            | Induction Air Filter (P/N 9910018-2)                                         |          | B       |
| <b>LANDING GEAR</b>            |                                                                              |          |         |
| 1.                             | Landing Gear Actuator                                                        |          | B       |
| 2.                             | Actuator Motor                                                               |          | B       |
| 3.                             | Actuator Reduction Unit                                                      |          | B       |
| 4.                             | Shimmy Dampener (see Section 4)                                              | B        |         |
| <b>AIRFRAME</b>                |                                                                              |          |         |
| 1.                             | Oxygen Bottle                                                                |          | C       |
| 2.                             | Heater (see Cessna Heater and Components Service/Parts Manual)               | A        |         |
| 3.                             | Autopilot Filter (P/N AMA201442), (see Nav-O-Matic 800 Service/Parts Manual) |          | A       |
| <b>FLIGHT CONTROLS</b>         |                                                                              |          |         |
| 1.                             | Flap Actuator Gearbox (see Section 8)                                        | B        |         |
| 2.                             | Flap Actuator Motor                                                          |          | B       |
| 3.                             | Aileron Trim Tab Actuator (see Section 5)                                    | B        |         |
| 4.                             | Elevator Trim Tab Actuator (see Section 5)                                   | B        |         |
| 5.                             | Rudder Trim Tab Actuator (see Section 5)                                     | B        |         |
| A - Every 500 hours            |                                                                              |          |         |
| B - Every 1200 hours           |                                                                              |          |         |
| C - Every 3 years              |                                                                              |          |         |

Figure 2-7A. Overhaul and Replacement Chart

## SERVICING PROCEDURES

For convenience, the items listed below are segregated into servicing intervals; that is, all items which must be checked or serviced daily are listed, then items requiring 50 hour service are listed, etc. The numbered symbol at each item refers to the item as shown in the Servicing Chart.

## SERVICING CHART

Symbol denotes servicing interval. Number within symbol refers to item to be serviced.



## DAILY

- 1 FUEL TANK FILLERS:**  
Service after each flight. Keep full to retard condensation in tanks. Service with 100/130 or alternate 115/145 aviation gasoline. Capacity each tip tank: 51 U.S. Gals., 42.5 Imp. Gals., or 193 Liters. Capacity each auxiliary (optional) tank: 20.5 U.S. Gals., 17.1 Imp. Gals., or 77.5 Liters. Capacity each wing locker (optional) tank: 20.3 U.S. Gals., 16.8 Imp. Gals., or 76.8 Liters.
- 2 FUEL TANK DRAINS:**  
On the first flight of each day and after each refueling, drain a small amount of fuel from the main and auxiliary tank drain valves.
- 3 FUEL STRAINER DRAIN:**  
Drain about 2 ounces of fuel from each fuel strainer before first flight each day and after refueling.
- 4 OIL DIPSTICK AND FILLER CAPS:**  
Check on preflight and add oil as necessary. Do not operate on less than 9 U.S. Qts. To minimize loss of oil through breather, fill to 10 U.S. Qts. level for normal flights of less than 3 hours. For extended flights, fill to 12 U.S. Qts. If optional oil filter is installed, one additional U.S. Qt. is required when the filter element is changed. Service with aviation grade SAE 30 below 40°F, SAE 50 above 40°F. Multi-viscosity oil with a range of SAE 10W30 is recommended for improved starting in cold weather. Detergent or Dispersant oil conforming to Continental Motors Specification MHS-24A must be used after the first 20 to 30 hours of new or overhauled engine operation. The aircraft is delivered from the factory with straight mineral oil. Therefore, it will be necessary during the break-in period or first 20 to 30 hours of operation to add straight mineral oil.
- 5 OXYGEN CYLINDER (OPTIONAL):**  
Check oxygen pressure gage for anticipated requirements before first flight. Whenever pressure drops below 300 PSI, refill with aviator's breathing oxygen, Military Specification MIL-O-27210. Maximum pressure 1800 PSI.

## 50 HOURS

- 6 BATTERY:**  
Check level of electrolyte every 50 hours or at least every 30 days, oftener in hot weather. Maintain level of electrolyte in the filler hole even with the bottom of the vent well by adding distilled water.
- 7 INDUCTION AIR FILTERS:**  
Service every 50 hours or oftener when operating in dusty conditions. Under extremely dusty conditions, daily maintenance of the filter is recommended. Follow instructions stamped on filter frame.

Figure 2-8. Service Chart (Sheet 1 of 3)

## 50 HOURS (Cont.)

8

## OIL SUMP DRAINS, OIL SCREENS, AND OPTIONAL EXTERNAL OIL FILTERS:

After break-in oil is removed (mineral oil), change engine oil and replace filter element every 50 hours. If optional oil filter is not installed, change oil and clean screen every 20 to 30 hours. Change engine oil at least every four months even though the above periods have not accumulated. Reduce period for prolonged operation in dusty areas, cold climates, or when short flights and long idle periods result in sludging conditions.

## 100 HOURS

9

## SHIMMY DAMPENER:

Check fluid level and fill as required with hydraulic fluid (Red) MIL-H-5606A.

10

## BRAKE MASTER CYLINDERS:

Check fluid level in reservoirs and fill as needed through plugs on master cylinder head. Fill with hydraulic fluid (Red) MIL-H-5606A.

11

## SUCTION RELIEF VALVE:

Check suction relief valve screen for dirt or obstructions. If suction gage reading appears high, remove screens and clean with compressed air or wash with Stoddard Solvent.

12

## HEATER FUEL FILTER:

Remove and wash thoroughly with unleaded gasoline.

13

## FUEL SELECTOR VALVE:

Clean and lubricate with Camie 1000, Dry Spray Lubricant.

14

## OIL SEPARATORS:

Remove separators, flush with Stoddard Solvent, dry with compressed air.

## 500 HOURS

15

## VACUUM SYSTEM FILTER:

Remove and replace with new filter element P/N C294501-0103.

16

## SHOCK STRUTS:

Check and fill to level of filler plug with hydraulic fluid (Red) MIL-H-5606A.

## AS REQUIRED

17

## TIRES:

Nose wheel tire maintain 24 PSI.  
Main wheel tire maintain 60 PSI.

18

## FUEL SELECTOR VALVE GEAR BOX:

Clean thoroughly with suitable solvent, allow to air dry and lubricate, by hand, with general purpose grease.

Figure 2-8. Service Chart (Sheet 2 of 3)



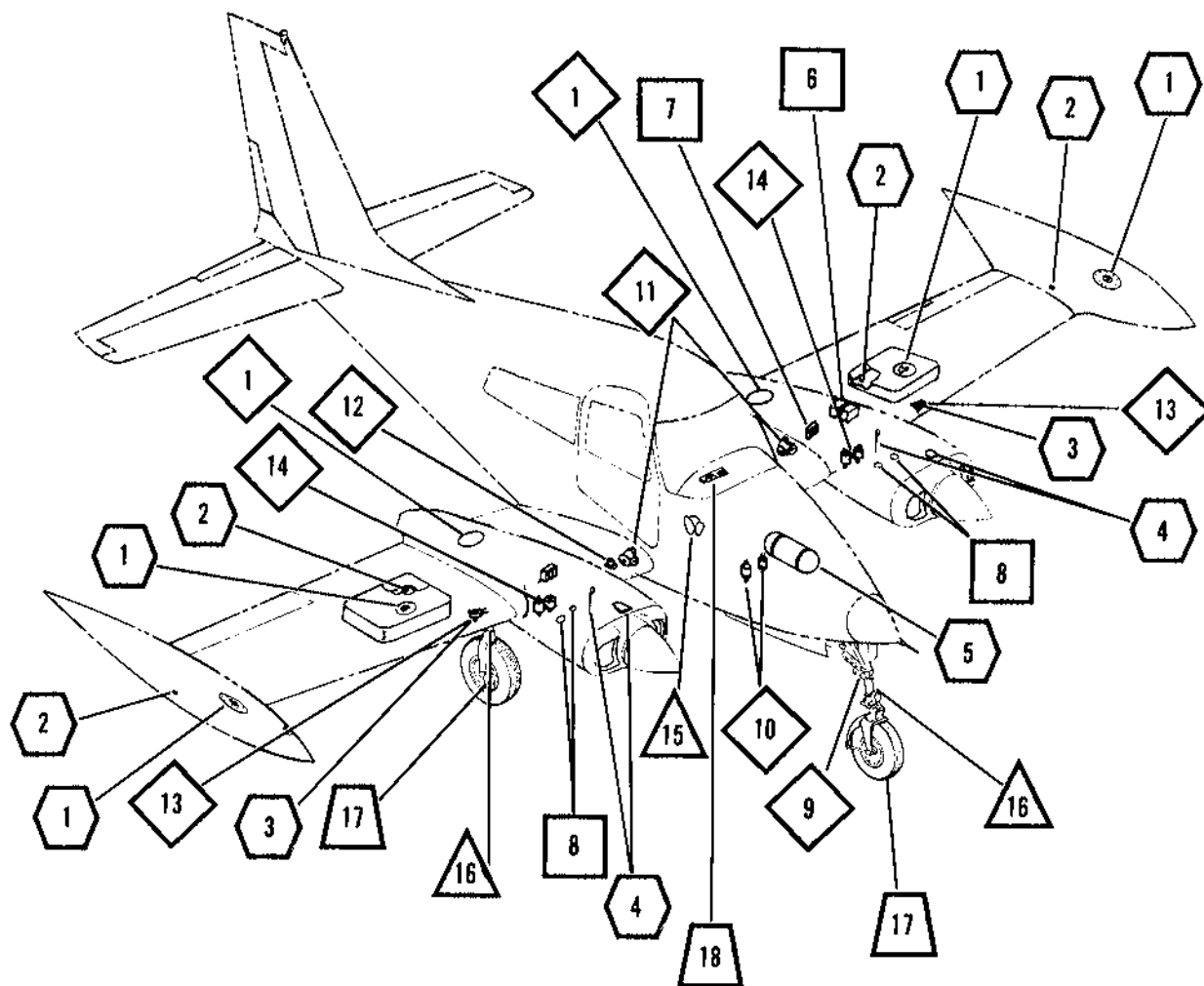


Figure 2-8. Service Chart (Sheet 3 of 3)

## FREQUENCY (HOURS)



CHECK OR SERVICE DAILY



50 HOURS



100 HOURS



500 HOURS



1000 HOURS

ON ASSEMBLY AND  
AS REQUIRED

## METHOD



HAND



SQUIRT CAN



FILLER CAN



GREASE GUN

## TYPE OF LUBRICANT

|          |                                                                                                                           |
|----------|---------------------------------------------------------------------------------------------------------------------------|
| GP ..... | Grease, General Purpose                                                                                                   |
| GL ..... | Grease, Low Temperature                                                                                                   |
| OG ..... | Oil, General Purpose (MIL-L-7870)                                                                                         |
| FG ..... | Graphite, Lubricating                                                                                                     |
| P .....  | Petrolatum or Terminal Grease                                                                                             |
| OI ..... | Oil, Lubricating, Aircraft Instrument (MIL-O-6085)                                                                        |
| OH ..... | Hydraulic Fluid (MIL-H-5606A)                                                                                             |
| GW ..... | Grease, Wide Temperature Range (MIL-G-25760)                                                                              |
| GS ..... | Grease, Medium Consistency Silicone (MIL-G-3278)                                                                          |
| DS ..... | Dry Spray, Lubricant Camie No. 1000 Watson<br>Industrial Park, St. Louis, Mo., or Dupont<br>Slip Spray Dry Film Lubricant |

Do not lubricate roller chains or cables except under seacoast conditions. Wipe with a clean, dry cloth.

Lubricate unsealed pulley bearings, rod ends, oilite bearings, pivot end hinge points, and any other friction point obviously needing lubrication, with general purpose oil every 500 hours or oftener, if required.

Lubricate door latches with automotive type door latch lubricate, and the latching mechanism with general purpose oil every 1000 hours, or oftener if binding occurs.

Lubricate control surface hinges with general purpose oil (MIL-L-7878) as required.

Lubricate door stop with Sil-Glide (MIL-G-3278).

Figure 2-9. Lubrication Diagram (Sheet 1 of 10)

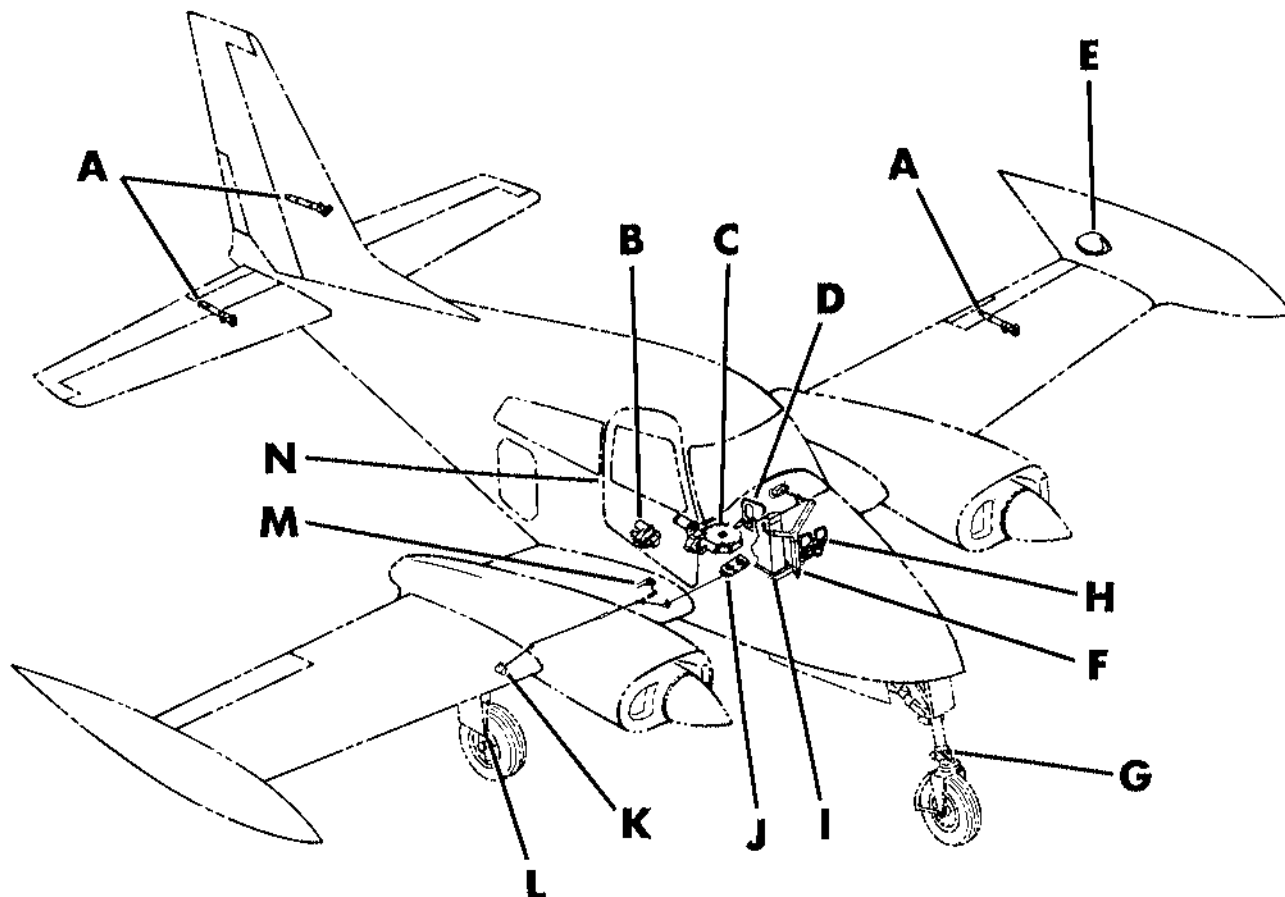


Figure 2-9. Lubrication Diagram (Sheet 2 of 10)

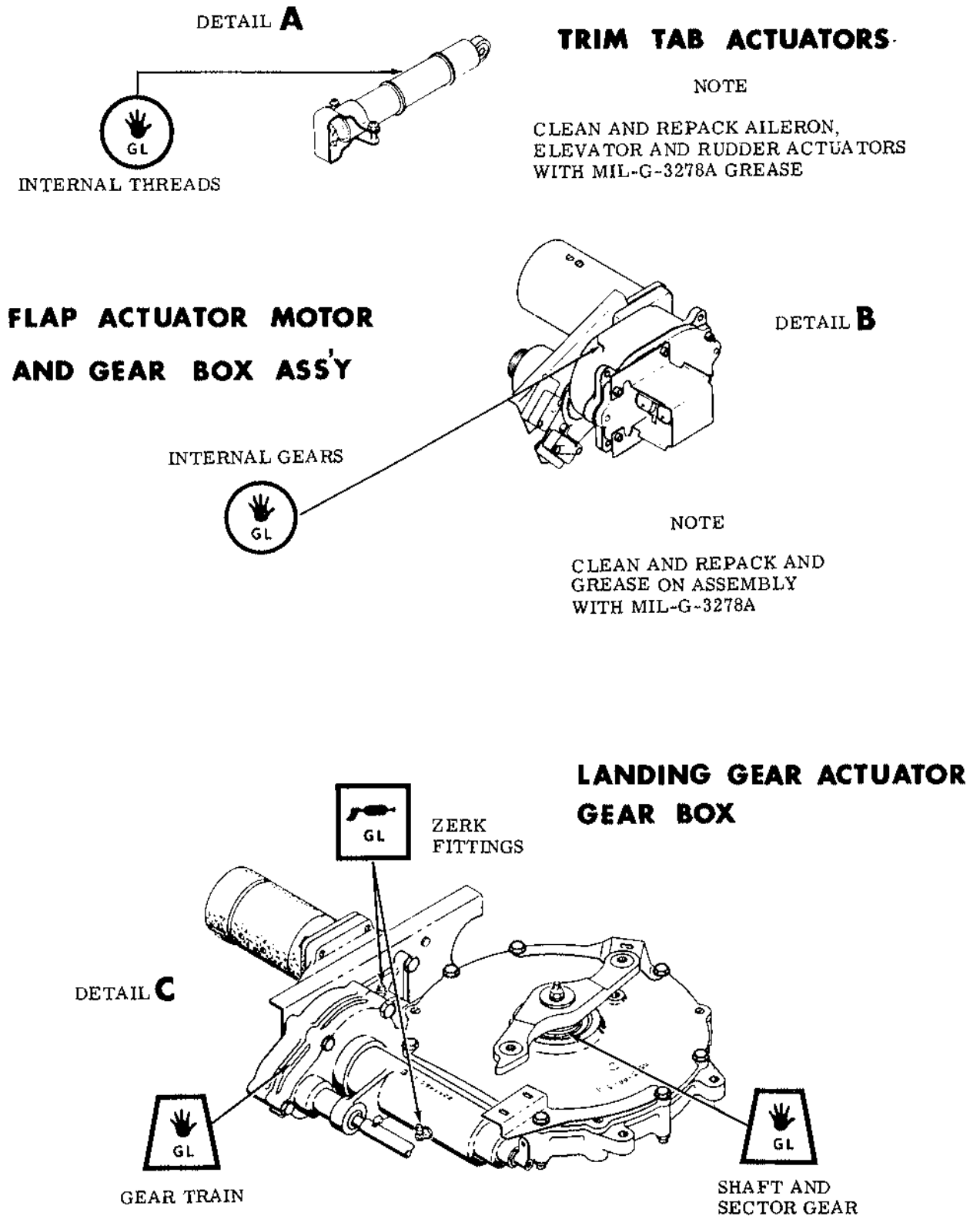
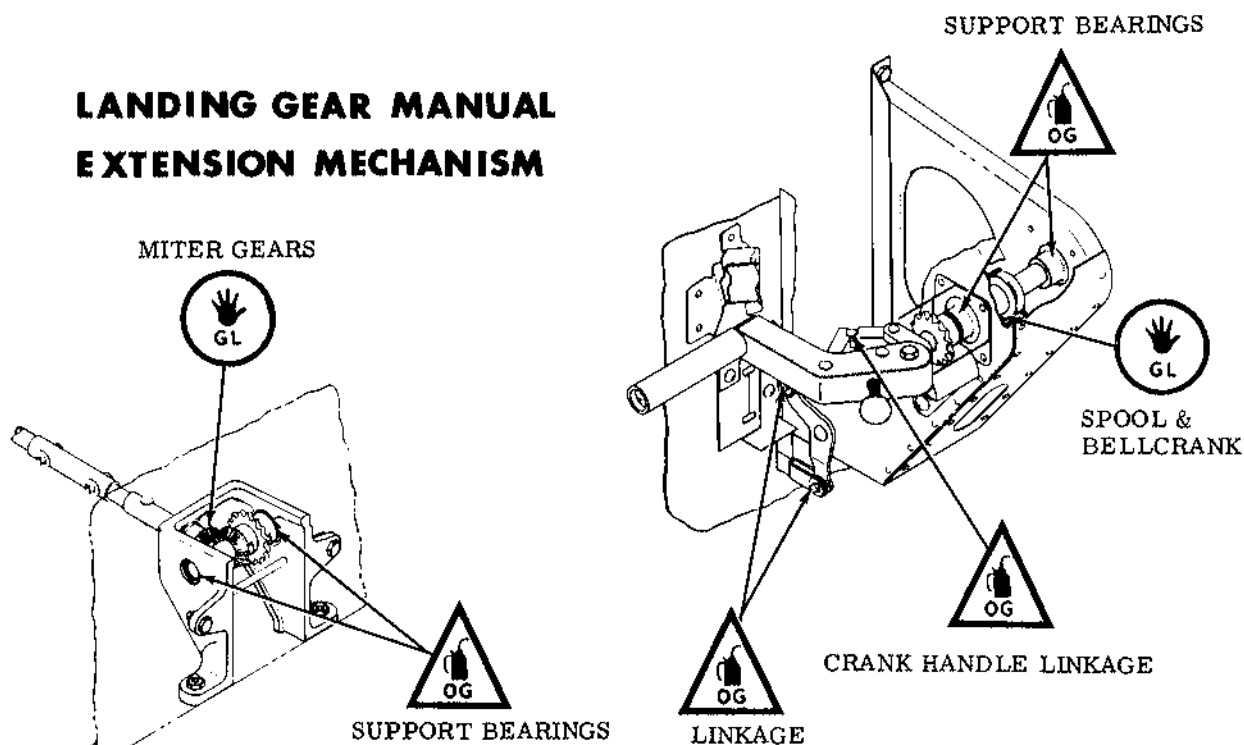


Figure 2-9. Lubrication Diagram (Sheet 3 of 10)

## LANDING GEAR MANUAL EXTENSION MECHANISM

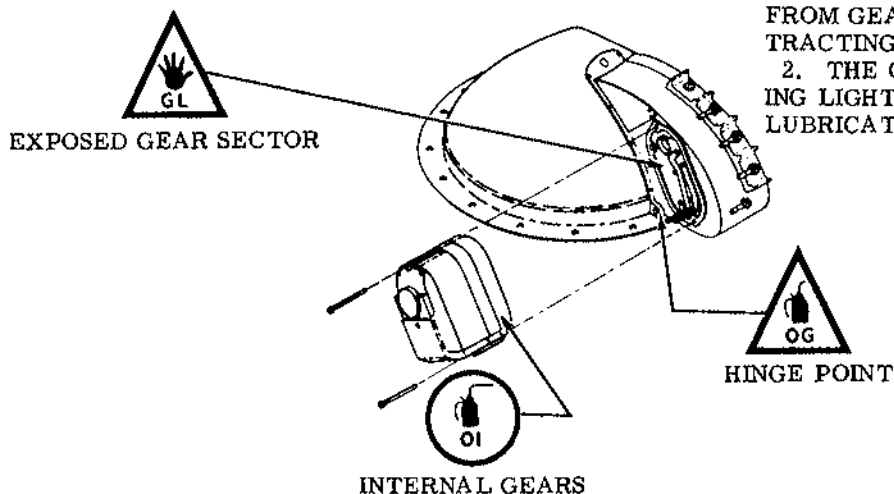


### NOTES:

1. AFTER LUBRICATING, WIPE OFF EXCESS LUBRICANT ADJACENT TO CRANKING HANDLE.
2. DO NOT OIL THE CHAIN; AN OILED CHAIN MAY COLLECT DIRT AND GRIT. WIPE CHAIN WITH A CLEAN DRY CLOTH.

DETAIL **D**

## LANDING LIGHT

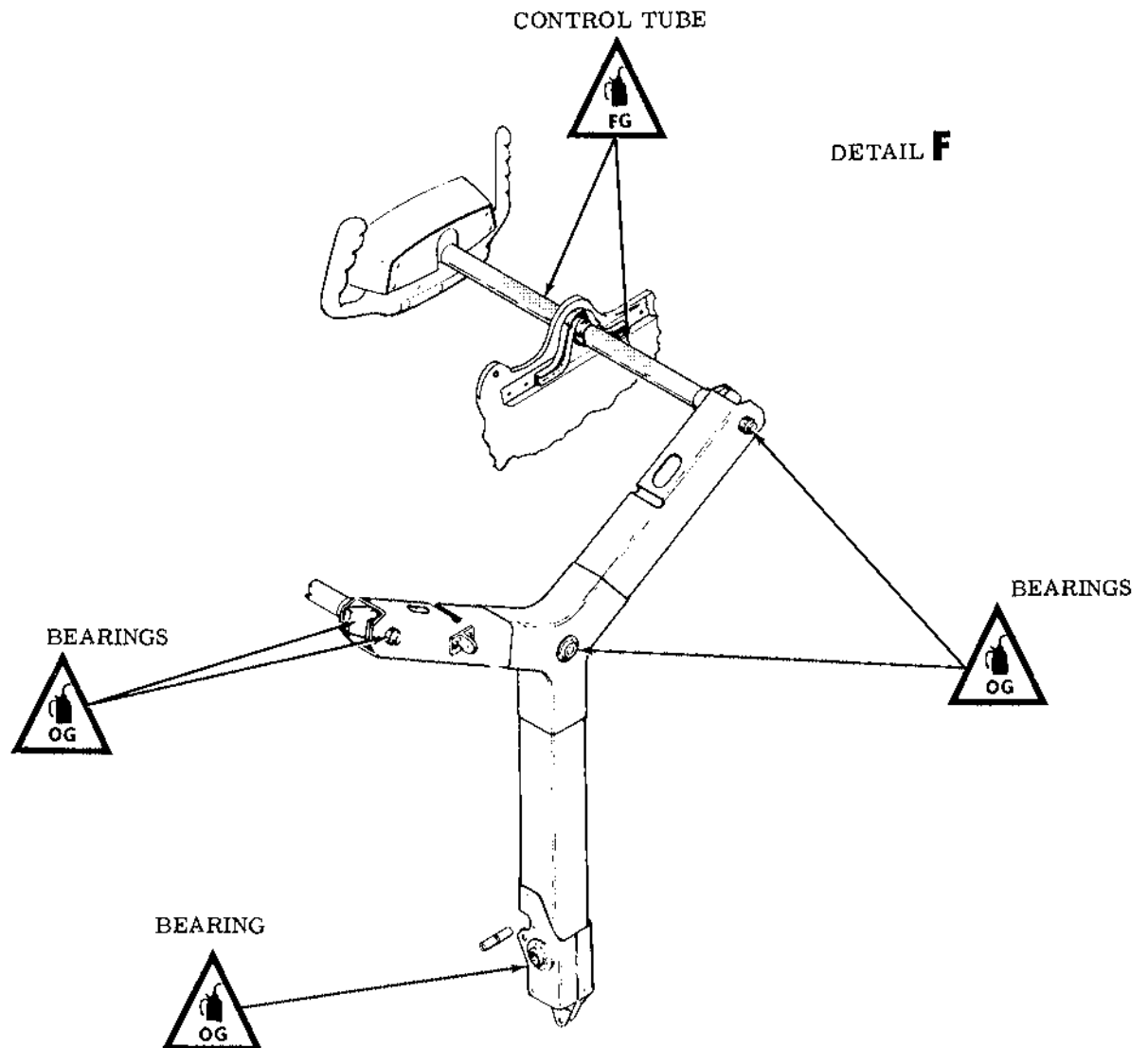


### NOTES:

1. THE LIGHT MUST BE EXTENDED TO LUBRICATE THE LARGE SECTOR GEAR. WIPE OFF EXCESS GREASE FROM GEAR SECTOR BEFORE RETRACTING THE LIGHT.
2. THE OPTIONAL RIGHT WING LANDING LIGHT, IF INSTALLED, MAY BE LUBRICATED IN THE SAME MANNER.

DETAIL **E**

Figure 2-9. Lubrication Diagram (Sheet 4 of 10)

**CONTROL COLUMN****NOTE**

APPLY A SMALL AMOUNT OF GENERAL PURPOSE POWDERED GRAPHITE, MIXED WITH LUBRICATING OIL, TO THE WHEEL CONTROL TUBE ADJACENT TO THE SOCKET ASSEMBLY ON THE INSTRUMENT PANEL. ACTUATE THE CONTROL TUBE FORWARD AND AFT TO INSURE PENETRATION OF THE LUBRICANT INTO THE SOCKET ASSEMBLY. WIPE OFF CONTROL TUBE THOROUGHLY.

Figure 2-9. Lubrication Diagram (Sheet 5 of 10)

## NOSE GEAR LINKAGE

DETAIL G

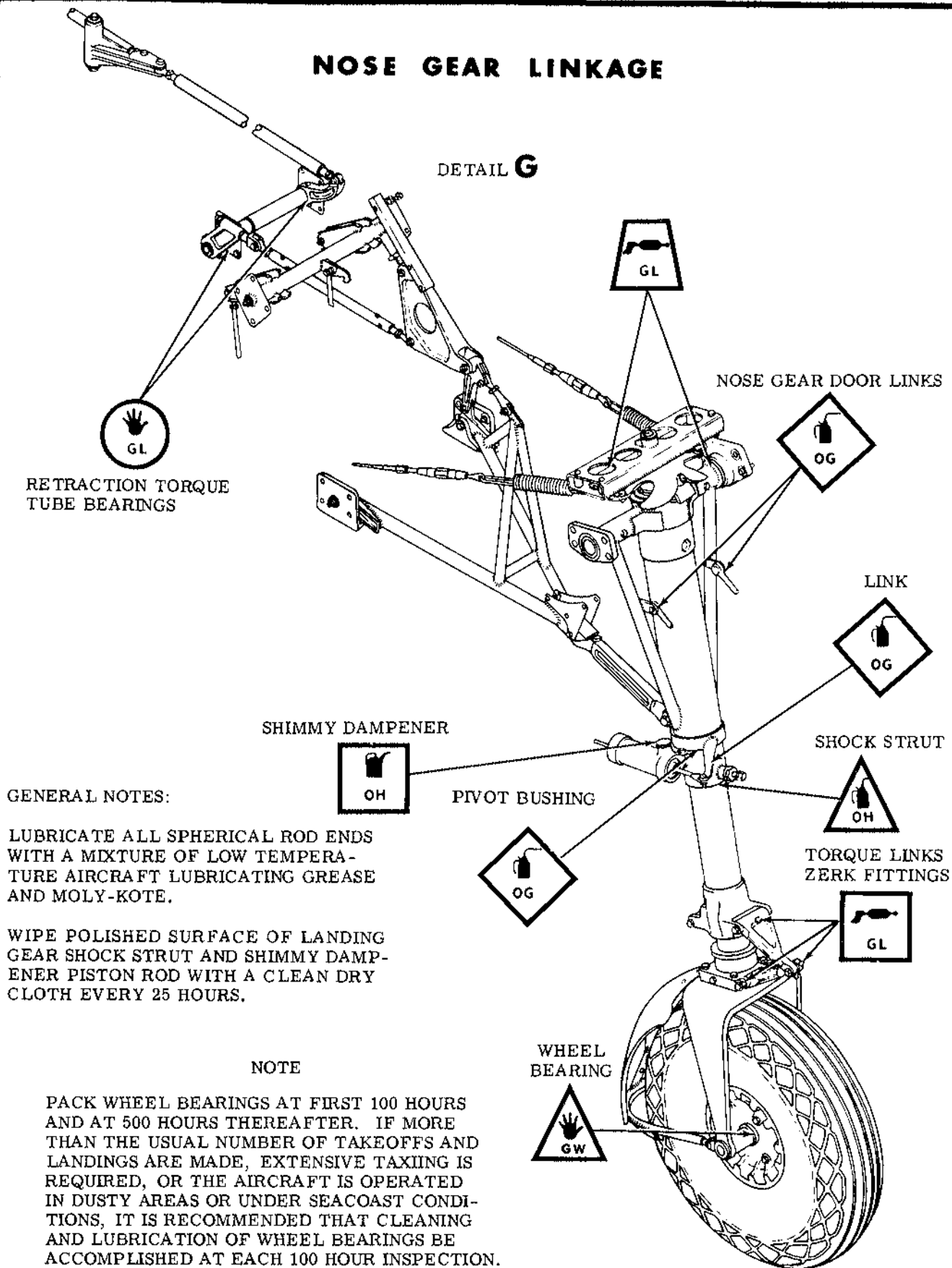


Figure 2-9. Lubrication Diagram (Sheet 6 of 10)

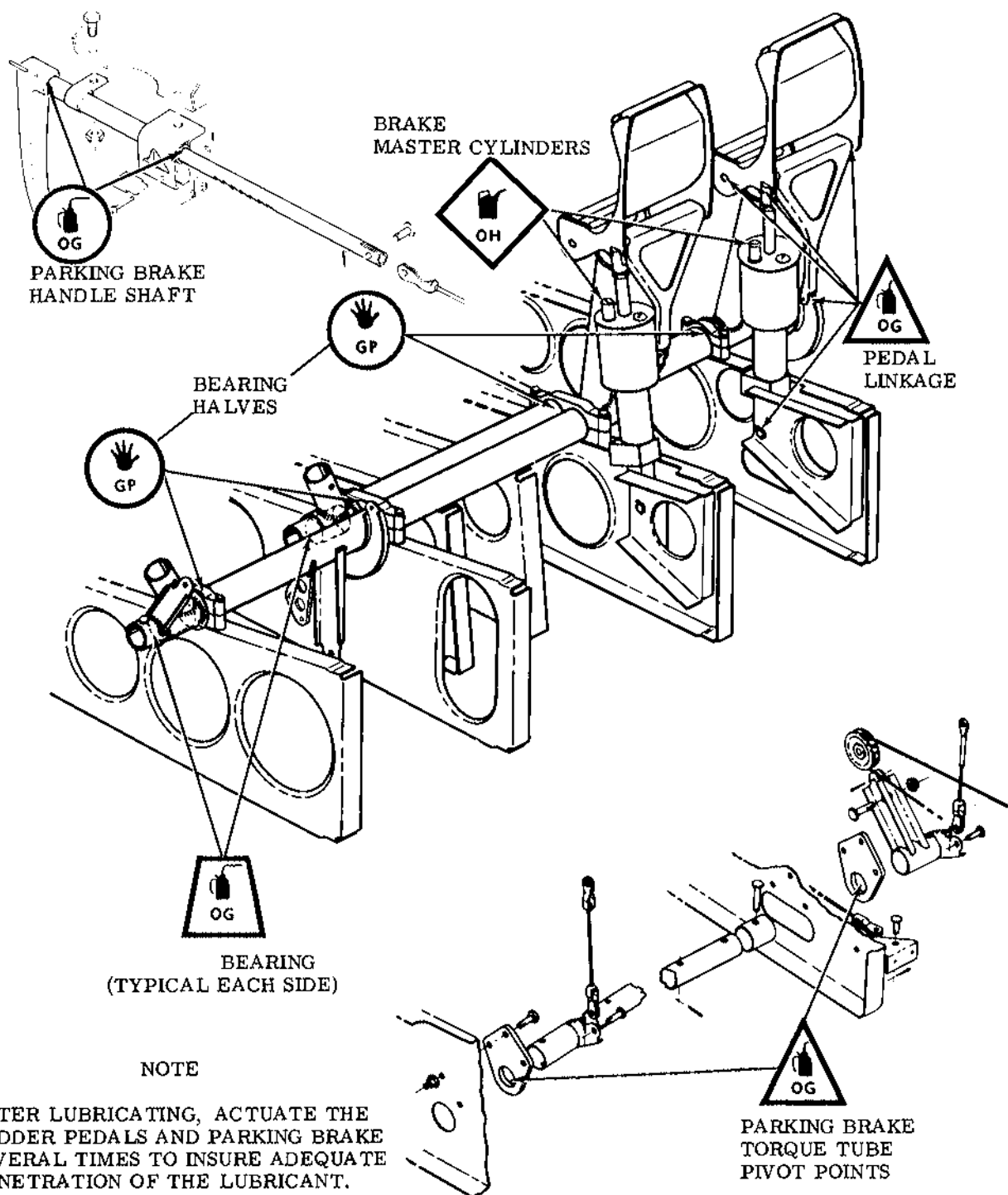
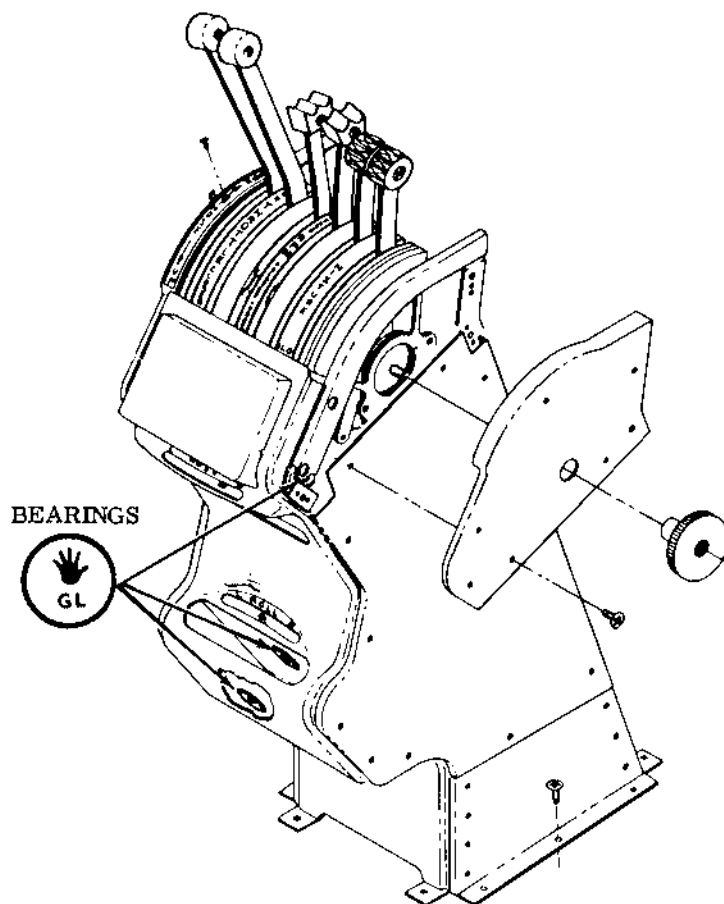
**RUDDER PEDAL MECHANISM**DETAIL **H**

Figure 2-9. Lubrication Diagram (Sheet 7 of 10)

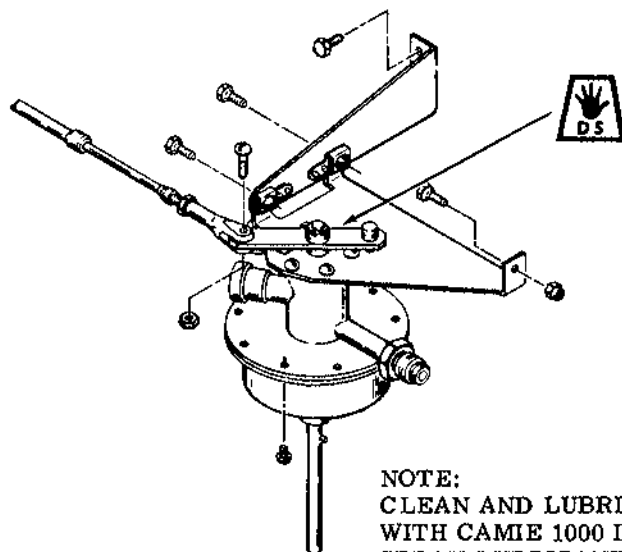


## ENGINE CONTROLS



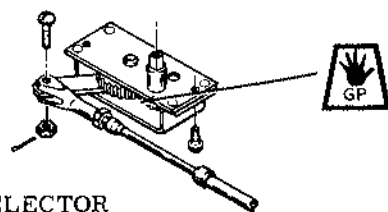
DETAIL I

## FUEL SELECTOR VALVE



NOTE:  
CLEAN AND LUBRICATE  
WITH CAMIE 1000 DRY  
SPRAY LUBRICANT  
EVERY 100 HOURS

FUEL SELECTOR  
GEAR BOX



DETAIL J

DETAIL K

Figure 2-9. Lubrication Diagram (Sheet 8 of 10)

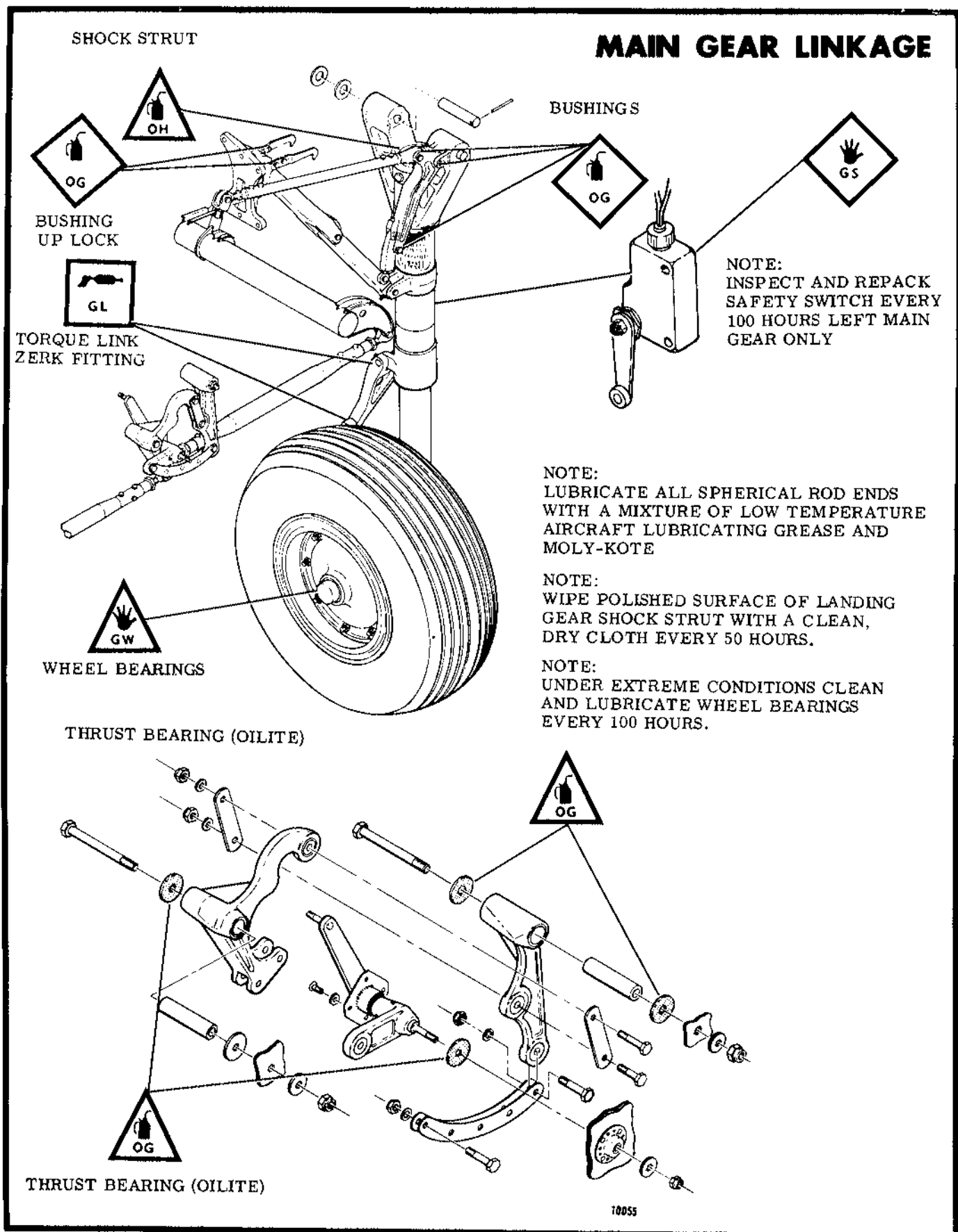


Figure 2-9. Lubrication Diagram (Sheet 9 of 10)

# CABIN DOOR

DETAIL N

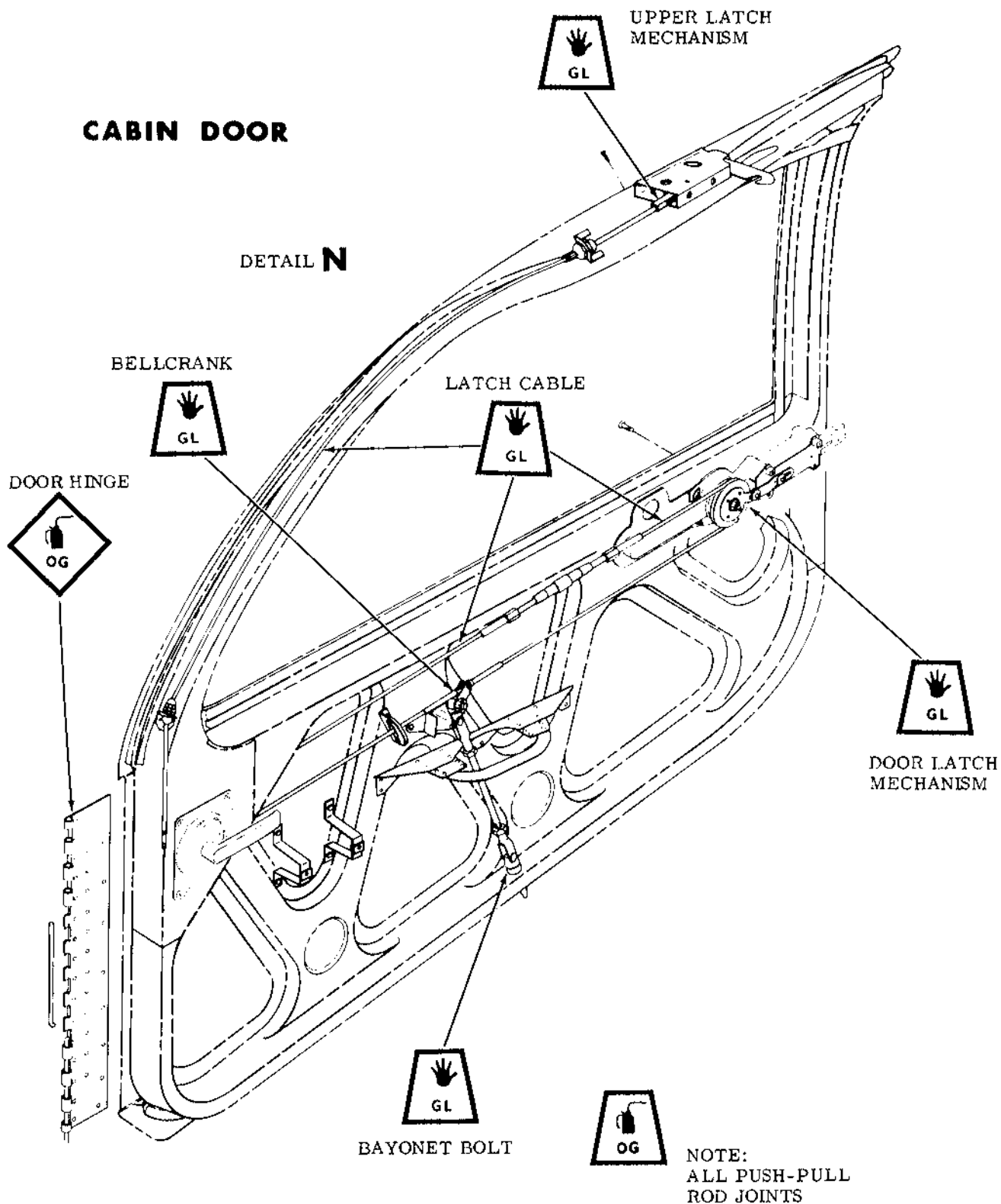


Figure 2-9. Lubrication Diagram (Sheet 10 of 10)

# AIRFRAME

## Table of Contents

|                                             | Page |                                             | Page |
|---------------------------------------------|------|---------------------------------------------|------|
| <b>FUSELAGE</b>                             | 3-2  | Disassembly & Assembly of Reclining         |      |
| Windshield and Windows                      | 3-2  | Rear Seat                                   | 3-14 |
| Plastic Windows Inspection Criteria         | 3-2  | Removal of Center Single Adjustable Seat    | 3-14 |
| Removal of Windshield                       | 3-3  | Installation of Center Single Adjustable    |      |
| Installation of Windshield                  | 3-3  | Seat                                        | 3-18 |
| Removal & Installation of Picture Windows   | 3-3  | Removal and Installation of Fifth and Sixth |      |
| Emergency Exit Window                       | 3-3  | Seats                                       | 3-18 |
| Removal                                     | 3-3  | Disassembly and Assembly of Fifth and       |      |
| Installation                                | 3-3  | Sixth Reclining Seats                       | 3-18 |
| Emergency Exit Window Release               |      | <b>UPHOLSTERY</b>                           | 3-18 |
| Mechanism                                   | 3-7  | Removal and Installation of Upholstery and  |      |
| Removal and Installation                    | 3-7  | Upholstery Trim                             | 3-18 |
| Removal and Installation of Foul            |      | Removal and Installation of the Carpet      | 3-18 |
| Weather Window                              | 3-7  | <b>WING</b>                                 | 3-25 |
| <b>DOORS</b>                                | 3-7  | Removal                                     | 3-25 |
| Removal of Cabin Door                       | 3-7  | Installation                                | 3-25 |
| Disassembly of Cabin Door                   | 3-10 | Removal of Wing Locker Door                 | 3-27 |
| Assembly of Cabin Door                      | 3-10 | Installation of Wing Locker Door            | 3-27 |
| Installation of Cabin Door                  | 3-10 | Removal and Installation of Wing Locker     |      |
| Trouble Shooting Cabin Door Latch           |      | Door Latch                                  | 3-27 |
| Assemblies                                  | 3-10 | Checking Baggage Door Stop Tension          | 3-27 |
| Removal of Cabin Door Latch Assemblies      | 3-10 | Adjustment of Wing Locker and Baggage       |      |
| Disassembly & Assembly of Cabin Door        |      | Door Stop                                   | 3-28 |
| Latch Assemblies                            | 3-11 | <b>FUSELAGE STINGER</b>                     | 3-28 |
| Installation of Cabin Door Latch Assemblies | 3-11 | Removal of Fuselage Stinger                 | 3-28 |
| Removal of Baggage Door                     | 3-11 | Installation of Fuselage Stinger            | 3-28 |
| Disassembly of Baggage Door & Latch         |      | <b>STABILIZERS</b>                          | 3-28 |
| Assembly                                    | 3-11 | Removal of Horizontal Stabilizer            | 3-28 |
| Assembly of Baggage Door & Latch            |      | Installation of Horizontal Stabilizer       | 3-28 |
| Assembly                                    | 3-11 | Removal of Vertical Stabilizer              | 3-30 |
| Installation of Baggage Door                | 3-11 | Installation of Vertical Stabilizer         | 3-30 |
| <b>SEATS</b>                                | 3-11 | <b>CONTROL PEDESTAL</b>                     | 3-33 |
| Trouble Shooting Individual Seat Assemblies | 3-11 | Removal                                     | 3-33 |
| Removal of Front Seats                      | 3-14 | Disassembly                                 | 3-33 |
| Installation of Front Seats                 | 3-14 | Assembly                                    | 3-33 |
| Trouble Shooting Reclining Rear Seat        | 3-14 | Installation                                | 3-33 |
| Removal of Reclining Rear Seat              | 3-14 | <b>RADOME</b>                               | 3-35 |
|                                             |      | Removal and Installation                    | 3-35 |

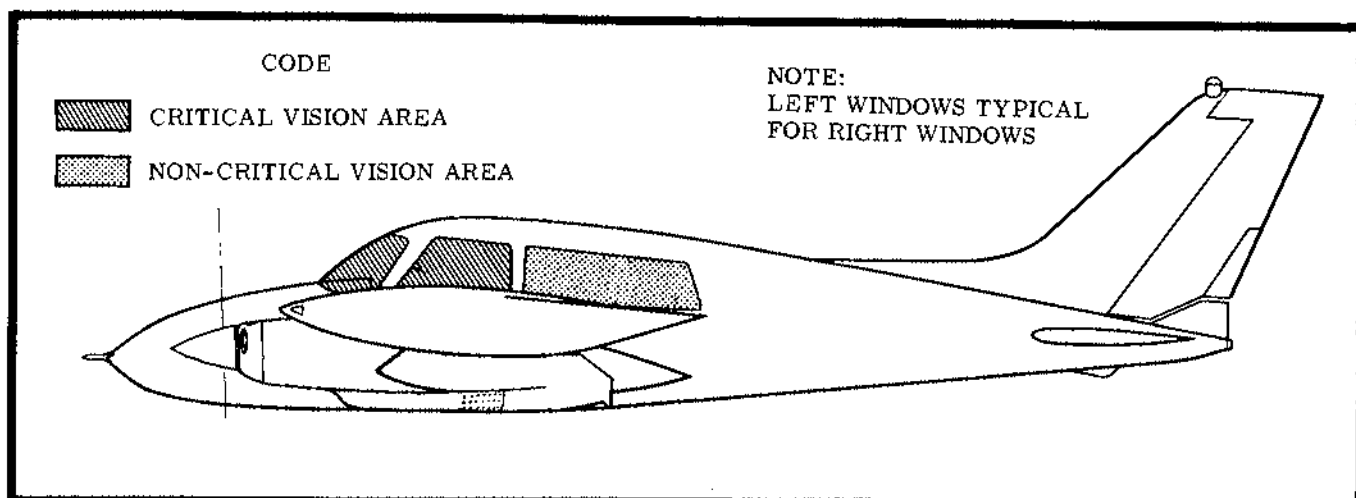


Figure 3-1. Critical Vision Areas

## FUSELAGE

## Windshield and Windows.

## Plastic Windows Inspection Criteria.

| DEFECTS           |                                                                                                               |  | CRITICAL VISION AREA                                                                        |                                       | NON-CRITICAL VISION AREA  |                                                                     |
|-------------------|---------------------------------------------------------------------------------------------------------------|--|---------------------------------------------------------------------------------------------|---------------------------------------|---------------------------|---------------------------------------------------------------------|
|                   |                                                                                                               |  | MAXIMUM REPAIRABLE                                                                          | MAXIMUM PERMISSIBLE WITHOUT REPAIRING | MAXIMUM REPAIRABLE        | MAXIMUM PERMISSIBLE WITHOUT REPAIRING                               |
| NICKS AND DENTS.  |                                                                                                               |  |                                                                                             |                                       |                           |                                                                     |
| Maximum Diameter. | Not repairable.                                                                                               |  | 0.025 inch.                                                                                 |                                       | 0.250 inch.               | 0.125 inch.                                                         |
| Depth.            | Not repairable.                                                                                               |  | 0.016 inch.                                                                                 |                                       | 0.076 inch.               | 0.032 inch.                                                         |
| Frequency.        | None.                                                                                                         |  | 2 per sq. ft.                                                                               |                                       | 2 per sq. ft.             | 1 per sq. ft.                                                       |
| SCRATCHES         |                                                                                                               |  |                                                                                             |                                       |                           |                                                                     |
| Length.           | 12 inches total per area.                                                                                     |  | 12 inches total per area.                                                                   |                                       | 24 inches total per area. | 24 inches total per area.                                           |
| Width.            | 0.020 inch.                                                                                                   |  | 0.020 inch.                                                                                 |                                       | 0.050 inch.               | 0.020 inch.                                                         |
| Depth.            | 0.016 inch.                                                                                                   |  | 0.008 inch.                                                                                 |                                       | 0.008 inch.               | 0.008 inch.                                                         |
| Frequency.        | 12 inches total per area.                                                                                     |  | 12 inches per area.                                                                         |                                       | 20% of total area.        | Total length of scratches equals 3 times longest dimension of area. |
| CRACKS.           |                                                                                                               |  |                                                                                             |                                       |                           |                                                                     |
| Length.           | Cracks originating at mounting holes or edge of glass and progressing into C. V. area must not exceed 1 inch. |  | None.                                                                                       |                                       | 6.00 inches.              | None.                                                               |
| Frequency.        | 12 inches total per area.                                                                                     |  | None.                                                                                       |                                       | 12 inches total per area. | None.                                                               |
| CRAZING.          |                                                                                                               |  |                                                                                             |                                       |                           |                                                                     |
| Slight.           | Not repairable.                                                                                               |  | Crazing adjacent to the edge of the glass must not extend more than 1 inch into C. V. area. |                                       | Not repairable.           | Shall be contained in a 9.00 inch circle.                           |
| Severe.           | Not repairable.                                                                                               |  | Crazing adjacent to the edge of the glass must not extend more than 1 inch into C. V. area. |                                       | Not repairable.           | Shall be contained in a 6.00 inch circle.                           |
| DISCOLORATION.    |                                                                                                               |  |                                                                                             |                                       |                           |                                                                     |
|                   | Not repairable.                                                                                               |  | None.                                                                                       |                                       | Not repairable.           | May extend 1 inch from all edges of non-critical areas.             |

**Removal of Windshield. (See figure 3-2.)**

- a. Remove magnetic compass (21).
- b. Remove left, right and upper windshield upholstery trim panels in accordance with upholstery trim removal procedures.
- c. Remove headliner from upper edge of windshield in accordance with upholstery trim removal procedures.
- d. Remove Cherry Rivets (10) and screws (2) from windshield upper retainer.
- e. Remove nuts (11) and screws (2) from windshield upper retainer.
- f. Drill rivets out of left outside retainer (19) and right outside retainer (20).
- g. Remove left skin (18) by removing nuts (13 and 14) and screws (16 and 17).
- h. Remove right skin (22) by removing nuts (25) and screws (23).
- i. Remove windshield (6) from aircraft.
- j. If optional Heated Windshield is installed, follow steps a thru i plus the removal of nuts (8 and 9), and screws (3 and 4) and windshield center stiffeners (5 and 7).

**Installation of Windshield. (See figure 3-2.)**

- a. Place seal tape (12) on windshield edges and apply sealing compound (Presstite Engineering Co., No. 579.6) on all edges of the windshield.
- b. Position windshield (6) and upper retainer (1). Temporarily fasten in place.
- c. Position right skin (22) and left skin (18). Temporarily fasten in place.
- d. Install left inside retainer (15) and right inside retainer (24).
- e. Secure left skin (18) and right skin (22) with screws (16, 17 and 22) and nuts (13, 14 and 24).
- f. Secure inside upper retainer (1) with screws (2), nuts (11) and cherry rivets (10).
- g. Install magnetic compass.
- h. Install headliner assembly in accordance with installation of upholstery procedures.
- i. Install windshield upholstery trim panels in accordance with installation of upholstery procedures.
- j. If optional Heated Windshield is installed, follow steps a thru f, plus aligning inside (7) and outside (5) metal stiffeners and secure with screws (3 and 4) and nuts (8 and 9). Complete steps h thru i after installing center stiffeners.

**Removal and Installation of Picture Windows. (See figure 3-3.)**

- a. Remove window trim panels (6, 7, 10 and 13).
- b. Remove wire tunnels.
- c. Remove inboard window panel (3) by removing aft support (8) and removing three attaching screws.
- d. Remove inboard window panel (3) from supports (5, 11 and 14).
- e. Remove outboard window (2) by removing upper support (5) and lower support (11) from fuselage structure by removing attaching screws.

- f. Remove forward support (14) and trim retainer (15) by removing attaching screws and nuts.
- g. Remove upper and lower retainers (4 and 12) by removing attaching screws.
- h. Remove aft retainer (9) by removing attaching screws.
- i. Remove outboard window pane (2) from window frame.
- j. Install picture windows by reversing procedures outlined in steps a thru i.

**Emergency Exit Window.**

The emergency exit or pilot's window is a single window located on the left forward side of the cabin. This window consists of a plastic panel with an integrally mounted foul weather window. The emergency exit window is mounted inside a spot-welded and riveted frame assembly. This frame assembly is secured to the main fuselage structure by four catch assemblies and three clips. When the emergency release pull ring is pulled, the cable assemblies release the frame assembly from the fuselage structure, thereby, the frame assembly can be pushed clear of the structure. Operating instructions are contained on a decal located on the window panel.

**Removal of Emergency Exit Window. (See figure 3-4.)**

- a. Remove window post trim, lower, upper and forward window trim in accordance with upholstery trim removal procedures.
- b. Remove emergency exit window by removing release cover (20) and actuating release ring (21) thus releasing cable ends (15) from latch assemblies (16).
- c. Supporting emergency exit window, push outwards until pivot pins (8) and clips (10) clear fuselage structure.

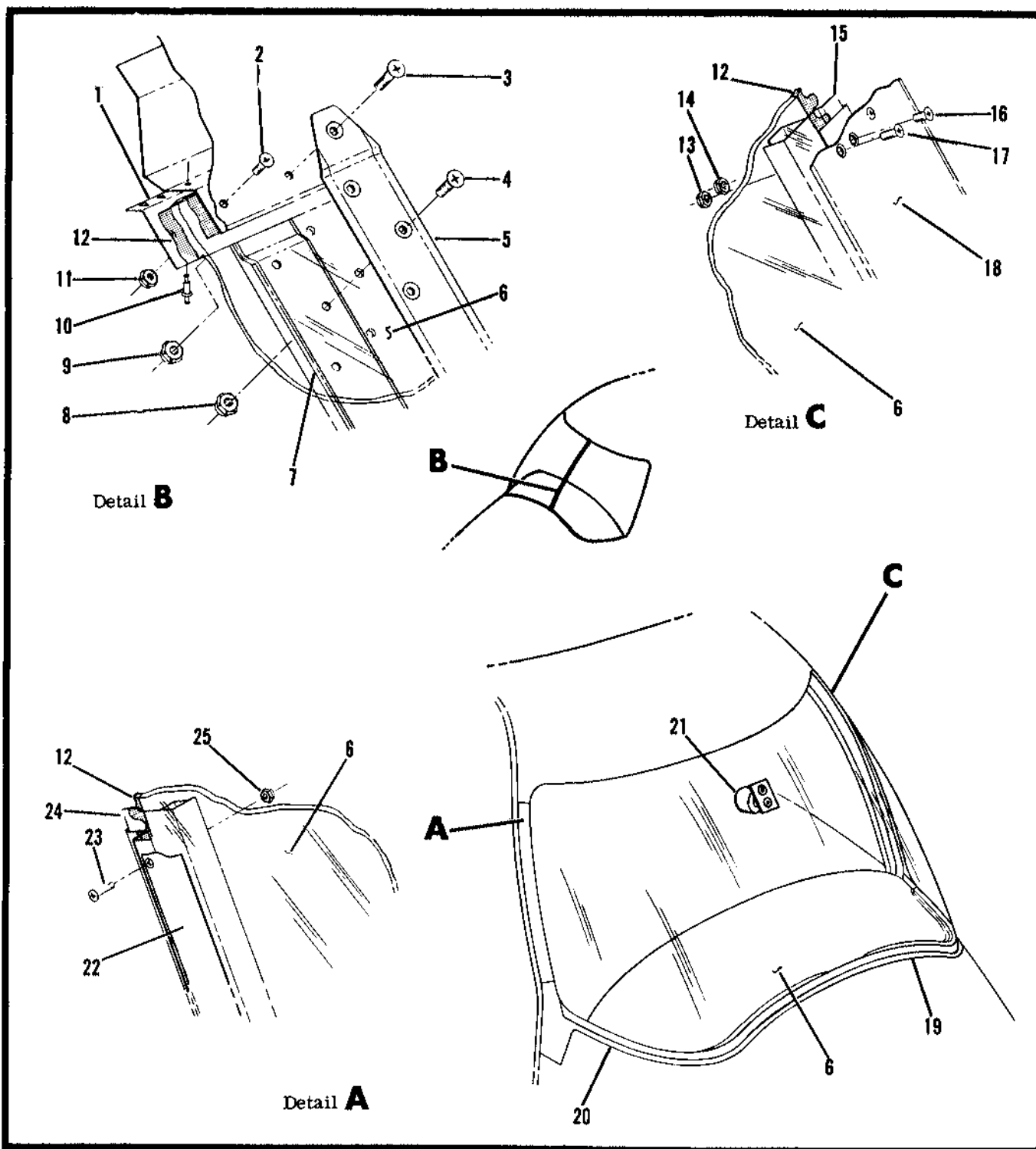
**Installation of Emergency Exit Window. (See figure 3-4.)****NOTE**

Before installing emergency window, replace four clips (10).

- a. Hold emergency window assembly at a slight angle, engage pivot pins (8) into fuselage structure and position window in fuselage frame.

**NOTE**

Pivot pins (8) are provided with adjustable mountings. Normally the pivot pins settings are not disturbed during emergency window removal. If pivot pin settings were disturbed, it will become necessary to realign them upon installation. This is accomplished by loosening the four screws in the mounting plate



1. Inside Upper Retainer
2. Screw
3. Screw
4. Screw
5. Outside Center Stiffener
6. Windshield Panel
7. Inside Center Stiffener
8. Nut
9. Nut

10. Cherry Rivet
11. Nut
12. Tape
13. Nut
14. Nut
15. Left Inside Retainer
16. Screw
17. Screw

18. Left Skin
19. Left Outside Retainer
20. Right Outside Retainer
21. Magnetic Compass
22. Right Skin
23. Screw
24. Right Inside Retainer
25. Nut

Figure 3-2. Windshield Assembly

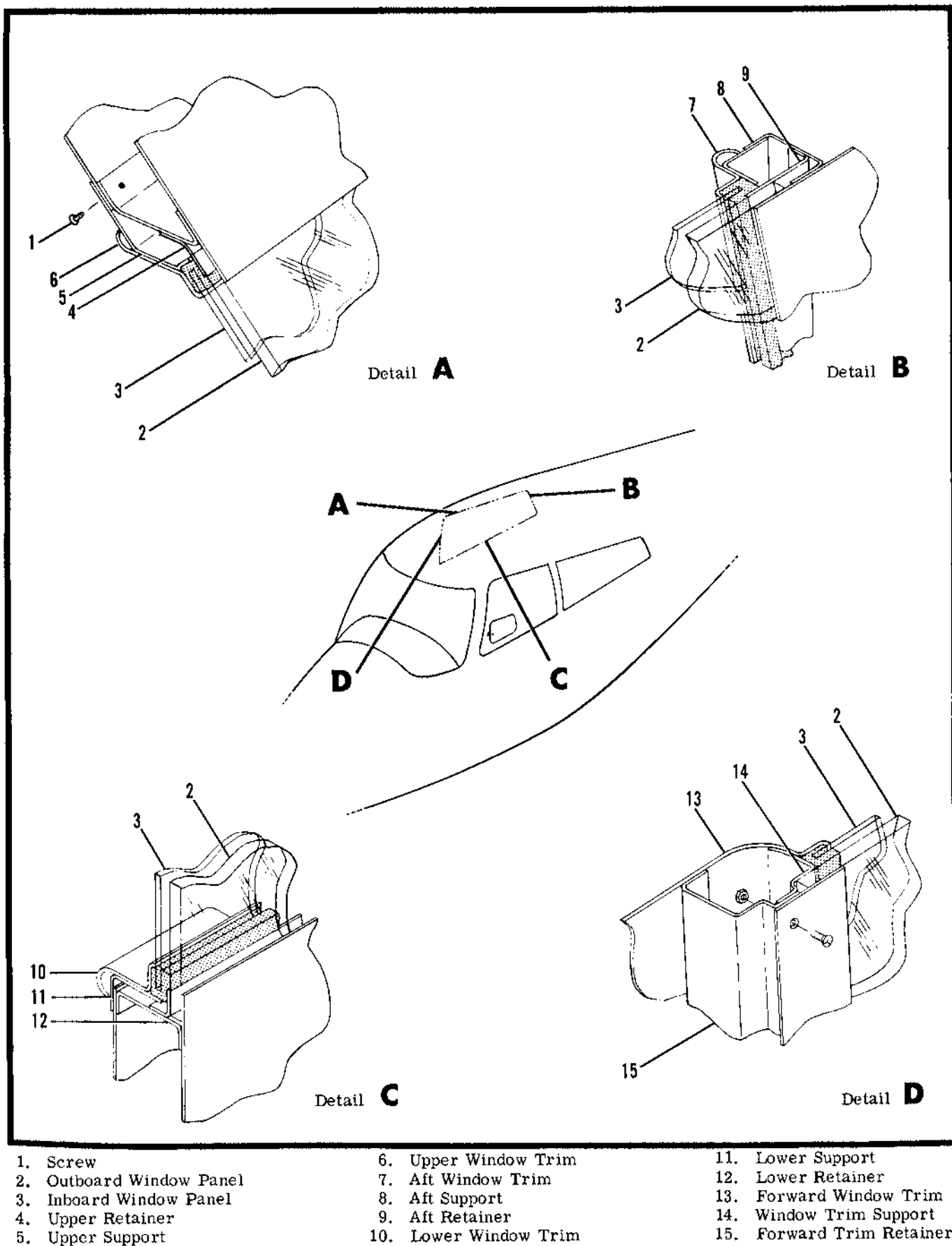
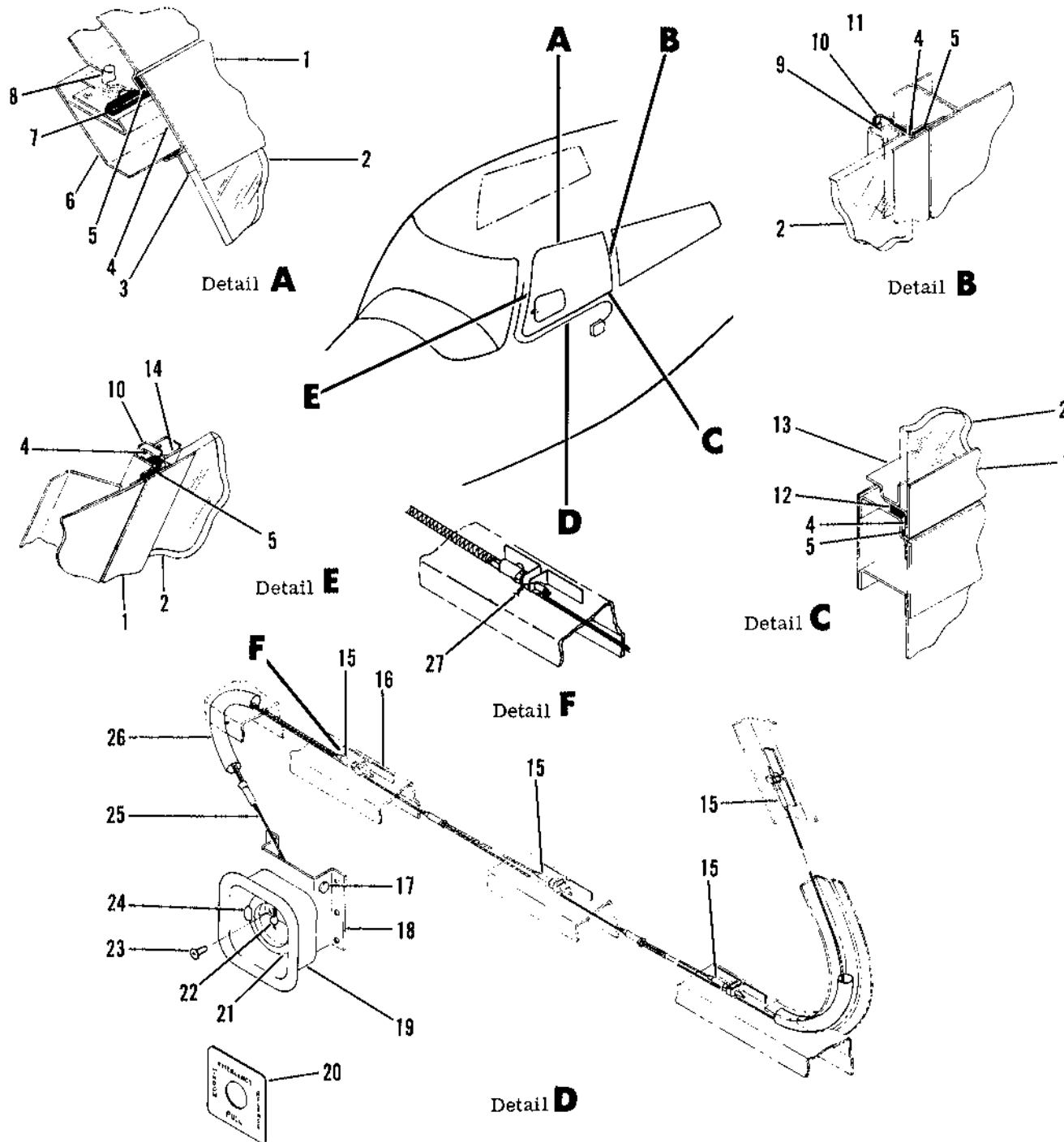


Figure 3-3. Picture Window Installation





- |                             |                        |                          |
|-----------------------------|------------------------|--------------------------|
| 1. Window Skin              | 10. Clip               | 19. Window Release Pan   |
| 2. Pilot's Glass Assembly   | 11. Seal (Aft)         | 20. Window Release Cover |
| 3. Retainer (Upper)         | 12. Seal (Lower)       | 21. Window Release Ring  |
| 4. Support (Glass Assembly) | 13. Retainer (Lower)   | 22. Truloc Ball          |
| 5. Seal (Outer)             | 14. Retainer (Forward) | 23. Screw                |
| 6. Retainer                 | 15. Cable Assembly End | 24. Ring Clip            |
| 7. Seal (Upper)             | 16. Latch Assembly     | 25. Cable Assembly       |
| 8. Pivot Pin Assembly       | 17. Flat Head Pin      | 26. Guide Tube           |
| 9. Retainer (Aft)           | 18. Hat Section        | 27. Safety Wire          |

Figure 3-4. Pilot's and Emergency Exit Window Installation

and positioning emergency window in fuselage frame aligning the pivot pin with hole. Scribe an index mark along edge of mounting plate after alignment is achieved. Remove emergency window from fuselage and tighten mounting plate along scribe line with the four attaching screws. Several adjustments may become necessary before positive alignment is achieved.

b. Position a man outside the emergency exit window to apply pressure on the frame at each point while cable end assemblies (15) are being inserted through latch assemblies (16). Safety cable end assemblies (15) in place using .011 copper safety wire. Only a single strand of safety wire should be used.

### CAUTION

The barrel on aft emergency window cable end assembly (15) must be housed inside guide tube (26) or serious binding may result.

- c. Using a rubber mallet, bend exposed tab of clip (10) over fuselage window frame.
- d. Install release ring (21) into clip (24) and replace cover (20).
- e. Install forward window trim, upper, lower, and window post trim in accordance with upholstery trim installation procedures.
- f. Using an aerodynamic sealant (579-6 sealer-extruded) pack entire joints of edge of emergency exit window assembly opening trim. Wipe off and remove all excess 579-6 sealer from exterior of emergency exit window assembly and trim. Mix (Bondtite BTC 20 Aerodynamic smoother and apply a light coat on outer perimeter joints of emergency exit window. This smoother should not overlap the joint by more than 1/10 of an inch, nor should it be more than .02 of an inch in depth. After smoother has cured, sand lightly to fair in edges. Repaint all surfaces affected as required.

### Emergency Exit Window Release Mechanism.

The emergency release mechanism is located in the left rear upholstery panel, just aft of and below the emergency exit window. A red pull ring is secured in the royalite trim pan assembly, covered and identified by an instructional plastic cover. A finger size center hole in the plastic cover can be quickly grasped to include the pull ring when an emergency condition exists. The cover decal reads: EMERGENCY WINDOW RELEASE, PULL. When the pull ring is pulled, the catch assembly is released and the window then can be pushed free.

### Removal and Installation of Emergency Window Release Mechanism. (See figure 3-4.)

- a. Remove window post trim, lower, upper, and forward window trim in accordance with upholstery trim removal procedures.
- b. Remove pilot's seat in accordance with seat

removal instructions.

- c. Remove ash tray and wemac in accordance with upholstery removal procedures.
- d. Remove cover (20) from pan assembly (19).
- e. Remove pull ring (21) by removing ball (22) from cable assembly (25).
- f. If removal of cable assembly (25) is necessary, remove the following items:
  - 1. Remove upholstery side panel in accordance with upholstery removal procedures.
  - 2. Remove safety wire and disengage cable end assemblies (15) from latch assemblies (16).
  - 3. Remove window release pan (19) and ring clip (24) by removing screws (23).
  - 4. Remove flat head pin (17) and route cable assemblies (25) through hat section (18).
- g. Install emergency window release mechanism by reversing procedures a thru f and 1 thru 4.
- h. Safety cable end assemblies (15) using .011 copper safety wire. Only a single strand of safety wire should be used.

### NOTE

The maximum pull required to release the emergency window shall not exceed 80 pounds on the ring.

### Removal and Installation of Foul Weather Window. (See figure 3-5.)

- a. Tape or mask pilot's window as necessary to protect the plexiglass during removal and installation of hinge pin (7).
- b. Remove nuts (6), washer (10), spring (9), and hinge pin (7) and remove foul weather window (3) from pilot's window (11).

### CAUTION

When removing or installing foul weather window, use foul weather window spring tool, Part Number 5090003 to prevent spring from accidentally damaging pilot's window.

- c. Refer to illustration for further disassembly and assembly of the foul weather window.

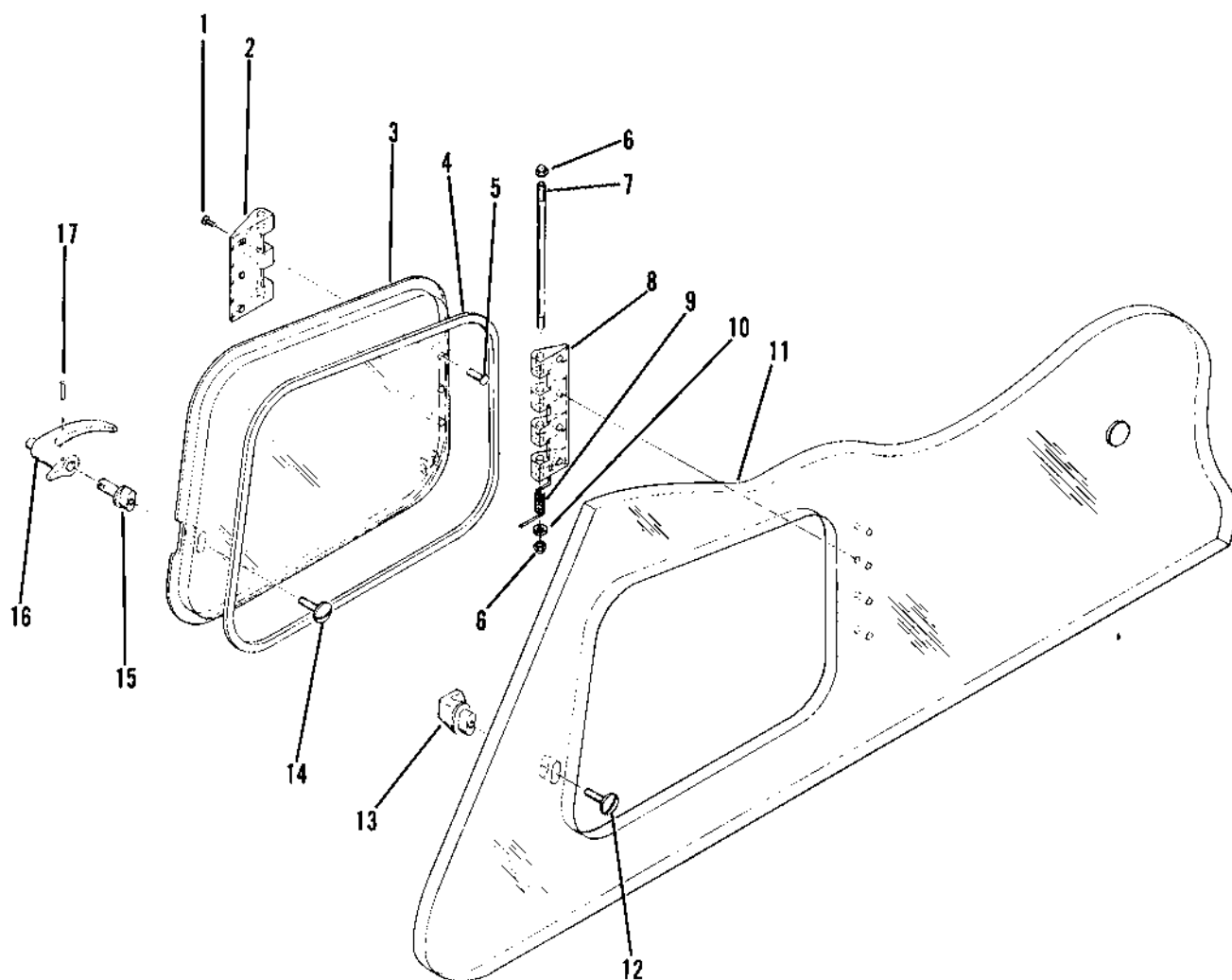
### NOTE

If seal (4) is being replaced, bond to foul weather window (3) using Eastman 910 adhesive (Armstrong Cork Company, Lancaster, Pennsylvania, or equivalent).

### DOORS.

#### Removal of Cabin Door. (See figure 3-6.)

- a. With the cabin door open and supported, remove screw, washer, spacer and washer securing door stop strap assembly (12) to fuselage.
- b. Remove cotter pins securing hinge pins (18).
- c. Remove hinge pins (18) by pulling pins through

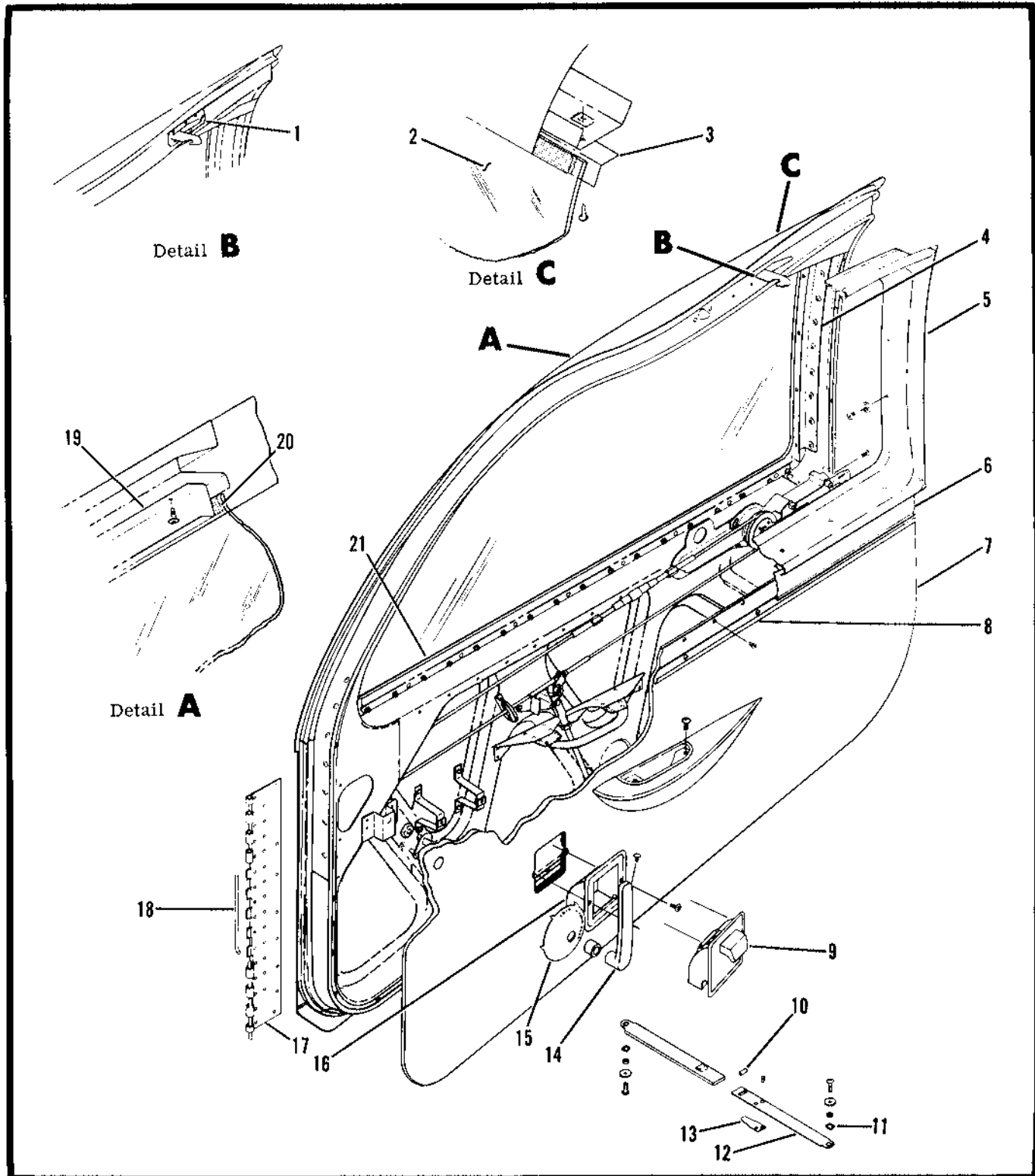


1. Screw
2. Hinge Half
3. Foul Weather Window
4. Seal
5. Screw Post
6. Nut

7. Pin
8. Hinge Half
9. Spring
10. Washer
11. Pilot's Window

12. Screw
13. Hook
14. Screw
15. Stud
16. Handle
17. Roll Pin

Figure 3-5. Foul Weather Window Installation



- |                            |                               |                          |
|----------------------------|-------------------------------|--------------------------|
| 1. Escutcheon Latch Plate  | 8. Upholstery Retainer        | 15. Escutcheon Plate     |
| 2. Cabin Door Window Panel | 9. Ash Receiver               | 16. Ash Receiver Adapter |
| 3. Upper Window Retainer   | 10. Door Stop Roller          | 17. Hinge Half           |
| 4. Aft Window Retainer     | 11. Shake Proof Spring Washer | 18. Hinge Pin            |
| 5. Window Trim Panel       | 12. Strap Assembly            | 19. Window Retainer      |
| 6. Trim Pad                | 13. Spring Clip               | 20. Tape                 |
| 7. Upholstery Panel        | 14. Handle                    | 21. Lower Retainer       |

Figure 3-6. Cabin Door Installation

hinge halves (17).

- d. Remove the door from the aircraft.

#### Disassembly of Cabin Door. (See figure 3-6.)

- a. Remove door stop strap assembly from cabin door by removing screws, washers and spacers.
- b. Press escutcheon plate (15) enough to permit removal of setscrew securing door handle (14).
- c. Pull off inside door handle (14) from door and remove escutcheon plate (15).
- d. Remove trim pad (6) and retainer pad (8).
- e. Remove window trim panel (5) by removing screws and washers.
- f. Remove screws securing upholstery panel (7).
- g. Remove window lower retainer by removing attaching screws and nuts (21).
- h. Remove window lower retainer by removing

attaching screws.

- i. Remove window forward retainer (19) by removing attaching screws.
- j. Remove window upper retainer (3) by removing attaching screws and remove cabin door window (2).

#### Assembly of Cabin Door. (See figure 3-6.)

- a. To assembly cabin door, reverse disassembly procedures.

#### Installation of Cabin Door. (See figure 3-6.)

- a. Install cabin door by reversing removal procedures.
- b. If a replacement cabin door is being installed, it may become necessary to carefully trim the edges of the door skin to achieve a good fit.

#### Trouble Shooting Chart of Cabin Door Latch Assemblies.

| TROUBLE                                            | PROBABLE CAUSE                 | CORRECTION           |
|----------------------------------------------------|--------------------------------|----------------------|
| DOOR LATCHES OPERATE TOO TIGHTLY                   | Tension wrong on linkage rods. | Adjust rods.         |
|                                                    | Idler Assembly binding.        | If bent, replace.    |
|                                                    | Wrong spring.                  | Replace spring.      |
|                                                    | Bayonet assembly binding.      | Repair or replace.   |
|                                                    | Teleflex clevis too tight.     | Adjust clevis gap.   |
| DOOR FAILS TO LATCH PROPERLY                       | Spring broken.                 | Replace spring.      |
|                                                    | Linkage rod broken.            | Replace linkage rod. |
|                                                    | Improper lubrication.          | Lubricate.           |
|                                                    | Bolt broken                    | Replace bolt.        |
| CASE AND HANDLE ASSEMBLY FAILS TO OPERATE PROPERLY | Spring broken.                 | Replace spring.      |
|                                                    | Pin broken.                    | Replace pin.         |
|                                                    | Plate loose.                   | Check screws.        |
| BAYONET ASSEMBLY FAILS TO OPERATE                  | Broken pin.                    | Replace pin.         |
|                                                    | Linkage too tight.             | Adjust linkage.      |
|                                                    | Bellcrank broken or bent.      | Replace bellcrank.   |

#### Removal of Cabin Door Latch Assemblies. (See figure 3-7.)

- a. Remove cabin door in accordance with cabin door removal procedures.
- b. Disassemble cabin door in accordance with disassembly procedures.
- c. Disconnect teleflex cable clevis (16) from upper latch assembly (18) by removing cotter pin, washer (17), and pin (19) attaching clevis to upper latch idler

bellcrank assembly (12).

- d. Remove upper latch assembly (18) by removing attaching screws (20).
- e. Remove cable assembly (23) from door latch pulley assembly (56).
- f. Remove screws (21) from lower latch assembly (22). Remove lower latch assembly (22).
- g. Remove cable assembly (23) by removing turnbuckle (63), pin (62), washer and cotter pin.
- h. Remove the handle (26) by removing screw (25).

- i. Remove door handle plate (29) and slip cables (60 and 61) from pulley (31). Remove cables.
- j. Remove cotter pin (34) and remove latch cable (15).
- k. Remove nut (36) and slip arm assembly (33) from the door.
- l. Remove cotter pin and nut, slip bayonet assembly (24) from the door.

Disassembly and Assembly of Cabin Door Latch Assemblies. (See figure 3-7.)

- a. If further disassembly of latch assembly is necessary for repairs and/or replacement of components, use figure 3-7 as a guide for disassembly sequence.
- b. Assemble latch assemblies using figure 3-7 as a guide for assembly sequence.

Installation of Cabin Door Latch Assemblies. (See figure 3-7.)

- a. Install cabin door latch assemblies by reversing removal procedures.

Removal of Baggage Door. (See figure 3-8.)

- a. Remove screw attaching door stop (21) to fuselage.
- b. Remove door hinge pin (22) and remove baggage door (16) from the aircraft.

Disassembly of Baggage Door and Latch Assembly. (See figure 3-8.)

- a. Remove screw attaching door stop (21) to upholstery panel (17).
- b. Remove upholstery panel (17) by releasing the attaching trimount studs.
- c. If removal of the cylinder lock assembly (15) is necessary, proceed as follows: remove screw (9)

and washer (8) from cam (7).

#### NOTE

When cam (7) is removed, the cylinder assembly (15) remains free within the shell (14). Care should be taken not to lose or disarrange tumblers or the key will not operate the locking mechanism. When cam (7), shell nut (6), and lock-flap stop plate (5) are removed or replaced, tape the cylinder (15) to the shell (14), keeping the tumblers intact within the cylinder assembly (15).

- d. To replace spring (3), remove latch assembly (29) from the door. Drive out pin (2).
- e. To remove and replace lock flap (1), drill out attaching rivets.
- f. To replace locking bolt (11), remove cotter pin and pin (10) from lock flap (1).
- g. To replace cam (7), remove screw (9) and washer (8).

#### NOTE

If cylinder lock assembly is replaced, mark keys accordingly or install a new cylinder in cabin door latch assembly.

Assembly of Baggage Door and Latch Assembly. (See figure 3-8.)

- a. Assemble latch assembly by reversing disassembly procedure.
- b. Position latch assembly (29) in baggage door (16) and rivet in place.
- c. Install upholstery panel (17).

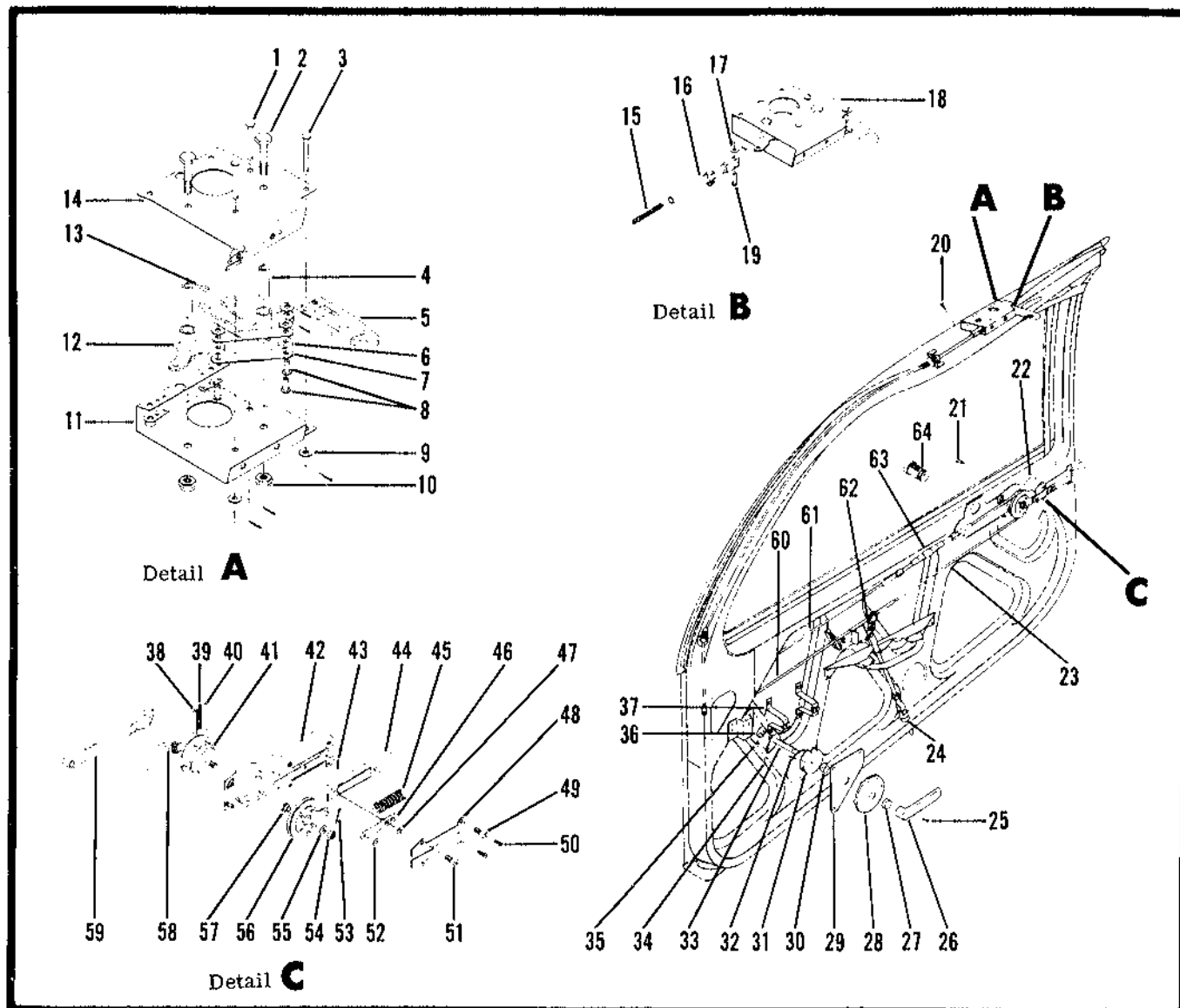
Installation of Baggage Door. (See figure 3-8.)

- a. Place baggage door (16) in position on fuselage and install and secure hinge pin (22).
- b. Attach door stop (21) to door and fuselage with attaching screws and washers.

## SEATS.

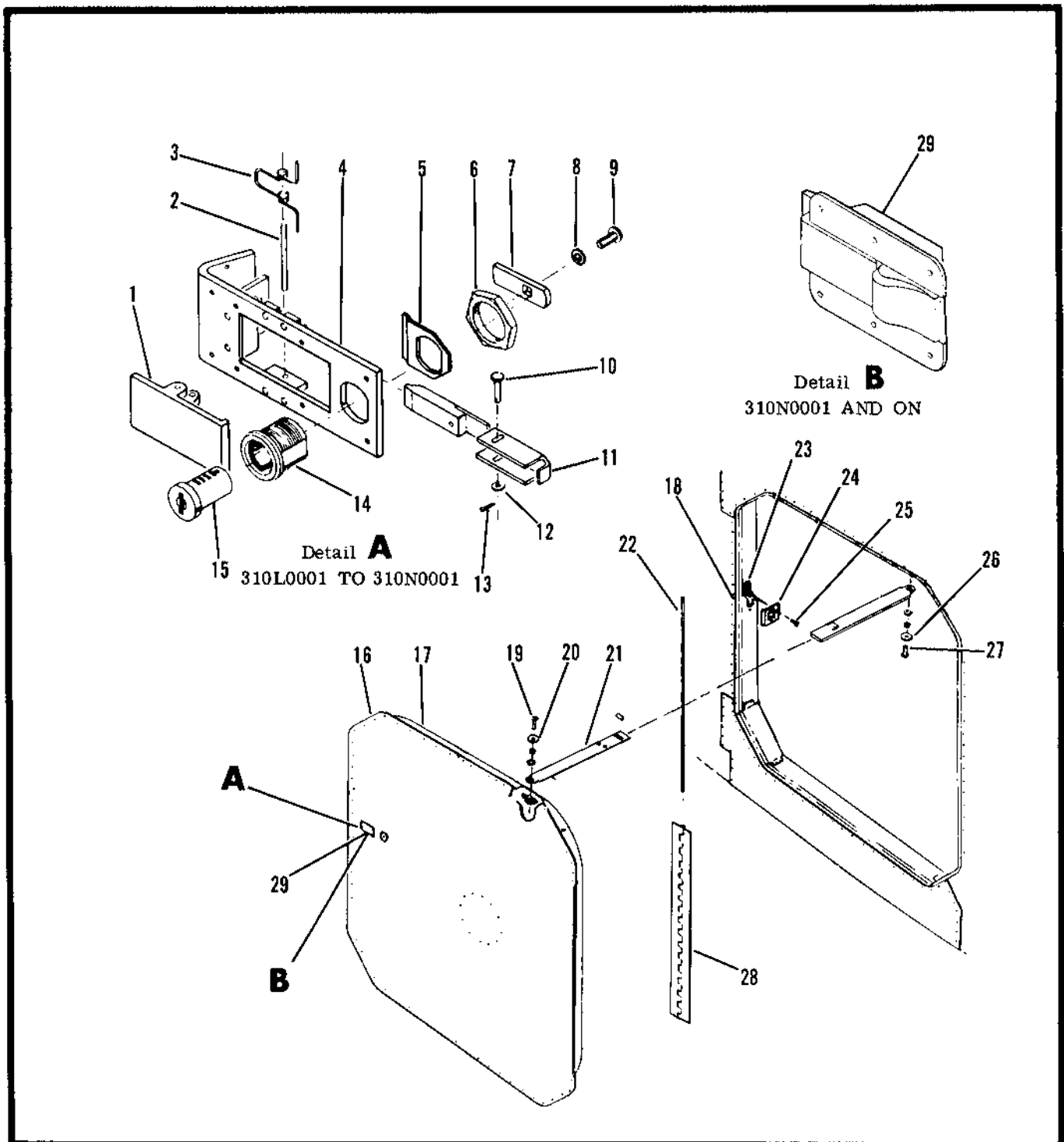
Trouble Shooting the Individual Seat Assemblies.

| TROUBLE                                             | PROBABLE CAUSE                          | CORRECTION                                                |
|-----------------------------------------------------|-----------------------------------------|-----------------------------------------------------------|
| LOCKING MECHANISM FAILS TO ENGAGE IN SEAT SUPPORT   | Broken, disconnected or missing spring. | Replace spring.                                           |
|                                                     | Distorted parts.                        | Repair or replace parts.                                  |
| SEAT ADJUSTMENT MECHANISM FAILS TO OPERATE          | Broken, disconnected or missing spring. | Replace spring.                                           |
|                                                     | Distorted parts.                        | Repair or replace parts.                                  |
| SEAT ASSEMBLY FAILS TO SLIDE FREELY ON SEAT SUPPORT | Improper lubrication.                   | Apply paraffin wax to the seat rails on the pan assembly. |
|                                                     | Parts bent or broken.                   | Repair or replace parts.                                  |



- |                              |                       |                     |
|------------------------------|-----------------------|---------------------|
| 1. Pin                       | 23. Cable Assembly    | 44. Bolt Assembly   |
| 2. Bolt                      | 24. Bayonet Assembly  | 45. Spring          |
| 3. Pin                       | 25. Screw             | 46. Link            |
| 4. Bellcrank Spacer          | 26. Handle            | 47. Washer          |
| 5. Lock Arm                  | 27. Spacer            | 48. Plate           |
| 6. Lock Bellcrank Assembly   | 28. Escutcheon Plate  | 49. Stud            |
| 7. Upper Latch Link          | 29. Door Handle Plate | 50. Screw           |
| 8. Pin                       | 30. Bushing           | 51. Stud            |
| 9. Washer                    | 31. Pulley            | 52. Washer          |
| 10. Nut                      | 32. Pin               | 53. Cotter Pin      |
| 11. Lower Panel Assembly     | 33. Arm Assembly      | 54. Nut             |
| 12. Idler Bellcrank Assembly | 34. Cotter Pin        | 55. Washer          |
| 13. Spring                   | 35. Washer            | 56. Pulley Assembly |
| 14. Upper Panel Assembly     | 36. Nut               | 57. Bearing         |
| 15. Latch Cable              | 37. Cotter Pin        | 58. Spring          |
| 16. Teleflex Cable Clevis    | 38. Pin               | 59. Handle Assembly |
| 17. Washer                   | 39. Pin               | 60. Cable Assembly  |
| 18. Upper Latch Assembly     | 40. Pin               | 61. Cable Assembly  |
| 19. Pin                      | 41. Case              | 62. Pin             |
| 20. Screw                    | 42. Case Assembly     | 63. Turnbuckle      |
| 21. Screw                    | 43. Cotter Pin        | 64. Lock            |
| 22. Lower Latch Assembly     |                       |                     |

Figure 3-7. Cabin Door Latch Assemblies



- |                         |                              |                    |
|-------------------------|------------------------------|--------------------|
| 1. Lock Flap            | 11. Locking Bolt             | 20. Washer         |
| 2. Lock Flap Pin        | 12. Cotter Pin               | 21. Door Stop      |
| 3. Spring               | 13. Washer                   | 22. Hinge Pin      |
| 4. Case Assembly        | 14. Shell                    | 23. Esna Nut       |
| 5. Lock Flap Stop Plate | 15. Cylinder Assembly        | 24. Striker Plate  |
| 6. Shell Nut            | 16. Baggage Door             | 25. Screw          |
| 7. Cam                  | 17. Baggage Upholstery Panel | 26. Washer         |
| 8. Washer               | 18. Seal                     | 27. Nut            |
| 9. Screw                | 19. Screw                    | 28. Hinge Assembly |
| 10. Pin                 |                              | 29. Latch Assembly |

Figure 3-8. Baggage Door and Latch Assembly Installation (Sheet 1 of 2)



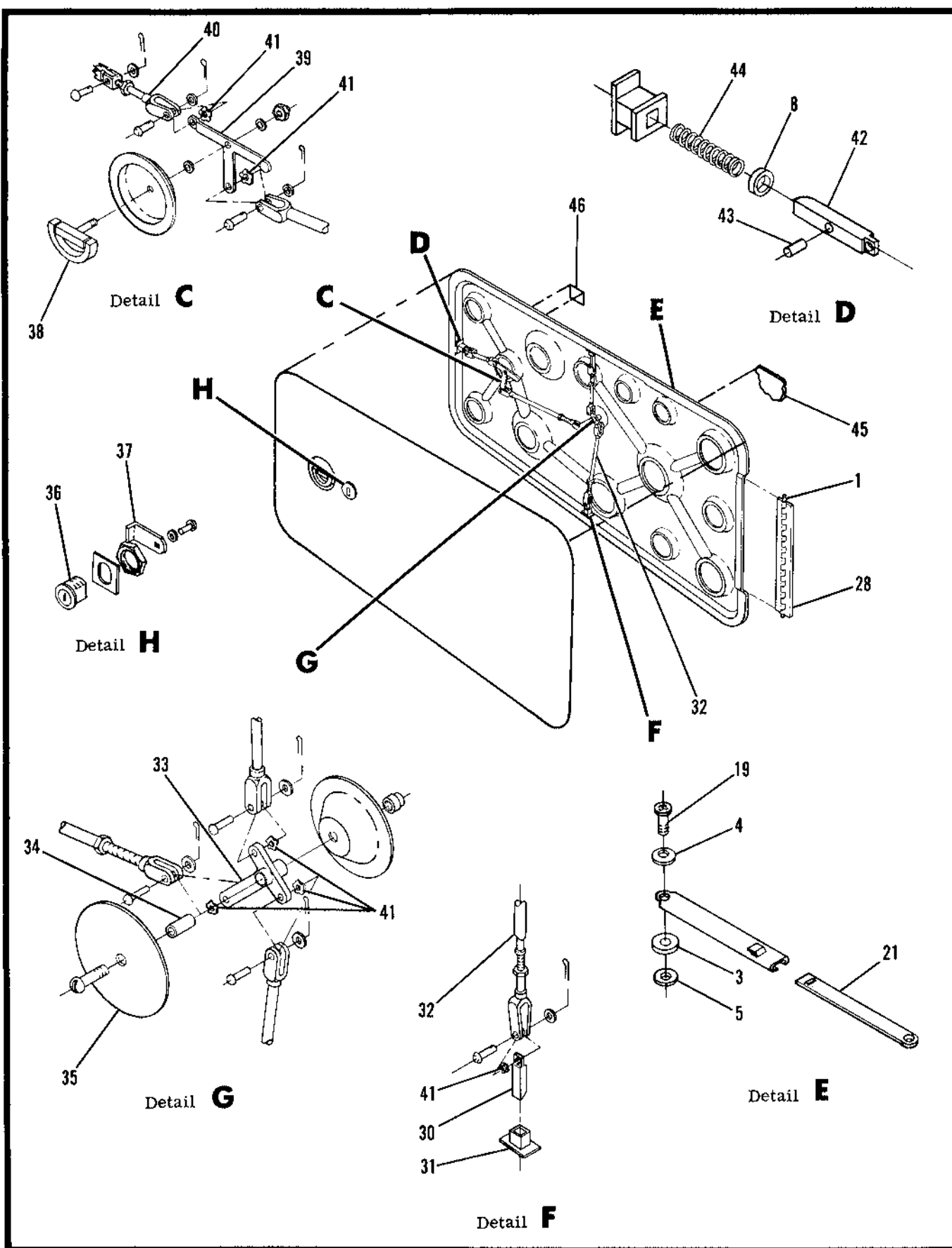


Figure 3-8. Baggage Door and Latch Assembly Installation (Sheet 2 of 2)

- |                         |                              |                      |
|-------------------------|------------------------------|----------------------|
| 1. Lock Flap            | 16. Baggage Door             | 32. Pushrod Assembly |
| 2. Lock Flap Pin        | 17. Baggage Upholstery Panel | 33. Bellcrank        |
| 3. Spring               | 18. Seal                     | 34. Spacer           |
| 4. Case Assembly        | 19. Screw                    | 35. Plate            |
| 5. Lock Flap Stop Plate | 20. Washer                   | 36. Lock Assembly    |
| 6. Shell Nut            | 21. Door Stop                | 37. Arm              |
| 7. Cam                  | 22. Hinge Pin                | 38. Handle           |
| 8. Washer               | 23. Esna Nut                 | 39. Bellcrank        |
| 9. Screw                | 24. Striker Plate            | 40. Clevis           |
| 10. Pin                 | 25. Screw                    | 41. Spring Washer    |
| 11. Locking Bolt        | 26. Washer                   | 42. Pin Assembly     |
| 12. Washer              | 27. Nut                      | 43. Roll Pin         |
| 13. Washer              | 28. Hinge Assembly           | 44. Spring           |
| 14. Shell               | 29. Latch Assembly           | 45. Upholstery Panel |
| 15. Cylinder Assembly   | 30. Latch Pin                | 46. Cover            |
|                         | 31. Guide                    |                      |

Figure 3-8. Baggage Door and Latch Assembly Installations Callouts

Removal, Installation and Adjustment of Baggage Door and Latch Assembly. (Optional) (See figure 3-8.)

- a. Remove screw (19) attaching door stop (21) to door frame.
- b. Remove door hinge pin (22) and remove baggage door from aircraft.
- c. Remove upholstery panel (45) by removing attaching studs.
- d. If removal of the cylinder lock assembly (36) is necessary, proceed as follows: remove screw and washer securing arm (37) to the cylinder assembly.

#### NOTE

When arm (37) is removed, the cylinder assembly (15) remains free within the shield (14). Care should be taken not to lose or disarrange tumblers or the key will not operate the locking mechanism. When arm (37) and nut (6) are removed or replaced, tape the

cylinder (15) to shell (14), keeping the tumblers intact within the cylinder assembly (15).

- e. Remove cover (46) to gain access to aft latch assembly.
- f. Remove plate (35) by removing retaining screws and bellcrank pivot screw.
- g. Using Detail B, figure 3-8, disassemble, repair and reassemble door latch mechanism as necessary.
- h. Install door by reversing the removal procedures.
- i. With handle (38) against the closed position stop, adjust clevis (40) so that the pin assembly (43) has 3/8 inch engagement within the striker plate (25).
- j. Rig pushrods (32) so that latch pins (30) have 3/8 inch engagement within the upper and lower striker plates.
- k. Secure all lock nuts, pins and cotter pins.
- l. Install upholstery panel (45).
- m. Adjust striker plates to obtain a tight seal around door.

## Removal of Front Seats. (See figure 3-9.)

- a. Pull on seat right-hand adjusting handle and tilt the seat back as far as possible.
- b. Remove two screws securing the seat stop plates on both sides of the seat pan assembly.
- c. Remove stop plates.
- d. Pull up on the left-hand adjusting handle and slide the seat aft to clear it from the tracks.
- e. Remove the seat from the aircraft and disassemble and assemble front seat in accordance with figure 3-9.

## Installation of Front Seats. (See figure 3-9.)

- a. Pull up on right-hand seat adjusting handle and

tilt the seat back as far as possible.

- b. Install seat pan assembly on floorboard seat supports.
- c. Pull up on the left-hand adjusting handle and slide seat forward until the rear seat stops come to rest against the seat supports.
- d. Install the front stop plates on seat pan assembly with attaching screws.

## WARNING

After the pilot's seat has been installed, insure that the stop plate (18) has been installed and that the seat adjustment mechanism functions properly.

## Trouble Shooting the Reclining Rear Seat.

| TROUBLE                        | PROBABLE CAUSE                                                         | CORRECTION                                                         |
|--------------------------------|------------------------------------------------------------------------|--------------------------------------------------------------------|
| SEATS WILL NOT CHANGE POSITION | Teleflex cable disconnected.                                           | Connect teleflex cable and observe operation.                      |
|                                | Defective stop assembly.                                               | Replace stop assembly.                                             |
| SEAT HARD TO OPERATE           | Seat adjustment tube bent.                                             | Replace seat adjustment tube.                                      |
|                                | Teleflex cable improperly rigged.                                      | Rig teleflex cable and observe operation.                          |
|                                | Seat adjustment tube bent.                                             | Replace seat adjustment tube.                                      |
|                                | Seat adjustment handle return spring broken, disconnected, or missing. | Replace and/or connect return spring.                              |
|                                | Bolts securing seat adjustment handle too tight.                       | Loosen bolts securing seat handle enough to permit free operation. |
|                                | Seat rollers broken or binding.                                        | Repair or replace seat rollers.                                    |

## Removal of Reclining Rear Seat. (See figure 3-10.)

- a. To remove the reclining rear seat, enter the baggage compartment and proceed as follows:
  1. Unfasten snaps securing the upholstery at the bottom of the seat backs.
  2. Remove bolts securing seat back to seat frame (4).
  3. Tilt the seat back forward and remove the two bolts securing the seat back to the seat bottom.
  4. Remove the seat back (1) from the aircraft.
  5. Repeat this procedure to remove the other seat back.
  6. Remove the two seat belts (12), by removing nuts, washers, spacers and bolts.
  7. Tilt the seat bottoms (3) as far forward as possible.
  8. Remove the three bolts securing the seat frame to the aircraft structure.
  9. Remove the seat frame (4), with seat bottoms (3) attached, from the aircraft.

## Disassembly and Assembly of Reclining Rear Seat.

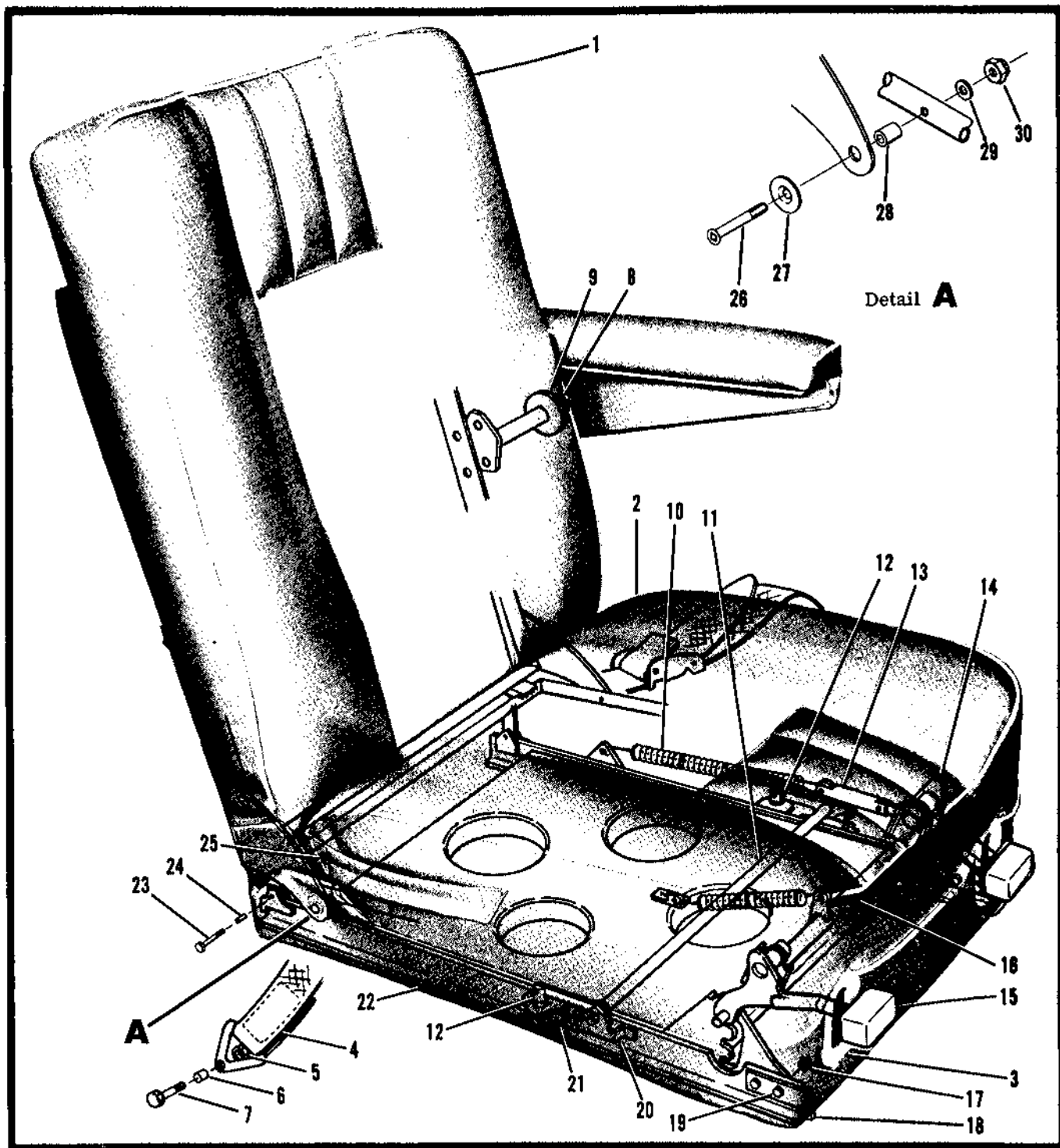
- a. Disassemble and assemble the reclining rear seat in accordance with figure 3-10.

## Installation of Reclining Rear Seat. (See figure 3-10.)

- a. To install the reclining rear seat, reverse the removal procedures.

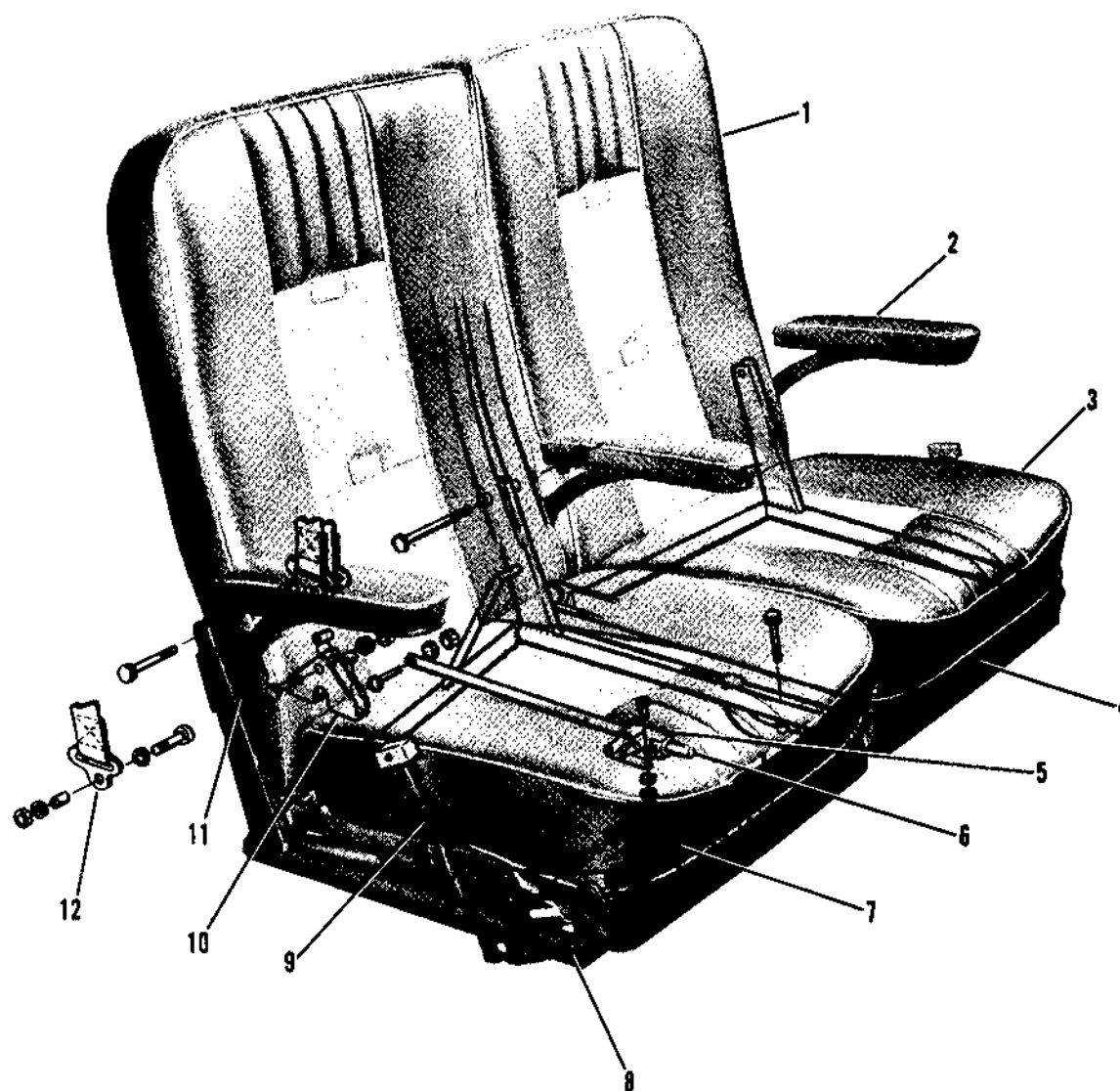
## Removal of Center Single Adjustable Seats (Optional) (See figure 3-11.)

- a. Pull up on left-hand adjusting handle and move front seat as far forward as possible.
- b. Remove bolt (28) and stop (27) from seat track (26).
- c. Pull up on left-hand adjusting handle and move center seat forward until it clears the support as-



- |                               |                             |                       |
|-------------------------------|-----------------------------|-----------------------|
| 1. Front Seat Back Assembly   | 11. Actuator Assembly       | 21. Guide             |
| 2. Front Seat Bottom Assembly | 12. Adjusting Pin           | 22. Seat Pan Assembly |
| 3. Escutcheon Plate           | 13. Adjustment Release Tube | 23. Spacer            |
| 4. Safety Belt                | 14. Arm Assembly            | 24. Bolt              |
| 5. Nut                        | 15. Handle                  | 25. Nut               |
| 6. Spacer                     | 16. Actuator Assembly       | 26. Screw             |
| 7. Bolt                       | 17. Nut                     | 27. Washer            |
| 8. Nut                        | 18. Stop                    | 28. Spacer            |
| 9. Washer                     | 19. Screw                   | 29. Washer            |
| 10. Spring                    | 20. Bracket                 | 30. Nut               |

Figure 3-9. Front Seat Installation

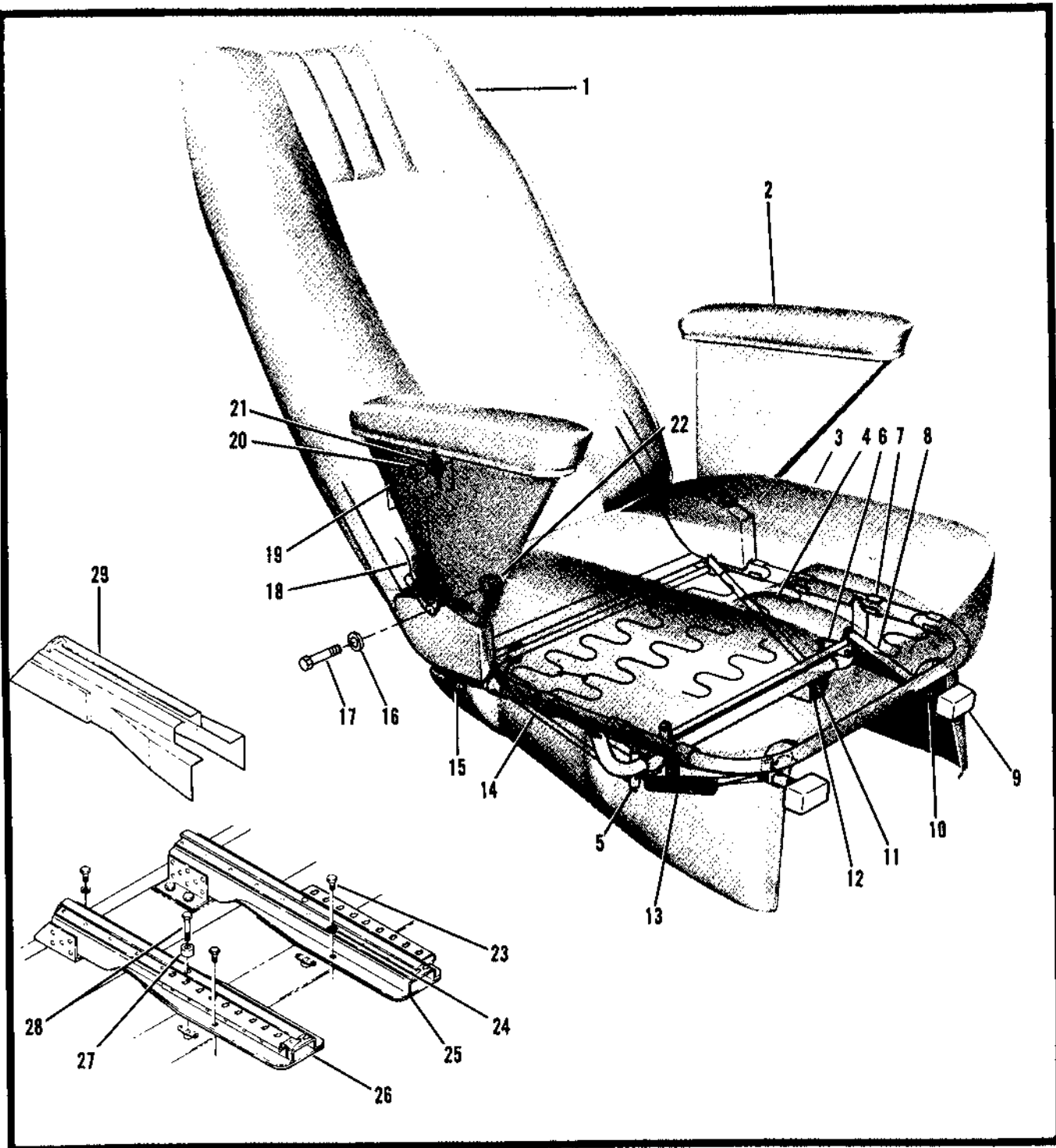


- 1. Seat Back
- 2. Armrest
- 3. Seat Bottom
- 4. Seat Frame

- 5. Stop Assembly
- 6. Adjustment Tube
- 7. Teleflex Cable
- 8. Spring

- 9. Seat Adjustment Handle
- 10. Safety Belt Bracket
- 11. Armrest Bracket
- 12. Seat Belt

Figure 3-10. Individual Reclining Rear Seat



1. Seat Back
2. Armrest Assembly
3. Seat Bottom
4. Seat Spring
5. Stop Pin
6. Bellcrank Assembly
7. Spring Clip
8. Link
9. Knob
10. Pivot Arm Assembly

11. Bushing
12. Roller
13. Spring
14. Push Rod
15. Torque Tube Assembly
16. Washer
17. Bolt
18. Safety Belt
19. Spacer

20. Spacer
21. Spring
22. Nut
23. Bolt
24. Washer
25. LH Inboard Track
26. RH Inboard Track
27. Stop
28. Bolt
29. Track Cover

Figure 3-11. Individual Adjusting Center Seat

semblies.

d. Remove center seat from aircraft through cabin door and disassemble and assemble in accordance with figure 3-11.

#### Installation of Center Single Adjustable Seats. (Optional)

a. To install the center seats, reverse the removal procedures.

#### REMOVAL AND INSTALLATION OF THE FIFTH AND SIXTH SEATS. (See figure 3-12.)

- a. Turn slotted screws on fasteners (20) and lift seat from the floor.
- b. To install, align the four round headed studs (14) with the receptacle in the fasteners and apply pressure downward on the seat until the bolts snap into position.

#### Disassembly and Assembly of Fifth and Sixth Reclining Seats. (Optional)

a. Disassemble and assemble the fifth and sixth seats in accordance with figure 3-12.

#### UPHOLSTERY.

##### Removal and Installation of Upholstery and Upholstery Trim. (See figure 3-13.)

- a. Remove seats in accordance with seat removal procedures.
- b. Remove headliner assembly (2) as follows:
  1. Remove overhead console light and cabin lights in accordance with removal procedures outlines in Section 14.
  2. (See figure 3-14.) Remove windshield upper trim (19).
  3. (See figure 3-14.) Remove emergency exit window upper trim (14) and front trim (15).
  4. (See figure 3-14.) Remove curtain stops (2) and curtains (1), and upper curtain track (3).
  5. (See figure 3-14.) Remove picture window trim (5, 6, 8 and 10).
  6. (See figure 3-14.) Remove wire tunnel covers (21, 33, 36 and 37).
  7. Remove rear panel (37), side panel (38 and 39).
  8. Start at the left side of the windshield and remove the headliner from the prong edges of the windshield upper retainer.
  9. Working from left to right and front to rear, remove the headliner assembly by unhooking the headliner supports (1) from headliner hangers (3).
- c. Remove cabin door upholstery as follows:
  1. (See figure 3-14.) Remove door window trim (27).
  2. Remove upper door upholstery panel (27) from retainers (19 and 20).
  3. (See figure 3-14.) Remove door trim pad (29) from retainers (28 and 30).
  4. Remove armrest assembly (22), lower door panel (21), and lower door upholstery panel (18).

d. Remove rear shelf upholstery as follows:

1. Remove upholstery panel (42) by rotating fasteners.
  2. Remove cover assembly (41) and shelf assembly (40).
- e. Remove cabin side upholstery as follows:
1. Remove carpeting in accordance with carpet removal procedures.
  2. (See figure 3-14.) Remove right cover assembly (25) and retainer strip (26).
  3. Remove side panel (10) and upholstered side panel (9).
  4. (See figure 3-14.) Remove wire tunnel cover assemblies (21, 33, 36 and 37) and retainers (23, 35 and 38).

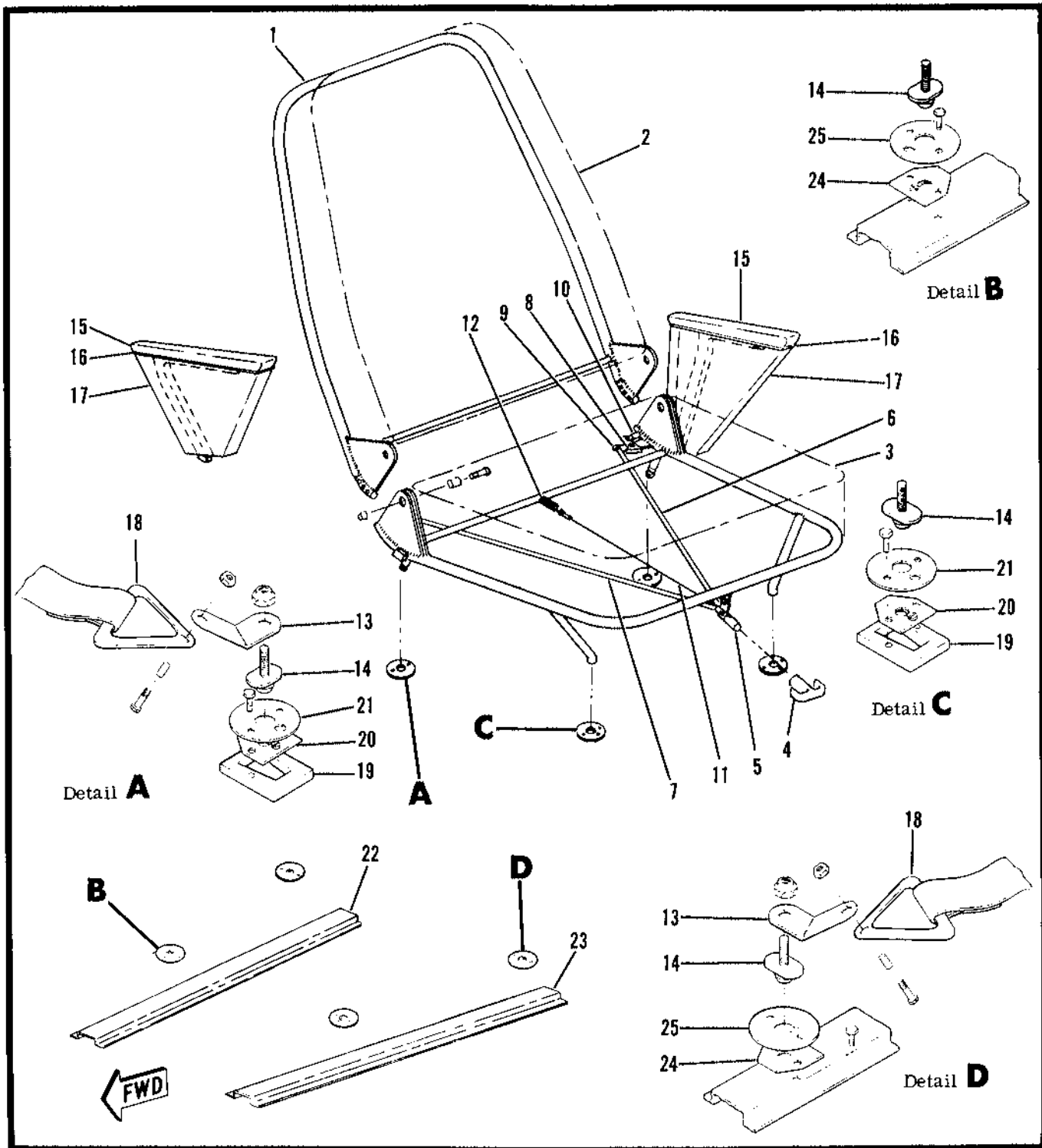
#### NOTE

Lower portion of window trim (5, 8, and 13) may be loosened for easy access to fasteners in tunnel assemblies and side panels.

5. Remove LH side panels (4, 5, 6, 34 and 35).
6. Remove RH side panels (12, 32, and 33).
- f. If further removal of the upholstery or upholstery trim is necessary, remove in accordance with figures 3-13 and 3-14.
- g. Install upholstery and upholstery trim by reversing the removal procedures outlines in the above steps.

##### Removal and Installation of the Carpet. (See figure 3-15.)

- a. Remove front and rear seats in accordance with seat removal procedures.
- b. Remove the regulator shield by removing attaching screws. The regulator shield is located underneath the copilot's seat protecting the alternator main and standby voltage regulator terminals.
- c. Remove screws (17) from angles (12 and 16) securing the bulkhead carpet (15). Remove angles (12 and 16) and bulkhead carpet.
- d. Remove left and right cover plates (11 and 18) by removing attaching screws.
- e. Remove the scuff plates by removing the attaching screws.
- f. Remove the control column boot (8) and retainer (7) by removing screws (6).
- g. Remove control column cover (9) by removing attaching screws.
- h. Remove left (10) and right (21) carpets by removing attaching screws, and freeing carpet from glued insulation.
- i. Remove front center spar carpet (4) by loosening and freeing carpet from glued insulation.
- j. Remove the center floorboard carpet (3) by removing attaching screws. The center floorboard carpet has an insulation cover glued to the assembly.
- k. Remove the rear floor cover by removing the lower rear curtain support and the attaching screws.
- l. Install carpet by reversing the removal procedure outlined in the above steps.



1. Seat Back
2. Back Cover Assembly
3. Bottom Cover Assembly
4. Knob
5. Pivot Arm
6. Link LH
7. Link RH
8. Stop
9. Bellcrank

10. Stop Pin
11. Cable Assembly
12. Spring
13. Belt Link LH
14. Stud
15. Armrest Assembly
16. Cover Plate
17. Armrest Support Cover

18. Safety Belt Assembly
19. Spacer
20. Fastener Plate Assembly
21. Seat Attach Cover Plate
22. Outboard Seat Support Assembly
23. Inboard Seat Support Assembly
24. Fastener Plate Assembly
25. Seat Attach Cover Plate

Figure 3-12. Aft Seat Installation



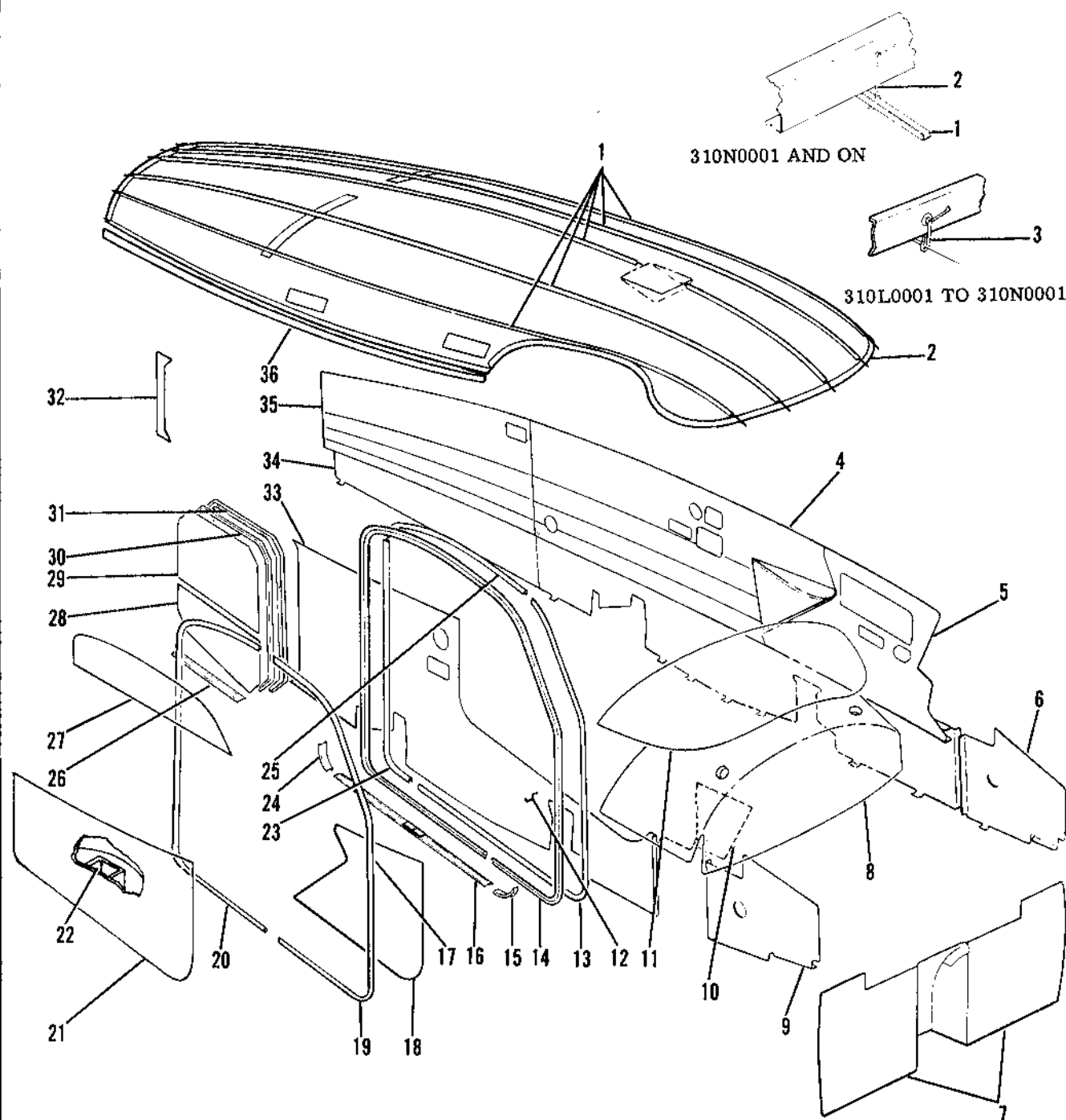
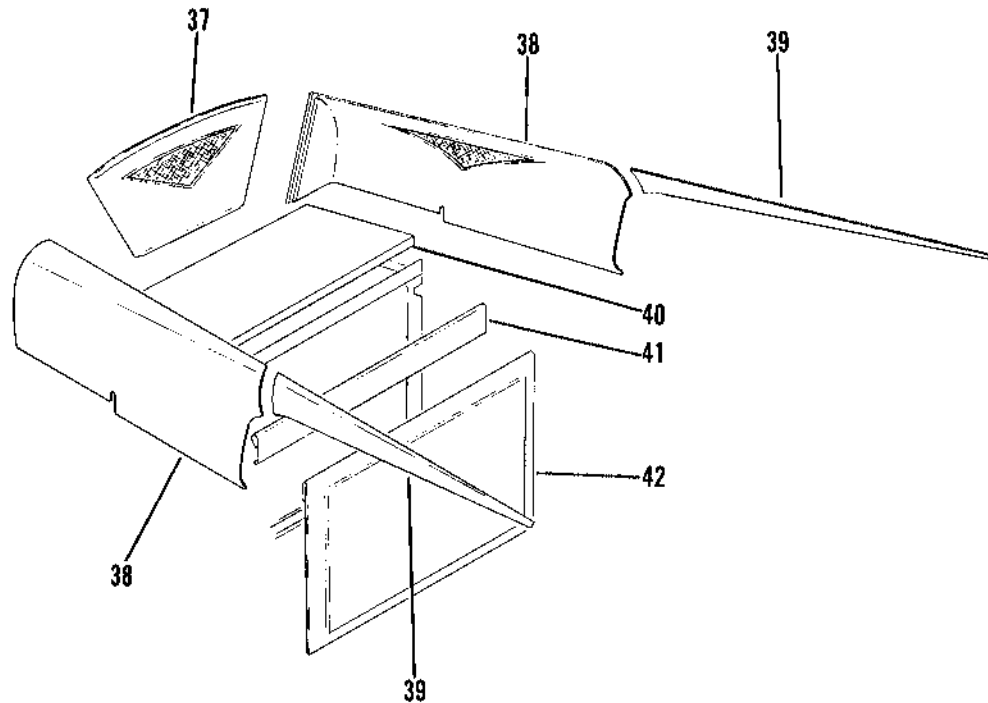
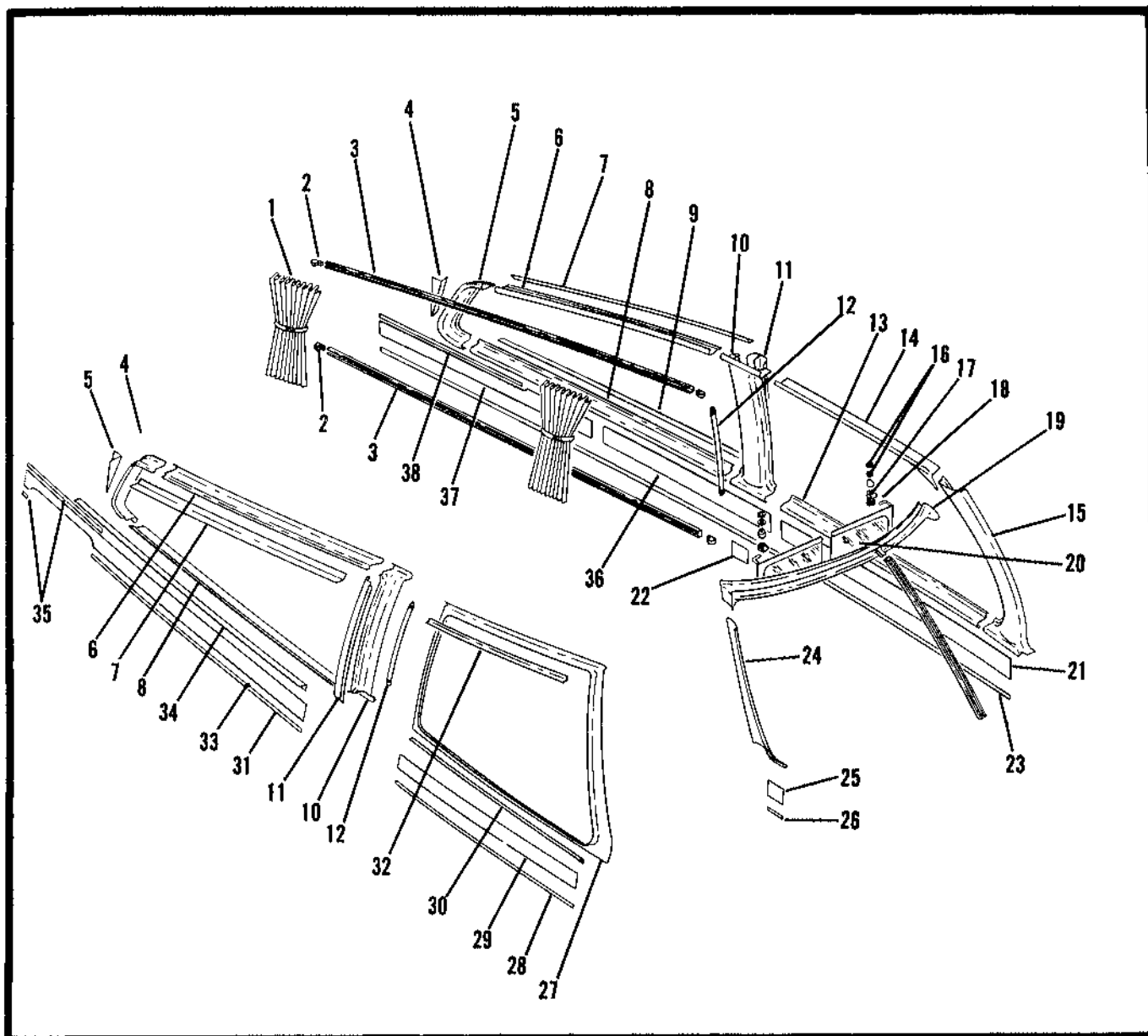


Figure 3-13. Upholstery Installation (Sheet 1 of 2)



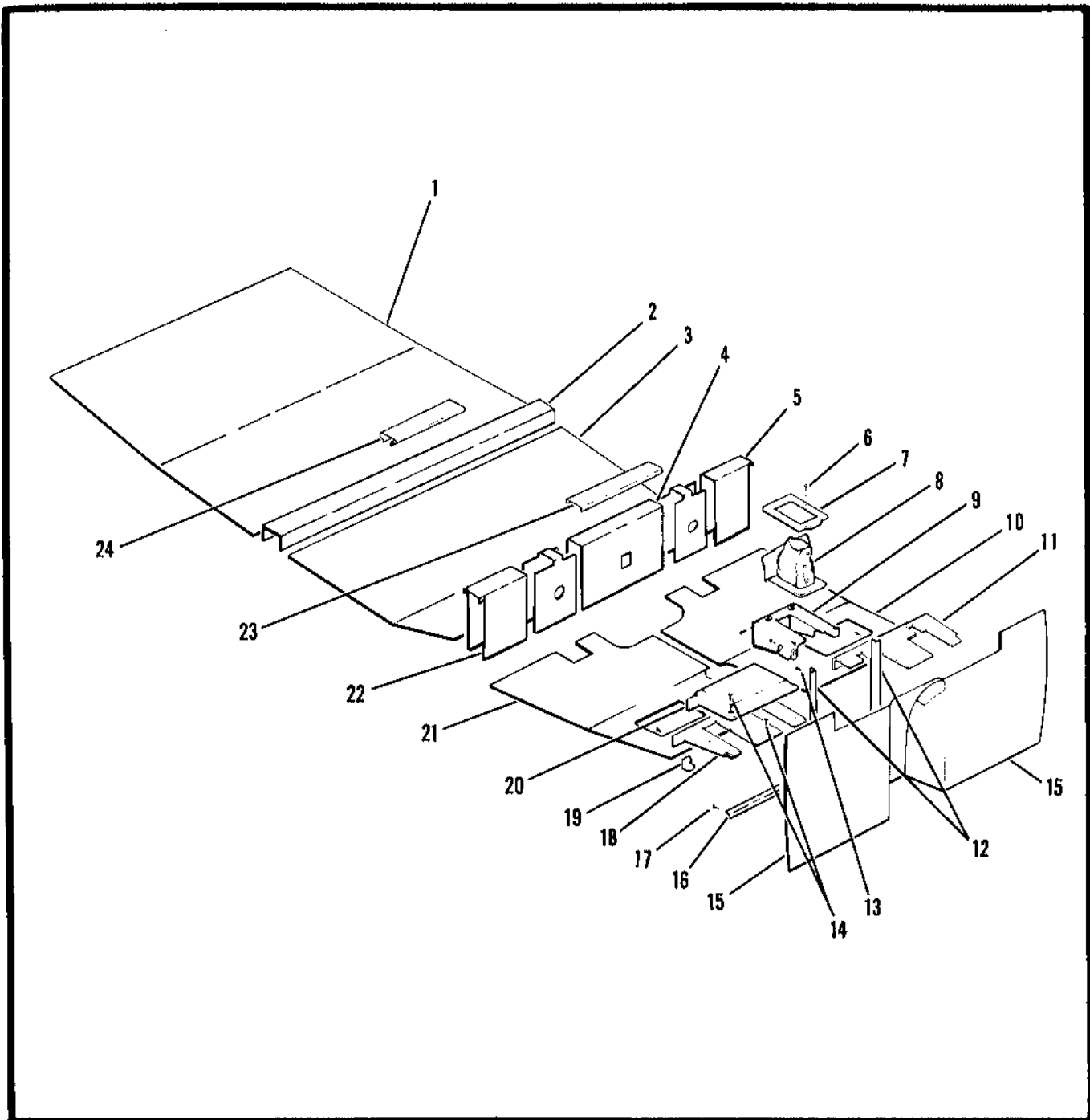
- |                                                     |                                   |
|-----------------------------------------------------|-----------------------------------|
| 1. Headliner Support                                | 22. Armrest Assembly              |
| 2. Headliner Assembly                               | 23. Retainer Aft Door Jamb        |
| 3. Headliner Hanger                                 | 24. Aft Door Jamb Fillet          |
| 4. Left Upholstery Panel                            | 25. Clip Upper Door Jamb          |
| 5. Side Panel (Left upper forward)                  | 26. Scuff Plate                   |
| 6. Left Upholstered Side Panel (Lower forward)      | 27. Upper Door Upholstery Panel   |
| 7. Bulkhead Carpet                                  | 28. Lower Baggage Door Panel      |
| 8. Cover (Instrument Panel Deck)                    | 29. Upper Baggage Door Panel      |
| 9. Right Upholstered Side Panel (Lower forward)     | 30. Windlace                      |
| 10. Side Panel (Right upper forward)                | 31. Retainer Baggage Door Opening |
| 11. Glare Shield                                    | 32. Aft Upholstery                |
| 12. Right Upholstered Side Panel (Lower center aft) | 33. Upper Center Upholstery Panel |
| 13. Retainer Forward Door Jamb                      | 34. Lower Aft Upholstery Panel    |
| 14. Windlace                                        | 35. Upper Aft Upholstery Panel    |
| 15. Forward Door Jamb Fillet                        | 36. Retainer (Upper)              |
| 16. Door Jamb Stop                                  | 37. Rear Panel                    |
| 17. Retainer (Forward door frame upper)             | 38. Rear Side Panel               |
| 18. Lower Door Panel                                | 39. Forward Side Panel            |
| 19. Retainer (Forward door frame lower)             | 40. Shelf Assembly                |
| 20. Retainer (Aft door frame)                       | 41. Cover Assembly                |
| 21. Lower Door Upholstery Panel                     | 42. Upholstery Panel Assembly     |

Figure 3-13. Upholstery Installation (Sheet 2 of 2)



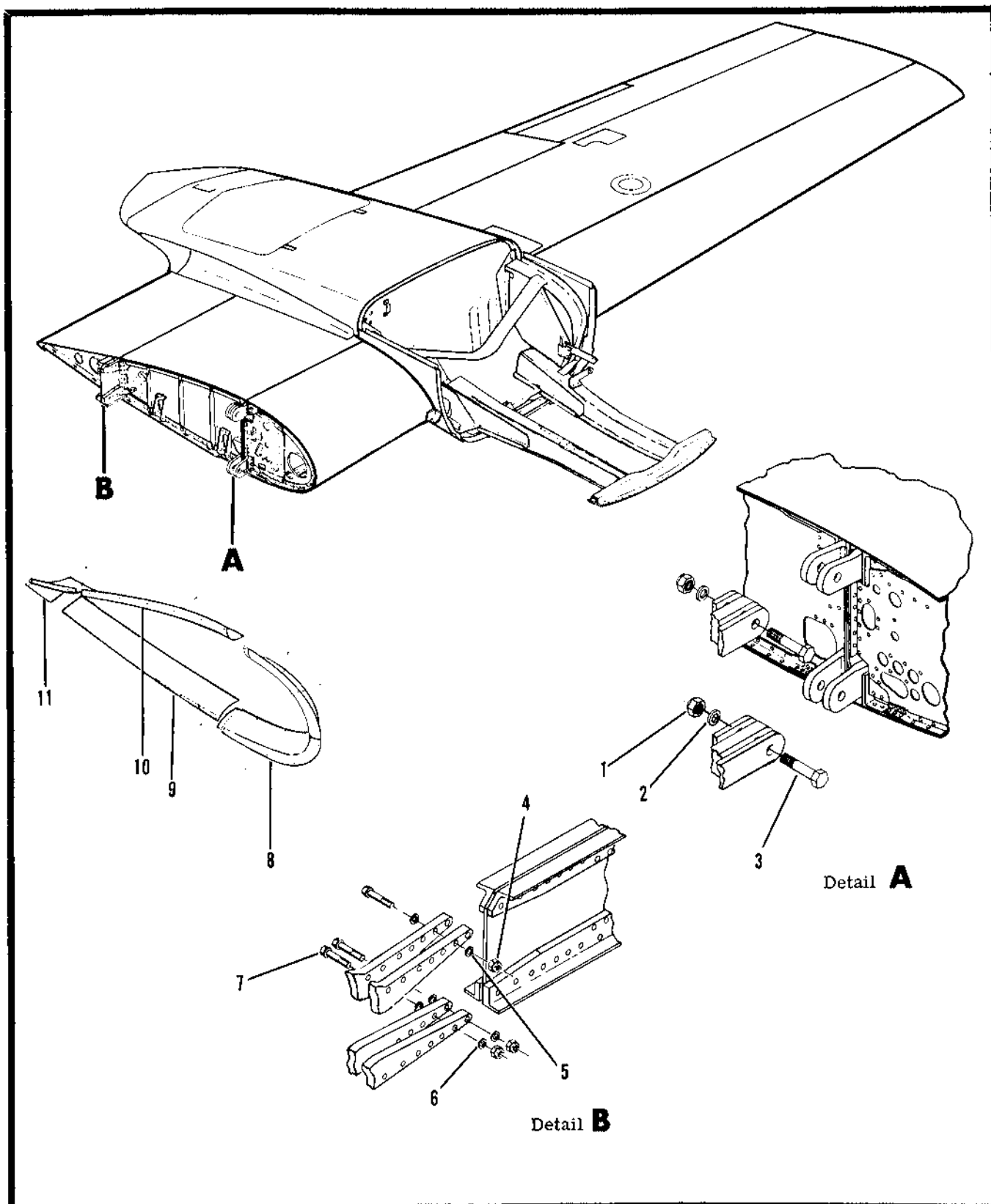
- |                                    |                              |
|------------------------------------|------------------------------|
| 1. Curtain                         | 20. Sun Visors               |
| 2. Stop                            | 21. Forward Wire Tunnel (LH) |
| 3. Curtain Track                   | 22. Ash Receiver             |
| 4. Aft Trim Support                | 23. Retainer                 |
| 5. Aft Picture Window Trim         | 24. Window Post Trim         |
| 6. Upper Picture Window Trim       | 25. Forward Right Cover      |
| 7. Upper Rear Window Trim Support  | 26. Retainer                 |
| 8. Lower Picture Window Trim       | 27. Door Window Trim         |
| 9. Lower Trim Support              | 28. Retainer                 |
| 10. Window Post Trim               | 29. Door Trim Pad            |
| 11. Forward Trim Support           | 30. Lower Trim Support       |
| 12. Assist Strap                   | 31. Retainer                 |
| 13. Lower Left Front Window Trim   | 32. Upper Trim Support       |
| 14. Upper Left Front Window Trim   | 33. Rear Wire Tunnel (RH)    |
| 15. Forward Left Front Window Trim | 34. Lower Trim Support       |
| 16. Washer                         | 35. Retainer                 |
| 17. Visor Mount                    | 36. Center Wire Tunnel (LH)  |
| 18. Bolt                           | 37. Aft Wire Tunnel (LH)     |
| 19. Upper Windshield Trim          | 38. Retainer                 |

Figure 3-14. Upholstery Trim Installation



- |                             |                             |
|-----------------------------|-----------------------------|
| 1. Rear Floor Carpet        | 13. Screw                   |
| 2. Rear Spar Carpet         | 14. Screw                   |
| 3. Center Floor Carpet      | 15. Bulkhead Carpet         |
| 4. Front Spar Carpet        | 16. Angle                   |
| 5. Front Spar Carpet LH     | 17. Screw                   |
| 6. Screw                    | 18. Cover Plate             |
| 7. Retainer                 | 19. Angle                   |
| 8. Boot                     | 20. Cover Plate             |
| 9. Cover Assembly           | 21. Pilot's Floor Carpet RH |
| 10. Pilot's Floor Carpet LH | 22. Front Spar Carpet RH    |
| 11. Cover Plate             | 23. Cover Front Spar        |
| 12. Angle                   | 24. Cover Rear Spar         |

Figure 3-15. Carpet Installation



- 1. Nut
- 2. Washer
- 3. Bolt
- 4. Nut

- 5. Washer
- 6. Countersunk Washer
- 7. Bolt

- 8. Forward Fillet
- 9. Lower Fillet
- 10. Upper Fillet
- 11. Aft Fillet

Figure 3-16. Wing Installation

**WING.****Removal of Wing.**

- a. Remove batteries in accordance with Section 14.
- b. Drain fuel system at three places: wing tip tank, fuel strainer just forward of front spar and adjacent to nacelle, and auxiliary fuel cell just forward of rear spar and adjacent to nacelle.

**NOTE**

Wings can be removed with all fuel tanks and cells installed. If fuel tank and cell removal is desired, remove in accordance with Section 11.

- c. Remove engine in accordance with removal procedures in Section 9.

**CAUTION**

If one or both engines are removed, the aircraft may become tail heavy. Therefore, to balance the aircraft, place equivalent weight (shot bags or sand bags) in the engine nacelles and support the tailcone with padded support.

- d. Jack aircraft in accordance with jacking procedures in Section 2.
- e. Place suitable padded supports beneath cabin section and wings; then remove jacks.

**NOTE**

To prevent damage to skin, place padded supports beneath front and rear spars in fuselage and beneath wing ribs. If both engines were removed and weight was placed in the nacelles, remove weight after removing jacks.

**CAUTION**

If only one wing is being removed and the engine on the opposite wing remains installed; relieve the engine weight on opposite wing by using engine hoist before removing wing or serious damage may occur due to an over-balance tipping condition.

- f. Remove wing root fillets by removing attaching screws.
- g. Disconnect or remove landing gear drive tube in accordance with removal procedures in Section 4.

**NOTE**

Wings can be removed with main landing gear installed. If gear removal is desired, remove in accordance with removal procedures in Section 4.

- h. Remove flap cables from wing in accordance with removal procedures in Section 8.
- i. Remove aileron cables from wing in accordance with removal procedures in Section 5.

- j. On left wing only, remove aileron trim cables in accordance with removal procedures in Section 5.
- k. Disconnect engine controls in engine nacelle in accordance with Section 9.
- l. Remove upholstery panels in cabin as necessary to gain access to junction box located on side of aircraft from which wing is to be removed.
- m. At the junction box, disconnect and tag each wire to affected engine and route wire from fuselage.

**NOTE**

Some wires in each junction box have solenoid connections which must be unsoldered.

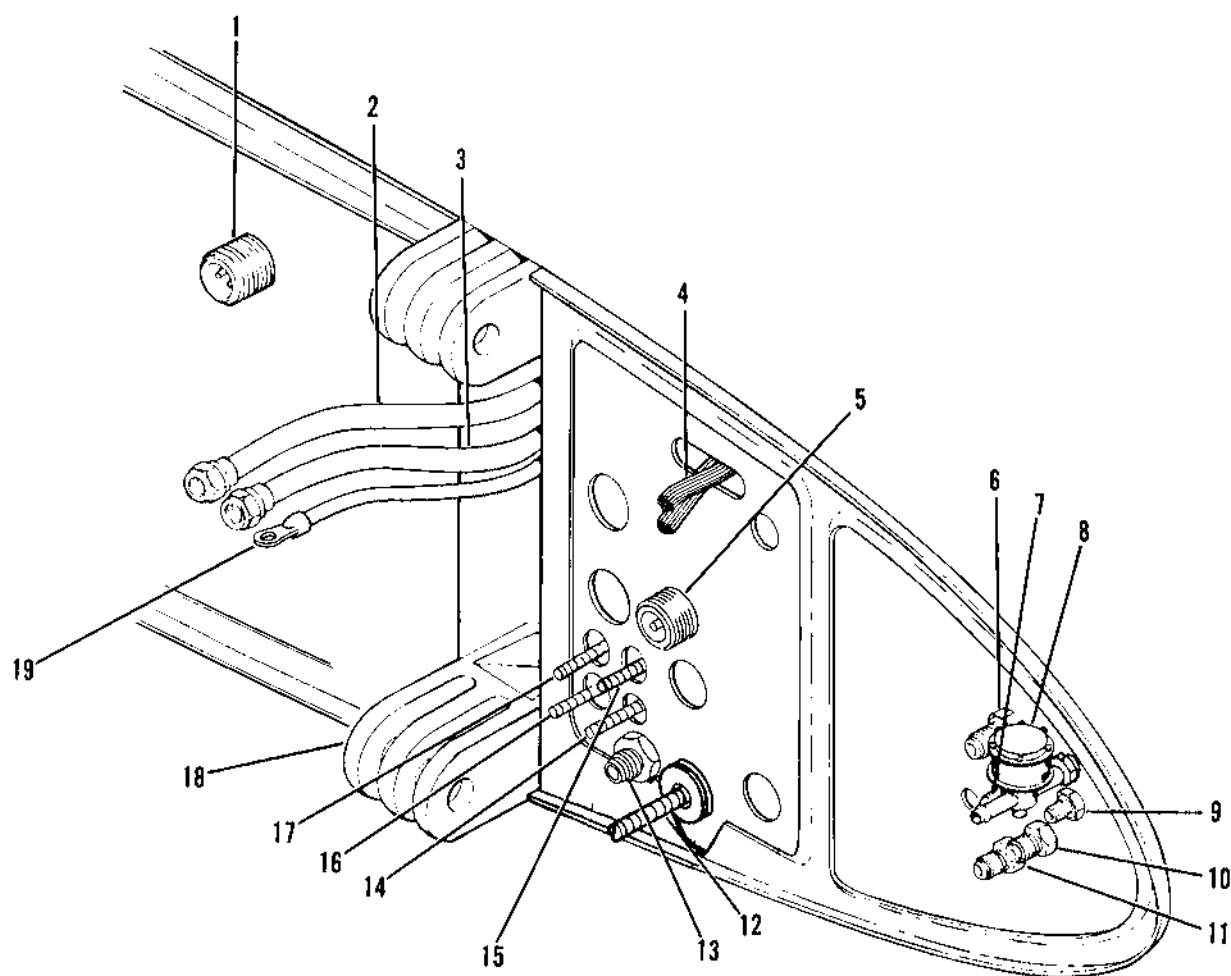
- n. (See figure 3-17.) Disconnect, tag or route the following items in the wing root area:
  1. Route engine flex cables (14, 15 and 16) to fuselage.
  2. Disconnect magneto wires at electrical connector (5).
  3. Route starter cable (18) to fuselage.
  4. Disconnect fuel lines (2 and 3).
  5. Disconnect manifold pressure line at fitting (7).
  6. Disconnect oil pressure line at fitting (10).
  7. Disconnect fuel pressure line at fitting (9).
  8. Disconnect vacuum hose at pressure relief valve (8).
  9. Disconnect brake line at fitting (11).
  10. Route fuel selector flex cable (12) to fuselage.
  11. If installed, disconnect deice line at fitting (13).
  12. If installed, disconnect auxiliary fuel tank plug at electrical connector (1).
  13. Route wing wiring bundle (4) from fuselage.
  14. Disconnect heater fuel line at fitting (6).
  15. If Nav-O-Matic Autopilot is installed, disconnect line at fitting.
- o. (See figure 3-16.) Remove nuts (1 and 4), washers (2, 5 and 6) and bolts (3 and 7) from wing attachment fittings.
- p. Move wing and padded wing supports outboard until wing attachment fittings have disengaged.

**NOTE**

If difficulty is encountered in driving out wing bolts or disengaging fittings, it may be necessary to rock wing slightly.

**Installation of Wing. (See figure 3-17.)**

- a. Position wing approximately one foot from fuselage.
- b. (Refer to Section 2.) Clean and/or lubricate engine flex cables fittings, electrical wiring and all other items relating to the wing needing servicing.
- c. Route flex cables (14, 15 and 16) through root rib towards engine nacelle. Do not secure cables to structure at this time.
- d. Route fuel selector valve flex cable (12) through root rib towards engine nacelle.
- e. Move the wing toward fuselage until wing attachment fittings begin to engage, guide landing gear drive tube through opening in root rib.
- f. (See figure 3-16.) Align bolt holes in wing attachment fittings and install bolt (3), washer (2), and nut (1) on front attach fitting; install bolt (7), washer (6),



RH WING ROOT

- |                                          |                                      |
|------------------------------------------|--------------------------------------|
| 1. Electrical Connector (Auxiliary Fuel) | 11. Fitting (Brake Line)             |
| 2. Fuel Line (Crossover)                 | 12. Flex Cable (Fuel Selector Valve) |
| 3. Fuel Line (Crossover)                 | 13. Fitting (Deice Line)             |
| 4. Wire Bundle                           | 14. Flex Cable (Mixture Control)     |
| 5. Electrical Connector (Magnetos)       | 15. Alternate Air Control            |
| 6. Fitting (Heater Fuel Line)            | 16. Flex Cable (Throttle Control)    |
| 7. Fitting (Manifold Pressure Line)      | 17. Flex Cable (Propeller Control)   |
| 8. Pressure Relief Valve                 | 18. Fuselage Front Spar Fitting      |
| 9. Fitting (Fuel Pressure Line)          | 19. Starter Cable                    |
| 10. Fitting (Oil Pressure Line)          |                                      |

Figure 3-17. Wing Connections

washer (5), and nut (4) on rear attach fitting.

#### NOTE

Refer to figure 3-16, install front spar bolts with heads facing forward and rear spar bolts with heads facing aft. On rear spar bolts, place countersunk washers (6) under heads of bolts (7). Torque front spar nuts (1) to 60  $\pm$  5 foot-pounds, and rear spar nuts (4) to 175  $\pm$  15 inch-pounds.

g. Connect any of the following items of optional equipment which were disconnected during wing removal:

1. Connect deice line to fitting (13).
2. Connect auxiliary fuel tank electrical plug to electrical connector (1).
3. Connect Nav-O-Matic autopilot line to fitting.

#### NOTE

Lubricate all fittings used on fuel, oil and air lines with suitable thread lubricant. Apply lubricant to the male fittings only, omitting the first two threads. Lubricate straight threads of hydraulic fittings with system fluid.

h. Connect the following items at the wing root area and remove tags:

1. Connect heater fuel line to fitting (6).
2. Route wing wiring bundle (4) through fuselage.
3. Connect brake line to fitting (11).
4. Connect vacuum hose to pressure relief valve (8).
5. Connect fuel pressure line to fitting (9).
6. Connect oil pressure line to fitting (10).
7. Connect manifold pressure line to fitting (7).
8. Connect fuel lines (2 and 3).
9. Route starter cable (19) to wing.
10. Connect magnet wires to electrical connector (5).
- i. Connect electrical wires to proper terminals in junction box and remove tags. Solder wires which require soldering.
- j. Refer to Section 8, install flap cables in wing and rig in accordance with rigging procedures.
- k. Refer to Section 5, install aileron cables in wing and rig in accordance with rigging procedures.
- l. If left wing was removed, install and rig aileron trim cables.
- m. If wing tip fuel tank was removed, install in accordance with Section 11. Do not install lower fairing at this time.
- n. Refer to Section 2, jack aircraft in accordance with jacking procedures.

#### CAUTION

If both engines were removed, the aircraft is tail heavy. To balance the aircraft, place weight (such as shot bags or sand bags) in engine nacelles prior to jacking.

o. Remove padded supports from beneath cabin section, tail section, and wings.

- p. Place tailcone support beneath tailcone bumper.
- q. If landing gear was removed, refer to Section 4 and install and rig landing gear.

#### NOTE

To facilitate rigging of landing gear, use external power source.

r. Refer to Section 9, install engine in accordance with installation procedures and connect flex cables (14, 15 and 16) to engine.

#### NOTE

To prevent serious binding, check flex cables for proper security during rigging of cables.

- s. Remove support from beneath tailcone bumper.
- t. Remove aircraft jacks.
- u. Refer to Section 14, install batteries in accordance with installation procedures.
- v. Check control cables for proper operation and correct directional travel.
- w. Service aircraft and check for fuel leaks, especially at the fuel tank and wing connections.
- x. Install wing root and fuel tank fairings.
- y. Refer to Section 9, perform an engine operation check and observe engine controls and electrical equipment for proper operation.

#### Removal of Wing Locker Door. (See figure 3-19.)

- a. Open wing locker door.
- b. Remove screw (11), spacer (12) and bracket (13) from lower end of stop assembly (10).
- c. Remove nuts (5), washers (2), spacers (3), and screws (1) from door hinge (4) and remove door (6) from nacelle.

#### Installation of Wing Locker Door. (See figure 3-19.)

Install wing locker door by reversing removal procedures.

#### Removal and Installation of Wing Locker Door Latch.

Removal and installation of wing locker door latch is not recommended unless replacement or repair is necessary. Use figure 3-19 as a guide for removal and installation.

#### Checking Baggage Door Stop Tension

- a. Remove stop assembly from aircraft and set in a vice.
- b. Using a spring scale (0 to 50 pounds), measure the tension required to close the stop. Read tension when stop releases to close the stop. Tension should read 25  $\pm$  3 pounds.
- c. If correct tension is not obtained, refer to Baggage Door Stop Adjustment procedures.



### Adjustment of Wing Locker and Baggage Door Stop (See figure 3-18.)

- a. Adjust tension on stop assembly to obtain 25 +3 pounds tension (applied directly to the stop) as follows:
  1. Position stop assembly on block with stop extended and tongue down.
  2. Using a drift punch and hammer, tap on roller to increase tension.
  3. To decrease tension, turn stop over on block and bend tongue down.

#### NOTE

Be sure block is inside of channel to prevent damage to the channel flanges.

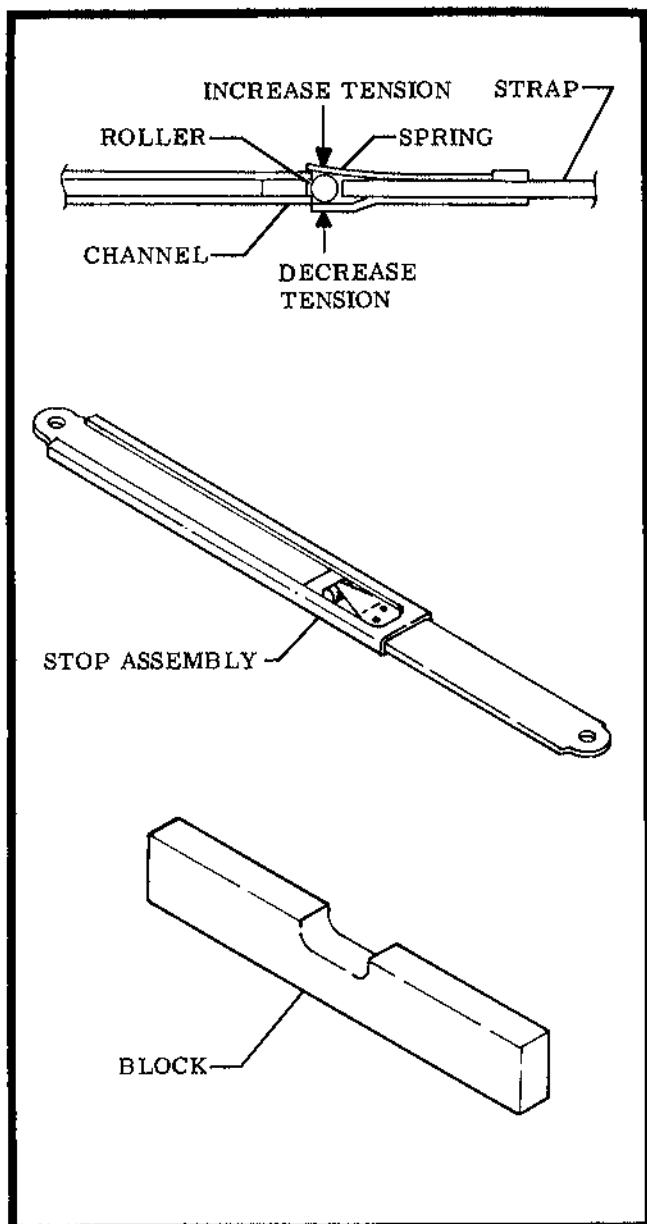


Figure 3-18. Adjustment of Wing Locker and Baggage Door Stop

### FUSELAGE STINGER.

Removal of Fuselage Stinger. (See figure 3-20.)

- a. Remove attaching screws and move stinger assembly aft slightly.
- b. Disconnect electrical wires (4) to the navigation light.
- c. If a reel antenna (optional equipment) has been installed, disconnect the reel antenna lead wires.
- d. Remove stinger assembly (1) from tailcone.

Installation of Fuselage Stinger. (See figure 3-20.)

- a. If removed, install tail navigation light with attaching screws, washers and nuts.
- b. Place stinger assembly (1) near tailcone.
- c. If antenna reel (optional equipment) is installed, connect reel and lead wires.
- d. Connect electrical wire (4).
- e. Secure stinger assembly (1) to tailcone with screws.

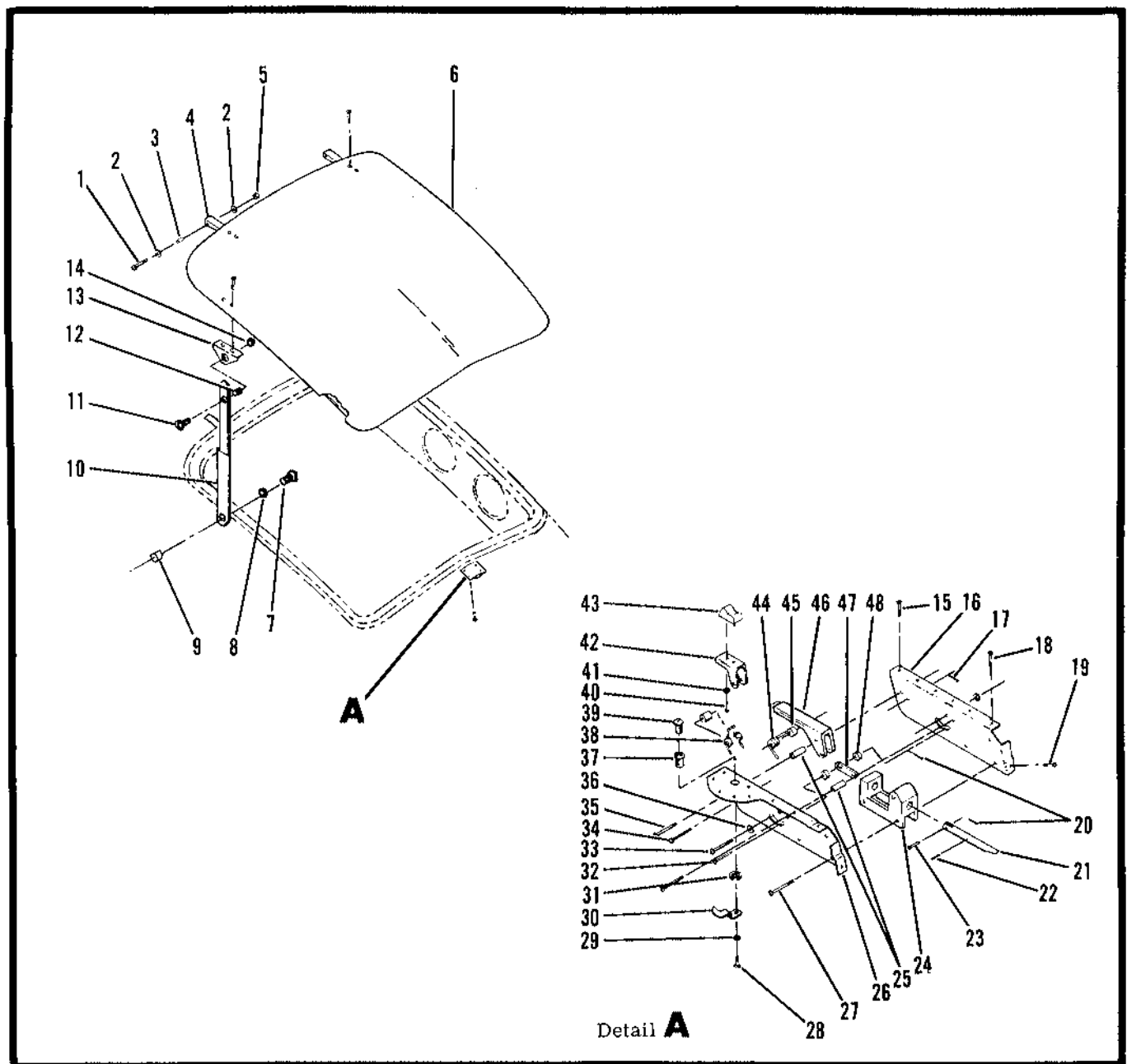
### STABILIZERS.

Removal of Horizontal Stabilizer. (See figure 3-21.)

- a. Refer to Section 6, remove elevator in accordance with removal procedures.
- b. Disconnect elevator trim tab push-pull tube from actuator by removing attaching nut, washer and bolt.
- c. Remove vertical fin and rudder in accordance with removal procedures.
- d. Refer to Section 6, remove elevator and trim control cables from stabilizer.
- e. Remove tail navigation light wires by removing screws from attaching clamps and wire terminal.
- f. If deice system (optional equipment) is installed, disconnect and tag hoses at tee located on support bracket just forward of center bulkhead in tailcone.
- g. Remove four nuts, washers and bolts attaching rear spar to tailcone bulkhead.
- h. Remove two bolts and washers attaching front spar to fuselage bulkhead.
- i. Lift the rear spar until the stabilizer is at an angle of approximately 45 degrees, then remove from the aircraft by lifting vertically.

Installation of Horizontal Stabilizer. (See figure 3-21.)

- a. Position horizontal stabilizer on tailcone and align mounting holes.
- b. Attach stabilizer front spar to fuselage bulkhead with two bolts and washers. Torque bolts to 110 ± 15 pound-inches.
- c. Attach stabilizer rear spar to tailcone bulkhead with four bolts, washers and nuts. Torque bolts to 120 ± 20 pound-inches.
- d. If deice system (optional equipment) is installed, connect hoses to tee located on support bracket forward of center bulkhead in tailcone.
- e. Install tail navigation light wires by installing screws in attaching clamps and wire terminal.



- |                   |                 |                           |
|-------------------|-----------------|---------------------------|
| 1. Screw          | 17. Cotter Pin  | 33. Screw                 |
| 2. Washer         | 18. Screw       | 34. Pin                   |
| 3. Spacer         | 19. Screw       | 35. Screw                 |
| 4. Hinge Strap    | 20. Cotter Pin  | 36. Washer                |
| 5. Nut            | 21. Bolt Latch  | 37. Shell                 |
| 6. Door Assembly  | 22. Spring      | 38. Spring                |
| 7. Screw          | 23. Pin         | 39. Cylinder Assembly     |
| 8. Washer         | 24. Block Guide | 40. Screw                 |
| 9. Spacer         | 25. Spacer      | 41. Lockwasher            |
| 10. Stop Assembly | 26. Support     | 42. Latch Handle Retainer |
| 11. Screw         | 27. Screw       | 43. Button                |
| 12. Spacer        | 28. Screw       | 44. Spring                |
| 13. Bracket       | 29. Lockwasher  | 45. Spacer                |
| 14. Nut           | 30. Lock Arm    | 46. Latch Handle          |
| 15. Screw         | 31. Nut         | 47. Link                  |
| 16. Support       | 32. Pin         | 48. Spacer                |

Figure 3-19. Wing Locker Installation

- f. Refer to Section 6, install elevator in accordance with installation procedures.
- g. Install vertical fin and rudder in accordance with installation procedures.
- h. Connect the elevator trim tab push-pull tube to the actuator by installing attaching bolt, washer and nut.

#### Removal of Vertical Stabilizer. (See figure 3-22.)

- a. Place suitable support beneath tail section.
- b. (See figure 3-21.) Remove horizontal stabilizer fairings (6 and 8).
- c. If omni-antenna (optional equipment) is installed, disconnect the coaxial cable in the aft fuselage.

#### NOTE

If the coaxial cable is disconnected at the vertical fin tip, a wire should be attached to it before removal to facilitate installation.

- d. If rotating beacon (optional equipment) is installed, two quick disconnects must be unhooked and the ground wire disconnected at the bulkhead in the aft fuselage.
- e. Refer to Section 7, remove rudder in accordance with removal procedures.
- f. Remove four screws attaching forward dorsal skin to fuselage.

- g. Remove nut, washer and eyebolt attaching elevator down spring to vertical fin rear spar.
- h. Refer to Section 7, remove rudder and trim control cables.
- i. Refer to Section 6, remove elevator push-pull tube in accordance with removal procedures.
- j. Remove two nuts and bolts attaching front spar to fuselage.
- k. Remove four bolts and washers attaching rear spar to fuselage.
- l. Lift fin vertically until front spar has cleared fuselage and remove from aircraft.

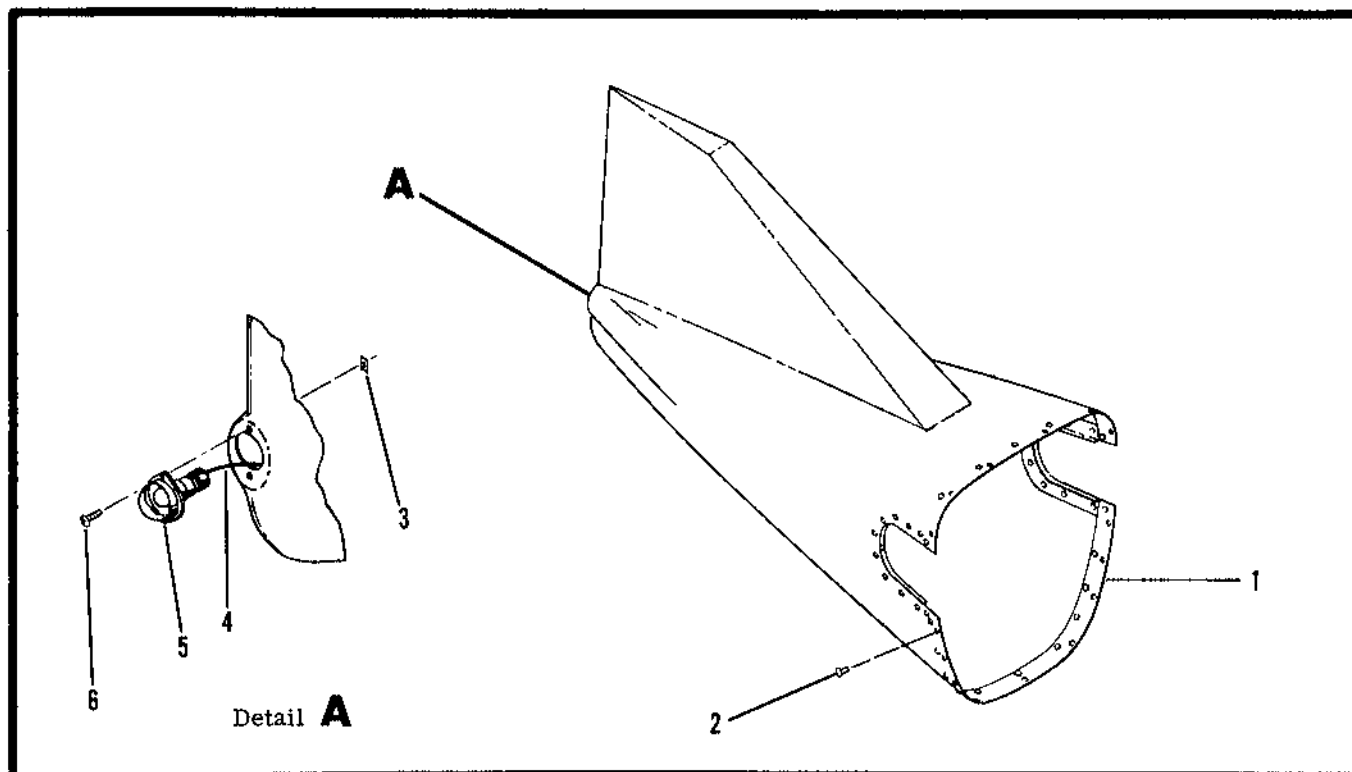
#### Installation of Vertical Stabilizer. (See figure 3-22.)

- a. Place vertical fin in position on fuselage and align mounting holes.
- b. Attach vertical fin rear spar to tailcone bulkhead with four bolts and washers.

#### NOTE

Torque vertical fin attaching bolts to  $175 \pm 15$  pound-inches.

- c. Attach forward dorsal skin to fuselage with four screws.
- d. Attach vertical fin front spar to fuselage with two bolts and nuts.
- e. Refer to Section 6, install elevator push-pull

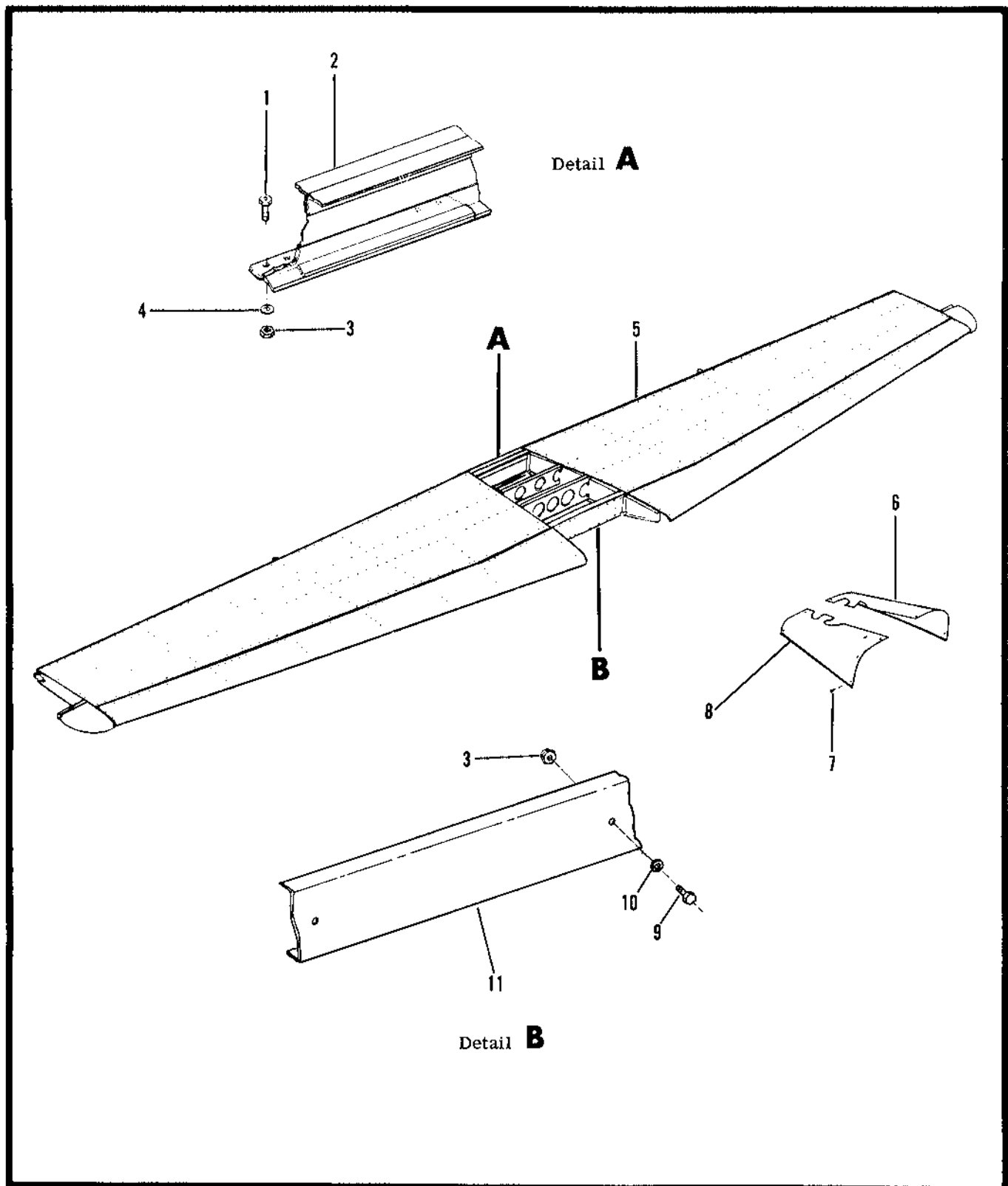


- 1. Fuselage Stinger
- 2. Screw

- 3. Nut
- 4. Electrical Wire

- 5. Tail Light Assembly
- 6. Screw

Figure 3-20. Fuselage Stinger

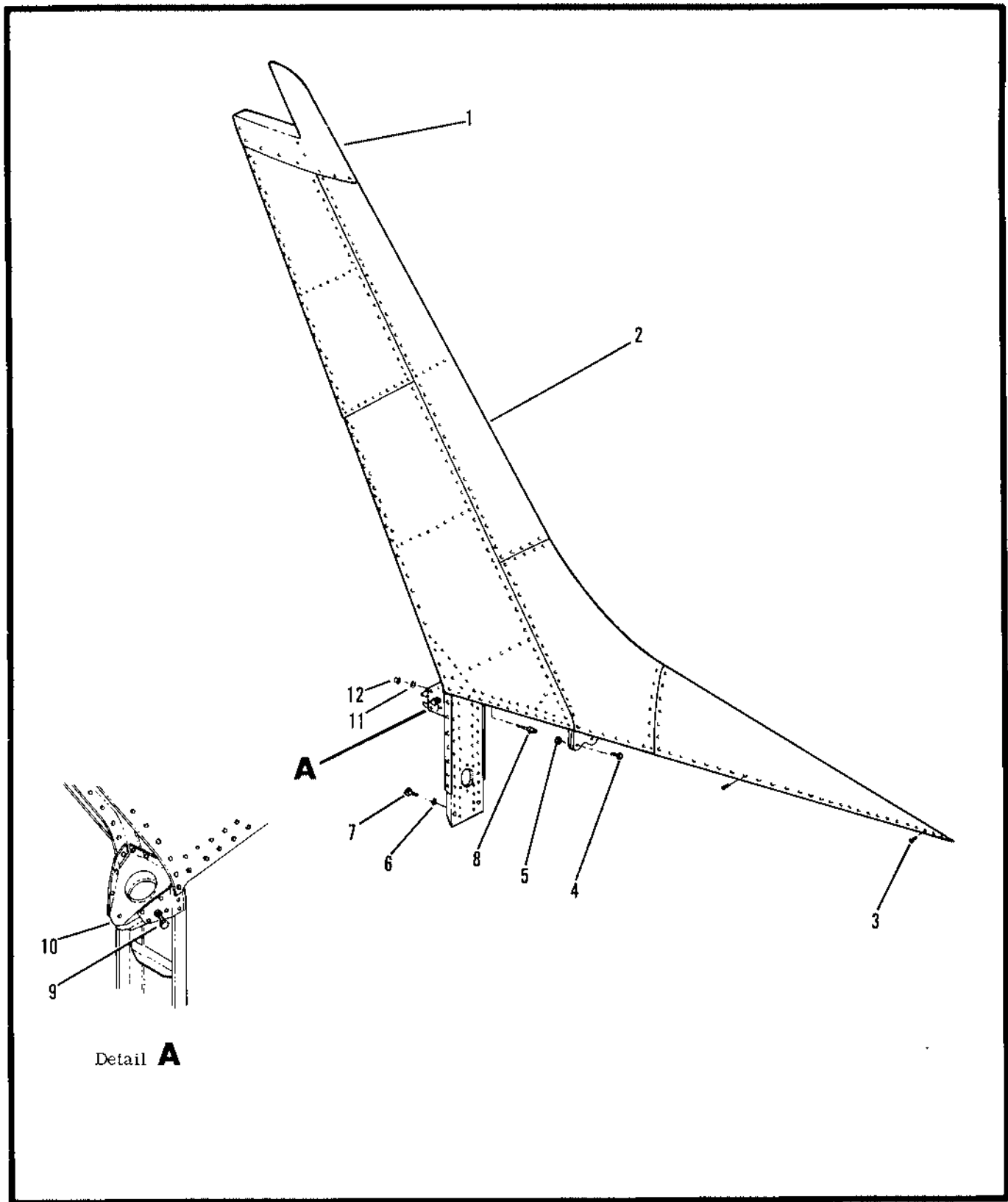


1. Bolt
2. Stabilizer Rear Spar
3. Nut
4. Washer

5. Horizontal Stabilizer
6. Left Stabilizer Fairing
7. Screw

8. Right Stabilizer Fairing
9. Bolt
10. Washer
11. Stabilizer Front Spar

Figure 3-21. Horizontal Stabilizer Installation



- |                   |            |                               |
|-------------------|------------|-------------------------------|
| 1. Fiberglass Tip | 5. Nut     | 9. Rudder Bellcrank Stop Bolt |
| 2. Vertical Fin   | 6. Washer  | 10. Lower Hinge Assembly      |
| 3. Screw          | 7. Bolt    | 11. Washer                    |
| 4. Bolt           | 8. Eyebolt | 12. Nut                       |

Figure 3-22. Vertical Fin Installation

tube in accordance with installation procedures.

f. Install elevator down spring with eyebolt, washer and nut.

g. Refer to Section 7, install rudder to vertical stabilizer and connect rudder and trim control cables.

h. If omni-antenna (optional equipment) is installed, connect the coaxial cable in the aft fuselage.

i. If rotating beacon (optional equipment) is installed, fasten the two disconnects and attach the ground wire to the bulkhead in the aft fuselage.

j. Remove support from beneath tail section and install stabilizer fairings.

## CONTROL PEDESTAL.

The control pedestal is located in the cabin, between the pilot's and copilot's positions, just below and aft of the instrument panel. This pedestal contains the engine control quadrant, elevator trim, aileron trim and rudder trim control wheels and indicators. Provision is made for installation of an automatic pilot control head in the upper part of the control pedestal, immediately aft of the control quadrant.

### Removal of Control Pedestal. (See figure 3-23.)

a. Refer to Section 3, remove the front seats, front carpet and kick plates.

b. Remove engine controls cover (21).

c. Remove elevator trim control wheel (3) by removing four screws and washers.

d. Remove cover plate (7) and side panels (11 and 12) from both sides of control pedestal by removing attaching screws.

e. Refer to Section 6, remove elevator trim control sprocket (2) in accordance with removal procedures.

f. Disconnect rudder trim control torque tube (16) by removing roll pin.

g. Disconnect upper aileron trim control chain (15) at master link.

h. Route aileron, elevator, and rudder trim control cables from pedestal.

i. Disconnect throttle, propeller and mixture control cables by loosening the coupling nuts.

### NOTE

If autopilot (optional equipment) is installed, disconnect wire bundle from rear of control unit box.

j. Remove alternate air control bracket (10) from control pedestal (9) by removing attaching rivets.

k. Remove two screws fastening upper part of control pedestal to stationary instrument panel (8).

l. Remove ten screws which fasten control pedestal to floor.

m. Carefully lift control pedestal upward to disengage the rudder trim control torque tube (16) from the torque tube shaft (17). Tilt the control pedestal aft, work it free of all units, and remove from cabin.

### Disassembly of Control Pedestal. (See figure 3-23)

This disassembly procedure will deal only with those parts which could normally be expected to be removed without disassembling the basic (riveted) structure. If further disassembly is required, standard shop procedure should be used. For disassembly of removed components, refer to the appropriate paragraph in this manual.

a. Remove control quadrant (22) and linkage.

b. Remove control swivel connectors (5) and push-pull unit (4).

c. Remove rudder trim control chain (19) by disconnecting at master link. Remove sprocket (18) and shaft (17). Remove bearing plate by removing screws and nuts. Removal of remaining rudder trim control components is not recommended.

### Assembly of Control Pedestal. (See figure 3-23.)

Assembly of control pedestal should be accomplished by reversing the disassembly procedures.

### Installation of Control Pedestal. (See figure 3-23.)

a. Work control pedestal carefully into position over control cable (6) and rudder trim control torque tube (16). Lower into place to align holes in pedestal flanges with nutplates in floor, so that torque tube shaft (17) enters into upper end of torque tube (16).

b. Fasten control pedestal to floor with ten screws and to stationary instrument panel (8) with two screws.

c. Insert roll pin through rudder trim control torque tube (16) and shaft (17), and safety wire in place.

### NOTE

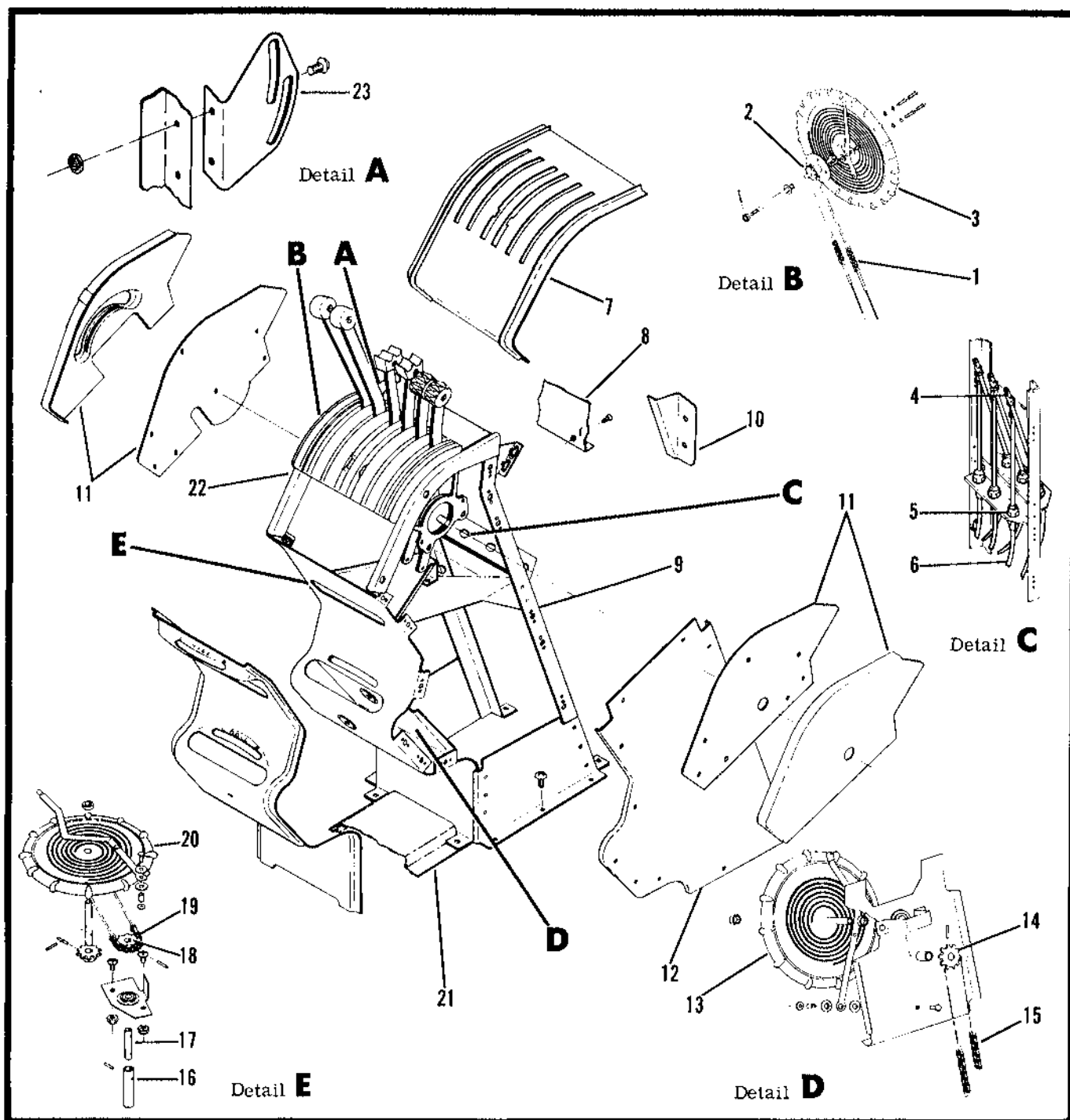
If rudder trim tab position or cable tension has been disturbed while the torque tube was disconnected, it may be necessary to adjust the rigging of the rudder trim control system in accordance with Section 7.

d. Install upper aileron trim control chain (14) and fasten at master link.

### NOTE

If aileron trim tab position or cable tension has been disturbed while chain was disconnected, it may be necessary to adjust the rigging of the aileron trim control system in accordance with Section 5.

e. Install elevator trim control sprocket (2), chain (1), left upper side panel (11) and left center side panel (12).



- |                                   |                                   |
|-----------------------------------|-----------------------------------|
| 1. Elevator Trim Control Chain    | 13. Aileron Trim Control Wheel    |
| 2. Elevator Trim Control Sprocket | 14. Aileron Trim Control Sprocket |
| 3. Elevator Trim Control Wheel    | 15. Aileron Trim Control Chain    |
| 4. Control Push-pull Unit         | 16. Torque Tube                   |
| 5. Swivel                         | 17. Torque Tube Shaft             |
| 6. Control Cable                  | 18. Rudder Trim Control Sprocket  |
| 7. Top Panel                      | 19. Rudder Trim Control Chain     |
| 8. Stationary Instrument Panel    | 20. Rudder Trim Control Wheel     |
| 9. Control Pedestal               | 21. Control Cover                 |
| 10. Alternate Air Control Bracket | 22. Control Quadrant              |
| 11. Upper Side Panel              | 23. Switch Bracket                |
| 12. Center Side Panel             |                                   |

Figure 3-23. Pedestal Installation

## NOTE

If elevator trim tab position or cable tension has been disturbed while chain was disconnected, it may be necessary to adjust the rigging of the elevator trim control system in accordance with Section 6.

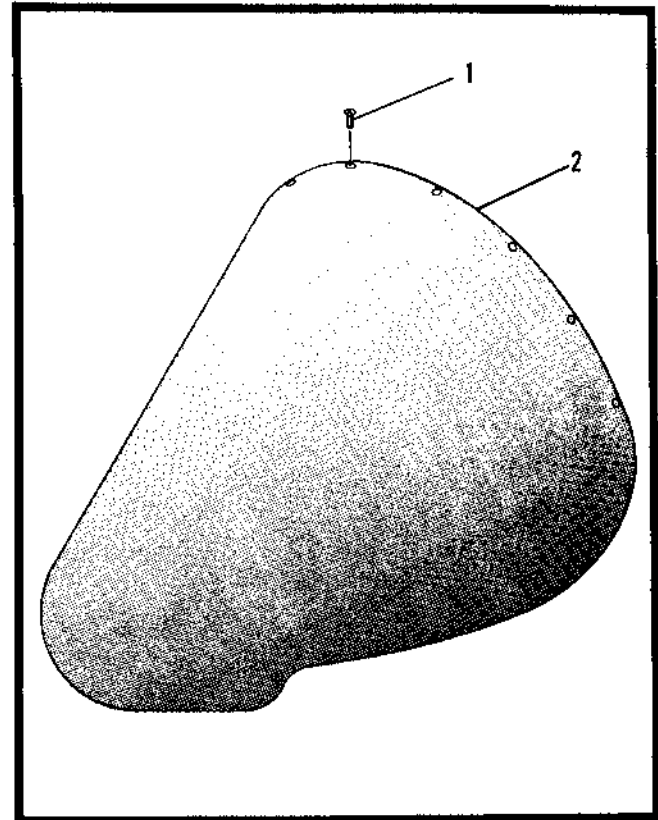
- f. Attach cables (6) in place by tightening the coupling nuts. (Use a suitable thread lubricant on the male threads of all connectors.)
- g. Attach all engine controls in accordance with Section 9.
- h. Rig all engine controls in accordance with Section 9.
- i. Install the right center side panel (12), the right upper side panels (11), and the cover plate (7).
- j. Fasten carpet and floor covering in place and replace control cover (21).
- k. Install front seats.

**Radome.**

The radome is a covering designed to protect the radar antenna from the elements. It is part of the nose section and has certain physical and electrical properties. Physically, the radome must withstand airloads subjected to it and also minimize drag. Electrically, the radome must permit passage of the radar transmitted signals and return echoes with minimum distortion and absorption. In order to do this, it must have a certain electrical thickness and this is related to the physical thickness, operating frequency and type of material and construction. This relationship is defined by a number of complex mathematical equations. These equations show that for given physical properties a radome will have certain electrical thickness for a narrow range of operating frequencies. This is why C-band radomes will not give optimum performance with X-band radar and vice-versa. Also, a very small variation in physical thickness will cause a sizeable variation in electrical thickness. This can mean the difference between an efficient radome and an inefficient radome that can reduce radar range, distort displays and cause inaccurate directions and false targets.

Removal and Installation of Radome. (See figure 3-24.)

- a. Remove screws securing radome to nose structure.
- b. Move radome forward in order to disconnect the glide slope quick-disconnect antenna lead and remove radome from aircraft.
- c. Reverse this procedure for installation.



1. Screw

2. Radome

Figure 3-24. Radome Installation



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## SECTION 4

## LANDING GEAR AND BRAKE SYSTEM

## Table of Contents

|                                                                         | Page |                                                         | Page |
|-------------------------------------------------------------------------|------|---------------------------------------------------------|------|
| LANDING GEAR SYSTEM . . . . .                                           | 4-1  | Installation of Nose Gear Doors . . . . .               | 4-37 |
| Trouble Shooting Landing Gear and Cabin Step . . . . .                  | 4-2  | Rigging of Nose Gear Doors . . . . .                    | 4-37 |
| LANDING GEAR ACTUATOR . . . . .                                         | 4-3  | Removal of Nose Gear Retracting Linkage . . . . .       | 4-37 |
| Removal . . . . .                                                       | 4-3  | Installation of Nose Gear Retracting Linkage . . . . .  | 4-40 |
| Installation . . . . .                                                  | 4-3  | Rigging . . . . .                                       | 4-42 |
| CABIN STEP SYSTEM . . . . .                                             | 4-10 | Removal of Nose Gear Shimmy Dampener . . . . .          | 4-43 |
| Removal . . . . .                                                       | 4-10 | Disassembly of Nose Gear Shimmy Dampener . . . . .      | 4-43 |
| Installation . . . . .                                                  | 4-10 | Assembly of Nose Gear Shimmy Dampener . . . . .         | 4-45 |
| MANUAL EXTENSION SYSTEM . . . . .                                       | 4-10 | Installation of Nose Gear Shimmy Dampener . . . . .     | 4-45 |
| Removal . . . . .                                                       | 4-12 | NOSE GEAR STEERING . . . . .                            | 4-45 |
| Installation . . . . .                                                  | 4-12 | Removal . . . . .                                       | 4-45 |
| MAIN LANDING GEAR . . . . .                                             | 4-14 | Installation . . . . .                                  | 4-47 |
| Removal . . . . .                                                       | 4-14 | Rigging . . . . .                                       | 4-48 |
| Disassembly . . . . .                                                   | 4-14 | NOSE WHEEL AND TIRE . . . . .                           | 4-48 |
| Assembly . . . . .                                                      | 4-17 | Removal and Disassembly . . . . .                       | 4-48 |
| Installation . . . . .                                                  | 4-18 | Assembly and Installation . . . . .                     | 4-48 |
| Removal and Disassembly of Main Gear Torque Link Assemblies . . . . .   | 4-18 | MAIN WHEEL AND TIRE . . . . .                           | 4-49 |
| Assembly and Installation of Main Gear Torque Link Assemblies . . . . . | 4-18 | Removal and Disassembly . . . . .                       | 4-49 |
| Removal of Main Landing Gear Doors . . . . .                            | 4-20 | Assembly and Installation . . . . .                     | 4-49 |
| Installation of Main Landing Gear Doors . . . . .                       | 4-20 | MAIN WHEEL ALIGNMENT . . . . .                          | 4-51 |
| Rigging of Main Landing Gear Doors . . . . .                            | 4-20 | BRAKE SYSTEM - MAIN AND PARKING . . . . .               | 4-51 |
| Removal of Main Landing Gear Retracting Linkage . . . . .               | 4-23 | Trouble Shooting . . . . .                              | 4-51 |
| Installation of Main Landing Gear Retracting Linkage . . . . .          | 4-24 | Removal . . . . .                                       | 4-52 |
| Rigging . . . . .                                                       | 4-24 | Installation . . . . .                                  | 4-54 |
| Adjustment of Landing Gear Safety Switch . . . . .                      | 4-30 | Removal and Disassembly of Main Wheel Brake . . . . .   | 4-56 |
| Adjustment of Landing Gear Warning System . . . . .                     | 4-32 | Assembly and Installation of Main Wheel Brake . . . . . | 4-56 |
| NOSE GEAR . . . . .                                                     | 4-34 | Replacement of Brake Linings . . . . .                  | 4-58 |
| Removal . . . . .                                                       | 4-34 | Bleeding Brake System . . . . .                         | 4-58 |
| Disassembly . . . . .                                                   | 4-34 | Parking Brake System . . . . .                          | 4-58 |
| Assembly . . . . .                                                      | 4-35 | Removal . . . . .                                       | 4-58 |
| Installation . . . . .                                                  | 4-36 | Installation . . . . .                                  | 4-60 |
| Removal and Disassembly of Nose Gear Torque Link Assemblies . . . . .   | 4-36 | Master Cylinder . . . . .                               | 4-60 |
| Assembly and Installation of Nose Gear Torque Link Assemblies . . . . . | 4-36 | Removal . . . . .                                       | 4-61 |
| Removal of Nose Gear Doors . . . . .                                    | 4-36 | Disassembly . . . . .                                   | 4-61 |
|                                                                         |      | Assembly . . . . .                                      | 4-61 |
|                                                                         |      | Installation . . . . .                                  | 4-63 |

## LANDING GEAR SYSTEM.

The fully-retractable tricycle landing gear consists of a main gear located aft of each engine nacelle and a nose gear located near the forward end of the fuselage. Each landing gear is mechanically connected to a single gearbox, which is normally driven by an electric motor. In the event of landing gear electrical system failure, the landing gear can be

extended by operating a hand crank, located at the right side of the pilot's seat, landing gear over-travel during operation is prevented by limit switches which open the electrical circuit to the motor when the correct amount of travel has been attained. A safety switch prevents accidental retraction on the ground by opening the landing gear electrical circuit while the weight of the aircraft is on the landing gear.

## Trouble Shooting Landing Gear and Cabin Step.

| TROUBLE                                                     | PROBABLE CAUSE                                                                 | CORRECTION                                                                                        |
|-------------------------------------------------------------|--------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| LANDING GEAR FAILS TO RETRACT - GEAR MOTOR OPERATES         | Manual extension crank improperly stowed.                                      | Stow crank properly.                                                                              |
|                                                             | Defective landing gear actuator.                                               | Replace actuator.                                                                                 |
|                                                             | Defective reduction unit.                                                      | Replace reduction unit.                                                                           |
|                                                             | Pin sheared on gear motor shaft.                                               | Replace pin.                                                                                      |
|                                                             | Broken bolts or retracting linkage, or disconnected retracting linkage.        | Replace broken parts. Connect linkage if disconnected.                                            |
| LANDING GEAR FAILS TO RETRACT - GEAR MOTOR DOES NOT OPERATE | Circuit breaker out.                                                           | Reset circuit breaker.                                                                            |
|                                                             | Defective circuit breaker.                                                     | Replace circuit breaker.                                                                          |
|                                                             | Insufficient electrical power.                                                 | Recharge batteries. Check voltage regulators.                                                     |
|                                                             | Defective UP limit switch.                                                     | Replace switch. Adjust in accordance with rigging procedures.                                     |
|                                                             | Defective landing gear safety switch.                                          | Replace switch.                                                                                   |
|                                                             | Incorrectly adjusted landing gear safety switch.                               | Adjust safety switch.                                                                             |
|                                                             | Defective landing gear relay.                                                  | Replace relay.                                                                                    |
|                                                             | Defective landing gear switch.                                                 | Replace switch.                                                                                   |
|                                                             | Defective landing gear motor.                                                  | Replace motor.                                                                                    |
|                                                             | Defective UP electrical circuit.                                               | Repair circuit.                                                                                   |
| LANDING GEAR FAILS TO RETRACT COMPLETELY                    | Landing gear incorrectly rigged for retracted position.                        | Rig in accordance with rigging procedures.                                                        |
|                                                             | Circuit breaker out, due to overload caused by incorrect landing gear rigging. | Reset circuit breaker and rig in accordance with rigging procedures.                              |
|                                                             | Circuit breaker out, due to overload caused by defective retracting linkage.   | Reset circuit breaker, replace defective linkage, and rig in accordance with rigging procedures.  |
|                                                             | UP limit switch incorrectly adjusted.                                          | Adjust in accordance with rigging procedures.                                                     |
| LANDING GEAR FAILS TO RETRACT                               | Retracting linkage to affected gear broken or disconnected.                    | Replace broken parts. Connect linkage if disconnected. Rig in accordance with rigging procedures. |
| ONE LANDING GEAR FAILS TO RETRACT COMPLETELY                | Affected landing gear incorrectly rigged for retracted position.               | Rig in accordance with rigging procedures.                                                        |
|                                                             | Defective retracting linkage to affected landing gear.                         | Replace defective linkage and rig in accordance with rigging procedures.                          |
| LANDING GEAR FAILS TO EXTEND- GEAR MOTOR OPERATES           | Manual extension crank improperly stowed.                                      | Stow crank properly.                                                                              |

| TROUBLE                                                    | PROBABLE CAUSE                                                               | CORRECTION                                                                                        |
|------------------------------------------------------------|------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| LANDING GEAR FAILS TO EXTEND - GEAR MOTOR OPERATES (CONT)  | Defective landing gear actuator.                                             | Replace actuator.                                                                                 |
|                                                            | Defective reduction unit.                                                    | Replace reduction unit.                                                                           |
|                                                            | Pin sheared on gear motor shaft.                                             | Replace pin.                                                                                      |
|                                                            | Broken bolts or retracting linkage, or disconnected retracting linkage.      | Replace broken parts. Connect linkage if disconnected.                                            |
| LANDING GEAR FAILS TO EXTEND - GEAR MOTOR DOES NOT OPERATE | Circuit breaker out.                                                         | Reset circuit breaker.                                                                            |
|                                                            | Defective circuit breaker.                                                   | Replace circuit breaker.                                                                          |
|                                                            | Insufficient electrical power.                                               | Recharge batteries. Check voltage regulators.                                                     |
|                                                            | Defective DOWN limit switch.                                                 | Replace switch. Adjust in accordance with rigging procedures.                                     |
|                                                            | Defective landing gear switch.                                               | Replace switch.                                                                                   |
|                                                            | Defective landing gear motor.                                                | Replace motor.                                                                                    |
|                                                            | Defective DOWN electrical circuit.                                           | Repair circuit.                                                                                   |
| LANDING GEAR FAILS TO EXTEND COMPLETELY                    | DOWN limit switch incorrectly adjusted.                                      | Adjust in accordance with rigging procedures.                                                     |
|                                                            | Landing gear incorrectly rigged for the DOWN position.                       | Rig in accordance with rigging procedures.                                                        |
|                                                            | Circuit breaker out, due to overload caused by incorrect rigging.            | Reset circuit breaker and rig in accordance with rigging procedures.                              |
|                                                            | Circuit breaker out, due to overload caused by defective retracting linkage. | Reset circuit breaker, replace defective linkage, and rig in accordance with rigging procedures.  |
| ONE LANDING GEAR FAILS TO EXTEND                           | Retracting linkage to affected gear broken or disconnected.                  | Replace broken parts. Connect linkage if disconnected. Rig in accordance with rigging procedures. |
| ONE LANDING GEAR FAILS TO EXTEND COMPLETELY                | Affected landing gear incorrectly rigged for the DOWN position.              | Rig in accordance with rigging procedures.                                                        |
|                                                            | Defective retracting linkage to affected gear.                               | Replace defective linkage and rig in accordance with rigging procedures.                          |
| MANUAL EXTENSION SYSTEM FAILS TO EXTEND LANDING GEAR       | Manual extension crank not fully engaged.                                    | Engage crank fully.                                                                               |
|                                                            | Incorrect adjustment of manual extension linkage.                            | Adjust linkage in accordance with rigging procedures.                                             |
|                                                            | Defective manual extension linkage.                                          | Replace defective linkage.                                                                        |
|                                                            | Defective landing gear retracting linkage or actuator.                       | Replace defective linkage or actuator.                                                            |
|                                                            | Landing gear improperly rigged.                                              | Rig landing gear in accordance with rigging procedures.                                           |
| GEAR UP (RED) LIGHT FAILS TO LIGHT                         | Circuit breaker out.                                                         | Reset circuit breaker.                                                                            |
|                                                            | Defective circuit breaker.                                                   | Replace circuit breaker.                                                                          |

| TROUBLE                                                                                                                   | PROBABLE CAUSE                                                              | CORRECTION                                                                              |
|---------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| GEAR UP (RED) LIGHT<br>FAILS TO LIGHT (CONT)                                                                              | Lamp burned out.                                                            | Replace lamp.                                                                           |
|                                                                                                                           | Lamp loose.                                                                 | Repair or replace receptacle.                                                           |
|                                                                                                                           | Defective electrical circuit.                                               | Repair circuit.                                                                         |
|                                                                                                                           | Landing gear not fully retracted.                                           | Retract fully.                                                                          |
|                                                                                                                           | Defective or incorrectly adjusted<br>UP limit switch.                       | Replace and/or adjust switch in ac-<br>cordance with rigging procedures.                |
| GEAR UP (RED) LIGHT<br>REMAINS ON WHEN GEAR<br>IS DOWN                                                                    | Defective UP limit switch.                                                  | Replace switch and adjust in accord-<br>ance with rigging procedures.                   |
|                                                                                                                           | Circuit shorted to another system.                                          | Locate and repair.                                                                      |
| GEAR DOWN (GREEN)<br>LIGHT FAILS TO LIGHT                                                                                 | Circuit breaker out.                                                        | Reset circuit breaker.                                                                  |
|                                                                                                                           | Defective circuit breaker or el-<br>ectrical circuit.                       | Replace circuit breaker. Repair de-<br>fective electrical circuit.                      |
|                                                                                                                           | Lamp burned out.                                                            | Replace lamp.                                                                           |
|                                                                                                                           | Lamp loose.                                                                 | Repair or replace receptacle.                                                           |
|                                                                                                                           | Landing gear not fully extended.                                            | Extend fully.                                                                           |
|                                                                                                                           | One or more DOWN indicator switch-<br>es defective or incorrectly adjusted. | Replace defective switches and/or<br>adjust in accordance with rigging<br>procedures.   |
| GEAR DOWN (GREEN)<br>LIGHTS REMAIN ON<br>WHEN GEAR IS UP                                                                  | Circuit shorted to another system.                                          | Locate and repair.                                                                      |
| GEAR DOWN (GREEN)<br>LIGHTS FLICKER WHEN<br>GEAR IS DOWN                                                                  | One or more DOWN indicator switch-<br>es defective or incorrectly adjusted. | Replace defective switches and/or<br>adjust in accordance with rigging pro-<br>cedures. |
|                                                                                                                           | Loose lamp.                                                                 | Repair or replace receptacle.                                                           |
| GEAR WARNING HORN<br>SOUNDS IN FLIGHT WHEN<br>LANDING GEAR IS DOWN<br>AND THROTTLES ARE<br>RETARDED                       | Defective gear DOWN indicator<br>switch.                                    | Replace defective switch and adjust<br>in accordance with rigging proced-<br>ures.      |
| GEAR WARNING HORN<br>SOUNDS IN FLIGHT WHEN<br>LANDING GEAR IS UP<br>AND THROTTLES ARE NOT<br>RETARDED                     | Defective throttle microswitch.                                             | Replace switch and adjust in accord-<br>ance with rigging procedures.                   |
|                                                                                                                           | Incorrectly adjusted throttle micro-<br>switch.                             | Adjust in accordance with rigging<br>procedures.                                        |
| GEAR WARNING HORN<br>SOUNDS ON THE GROUND<br>WHILE LANDING GEAR<br>SWITCH IS DOWN                                         | Incorrectly adjusted gear DOWN in-<br>dicator switch.                       | Adjust switch in accordance with rig-<br>ging procedures.                               |
|                                                                                                                           | Defective gear DOWN indicator switch.                                       | Replace switch and adjust in accord-<br>ance with rigging procedures.                   |
| GEAR WARNING HORN<br>SOUNDS WHEN BATTERY<br>SWITCH IS TURNED ON,<br>OR SOUNDS WHEN AN<br>UNRELATED SYSTEM<br>IS TURNED ON | Circuit shorted to another system.                                          | Locate and repair.                                                                      |
|                                                                                                                           | Incorrectly adjusted gear DOWN in-<br>dicator switch.                       | Adjust switch in accordance with<br>rigging procedures.                                 |

| TROUBLE                                                                                                           | PROBABLE CAUSE                                            | CORRECTION                                                       |
|-------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|------------------------------------------------------------------|
| GEAR WARNING HORN SOUNDS WHEN BATTERY SWITCH IS TURNED ON, OR SOUNDS WHEN AN UNRELATED SYSTEM IS TURNED ON (CONT) | Defective gear DOWN indicator switch.                     | Replace switch and adjust in accordance with rigging procedures. |
| GEAR WARNING HORN FAILS TO SOUND WHEN LANDING GEAR SWITCH IS PLACED UP WHILE ON THE GROUND                        | Circuit breaker out.                                      | Reset circuit breaker.                                           |
|                                                                                                                   | Defective circuit breaker.                                | Replace circuit breaker.                                         |
|                                                                                                                   | Landing gear safety switch incorrectly adjusted.          | Adjust safety switch.                                            |
|                                                                                                                   | Defective landing gear safety switch.                     | Replace switch and adjust safety switch.                         |
|                                                                                                                   | Defective electrical circuit.                             | Repair circuit.                                                  |
|                                                                                                                   | Defective warning horn and flasher unit.                  | Replace horn and flasher unit.                                   |
| GEAR WARNING HORN FAILS TO SOUND IN FLIGHT WHEN LANDING GEAR IS UP AND THROTTLES ARE RETARDED                     | Circuit breaker out.                                      | Reset circuit breaker.                                           |
|                                                                                                                   | Defective circuit breaker.                                | Replace circuit breaker.                                         |
|                                                                                                                   | Defective gear DOWN indicator switch.                     | Replace switch and adjust in accordance with rigging procedures. |
|                                                                                                                   | Defective electrical circuit.                             | Repair circuit.                                                  |
|                                                                                                                   | Defective warning horn.                                   | Replace horn.                                                    |
|                                                                                                                   | Throttle microswitch incorrectly adjusted.                | Adjust in accordance with rigging procedures.                    |
|                                                                                                                   | Defective throttle microswitch.                           | Replace switch and adjust in accordance with rigging procedures. |
| LANDING GEAR DOORS FAIL TO OPERATE PROPERLY                                                                       | Doors incorrectly rigged.                                 | Rig doors in accordance with rigging procedures.                 |
|                                                                                                                   | Defective door operating linkage.                         | Replace defective linkage.                                       |
| LANDING GEAR SHIMMIES DURING FAST TAXI, TAKE-OFF, OR LANDING                                                      | Insufficient fluid in shimmy dampener.                    | Service shimmy dampeners in accordance with Section 2.           |
|                                                                                                                   | Internal leakage in shimmy dampener.                      | Replace defective seats and/or piston.                           |
|                                                                                                                   | Roll pin attaching piston to piston rod sheared.          | Replace roll pin.                                                |
|                                                                                                                   | Shimmy dampener loose at mounting.                        | Replace worn housing and/or attaching bolt.                      |
|                                                                                                                   | Tires out of balance.                                     | Replace tires with tread worn unevenly or flat spots.            |
|                                                                                                                   | Worn or loose wheel bearings.                             | Replace and/or adjust wheel bearings.                            |
|                                                                                                                   | Excessive clearance between upper and lower torque links. | Adjust clearance in accordance with alignment procedure.         |

| TROUBLE                                                           | PROBABLE CAUSE                                            | CORRECTION                                                                                                              |
|-------------------------------------------------------------------|-----------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| LANDING GEAR SHIMMIES DURING FAST TAXI, TAKEOFF OR LANDING (CONT) | Worn torque link bushings.                                | Replace bushings.                                                                                                       |
| EXCESSIVE OR UNEVEN WEAR ON TIRES                                 | Incorrect operating pressure.                             | Inflate to correct pressure.                                                                                            |
|                                                                   | Incorrect wheel alignment.                                | Align in accordance with alignment procedure.                                                                           |
|                                                                   | Wear resulting from shimmy.                               | See the preceding corrections for shimmy.                                                                               |
| NOSE GEAR FAILS TO STEER PROPERLY                                 | Incorrect rigging of nose gear steering system.           | Rig in accordance with nose gear steering procedure.                                                                    |
|                                                                   | One brake dragging.                                       | Determine cause and correct.                                                                                            |
|                                                                   | Steering cam roller sheared at the top of the nose strut. | Replace defective assembly.                                                                                             |
|                                                                   | Defective nose gear steering springs.                     | Replace springs.                                                                                                        |
| NOSE GEAR FAILS TO STRAIGHTEN WHEN LANDING GEAR EXTENDS           | Steering cam roller sheared at the top of the nose strut. | Replace defective assembly.                                                                                             |
|                                                                   | Incorrect rigging of nose gear steering system.           | Rig in accordance with nose gear steering procedure.                                                                    |
| NOSE GEAR FAILS TO STRAIGHTEN WHEN LANDING GEAR RETRACTS          | Centering cam follower sheared at steering yoke support.  | Replace defective assembly.                                                                                             |
| ATTITUDE OF AIRCRAFT ON GROUND IS INCORRECT                       | Landing gear struts incorrectly inflated.                 | Inflate struts correctly.                                                                                               |
| STRUT BOTTOMS ON NORMAL LANDING OR TAXIING ON ROUGH GROUND        | Insufficient air and/or fluid in strut.                   | Service strut with proper amount of fluid and air.                                                                      |
|                                                                   | Defective internal parts in strut.                        | Replace defective parts.                                                                                                |
| STRUT DEFLATED WITH EVIDENCE OF FLUID LEAKAGE                     | Defective O-rings.                                        | Determine which O-rings are defective and replace.                                                                      |
| CABIN STEP DOES NOT RETRACT                                       | Broken cable.                                             | Replace cable.                                                                                                          |
|                                                                   | Cable off pulley at landing gear actuator.                | Place cable in pulley track. Check operation.                                                                           |
|                                                                   | Cable disconnected.                                       | Connect and check cable as described in installation of cabin step system.                                              |
| CABIN STEP DOES NOT EXTEND                                        | Cable off pulley track and binding.                       | Place cable in pulley track. Check pulley for freedom of operation. Check that pulley cable retaining pin is installed. |
|                                                                   | Step assembly binding.                                    | Retract and extend cabin step by hand to locate source of binding.                                                      |
| CABIN STEP DOES NOT FULLY RETRACT                                 | Improperly rigged.                                        | Rig in accordance with installation of cabin step system.                                                               |

| TROUBLE                                  | PROBABLE CAUSE          | CORRECTION                                                                                                              |
|------------------------------------------|-------------------------|-------------------------------------------------------------------------------------------------------------------------|
| CABIN STEP DOES NOT FULLY RETRACT (CONT) | Cable off pulley track. | Place cable in pulley track. Check pulley for freedom of operation. Check that pulley cable retaining pin is installed. |
| CABIN STEP DOES NOT FULLY EXTEND         | Improperly rigged.      | Rig in accordance with installation of cabin step system.                                                               |

### LANDING GEAR ACTUATOR.

The landing gear actuator consists of an electric motor, a reduction unit and a worm-and-sector assembly. The actuator is normally operated by the electric motor; however, linkage is provided to disengage the motor-driven reduction unit and engage the manual extension system, which linked directly to the actuator worm gear. The bellcrank that operates the main landing gear drive tubes is attached to the upper end of the sector shaft, which extends vertically through the actuator assembly, and the bellcrank that operates the nose gear drive tube is attached to the lower end of the sector shaft. Adjustable limit switches are provided so that correct landing gear travel can be obtained.

Removal of Landing Gear Actuator. (See figure 4-1.)

- Jack the aircraft in accordance with Section 2.
- Remove the carpet in accordance with Section 3.
- Remove the floorboards between front and rear spar, and access hole cover from underside of fuselage beneath landing gear actuator.

#### NOTE

Disconnect aircraft battery terminals to prevent accidental electrical operation of gear during disassembly procedures.

- (See figure 4-6.) Engage manual extension crank and operate toward the UP position until the main gear doors open sufficiently to disconnect link (3) from door (6) by removing nut, washer, spacers and bolt.
- (See figure 4-7.) Disconnect the inboard LH drive tube (35) and the intermediate drive tube (40) from idler bellcranks (7) by removing nuts, spacers and bolts. For ease of bolt removal, support the wheel by hand to remove shear load from bolt. After bolt is removed, gently lower gear to its free fall or extended position.
- Engage manual extension crank and operate toward the UP position until nose gear drive tube attaching bolt (43) is accessible through lower access hole. Support nose gear while removing cotter pin, nut, washer and bolt (43). Gently lower nose gear to its free fall or extended position.
- Engage manual extension crank and operate toward the DOWN position until the upper bellcrank is in approximately a lateral position.
- Remove nut, washer, caps (6 and 47) and bolt attaching upper and lower bellcrank to the sector shaft.

- (See figure 4-7.) Disconnect RH inboard drive tube (43) from idler (46) by removing nut, washer, spacers and bolt.
- Lift upper bellcrank (5) enough to clear sector shaft. Remove upper bellcrank, RH inboard drive tube (54) and LH inboard drive tube (11) as a unit by pulling inboard until LH tube clears fuselage skin.
- Remove lower bellcrank (50) and pulley (44) as a unit from sector shaft, leaving step connected.
- Disconnect manual extension disengage rod (32) by removing cotter pin and pin.
- Disconnect manual extension drive tubes by removing three cotter pins, washers and pins. To disconnect, slide outer shaft (31) aft and inner shaft (30) forward.
- Remove safety wire from all bolts which must be removed.
- Remove four bolts and washers attaching reduction unit (3) and actuator assembly (18) to bulkhead (4).

#### NOTE

To remove reduction unit (3) or motor (1) from aircraft, remove four bolts. When removing motor, disconnect and tag the electrical wires at the relays to insure proper placement on reinstallation.

- Remove four nuts, washers and bolts attaching switch brackets (16 and 33) to actuator assembly. Do not disturb switch adjustment except to replace switches or brackets.
- Remove remaining nuts, washers and bolts attaching actuator assembly (18) to mounting channel.
- Remove bolts and washers attaching actuator assembly (18) to forward mounting bracket (25).
- Remove bolts, washers and spacer (55) attaching actuator assembly (18) to bulkhead (4).
- Lift actuator assembly (18) vertically and remove from aircraft.

Installation of Landing Gear Actuator. (See figure 4-1.)

- Position actuator assembly being sure that lower bellcrank (50) and pulley (44) is positioned so as not to cause damage to lower skin. Install spacer (53) and lower bellcrank (50) on lower end of sector shaft. Outer shaft (31) and inner shaft (30) must be in place before positioning actuator.



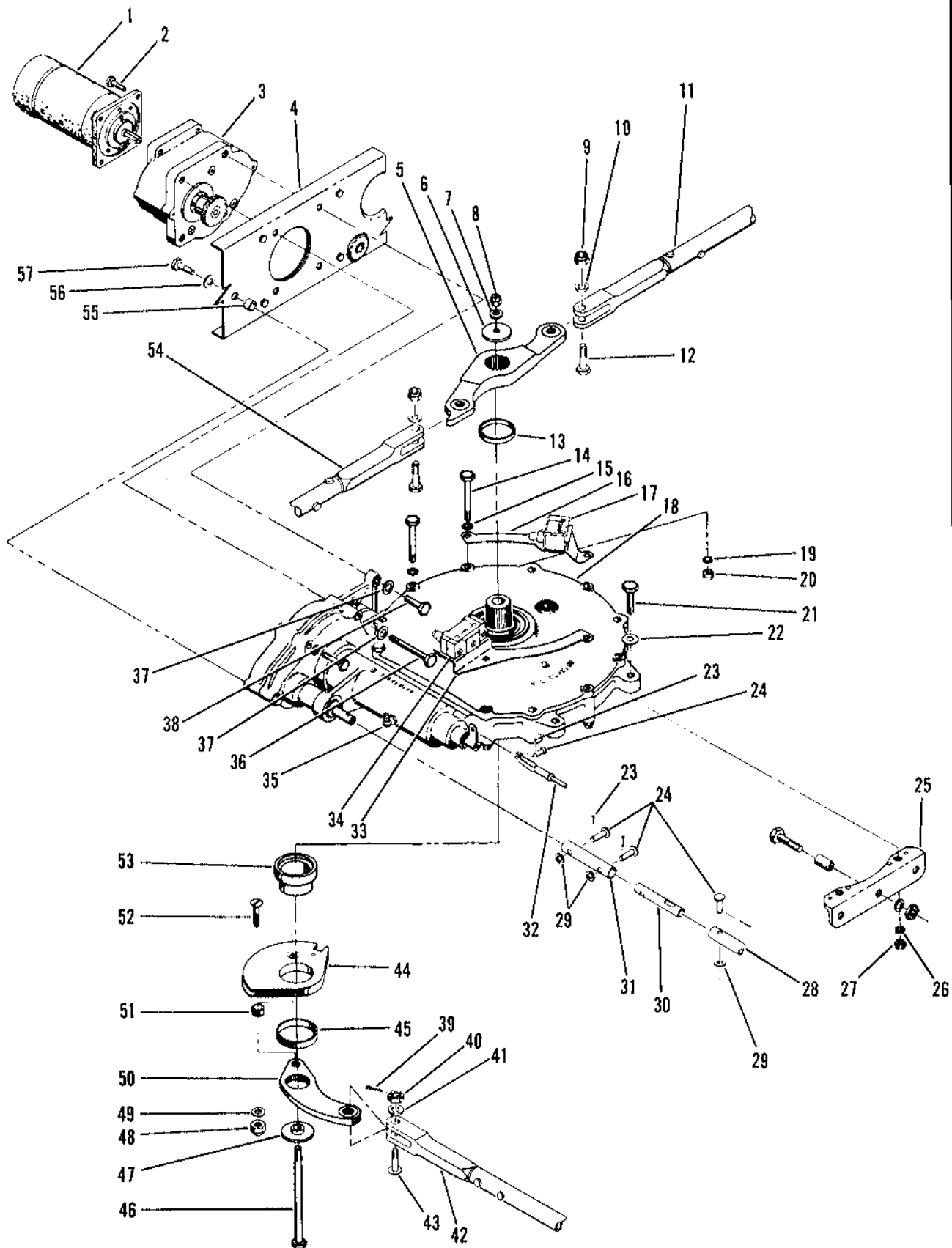


Figure 4-1. Landing Gear Actuator

Figure 4-1. Landing Gear Actuator Callouts

|                           |                                    |                           |
|---------------------------|------------------------------------|---------------------------|
| 1. Landing Gear Motor     | 20. Nut                            | 39. Cotter Pin            |
| 2. Bolt                   | 21. Bolt                           | 40. Nut                   |
| 3. Reduction Unit         | 22. Washer                         | 41. Washer                |
| 4. Bulkhead               | 23. Cotter Pin                     | 42. Nose Gear Drive Tube  |
| 5. Upper Bellcrank        | 24. Pin                            | 43. Bolt                  |
| 6. Cap                    | 25. Mounting Bracket               | 44. Pulley                |
| 7. Washer                 | 26. Washer                         | 45. Spacer                |
| 8. Nut                    | 27. Nut                            | 46. Bolt                  |
| 9. Nut                    | 28. Gear Shaft                     | 47. Cap                   |
| 10. Washer                | 29. Washer                         | 48. Nut                   |
| 11. LH Inboard Drive Tube | 30. Inner Shaft                    | 49. Washer                |
| 12. Bolt                  | 31. Outer Shaft                    | 50. Lower Bellcrank       |
| 13. Spacer                | 32. Manual Extension Disengage Rod | 51. Spacer                |
| 14. Bolt                  | 33. Switch Bracket                 | 52. Screw                 |
| 15. Washer                | 34. Down Limit Switch              | 53. Spacer                |
| 16. Switch Bracket        | 35. Grease Fitting                 | 54. RH Inboard Drive Tube |
| 17. Up Limit Switch       | 36. Bolt                           | 55. Spacer                |
| 18. Actuator Assembly     | 37. Washer                         | 56. Washer                |
| 19. Washer                | 38. Bolt                           | 57. Bolt                  |

## NOTE

Support entrance step in retracted position to facilitate installation of lower bellcrank and pulley. When installing lower bellcrank, align the index punch mark on the bellcrank with the chamfered spline on the sector shaft.

- b. Install spacer (55), washer and bolt attaching actuator assembly (18) to bulkhead (4).

## NOTE

To facilitate installation, install all actuator assembly (18) attaching bolts before any are tightened.

- c. Install two bolts and washers attaching actuator assembly (18) to forward mounting bracket (25).  
d. Install switch bracket (16 and 33) with bolts, nuts and washers.

## CAUTION

Check switches thoroughly for proper operation. A faulty switch may cause damage to landing gear actuator.

- e. Install bolt, washer and nut attaching actuator assembly (18) to mounting channel.

## NOTE

Use AN960-10L washers to shim as required between actuator and two mounting channels.

- f. Install four bolts and washers attaching actuator assembly (18) and reduction unit (3) to bulkhead (4).

## NOTE

Shim as required between reduction unit (3) and bulkhead (4) to align reduction unit

gear with the drive gear in the actuator.

- g. If removed, install four bolts attaching motor (1) to reduction unit (3).  
h. If motor was removed, connect the electrical wires at the appropriate relay as previously marked.  
i. Tighten all nuts and bolts which were installed but not tightened.  
j. Safety bolts attaching motor (1) to reduction unit (3).  
k. Safety bolts attaching actuator to bulkhead (4).  
l. Connect manual extension drive tubes with pins, washers and cotter pins.  
m. Connect manual extension disengage rod (32) with pin and cotter pin.  
n. Insert LH inboard drive tube (11) through opening in fuselage skin until upper bellcrank (5) is in position to be installed on sector shaft with the threaded portion of bolts (12) in the UP position.

## NOTE

If inboard drive tubes were disconnected from upper bellcrank, insure that bow in end fittings is properly positioned.

- o. Place spacer (13) and upper bellcrank (5) on sector shaft.

## NOTE

When installing upper or lower bellcrank, align the index punch mark on the bellcrank with the chamfered spline on the sector shaft.

- p. Insure that lower bellcrank (50) and spacer (45) are correctly in place and install bolt, caps (6 and 47), washer and nut.  
q. (See figure 4-7.) Connect RH inboard drive tube (43) and intermediate drive tube (40) to idler (46) by installing spacers, bolts washer and nut.  
r. (See figure 4-7.) Connect LH inboard drive

tube (35) and intermediate drive tube (40) to idler bellcranks (7) with bolts, spacers and nuts.

s. Connect forward push-pull tube (42) to lower bellcrank (50) with bolt, washer, nut and cotter pin.

t. (See figure 4-6.) Connect main gear doors (6) to links (3) with bolt, spacer, washer and nut.

u. Connect battery terminals.

v. Perform an operational check of landing gear, checking especially that limit switches are correctly adjusted and landing gear is correctly rigged. Refer to landing gear rigging procedures.

w. Install access hole covers on cabin floor and underside of fuselage, beneath landing gear actuator.

x. Install the carpet in accordance with Section 3.

y. Insure that landing gear is DOWN, then remove jacks.

#### CABIN STEP SYSTEM.

During retraction of the landing gear, a cable connected to the landing gear actuator retracts the cabin step into a well provided for it in the bottom right side of the fuselage. During extension of the landing gear, spring tension forces the step to extend. Extension and retraction are simultaneous with landing gear operation.

#### Removal of Cabin Step System. (See figure 4-2.)

a. Remove the rear seats and center and rear carpet in accordance with Section 3.

b. Remove the two access covers between the front and rear spars, also the three access covers aft of the rear spar, in accordance with Section 1.

c. Remove skin access cover from below landing gear actuator.

d. Disconnect cable at turnbuckle (36).

e. Disconnect cable from spring bail (35) by removing spring bail.

f. Remove cable (13) from pulley by removing cotter pin, washer, pin and clamp.

g. Remove cable (13) from aircraft.

h. Disconnect cable (31) from arm (22) by removing cotter pin and pin.

i. Remove cable (31) from aircraft.

j. Remove cabin step assembly from aircraft, being careful to disengage spring (23) from step support (32) when bolt, washer and nut are removed.

k. Location and parts necessary for disassembly or assembly of the cabin step assembly and pulley are clearly shown in figure 4-2.

l. For removal of pulley (12) from landing gear actuator, refer to "Removal of Landing Gear Actuator."

#### Installation of Cabin Step System. (See figure 4-2.)

a. Place bail at end of cable (13) just outside of the pulley track (12) and with the cable (13) in the pulley, install clip and secure with pin, washer and cotter pin.

b. Route cable (13) aft through pulley (3) and attach spring bail (35).

c. Make certain that cotter pins are installed in

pulley bracket (4) to prevent the cable from leaving the pulley track.

d. Attach the short cable between the turnbuckle (36) and the spring bail (35).

e. Attach the cable (31) to arm (22) by installing pin and cotter pin.

f. Before installing step assembly, make certain that spacer (24) is installed.

g. Install spring (23) on step assembly. Preload spring 160°.

h. Place step assembly, with spring (23) installed into step support (32) and install bolt, washer and nut.

i. Route cable (31) through pulley (16).

j. Make certain that cotter pins are installed in pulley bracket (17) to prevent the cable from leaving the pulley track.

k. Raise the cabin step by hand and note that the spring (23) returns the cabin step to the extended position.

l. Raise the cabin step by hand to provide slack in cable (31) and install turnbuckle (36).

m. After turnbuckle (36) is installed, then return step to its extended position.

n. Adjust the turnbuckle (36) to place tension on the cable until just a small amount of light may be seen between the step assembly and step stop.

o. Check the cabin step installation as follows:

1. Jack aircraft in accordance with Section 2.
2. Raise the cabin step into the fuselage well by hand to make certain there are no obstructions.
3. Retract landing gear using normal retraction system

#### NOTE

Use of an external power source is advisable to prevent draining battery power.

4. Note that the cabin step retracts fully into the step well.

5. Using a spring scale, it should require approximately 4 to 6 pounds pressure to move the cabin step downward a short distance.

6. Safety turnbuckle.

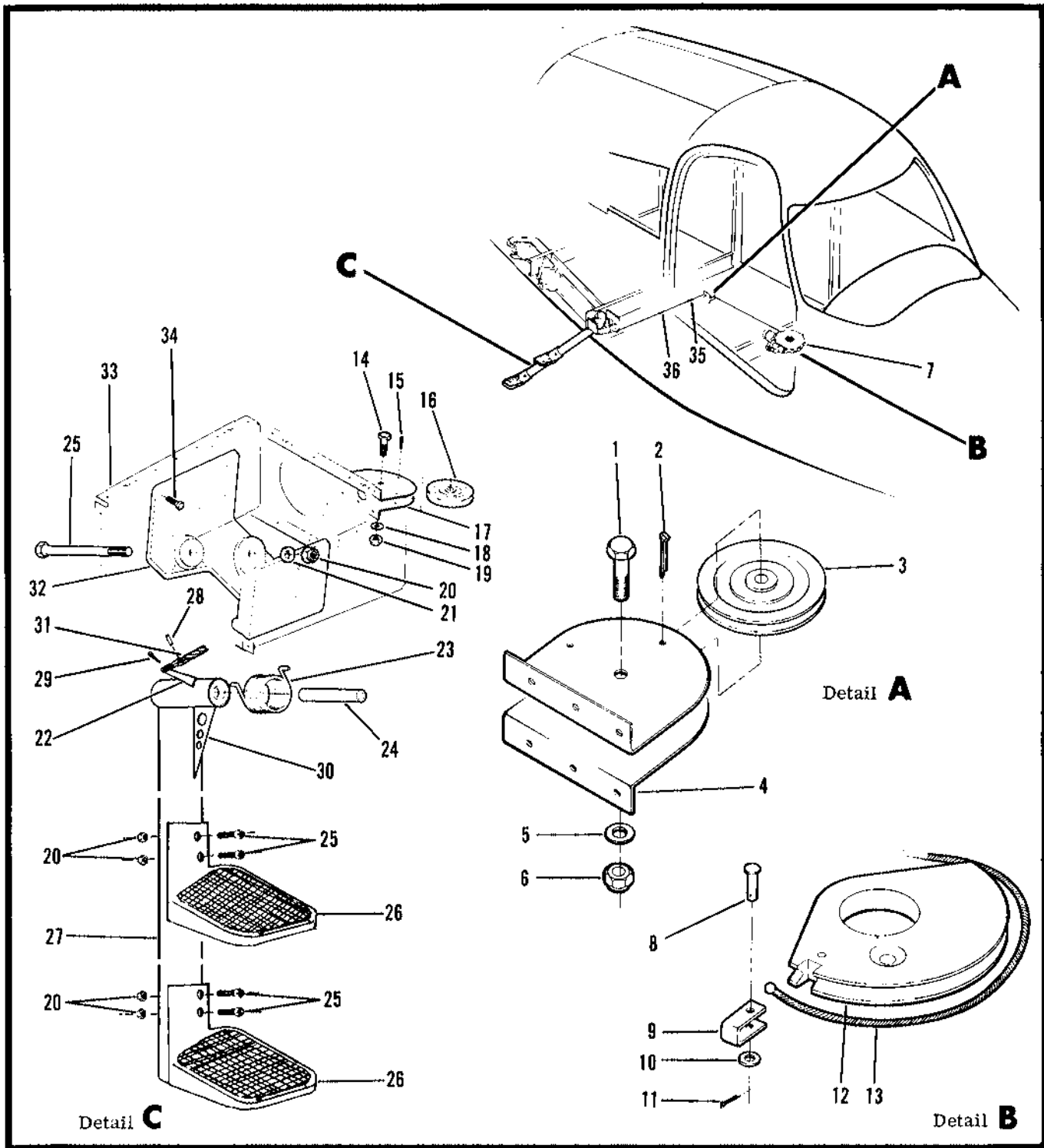
7. Insure that landing gear is down and remove jacks.

p. Install the floorboard access covers and skin access cover in accordance with Section 1.

q. Install the center and rear carpets and the rear seats in accordance with Section 3.

#### MANUAL EXTENSION SYSTEM.

The manual extension system consists of a hand crank, which is connected to the landing gear actuator by an arrangement of chain and sprockets, bellcrank, miter gears, and push-pull rods. The hand crank located at the right of the pilot's seat is normally in a stowed position. When unfolded into its operation position the hand crank disengages the normal landing gear operating system, and allows the gear to be operated manually. A spring loaded release button is provided to unlock the hand crank so that it may be unfolded and stowed.



- |                          |                    |            |                        |
|--------------------------|--------------------|------------|------------------------|
| 1. Bolt                  | 10. Washer         | 19. Nut    | 28. Pin                |
| 2. Cotter Pin            | 11. Cotter Pin     | 20. Nut    | 29. Cotter Pin         |
| 3. Pulley                | 12. Pulley Track   | 21. Washer | 30. Web                |
| 4. Pulley Bracket        | 13. Cable          | 22. Arm    | 31. Cable              |
| 5. Washer                | 14. Bolt           | 23. Spring | 32. Step Support       |
| 6. Nut                   | 15. Cotter Pin     | 24. Spacer | 33. Fuselage Structure |
| 7. Landing Gear Actuator | 16. Pulley         | 25. Bolt   | 34. Bolt               |
| 8. Pin                   | 17. Pulley Bracket | 26. Step   | 35. Spring Bail        |
| 9. Clamp                 | 18. Washer         | 27. Tube   | 36. Turnbuckle         |

Figure 4-2. Cabin Step System

Removal of Manual Extension System. (See figure 4-3.)

- a. Remove pilot's seat and center carpet in accordance with Section 3.
- b. Remove floorboards between front and rear spar, above landing gear actuator.
- c. Remove chain guards by removing attaching screws.
- d. Remove chain (12) by disconnecting at the master link.
- e. Remove crank handle and shaft assembly as follows:
  1. Remove roll pin, collar (1) and washer (2) from shaft (6).
  2. Remove cotter pin and pin attaching spool (4) to shaft (6).
  3. Pull crank handle and shaft from supports, removing spool (4) as shaft is pulled through it.
  - f. If desired, disassemble crank handle and shaft by removing nut, bolt, cotter pins and pins.
  - g. Remove upper rod assembly (16) by removing cotter pins, washers and pins attaching rod assembly to bellcranks (15 and 17).
  - h. Remove upper bellcrank (15) by removing nut, washers and bolt. Remove bushing (14) from bellcrank.
  - i. Remove lower rod assembly (18) by removing cotter pins, washer and pins attaching rod assembly to lower bellcrank and landing gear actuator.
  - j. Remove lower bellcrank (17) by removing nut, washer, spacer and bolt.
  - k. Remove chain tightener (11) by removing attaching screw and washer, and adjusting screw, washers and nut.
  - l. Remove gear support bracket (21) as follows:
    1. Disconnect shafts (27, 28 and 29) by removing the three cotter pins, washers and pins.
    2. Slide outer shaft (29) aft and inner shaft (28) forward to disconnect.
    3. Remove two bolts and nuts attaching gear support bracket to front spar.
    4. Remove two screws, washers and nuts attaching gear support bracket to bottom of fuselage.
  - m. If desired, disassemble gear support bracket as follows:
    1. Remove three roll pins attaching sprocket (23) and gears (24 and 26) to gear shafts (22 and 27).
    2. Remove snap ring (25) from gear shaft (22).
    3. Remove gear shaft (22) through the left side of the bracket, removing sprocket (23) and gear (24) as shaft is removed.
    4. Remove gear (26) and shaft (27) from gear sup-

port bracket.

#### NOTE

The bearings in which the gear shafts rotate are a press fit and should be removed only for replacement.

Installation of Manual Extension System. (See figure 4-3.)

- a. If disassembled, assembly gear support bracket (21) as follows:
  1. If removed, press bearings into gear support bracket.
  2. Assemble gear (26) to shaft (27) with attaching roll pin, and insert into position in gear support bracket.
  3. Insert shaft (22) through the left side of gear support bracket, through sprocket (23) and gear (24). Install two roll pins attaching sprocket and gear to shaft, and safety all three roll pins.
  4. Install snap ring (25) on gear shaft (22).
- b. Install gear support bracket (21) as follows:
  1. Place outer shaft (29) on actuator shaft (30) and slide aft.
  2. Insert inner shaft (28) into gear shaft (27) and slide forward.
  3. Position gear support bracket in aircraft and attach to fuselage bottom with two screws, washers and nuts.
  4. Install two bolts and nuts attaching gear support bracket to front spar.
  5. Align the holes in the shafts connecting miter gear assembly to landing gear actuator, and install pins, washers and cotter pins.
- c. Install chain tightener (11) with attaching screw and washer. Install adjusting screw, washers and nut, but do not tighten at this time.
- d. Install lower bellcrank (17) with bolt, spacer (20), washer and nut.
- e. Insert bushing (14) into upper bellcrank (15) and install bellcrank with bolt, washers and nut.
- f. If disassembled, reassemble crank handle and shaft with pins, cotter pins, nut and bolt.
- g. Install crank handle and shaft assembly as follows:
  1. Insert crank handle and shaft through inboard support (5), spool (4), and outboard support (3).
  2. Engage upper bellcrank (15) with spool (4), align spool attaching holes, and install pin and cotter pin.
  3. Place washer (2) and collar (1) on shaft (6), in-

Figure 4-3. Manual Extension System Callouts

- |                     |                           |                          |
|---------------------|---------------------------|--------------------------|
| 1. Collar           | 11. Chain Tightener       | 21. Gear Support Bracket |
| 2. Washer           | 12. Chain                 | 22. Gear Shaft           |
| 3. Outboard Support | 13. Bracket               | 23. Sprocket             |
| 4. Spool            | 14. Bushing               | 24. Gear                 |
| 5. Inboard Support  | 15. Upper Bellcrank       | 25. Snap Ring            |
| 6. Shaft            | 16. Upper Rod Assembly    | 26. Gear                 |
| 7. Sprocket         | 17. Lower Bellcrank       | 27. Gear Shaft           |
| 8. Spool Link       | 18. Lower Rod Assembly    | 28. Inner Shaft          |
| 9. Crank Link       | 19. Landing Gear Actuator | 29. Outer Shaft          |
| 10. Crank           | 20. Spacer                | 30. Actuator Shaft       |

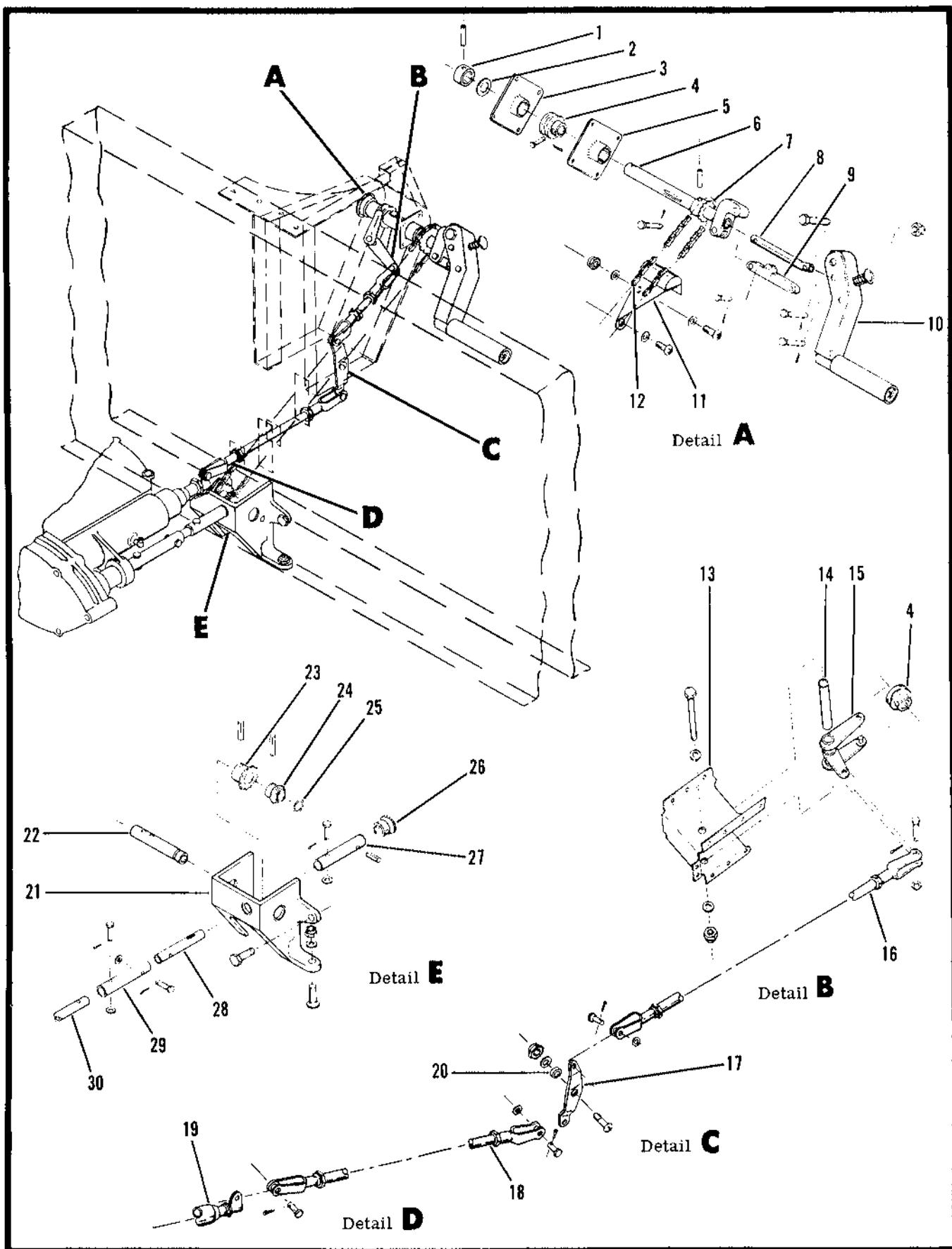


Figure 4-3. Manual Extension System

stall roll pin and safety.

#### NOTE

Washer (2) is used as required to eliminate end play from the shaft assembly.

h. Install chain (12) on sprockets (7 and 23) and connect with master link. Adjust chain tightener (11), and tighten adjusting screw and nut.

i. Attach lower rod assembly (18) to lower bellcrank (17) and landing gear actuator (19) with pins, washers and cotter pins.

j. Attach upper rod assembly (16) to bellcranks (15 and 17) with pins, washers and cotter pins.

k. If length of upper or lower rod assembly has been changed, adjust as follows:

1. Place hand crank in operating position.

2. Adjust lower rod assembly (18) to a length of approximately 4.80 inches, measured between the center lines of rod end bolt holes, and install.

3. Pull lower rod assembly forward until internal gear in landing gear actuator reaches the end of its travel, and adjust upper rod assembly (16) so that rod end bolt holes align with holes in upper and lower bellcranks (15 and 17).

4. Lengthen upper rod assembly (16) one-half turn and install.

#### NOTE

If the upper rod assembly adjustment cannot be obtained because an excessive amount of threads would be exposed, readjust the lower rod assembly to obtain the desired result, and repeat step "3 and 4".

1. Perform an operational check to see that manual extension system functions properly.

#### CAUTION

Do not use the manual extension system to fully retract the landing gear, except when manually pushing upward on all landing gear to relieve strain on manual extension system.

m. Install chain guards with attaching screws.

n. Install access covers on cabin floor above landing gear actuator.

o. Install center carpet and pilot's seat in accordance with Section 3.

#### MAIN LANDING GEAR.

Removal of Main Landing Gear. (See figure 4-4.)

a. Jack the aircraft in accordance with Section 2.

b. Drain brake system by removing bleeder plug.

c. Disconnect brake hose at forward wheel well bulkhead union. Plug hose and cap fitting to prevent entry of foreign matter.

d. Remove safety switch (1) and down indicator switch (20) by removing attaching nuts and screws.

e. Remove clamps and tie switches where they will not interfere with gear removal.

f. Release tension on retracting linkage by engaging manual extension crank and operating a few turns toward the UP position.

g. Disconnect main landing gear doors.

h. Disconnect retracting linkage as follows:

1. Disconnect outboard push-pull tube (18) from bellcrank (15) by removing nut, washers and bolt.

2. Disconnect upper side link from lower side link by removing nut, washer and bolt.

i. Remove roll pins (13) from attaching shafts (11), and insert AN6 bolt or puller tool.

j. Support gear and pull attaching shafts (11).

#### NOTE

Needle bearings, in which the attaching shafts pivot, are a press fit and should be removed only for replacement. Bearings must be removed by driving them toward the wheel well.

#### CAUTION

NOTE the amount of thickness of washers removed. These washers should be installed exactly as they were located before removal to insure proper alignment of side link assembly.

Disassembly of Main Landing Gear. (See figure 4-5.)

a. Completely deflate strut, and after all the air has

Figure 4-4. Main Landing Gear Installation Callouts

- |                               |                             |
|-------------------------------|-----------------------------|
| 1. Landing Gear Safety Switch | 14. Bolt                    |
| 2. Screw                      | 15. Bellcrank               |
| 3. Bracket                    | 16. Washer                  |
| 4. Screw                      | 17. Nut                     |
| 5. Washer                     | 18. Outboard Push-Pull Tube |
| 6. Nut                        | 19. Spacer                  |
| 7. Nut                        | 20. Down Indicator Switch   |
| 8. Landing Gear Support       | 21. Spacer                  |
| 9. Bearing                    | 22. Screw                   |
| 10. Washer                    | 23. Side Lock Link          |
| 11. Attaching Shaft           | 24. Bracket                 |
| 12. Truss Assembly            | 25. Nut                     |
| 13. Roll Pin                  |                             |

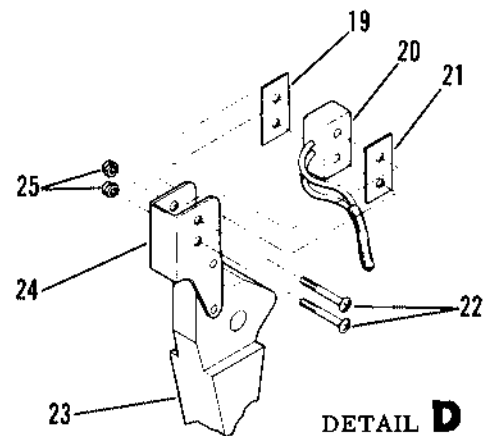
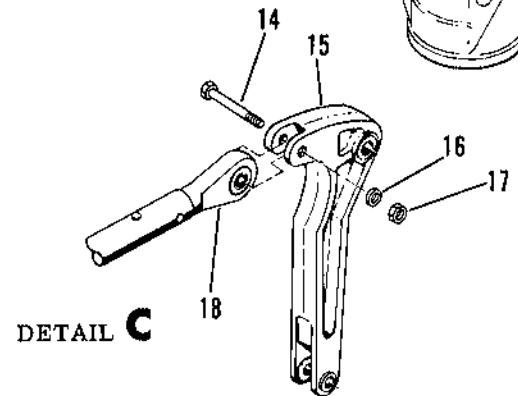
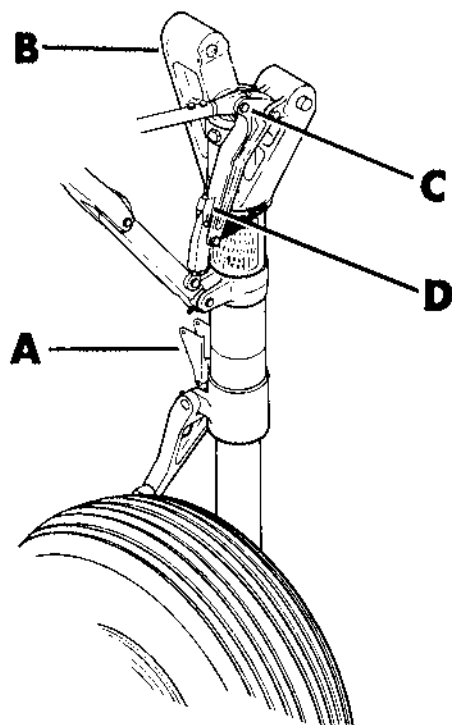
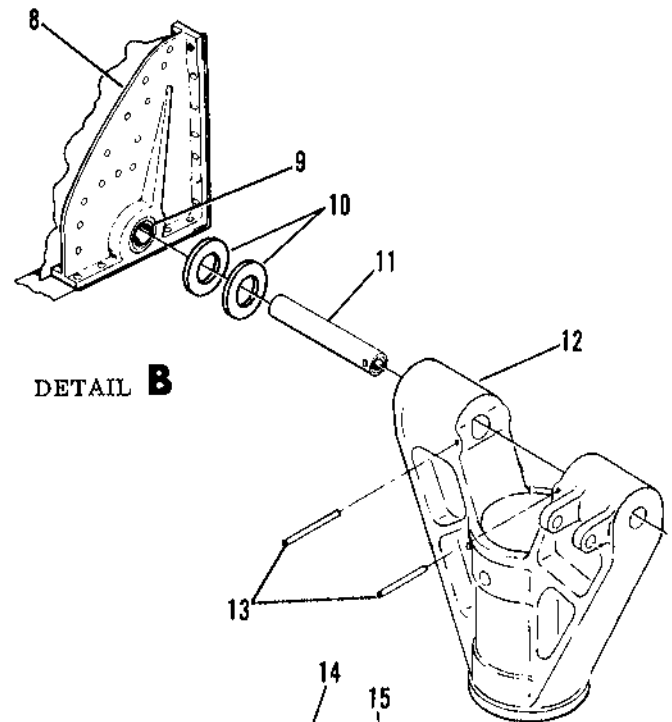
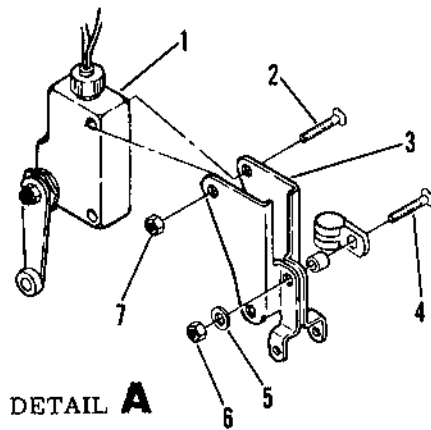


Figure 4-4. Main Landing Gear Installation



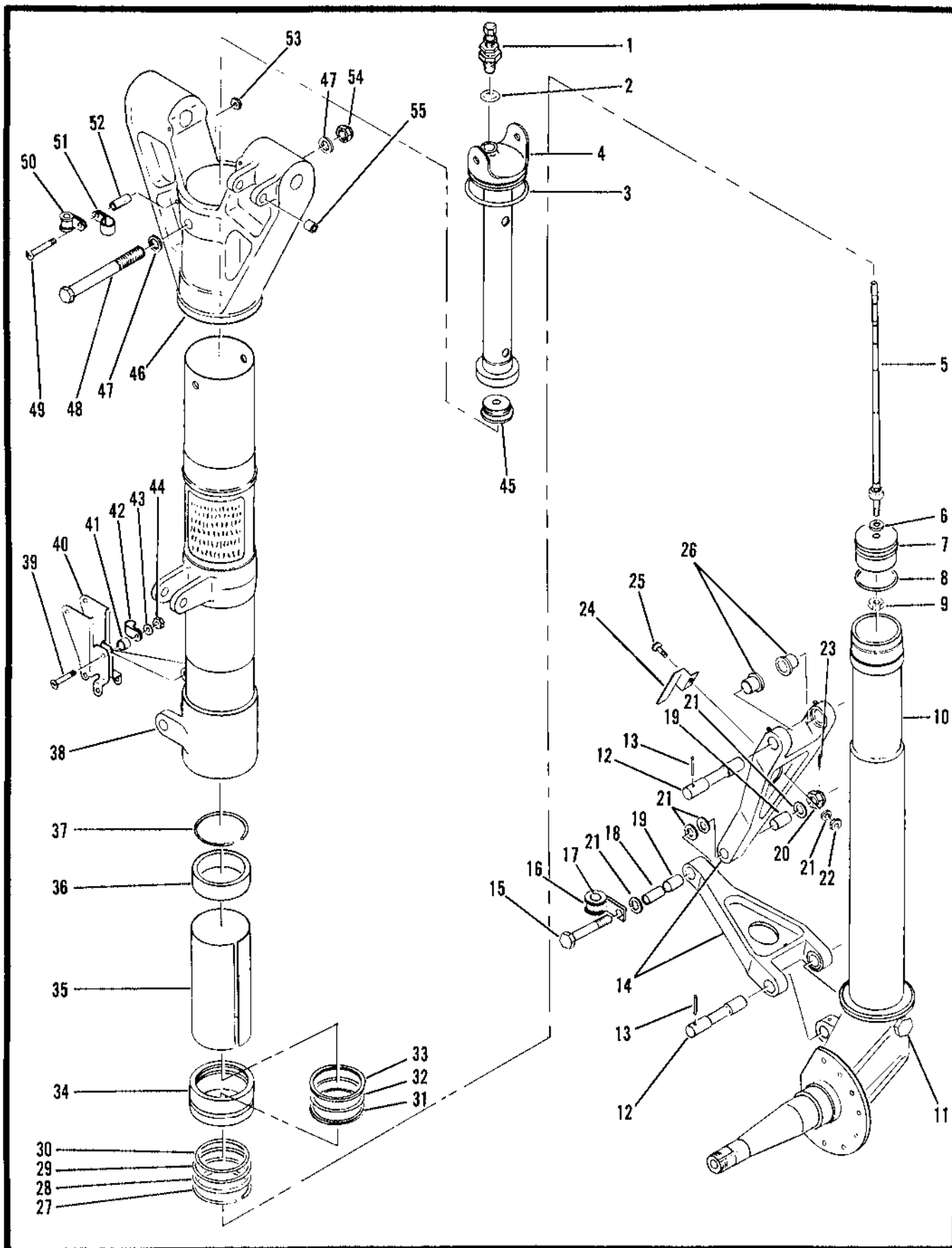


Figure 4-5. Main Landing Gear Strut

Figure 4-5. Main Landing Gear Strut Callouts

|                          |                        |                     |
|--------------------------|------------------------|---------------------|
| 1. Valve Body            | 20. Nut                | 38. Barrel Assembly |
| 2. Packing               | 21. Washer             | 39. Screw           |
| 3. "O" Ring              | 22. Nut                | 40. Switch Bracket  |
| 4. Orifice Tube Assembly | 23. Cotter Pin         | 41. Spacer          |
| 5. Metering Pin          | 24. Striker Plate      | 42. Clamp           |
| 6. "O" Ring              | 25. Screw              | 43. Washer          |
| 7. Seal Support          | 26. Bushing            | 44. Nut             |
| 8. "O" Ring              | 27. Lock Ring          | 45. Orifice         |
| 9. Nut                   | 28. Scraper Ring       | 46. Trunnion        |
| 10. Barrel Piston        | 29. Internal Lock Ring | 47. Washer          |
| 11. Bolt                 | 30. "O" Ring           | 48. Bolt            |
| 12. Shaft                | 31. Backup Ring        | 49. Screw           |
| 13. Roll Pin             | 32. "O" Ring           | 50. Clamp           |
| 14. Torque Link          | 33. Backup Ring        | 51. Clamp           |
| 15. Bolt                 | 34. Ring Pack Support  | 52. Spacer          |
| 16. Clamp                | 35. Spacer             | 53. Nut             |
| 17. Bushing              | 36. Inner Bearing      | 54. Nut             |
| 18. Spacer               | 37. External Lock Ring | 55. Bushing         |
| 19. Bushing              |                        |                     |

has been expelled, remove the valve body and drain fluid.

b. Remove lower strut assembly from upper truss assembly as follows:

1. Disconnect the torque link, brake hose clamps, bushings, and safety switch bracket by removing the cotter pins, nuts, washers and bolts.

2. Disconnect brake hose from brake at elbow and remove hose.

3. Remove wheel and tire assembly and brake assembly from axle fitting.

#### CAUTION

Removal and handling of the lower strut should be done with care to prevent the possibility of damage to exposed parts.

c. (See figure 4-5.) Disassemble upper cylinder assembly as follows:

1. Remove bolts (48), washers (47) and nut (54) from trunnion (46) and remove trunnion from upper barrel (38).

2. Remove orifice tube (4) from upper barrel assembly by pulling straight out.

#### CAUTION

If the metering pin and seal support are to be reinstalled, use extreme caution during removal.

3. Disconnect torque link (14) by removing nut (20), washer (21), bushing (19), clamp (16) and bolt (15).

4. Remove lock ring (27), scraper ring (28), and internal lock ring (29).

5. Pull piston assembly (10) from upper cylinder assembly (38).

#### NOTE

Lower piston barrel and axle fittings are a

press fit and drilled on assembly. Disassembly is not recommended.

6. See Section 2 for cleaning and inspection of main landing gear.

Assembly of Main Landing Gear. (See figure 4-5.)

#### NOTE

Before each component of the main landing gear shock strut is assembled, assure that it is thoroughly clean, then lubricate with system hydraulic fluid.

a. Assemble landing gear as follows:

1. Carefully work O-ring (6) over threads of metering pin (5) and install in seal support (7) with nut (9).

2. Install O-ring (8) in groove on outside of seal support (7).

3. Insert seal support (7), with metering pin assembled, into lower piston barrel (10).

4. Slide lock ring (27), scraper ring (28), and internal lock ring (29) on piston barrel (10).

5. Install backup ring (33), O-ring (32), and backup ring (31) inside ring pack support (34); then work O-ring (30) on the outside into groove on ring pack support (34) and slide onto piston barrel (10).

6. Install spacer (35) on piston barrel (10).

7. Install inner bearing (36) on piston barrel (10) and secure with external lock ring (37).

#### NOTE

Install inner bearing with chamfered end up in order to seat against external lock ring.

8. Carefully work piston barrel into cylinder assembly (38) and slide ring pack support (34), internal lock ring (29), scraper ring (28), and lock ring (27) into barrel assembly (38) and secure.

9. Carefully work O-ring (3) into groove in orifice

tube (4) and insert into barrel assembly (38) taking care to align holes.

10. Install trunnion (46) on barrel assembly (38); align holes and install two bolts (48), washers (47), and nuts (54).

b. Assemble torque link (14), if removed, then connect with bolt (15), washers (21), bushing (19), washers (21) and nut (20).

c. Install switch striker plate and switch bracket assembly as shown in figure 4-4.

d. Install brake assembly, wheel and tire assembly; then connect hoses and clamp.

e. Service strut with hydraulic fluid in accordance with Section 2. Do not fill with air at this time.

f. Install new O-ring (13) on valve body (1) and install in top of orifice tube (4).

g. Install side braces with bolts, washers, and nuts.

#### Installation of Main Landing Gear.

a. If needle bearings were removed, install as follows:

1. Press needle bearings into landing gear supports. Bearing must seat against shoulders provided in supports.

b. Position gear in place; then install washers between supports and trunnion and align holes.

c. Install attaching shafts into gear trunnion and align gear trunnion, washer, and bearing in the landing gear supports, then work the shafts into position, using care to align holes in shaft and trunnion for the installation of roll pin.

#### NOTE

The attaching shafts are a slip fit and should be lubricated with light oil to aid in the installation of the shafts.

d. Remove AN6 bolt used in removal and installation of attaching shafts and install roll pin.

e. Connect side brace and push-pull tubes and gear door using bolts, washers and nuts.

f. Install safety switch and down indicator switch with screws and nuts and adjust in accordance with Rigging of Main Landing Gear.

#### NOTE

Make sure landing gear limit switches have all holes in switch housing plugged and packed with DC-4 Silicone Compound to prevent moisture entering limit switches.

g. Remove plug and caps and connect brake hose to union at bulkhead at forward wheel well. Use suitable lubricant on threads.

h. Install clamps securing switch wire bundle and brake hose.

i. Service and bleed brake system in accordance with Servicing Instructions, Section 2.

j. Perform operational check on landing gear.

k. Remove jacks and inflate strut in accordance with Section 2.

l. Check landing gear alignment in accordance with

Main Wheel Alignment and figure 4-22.

#### Removal and Disassembly of Main Gear Torque Links. (See figure 4-5.)

a. Remove cotter pin (23).

b. Remove nut (20).

c. Remove washer (21).

d. Remove bolt (15).

e. Remove spacer (18) and clamp (16).

f. Remove roll pin (13) and then shaft (12).

g. Remove main gear torque links by pulling aft.

#### NOTE

Observe thickness, number and position of all shims and washers before removing bolts.

#### NOTE

The bushings in the torque links are a press fit and should be removed only for replacement.

#### Assembly and Installation of Main Gear Torque Links. (See figure 4-5.)

a. Install grease fittings into torque links.

b. If removed, install bushings (26), insure grease fitting holes are in alignment.

c. Install torque links (14) in position and install shafts (12). Secure with pins (13).

d. Install spacer (18).

e. Install washers (21).

f. Install bolt (15), clamp (16), washer (21) and nut (20).

#### NOTE

Washers should be installed in the same position from which they were removed. If new components are being installed, align landing gear in accordance with Alignment Procedures, Section 4.

g. If aircraft was placed on jacks, insure the gear is DOWN and locked and remove aircraft from jacks.

h. Inflate struts in accordance with Section 2.

i. Lubricate torque links in accordance with Lubrication Chart.

#### Main Landing Gear Doors.

The main landing gear is equipped with wheel well doors and strut doors. Each strut door, pivoting on a continuous hinge located at its outboard end, is operated by a push-pull rod attached to the main landing gear strut. Each wheel well door, pivoting on forged aluminum hinges located at its inboard end, is operated by a bellcrank and push-pull tube, which is connected to the landing gear retracting linkage. The operating mechanism is so arranged that the wheel well door is closed when the main gear is either fully retracted or fully extended.

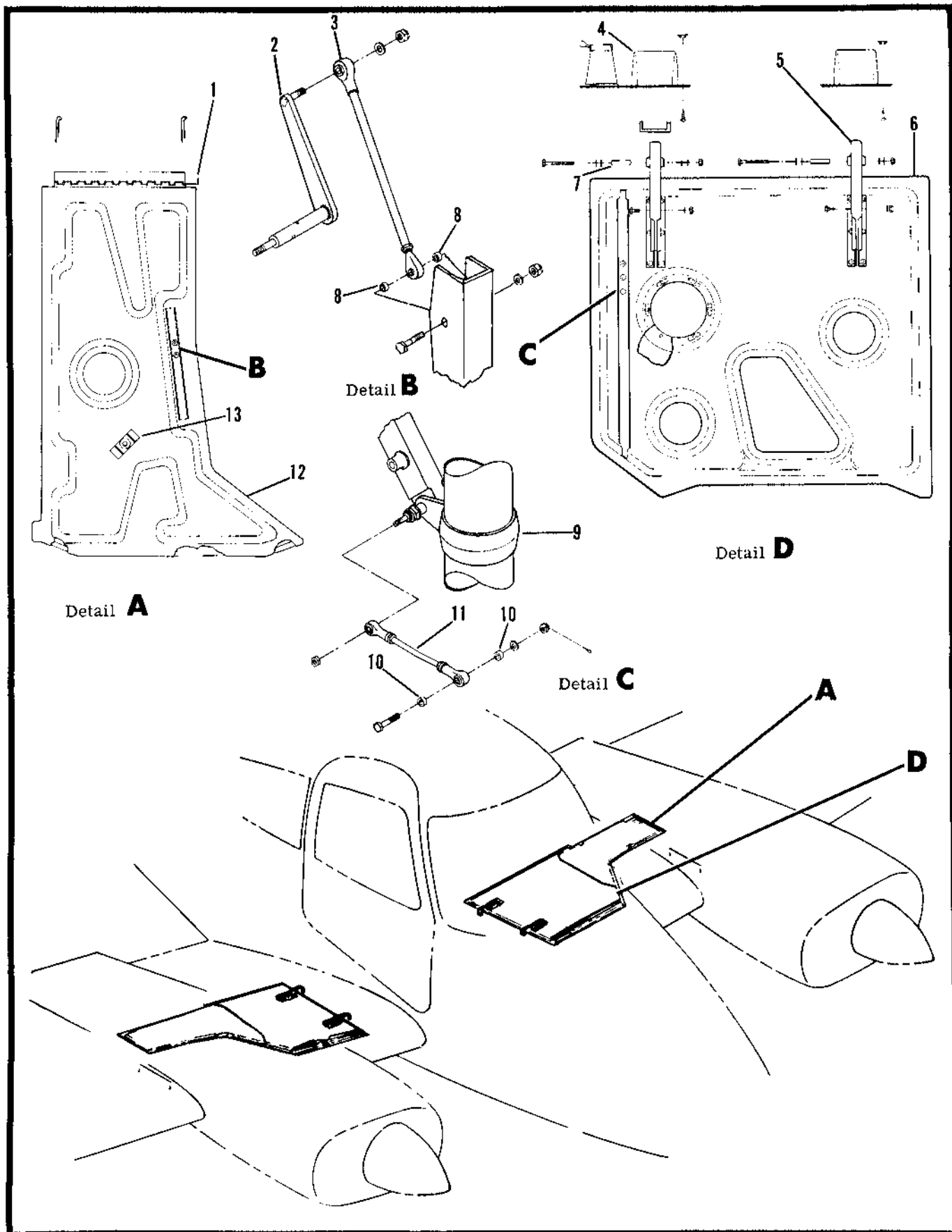


Figure 4-6. Main Landing Gear Door Installation

Figure 4-6. Main Landing Gear Door Installation Callouts

- |                      |                         |                   |
|----------------------|-------------------------|-------------------|
| 1. Hinge Pin         | 5. Hinge                | 10. Spacer        |
| 2. Door Actuator Arm | 6. Main Wheel Well Door | 11. Door Link Rod |
| 3. Door Link Tube    | 7. Spacer               | 12. Strut Door    |
| 4. Hinge Cover       | 8. Spacer               | 13. Snubber       |
|                      | 9. Main Landing Gear    |                   |

Removal of Main Landing Gear Doors. (See figure 4-6.)

- a. Remove strut door as follows:
  1. Disconnect door link rod from strut by removing nut and bolt.
  2. Remove cotter pins in the ends of hinge pin; then remove the hinge pin and outboard door.
- b. Remove wheel well door as follows:
  1. Jack aircraft, engage manual extension crank and operate toward the UP position until the main gear doors open sufficiently to disconnect link (3) from door (6) by removing nut, washer, spacers and bolt.
  2. Remove wheel well door by removing nuts, washers and bolts attaching hinge arms to door.
- c. If desired, remove hinge arms as follows:
  1. Remove lower wing root fillet and hinge covers by removing attaching screws.
  2. Remove hinge arms from brackets by removing nuts, washers, spacers, and bolts.

Installation of Main Landing Gear Door. (See figure 4-6.)

- a. If hinge arms were removed, attach to brackets with bolts, spacers, washers and nuts. Install hinge covers and lower wing root fillet with attaching screws.
- b. Install wheel well door as follows:
  1. Jack aircraft and engage manual extension to release tension on gear retraction system.
  2. Place wheel well door in position, align mounting holes, and attach to hinge arms with bolts, washers, and nuts.
  3. Attach door link tube to door with bolt, spacers, washer and nut.

#### NOTE

If length of door link tube has been changed, or new door components are being installed, rig in accordance with Rigging Procedures of Main Landing Gear Doors.

- d. Install strut door as follows:
  1. Place strut door in position and install hinge pin. Install cotter pins in each end of hinge pin to safety.
  2. Attach door link rod to strut with nut.

#### NOTE

If length of door link rod has been changed or new door components are being installed, rig in accordance with Rigging Procedures of Main Landing Gear Doors.

Rigging Main Landing Gear Door. (See figure 4-6.)

- a. Jack aircraft in accordance with Section 2.
- b. Disconnect wheel well door by removing nut attaching door link tube (3) to actuator arm (2).
- c. Disconnect strut door by removing nut attaching door link rod (11) to strut.
- d. Using the normal landing gear retraction system, operate gear to the UP position.

#### NOTE

The use of an external power source is recommended for operation of electrical units while engines are not being operated. Low voltage could cause low downlock tension readings.

- e. Close strut door and adjust door link rod (11) so that door fits flush.
- f. Operate gear to the DOWN position.
- g. Close wheel well door and adjust door link tube (3) so that door just fits flush.
  1. Adjust rod end on door link tube one-half turn shorter and connect.

#### NOTE

Make sure door link tube adjustment does not cause deformation of door.

- h. Operate gear to the UP position.

#### CAUTION

When retracting gear while rigging door, be prepared to stop before damage can occur.

- i. If necessary, readjust door link tube (3) so that door fits flush.
- j. Repeat steps "d" thru "i" as necessary to obtain proper fit of doors, checking that wheel well door clears tire and wheel.
- k. The door push-pull tube is to be 5 degrees over-center with the door actuator arm against its stop in both gear UP and gear DOWN position.
  - l. Install access hole cover on wheel well door.
  - m. Insure that the landing gear is DOWN, remove jacks.

Main Landing Gear Retracting Linkage.

The main landing gear retracting linkage consists of push-pull tubes, bellcranks, torque tubes, braces, and links interconnected between the landing gear actuator and the main landing gear. A positive downlock is obtained by rigging the main side links to an

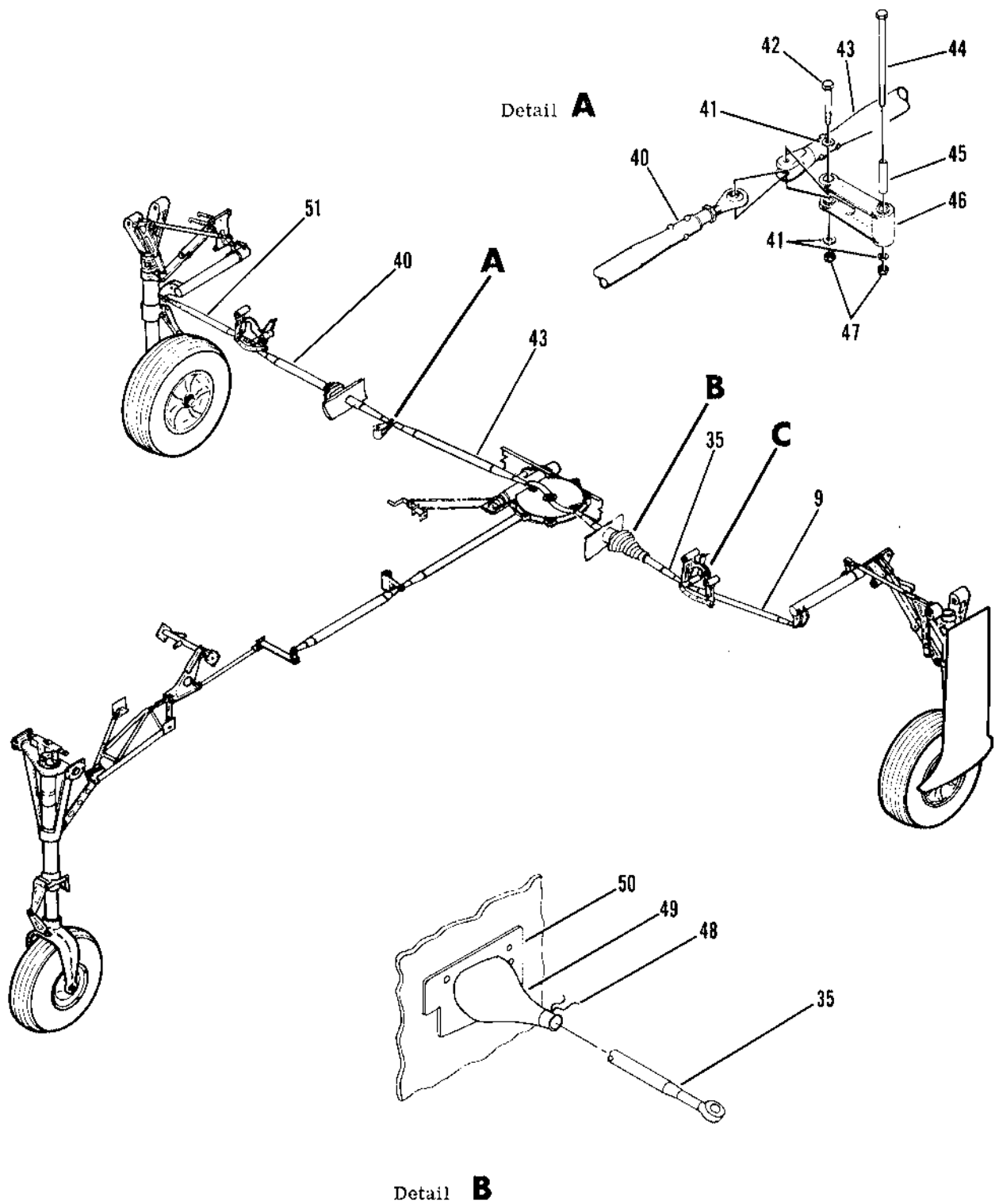


Figure 4-7. Main Landing Gear Retracting Linkage - Inboard Components (Sheet 1 of 2)

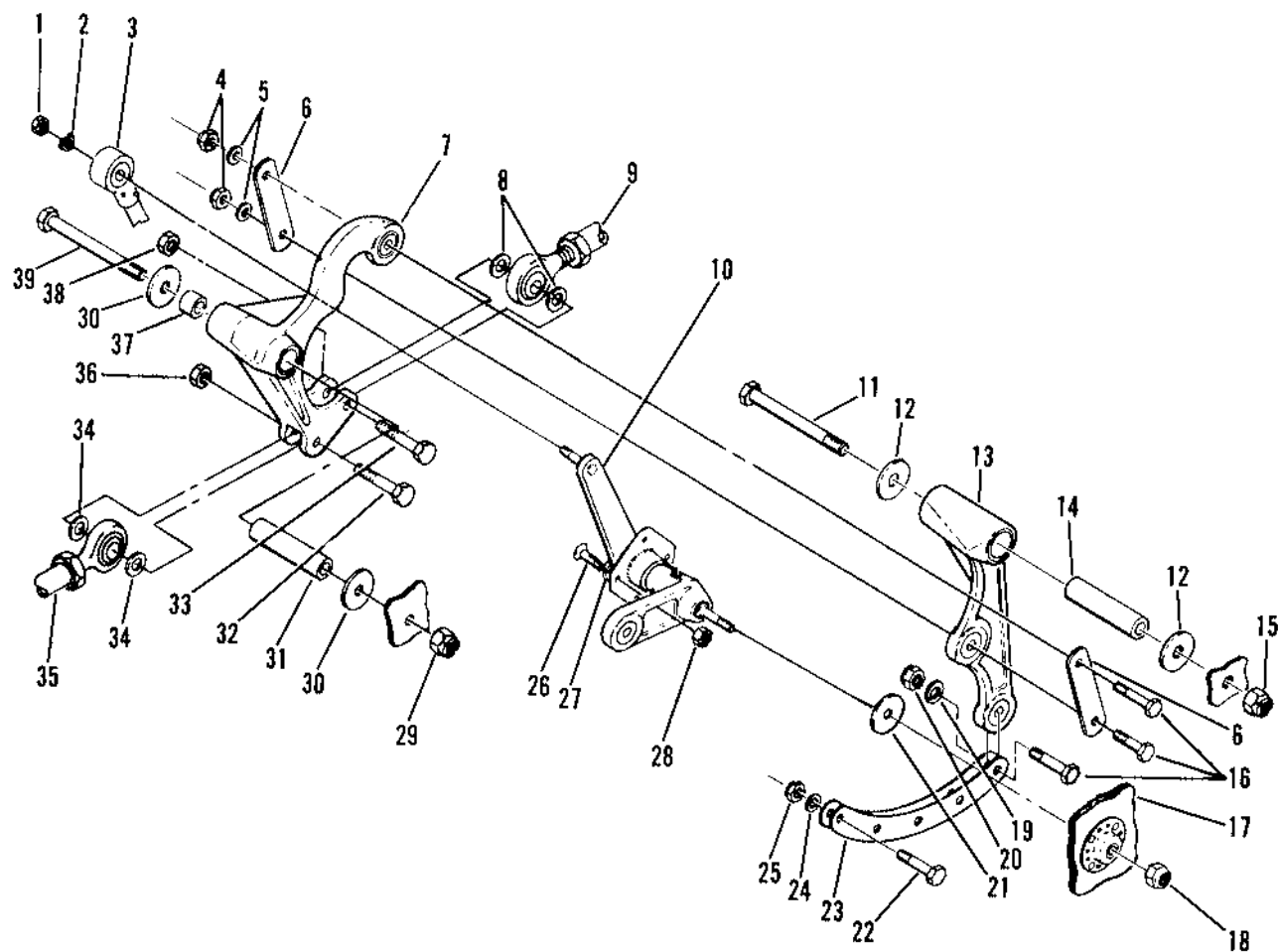


Figure 4-7. Main Landing Gear Retracting Linkage - Inboard Components (Sheet 2 of 2)

Figure 4-7. Main Landing Gear Retracting Linkage - Inboard Components Callouts

|                            |                           |                             |
|----------------------------|---------------------------|-----------------------------|
| 1. Nut                     | 18. Nut                   | 35. LH Inboard Drive Tube   |
| 2. Washer                  | 19. Washer                | 36. Nut                     |
| 3. Door Link Tube          | 20. Nut                   | 37. Bearing                 |
| 4. Nut                     | 21. Thrust Bearing Washer | 38. Nut                     |
| 5. Washer                  | 22. Bolt                  | 39. Bolt                    |
| 6. Upper Connecting Link   | 23. Rocker Arm Lower Link | 40. Intermediate Drive Tube |
| 7. Idler Bellcrank         | 24. Washer                | 41. Washer                  |
| 8. Spacer                  | 25. Nut                   | 42. Bolt                    |
| 9. LH Outboard Drive Tube  | 26. Screw                 | 43. RH Inboard Drive Tube   |
| 10. Door Actuator Assembly | 27. Washer                | 44. Bolt                    |
| 11. Bolt                   | 28. Nut                   | 45. Bushing                 |
| 12. Thrust Bearing Washer  | 29. Nut                   | 46. Idler                   |
| 13. Bellcrank Rocker Arm   | 30. Thrust Bearing Washer | 47. Nut                     |
| 14. Spacer                 | 31. Spacer                | 48. Drawstring              |
| 15. Nut                    | 32. Bolt                  | 49. Seal Boot               |
| 16. Bolt                   | 33. Bolt                  | 50. Doubler                 |
| 17. Spar Web               | 34. Spacer                | 51. RH Outboard Drive Tube  |

over-center position. The link assemblies which hold the main side links in an over-center position are also rigged over-center. Downlock springs, which apply spring tension to the over-center position of the link assemblies, are provided as an added safety feature. Hook-type mechanical locks are provided to lock the landing gear in its retracted position. The main landing gear retracting linkage also operates the main landing gear door operating mechanism.

#### Removal of Main Landing Gear Retracting Linkage. (See figure 4-7.)

- a. Jack the aircraft in accordance with Section 2.
- b. Disconnect main landing gear doors.
- c. Release tension on retracting linkage by engaging hand crank and operating a few turns toward the UP position.
- d. Remove access hole cover from underside of wing, forward of wheel well.
- e. Remove center seats, carpet and floorboard to gain access to the landing gear actuator.
- f. Remove the outboard drive tubes (9 and 51) as follows:
  1. Disconnect drive tubes from landing gear actuator bellcrank in accordance with actuator removal procedures.
  2. Disconnect drive tube from idler bellcrank (7) by removing nut, spacers and bolt; then remove drive tube by pulling into the fuselage area.
- g. Remove idler bellcrank (7) and door operating linkage as follows:
  1. Remove nut (25) and bolt (22) and four screws attaching bearing housing to web.
  2. Remove nut (18) and thrust bearing washer (21) then pull door actuator arm assembly (10) through web.

#### NOTE

Door actuator arm assembly (10) is a matched set, and disassembly is not recommended.

3. Remove nut (29), thrust bearing washers (30) and bolt (39) attaching idler bellcrank (7) to front

spar and support web.

4. Remove nut (15), thrust bearing washers (12) and bolt (11) attaching bellcrank rocker arm (13) to front spar and support web.
5. Pull bellcranks and attached linkage from between front spar and support web.
6. Remove the spacers (14 and 31) from the idler bellcrank (7) and bellcrank rocker arm (13).
7. Remove upper connecting links (6) by removing nuts (4), washers (2) and bolts (16).
8. Remove rocker arm lower link (23) by removing nuts (20 and 25), washers (19 and 24) and bolts (16 and 22).

#### NOTE

See figure 4-8 for the following steps:

- h. Remove outboard push-pull tube (18) as follows:
  1. Disconnect the push-pull tube from the bellcrank (25) by removing nut (21), washer (22) and bolt (24).
  2. Disconnect push-pull tube from torque tube (57) by removing nut (52) and bolt (54).
    - i. Remove bellcrank (25) and side brace (32) lock link as follows:
      1. Disconnect DOWN indicator switch (27) by removing nuts (51) and screws (30).
      2. Remove downlock spring (29).
      3. Disconnect side brace lock link from lower side link (46) by removing nut (45), washer (50) and bolt (35).
      4. Disconnect bellcrank (25) from the upper barrel by removing nut (19), spacer (20) and bolt (23).
      5. Remove the side brace lock link (32) from the bellcrank (25) by removing setscrew (31) and pin (26).
    - j. Remove uplock assembly as follows:
      1. Disconnect uplockpush-pull tube (12) from uplock assembly by removing nut (10), washer (11) and bolt (13).
      2. Remove nut (9), washer (17), spacer (15) and bolt (14) attaching uplock assembly to side link (6).
  - k. Remove side links (6 and 46) as follows:
    1. Disconnect lower side link (46) from upper barrel by removing nut (39), door link rod (40), nut (41), washers (42), spacers (43) and bolt (44).



1. Remove torque tube (57) as follows:
  1. Disconnect uplock push-pull tube (12) from torque tube by removing nut (61), washer (60) and bolt (55).
  2. Remove nut (59), washer (58) and bolt (56) attaching torque tube to torque tube support (66).

Installation of Main Landing Gear Retracting Linkage.  
(See figure 4-8.)

- a. Install torque tube as follows:
  1. Attach torque tube (57) to torque tube support (66) with bolt (68), washer (70) and nut (62).
  2. Attach torque tube (57) to rib mounting bracket (53) with bolt (56), washer (58) and nut (59).
  3. Connect uplock push-pull tube (12) to torque tube (57) with bolt (55), washer (60) and nut (61).
- b. Install side links (6 and 46) as follows:
  1. Attach upper side link (6) to lower side link (46) with bolt (49), washer (47) and nut (48). Torque nut to 110 ± 5 inch-pounds.
  2. Attach upper side link (6) to support with bolt (5), washer (17) and nut (16). Torque nut (16) to 200 ± 25 inch-pounds.
  3. Attach lower side link (46) to upper barrel with bolt (44), washers (42), spacers (43) and nut (41). Torque nut (41) to 110 ± 5 inch-pounds. Install door link rod (40) on bolt (44) with nut (39).
- c. Install uplock assembly as follows:
  1. Insert spacer (15) into upper side link (6) and attach uplock assembly with bolt (14), washer (8) and nut (9).
  2. Attach uplock push-pull tube (12) to uplock assembly with bolt (13), washer (11) and nut (10).
- d. Install bellcrank (25) and side brace lock link (32) as follows:
  1. Attach side brace lock link (32) to bellcrank (25) with pin (26) and setscrew (31).
  2. Attach bellcrank (25) to upper barrel with bolt (23), spacer (20) and nut (19).
  3. Attach side brace lock link (32) to lower side link (46) with bolt (35), washer (50) and nut (45).
  4. Install downlock spring.
  5. Install DOWN indicator switch (27) with attaching screws and nuts.
- e. Install outboard push-pull tube (18) as follows:
  1. Attach push-pull tube to bellcrank (25) with bolt (24), washer (22) and nut (21).
  2. Attach push-pull tube to torque tube (57) with bolt (54), washer (60) and nut (52).
  3. Insert push-pull tube and verify that the heads of the three in line rivets are facing down.

#### NOTE

See figure 4-7 for the following steps:

- f. Install idler bellcrank (7) and door operating linkage as follows:
  1. Attach rocker arm lower link (23) to bellcrank rocker arm (13) with bolt (16), washer (19) and nut (20).
  2. Attach upper connecting links (6) to bellcrank rocker arm (13) and idler bellcrank (7) with bolts (16), washers (2), and nuts (4).
  3. Install spacers (14 and 31) in idler bellcrank (7)

and bellcrank rocker arm (13).

4. Place bellcranks and attached linkage in position between front spar and support web.
5. Install bellcrank rocker arm (13) with bolt (11), thrust bearing washers (12) and nut (15).
6. Install idler bellcrank (7) with bolt (39), thrust bearing washers (30) and nut (29).
7. Insert door actuator arm assembly (10) through bracket, thrust bearing washer (21) and spar web (17). Then install nut (18).
8. Install four screws attaching bearing housing to bracket and safety with loctite sealant.
9. Attach rocker arm lower link (23) to door actuator arm assembly (10) with bolt (22), washer (24), and nut (25).
- g. Install inboard drive tube (35) as follows:
  1. Insert drive tube into position from the fuselage area and attach to idler bellcrank (7) with bolt (32), spacers (34) and nut (36).
  2. Attach drive tube to landing gear actuator bellcrank in accordance with landing gear actuator installation procedures.
- h. (See figure 4-8.) Install outboard drive tube (69) as follows:
  1. (See figure 4-8.) Attach outboard drive tube to torque tube (57) with bolt (65), washer (64) and nut (63).
  2. Attach outboard drive tube to idler bellcrank (7) with bolt (33), spacers (8) and nut (38).
- i. Rig main landing gear in accordance with rigging procedures.
- j. Install access hole covers on underside of wing forward of wheel well.
- k. Install floorboard and rear carpet.
  1. Connect landing gear doors and rig per Main Landing Gear Door Rigging Procedure.
- m. Insure that landing gear is DOWN and locked, then remove aircraft from jacks.
- n. Install center seats.

Rigging of Main Landing Gear. (See figure 4-9).

- a. Jack aircraft in accordance with Section 2.
- b. Remove center seats and center carpet in accordance with Section 3.
- c. Remove floorboard from cabin floor above landing gear actuator.

#### NOTE

Prior to any operation of the gear by the manual extension crank, assure that there is no electrical power on the aircraft, or that the landing gear switch is in the neutral position.

- d. Release tension on retracting linkage by engaging manual extension crank and operating a few turns toward the UP position.
- e. (See figure 4-6.) Remove main wheel well door link tubes (3) by removing nuts, washers, spacers and bolts.
- f. (See figure 4-15.) Disconnect nose gear retracting linkage by removing nut and bolt attaching forward push-pull tube (17) to fork bolt (18).
- g. (See figure 4-7.) Disconnect the inboard ends of both outboard drive tubes (9) from idler bellcrank (7)

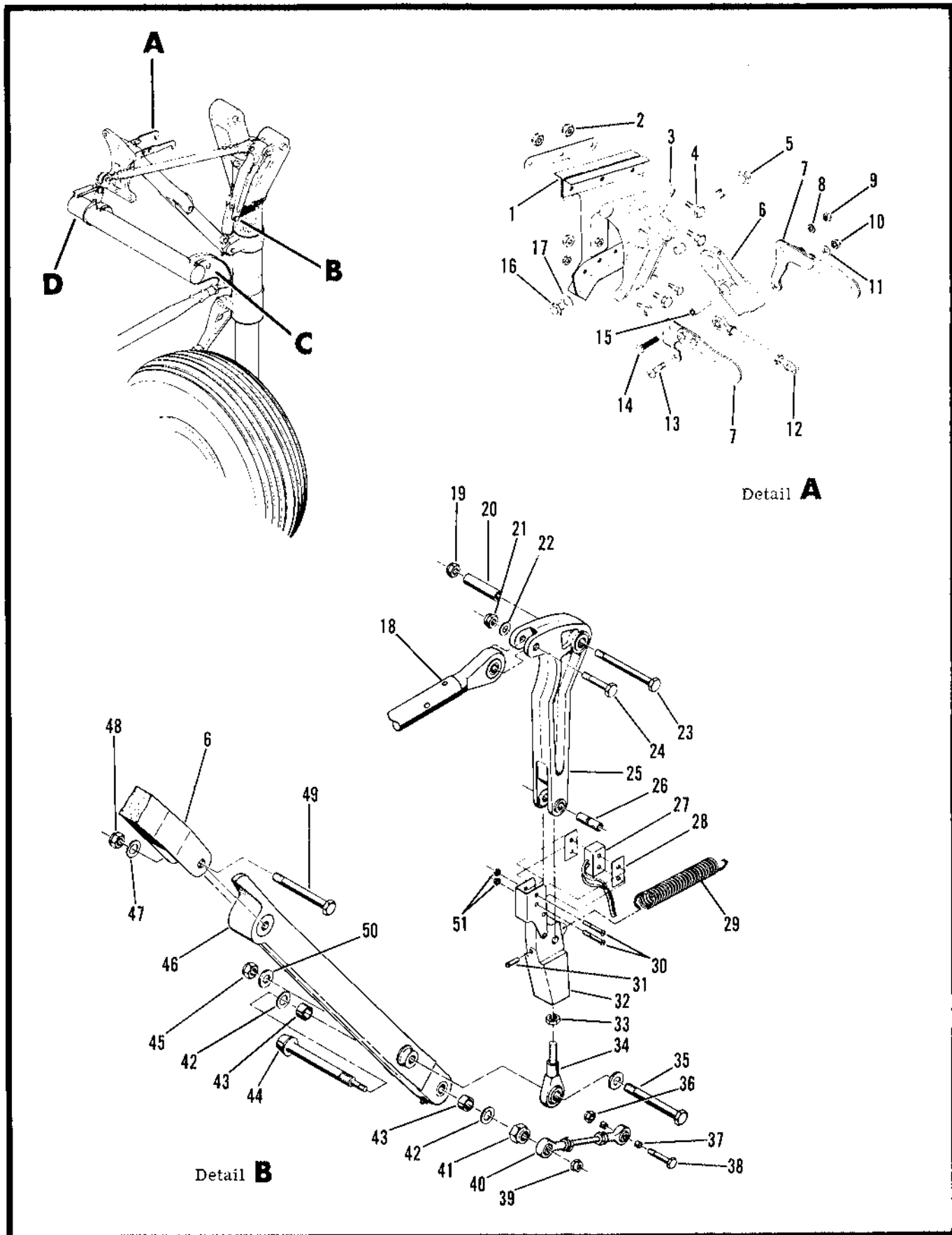
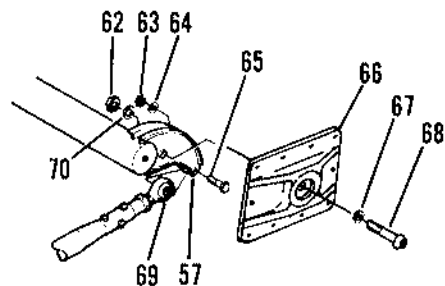
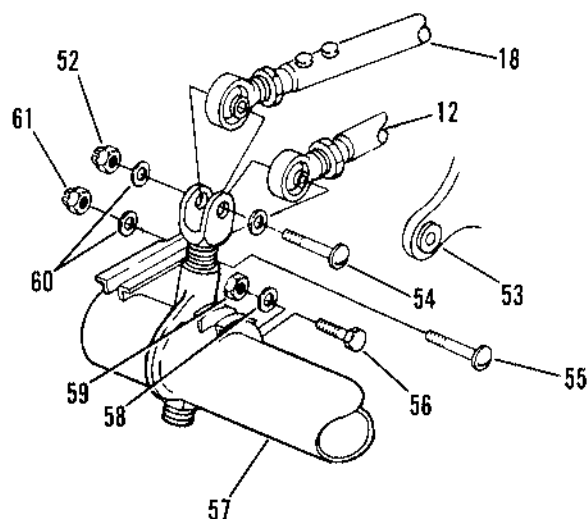


Figure 4-8. Main Gear Retracting Linkage - Outboard Components (Sheet 1 of 2)

Detail **D**



Detail **C**

- |                             |                           |                         |
|-----------------------------|---------------------------|-------------------------|
| 1. Rib Assembly             | 24. Bolt                  | 48. Nut                 |
| 2. Nut                      | 25. Bellcrank             | 49. Bolt                |
| 3. Support                  | 26. Pin                   | 50. Washer              |
| 4. Bolt                     | 27. Down Indicator Switch | 51. Nut                 |
| 5. Bolt                     | 28. Spacer                | 52. Nut                 |
| 6. Upper Side Link          | 29. Spring                | 53. Mounting Bracket    |
| 7. Uplock Assembly          | 30. Screw                 | 54. Bolt                |
| 8. Washer                   | 31. Setscrew              | 55. Bolt                |
| 9. Nut                      | 32. Side Brace Lock Link  | 56. Bolt                |
| 10. Nut                     | 33. Check Nut             | 57. Torque Tube         |
| 11. Washer                  | 34. End Fitting           | 58. Washer              |
| 12. Uplock Push-Pull Tube   | 35. Bolt                  | 59. Nut                 |
| 13. Bolt                    | 36. Nut                   | 60. Washer              |
| 14. Bolt                    | 37. Spacer                | 61. Nut                 |
| 15. Spacer                  | 38. Bolt                  | 62. Nut                 |
| 16. Nut                     | 39. Nut                   | 63. Nut                 |
| 17. Washer                  | 40. Door Link Rod         | 64. Washer              |
| 18. Outboard Push-Pull Tube | 41. Nut                   | 65. Bolt                |
| 19. Nut                     | 42. Washer                | 66. Torque Tube Support |
| 20. Spacer                  | 43. Spacer                | 67. Washer              |
| 21. Nut                     | 44. Bolt                  | 68. Bolt                |
| 22. Washer                  | 45. Nut                   | 69. Outboard Drive Tube |
| 23. Bolt                    | 46. Lower Side Link       | 70. Washer              |
|                             | 47. Washer                |                         |

Figure 4-8. Main Gear Retracting Linkage - Outboard Components (Sheet 2 of 2)

by removing nuts, spacers and bolts.

h. Adjust limit switches (17 and 34, figure 4-1) and inboard drive tubes (19 and 21, figure 4-9) as follows:

1. Disconnect the LH inboard drive tube (21) and intermediate drive tube (17) from idler bellcranks (16).
2. Adjust both limit switches to the end of their adjusting slots in a direction which will permit maximum bellcrank travel.

#### NOTE

When adjusting either limit switch, align switch so that switch plunger is contacted squarely by the bellcrank or drive tube.

3. Engage manual extension crank and operate toward the UP position until the internal stop in the actuator is reached.

#### CAUTION

To prevent possible damage to the actuator, do not force against the internal stop.

4. Note the angular position of the crank when internal stop is reached, back crank off two turns, then advance crank one-half turn. Adjust the UP limit switch (17, figure 4-1) so that it is just actuated at this point.

5. Manually operate gear toward the DOWN position until the internal stop in the actuator is reached.

#### CAUTION

To prevent possible damage to the actuator, do not force against the internal stop.

6. Note the angular position of the crank when internal stop is reached, then back crank off two turns. Adjust the DOWN limit switch (34, figure 4-1) so it is just actuated at this point.

7. After these preliminary adjustments to the limit switches have been made, stow the manual extension crank and operate the actuator electrically until the UP limit switch is actuated.

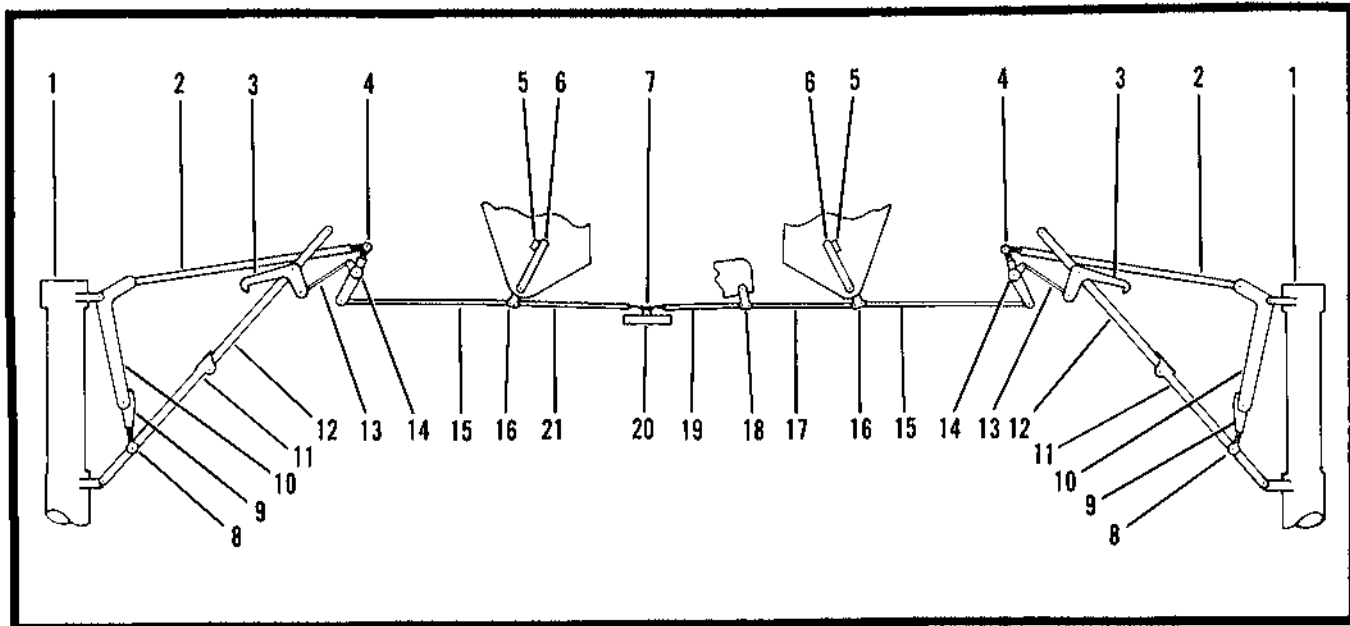
#### CAUTION

Caution must be observed during gear actuation to insure that no damage is incurred by the disconnected ends of the main drive tubes.

#### NOTE

To facilitate rigging of the landing gear, a two-position momentary ON switch with suitable lengths of electrical wires can be connected to the landing gear electrical circuit in such a manner that the landing gear can be observed while being operated during rigging. The use of an external power source is also recommended.

8. Engage the manual extension crank and note the angular position of the crank. Operate crank toward



1. Main Landing Gear Strut
2. Outboard Push-Pull Tube
3. Uplock
4. Fork Bolt
5. Door Actuator Arm Stop
6. Door Actuator Arm
7. Bellcrank

8. Lock Link End Fitting
9. Side Brace Lock Link
10. Bellcrank
11. Lower Side Link
12. Upper Side Link
13. Uplock Push-Pull Tube
14. Torque Tube

15. Outboard Drive Tube
16. Idler Bellcrank
17. Intermediate Drive Tube
18. Idler
19. RH Inboard Drive Tube
20. Landing Gear Actuator
21. LH Inboard Drive Tube

Figure 4-9. Schematic of Main Landing Gear Retracting Linkage

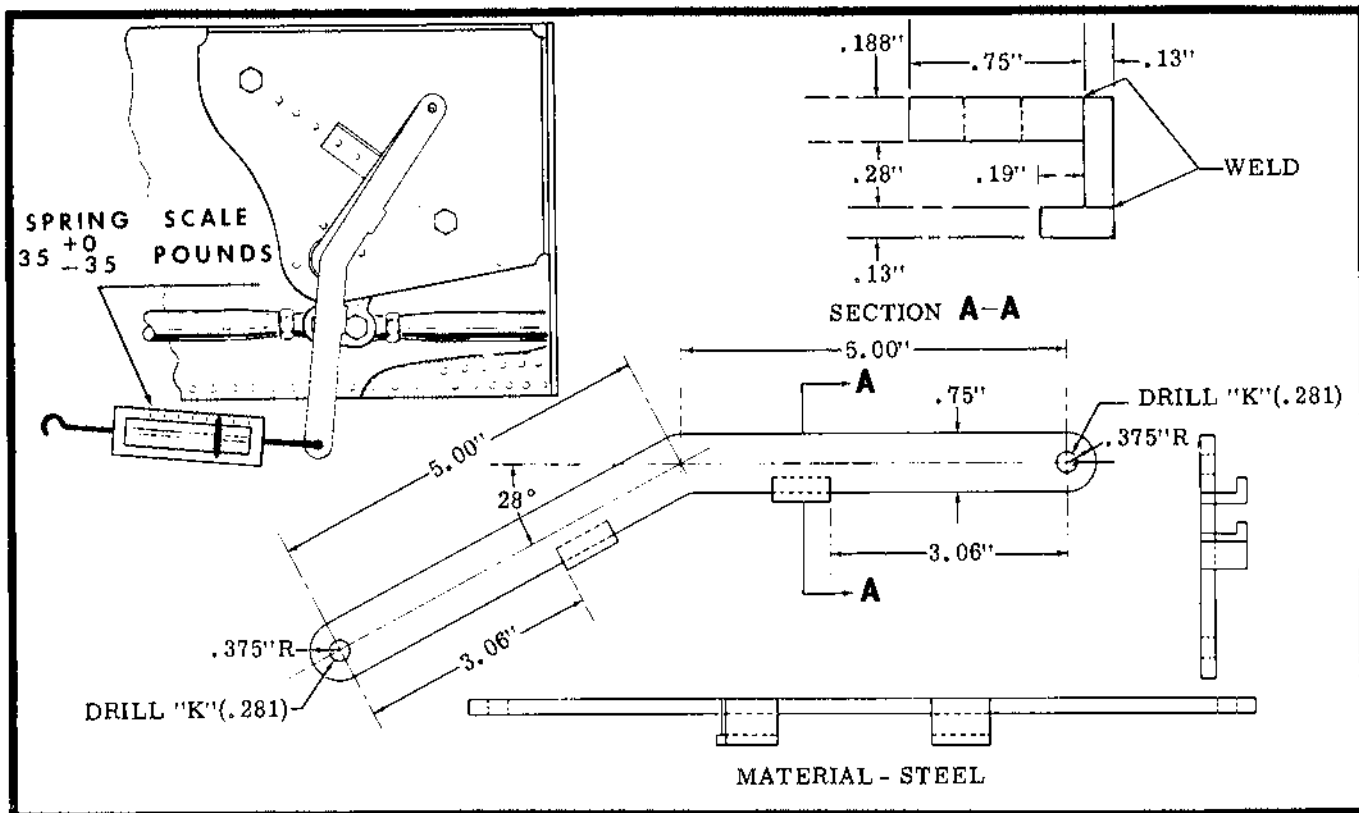


Figure 4-10. Fabrication and Use of Tool for Measuring Door Actuator Arm Tension

the UP position, noting the number of turns required to reach the internal stop in the actuator. The minimum number of turns required in the UP position is three-fourths of one turn and the maximum (and desired) number of turns is one and one-half turns. If necessary, adjust UP limit switch to obtain this requirement.

9. Stow the manual extension crank and operate the actuator electrically until the DOWN limit switch is actuated.

10. Engage the manual extension crank and note the position of the crank. Operate crank toward the DOWN position, noting the number of turns required to reach the internal stop in the actuator. The minimum number of turns required in the DOWN position is one turn and the maximum (and desired) number of turns is two turns. If necessary, adjust the DOWN limit switch to obtain this requirement.

11. Adjust the length of the LH drive tube (21) and the intermediate drive tube (19) as short as possible and connect to idler bellcranks (16).

12. Operate actuator to the UP position and check the pull required to move door actuator arms (6) from stops (5) as illustrated in figure 4-10.

## NOTE

The pull required to move door actuator arm from the stop must be measured at a right angle to the arm. The tool illustrated in figure 4-10 can be made to facilitate this measurement.

13. Adjust the length of both main drive tubes as

necessary to obtain a force of 15 to 35 pounds required to move door actuator arms from stops, in both the gear UP position and the gear DOWN position. The maximum difference between the forces required to move either door actuator arm from its stop, in both gear UP and gear DOWN positions, is ten pounds. If necessary, readjust the UP limit switch to obtain the required forces and maximum differences. If UP limit switch is readjusted, recheck the minimum turn requirement specified in step 8.

i. Adjust side brace lock links (9) as follows:

1. With landing gear in DOWN position, adjust end fitting (8) so that lower side link (11) and upper side link (12) are held firmly in over-center position, when side brace lock link (9) is firmly in over-center position.

2. Manually "break" the lock link from its over-center position and move the landing gear to a position five to six inches inboard from the DOWN and LOCKED position, then release. The landing gear must free fall and lock when released from this position.

## NOTE

Adjust the side brace lock link end fitting to the greatest length at which the free fall requirement can be obtained and maintained.

3. Check for clearance between upper end of side link and lower end of upper side link as illustrated in figure 4-11. Zero clearance is required.

4. Adjust side brace lock links for both main landing gear in this manner.

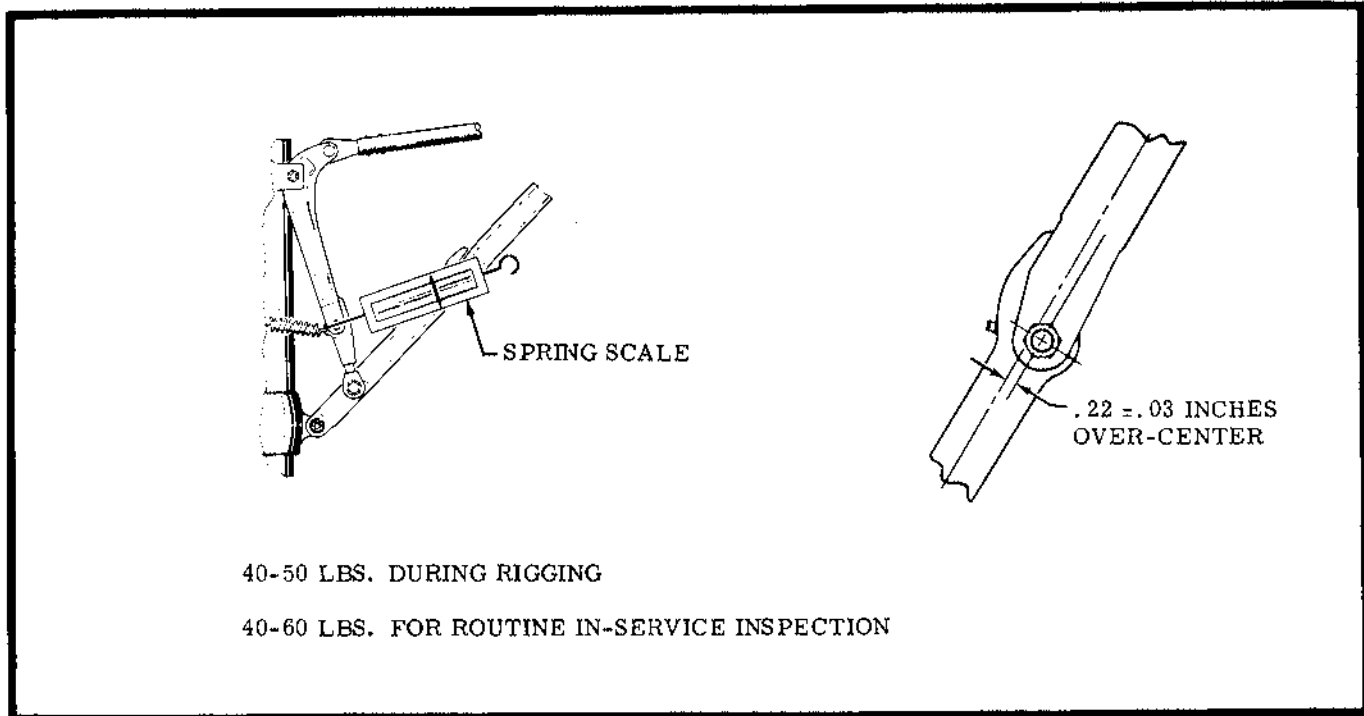


Figure 4-11. Main Landing Gear Downlock Requirements

## NOTE

After the preceding steps have been completed, the main landing gear retracting system is rigged from the limit switches through the idler bellcranks and both side brace links are adjusted at the landing gear. The following procedure is to rig the retraction system from the idler bellcranks to the side brace lock links.

- j. Make the following preliminary preparations:
  1. Remove uplocks (3) and uplock push-pull tubes (13) by removing attaching bolts.
  2. Adjust the length of the outboard drive tubes (15) as short as possible, and install.
  3. Screw fork bolts (4) into torque tubes (14) as far as possible.
  4. Operate landing gear actuator to DOWN position.
  5. With landing gear DOWN, adjust length of outboard push-pull tubes (2) so that rod end holes align with the holes in fork bolts (4) and bellcranks (10), then shorten one turn. Operate landing gear actuator toward the UP position far enough to permit installation and install outboard push-pull tubes (2). Install with the collar-ends of the hi-shear rivets pointing upward for clearance.

## NOTE

The preceding preparations will result in incomplete retraction, thus eliminating the possibility of damage to the wing structure caused by retracting too far.

- k. Operate landing gear to the UP position and observe the highest position reached by the gear during

retraction and the amount of drop-off.

1. Adjust the highest position reached by the gear during retraction as follows:

1. Lengthen fork bolt (4) in half-turn increments to increase the highest position during retraction.
2. The wheel should make contact with the corrugated reinforcement at the top of the wheel well, then drop down a specified distance.
3. Adjust the fork bolts for both main landing gear in this manner.

- m. Adjust the amount of drop-off as follows:

1. Determine whether drop-off is too little or too much. The minimum and desired amount of drop-off measured at the center of the wheel, is 1/16 inch. The maximum is 1/8 inch.
2. If drop-off is too much, lengthen intermediate push-pull tube (15) in half-turn increments until drop-off is correct.
3. If drop-off is too little, shorten intermediate push-pull tube (15) in half-turn increments until drop-off is correct.

4. Adjust the amount of drop-off for both main landing gear in this manner.

- n. Adjust the downlock tension as follows:

1. Operate the landing gear to the DOWN position. The main landing gear downlock tension should be 40 to 60 pounds. During rigging, the downlock tension should be maintained between 40 to 50 pounds. The 60 pound upper limit during routine maintenance is established in order to compensate for variances of aircraft loading and temperature. If at anytime either main landing gear downlock tension checks under 40 or over 60 pounds, re-rig as necessary.
2. If downlock tension is too high, lengthen outboard push-pull tube (2) until the correct downlock tension is obtained.

### NOTE

Since the highest position during retraction is controlled by the combined length of the outboard push-pull tube (2) and the fork bolt (4), this combined length must remain unchanged to maintain the correct highest position. When adjusting the outboard push-pull tube to obtain the specified downlock tension, the fork bolt must be readjusted a corresponding amount in the direction that will not change the combined length of the push-pull tube and fork bolt.

### CAUTION

(See figure 4-8.) Bolt (54) attaching outboard push-pull tube (18) to torque tube fork bolt must be of proper length and installed with head forward or damage to structure may occur.

3. If downlock tension is too low, shorten outboard push-pull tube (2) until the correct downlock tension is obtained. Readjust the fork bolt (4) as required in the preceding "NOTE."

4. Adjust the downlock tension for both main landing gear in this manner.

### NOTE

In addition to the downlock tension requirement, the landing gear must also "free fall" and lock when released from a position which is not more than six inches inboard from the DOWN position, while main drive tube is disconnected. If necessary, readjust side brace lock link (9) to obtain this condition.

0. (See figure 4-8.) Install and adjust uplocks as follows:

1. Insure that spacers (43) are in place, position uplock assemblies (7), and attach to upper side links (6) with bolts, washers and nuts.

2. Adjust uplock push-pull tubes (12) to a preliminary length of 5.15 inches and attach to torque tube (57) with bolts, washers and nuts.

3. Connect uplock push-pull tubes (12) to uplock assemblies (7) with bolts, washers and nuts.

4. Operate landing gear to the UP position.

### CAUTION

Use caution when landing gear nears the UP position before adjustment of uplock push-pull tubes has been completed. If necessary, readjust the push-pull tube and/or uplock hooks to prevent damage.

5. Adjust uplock push-pull tubes so that uplock assemblies fully engage the spacers provided on the landing gear.

### NOTE

Elongated slots are provided in the uplock hooks so that each uplock hook can be ad-

justed vertically to contact the spacers.

6. Visually check the alignment of all rod ends to insure that they align with their attach fittings.

7. Operate the landing gear several times, observing uplock assemblies. Uplock hooks must engage fully with the spacers provided on the gear, and must engage and disengage freely and smoothly with no indication of binding.

p. (See figure 4-15.) Connect nose gear retracting linkage by installing bolt and nut attaching forward push-pull tube (17) to fork bolt (18).

### NOTE

If landing gear retraction system limit switch adjustment was changed while rigging the main landing gear, disregard step "p" and rig nose gear in accordance with Rigging of Nose Gear procedure.

q. (See figure 4-6.) Install main wheelwell door link tubes (11) with bolts, spacers, washers and nuts. Rig doors in accordance with Rigging of Main Landing Gear Doors Procedure.

r. Install floorboard above landing gear actuator.

s. Install center carpet and seats in accordance with Section 3.

t. Insure that landing gear is DOWN, then remove jacks.

### Adjustment of Landing Gear Safety Switch.

The landing gear safety switch is located on the aft side of the left main landing gear and is actuated by the upper torque link.

a. Jack aircraft in accordance with Section 2.  
b. Place landing gear switch in the DOWN position.  
c. Insure that battery switch is OFF.  
d. With left main landing gear strut fully extended, adjust arm of landing gear safety switch so that switch is actuated when the arm is raised to a position which is approximately .30 inch from upper torque link.

### NOTE

The arm is adjusted by removing the cotter pin and nut which attach the arm to the switch, repositioning the arm, and reinstalling the nut and cotter pin.

e. Check the adjustment of the landing gear safety switch as follows:

### WARNING

Since landing gear may retract if adjustment of safety switch is incorrect, insure that all wheel well areas are clear while performing the following checks.

1. If available, connect an external power source, if not available, turn battery switch ON.

2. Raise the switch arm to the position adjusted in step "d". While holding the switch arm in this posi-

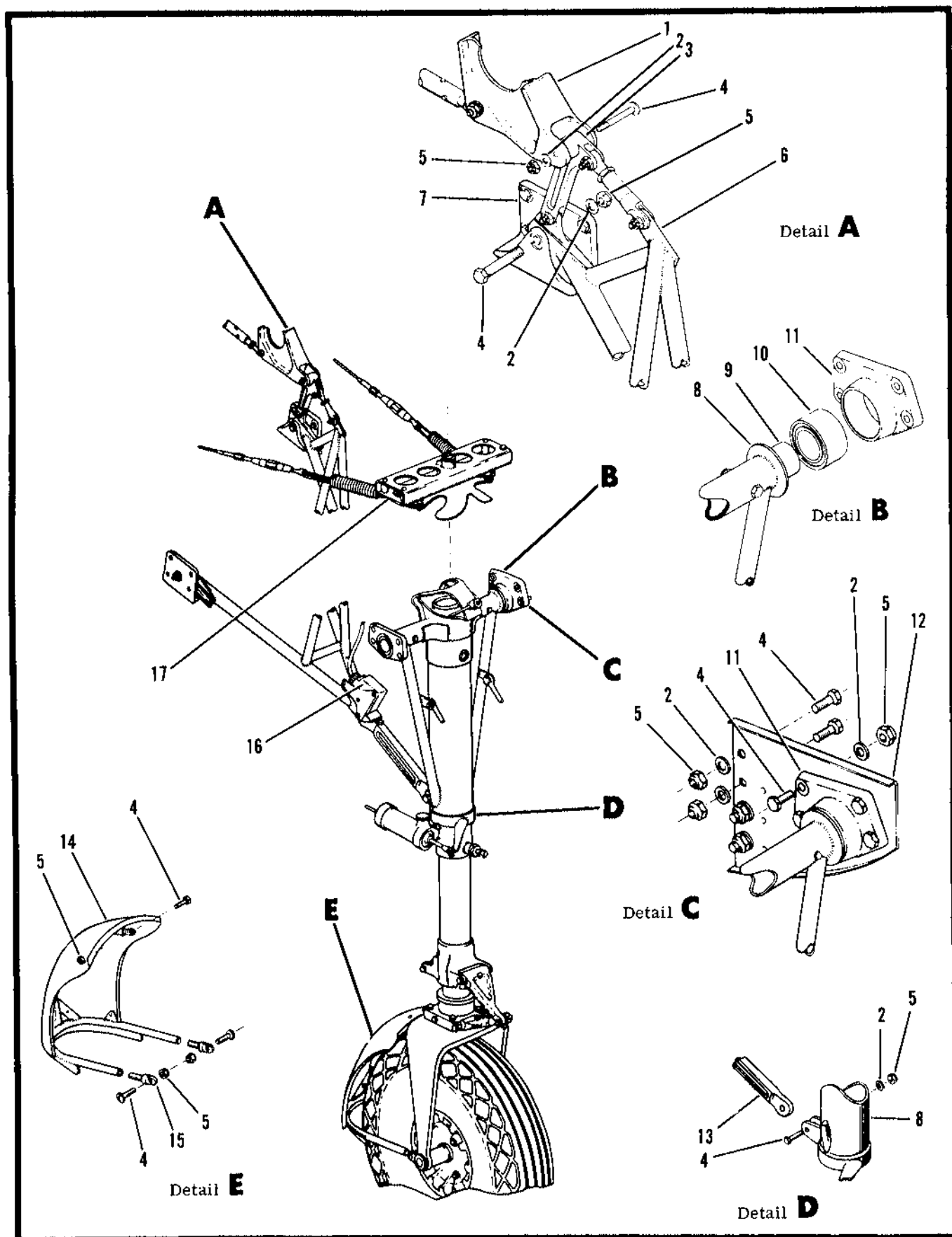


Figure 4-12. Nose Gear Installation



Figure 4-12. Nose Gear Installation Callouts

- |                   |                 |                                     |
|-------------------|-----------------|-------------------------------------|
| 1. Connector Link | 7. Retainer     | 12. Nose Wheel Well Doubler         |
| 2. Washer         | 8. Trunnion     | 13. Drag Brace                      |
| 3. Retracting Arm | 9. Support Tube | 14. Mud Guard and Scraper Assembly  |
| 4. Bolt           | 10. Bearing     | 15. Eye Bolt                        |
| 5. Nut            | 11. Retainer    | 16. Nose Gear Down Indicator Switch |
| 6. Truss Assembly |                 | 17. Nose Gear Steering Assembly     |

tion, have an assistant place the landing gear switch in the UP position. Landing gear should NOT retract.

3. Continue to raise the switch arm upward to the end of its travel. Landing gear should NOT retract.

4. Release the switch arm. Landing gear SHOULD retract.

5. Operate landing gear through several cycles, checking landing gear for proper operation.

f. Insure that landing gear switch and landing gear are DOWN and battery switch is OFF, then remove jacks.

g. If used, disconnect the external power source.

#### Adjustment of Landing Gear Warning System.

- a. Adjust the throttle microswitch as follows:

##### NOTE

To properly adjust the throttle microswitch, located behind the throttle quadrant, it is necessary to fly the aircraft. As a preliminary adjustment before flight, adjust microswitch to actuate when the aft edges of the throttle levers are approximately one inch forward in the slot of the control quadrant.

1. Obtain a pressure altitude of 2500 feet.
2. Adjust propeller pitch levers to obtain 2300 rpm on both engines.
3. Place mixture levers in FULL RICH.
4. Retard throttle levers to obtain 12 inches of manifold pressure.

##### NOTE

If throttle levers are retarded below the specified manifold pressure, advance them and repeat the retarding procedure.

5. Using a pencil, tape, or other suitable means of marking, index the position of the throttle levers in the control quadrant.

##### NOTE

The remainder of the adjusting procedure must be accomplished with the aircraft on the ground.

6. Jack aircraft in accordance with Section 2.
7. Fully advance throttle levers, then retard to the position marked on the control quadrant during flight. Adjust the throttle microswitch (located behind the throttle quadrant) to actuate at this position.
8. Turn the battery switch ON, partially retract landing gear and check that warning horn sounds as

throttle levers are retarded to the marked position.

9. Extend landing gear and turn battery switch OFF.

##### NOTE

Adjustment of the throttle microswitch may be accomplished by loosening the two attaching screws and positioning the switch in the crescent shaped slots provided. After each adjustment, tighten attaching screws.

10. After microswitch adjustment is completed, place throttle levers in the CLOSED position.

##### NOTE

The landing gear warning horn should be flight checked to function at 12  $\pm$  1 inches of manifold pressure.

- b. Adjust DOWN indicator switches as follows:

1. (See figure 4-6.) Disconnect main wheel door link tubes (3) from main wheel well door (6).
2. (See figure 4-14.) Disconnect nose gear door link tube (20) from nose gear door (1).
3. Release tension on retracting linkage by engaging manual extension crank and operating a few turns toward the UP position.
4. (See figure 4-15.) Disconnect nose gear forward push-pull tube (17) from fork bolt (18) by removing nut and bolt.
5. (See figure 4-7.) Disconnect main gear outboard drive tube (9) from idler bellcrank (7) by removing nut, spacers and bolt.
6. Adjust all three DOWN indicator switches so that they are not actuated until landing gear is DOWN and locked by the over-center linkage. Adjust the main landing gear switches by repositioning. Adjust the nose gear switch by adjusting the switch actuating bolt.
7. Attach the push-pull tubes disconnected in steps "4" and "5".
8. Using the normal landing gear retraction system, operate landing gear to the UP position.
9. Place landing gear switch in a neutral position, engage the manual extension crank, and lower the landing gear. Stop cranking immediately when the green light illuminates, and note the exact angular position of the crank.
10. Check that both main gear and nose gear are DOWN and locked in the over-center position.
11. Resume cranking toward the DOWN position, noting the number of turns required, until the internal stop in the landing gear actuator is reached. The number of turns required should not be less than four, nor more than eight.
12. If necessary, readjust DOWN indicator switches as required to meet the conditions of steps "6" and "11".

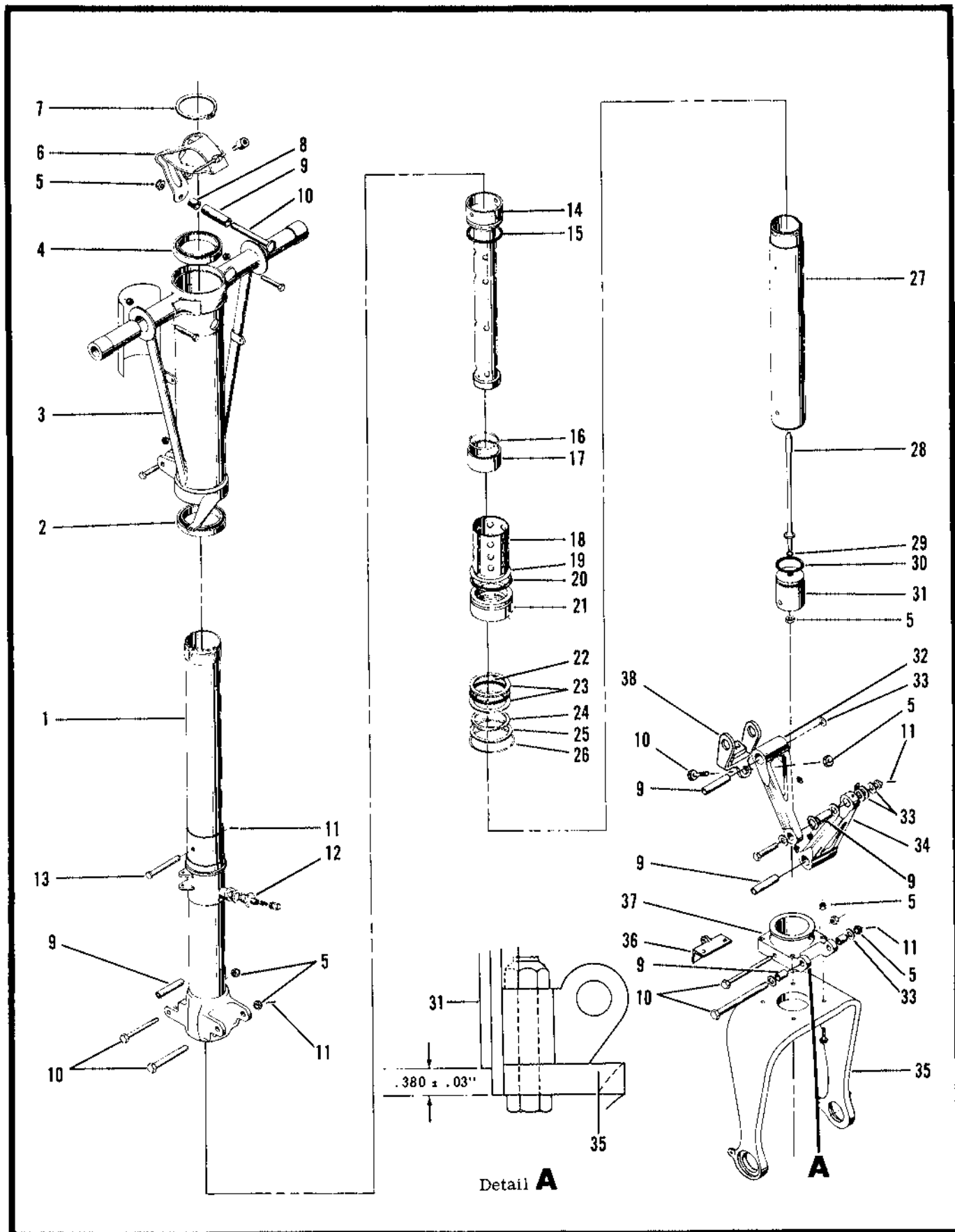


Figure 4-13. Nose Gear Disassembly

13. (See figure 4-16.) Connect nose gear forward push-pull tube (6) to fork bolt (7).
14. (See figure 4-7.) Connect main gear outboard drive tube (9) to idler bellcrank (7).
15. Insure that landing gear is DOWN, then remove jacks.

#### NOSE GEAR.

Removal of Nose Gear. (See figure 4-12.)

- a. Remove taxi light in accordance with Section 14.
- b. Jack aircraft in accordance with Section 2.
- c. Release tension on retracting linkage by engaging manual extension crank and operating a few turns toward UP position.
- d. Disconnect nose gear doors.
- e. Disconnect retracting linkage as follows:
  1. Remove nut, washer, and bolt attaching drag brace (13) to trunnion (8).
  2. Remove nut, washer, and bolt attaching connector link (1) to retracting arm (3).
  3. Disconnect nose gear DOWN indicator switch (16) and electrical wires from truss assembly (6).

#### NOTE

To facilitate installation, note the number and position of attaching clamps and the routing of the electrical wires.

4. Remove truss assembly (6) by removing nuts, washers, and bolts attaching truss assembly to both retainers (7).
  - f. Remove nose gear steering assembly (17) in accordance with Removal of Nose Gear Steering Procedure.
  - g. Remove eight nuts, washers, and bolts attaching retainers (11) to airframe.
  - h. Remove two nuts, washers and bolts from each side of nose wheel well doubler (12) so that gear can be removed.
  - i. Force nose gear assembly aft, then turn it to clear airframe and remove from nose wheel well.

#### NOTE

Rub wax or paraffin on wheel well bulkheads just aft of retainers (11) to facilitate removal.

Disassembly of Nose Gear. (See figure 4-13.)

#### WARNING

Deflate the nose gear strut before removing or disconnecting nose gear torque links.

- a. Remove wheel and tire assembly.
- b. (See figure 4-12.) Remove mud guard and scraper assembly (14) by removing nuts and bolts.
- c. Remove shimmy dampener.
- d. (See figure 4-12.) Remove retainer (11) from trunnion assembly (8).

#### NOTE

Needle bearings (10) are a press fit and should be removed only for replacement. Removal of support tubes (9) is not recommended.

- e. Completely deflate strut and after all air has been expelled, remove valve body and drain fluid.
- f. Separate upper strut assembly (1) from trunnion assembly (3) as follows:
  1. Align head of bolt (10) with hole in trunnion assembly, and remove nut, spacers and bolt.
  2. Remove external retainer ring (7) and wheel straightener (6).
  3. Pull upper strut from trunnion assembly.

#### NOTE

Upper bearing (4) will remain in the trunnion assembly and can be removed if desired.

- g. Separate upper strut (1) from lower strut (27) as follows:
  1. Remove torque links (32 and 34) and stop assembly (38) by removing cotter pins, nuts, washers, shim, spacers and bolts.
  2. Remove lock ring (26) from lower end of upper strut (1) and separate lower strut from upper strut by applying a straight, sharp pull.

#### CAUTION

Removal and handling of the lower strut should be done with care to prevent the possibility of damage to exposed parts.

Figure 4-13. Nose Gear Disassembly Callouts

- |                           |                                     |                       |
|---------------------------|-------------------------------------|-----------------------|
| 1. Upper Strut            | 14. Orifice Piston Support Assembly | 26. Lock Ring         |
| 2. Lower Bearing          | 15. O-Ring                          | 27. Lower Strut       |
| 3. Trunnion Assembly      | 16. Lock Ring                       | 28. Metering Pin      |
| 4. Upper Bearing          | 17. Bearing                         | 29. O-Ring            |
| 5. Nut                    | 18. Extend Stop                     | 30. O-Ring            |
| 6. Wheel Straightener     | 19. Shim                            | 31. Pin Base Plug     |
| 7. External Retainer Ring | 20. O-Ring                          | 32. Upper Torque Link |
| 8. Spacer                 | 21. Packing Support Ring            | 33. Washer            |
| 9. Spacer                 | 22. O-Ring                          | 34. Lower Torque Link |
| 10. Bolt                  | 23. Backup Ring                     | 35. Nose Wheel Yoke   |
| 11. Cotter Pin            | 24. Scraper Ring                    | 36. Bracket           |
| 12. Valve Assembly        | 25. Retainer Ring                   | 37. Yoke Hub          |
| 13. Pin                   |                                     | 38. Stop Assembly     |

- h. Disassemble upper strut (1) as follows:
1. Remove cotter pin (11), pin (13) and bearing (2).
  2. Remove orifice piston support assembly (14) through lower end of upper strut.
  3. Remove O-ring (15) from orifice piston support head.
  4. If desired, orifice piston and tube can be removed from orifice piston support assembly by removing eight screws.

## NOTE

These three parts are drilled and tapped on assembly. Mark each part before disassembly, and reassemble in the same position to assure proper mating of parts.

- i. Disassemble lower strut (27) as follows:
1. Remove lock ring (16) and bearing (17) from upper end of strut.
  2. Remove shim (19), packing support ring (21), scraper ring (24), packing retainer ring (25), and lock ring (26).

## NOTE

Shim (19) is installed as required, and may not be found on all struts.

3. Remove O-rings (20 and 22) and backup rings (23) from packing support ring (21).
4. Remove the metering pin base plug (31) by removing the nut and bolt, and removing through the hole provided in the top of nose wheel yoke hub (37).
5. Remove metering pin (28) from pin base plug (31) by removing nut and O-ring (29). Remove outer O-ring (30) from pin base plug.
6. Remove yoke and bracket assembly.

## NOTE

Lower strut (27) and yoke hub (37) are a press fit and drilled on assembly. Disassembly is not recommended.

## Assembly of Nose Gear. (See figure 4-13.)

Before each component of the nose gear shock strut is assembled, assure that it is thoroughly clean, then lubricate with system hydraulic fluid.

- a. Assemble lower strut (27) as follows:
1. Carefully work O-ring (29) over threads of metering pin (28) and install in pin base plug (31) with nut.
  2. Install O-ring (30) in groove on outside of pin base plug (31).
  3. Insert pin base plug (31) with metering pin and O-ring assembled, into lower end of strut, through the hole provided in top of nose wheel yoke hub (37).
  4. Align mounting holes and install bolt and nut.

## NOTE

If a new pin base plug is being installed, insert into strut to a depth of  $.380 \pm .03$  inches from the lower end of the strut to the lower

end of the pin base plug as illustrated in figure 4-13. Using the existing holes in the strut, drill and ream pin base plug to .313 inch (plus .003, minus zero inch).

5. Install O-ring (20) in groove provided on outside of packing support ring (21). Install O-ring (22) and backup rings (23) in groove provided on inside of packing support ring (21), with O-ring (22) between the two backup rings.

## NOTE

Lubricate O-ring (20) or tape sharp edges of lower strut to prevent O-ring damage.

6. Slide over the top of lower strut (27) in the order mentioned, the following parts: lock ring (26), retaining ring (25), scraper ring (24), packing support ring (21), shim (19) and extend stop (18).

## NOTE

Install shim (19) as required to remove end play from packing support ring (21), when installed in upper strut.

7. Install bearing (17) and lock ring (16) on upper end of strut.

## NOTE

Bearing (17) must be installed with the chamfered edge up to accept lock ring (16) on upper end of strut.

- b. Assemble upper strut (1) as follows:
1. Install O-ring in groove provided on orifice piston support assembly (14).
  2. Insert orifice piston support assembly (14) into lower end of upper strut (1), slide bearing (2) down past the holes for pin (13), align the holes and install pin (13) and cotter pin.

## NOTE

The upper strut and orifice piston support assembly (14) are drilled on assembly. If a new orifice piston support assembly is being installed, align the pilot hole provided in the new support and drill and ream to .313 inch (plus .003, minus zero inch).

- c. To assemble lower strut (27) to upper strut (1).
1. Insert lower strut into upper strut, slide packing support ring (21), scraper ring (24), and retaining ring (25) into lower end of upper strut (1). Secure with lock ring (26).

## NOTE

The nose strut extend stop (18) is installed between bearing (17) and packing support ring (21).

2. Install torque links (32 and 34) and stop assembly (38) with bolts, washers, shim, spacers, nuts,

and cotter pins.

d. Assemble upper strut (1) to trunnion assembly (3) as follows:

1. Insert upper strut into trunnion assembly and install upper bearing (4).
2. Align hole in trunnion assembly (3) with mounting hole in upper strut (1) and install bolt, spacers, wheel straightener (6) and nut.
3. Install external retainer ring (7) in groove at upper end of strut.
- e. (See figure 4-12.) If needle bearings (10) were removed from retainers, press into place. Install retainers (11) on support tubes (9).
- f. Install shimmy dampener.
- g. (See figure 4-12.) Install mud guard and scraper assembly (14) with bolts and nuts.

#### NOTE

Mud guard and scraper assembly must have a minimum clearance of .70 inch at the center of the tire tread, with side clearance divided equally. Side clearance adjustment is provided by eye-bolts (15).

- h. Install wheel and tire assembly.
- i. With strut completely deflated, fill with MIL-H-5606A hydraulic fluid and install valve body. Do not inflate strut at this time.

Installation of Nose Gear. (See figure 4-12.)

- a. Place nose gear in the wheel well and turn into position for installation. Force nose gear forward and align mounting holes.

#### NOTE

To facilitate installation, rub wax or paraffin on the wheel well bulkheads against which the retainers must slide, and move forward evenly.

- b. Install eight bolts, washers and nuts attaching retainers (11) to airframe. Torque to 85 ±15 pound-inches.
- c. Install nose gear steering assembly (17).
- d. Install two bolts, washers and nuts in each side of wheel well; removed from nose well doubler (12).
- e. Install retracting linkage as follows:
  1. Place truss assembly (6) in position and install bolts, washers and nuts attaching truss assembly to retainers (7).
  2. Attach the electrical wires and nose gear DOWN indicator switch (16) to truss assembly (6).
  3. Attach retracting arm (3) to connector link (1) with bolt, washer and nut.
  4. Attach drag brace (13) to trunnion (8) with bolt, washer and nut.
- f. Install taxi light in accordance with Section 14.
- g. Check rigging of nose gear steering system.
- h. Check rigging of nose gear retracting linkage.
- i. Connect nose gear doors and check door rigging.
- j. Remove jacks and inflate strut in accordance with Section 2.

Removal and Disassembly of Nose Gear Torque Link Assemblies. (See figure 4-13.)

#### NOTE

Deflate nose strut before removing or disconnecting nose gear torque link assembly.

- a. Remove cotter pins, nuts, washers, shims and bolts attaching torque links to struts and attaching upper torque link to lower torque link.

#### NOTE

Observe thickness, number, and position of all shims and washers before removing bolts.

- b. Remove nose gear torque links by pulling forward.
- c. Remove spacers (9) from torque links.

#### NOTE

Torque link bushings are a press fit, and should be removed only for replacement.

Assembly and Installation of Nose Gear Torque Link Assembly. (See figure 4-13.)

- a. If new bushings are installed, insure that holes in bushings are aligned with grease fitting.

#### NOTE

When replacing bushings, add two AN960-716 washers between the upper and lower torque links.

- b. Insert spacers (9) into torque links.
- c. Position torque links and install bolts, washers, shims, nuts and cotter pins.

#### NOTE

Shims and washers should be installed in the same position from which they were removed.

- d. Inflate and service strut in accordance with Section 2.
- e. Lubricate torque links in accordance with Section 2.

Removal of Nose Gear Doors. (See figure 4-14.)

- a. Remove forward nose gear door (11) as follows:
  1. Disconnect door (11) from strut by removing cotter pins and pins.
  2. Remove door (11) by removing cotter pin, washer and pin.
- b. Remove either main nose gear door (1) as follows:
  1. Disconnect door link tube (20) from hinge (18) by removing cotter pin and pin.
  2. Remove door by removing nuts, washers, spacers and bolts attaching hinges (2 and 18) to hinge brackets (16 and 5).
  3. If desired, center hinge (18) can be removed

from door by removing four nuts, washers and screws.

#### Installation of Nose Gear Doors. (See figure 4-14.)

- a. Install either main nose gear door (1) as follows:
  1. If removed, install center hinge (18) with four screws, washers and nuts.
  2. Place door in position and attach hinges (2 and 18) to hinge brackets (5 and 16) with bolts, spacers, washers and nuts.
  3. Attach door link tube (20) to hinge (18) with pin and cotter pin.
- b. Install forward nose gear door (11) as follows:
  1. Place door (11) in position and install pin, washer, and cotter pin.
  2. Attach door to strut with pins and cotter pins.
- e. If new components have been installed, or connecting linkage adjustments have been changed, rig nose gear doors.

#### Rigging of Nose Gear Doors. (See figure 4-14.)

- a. Jack aircraft in accordance with Section 2.
- b. Disconnect main door link tubes (20) from center hinges (18) by removing cotter pins and pins.
- c. Using the normal landing gear retraction system, operate gear to the UP position.

#### NOTE

The use of an external power source is recommended for operation of electrical units while engines are not being operated.

#### CAUTION

When operating gear before door rigging is completed, be prepared to stop before damage can occur.

- d. Adjust ends of tie rod assembly (8) until forward door closes snugly when gear is in the UP position.
- e. Connect and adjust main door link tubes (20) until main doors close snugly when gear is in the UP position.
- f. Extend and retract gear, check for clearance between nose tire and doors, and readjust door link tubes (20) as necessary to obtain clearance.
- g. Insure that landing gear is DOWN, then remove jacks.

#### Removal of Nose Gear Retracting Linkage. (See figure 4-15.)

- a. Jack aircraft in accordance with Section 2.
- b. Remove pilot's seat and carpet in accordance with Section 3.
- c. Remove access hole covers from left cabin floor and underside of fuselage beneath landing gear actuator.
- d. Disconnect nose gear main doors.
- e. Release tension on retracting linkage by engaging manual extension crank and operating a few turns toward the UP position.

#### NOTE

Prior to any operation of the gear by the manual extension crank, assure that there is no electrical power on the aircraft; or that the landing gear switch is in the neutral position.

- i. Remove forward push-pull tube (17) as follows:
  1. Remove nut and bolt attaching push-pull tube (17) to fork bolt (18).
  2. Remove nut, washer and bolt attaching push-pull tube (17) to connector link (21).

#### NOTE

During removal of nose gear linkage, manually move gear as required for access to attaching bolts and nuts.

- g. Remove nose gear drive tube (1) as follows:
  1. (See figure 4-1.) Using the normal landing gear retraction system, operate landing gear to the UP position. From underside of fuselage, remove cotter pin, nut, washer and bolt attaching drive tube (42) to landing gear actuator lower bellcrank (50).

#### NOTE

The use of an external power source is recommended for operation of electrical units while engines are not being operated.

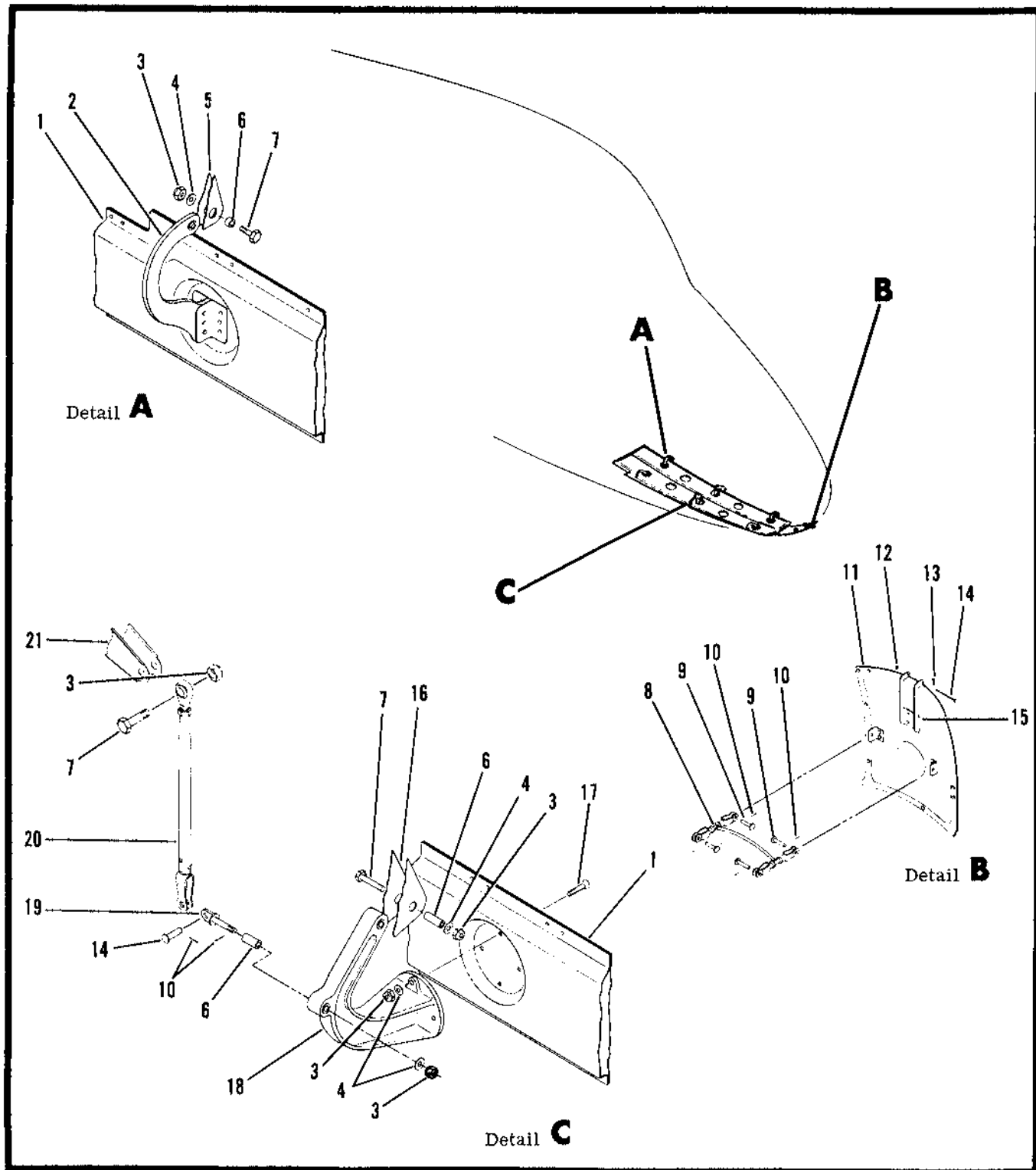
2. Move drive tube (1) forward as far as possible to gain access to idler bellcrank (7) attachment point and remove nut, washer, spacers and bolt.
- h. Remove intermediate push-pull tube (5) as follows:
  1. Remove nut, washer, spacers and bolt attaching push-pull tube (5) to idler bellcrank (7).
  2. Remove nut and bolt attaching push-pull tube (5) to outboard bellcrank (14).
  - i. Remove idler bellcrank (7) by removing bolt and washers. Remove spacer from idler bellcrank.

#### NOTE

Access to bolt for removal at idler bellcrank (7) is provided by a hole in the cabin floor above the bolt head.

- j. Remove torque tube (12) as follows:
  1. Remove adjusting bellcrank (9) by removing cotter pin and pin. If desired, fork bolt (18) can be removed from adjusting bellcrank.
  2. Remove inboard support bearing (10) by removing four nuts and bolts. Remove washer (4).
  3. Pull torque tube (12) inboard until it clears outboard support bearing (15), then tilt the outboard end upward and remove from nose section. Remove washer (4).
  4. If desired, outboard support bearing (15) can be removed by removing attaching nuts and bolts.
  5. Remove stop collar (11) from torque tube by removing cotter pin and pin.

## BRAKE SYSTEM



1. Nose Gear Main Door
2. Hinge
3. Nut
4. Washer
5. Bracket
6. Spacer
7. Bolt

8. Tie Rod Assembly
9. Pin
10. Cotter Pin
11. Nose Gear Forward Door
12. Washer
13. Cotter Pin
14. Pin

15. Hinge
16. Bracket
17. Screw
18. Hinge
19. Eye Bolt
20. Door Link Tube
21. Door Actuator Arm

Figure 4-14. Nose Gear Doors Installation

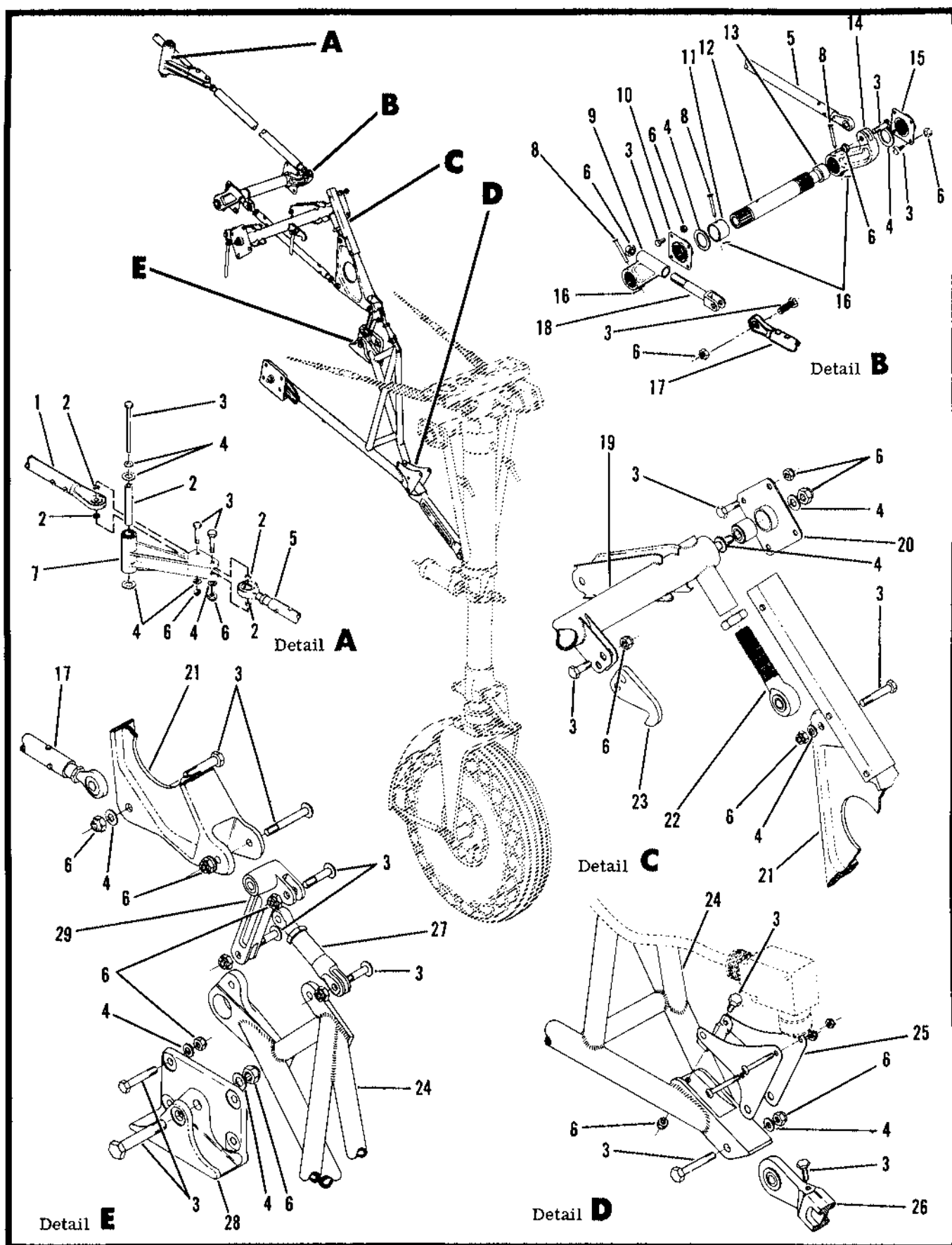


Figure 4-15. Nose Gear Retracting Linkage



Figure 4-15. Nose Gear Retracting Linkage Callouts

- |                                |                              |                             |
|--------------------------------|------------------------------|-----------------------------|
| 1. Nose Gear Drive Tube        | 11. Collar                   | 20. Bearing Assembly        |
| 2. Spacer                      | 12. Torque Tube              | 21. Connector Link Assembly |
| 3. Bolt                        | 13. Collar                   | 22. Adjusting Rod End       |
| 4. Washer                      | 14. Outboard Bellcrank       | 23. Uplock Hook             |
| 5. Intermediate Push-Pull Tube | 15. Outboard Support Bearing | 24. Truss Assembly          |
| 6. Nut                         | 16. Cotter Pin               | 25. Switch Bracket          |
| 7. Idler Bellcrank             | 17. Forward Push-Pull Tube   | 26. Drag Brace              |
| 8. Pin                         | 18. Fork Bolt                | 27. Adjusting Fork          |
| 9. Adjusting Bellcrank         | 19. Uplock Torque Tube       | 28. Retainer                |
| 10. Inboard Support Bearing    |                              | 29. Retracting Arm          |

**NOTE**

Removal of collar (13) and outboard bellcrank (14) from torque tube (12) is not recommended. These are matched parts and collar (13) is a press fit.

## k. Remove connector link assembly (21) as follows:

1. Remove bolt and nut attaching connector link assembly (21) to retracting arm (29).
2. Remove nut, washer and bolt attaching connector link assembly (21) to adjusting rod end (22).

**NOTE**

Access to bolt for removal at adjusting rod end (22) is provided by a hole in the adjacent structure. Rotate connector link assembly to align hole.

## l. Remove drag brace (26) as follows:

1. Remove nut, washer, and bolt attaching drag brace (26) to truss assembly (24).
2. Remove nut and bolt attaching drag brace to strut.

## m. Remove uplock torque tube (19) as follows:

1. Remove nut and washer from each end of torque tube.

**NOTE**

Uplock torque tube (19) can be removed with left bearing assembly in place.

2. Remove bearing assemblies (20) by removing attaching nuts and bolts.

**NOTE**

Bearings are a press fit, and should be removed from supports only for replacement.

3. If desired, uplock hook (23) and adjusting rod end (22) can be removed from uplock torque tube.

n. Remove truss assembly (24), retracting arm (29), and adjusting fork (27) as an assembly as follows:

1. Remove nut and bolt attaching switch bracket (25) to truss assembly (24).
2. Remove clamps attaching wires to retracting linkage and tie switch where it will not interfere with linkage removal.
3. Remove nuts, washers and bolts attaching truss

assembly (24) to retainers (28).

4. Pull truss assembly (24) forward and remove from the aircraft.

5. If desired, retracting arm (29) and adjusting fork (27) can be removed from truss assembly by removing attaching nuts and bolts.

6. If desired, retainers (28) can be removed from aircraft by removing nuts, washers and bolts.

Installation of Nose Gear Retracting Linkage. (See figure 4-15.)

## a. Install truss assembly (24) as follows:

1. If removed, install retracting arm (29) and adjusting fork (27) on truss assembly.

**NOTE**

Lower retracting arm (29) bolt is inaccessible after truss assembly is installed.

2. If removed, install retainers (28) with bolts, washers and nuts.

3. Place truss assembly (24) in position and attach to retainers with bolts, washers and nuts.

4. Install clamps attaching wires to retracting linkage and attach switch bracket (25) to truss assembly with bolt and nut.

## b. Install uplock torque tube assembly (19) as follows:

1. If removed, attach uplock hook (23) and adjusting rod end (22) to uplock torque tube.

2. Install left bearing assembly, then place uplock torque tube in position and install right bearing assembly. Install bearing assemblies (20) with bolts and nuts.

3. Install washer and nut on each end of uplock torque tube assembly.

## c. Install drag brace (26) as follows:

1. Attach drag brace (26) to truss assembly (24) with bolt, washer and nut.

**NOTE**

When installing bolt, insure that down indicator switch bracket (25) is properly in place.

2. Connect drag brace (26) to strut with attaching bolt and nuts.

## d. Install connector link assembly (21) as follows:

1. Attach connector link assembly (21) to retracting arm (29) with bolt and nut.
2. Attach connector link assembly (21) to adjusting

rod end (22) with bolt, washer and nut.

## NOTE

Access to bolt for installation of adjusting rod end (22) is provided by a hole in the adjacent structure. Rotate connector link assembly to align hole.

e. Install torque tube (12) as follows:

1. Install stop collar (11) on torque tube with pin and cotter pin.

## NOTE

Bellcrank (14) and collar (13), located at the outboard end of torque tube (12), are mated to the torque tube and drilled on assembly. These three parts must be assembled before installation.

2. If removed, install outboard support bearing (15) with bolts and nuts.

## NOTE

Torque the nuts attaching inboard and outboard support bearings to 13.5 ± 1.5 pound-inches.

3. Install outboard washer on torque tube and place in position.

## NOTE

Insert inboard end of torque tube through the inboard mounting hole from the left, pull into wheel well area until outboard end of torque tube can be inserted into outboard support bearing.

4. Place inboard washer, then inboard support bearing (10) on inboard end of torque tube. Install support bearing with bolts and nuts.
5. If removed, install fork bolt (18) in adjusting bellcrank (9).
6. Install adjusting bellcrank (9) on torque tube with pin and cotter pin.

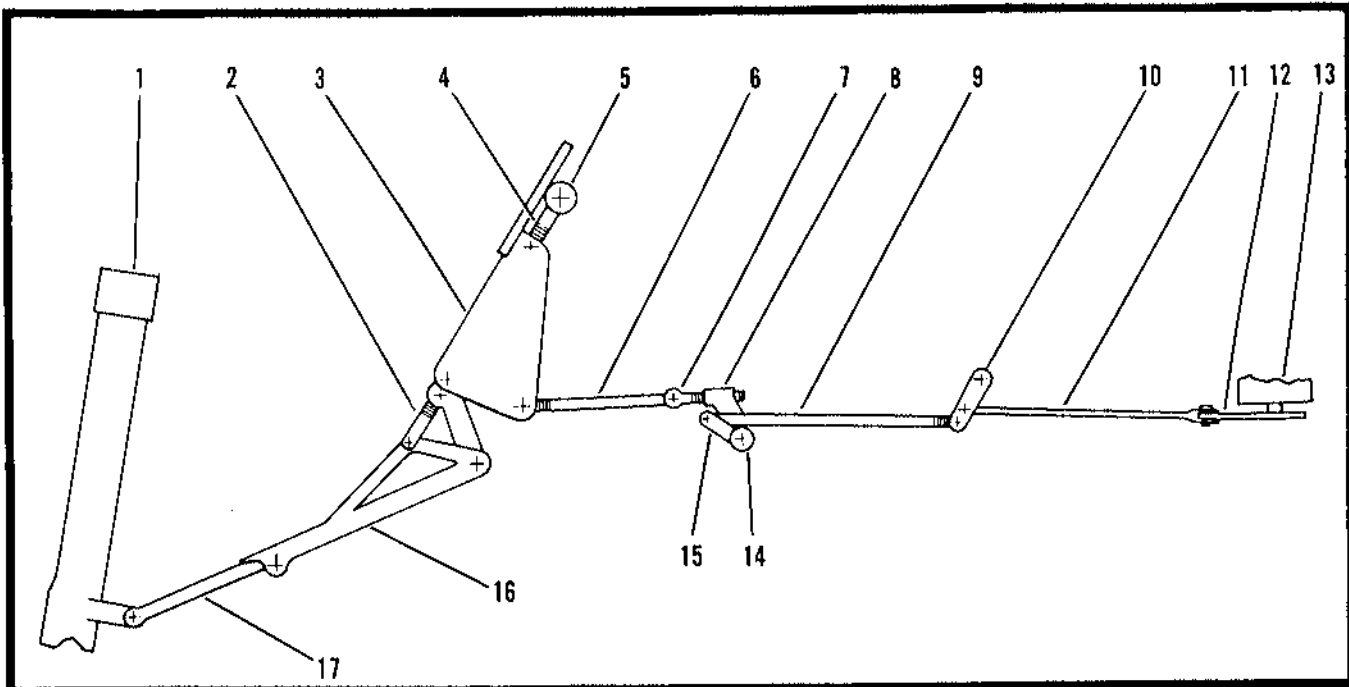
## NOTE

Splines must align so that pin can be installed, and bellcranks (9 and 14) both extend forward from torque tube.

- f. Insert spacer into idler bellcrank (7), place bellcrank in position, and install with bolt and washers.
- g. Install intermediate push-pull tube (5) as follows:
  1. Attach push-pull tube (5) to outboard bellcrank (14) with bolt and nut.

## NOTE

The collar-end of the forward horizontal hi-



- |                           |                                |                           |
|---------------------------|--------------------------------|---------------------------|
| 1. Nose Gear Strut        | 7. Fork Bolt                   | 12. Actuator Bellcrank    |
| 2. Adjusting Fork         | 8. Adjusting Bellcrank         | 13. Landing Gear Actuator |
| 3. Connector Link         | 9. Intermediate Push-Pull Tube | 14. Torque Tube Assembly  |
| 4. Adjusting Rod End      | 10. Idler Bellcrank            | 15. Outboard Bellcrank    |
| 5. Uplock Torque Tube     | 11. Nose Gear Drive Tube       | 16. Truss Assembly        |
| 6. Forward Push-Pull Tube |                                | 17. Drag Brace            |

Figure 4-16. Schematic of Nose Gear Retracting Linkage

shear rivet must point inboard for clearance.

2. Attach push-pull tube (5) to idler bellcrank (7) with bolt, washer, spacers and nut.

#### NOTE

To gain access to idler bellcrank attachment points, rotate bellcrank forward as far as possible.

- h. Install nose gear drive tube (1) as follows:
  1. Attach drive tube to idler bellcrank (7) with bolt, washer, spacers and nut.
  2. (See figure 4-1.) Attach drive tube (42) to landing gear actuator lower bellcrank (50) with bolt, washer, nut and cotter pin.

#### NOTE

Access to lower bellcrank is gained through an access hole on underside of fuselage.

- i. Install forward push-pull tube (17) as follows:
  1. Using the manual extension system, operate landing gear to the DOWN position, then crank a few turns toward the UP position.
  2. Attach push-pull tube (17) to connector link assembly (21) with bolt, washer and nut.
  3. Attach push-pull tube (17) to fork bolt (18) with bolt and nut.
- j. Rig nose gear retracting linkage in accordance with rigging procedure.
- k. Connect nose gear doors and rig nose gear doors in accordance with rigging procedure.
- l. Install floorboards on cabin floor and access hole covers on underside of fuselage beneath landing gear actuator.
- m. Install carpet and seats in accordance with Section 3.
- n. Insure that landing gear is DOWN, then remove jacks.

Rigging of Nose Gear. (See figure 4-16.)

The following is a procedure for rigging the nose gear. The main landing gear should be properly rigged before rigging the nose gear.

- a. Jack aircraft in accordance with Section 2.
- b. (See figure 4-14.) Remove door link tubes (20) by removing nuts, bolts, cotter pins and pins.
- c. Release tension on retracting linkage by engaging manual extension crank and operating a few turns toward the UP position.

#### NOTE

Prior to any operation of the gear by the manual extension crank, assure that there is no electrical power on the aircraft; or that the landing gear switch is in the neutral position.

- d. Remove forward push-pull tube (6) as follows:
  1. Remove nut and bolt attaching the push-pull tube (6) to fork bolt (7).
  2. Remove nut and bolt attaching the push-pull tube

(6) to connector link (3).

#### NOTE

Because the nose gear drive tube (11) is a fixed length, the idler bellcrank (10) is correctly positioned to the actuator bellcrank (12).

- e. Operate the actuator to the DOWN position, then adjust the length of the intermediate push-pull tube (9) as follows:

1. Disconnect intermediate push-pull tube (9) from outboard bellcrank (15) of torque tube assembly (14).
2. Adjust the length of intermediate push-pull tube (9) so that fork bolt (7) is parallel with the upper flange of the wheel well former adjacent to the fork bolt. The forward end of fork bolt may point downward any amount caused by less than one turn of the push-pull tube.

#### NOTE

When adjusting the length of the intermediate push-pull tube, adjust in full-turn increments. The collar-end of the forward horizontal hi-shear rivet must point inboard for clearance.

- f. Make the following preliminary adjustments:
  1. Screw fork bolt (7) into adjusting bellcrank (8) as far as possible.
  2. Screw adjusting rod end (4) into uplock torque tube (5) as far as possible.
  3. Shorten adjusting fork (2) as much as possible.
  4. Lengthen forward push-pull tube (6) as much as possible, but do NOT install. Insure that rod end is visible through the inspection hole for thread engagement.
  5. (See figure 4-15.) Adjust uplock hook (23) to the end of its adjusting slots in the direction that will prevent hook from fully engaging.

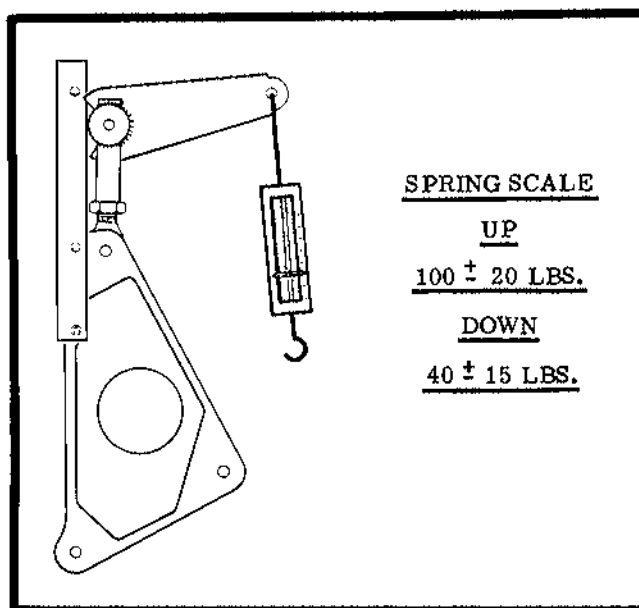


Figure 4-17. Nose Gear Tension Requirements

- g. Adjust connector link (3) as follows:
1. With nose gear DOWN, check the over-center position of connector link (3).

## NOTE

A slight force should be required to snap connector link into its over-center position.

2. Lengthen adjusting rod end (4) in half-turn increments to increase the force required to snap connector link over-center; shorten, to decrease.
3. Manually place nose gear UP, push upward on door actuator arm to lock connector link (3) over-center and check the retracted position.

## NOTE

The nose gear should retract to a position that will align the center of the uplock hook with the spacer provided on the gear for hook engagement.

4. If the retracted position is too low, lengthen adjusting rod end (4) and shorten adjusting fork (2) in half-turn increments.

## NOTE

Since the combined length of adjusting rod end (4) and adjusting fork (2) determines the force required to snap connector link over-center in the DOWN position, this combined length must remain unchanged. When changing the length of adjusting rod end (4) to obtain the correct retracted position, change the length of adjusting fork (2) a corresponding amount in the direction that will not change their combined length.

5. If the retracted position is too high, shorten adjusting rod end (4) and lengthen adjusting fork (2) in half-turn increments. Refer to preceding "NOTE".
- h. Adjust uplock and downlock tensions as follows:
  1. Temporarily install forward push-pull tube (6).
  2. Retract landing gear electrically.

## NOTE

If the auxiliary switch described in paragraph on rigging of main landing gear is not being used to rig the landing gear, use the normal retraction system. The use of an external power source is recommended for operation of electrical units while engines are not being operated.

3. Check the uplock tension at the nose gear door actuator arm, as illustrated in figure 4-17. The force required to move the connector link from its position against uplock torque tube must be  $100 \pm 20$  pounds.
4. Shorten forward push-pull tube (6) in half-turn increments to increase uplock tension, lengthen, to decrease.
5. Operate landing gear to the DOWN position and

check the downlock tension in the same manner. The force required to move the connector link from its position against the uplock torque tube must be  $40 \pm 15$  pounds.

6. Lengthen fork bolt (7) in half-turn increments to increase downlock tension; shorten, to decrease. DO NOT adjust forward push-pull tube (6).

7. Operate landing gear to the UP position and recheck the uplock tension. If necessary, readjust forward push-pull tube (6) in accordance with step "4".

## NOTE

Since the combined length of fork bolt (7) and forward push-pull tube (6) determines the downlock tension, this combined length must remain unchanged. When changing the length of the push-pull tube (6) to obtain the correct uplock tension, change the length of the fork bolt (7) a corresponding amount in the direction that will not change their combined length.

- i. Adjust the uplock hook as follows:

1. With landing gear in the UP position, check the clearance between uplock hook and the spacer on the strut with which the hook engages.
2. Adjust uplock hook to obtain a minimum clearance of .003 inch and a maximum clearance of .06 inch at the closest point, which should be at the underside of the spacer, near the fully engaged position of the hook.

## NOTE

For adjustment of uplock hook, elongated holes are provided in the supports to which the hook is attached.

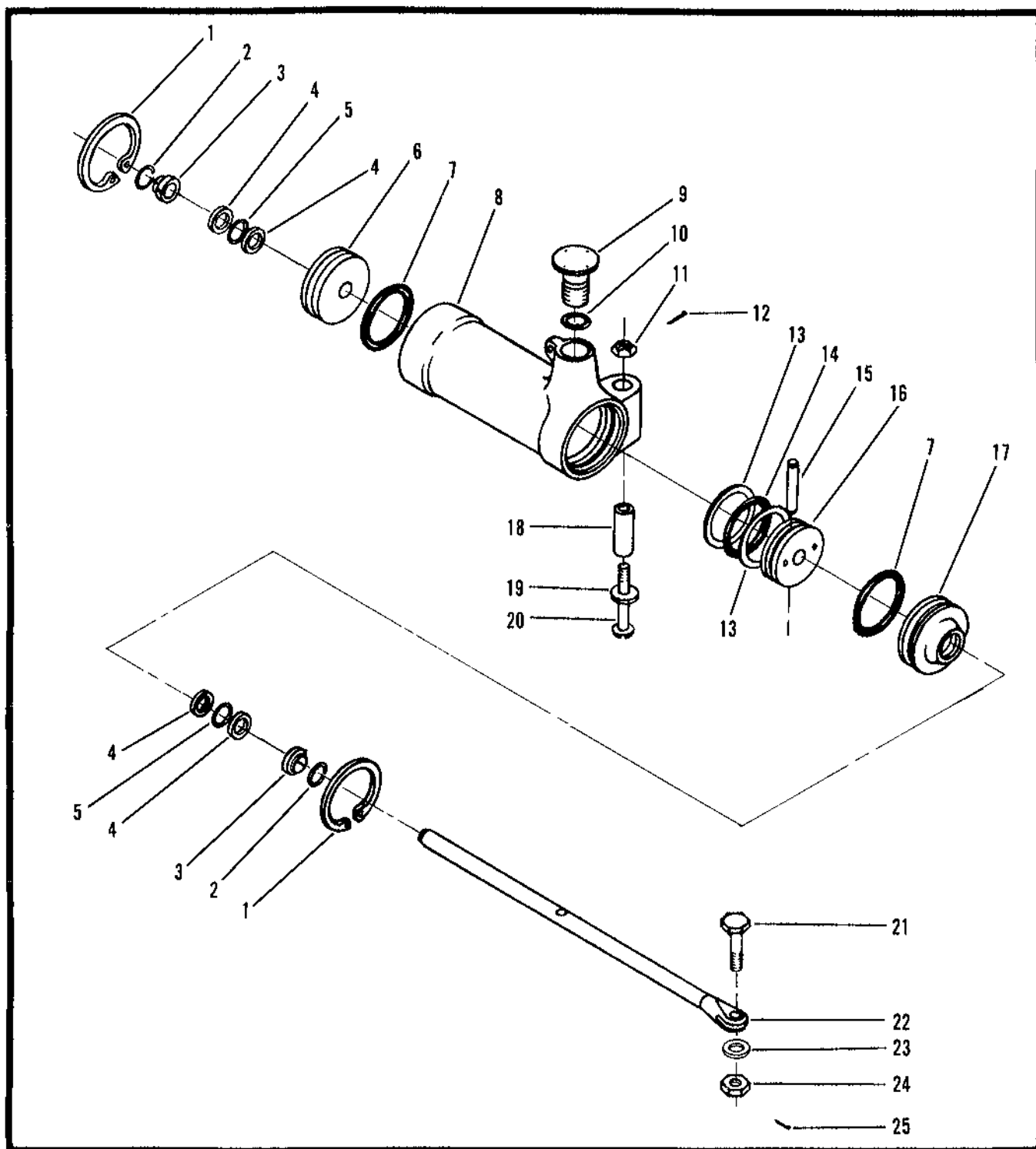
3. Operate landing gear several times to observe the uplock hook. The hook must engage and disengage freely, with no indication of binding between the hook and the spacer.
- j. (See figure 4-14.) Install door link tubes (20) with bolts, nuts, pins and cotter pins, and rig nose gear doors in accordance with rigging procedure.
- k. Insure that landing gear is DOWN, then remove jacks.

Removal of Nose Gear Shimmy Dampener. (See figure 4-18.)

- a. Disconnect piston rod (22) from trunnion assembly by removing cotter pin, nut, washer and bolt.
- b. Remove shimmy dampener from strut by removing cotter pin, nut, bushing, washer and bolt.

Disassembly of Nose Gear Shimmy Dampener. (See figure 4-18.)

- a. Push piston rod (22) into shimmy dampener, remove filler plug (9) and O-ring (10) and drain fluid.
- b. Remove lock ring (1) from forward end of shimmy dampener and pull piston and rod assembly from barrel (8).



1. Lock Ring
2. Internal Retaining Ring
3. Wiper Ring
4. Backup Ring
5. O-Ring
6. Bearing Head
7. O-Ring
8. Barrel
9. Filler Plug

10. O-Ring
11. Nut
12. Cotter Pin
13. Backup Ring
14. O-Ring
15. Roll Pin
16. Piston
17. Bearing Head

18. Bushing
19. Washer
20. Bolt
21. Bolt
22. Piston Rod
23. Washer
24. Nut
25. Cotter Pin

Figure 4-18. Shimmy Dampener

## CAUTION

Remove bearing heads and piston assemblies with care to prevent damage to seals.

- c. Remove O-ring (14) and backup rings (13) from piston (16).
- d. Remove piston (16) from piston rod (22) by removing roll pin (15).
- e. Remove bearing head (17) from piston rod (22).
- f. Remove lock ring (1) from aft end of shimmy dampener and pull bearing head (6) from barrel (8).
- g. Remove outer O-rings (7) from bearing heads (6 and 17).
- h. Remove internal retaining rings (2), wiper rings (3), O-rings (5) and backup rings (4) from bearing heads (6 and 17).

Assembly of Nose Gear Shimmy Dampener. (See figure 4-18.)

Before each component of the shimmy dampener is assembled, assure that it is thoroughly clean, then lubricate with system hydraulic fluid.

- a. Install O-rings (5), backup rings (4), wiper rings (3), and internal retaining rings (2) inside bearing heads (6 and 17).
- b. Install outer O-rings (7) on bearing heads (6 and 17).
- c. Install bearing head (6) in barrel (8) and secure with aft lock ring (1).
- d. Position bearing head (17) on piston rod (22), then assemble piston (16) to piston rod (22) with roll pin (15).
- e. Install O-ring (14) and backup rings (13) on piston (16).
- f. Insert piston and piston rod assembly into barrel (8), slide bearing head (17) into position, and secure with forward lock ring (1).

## CAUTION

Insert piston and bearing heads with care to prevent damage to O-rings.

- g. Completely fill shimmy dampener with MIL-H-5606A hydraulic fluid, and install filler plug (9) and O-ring (10).

## NOTE

For proper operation, shimmy dampener must be completely full of hydraulic fluid, with no trapped air present. Push piston rod into the shimmy dampener to the limit of its travel, then fill with hydraulic fluid. If desired, shimmy dampener can be serviced after installation in accordance with Section 2.

Installation of Nose Gear Shimmy Dampener. (See figure 4-18.)

- a. Place bushing (18) in barrel (8), align mounting holes, and install bolt, washer, nut and cotter pin.

## NOTE

Lubricate bushing (18) with light oil during installation.

- b. Connect the piston rod (22) to the trunnion assembly with bolt, washer, nut and cotter pin.
- c. If not filled with hydraulic fluid during assembly, service shimmy dampener in accordance with Section 2.

## NOSE GEAR STEERING.

The nose gear steering system permits nose gear steering with the rudder pedals, for angles up to 15 degrees, either right or left of center. Spring-loaded nose gear steering cables permit continued free turning action of the nose gear for steering angles greater than 15 degrees, up to a maximum of 55 degrees. Steering arms welded to the rudder torque tubes are connected by the steering cables, to a steering yoke which pivots in a support mounted directly above the nose gear trunnion assembly. When the nose gear is in the DOWN position, the steering yoke is coupled to the nose gear strut by the engagement of a steering cam roller at the top of the strut, with a cam slot in the steering yoke. This roller disengages from the steering yoke when the landing gear is retracted, so that the nose gear steering system will be uncoupled while the aircraft is flying.

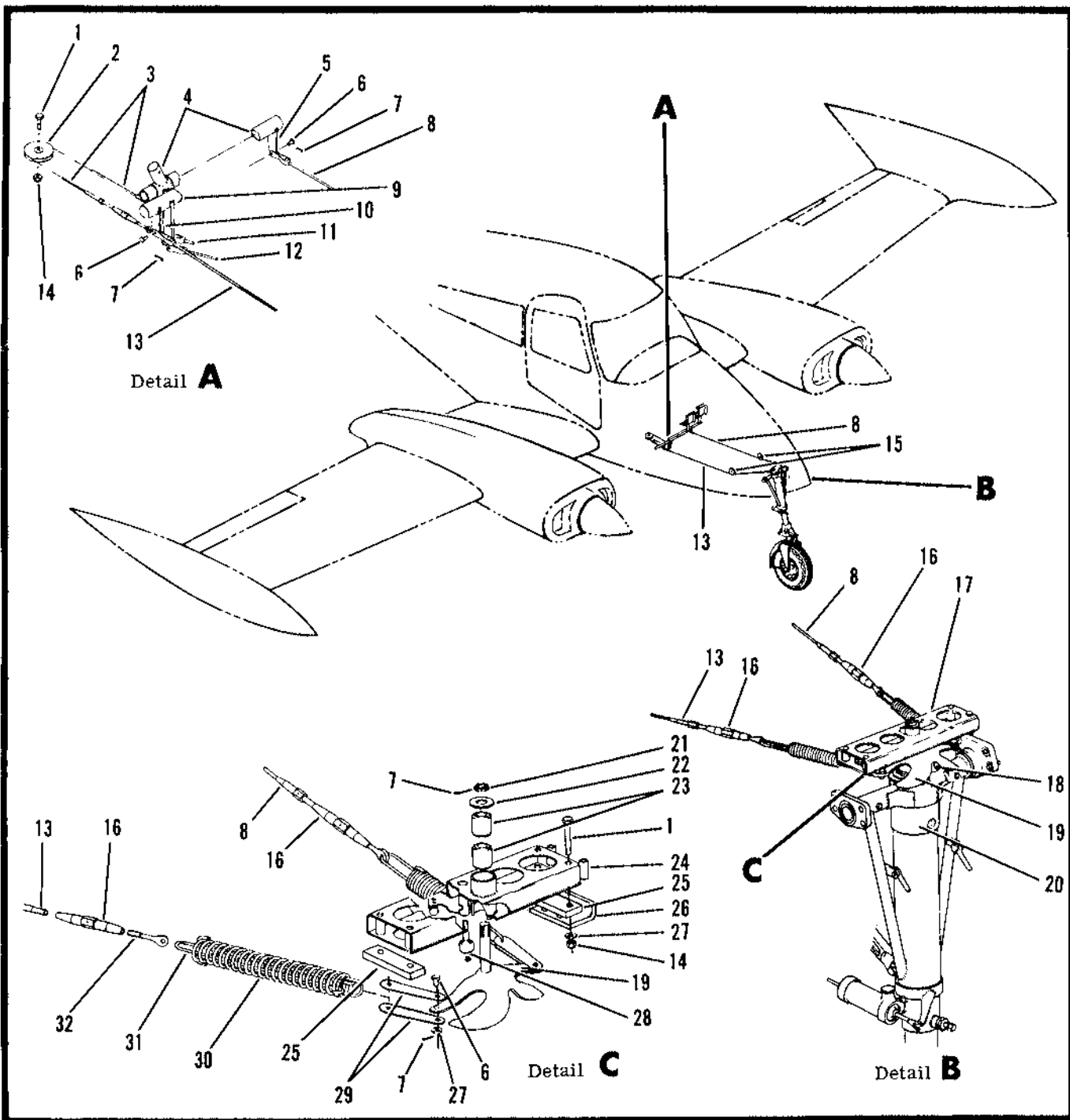
Removal of Nose Gear Steering. (See figure 4-19.)

- a. Remove pilot's and copilot's seats and front carpet in accordance with Section 3.
- b. Remove access hole covers from cabin floor as necessary to gain access to steering cables.
- c. Disconnect left and right steering cables (8 and 13) as follows:
  - 1. Manually turn nose gear to an extreme right or left position to release tension on spring (30).
  - 2. Disconnect nose gear steering cables (8 and 13) by either separating nose gear steering spring components or removing cotter pins, washers and pins from spring links (29).
  - 3. Remove steering cables (8 and 13) from steering arm (5 and 10) by removing cotter pins and pins.

## NOTE

Outboard end of rudder position cable (3) is attached with the same pin used to attach the right steering cable (13) and will be disconnected when right steering cable is released. So tension on opposite cable or rudder cables will have to be released before this pin is removed.

- d. Remove attaching nuts, washers and bolts to remove pulleys (15).
- e. Remove safety from turnbuckles (16) and detach left and right steering cables (8 and 13) from springs (30) by unscrewing turnbuckle barrels (16).



- |                             |                           |                            |
|-----------------------------|---------------------------|----------------------------|
| 1. Bolt                     | 12. Right Rudder Cable    | 22. Washer                 |
| 2. Pulley                   | 13. Right Steering Cable  | 23. Bearing                |
| 3. Rudder Position Cable    | 14. Nut                   | 24. Spacer                 |
| 4. Left Rudder Torque Tube  | 15. Pulley                | 25. Support Spacer         |
| 5. Left Steering Arm        | 16. Turnbuckle            | 26. Bracket                |
| 6. Pin                      | 17. Steering Yoke Support | 27. Washer                 |
| 7. Cotter Pin               | 18. Steering Cam Roller   | 28. Centering Cam Follower |
| 8. Left Steering Cable      | 19. Steering Yoke         | 29. Spring Link            |
| 9. Right Rudder Torque Tube | 20. Trunnion Assembly     | 30. Spring                 |
| 10. Right Steering Arm      | 21. Nut                   | 31. Bail                   |
| 11. Left Rudder Cable       |                           | 32. Turnbuckle Eye         |

Figure 4-19. Nose Gear Steering System

## NOTE

To detach cables from steering yoke when cable removal is not required, turn nose wheel to an extreme right or left position to ease cable tension and disassemble spring by removing bail to which turnbuckle eye is attached.

f. Withdraw left and right steering cables (8 and 13) aft through fairleads in forward cabin bulkhead and remove through access holes in cabin floorboards.

g. Remove four nuts, washers and bolts to remove steering yoke support (17) with components attached. Spacers (24), and support spacers (25) will be released when bolts are removed.

h. Remove springs (30) from steering yoke (19) by removing cotter pins, nut and bolt. Springs can be disassembled to release spring links (29) and turnbuckle eyes (16), by removing bails (31).

i. Remove cotter pin, nut (21) and washer (22) to remove steering yoke (19) from steering yoke support (17). Bearings (23) are a press fit and should be removed only as required for replacement.

a tube welded to the steering yoke support (17) and is secured by a roll pin. Removal of this cam follower is not recommended.

Installation of Nose Gear Steering. (See figure 4-19.)

a. Set steering yoke (19) in place in steering yoke support (17) and secure with washer (22), nut (21) and cotter pin.

b. Place turnbuckle eyes (16) and spring links (29) on bails (31) and assemble spring as illustrated.

## NOTE

Bails should be attached to large ends of spring links.

c. Attach springs (30) to steering yoke (19) with bolt, nut and cotter pins.

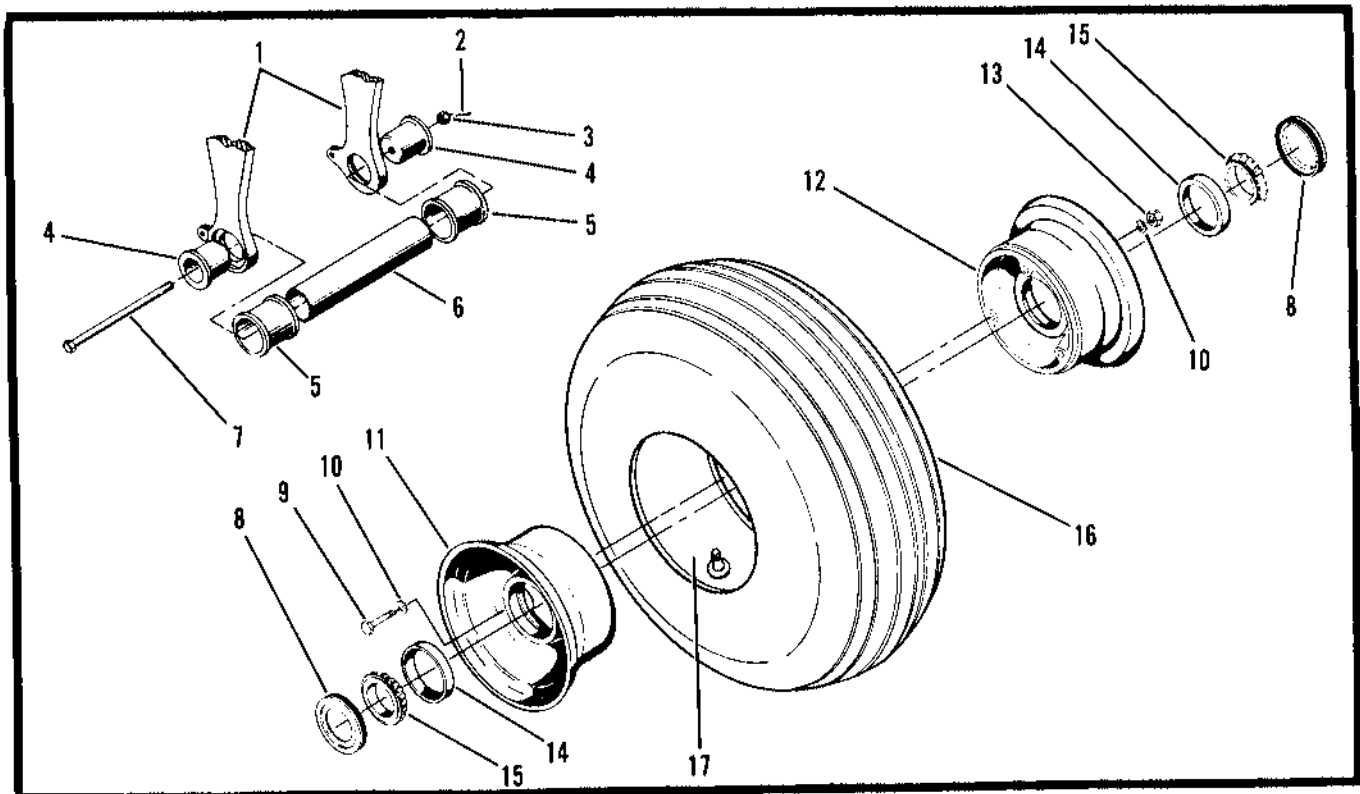
d. Set steering yoke support (17) and support spacers (25) in position on brackets (26). Install bolts, washers and nuts; make sure that spacers (24) are in place.

## NOTE

Centering cam follower (28) is threaded into

## NOTE

When positioning steering yoke support, make



1. Nose Wheel Yoke
2. Cotter Pin
3. Nut
4. Axle Bolt Bucket
5. Spacer
6. Axle Tube

7. Bolt
8. Retainer
9. Bolt
10. Washer
11. Female Wheel Half

12. Male Wheel Half
13. Nut
14. Bearing Cup
15. Bearing Cone
16. Tire
17. Tube

Figure 4-20. Nose Wheel and Tire Assembly



certain that centering cam follower (28) is aft, with cam surface of steering yoke facing forward as illustrated.

e. Position left and right steering cables (8 and 13) forward from floorboard access holes through fairleads in forward cabin bulkhead, with threaded turnbuckle fittings forward.

f. Attach pulleys (15) to pulley brackets, with left and right steering cables (8 and 13) in position around pulleys.

#### NOTE

Cable guard cotter pins are installed through pulley brackets at lower circumference of pulleys (15). If these cotter pins are not in place, they should be installed to prevent cables from leaving pulley grooves.

g. Attach aft ends of left and right steering cables (8 and 13) to left and right steering arms (5 and 10), with pins and cotter pins.

#### NOTE

Outboard end of rudder position cable (3) must be attached to right steering arm (10) with pin and cotter pin which are used to attach right steering cable (13).

h. Connect nose gear steering cables (8 and 13) to turnbuckles (16) and tighten. Rig cables in accordance with Rigging of the Rudder Control System (Section 7); resafety turnbuckles.

i. Install access covers removed.

j. Install carpet and pilot's and copilot's seats in accordance with Section 3.

#### Rigging of Nose Gear Steering.

For nose gear steering rigging, see Section 7, Rigging of Rudder Control System.

#### NOSE WHEEL AND TIRE.

Removal and Disassembly of Nose Wheel and Tire. (See figure 4-20.)

- a. Jack aircraft in accordance with Section 2.
- b. Remove cotter pin (2), nut (3) and bolt (7).
- c. Remove axle bolt buckets (4). After removal of buckets, the wheel and tire assembly can be removed from yoke (1).
- d. Remove spacers (5) and axle tube (6) from wheel.
- e. Remove retainers (8) and bearing cones (15) from wheel.
- f. Remove tire (16) and tube (17) as follows:
  1. Deflate tire and tube by removing valve core.

#### WARNING

Always deflate tire and tube before separating wheel halves.

2. Remove nuts, washers and bolts and separate wheel halves (11 and 12).

3. Remove each wheel half from tire and tube and remove tube from tire.

g. Bearing cups (14) are a shrink fit and should be removed only for replacement.

#### NOTE

If removal of bearing cups is necessary, place wheel half in boiling water for at least 30 minutes, then remove bearing cup by tapping cup evenly from the inner side.

Assembly and Installation of Nose Wheel and Tire. (See figure 4-20.)

- a. If removed, replace bearing cups (14).

#### NOTE

Bearing cups are a shrink fit in wheel. To install, place wheel in boiling water for at least 30 minutes, chill bearing cups with dry ice, and tap lightly into position to insure proper seating.

b. Place wheel halves (11 and 12) in position on tire (16) and tube (17).

c. Install bolts, washers and nuts. Torque nut to value marked on wheel half.

#### CAUTION

Tighten nuts evenly and torque correctly to lessen the possibility of bolt failure.

d. Inflate tire enough to seat the beads on the wheels, deflate completely, then reinflate to approximately one-half operating pressure.

e. Install bearing cones (15) and retainers (8) in the wheel halves (11 and 12).

#### CAUTION

Insure that bearing cones (15) are properly greased before installing.

f. Insert axle tube (6) in wheel and place spacers (5) on end of axle tube.

g. Place wheel and tire assembly in position, align with mounting holes in yoke (1) and install axle bolt buckets (4).

h. Install bolt (7) and nut (3).

#### NOTE

Tighten nut (3) until a slight bearing drag is felt as wheel is rotated. Loosen nut to the nearest slot that will align cotter pin hole.

- i. Install cotter pin.

## MAIN WHEEL AND TIRE.

Removal and Disassembly of Main Wheel and Tire.  
(See figure 4-21.)

- a. Jack aircraft in accordance with Section 2.
- b. Remove snap ring (12), bearing cap (11), cotter pin (13), nut (14) and washer (10) from axle.
- c. Remove brake disc clips from brake side of the wheel as follows:
  1. Turn wheel until a disc clip is opposite the brake unit.
  2. Move brake disc to outer edge of wheel and insert a thin screwdriver, or other suitable tool, between disc clip and wheel.
  3. Pry the inner edge of disc clip out of groove inside the wheel, and pull disc clip out.
  4. Repeat this procedure until all clips are removed.
- d. Remove wheel and tire assembly from axle, using caution to prevent damage to axle threads and to keep bearings clean.
- e. Remove seal (1) and bearing cones (2 and 9) from wheel to prevent them from dropping out of wheel after wheel removal.
- f. Remove tire (18) as follows:

## WARNING

Always deflate tire before separating wheel halves.

1. Deflate tire by removing the valve core with a suitable tool.
2. Remove nuts, washers and bolts and separate wheel halves (4 and 17).
3. Remove each wheel half from tire and remove tire.
4. Remove tube (7) from tire (18).
5. Bearing cups (3 and 8) are a shrink fit and should be removed for replacement only.

## NOTE

If removal is necessary, place wheel half in boiling water for at least 30 minutes, then remove bearing cup by tapping cup evenly from the inner side.

- g. If necessary, remove drive keys (5) by removing screws (6).

## NOTE

Screws (6) are staked to the drive keys (5) and should be removed only for replacement.

Assembly and Installation of Main Wheel and Tire.  
(See figure 4-21.)

- a. If removed, replace disc drive keys (5) and in-

stall retaining screws (6).

## NOTE

When replacing drive keys, prime the contact surfaces, torque retaining screws to 60-10 pound-inches, and stake.

- b. If removed, replace bearing cups (3 and 8).

## NOTE

Bearing cups are a shrink fit in wheel. To install, place wheel in boiling water for at least 30 minutes, chill bearing cups with dry ice, and tap lightly into position to insure proper seating.

- c. Install tube (7) in tire (18).
- d. Place wheel halves (4 and 17) in position on the tire.
- e. Install bolts, washers and nut. Torque nut to value marked on wheel half.

## CAUTION

Tighten nuts evenly and torque correctly to lessen the possibility of bolt failure.

- f. Inflate tire enough to seat the beads on the wheels, deflate completely, then reinflate to approximately one-half operating pressure.
- g. Install bearing cone (2) and seal (1) in wheel half (4).

## CAUTION

Insure that bearing cones (2 and 9) are properly greased before installing.

- h. Place the wheel and tire assembly in position on the axle, aligning brake disc with disc drive keys in wheel.
- i. Install outer bearing cone (9), washer (10) and nut (14).

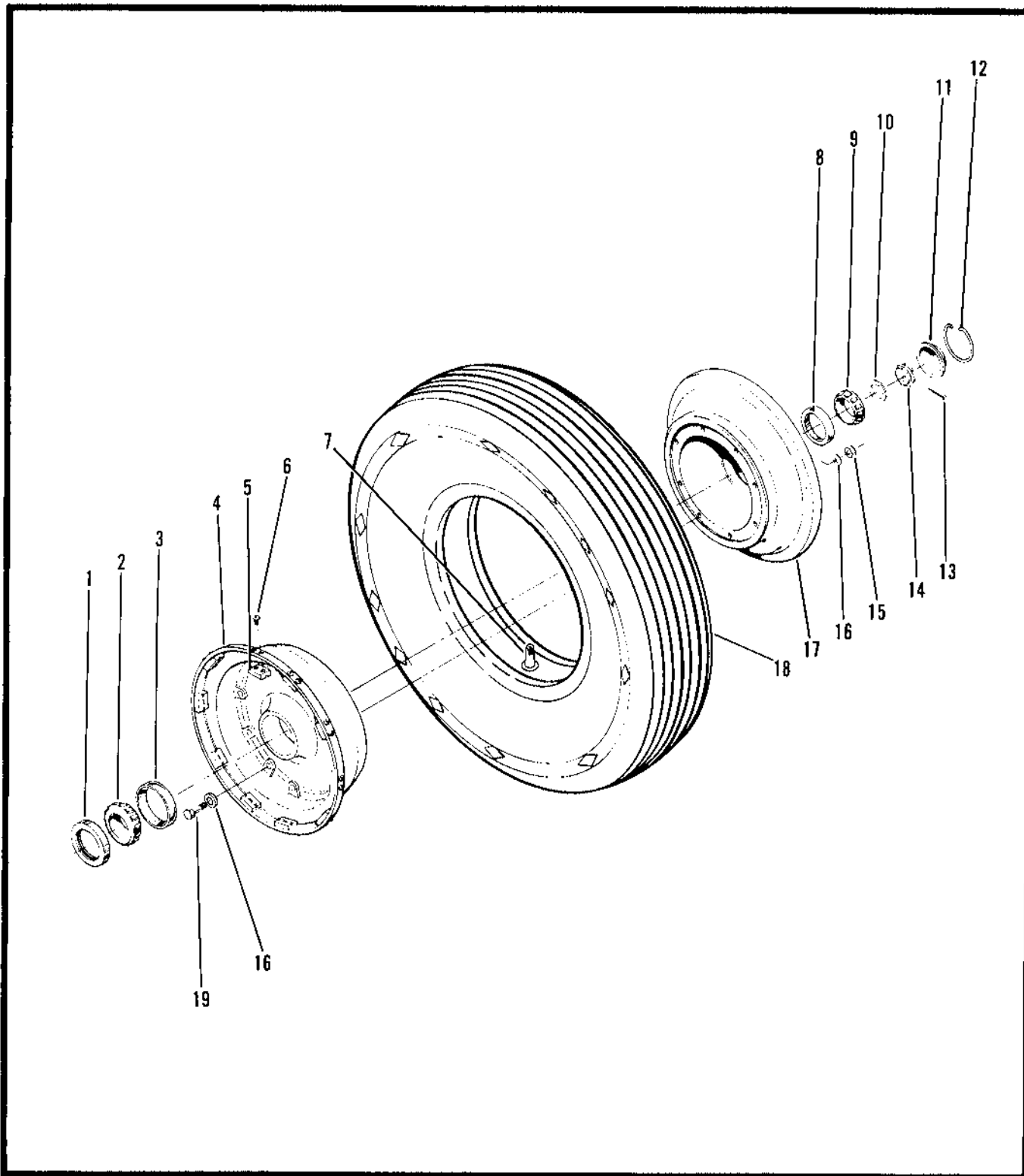
## NOTE

Tighten wheel bearing nut (14) to 40 inch-pounds while rotating wheel, then back off nut and retighten to 20 inch-pounds while rotating wheel. If the nut is not positioned to allow installation of the cotter pin at the 20-inch pound torque, continue tightening to the next locking position that will align the cotter pin hole.

- j. Install cotter pin (13), bearing cap (11) and snap ring (12).

- k. Install brake disc clip as follows:

1. Starting opposite the brake unit, insert disc clip between disc and wheel, and between any two adjacent drive keys.



1. Seal
2. Bearing Cone
3. Bearing Cup
4. Brake Wheel Half
5. Drive Key
6. Screw

7. Tube
8. Bearing Cup
9. Bearing Cone
10. Washer
11. Bearing Cap
12. Snap Ring
13. Cotter Pin

14. Nut
15. Nut
16. Washer
17. No-Brake Wheel Half
18. Tire
19. Bolt

Figure 4-21. Main Wheel and Tire Assembly

2. Install disc clip so that ends of clip contact the disc, and the smaller of the two bent center flanges is inserted first.

3. Press the disc clip into the wheel until the small bent flange seats in the groove provided inside the wheel.

4. Rotate wheel, omit the next space between the drive keys, and repeat the above procedure until all five disc clips are installed.

e. Check that all disc clips are properly installed and that wheel rotates freely, remove jack and inflate tire to correct operating pressure.

Main Wheel Alignment. (See figure 4-22.)

Correct alignment of the main landing wheels is necessary to minimize tire wear. If the tires are wearing excessively or unevenly, the wheel alignment should be checked and corrected in accordance with the following procedure:

a. Position the aircraft with the main wheels resting on grease plates.

#### NOTE

For each set of grease plates, use two aluminum sheets approximately 18 inches square with sufficient grease spread between them to permit the top plates to slide freely on the bottom plates.

b. Set a straightedge in place against the main wheel tires at axle height as illustrated.

c. Place one leg of a carpenter's framing square against the straightedge, with the other leg against the inboard side of the wheel being checked. Measure the distance from framing square leg adjacent to wheel, to wheel rim, at extreme aft circumference of wheel rim. The difference between the two measurements will be the toe-in or toe-out for that wheel. Maximum permissible toe-out for either wheel is .06 ± .05 inch.

#### NOTE

Remove weight from gear by jacking aircraft before attempting to add or remove washers

to torque links. Jack the aircraft in accordance with Section 2.

d. Add washers between torque links to correct for excessive toe-in. Wheel alignment after adjustment must be within limits prescribed in step "c".

#### NOTE

(See figure 4-5.) AN960-716 and AN960-716L washers are used as shims between the upper and lower torque links. Combinations of thick and thin washers can be used between the torque links to obtain the correct wheel alignment. Washers that are added or removed between the torque links must also be added or removed to the outside end of the spacer to maintain an .004 to .020 inch side-play of the torque link. Torque the bolt to one castellation beyond firm. Insure that washers are centered on spacer.

#### BRAKE SYSTEM- MAIN AND PARKING.

The aircraft has a hydraulically actuated main brake system. A hydraulic master cylinder is attached to each pilot's rudder pedal, and hydraulic lines and hoses are routed from these cylinders through the cabin, through the wing, and to the brake assemblies on each main landing gear. The brakes are Good-year single-disc, non self-adjusting type, with two actuating cylinders in each brake assembly. No manual adjustment is required on these brakes. The brake can be operated by applying pressure to either the pilot's or copilot's rudder pedals. The parking brake system consists of a manually operated handle assembly connected to the parking brake torque tube. The parking brake torque tube is connected to the pilot's rudder pedal brake links by two short cables. The parking brake is set by applying pressure to both rudder pedals and then setting parking brake handle.

#### Trouble Shooting Brake System.

| TROUBLE             | PROBABLE CAUSE                                                          | CORRECTION                                                   |
|---------------------|-------------------------------------------------------------------------|--------------------------------------------------------------|
| BRAKE PEDAL BOTTOMS | Insufficient brake fluid in system.                                     | Bleed and fill system in accordance with bleeding procedure. |
|                     | Brake disc warped, causing excessive clearance.                         | Replace disc.                                                |
|                     | Disc clips missing.                                                     | Replace disc clips.                                          |
|                     | Loose bleeder screw, faulty bleeder screw washer, or adaptor not tight. | Tighten bleeder screw. Replace washer. Tighten adaptor.      |

| TROUBLE                       | PROBABLE CAUSE                                                                                  | CORRECTION                                                                                                                           |
|-------------------------------|-------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| BRAKE PEDAL BOTTOMS<br>(CONT) | Leaking connections or broken lines or hoses.                                                   | Tighten connections. Replace or repair lines or hoses.                                                                               |
|                               | Rudder pedals not connected to master cylinders.                                                | Connect pilot's rudder pedals to master cylinders.                                                                                   |
|                               | Damaged O-ring seal in master cylinder or in brake actuating cylinder.                          | Replace O-ring seal.                                                                                                                 |
|                               | Damaged Lock-o-seal in master cylinder.                                                         | Replace Lock-o-seal.                                                                                                                 |
| "SPONGY" BRAKES               | Air trapped in system.                                                                          | Bleed system.                                                                                                                        |
|                               | Expanded hose.                                                                                  | Replace hose.                                                                                                                        |
| BRAKES DRAG                   | Weak or broken piston return spring in master cylinder.                                         | Replace piston return spring.                                                                                                        |
|                               | Binding brake pedal linkage.                                                                    | Free linkage to prevent binding.                                                                                                     |
|                               | Brake disc badly dished.                                                                        | Replace brake disc.                                                                                                                  |
|                               | Brake disc coming out of wheel due to loss of disc clips.                                       | Replace disc clips.                                                                                                                  |
| BRAKES FAIL TO HOLD           | Internally swollen hoses and/or swollen O-ring seals due to improper hydraulic fluid in system. | Replace hoses and/or O-ring seats. Flush system with denatured alcohol. Bleed and fill system in accordance with bleeding procedure. |
|                               | Brake linings worn out.                                                                         | Replace lining in accordance with replacement of brake lining procedure.                                                             |
|                               | New linings just installed.                                                                     | Taxi aircraft and apply brakes several times to condition linings.                                                                   |
|                               | Air in system.                                                                                  | Bleed and fill system in accordance with bleeding procedure.                                                                         |
|                               | Oil, grease or other foreign material on disc or brake linings.                                 | Clean and flush with carbon tetrachloride, then taxi the aircraft slowly, apply the brakes several times to condition the linings.   |
|                               | Rudder pedals positioned so that brakes cannot be fully applied.                                | Reposition pedals.                                                                                                                   |
|                               | Brakes too hot from extensive use.                                                              | Allow time for brakes to cool.                                                                                                       |

## Removal of Brake System. (See figure 4-23.)

- Remove pilot's and copilot's seats in accordance with Section 3.
- Remove front carpets and scuff plates in accordance with Section 3.
- Remove upholstery side panels in accordance with Section 3.
- Remove control column access cover from underside of fuselage by removing attaching screws.
- Remove the rectangular access hole cover from right floorboard adjacent to the aft part of control

pedestal.

- Drain system fluid by removing bleeder screw from both main wheel brake assemblies.
- Remove brake master cylinders.
- Disconnect left master cylinder hose (22) from elbow in web of pilot's left rudder pedal bracket, and remove through access hole.
- Remove left cabin brake line (20) as follows:

## NOTE

As removal of this line requires its destruction.

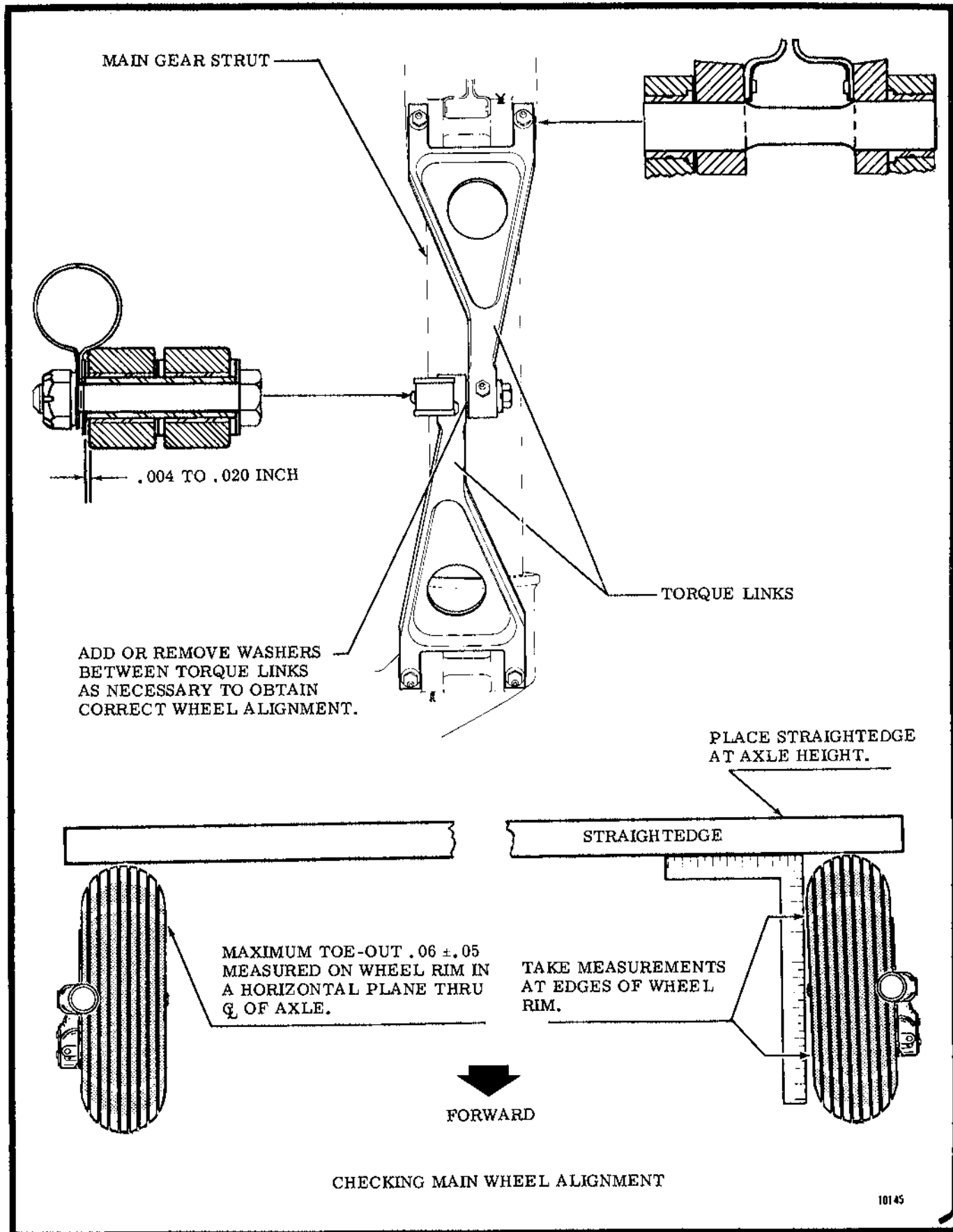


Figure 4-22. Main Wheel Alignment

it is not recommended that it be removed except as required for replacement. Replacement of the factory installed line (20) will require two separate lines (1 and 3) joined with a union (2) just above the floorboard on the forward side of the bulkhead. These parts can be ordered as spares.

1. Cut line at riser portion forward of bulkhead and as close to the floorboard as practical.
2. Loosen coupling nuts from elbows and remove each section of line.
- j. To remove right master cylinder hose:
  1. Disconnect cabin crossover brake line (24) from elbow in web of pilot's right rudder pedal bracket.
  2. Remove attaching nut and washer from elbow to allow its removal from web or rudder pedal bracket. Remove hose (25), with elbow attached, through master cylinder mounting position.
  3. Detach hose from elbow.
- k. Disconnect cabin crossover brake line (24) from elbow in right side of control column well and remove through access hole in left floorboard.
  1. Remove intermediate cabin brake line (26) as follows:

#### NOTE

Due to difficulty of access, it is recommended that this line be removed only as necessary for replacement.

1. Remove attaching nut and washers from elbow in right side of control column well to allow its withdrawal from position.
2. Disconnect line (26) from aft elbow.

#### NOTE

Access to the aft coupling nut on this line is through the forward rectangular access hole in the right floorboard and through the lightening hole in the web of the copilot's left rudder pedal bracket. A 9/16 inch crowfoot wrench and extension can be manipulated through this opening to loosen the coupling nut.

3. Remove line through lightening hole, with elbow still attached, by manipulating forward end outboard and forward, to allow aft end to clear edge of lightening hole.
4. Detach line (26) from elbow.
- m. Disconnect right cabin brake line (29) from elbows. Carefully work line from its position beneath the floorboards, and remove through access hole.

#### CAUTION

It may be necessary to flex this line slightly to facilitate removal. However, excessive bending should be avoided to prevent deformation or other damage to the line.

- n. Remove forward wing root fillets, and the two inboard access hole covers from underside of each wing leading edge.

- o. To remove right and left wing inboard brake lines (19 and 30), disconnect each one from fittings at both ends, and carefully work them free of adjacent lines inside the wings so that they can be removed through the rectangular access holes.
- p. Disconnect right and left wing outboard brake lines (17 and 31) from fittings at both ends, remove clamps and remove lines through main wheel wells.
- q. Disconnect right and left brake hoses (4 and 32) from elbows at their upper ends and detach right and left brake hoses (4 and 22) at lower ends of hoses. Remove two upper hose clamps. To release hoses, remove hose clamps by removing nuts from bolts in main gear torque links. Replace nuts and secure with cotter pins after hose clamps have been removed.
- r. Remove brake hoses (4 and 32) by detaching coupling nuts from fittings in main brake assemblies. Install temporary caps over brake assembly fittings to prevent entry of foreign material.

Installation of Brake System. (See figure 4-23.)

#### NOTE

Use clean system hydraulic fluid only as a lubricant for all hydraulic fittings.

- a. Remove temporary caps from fittings in brake assemblies and attach brake hoses (4 and 32) to fittings.
- b. Attach upper hose ends to elbows. Fasten hoses (4 and 32) in position illustrated. Secure clamps to torque link bolts with nuts. Secure nuts with cotter pins. Attach clamps to upper portion of hoses.
- c. Working through main wheel wells, place right and left wing outboard brake lines (17 and 31) in position and attach ends to elbows as illustrated. Attach clamps.
- d. Working through wing access holes, carefully work right and left wing inboard brake lines (19 and 30) into position and attach ends to elbows as illustrated.

#### CAUTION

Some flexing of the lines may be necessary to work them into position. However, excessive bending should be avoided.

- e. Replace access hole covers and wing root fillets.
- f. Working through aft, right rectangular floorboard access hole, carefully work right cabin brake line (29) into position beneath the floorboard, with outboard end extending upward through routing hole in floorboard. Attach ends to elbows.

#### CAUTION

Some flexing of this line will be required to work it into position. However, excessive bending should be avoided.

- g. Install intermediate cabin brake line (26) as follows:

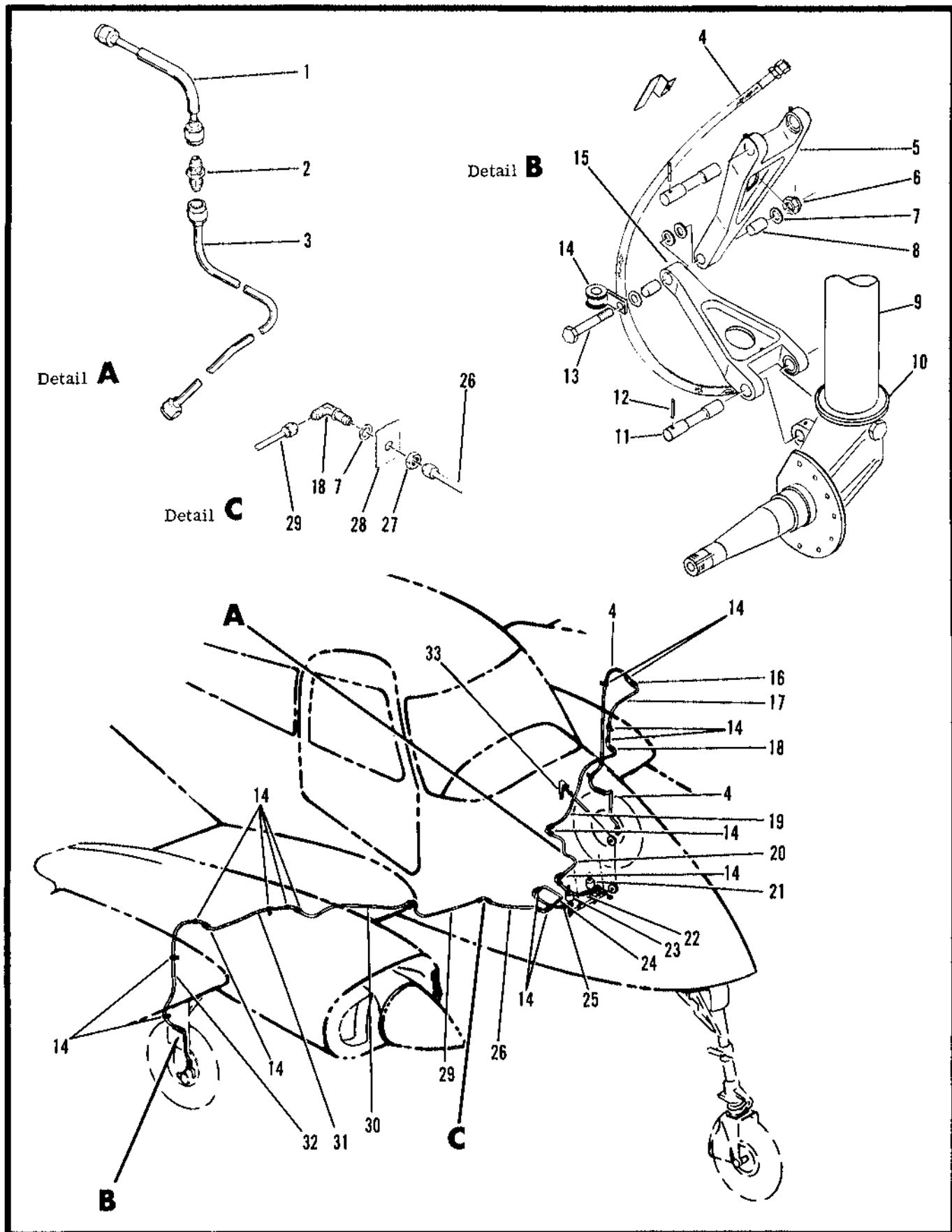


Figure 4-23. Brake System Plumbing



Figure 4-23. Brake System Plumbing Callouts

- |                               |                                   |                                    |
|-------------------------------|-----------------------------------|------------------------------------|
| 1. Left Bulkhead Brake Line   | 13. Bolt                          | 24. Cabin Crossover Brake Line     |
| 2. Union                      | 14. Clamp                         | 25. Right Master Cylinder Hose     |
| 3. Left Floorboard Brake Line | 15. Lower Torque Link             | 26. Intermediate Cabin Brake Line  |
| 4. Left Brake Hose            | 16. Elbow                         | 27. Nut                            |
| 5. Upper Torque Link          | 17. Left Wing Outboard Brake Line | 28. Bulkhead Web                   |
| 6. Nut                        | 18. Elbow                         | 29. Right Cabin Brake Line         |
| 7. Washer                     | 19. Left Wing Inboard Brake Line  | 30. Right Wing Inboard Brake Line  |
| 8. Bushing                    | 20. Left Cabin Brake Line         | 31. Right Wing Outboard Brake Line |
| 9. Barrel Piston              | 21. Left Master Cylinder          | 32. Right Brake Hose               |
| 10. Main Gear Axle Assembly   | 22. Left Master Cylinder Hose     | 33. Parking Brake Handle           |
| 11. Shaft                     | 23. Right Master Cylinder         |                                    |
| 12. Roll Pin                  |                                   |                                    |

1. Attach elbow to forward end of line and set washer in place over elbow.
2. Working through forward right floorboard access hole, and through lightening hole in web of copilot's left rudder pedal bracket, work line (26) into position, with elbow extending through routing hole in right side of control column well.

**NOTE**

Do not allow washer to drop from elbow while working line into position.

3. Using a 9/16 inch crowfoot wrench with extension, attach aft coupling nut on line (26) to elbow.
4. Secure elbow in place at right side of control column well with washer and attaching nut.
- h. Working through left floorboard access hole, position U-shaped cabin crossover brake line (24) beneath left floorboard, with longer leg extending through routing hole in left side of control column well. Attach coupling nut to elbow in right side of control column well.
- i. To install right master cylinder hose (25):
  1. Connect elbow to hose end.
  2. Place washer over elbow, and working aft through right master cylinder mounting position, place elbow with hose attached, into position in routing hole through web of pilot's right rudder pedal bracket.

**NOTE**

Do not allow washer to drop from elbow, while working elbow into position.

3. Secure elbow with washer and nut.
4. Attach coupling nut on cabin crossover line (24) to elbow.
- j. To install left cabin brake line (20):

**NOTE**

If left cabin brake line (20) was removed, three parts which can be ordered as spares are required to replace it. This spares assembly consists of a left floorboard brake line (3), a union (2), and a left bulkhead brake line (1).

1. Join union (2) to short end of left floorboard brake line (3).

2. Position left floorboard brake line beneath left floorboard so that end with union attached extends upward through routing hole in floorboard. Attach coupling nut to elbow.

3. Position left bulkhead brake line (1) through routing hole in bulkhead, and attach coupling nuts to elbow and union (2).

- k. Attach coupling nut on left master cylinder hose (22) to elbow in web of pilot's left rudder pedal bracket.

- l. Replace brake master cylinders (21 and 23).
- m. Fill and bleed brake system in accordance with bleeding procedure.
- n. Replace all access covers removed.
- o. Replace upholstery, carpets and seats in accordance with Section 3.

#### Removal and Disassembly of Main Wheel Brake. (See figure 4-24.)

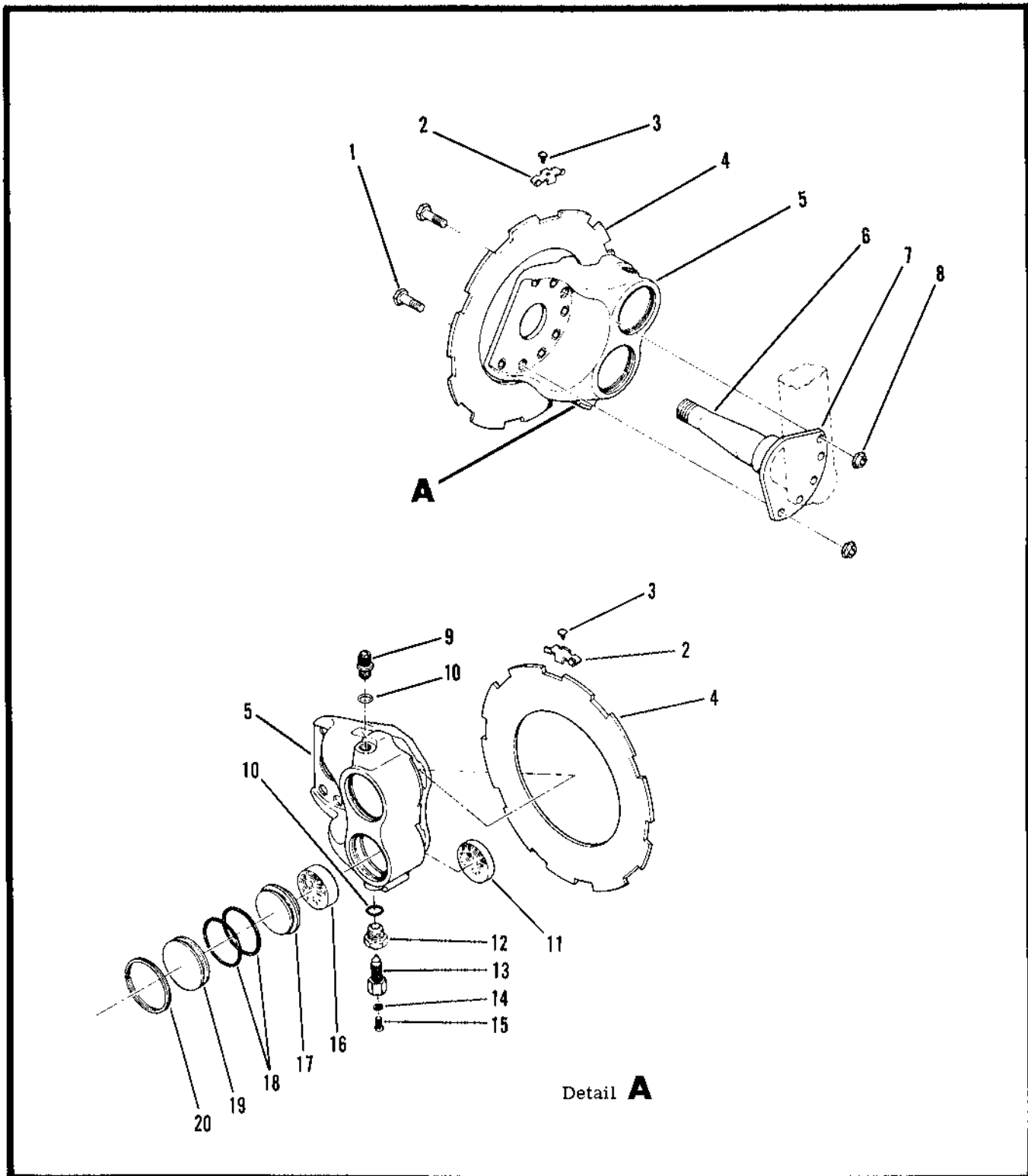
To remove either brake assembly, proceed as follows:

- a. Remove wheel and tire assembly.
- b. Disconnect brake line from union (9) and drain hydraulic fluid into a suitable container. Drain remaining fluid from brake housing (5) by removing bleeder screw (15) and unscrewing plug bleeder (13) until fluid flows from hole in plug bleeder (13). Tighten plug bleeder (13) when housing is drained.
- c. Remove brake housing (5) and brake disc (4) by removing five bolts and nuts.
- d. Remove brake disc (4) and linings (11 and 16) from brake housing (5).
- e. Use snap ring pliers and remove cylinder heads (19).
- f. Push pistons (17) from cylinders.
- g. Remove O-ring seals (18) from pistons (17) and cylinder heads (19).
- h. Remove plug bleeder (13), bleeder adapter (12) and O-ring (10).
- i. Remove union (9) and O-ring (10).

#### Assembly and Installation of Main Wheel Brake. (See figure 4-24.)

Reassemble either brake assembly as follows:

- a. Install union (9) and O-ring (10) in upper inlet port of housing (5).
- b. Install bleeder adapter (12), plug bleeder (13)



1. Bolt
2. Disc Clip
3. Fastener
4. Brake Disc
5. Brake Housing
6. Axle
7. Axle Torque Flange

8. Nut
9. Union
10. O-Ring
11. Anvil Lining
12. Bleeder Adapter
13. Plug Bleeder

14. Washer
15. Bleeder Screw
16. Piston Lining
17. Piston
18. O-Ring
19. Cylinder Head
20. Retaining Ring

Figure 4-24. Main Wheel Brakes

and O-ring (10) into lower inlet port of housing (5), as illustrated.

c. Using clean system hydraulic fluid as a lubricant, set new serviceable O-rings (18) in place on cylinder heads (19) and pistons (17).

d. Lubricate cylinder walls and pistons (17) with clean system hydraulic fluid and insert pistons into cylinders.

e. Install cylinder heads (19) in place, and replace retaining rings (20).

f. Install new or serviceable brake linings (11) and 16), setting piston lining (16) in piston side, with smooth sides of linings facing each other.

g. Set brake disc (4) in place between linings.

h. Position brake housing (5) over axle (6), against axle torque flange (7) so that uppermost hole in the uppermost side of the brake housing (5). Install five bolts and nuts and torque to 100 pound-inches. Tolerance is plus zero and minus 10 pound-inches.

i. Install wheel and tire assembly.

j. Attach brake line coupling nut to union (9).

k. Fill and bleed brake system in accordance with bleeding procedure.

l. Insure that landing gear is DOWN, then remove jacks.

Replacement of Brake Linings. (See figure 4-24.)

#### NOTE

Brake linings should be replaced at overhaul periods and at such time as they become worn beyond limits.

a. Checking brake lining wear.

1. Set the parking brakes to force the brake disc (4) against the anvil linings (11).

2. Check clearance between outboard surface of brake discs (4) and flat surface of brake housing (parallel to the disc) near the center of the disc face. Replace lining if space is (or exceeds)  $3/8$  (.375) inch.

b. Replacement of brake linings.

1. Remove wheel and tire assembly.

2. Remove brake disc (4) from slot in brake housing (5) and remove worn linings (11 and 16).

3. Install new linings (11 and 16) with the thicker piston lining (16) in piston side of housing (5), and the thinner anvil lining (11) in anvil side of housing. Smooth sides of the linings should face to contact brake disc (4).

4. Position brake disc (4) between linings in brake housing (5).

5. Install wheel and tire assembly.

#### NOTE

Before removing jacks, spin wheels to make certain they will turn freely. Apply brakes and check to see that they do not drag when released.

Bleeding the Brake System. (See figure 4-24.)

In order to have proper brake action, it is necessary

to have positive transfer of hydraulic pressure through the system. To insure proper brake action, any air trapped in the system must be removed. This is accomplished by bleeding, which can be done in any one of several different ways. The following procedure is bleeding by pressure with a bleeder pump.

a. Fill reservoir of bleeder pump with clean system hydraulic fluid (see Section 2 for hydraulic fluid specification).

b. Remove filler plug from master cylinder.

c. Remove bleeder screw (15) and unscrew plug bleeder (13) to allow hydraulic fluid to drain from the system into a suitable container.

d. Connect the hose on the bleeder pump to the bleeder valve in the brake housing.

e. Pump slowly until fluid in master cylinder reservoir is within  $1/2$  inch of the top.

f. Close plug bleeder and detach bleeder pump hose connection.

g. Replace bleeder screw and washer in master cylinder and check brake operation.

Parking Brake System.

Removal of Parking Brake System. (See figure 4-25.)

a. Remove pilot's seat, copilot's seat, rudder scuff plate and carpet in accordance with Section 3.

b. To obtain working room beneath the left floorboard, remove left warm air duct in accordance with Section 13.

c. Detach left and right brake cables (15 and 24) from brake links (25) by removing cotter pins, pins and bushings.

d. Disconnect parking brake cable (8) at its upper end by removing cotter pin and pin.

e. Remove handle assembly parts (1, 2, 6 and 11) by removing nuts and bolts. Slide housing assembly (11) and spring (10) from parking brake tube (6), and remove spring from housing. Remove roll pin (1) and handle (2) from parking brake tube (6).

f. Working through nose wheel well, remove nuts, bolts, cable guards and pulleys (12 and 13) from pulley brackets on forward left side of forward cabin bulkhead.

#### NOTE

In some configurations, optional radio equipment is installed on a shelf adjacent to these pulleys. This equipment must be removed to permit access to the pulleys.

g. To remove parking brake torque tube (21) and attached components, proceed as follows:

#### NOTE

Because of difficulty of access removal of parking brake torque tube and attached components is not recommended, except as required for replacement.

1. Remove cotter pin and pin attaching left parking brake coupling (16) to parking brake torque tube (21)

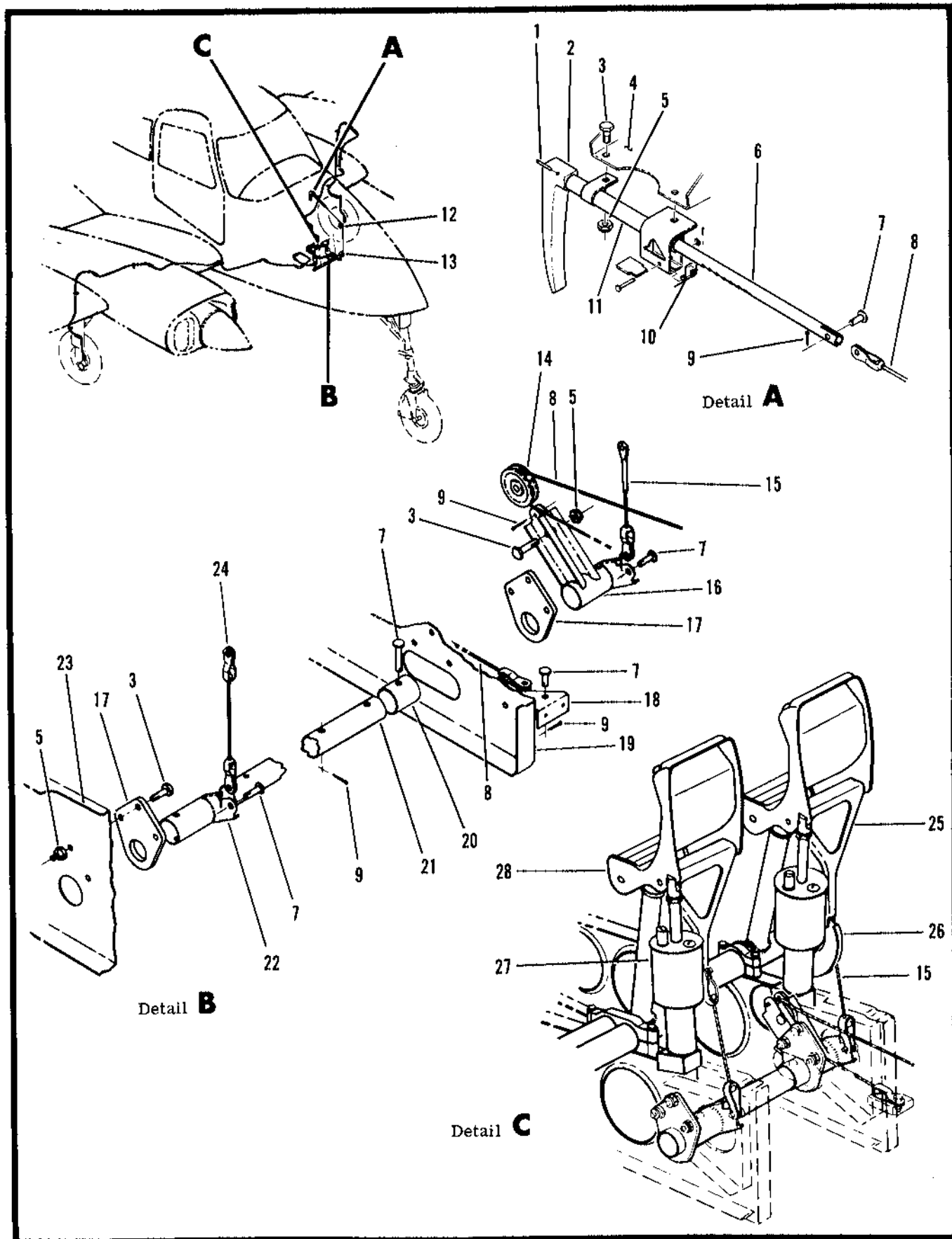


Figure 4-25. Parking Brake System

Figure 4-25. Parking Brake System Callouts

- |                         |                                 |                                  |
|-------------------------|---------------------------------|----------------------------------|
| 1. Roll Pin             | 10. Spring                      | 20. Collar                       |
| 2. Parking Brake Handle | 11. Housing Assembly            | 21. Parking Brake Torque Tube    |
| 3. Bolt                 | 12. Upper Pulley                | 22. Right Parking Brake Coupling |
| 4. Mounting Bracket     | 13. Lower Pulley                | 23. Right Rudder Pedal Bracket   |
| 5. Nut                  | 14. Pulley                      | 24. Right Brake Cable            |
| 6. Parking Bracket Tube | 15. Left Brake Cable            | 25. Brake Link                   |
| 7. Pin                  | 16. Left Parking Brake Coupling | 26. Brake Torque Tube Coupling   |
| 8. Parking Brake Cable  | 17. Torque Tube Support         | 27. Brake Master Cylinder        |
| 9. Cotter Pin           | 18. Cable Bracket               | 28. Rudder Pedal                 |
|                         | 19. Left Rudder Pedal Bracket   |                                  |

and remove from torque tube.

#### NOTE

Due to close tolerances between left parking brake coupling and parking brake torque tube, some difficulty may be encountered in separating these two parts.

Work parking brake coupling (16) aft, clear of the floorboard, with parking brake cable (8) still in place around pulley (14). Remove cotter pins, nut, bolt and pulley (14) to free coupling from parking brake cable (8).

2. Remove three nuts and bolts attaching left torque tube support (17) to left rudder pedal bracket (19) and remove.

3. Slide torque tube (21), with attached components, outboard to clear hole in right torque tube support (17) then work forward to clear the floorboards.

4. Remove three nuts and bolts to remove right torque tube support (17).

5. Further disassembly of removed components can be accomplished as shown in figure 4-25.

h. To remove parking brake cable (8), detach from cable bracket (18) by removing cotter pin and pin, and work free of routing holes in forward cabin bulkhead.

i. Inspect all components for excessive wear, cracks or deformation which could cause failure, and cables for wear or broken strands. Replace defective parts.

Installation of Parking Brake System. (See figure 4-25.)

a. Assemble right parking brake coupling (22) and collar (20) to parking brake torque tube (21) and attach right brake cable (24) as illustrated.

b. Attach right torque tube support (17) to right rudder pedal bracket (23), in position illustrated, using three bolts and nuts.

c. Attach end of parking brake cable (8) to cable bracket (18) with pin and cotter pin. Route other end of cable through lower routing hole in forward cabin bulkhead, leaving a loop of cable accessible through floorboard access hole.

d. Assemble pulley (14) to left parking brake coupling (16) with bolt and nut. Loop of parking brake cable (8) should be in place around pulley (14) as illustrated. Insert cable guard cotter pins, and attach left brake cable (15) as illustrated.

e. Position parking brake torque tube (21) between left and right rudder pedal brackets (19 and 23) with inboard end through hole in right torque tube support (17). Position left torque tube support (17) over outboard end of torque tube (21) as illustrated, and fasten to left rudder pedal bracket (19) with three attaching bolts and nuts.

f. Position left parking brake coupling (16) over end of parking brake torque tube (21) as illustrated, and secure with attaching pin and cotter pin.

g. Pull free end of parking brake cable (8) through upper routing hole in forward cabin bulkhead. Attach pulleys (12 and 13) and cable guards to mounting brackets on forward side of forward cabin bulkhead, with parking brake cable (8) routed around pulleys as illustrated.

#### NOTE

Replace any radio equipment it may have been necessary to remove to gain access to these pulleys.

h. Assemble components of parking brake handle assembly (parts 1, 2, 6 and 11) as illustrated, and attach handle assembly to mounting bracket (4) with bolts and nuts.

i. Connect free end of parking brake cable (8) to parking brake tube (6) with pin and cotter pin.

j. Retrieve free ends of left and right brake cables (15 and 24) through routing holes in floorboards and attach to brake links (25) as illustrated.

k. Replace left warm air duct in accordance with Section 13.

l. Check operation of parking brake system. There should be no binding in the system or interference from the left warm air duct. Brake master cylinders (27) should be positively actuated when parking brake handle (2) is pulled. Parking position of handle (2) should be maintained by action of spring (10) in notches of parking brake tube (6).

m. Replace left carpet, left scuff plate, and left rudder bar shield in accordance with Section 3.

n. Replace pilot's and copilot's seats in accordance with Section 3.

Master Cylinder. (See figure 4-26.)

Each vertical mounting type master cylinder used on the aircraft incorporates a fluid reservoir and cylinder within the same body. A plastic filler plug (3) is used to close the filler opening in the cover (5)

which is threaded into the body. The filler plug is vented, as sufficient ventilation is not provided by clearance between the piston rod (6) and piston rod passage through the cover boss. With the exception of the piston return spring (10), all internal operating parts are assembled onto the piston rod (6), piston (15), piston spring (13), lock-o-seal (17), O-ring (16) and compensating sleeve (18). A seal between the piston (15) and the cylinder walls is provided by an O-ring (14) installed in groove around the piston. As pressure is applied to advance the piston rod into the cylinder, the piston remains stationary until the lock-o-seal is seated on the piston (.040 inch movement). Proper operation of the master cylinder depends upon this seating action. When the lock-o-seal is seated, fluid cannot get past the piston and with continued movement of the piston rod forcing the piston farther into the cylinder, pressure in the cylinder is increased. At any time during the stroke that pressure on the piston is eased, the piston spring will tend to keep the piston seated against the lock-o-seal, maintaining pressure in advance of the piston. As the pressure is further eased, allowing the piston return spring to force the piston to retreat, the upper end of the compensating sleeve will contact the cover boss, forcing the piston to unseat itself from the lock-o-seal. This will allow additional fluid from the reservoir to enter the cylinder. This positive unseating also allows unrestricted passage of fluid from cylinder to reservoir while the piston is in the static position. This is to compensate for any excess fluid which may be present in the system due to pumping or from thermal expansion. The effective stroke of the piston is 1.437 inches with maximum displacement of .633 cubic inch. Reservoir capacity is approximately 3.391 cubic inches.

#### Removal of Master Cylinder. (See figure 4-26.)

Removal of either master cylinder can be accomplished as follows:

- a. Remove pilot's seat, left rudder bar shield, left scuff plate and carpet in accordance with Section 3.
- b. Remove the cover plate from around the master cylinder by removing the four screws with which it is fastened.
- c. Drain the hydraulic fluid from the master cylinder and lines by disconnecting the line at the main wheel brake assembly. Connect the line again after fluid has been drained, to prevent the entry of foreign material into the brake.

#### NOTE

When making connections on hydraulic lines, use only system fluid as a lubricant.

- d. Disconnect clevis (1) from rudder pedal (19) by removing cotter pin and pin.
- e. Disconnect lower end of body (9), by removing cotter pin, pin and spacers.
- f. Disconnect hose from elbow (7) in base of body (9), by lifting master cylinder enough to allow the coupling nut on the hose to be disconnected.
- g. Remove body (9) and install a suitable cap on

the end of the hose to prevent the entry of foreign material.

#### Disassembly of Master Cylinder. (See figure 4-26.)

Disassembly of either master cylinder can be accomplished as follows:

- a. Remove filler plug (3) and drain residual hydraulic fluid from reservoir portion of body (9). Screw (4) serves no purpose in this assembly except as a plug for the threaded hole in the cover, and need not be removed.
- b. Remove setscrew (8) and unscrew cover (5) to remove cover and piston rod (6) along with the other illustrated parts which are attached to the piston rod. The piston return spring (10) will remain inside body (9); to remove, lift from position.
- c. Remove nut (12) from piston rod (6), to remove piston spring (13), piston (15), O-ring (16), lock-o-seal (17) and compensating sleeve (18).
- d. Back off jamb nut (2) from its locking position against base of clevis (1) and remove both parts from piston rod (6).
- e. Remove O-ring (14) from piston (15).
- f. Remove elbow (7) from body (9), if required.

#### Assembly of Master Cylinder. (See figure 4-26.)

Assemble either master cylinder as follows:

- a. Install lock-o-seal (17) and O-ring (16) on shank of piston rod (6).

#### CAUTION

Lubricate O-ring portion of lock-o-seal with system hydraulic fluid and install carefully to prevent damage from the threaded portion of the piston rod shank.

O-ring (16) portion of lock-o-seal (17) should be installed first, then set retainer in place around O-ring and against piston rod shank base as illustrated.

- b. Slip O-ring (14) into groove in piston (15) as illustrated, using clean system hydraulic fluid as a lubricant.

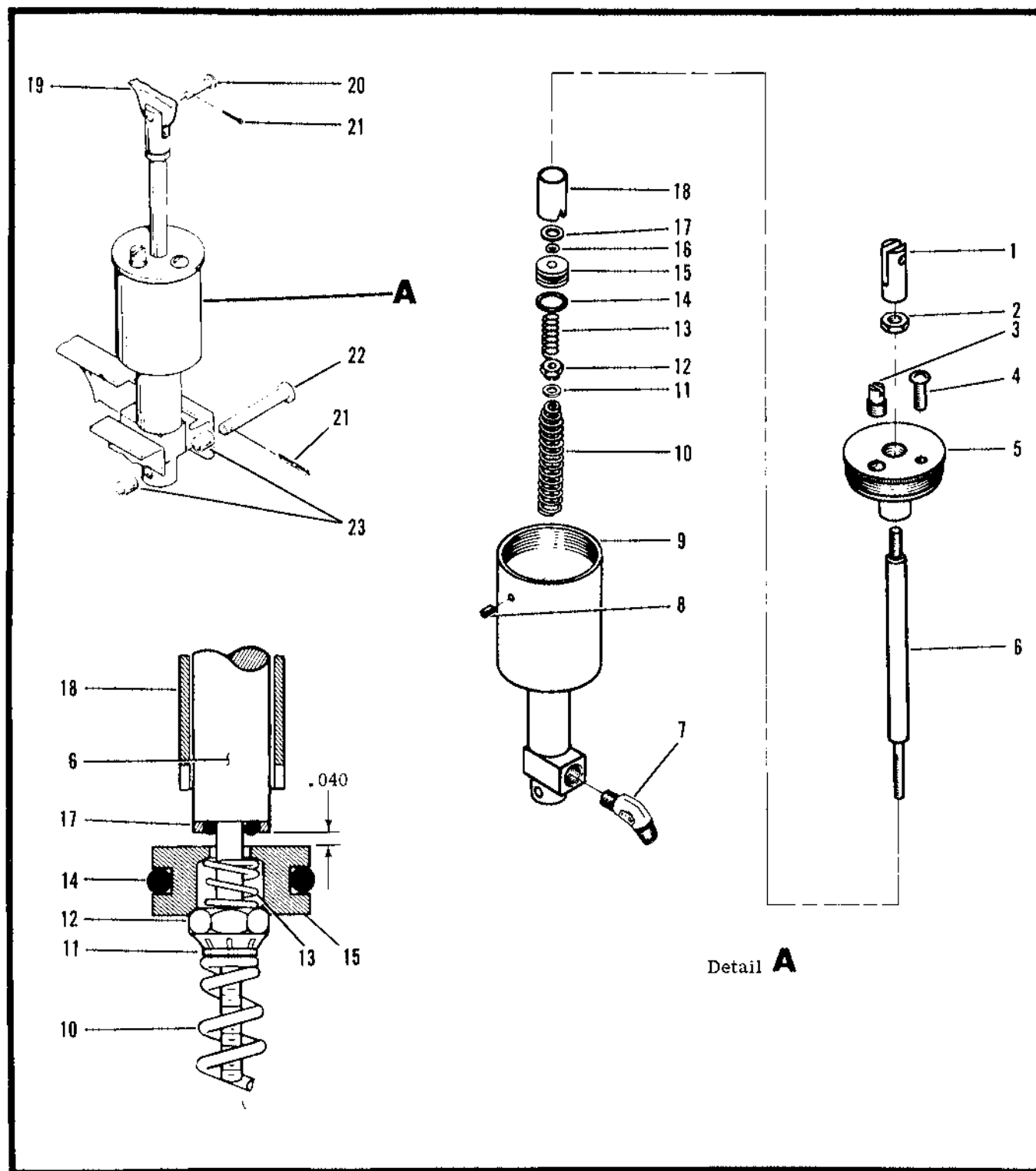
#### CAUTION

Install O-ring carefully to prevent chipping on sharp corner of piston.

- c. Install piston (15), piston spring (13) and nut (12) on piston rod (6) as illustrated. Tighten nut (12) and with piston spring (13) compressed to seat piston (15) against nut, adjust clearance between piston and lock-o-seal (17) to .040 inch as illustrated, using feeler gage or .040 wire to check measurement.

#### CAUTION

Be careful, when inserting feeler gage or wire, not to damage lock-o-seal.



Detail **A**

- |                |                          |                           |
|----------------|--------------------------|---------------------------|
| 1. Clevis      | 9. Body                  | 16. O-Ring                |
| 2. Jamb Nut    | 10. Piston Return Spring | 17. Lock-O-Seal           |
| 3. Filler Plug | 11. Washer               | 18. Compensating Sleeve   |
| 4. Screw       | 12. Nut                  | 19. Pilot's Rudder Pedals |
| 5. Cover       | 13. Piston Spring        | 20. Pin                   |
| 6. Piston Rod  | 14. O-Ring               | 21. Cotter Pin            |
| 7. Elbow       | 15. Piston               | 22. Pin                   |
| 8. Setscrew    |                          | 23. Spacer                |

Figure 4-26. Brake Master Cylinder

## NOTE

The .040 inch dimension between the lock-o-seal and the piston determines the relationship between piston rod travel and seating of the lock-o-seal to the piston. Proper master cylinder operation depends upon this dimension being set correctly.

- d. Place piston return spring (10) into cylinder section of body (9), broad base down, as illustrated.
- e. Lubricate cylinder walls and piston (15) with clean system hydraulic fluid and insert nut (12) against piston return spring (10).
- f. Place compensating sleeve (18) notched end toward piston, over piston rod (6). Slide cover (5) over piston rod, and tighten into body. Install setscrew (8) and tighten to prevent movement of cover (5).
- g. Screw jamb nut (2) and clevis (1) into piston rod end.
- h. Install filler plug (3) and elbow (7), if removed during disassembly.

## NOTE

If elbow is being installed, use a suitable thread lubricant on tapered threads before screwing into master cylinder. Do not allow lubricant to enter master cylinder or elbow passages.

Installation of Master Cylinder. (See figure 4-26.)

Install either master cylinder as follows:

- a. Lift hose end from its position between master cylinder mounting brackets and remove temporary cap. Attach hose to elbow (7) at base of master cylinder and tighten coupling nut.

## NOTE

Use only system hydraulic fluid for lubricant when making this connection.

- b. Insert pin (22) through master cylinder mounting brackets and hole in base of body (9), with spacers (23) in place as illustrated. Secure pin (22) with cotter pin.
- c. Connect clevis (1) to rudder pedal (19) with pin (20). Adjust clevis (1) to align tips of rudder pedals (19) with rudder pedals in a neutral position. Secure pin (20) with cotter pin, and secure clevis with jamb nut (2).
- d. Attach cover plate to floor around master cylinder with four screws.
- e. Fill and bleed brake system in accordance with bleeding procedure.
- f. Replace carpet, left scuff plate, left rudder bar and pilot's seat in accordance with Section 3.



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## SECTION 5

## CONTROL COLUMN, AILERON AND TRIM CONTROL SYSTEMS

## Table of Contents

|                                                  | Page |                                                 | Page |
|--------------------------------------------------|------|-------------------------------------------------|------|
| CONTROL COLUMN . . . . .                         | 5-1  | AILERON TRIM CONTROL SYSTEM . . . . .           | 5-10 |
| Removal . . . . .                                | 5-1  | Trouble Shooting . . . . .                      | 5-10 |
| Disassembly . . . . .                            | 5-1  | Removal of Aileron Trim Control                 |      |
| Assembly . . . . .                               | 5-2  | Cables and Chains . . . . .                     | 5-11 |
| Installation . . . . .                           | 5-3  | Installation of Aileron Trim Control            |      |
| AILERON CONTROL SYSTEM . . . . .                 | 5-3  | Cables and Chains . . . . .                     | 5-11 |
| Trouble Shooting . . . . .                       | 5-3  | Removal of Aileron Trim Tab Actuator . . . . .  | 5-11 |
| Removal of Aileron . . . . .                     | 5-5  | Disassembly, Overhaul and Assembly              |      |
| Installation of Aileron . . . . .                | 5-5  | of Aileron Trim Tab Actuator . . . . .          | 5-11 |
| Removal of Aileron Trim Tab . . . . .            | 5-5  | Installation of Aileron Trim Tab Actua-         |      |
| Installation of Aileron Trim Tab . . . . .       | 5-5  | tor . . . . .                                   | 5-12 |
| Removal of Aileron Control Cables . . . . .      | 5-5  | Removal of Aileron Trim Gear Assembly . . . . . | 5-12 |
| Installation of Aileron Control Cables . . . . . | 5-7  | Disassembly, Overhaul, and Reassembly           |      |
| Removal of Aileron Quadrant . . . . .            | 5-7  | of Aileron Trim Gear Assembly . . . . .         | 5-12 |
| Installation of Aileron Quadrant . . . . .       | 5-8  | Installation of Aileron Trim Gear Assem-        |      |
| Removal of Aileron Bellcrank . . . . .           | 5-8  | bly . . . . .                                   | 5-12 |
| Installation of Aileron Bellcrank . . . . .      | 5-8  | Removal and Installation of Aileron Trim        |      |
| Rigging . . . . .                                | 5-8  | Wheel and Indicator Assemblies . . . . .        | 5-14 |
|                                                  |      | Rigging . . . . .                               | 5-14 |

## CONTROL COLUMN

The control column "Y" assembly internally houses the forward aileron control system cables, chains and sprockets. Externally attached to the control column "Y" assembly, is the elevator forward push-pull tube and bob-weight assemblies. The pilot's and copilot's (optional) control wheels are attached to individual tubes which extend through the instrument panel and connect to a universal joint on the control column "Y" assembly.

Removal of Control Column Assembly. (See figure 5-1.)

- a. Refer to Section 3, remove the following items in accordance with removal procedures:
  1. Front and rear seats (middle individual optional).
  2. Bulkhead, pilot's floor and center carpets.
  3. Boot, retainer and cover from lower control column.
- b. Refer to Section 12, remove shock-mounted instrument panel in accordance with removal procedures.
- c. Drill out rivets and remove upper and lower instrument panel braces on RH side only.
- d. Remove access covers just forward of rear spar and just aft of nose wheel well on underside of fuselage.
- e. (See figure 5-3.) Remove safety wire and loosen

turnbuckles on aileron cables (17) to relieve tension on aileron control system.

- f. Refer to Section 6, disconnect bob-weight assembly and push-pull tube from control column assembly.
- g. Remove control wheels (1) from control column assembly by removing nuts, bushings and bolts attaching control tube (2) to universal joint (5).

## NOTE

If automatic pilot is installed, disconnect electrical wires from control tube assembly at the quick-disconnects.

- h. Disconnect chain assembly (26) from aileron control cables (37) by removing cotter pins and clevis pins.
- i. Remove nut, washer, spacers and bolt attaching control column assembly to fuselage structure.
- j. Carefully work control column assembly from beneath RH side of stationary instrument panel.

Disassembly of Control Column Assembly. (See figure 5-1.)

- a. On lower control column assembly, remove spacers, washers, bearings and sprockets by removing attaching nut, washer and bolt.
- b. Disengage chain assembly (26) from sprocket

assembly and remove chain assembly from control column assembly.

- c. Remove triple sprocket assembly from control column assembly by removing nut, washers and bolt.
- d. Disconnect cable assembly (21) by removing buckle (22) and routing chain assembly over sprockets.
- e. Remove cotter pin (15) and nut (16) from shaft (13).
- f. Remove nuts (17) from bolts (6 and 12) and remove bolts from adapter (7) and sprocket (11).
- g. Remove shaft (13), bearing (8), adapter (7) and universal joint (5) from control column assembly.

#### NOTE

Safety wire shaft (13), adapter (7) and universal joint (5) to each other so that they may be retained together as a matched set.

- h. Refer to figure 5-1 for further disassembly of control column components, as necessary.

Assembly of Control Column. (See figure 5-1.)

- a. Place control column assembly in a suitable padded fixture (such as a vise) facing bob-weight bracket away from the assembler.

#### NOTE

The following procedure is given for aircraft with dual control wheels installed; single control wheel aircraft need only install upper LH chain (21) and lower chain assembly (26).

- b. Install washer (38) and triple sprocket assembly (23) inside control column assembly using a long, thin bolt or heavy gauge wire to support components temporarily.
- c. If disassembled, assemble the long (twenty link) chains and the short (fourteen link) chains into chain assemblies (21) using attaching turnbuckles (22). Observe that the terminal ends are equal in length after turnbuckles are installed.

#### NOTE

If the assembly of long and short chains into chain assembly (21) was correct, the index link (red) on the long chain should be nine links from the now open end of the chain assembly (21) with all bolt heads facing in the same direction.

- d. Attach guide wires to each end of chain assembly (21) and route the long chain under the center sprocket on triple sprocket assembly (23) to LH leg of control column assembly.
- e. Assemble into LH leg of control column the following components:
  1. Insert sprocket shaft (13) into universal joint (5) and secure with roll pin (18).
  2. Place adapter (7) over universal joint (5) and sprocket shaft (13).

#### NOTE

Adapter (7), universal joint (5) and sprocket shaft (13) are drilled as a matched set and cannot be interchanged with other like components.

3. Place bearing (8) over adapter (7) and position adapter, universal joint, sprocket shaft, and sprocket (11) into LH leg of control column assembly with universal joint facing aft.

#### NOTE

Install sprocket (11) with collar of sprocket facing away from adapter (7).

4. Align holes and install long bolt (6) through adapter (7) and sprocket shaft (13); secure with nut.
5. Align holes and install short bolt (12) through sprocket (11) and sprocket shaft (13); secure with nut.
6. Place bearing (8) on sprocket shaft (13); secure sprocket shaft to control column assembly with washers, nut and cotter pin.
- f. Route the short chain of chain assembly (21) over the top of upper sprocket (11) and align index mark (red) on sprocket with index link (red) on chain.
- g. Secure chain assembly (21) together with turnbuckle and tighten just enough to take up slack. Observe that the terminals on chain are equal in length after turnbuckles are installed.
- h. Assemble and install components in leg of RH control column assembly as described in steps "e" through "g", except position collar on sprocket (11) butted against adapter (7).
- i. Install lower chain and cable assembly (26) on aft sprocket of triple sprocket assembly (23) and align index mark (red) on chain link with index mark (red) tooth of sprocket.
- j. Replace temporary bolt or heavy gauge wire which was used to support triple sprocket (23) during assembly with attaching bolt (20), washer and nut.

#### NOTE

Care should be taken to insure that the washer between triple sprocket assembly and wall of control column "Y" remains in place when attaching bolt is installed.

- k. Using a bolt or pin as a rigging pin, insert through tube assembly attachment holes in universal joints (5) and tighten turnbuckles (22) on upper chain assemblies (21) until bolts or pins are parallel with vertical leg of control column "Y".

#### NOTE

After rigging upper chain assemblies (21), safety wire last link on lower chain assemblies (26) to control column "Y", thus preventing chain assemblies from accidentally moving off index tooth on sprocket during installation of control column "Y" in aircraft.

1. Insert bolt through lower control column "Y" tab and assemble component parts as shown in figure 5-1; secure with washer and nut.

Installation of Control Column Assembly. (See figure 5-1.)

- a. Carefully work control column assembly into position from the RH side of instrument panel.
- b. Secure control column assembly to fuselage structure with attaching bolt, spacers, washers and nut.
- c. Connect chain assembly (26) to aileron control cables (37) with attaching clevis pins and cotter pins.
- d. Install control wheel (1) and control tube (2) on control column assembly with attaching bolts, bushings and nuts.

#### NOTE

If automatic pilot is installed, connect electrical wires to control tube assembly with quick-disconnects.

- e. Refer to Section 6, connect bob-weight assembly and push-pull tube to bracket on RH leg of control column assembly.

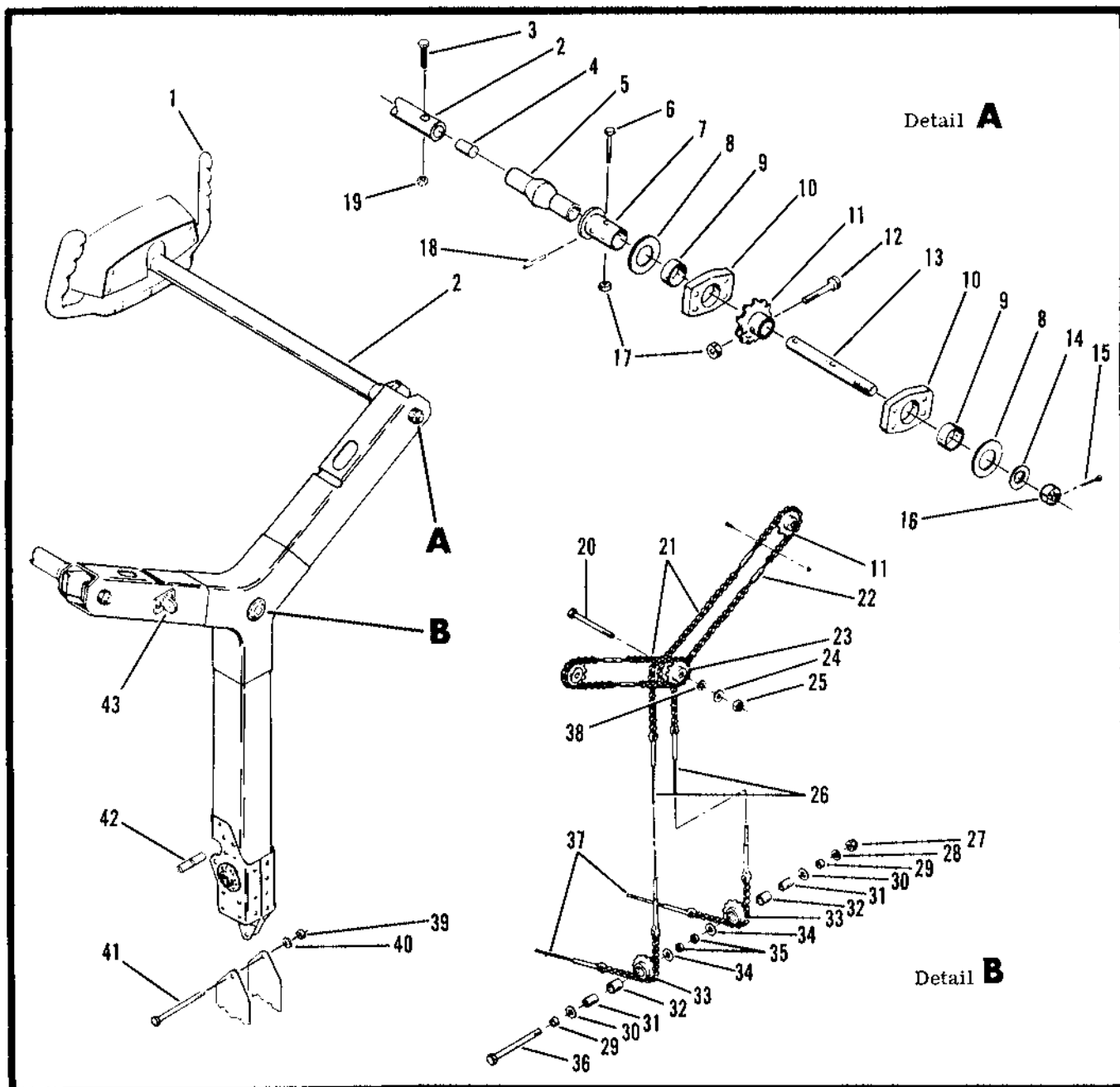
- f. Install upper and lower instrument panel braces using rivets.
- g. Refer to Section 12, and install shock-mounted instrument panel in accordance with installation procedures.
- h. Rig aileron control cables in accordance with rigging tolerances and safety turnbuckles.
- i. Replace access covers.
- j. Refer to Section 3 and install the following items:
  1. Control column assembly boot, retainer and cover.
  2. Center, pilot's floor and bulkhead carpets.
  3. Front and rear seats (middle individual optional)

#### AILERON CONTROL SYSTEM

The aileron control system is interconnected through a series of cables, chains, turnbuckles, push-pull rods, bellcranks and quadrants. This system, as described herein, extends from the cable to chain connections at the lower end of the control column to terminal point at the aileron itself.

#### Trouble Shooting Aileron Control System.

| TROUBLE                                       | PROBABLE CAUSE                                             | CORRECTION                                                                               |
|-----------------------------------------------|------------------------------------------------------------|------------------------------------------------------------------------------------------|
| LOST MOTION BETWEEN CONTROL WHEEL AND AILERON | Cable tension too low.                                     | Adjust cable tension in accordance with aileron rigging procedures.                      |
|                                               | Chain tension too low in control column assembly.          | Adjust chain tension in accordance with assembly of control column.                      |
|                                               | Broken pulley.                                             | Replace pulley.                                                                          |
| RESISTANCE TO CONTROL WHEEL ROTATION          | Cables not in place on pulleys or quadrants.               | Install cables correctly. Check cable guards.                                            |
|                                               | Cable tension too high.                                    | Adjust cable tension in accordance with aileron rigging procedures.                      |
|                                               | Pulleys binding or rubbing.                                | Replace binding pulleys. Provide clearance if rubbing pulley brackets or cable guards.   |
| CONTROL WHEELS NOT SYNCHRONIZED               | Chain tension too high in control column assembly.         | Adjust chain tension in accordance with assembly of control column.                      |
|                                               | Cables not in place on pulleys or quadrants.               | Install cables correctly.                                                                |
|                                               | Bent aileron.                                              | Repair or replace aileron.                                                               |
| CONTROL WHEELS NOT SYNCHRONIZED               | Unequal tensions on control column upper chain assemblies. | Adjust chain tensions in accordance with assembly of control column.                     |
|                                               | Chain not indexed on sprockets properly.                   | Re-index chains and adjust chain tensions in accordance with assembly of control column. |



- |                      |                              |                              |
|----------------------|------------------------------|------------------------------|
| 1. Control Wheel     | 16. Nut                      | 30. Washer                   |
| 2. Tube Assembly     | 17. Nut                      | 31. Race Bearing             |
| 3. Bolt              | 18. Roll Pin                 | 32. Bearing                  |
| 4. Bushing           | 19. Nut                      | 33. Sprocket (Lower)         |
| 5. Universal Joint   | 20. Bolt                     | 34. Washer                   |
| 6. Bolt (Long)       | 21. Chain Assembly (Upper)   | 35. Spacer                   |
| 7. Adapter           | 22. Turnbuckle               | 36. Bolt                     |
| 8. Bearing           | 23. Triple Sprocket Assembly | 37. Cable Assembly (Aileron) |
| 9. Bearing           | 24. Washer                   | 38. Washer                   |
| 10. Bearing Block    | 25. Nut                      | 39. Nut                      |
| 11. Sprocket (Upper) | 26. Chain Assembly (Lower)   | 40. Washer                   |
| 12. Bolt (Short)     | 27. Nut                      | 41. Bolt                     |
| 13. Sprocket Shaft   | 28. Washer                   | 42. Spacer                   |
| 14. Washer           | 29. Spacer (Thick)           | 43. Bob-Weight Bracket       |
| 15. Cotter Pin       |                              |                              |

Figure 5-1. Control Column

| TROUBLE                                                               | PROBABLE CAUSE                                                                                   | CORRECTION                                                                             |
|-----------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| CONTROL WHEELS NOT HORIZONTAL WHEN AILERONS ARE NEUTRAL               | Incorrect aileron system rigging.                                                                | Rig in accordance with aileron rigging procedures.                                     |
|                                                                       | Lower chain assembly not indexed on triple sprocket properly.                                    | Re-index lower chain on triple sprocket in accordance with assembly of control column. |
| INCORRECT AILERON TRAVEL                                              | Aileron quadrant stops incorrectly adjusted.                                                     | Adjust in accordance with aileron rigging procedures.                                  |
| CORRECT AILERON TRAVEL CANNOT BE OBTAINED BY ADJUSTING QUADRANT STOPS | Incorrect rigging of quadrant cables, compensated for by incorrect adjustment of push-pull rods. | Rig in accordance with aileron rigging procedures.                                     |
|                                                                       | Incorrect rigging of aileron bellcranks.                                                         | Rig in accordance with aileron rigging procedures.                                     |

Removal of Aileron. (See figure 5-2.)

- a. If the left aileron is being removed, move aileron trim tab to the extreme UP position and remove nut, bolt, and spacer from aileron trim tab push-pull tube (6).
- b. Lower flap and disconnect aileron push-pull rod (10) by removing attaching bolt.
- c. Disconnect bonding strap from aileron by removing screw and washer.
- d. Remove aileron from wing by removing attaching bolts.

#### NOTE

If left aileron is being removed, carefully guide aileron trim tab push-pull tube (6) through opening on aileron during removal.

Installation of Aileron. (See figure 5-2.)

- a. Install aileron by reversing removal procedures.

#### NOTE

When installing the left aileron, guide aileron trim tab push-pull tube (6) through opening in aileron.

- b. Check aileron and trim tab for proper operation and correct travel. If necessary, rig in accordance with aileron control system rigging procedures.

Removal of Aileron Trim Tab. (See figure 5-2.)

- a. Move aileron trim tab to extreme UP position and remove nut, bolt and spacer disconnecting push-pull tube from trim tab.
- b. Remove aileron trim tab from aileron by removing cotter pins and attaching hinge pin.

Installation of Aileron Trim Tab. (See figure 5-2.)

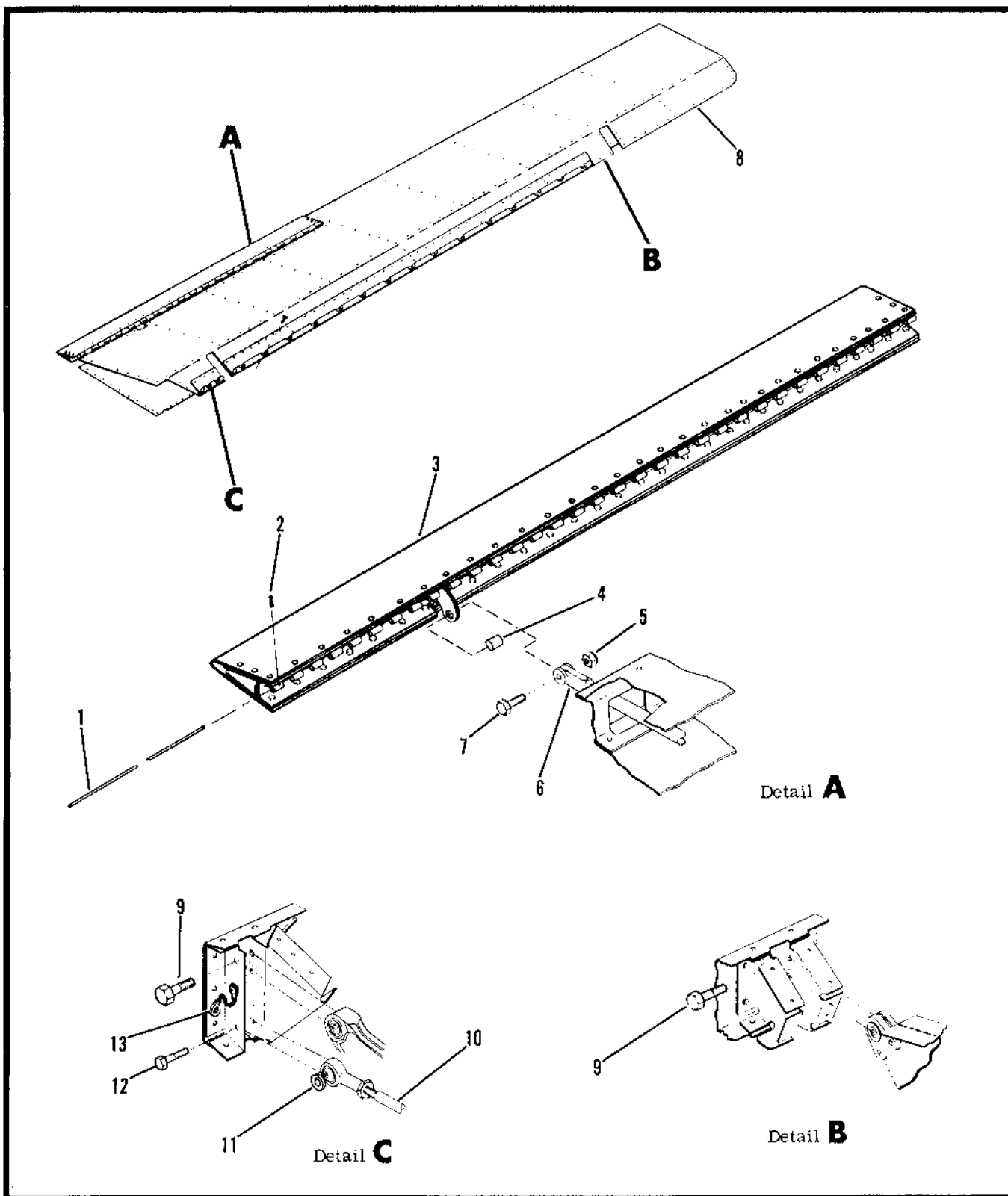
- a. Install aileron trim tab by reversing removal procedures.
- b. Check trim tab for proper operation.

Removal of Aileron Control Cables. (See figure 5-3.)

#### NOTE

The following procedure is for removing the aileron cables with turnbuckles attached to the cables and pulley cable guard cotter pins removed. If desired, turnbuckle barrels may be unscrewed to leave the turnbuckle forks attached to the fuselage bellcrank.

- a. Refer to Section 3 and remove the following items from the aircraft:
  1. Front seats and rear reclining seat; or middle individual and aft fifth-sixth seats (optional equipment).
  2. Front, center and rear carpets.
  3. Rear upholstery panel if autopilot (optional equipment) is installed.
- b. Remove boot, retainer and cover from lower control column.
- c. Refer to Section 1 and remove floorboard and access covers, access panel located on rear spar adjacent to aft wheel well, lower aft wing root fillets, and aileron quadrant access cover.
- d. Remove safety wire and disconnect turnbuckle (2) to right and left hand return cables (1).
- e. Remove cable guard cotter pin on fuselage return cable pulley.
- f. Relieve tension on aileron direct cables (15 and 17) by loosening turnbuckles at the fuselage bellcrank (16).
- g. At the fuselage bellcrank (16), disconnect aileron direct cables (15 and 17) by removing attaching cotter pins, nuts and bolts.
- h. Disconnect aileron cables (17) from lower control column chain (18) by removing attaching cotter pins, washers and clevis pins.
- i. If an autopilot (optional equipment) is installed, disconnect autopilot cables from aileron direct cables (15) by removing attaching cable clamps.
- j. Remove aileron pulley (outboard of aileron quad-



1. Hinge Pin
2. Cotter Pin
3. Aileron Trim Tab
4. Spacer

5. Nut
6. Aileron Trim Tab Push-Pull Tube
7. Bolt
8. Aileron
9. Bolt

10. Aileron Push-Pull Rod
11. Washer
12. Bolt
13. Bonding Strap

Figure 5-2. Aileron and Aileron Trim Tab Installation

rant) by removing cable guard pins, attaching bolt and washer.

k. Disconnect aileron push-pull tube (8) from aileron quadrant (14) by removing nut, washer and bolt.

l. Remove two sets of pulleys aft of the wheel well and one set in each wing root by removing cable guard cotter pins and attaching nuts and bolts.

#### NOTE

When removing control cables, tie safety wire to ends of cables before removal.

m. Remove bolt and washer attaching aileron quadrant (14) to wing structure.

n. With aileron return and direct cables (1 and 15) attached to aileron quadrant, remove quadrant and cables from wing using aileron quadrant access hole.

o. Route fuselage direct cables (17) aft to bellcrank (16) and remove from aircraft.

#### NOTE

Leave guide wires in wing and fuselage to facilitate installation.

Installation of Aileron Control Cables. (See figure 5-3.)

a. Secure aileron cables (17) to guide wires and route cable from bellcrank (16) to lower control column chain (18).

b. Remove guide wires from cables.

c. Secure aileron cables (17) to chain (18) with attaching clevis bolt and cotter pin.

d. Install pulleys beneath fuselage floorboards and secure with attaching bolts, spacer, washer and nut.

#### NOTE

Insure that fuselage direct cables (17) are not crossed and routed on the underneath side of pulley.

e. Secure aileron cable (17) to bellcrank (16) with attaching bolt, nut and cotter pin.

f. Install cable guard cotter pin on fuselage pulleys.

g. Secure aileron cables (1 and 15) to guide wires and route cables and quadrant into position.

h. Remove guide wire from cables.

i. Install quadrant (14) in wing and secure with washer and bolt.

#### CAUTION

Be sure bushing (11) is installed with quadrant or serious binding will occur during rigging.

j. Install two sets of pulleys on pulley brackets aft of the wheel well and secure with attaching bolts and nuts.

k. Install one set of pulleys on lower aft wing root pulley brackets and secure with attaching bolt and nuts.

l. Position aileron direct cables (15) on lower pulleys and aileron return cables (1) on upper pulleys and install cable guard cotter pins.

#### NOTE

Aileron cables (1 and 15) must be routed on aft side wing pulleys.

m. Secure aileron cables (1 and 15) to fuselage bellcrank with attaching bolts, nuts and cotter pins.

#### CAUTION

Insure that aileron cables are in place on aileron quadrants and pulleys in both wings before rigging tension on aileron system. Wing structure can be damaged by the aileron cables if tension is rigged on the cables while not properly in place on aileron quadrants or pulleys.

o. If an autopilot (optional equipment) is installed, attach to the aileron cables and rig in accordance with rigging procedures.

p. Install lower aft wing root fillets, fuselage floorboard access covers, aft underside wing access covers, and quadrant access cover.

q. Install boot, retainer and cover on lower control column.

r. Refer to Section 3 and install the following items:

1. Rear upholstery panel, if autopilot (optional equipment) is installed.

2. Front, center and rear carpets.

3. Front seats and rear reclining seat, or middle individual and aft fifth and sixth seats (optional equipment).

Removal of Aileron Quadrant. (See figure 5-3.)

a. Refer to Section 3 and remove the following items:

1. Rear reclining seat or middle, fifth and sixth seats (optional equipment).

2. Rear carpet.

3. Rear upholstery panel, if autopilot (optional equipment) is installed.

b. Refer to Section 1 and remove aft floorboard access covers and wing access cover above quadrant.

c. If autopilot (optional equipment) is installed, disconnect autopilot cables from aileron cables.

d. Remove safety wire from turnbuckles (2) on cables (1 and 15) and disconnect cables at bellcrank.

e. Remove aileron pulley outboard of aileron quadrant by removing cable guard pins, attaching bolt and washer.

f. Attach safety wires to cables (1 and 15) to be used as guides on installation.

g. Disconnect aileron push-pull tube (8) from aileron quadrant (14) by removing attaching nut, washer and bolt.

h. Remove bolt and washer attaching aileron quadrant (14) to wing structure.

i. Remove aileron quadrant (14) from wing by working quadrant and cables through wing access hole.



# NOTE

To prevent routing cables (1 and 15) through entire wing, disconnect cable ends from quadrant as near to the wing access hole as working room will permit. Care also should be taken to prevent bushing (11) from falling during removal.

- j. Disconnect aileron cables from quadrant by removing cotter pins, cable guard, nut, washer and bolt.

Installation of Aileron Quadrant. (See figure 5-3.)

- a. Place aileron quadrant (14) near aft wing access hole and connect aileron cables (1 and 15) to quadrant using attaching bolt, washer and nut; secure cables in position with cable guard and cotter pins.

# NOTE

Position return cable (1) on bottom groove of quadrant and direct cable (15) on upper groove of quadrant.

- b. Install quadrant (14) in wing and secure with washer and bolt.

# CAUTION

Be sure bushing (11) is reinstalled with quadrant or serious binding will occur during rigging.

- c. Connect aileron push-pull tube (8) to quadrant with attaching bolt, washer and nut.
- d. Install pulley (outboard of aileron quadrant) with attaching bolt, washer and cable guard cotter pin.
- e. Route aileron cable (15) to bellcrank (16), connect cable to turnbuckle fork with turnbuckle.
- f. Route return cable (1) to center fuselage and connect with turnbuckle.
- g. Rig aileron control system in accordance with rigging procedures.

# CAUTION

Insure that aileron cables are in place on aileron quadrants and pulleys in both wings before rigging tension on aileron system. Wing structure can be damaged by the aileron cables if tension is rigged on the cables while not properly in place on aileron quadrants or pulleys.

- h. If autopilot (optional equipment) is installed, connect autopilot cables to aileron cables with attaching clamps.
- i. Install wing access covers and floorboard access covers.
- j. Install removed carpets and seats.

Removal of Aileron Bellcrank. (See figure 5-3.)

- a. Refer to Section 3. Remove rear seats and carpets.
- b. Remove floorboard access cover just in front of rear spar.
- c. Remove safety wire from turnbuckle (2) and loosen tension on aileron return cable (1).
- d. Disconnect aileron direct cables (15 and 17) from bellcrank (16) by removing cotter pins, nuts and bolts.
- e. Remove bellcrank (16) by removing attaching bolts.

Installation of Aileron Bellcrank. (See figure 5-3.)

- a. Reverse removal procedures and rig in accordance with rigging procedures.

# CAUTION

Insure that aileron cables are in place on aileron quadrants and pulleys in both wings before rigging tension on aileron system. Wing structure can be damaged by the aileron cables if tension is rigged on the cables while not properly in place on aileron quadrants or pulleys.

Rigging of Aileron Control System. (See figure 5-3.)

- a. Refer to Section 3, and remove rear seats and rear carpet.
- b. Remove floorboard access covers forward of rear spar.
- c. Remove wing access covers above aileron quadrant.
- d. Align control wheels horizontal and tape a straightedge to lower edge of both control wheels to insure alignment during rigging.

# NOTE

Dual control wheels are optional equipment, if only one control wheel is installed, it must be kept in the horizontal position during rigging.

- e. Remove safety wire from all turnbuckles at the fuselage bellcrank.
- f. Adjust turnbuckles on aileron cables (15 and 17) so that both halves of bellcrank (16) are aligned in the same relative position in respect to each other.

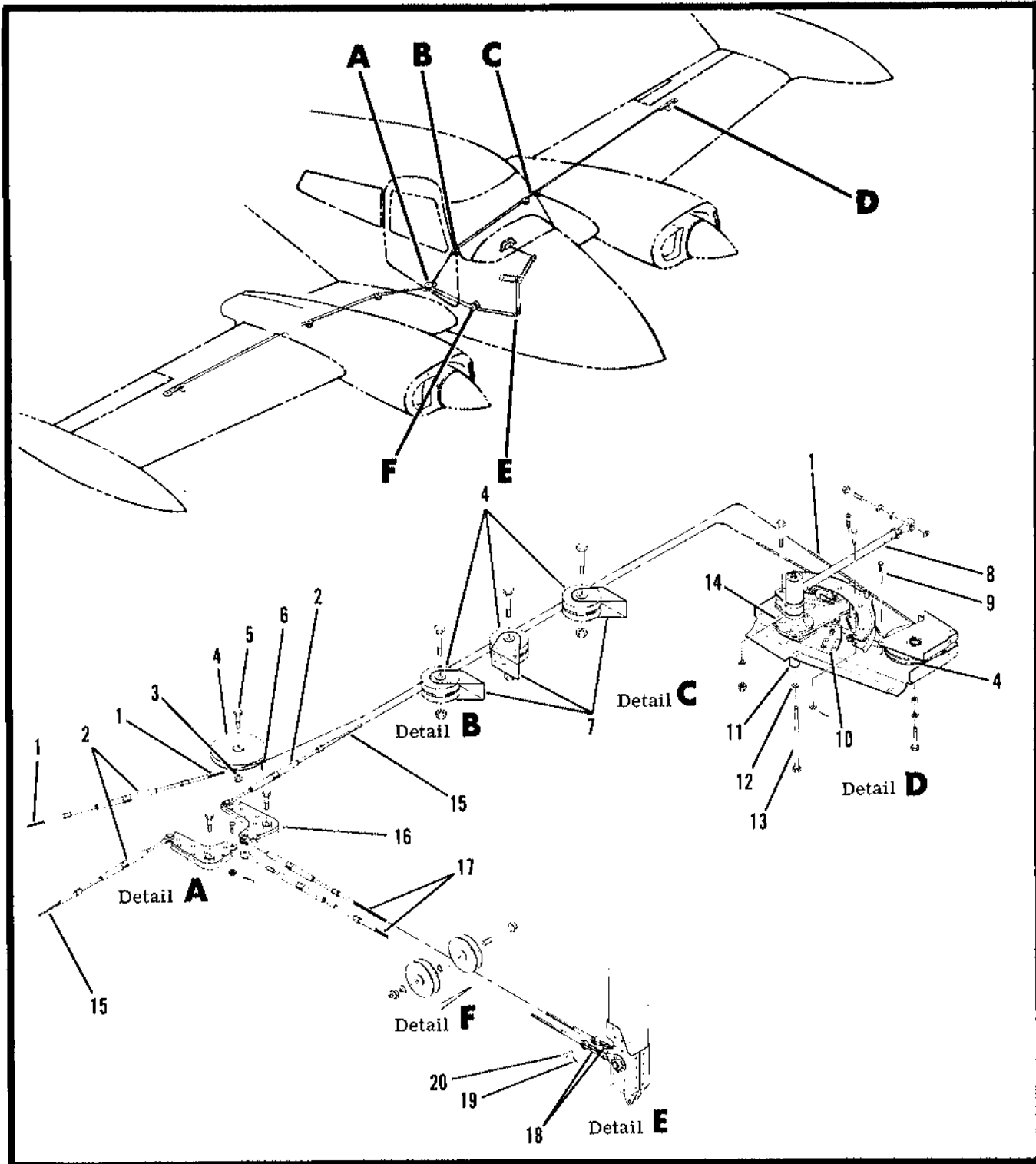
# NOTE

During all aileron rigging adjustments, maintain 25 +5 pounds tension on both the wing and fuselage forward cables.

- g. Adjust turnbuckles connecting wing direct cables (15) to bellcrank and turnbuckle connecting return cables (1) so that the ailerons align with the trailing edges of the wings.

# NOTE

If length of aileron push-pull tube (8) has



1. Aileron Cable
2. Turnbuckle
3. Nut
4. Pulley
5. Bolt
6. Cable Guard Cotter Pin
7. Pulley Bracket

8. Push-Pull Tube
9. Cable Guard Pin
10. Quadrant Stop Bolt
11. Bushing
12. Washer
13. Bolt

14. Aileron Quadrant
15. Aileron Cable (Wing Direct)
16. Bellcrank
17. Aileron Cable (Fuselage Direct)
18. Control Column Chain (Lower)
19. Cotter Pin
20. Clevis Bolt

Figure 5-3. Aileron Control System

been changed, or new push-pull rods are being installed, adjust rod ends so that centerline of holes are 9.10 inches apart, prior to alignment of ailerons with trailing edges of wings.

h. Resafety turnbuckles from which safety wire was removed, and remove straightedge which was taped to control wheels during rigging.

i. Adjust quadrant stop bolts (10) so that aileron travel is 20 degrees up and 20 degrees down.

#### WARNING

Insure that ailerons move in the proper di-

rection when operated by the control wheel.

j. Install access covers on wing and in fuselage.

k. Refer to Section 3, and install center carpet and seats.

#### AILERON TRIM CONTROL SYSTEM.

The aileron trim control system is interconnected by chains, cables, sprockets, turnbuckles, miter gears, an actuator, and a push-pull tube. The aileron trim control wheel, mounted on the aft side of the control pedestal, incorporates a track in which the indicator rides.

#### Trouble Shooting Aileron Trim Control System.

| TROUBLE                                                    | PROBABLE CAUSE                                      | CORRECTION                                                                             |
|------------------------------------------------------------|-----------------------------------------------------|----------------------------------------------------------------------------------------|
| TRIM CONTROL WHEEL MOVES WITH EXCESSIVE RESISTANCE         | Cable tension too high.                             | Adjust cable tension in accordance with rigging procedures.                            |
|                                                            | Defective miter gear assembly.                      | Repair or replace miter gear assembly.                                                 |
|                                                            | Defective trim tab actuator.                        | Repair or replace actuator.                                                            |
|                                                            | Pulleys binding or rubbing.                         | Replace binding pulleys. Provide clearance if rubbing pulley brackets or cable guards. |
|                                                            | Cables not in place on pulleys during installation. | Install pulleys correctly.                                                             |
|                                                            | Trim tab hinge binding.                             | Lubricate hinge. If necessary, replace.                                                |
| LOST MOTION BETWEEN TRIM CONTROL WHEEL AND TRIM TAB        | Cable tension too low.                              | Adjust cable tension in accordance with rigging procedures.                            |
|                                                            | Broken pulley.                                      | Replace pulley.                                                                        |
|                                                            | Cables not in place on pulleys.                     | Install pulleys correctly. Check cable guards.                                         |
|                                                            | Excessive backlash on miter gear assembly.          | Repair or replace miter gear assembly.                                                 |
|                                                            | Worn trim tab actuator.                             | Repair or replace actuator.                                                            |
| TRIM INDICATOR FAILS TO INDICATE CORRECT TRIM POSITION     | Indicator incorrectly engaged with wheel track.     | Engage in accordance with rigging procedures.                                          |
| INCORRECT TRIM TAB TRAVEL                                  | Travel stop blocks loose or incorrectly adjusted.   | Adjust stop blocks in accordance with rigging procedures.                              |
| CORRECT TRAVEL CANNOT BE OBTAINED BY ADJUSTING STOP BLOCKS | Actuator screw incorrectly adjusted.                | Adjust in accordance with rigging procedures.                                          |

### Removal of Aileron Trim Control Cables and Chains. (See figure 5-4.)

- a. Refer to Section 3, and remove the following items:
  1. Front seats, middle and rear seats.
  2. Front and rear carpets.
- b. Remove side panels from control pedestal.
- c. Remove floorboard access covers, bottom fuselage access cover aft of nose wheel well, aileron quadrant access cover on left wing, and aft left wing root fillet.
- d. In the fuselage, remove safety wire and disconnect turnbuckle (11) connecting the top cables together.
- e. In the fuselage, remove nut and bolt attaching bottom cable ends (8) together.
- f. Remove four sets of pulleys (6) in wing and two sets of pulleys (6) in fuselage by removing nuts, bolts, and cable guard cotter pins.
- g. Remove chain guard (3) from actuator (2) by removing nuts and screws. Remove chain (4).
- h. Remove stop blocks (7) and bushings (10) by removing nuts and bolts.
- i. Remove cables from wing by pulling out through aileron quadrant access hole in wing.

#### NOTE

When removing cables, tie safety wire to ends of cables before removal. Leave the wires in the aircraft to facilitate installation.

- j. Remove chain guard (12) by removing attaching screws and washers, and pull fuselage cables (8 and 9) out through access hole.
- k. Remove chain (4) from around sprockets on gear support (15) and trim wheel (22) by disconnecting at master link.

#### NOTE

If, during removal or installation of chain, the indicator reaches its extreme travel, it can be disengaged from trim control wheel track by inserting a screwdriver beneath indicator and prying out of track. This permits indicator to be moved to a different position or wheel to be turned, before indicator is re-engaged with track.

### Installation of Aileron Trim Control Cables and Chains. (See figure 5-4.)

- a. Install chain (4) around sprockets on gear support (15) and trim wheel (22) by connecting chain ends with master link.
- b. Secure fuselage cables (8 and 9) to guide wires and pull aft into position, then remove guide wires.
- c. Rotate trim control wheel to center indicator, engage lower chain with sprocket (13) so that ends of chain are equal in length and install chain guard (12) with screws and washers.
- d. Secure wing cables (8 and 9) to guide wires and route from actuator to fuselage connections, then remove guide wires.

- e. Align aileron with trailing edge of wing; then rotate sprocket on actuator to move trim tab to neutral. Engage chain with sprocket so that ends of chain are equal in length, and install chain guard (3) with attaching screws and nuts.
- f. Install four sets of pulleys (6) in wing and two sets of pulleys in fuselage with bolts and nuts.
- g. Connect fuselage and wing bottom cables (8) with attaching bolt and nut.
- h. Connect fuselage and wing top cables (9) with turnbuckle (11), rig in accordance with rigging procedures, and safety turnbuckle.
- i. Install stop blocks (7) and bushings (10) on cables (8 and 9) between ribs at wing stations 100.5 and 111.5 with bolts and nuts and rig in accordance with rigging procedures.
- j. Check trim tab for proper operation.
- k. Install aft wing root fillet, and access hole covers on underside of fuselage aft of nose wheel well, aft underside of left wing, and cabin floor.
- l. Install side panels on control pedestal.
- m. Install front and rear carpets in accordance with Section 3.
- n. Install front seats in accordance with Section 3.

### Removal of Aileron Trim Tab Actuator. (See figure 5-4.)

- a. Refer to Section 3, remove rear seats and rear carpet in accordance with removal procedures.
- b. Remove floorboard access covers above landing gear actuator and from aileron quadrant access cover on left wing.
- c. Remove safety wire from turnbuckle (11) and disconnect.
- d. Remove left aileron in accordance with removal procedures.
- e. Remove aileron trim tab push-pull tube from actuator (2) by removing attaching nut and bolt.
- f. Remove chain guard (3) from actuator by removing nuts and screws.
- g. Disengage chain from sprocket.
- h. Remove clamp (1) and clips (5) by removing attaching bolts, screws and nuts.
- i. Remove actuator from wing.

### Disassembly, Overhaul and Assembly of Aileron Trim Tab Actuator. (See figure 5-5.)

- a. Disassemble aileron trim tab actuator assembly in accordance with figure 5-5. This view clearly illustrates the proper relationship of all component parts.
- b. Do not remove bearing (4) from screw (5) unless replacement parts are required.
- c. Clean all component parts, except bearing (4), by washing in suitable solvent. Do not clean sealed bearing (4).
- d. Inspect all component parts for obvious indications of damage such as stripped threads, cracks, deep nicks and dents.
- e. Check bearings (6 and 13) and screws (5 and 11) for excessive wear and scoring. Dimension of parts shall be as follows:

|                       |                                  |
|-----------------------|----------------------------------|
| Front bearing (13) ID | 0.373 in. min.<br>0.380 in. max. |
| Rear bearing (6):     |                                  |
| Small hole ID         | 0.248 in. min.<br>0.253 in. max. |
| Large hole ID         | 0.373 in. min.<br>0.380 in. max. |
| Screw (5) OD (shank)  | 0.242 in. min.<br>0.246 in. max. |
| Screw (11) OD         | 0.367 in. min.<br>0.370 in. max. |

## NOTE

Maximum end play (linear movement) of screw (5) in screw (11) is 0.030 inch.

- f. Examine screws (5 and 11) for damaged threads or dirt particles that may impair smooth operation.
- g. Check sprocket (14) for broken, chipped, and/or worn teeth.
- h. Check bearing (4) for smoothness of operation.
- i. Do not attempt to repair damaged or worn parts of the actuator assembly. Discard all defective items and install new parts during reassembly.
- j. Always discard the following items and install new parts during reassembly: nuts (16), groov-pins (10 and 12), and O-ring packing (8).
- k. During reassembly, lubricate collars (7) and screw (11) with general purpose lubricating grease.
- l. Reassemble actuator in accordance with the following:
  1. Press sprocket (14) into hollow end of screw (11), making sure pin holes are aligned. Press two new groov-pins (10 and 12) into pin holes.
  2. Slip bearing (13) and collar (7) on screw (11) and slide down against sprocket (14). Install retaining rings (2) in the grooves of screw (11).
  3. Insert screw (11), with assembled parts, into housing (9).

## NOTE

Locate sprocket (14) at the end of housing (9) which is farthest from the groove for retaining ring (3).

4. Align pin holes in bearing (13) and housing (9). Press new groov-pin (10) into pin holes.
5. Insert collar (7), new O-ring (8), and bearing (6) into end of housing (9). Align pin holes in bearing and housing and install new groov-pin (10).
6. If new parts are required, press bearing (4) into boss at end of screw (5). Be sure force bears against outer race of bearing. Install screw (5) in housing (9) and screw (11).
7. Install retaining rings (3) in grooves provided on outside of housing (9).
- m. Test actuator assembly by rotating sprocket (14) with fingers while holding bearing end of screw (5). Screw (5) should travel in and out of housing (9) smoothly, with no indication of binding.

Installation of Aileron Trim Tab Actuator. (See figure 5-4.)

- a. Place actuator in position, install clamps (5) and clamp (1) with attaching bolt, screws and nuts.
- b. Engage chain on sprocket and install chain guard (3) with attaching screws and nuts.
- c. Connect turnbuckle (11) to fuselage and wing cables (9), tighten cables to 15 ±3 pounds tension, and safety turnbuckle.
- d. Connect aileron trim push-pull tube to actuator (2) with attaching bolt and nut.
- e. Install left aileron in accordance with installation procedures.
- f. Rotate aileron trim control knob to the neutral position and align aileron with trailing edge of wing.
- g. With trim tab in neutral, adjust actuator screw so that push-pull tube is aligned with hole in trim tab horn; install attaching bolt, spacer and nut.
- h. Check aileron trim tab for proper operation, correct travel and rigging.
- i. Install access covers, carpet and seats.

Removal of Aileron Trim Gear Assembly. (See figure 5-4.)

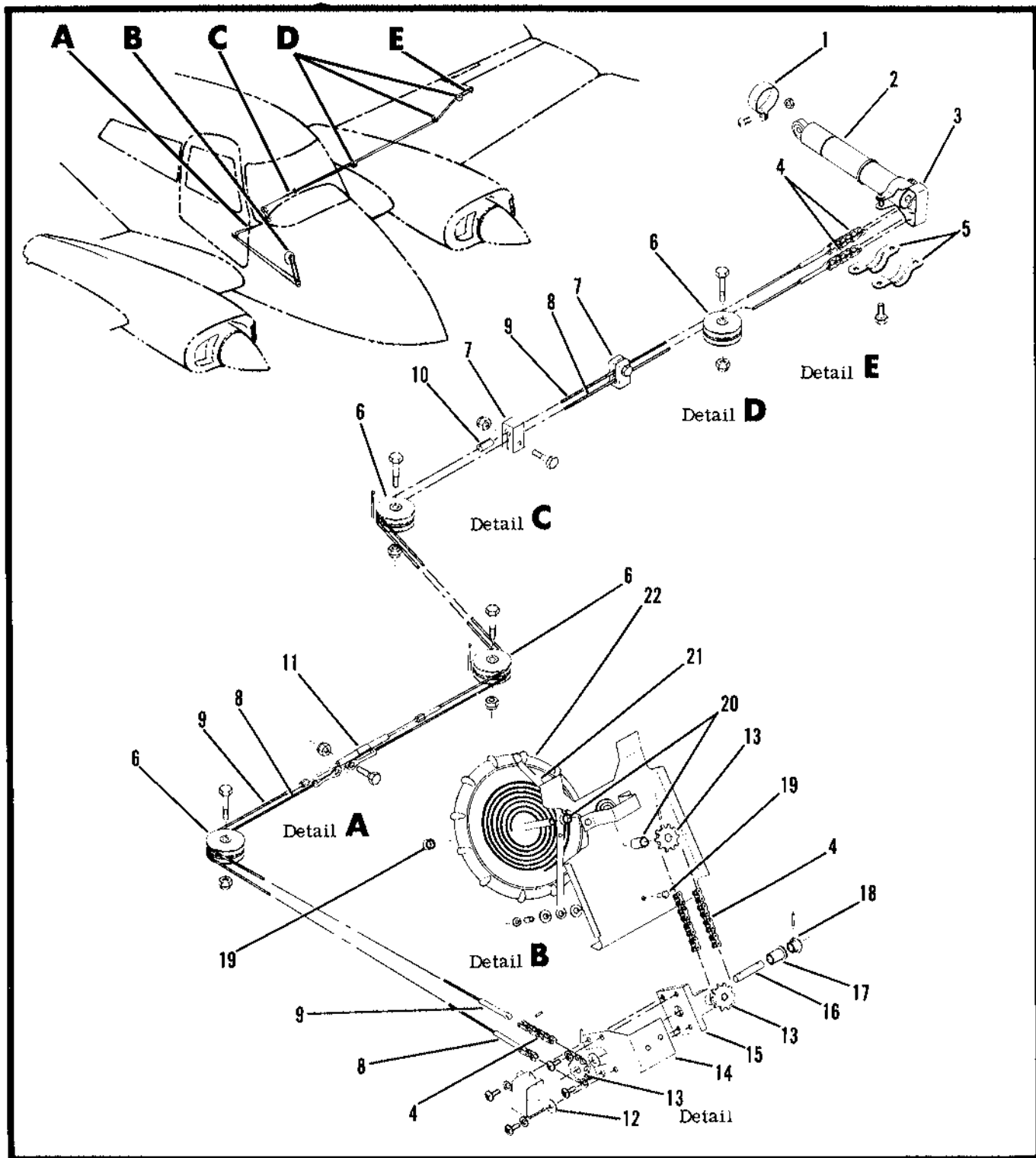
- a. Refer to Section 3 and remove front seats and left front carpet.
- b. Remove access hole covers from forward cabin floor, aft cabin floor above the landing gear actuator, and underside of fuselage just aft of the nose wheel well.
- c. Remove safety wire from turnbuckle (11) and disconnect.
- d. Remove chain guard (12) by removing two screws and washers, and disengage chain from sprocket (13).
- e. Remove sprocket (13) from shaft by removing roll pin.
- f. Remove two screws and washers attaching gear assembly support (15) and support guard (14) in fuselage.
- g. Rotate forward side of gear assembly support upward, disengage upper chain from sprocket, and remove support guard and gear assembly support through access hole in cabin floor.

Disassembly, Overhaul, and Reassembly of Aileron Trim Gear Assembly. (See figure 5-4.)

- a. Remove miter gears (18) and sprocket (13) from shafts by driving out roll pins. Remove shafts (16) from gear assembly support (15).
- b. Remove press-fit bearings (17) only to replace.
- c. Clean components with suitable solvent, inspect for visible damage and excessive wear, and replace all defective parts.
- d. To reassemble, reverse the above procedure.

Installation of Aileron Trim Gear Assembly. (See figure 5-4.)

- a. Insert gear assembly support (15) and support guard (14) through access hole in cabin floor, and engage upper chain with sprocket.
- b. With support guard in position, align mounting holes in gear assembly support and install with two



1. Aft Actuator Clamp
2. Aileron Trim Tab Actuator
3. Chain Guard
4. Chain
5. Aft Clamp
6. Aileron Trim Pulley
7. Stop Block

8. Bottom Cable
9. Top Cable
10. Stop Block Bushing
11. Turnbuckle
12. Chain Guard
13. Sprocket
14. Support Guard
15. Gear Support

16. Gear Shaft
17. Shaft Bearing
18. Miter Gear
19. Rivet
20. Spacer
21. Aileron Trim Indicator
22. Aileron Trim Wheel

Figure 5-4. Aileron Trim Control System

screws and washers. Use the two mounting holes that are not utilized to attach chain guard (12).

- c. Attach sprocket to shaft by installing roll pin.
- d. Engage chain (4) with sprocket (13) and install chain guard (12) with two screws and washers.
- e. Connect trim control cables with turnbuckle (11), tighten cables to 10 +3 pounds tension, and safety turnbuckle.
- f. Move aileron trim tab to neutral and adjust indicator to neutral.

#### NOTE

To disengage indicator from trim control wheel track, insert a screwdriver beneath indicator and pry out of track. This permits indicator to be moved to a neutral position and re-engaged with track.

- g. Check aileron trim tab for proper operation, correct travel and rigging.
- h. Install access hole covers on forward cabin floor, aft cabin floor and underside of fuselage aft of nose wheel well.
- i. Install carpets and front seats.

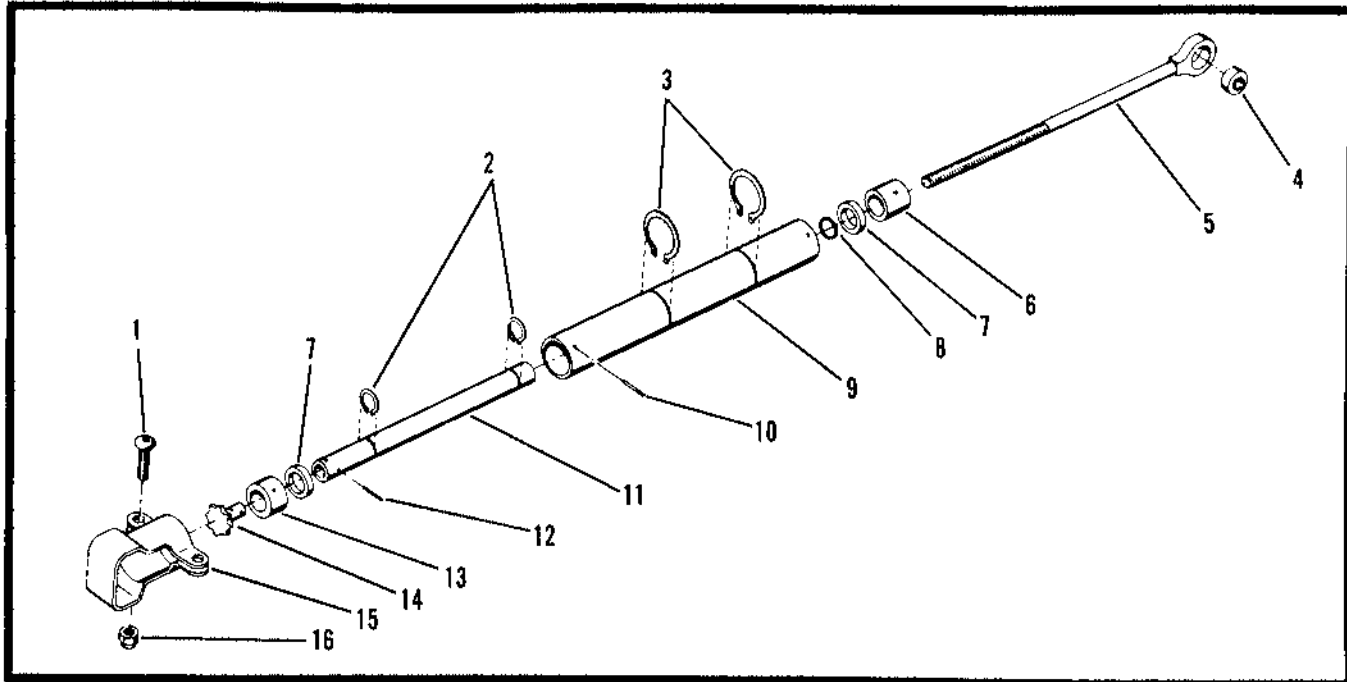
Removal and Installation of Aileron Trim Wheel and Indicator Assemblies. (See figure 5-4.)

Removal of aileron trim wheel and indicator assemblies is not recommended. However, removal can be accomplished by drilling out the rivets which

attach the wheel bracket to the control pedestal, and the rivet around which the indicator pivots.

Rigging of Aileron Trim Control System. (See figure 5-4.)

- a. Refer to Section 3 and remove the following items:
  1. Front seats, middle and rear seats.
  2. Front and center carpets.
- b. Remove access cover from underside of the fuselage just aft of the nose wheel well, the fuselage floorboards above the landing gear actuator, the spar access covers aft of main wheel wells, and the access cover above aileron quadrant.
- c. Remove safety wire from turnbuckle (11) connecting aileron trim control cables, adjust to 10 +3 pounds tension, and resafety turnbuckle.
- d. Move aileron trim control system to neutral by rotating trim control wheel so that the chain on actuator sprocket is equal in length, and the chain on gear support sprocket (13) is equal in length.
- e. Adjust aileron trim indicator (21) to neutral by inserting a screwdriver beneath indicator and prying out of track in trim control wheel, moving the indicator to neutral, and re-engaging with track.
- f. Remove nut, bolt and spacer attaching push-pull tube to aileron trim tab.
- g. Align aileron with trailing edge of wing and place trim tab in neutral.
- h. (See figure 5-5.) Adjust actuator screw (5) so that aft hole in push-pull tube is aligned with hole in



- |                   |                   |                 |
|-------------------|-------------------|-----------------|
| 1. Screw          | 6. Bearing        | 12. Groov-Pin   |
| 2. Retaining Ring | 7. Collar         | 13. Bearing     |
| 3. Retaining Ring | 8. O-Ring Packing | 14. Sprocket    |
| 4. Bearing        | 9. Housing        | 15. Chain Guard |
| 5. Screw          | 10. Groov-Pin     | 16. Nut         |
|                   | 11. Screw         |                 |

Figure 5-5. Aileron Trim Tab Actuator

trim tab horn; attach push-pull tube to trim tab horn with bolt, spacer and nut.

i. Loosen stop blocks (7), move trim tab to 20 degrees DOWN, slide outboard stop block against outboard rib (wing station 111.5), and tighten stop block.

#### NOTE

Stop blocks (7) should be installed so that bottom cable (8) passes through bushings (10), and top cable is clamped by stop blocks.

j. Move trim tab to 20 degrees UP, slide inboard

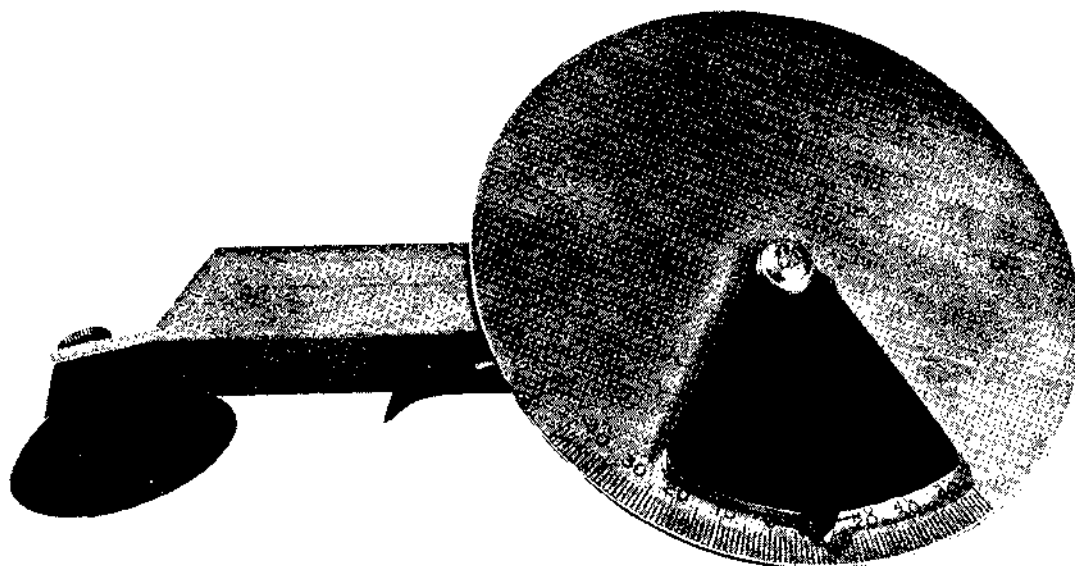
stop block against inboard rib (wing station 100.5), and tighten stop block.

k. Tolerance for aileron trim tab travel is plus one degree and minus zero degrees.

#### WARNING

Insure that aileron trim tab moves in the proper direction when operated by the trim control wheel.

l. Install access covers, carpets and seats.



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## SECTION 6

## ELEVATOR AND TRIM CONTROL SYSTEMS

## Table of Contents

|                                                   | Page |                                              | Page |
|---------------------------------------------------|------|----------------------------------------------|------|
| ELEVATORS . . . . .                               | 6-1  | Installation of Forward Elevator             |      |
| Removal . . . . .                                 | 6-1  | Bellcrank . . . . .                          | 6-5  |
| Installation . . . . .                            | 6-1  | Removal and Installation of Forward          |      |
| ELEVATOR TRIM TAB . . . . .                       | 6-1  | Elevator Push-Pull Tube . . . . .            | 6-5  |
| Removal . . . . .                                 | 6-1  | Rigging . . . . .                            | 6-5  |
| Disassembly and Assembly . . . . .                | 6-1  | ELEVATOR TRIM CONTROL SYSTEM . . . . .       | 6-7  |
| Installation . . . . .                            | 6-3  | Trouble Shooting . . . . .                   | 6-7  |
| ELEVATOR CONTROL SYSTEM . . . . .                 | 6-3  | Removal of Elevator Trim Control             |      |
| Trouble Shooting . . . . .                        | 6-3  | Cables and Chains . . . . .                  | 6-7  |
| Removal of Elevator Control Cables . . . . .      | 6-3  | Installation of Elevator Trim Control        |      |
| Installation of Elevator Control Cables . . . . . | 6-4  | Cables and Chains . . . . .                  | 6-8  |
| Removal of Aft Elevator Bellcrank . . . . .       | 6-4  | Removal of Trim Tab Actuator . . . . .       | 6-8  |
| Installation of Aft Elevator Bellcrank . . . . .  | 6-4  | Disassembly of Trim Tab Actuator . . . . .   | 6-8  |
| Removal and Installation of Elevator              |      | Installation of Trim Tab Actuator . . . . .  | 6-8  |
| Pylon . . . . .                                   | 6-4  | Removal of Elevator Trim Control Wheel,      |      |
| Removal and Installation of Elevator              |      | Sprocket and Indicator Assembly . . . . .    | 6-8  |
| Down Spring . . . . .                             | 6-4  | Installation of Elevator Trim Control Wheel, |      |
| Removal and Installation of Aft Elevator          |      | Sprocket and Indicator Assembly . . . . .    | 6-8  |
| Push-Pull Tube . . . . .                          | 6-5  | Rigging . . . . .                            | 6-10 |
| Removal of Forward Elevator Bellcrank . . . . .   | 6-5  |                                              |      |

## ELEVATORS.

The elevator control surfaces consist of two elevator assemblies connected by a torque tube, and an elevator trim tab located at the trailing edge of the right elevator. Each elevator is attached to the rear spar of the horizontal stabilizer with two hinges. The elevators are operated by a pylon to which the elevator torque tubes are bolted.

## Removal of Elevators. (See figure 6-1.)

- Refer to Section 3 and remove stinger in accordance with removal procedures.
- Disconnect elevator trim tab push-pull tube (3) by removing nut, washer and bolt.
- Disconnect elevator torque tubes from the elevator pylon (14) by removing nuts and bolts.
- Disconnect bonding straps (8) by removing attaching screws.
- Remove fiberglass tips (6) by removing attaching screws.
- Remove each elevator by removing nuts (12), washers (11), and bolts (10).
- When removing right elevator, guide elevator trim tab push-pull tube (3) out through elevator.

## Installation of Elevators. (See figure 6-1.)

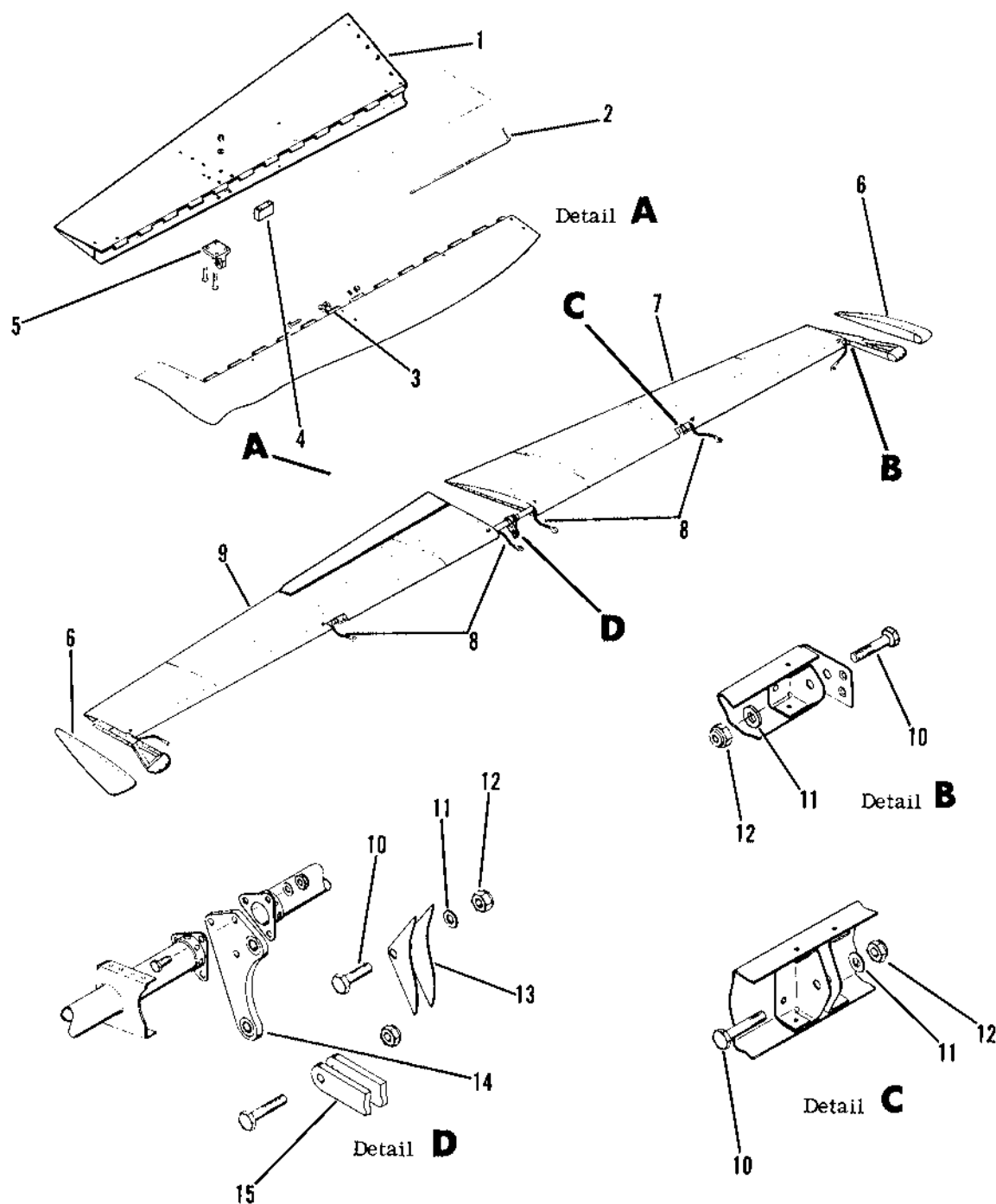
- Place elevators in position, guiding elevator trim tab push-pull tube (3) through opening in right elevator, and align mounting holes.
- Attach each elevator to horizontal stabilizer with bolts (10), washers (11) and nuts (12).
- Attach elevator torque tubes to elevator pylon (14) by installing bolts, washers and nuts.
- Attach bonding straps (8) with attaching screws.
- Install fiberglass tips (6) with attaching screw.
- Attach elevator trim tab push-pull tube (3) to trim tab with bolt, washer and nut.
- Refer to rigging procedures and check elevators and elevator trim tab for proper operation and travel.
- Refer to Section 3 and install stinger in accordance with installation procedures.

## ELEVATOR TRIM TAB.

## Removal of Elevator Trim Tab. (See figure 6-1.)

- Disconnect elevator trim tab push-pull tube (3) by removing nut, washer and bolt.
- Remove cotter pins from hinge pin (2), and detach trim tab from elevator by removing hinge pin.

Disassembly and Assembly of Elevator Trim Tab.  
(See figure 6-1.)



- |                                     |                   |                             |
|-------------------------------------|-------------------|-----------------------------|
| 1. Elevator Trim Tab                | 6. Fiberglass Tip | 11. Washer                  |
| 2. Hinge Pin                        | 7. Left Elevator  | 12. Nut                     |
| 3. Elevator Trim Tab Push-Pull Tube | 8. Bonding Strap  | 13. Hinge Bracket           |
| 4. Spacer                           | 9. Right Elevator | 14. Elevator Pylon          |
| 5. Elevator Trim Tab Horn           | 10. Bolt          | 15. Elevator Push-Pull Tube |

Figure 6-1. Elevator and Trim Tab Installation

- a. Remove elevator trim tab horn (5) and spacer (6) by removing nuts, washers and screws.
- b. To assemble, reverse the above procedure.

procedures, checking elevator trim tab for proper operation and correct travel.

Installation of Elevator Trim Tab. (See figure 6-1.)

- a. Attach trim tab to elevator with hinge pin (2) and safety in place with cotter pins.
- b. Connect elevator trim tab push-pull tube (3) to trim tab horn (5) with bolt, washer and nut.
- c. Refer to elevator trim control system rigging

#### ELEVATOR CONTROL SYSTEM.

The elevator control system consists of cables, turnbuckles, bellcranks, an elevator down spring, adjustable bellcrank stops and push-pull tubes. This system, as described herein, extends from the lower control column attachment point to the pylon which operates the elevators.

Trouble Shooting the Elevator Control System.

| TROUBLE                                                                 | PROBABLE CAUSE                                                           | CORRECTION                                                                                        |
|-------------------------------------------------------------------------|--------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| LOST MOTION BETWEEN CONTROL WHEEL AND ELEVATORS                         | Cable tension too low.                                                   | Adjust cable tension in accordance with elevator rigging procedures.                              |
|                                                                         | Broken pulley.                                                           | Replace pulley.                                                                                   |
|                                                                         | Cables not in place on pulleys.                                          | Install cables correctly. Check cable guards.                                                     |
| RESISTANCE TO ELEVATOR CONTROL MOVEMENT                                 | Excessive end play in aileron sprocket shaft on control column assembly. | Tighten sprocket shaft nut in accordance with control column assembly procedures (Section 5).     |
|                                                                         | Cable tension too high.                                                  | Adjust cable tension in accordance with elevator rigging procedures.                              |
|                                                                         | Pulleys binding or rubbing.                                              | Replace binding pulleys. Provide clearance if rubbing pulley brackets or cable guards.            |
|                                                                         | Cable not in place on pulleys during installation.                       | Install pulleys correctly.                                                                        |
|                                                                         | Instrument panel ball and socket needs lubricating.                      | Lubricate in accordance with Section 2.                                                           |
|                                                                         | Binding control column pivot bearings.                                   | Lubricate in accordance with Section 2.                                                           |
|                                                                         | Bent elevator or hinge.                                                  | Repair or replace elevator hinge.                                                                 |
| INCORRECT ELEVATOR TRAVEL                                               | Elevator bellcrank stops incorrectly adjusted.                           | Adjust in accordance with elevator rigging procedures.                                            |
| CORRECT ELEVATOR TRAVEL CANNOT BE OBTAINED BY ADJUSTING BELLCRANK STOPS | Elevator cables incorrectly rigged.                                      | Rig cables in accordance with elevator rigging procedures.                                        |
|                                                                         | Control column contacting fuselage bulkhead or instrument panel.         | Adjust length of forward elevator push-pull tubes in accordance with elevator rigging procedures. |
|                                                                         | Incorrect positioning of forward elevator bellcrank.                     | Rig elevator cables in accordance with elevator rigging procedures.                               |

Removal of Elevator Control Cables. (See figure 6-2.)

- a. Refer to Section 3 and remove the following

items:

1. Front and rear seats or; middle and aft rear seats (optional equipment).
2. Front, center and rear carpets.

3. Rear upholstery panel to tailcone.
- b. Remove access hole covers from floor as necessary to gain access to cables, pulleys, and attachment points.
- c. Unsafety turnbuckles (18) and disconnect elevator cables (6 and 7) from forward elevator bellcrank (17) by removing turnbuckles.
- d. Remove four pulleys (19) by removing nuts, bolts and cable guards (20).
- e. Remove fairleads through which elevator cables pass at fuselage rear spar.
- f. Disconnect elevator cables (6 and 7) from aft elevator bellcrank (9) by removing cotter pins, nuts, washers and bolts.
- g. Tie guide wires to forward ends of elevator cables (6 and 7), remove cables by pulling them out aft of baggage compartment, and disconnect guide wires.

Installation of Elevator Control Cables. (See figure 6-2.)

- a. Tie elevator cables (6 and 7) to guide wires, pull into position, and remove guide wires.
- b. Install fairleads through which elevator cables pass at fuselage rear spar.
- c. Install four pulleys (19) with bolts, cable guards (20) and nuts, insuring that cables are correctly in place as pulleys are installed.
- d. Attach elevator cables (6 and 7) to aft elevator bellcrank (9) with bolts, washers, nuts and cotter pins.
- e. Connect elevator cables (6 and 7) to forward elevator bellcrank (17) with turnbuckles (18), and rig elevator control system in accordance with rigging procedures.
- f. Install removed access panels.
- g. Refer to Section 3 and install the necessary upholstery panels, carpets and seats.

Removal of Aft Elevator Bellcrank. (See figure 6-2.)

- a. Refer to Section 3 and remove the following items:
  1. Front seats.
  2. Front carpet.
  3. Rear upholstery panel to tailcone.
- b. Remove access hole covers from cabin floor above forward elevator bellcrank (17).
- c. Unsafety and loosen either turnbuckle (18) to release tension on elevator cables.
- d. Disconnect elevator cables (6 and 7) from aft elevator bellcrank (9) by removing cotter pins, nuts and bolts.

#### NOTE

If an automatic pilot (optional equipment) is installed, disconnect from aft elevator bellcrank.

- e. Disconnect aft elevator push-pull tube (1) from elevator bellcrank (9) by removing nut and bolt.
- f. Release tension on elevator down spring cables (5) by either disconnecting elevator down spring (2) or blocking elevator down spring channel assembly (3) forward.

- g. Disconnect elevator down spring cables (5) from elevator bellcrank (9) by removing cotter pin, nut, washers, spacer and bolt.
- h. Remove aft elevator bellcrank (9) by removing nut, spacers and bolt.

Installation of Aft Elevator Bellcrank. (See figure 6-2.)

- a. Place aft elevator bellcrank (9) in position, and install with bolt, spacers and nut.
- b. Connect elevator down spring cables (5) to elevator bellcrank (9) with bolt, spacer, washers, nuts and cotter pin.
- c. Connect elevator down spring (2) or remove block aft of elevator down spring channel assembly (3) in accordance with the method used to release tension on elevator down spring cables.
- d. Attach aft elevator push-pull tube (1) to elevator bellcrank (9) with bolt and nut.
- e. Attach elevator cables (6 and 7) to elevator bellcrank (9) with bolts, nuts, and cotter pins.

#### NOTE

If an automatic pilot (optional equipment) is installed, connect to aft elevator bellcrank.

- f. Rig elevator control system in accordance with rigging procedures.
- g. Install access cover above forward elevator bellcrank.
- h. Refer to Section 3 and install rear upholstery panel, front carpet and front seats.

Removal and Installation of Elevator Pylon. (See figure 6-1.)

- a. Refer to Section 3 and remove stinger in accordance with removal procedures.
- b. Disconnect aft elevator push-pull tube (15) by removing nut and bolt.
- c. Remove three nuts, washers and bolts attaching elevators to elevator pylon (14). Remove nut, washer and bolt attaching elevator pylon (14) to hinge bracket (13) and remove by sliding aft.
- d. To install elevator pylon, reverse the above procedure.

Removal and Installation of Elevator Down Spring and Channel Assembly. (See figure 6-2.)

- a. Refer to Section 3, remove rear upholstery panel to tailcone and stabilizer fairings.
- b. Stretch elevator down spring (2) aft and unhook from eyebolt.
- c. Remove elevator down spring (2) from elevator down spring channel assembly by removing cotter pin, nut, washers, spacers and bolt.
- d. Disconnect elevator down spring cables (5) by removing cotter pin, nut, spacer and bolt.
- e. Remove elevator down spring channel assembly (3) by removing nut, spacer and bolt.
- f. To install elevator down spring and channel as-

sembly, reverse the above procedure.

#### Removal and Installation of Aft Elevator Push-Pull Tube. (See figure 6-2.)

- Refer to Section 3, remove rear upholstery panel to tailcone and stinger.
- Remove nut and bolt attaching push-pull tube (1) to aft elevator bellcrank (9).
- Remove nut and bolt attaching push-pull tube (1) to elevator pylon and remove push-pull tube by pulling aft.
- To install aft elevator push-pull tube, reverse the above procedures.

#### Removal of Forward Elevator Bellcrank. (See figure 6-2.)

- Refer to Section 3, remove the front seats and front carpet in accordance with removal procedures.
- Remove access covers from cabin floor above forward elevator bellcrank.
- Unsafety and loosen either turnbuckle (18) to release tension on elevator cables (6 and 7).
- Disconnect elevator cables (6 and 7) from forward elevator bellcrank (17) by removing cotter pins, nuts and bolts.
- Disconnect forward elevator push-pull tube (16) from elevator bellcrank (17) by removing nut, washer and bolt.
- Remove elevator bellcrank (17) by removing bolt.

#### Installation of Forward Elevator Bellcrank. (See figure 6-2.)

- Place forward elevator bellcrank (17) in position, and install with bolt.
- Attach forward elevator push-pull tube (16) to elevator bellcrank (17) with bolt, washer and nut.
- Attach elevator cables (6 and 7) to elevator bellcrank (17) with bolts, nuts and cotter pins.
- Rig elevator control system in accordance with rigging procedures.
- Install access covers on cabin floor.
- Refer to Section 3, install front carpet and front seats.

#### Removal and Installation of Forward Elevator Push-Pull Tube. (See figure 6-2.)

- Refer to Section 3, remove front seats and front carpet in accordance with removal procedures.
- Remove access covers from cabin floor above forward elevator bellcrank (17) and from underside of the fuselage aft of nose wheel well.
- Disconnect forward elevator push-pull tube (16) from elevator bellcrank (17) by removing nut, washer and bolt.
- Disconnect forward elevator push-pull tube (16) from control column by removing nut, spacers and bolt.
- To install forward elevator push-pull tube (16), reverse the above procedures.

#### NOTE

If length of forward elevator push-pull tube (16) has been changed or a new push-pull tube is being installed, adjust length to approximately 12 inches, measured between centerlines of the rod end bolt holes.

#### Rigging of Elevator Control System. (See figure 6-2.)

- Refer to Section 3, remove the following items:
  - Front seats.
  - Front carpet.
  - Rear upholstery panel to tailcone.
- Remove access covers from cabin floor above forward elevator bellcrank (17) and tailcone access cover below aft push-pull tube (1).
- Install an inclinometer on trailing edge of the elevator and adjust elevator bellcrank stops (10) so that the elevator travel is  $16 + 1/2$ ,  $-0$  degrees UP and  $15 + 1$ ,  $-0$  degrees DOWN.

#### CAUTION

When checking elevator travel, do not operate elevator from the elevator tip or serious damage to the elevator may result.

#### NOTE

The hole through the elevator bellcrank stop (10) is drilled off-center to provide a positive means of adjusting the elevator travel. At the extreme elevator travel limits ( $16 + 1/2$ ,  $-0$  degrees UP and  $15 + 1$ ,  $-0$  degrees DOWN), the bellcrank (9) should be tangent with the flat surface of stop (10). Adjustments (0 and  $1/2$  degree) are accomplished by rotating stop (10) approximately 60 degrees or until another side of the stop is encountered and tangent with bellcrank surface.

- Unsafety turnbuckles (18) and adjust so that tension on elevator cables (6 and 7) is  $32 \pm 5$  pounds, insuring that forward elevator bellcrank (17) does not contact the bulkhead located just forward of the bellcrank. When elevators are in either extreme position, the bellcrank should clear the bulkhead by approximately  $1/4$  inch.

#### NOTE

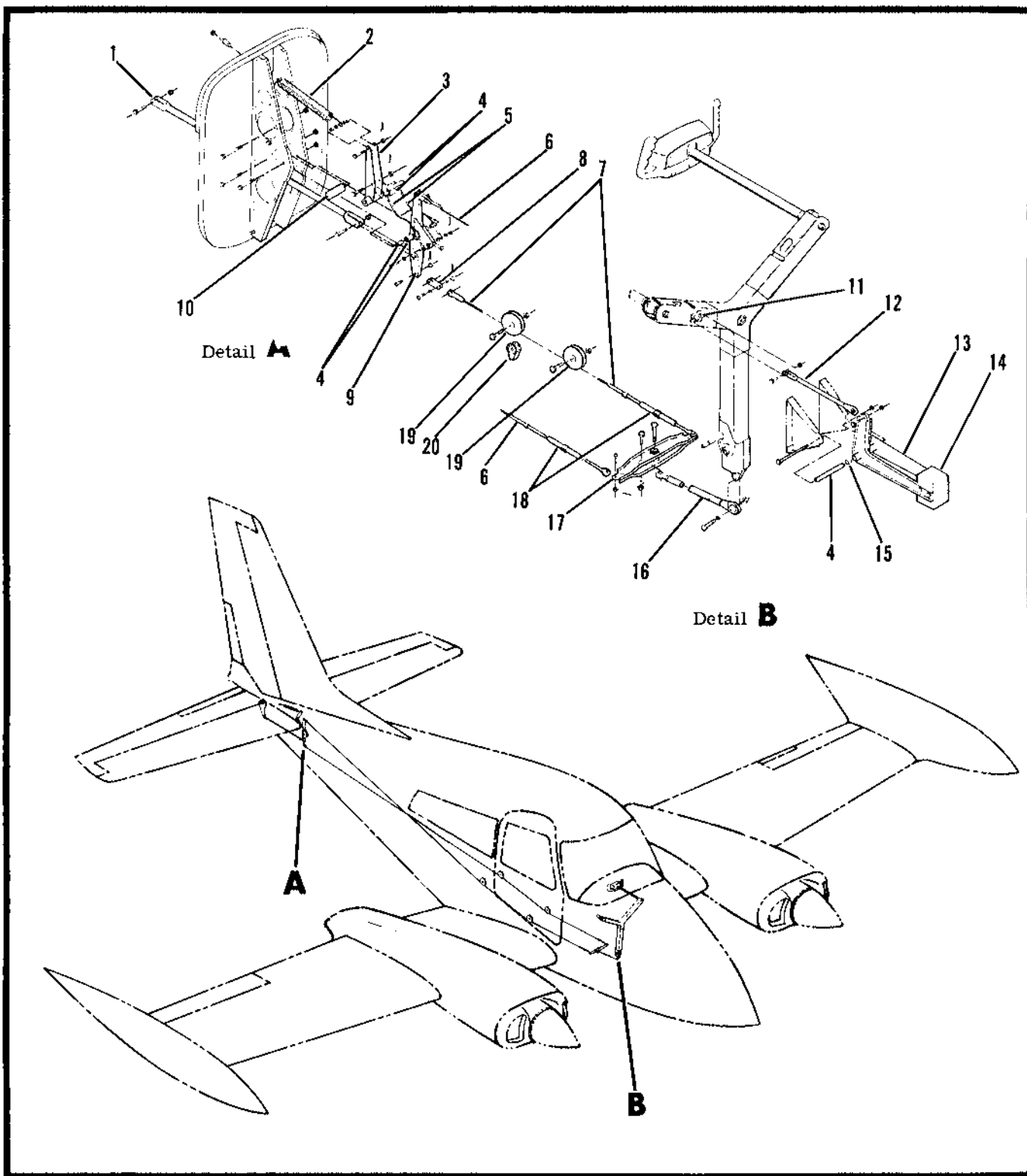
Cable tension readings should be taken just aft of rear cabin bulkhead (fuselage station 132) with bob-weight push-pull tube (12) disconnected from control column.

- Resafety turnbuckles (18).

#### WARNING

Insure that elevator moves in the proper direction when operated by the control wheel.

- Adjust length of forward elevator push-pull tube



- |                                  |                             |                                       |
|----------------------------------|-----------------------------|---------------------------------------|
| 1. Elevator Push-pull Tube (Aft) | 8. Link                     | 14. Bob-Weight                        |
| 2. Elevator Down Spring          | 9. Elevator Bellcrank (Aft) | 15. Bearing                           |
| 3. Down Spring Channel Assembly  | 10. Bellcrank Stop          | 16. Elevator Push-pull Tube (Forward) |
| 4. Spacer                        | 11. Bob-Weight Bracket      | 17. Elevator Bellcrank (Forward)      |
| 5. Down Spring Cable             | 12. Push-pull tube          | 18. Turnbuckle                        |
| 6. Right Elevator Control Cable  | 13. Bob-Weight Bellcrank    | 19. Pulley                            |
| 7. Left Elevator Control Cable   |                             | 20. Cable Guard                       |

Figure 6-2. Elevator Control System

(16) so that control column clears instruments in aft position and fuselage bulkhead in forward position.

h. Install rear upholstery panel, carpets and front seats.

### NOTE

When elevator system is correctly rigged, the length of forward elevator push-pull tube (16) should be approximately 12 inches, measured between centerlines of the rod end bolt holes.

g. Install access covers.

### ELEVATOR TRIM CONTROL SYSTEM.

The elevator trim control system is interconnected by chains, cables, sprockets, pulleys, miter gears, an actuator, and a push-pull tube. The elevator trim control wheel, mounted on the left side of the control pedestal, incorporates a track in which the indicator rides.

### Trouble Shooting the Elevator Trim Control System.

| TROUBLE                                                    | PROBABLE CAUSE                                      | CORRECTION                                                                             |
|------------------------------------------------------------|-----------------------------------------------------|----------------------------------------------------------------------------------------|
| TRIM CONTROL WHEEL MOVES WITH EXCESSIVE RESISTANCE         | Cable tension too high.                             | Adjust tension in accordance with rigging procedures.                                  |
|                                                            | Pulleys binding or rubbing.                         | Replace binding pulleys. Provide clearance if rubbing pulley brackets or cable guards. |
|                                                            | Cables not in place on pulleys during installation. | Install cables correctly.                                                              |
|                                                            | Trim tab hinge binding.                             | Lubricate hinge. If necessary, replace.                                                |
|                                                            | Defective trim tab actuator.                        | Repair or replace actuator.                                                            |
| LOST MOTION BETWEEN TRIM CONTROL WHEEL AND TRIM TAB        | Cable tension too low.                              | Adjust tension in accordance with rigging procedures.                                  |
|                                                            | Broken pulley.                                      | Replace pulley.                                                                        |
|                                                            | Cables not in place on pulleys.                     | Install cables correctly. Check cable guards.                                          |
|                                                            | Worn trim tab actuator.                             | Repair or replace actuator.                                                            |
| TRIM INDICATOR FAILS TO INDICATE CORRECT TRIM POSITION     | Indicator incorrectly engaged with wheel track.     | Engage in accordance with rigging procedures.                                          |
| INCORRECT TRIM TAB TRAVEL                                  | Stop blocks loose or incorrectly adjusted.          | Adjust stop blocks in accordance with rigging procedures.                              |
| CORRECT TRAVEL CANNOT BE OBTAINED BY ADJUSTING STOP BLOCKS | Actuator screw incorrectly adjusted.                | Adjust in accordance with rigging procedures.                                          |

### Removal of Elevator Trim Control Cables and Chains. (See figure 6-3.)

- Refer to Section 3, remove the following items:
  - Front and rear seats or; middle and individual rear seats (optional equipment).
  - Front, center and rear carpet.
  - Rear upholstery panel to tailcone.
  - Stinger and stabilizer fairings.
- Remove access covers on floorboard as necessary to gain access to cables and access covers from

underside of fuselage, aft of nose wheel well and stabilizer.

- Unsafely turnbuckle (10) and disconnect aft cables (7 and 8) by removing turnbuckle, cotter pin and pin.
- Remove aft pulleys (6) by removing nuts, bolts and cable guard cotter pins.
- Remove chain guard from elevator trim tab actuator (2) by removing nuts and screws.
- Disengage chain (5) from sprocket (4), attach a guide wire to the chain, and remove cables and chain by pulling out through opening in tailcone. Disconnect



guide wire and leave in horizontal stabilizer to facilitate installation.

- g. Remove stop blocks (12) by removing nuts, bolts and bushings (13).
- h. Remove three sets of pulleys (6) as illustrated in figure 6-3.
- i. Remove elevator trim control wheel (14) by removing four screws and washers.
- j. Remove upper left side panel from control pedestal.
- k. Remove four cable guard pins.
- l. Tie guide wires to aft ends of cables (9 and 11) and pull chain and cables out through control pedestal. Disconnect guide wires and leave in position to facilitate installation.

**NOTE**

Pulleys (6) are difficult to reinstall and should be removed only for replacement.

**Installation of Elevator Trim Control Cables and Chains.** (See figure 6-3.)

- a. Tie aft ends of cables (9 and 11) to guide wires, pull into position, and remove guide wires.
- b. Engage chain (15) with sprocket (20) and install upper left side panel on control pedestal.
- c. Install four cable guard pins.
- d. Install three sets of pulleys (6) as illustrated in figure 6-3.
- e. Tie aft chain (5) to the guide wire, pull into position, and remove guide wire.
- f. Engage aft chain (5) with actuator sprocket (4) and install chain guard with screws and nuts.
- g. Install aft pulleys (6) with bolts, nuts and cable guard cotter pins, insuring that the cables are correctly in place.
- h. Connect forward left cable (9) to aft left cable (8) with pin and cotter pin, and forward right cable (11) to aft right cable (7) with turnbuckle (10).
- i. Install stop blocks (12) and bushings (13) with bolts and nuts. Do not tighten at this time.
- j. Install elevator trim control wheel (14) with washers and screws, and rig elevator trim control system in accordance with rigging procedures.
- k. Install access covers.
  1. Refer to Section 3, install the following items:
    1. Stinger and stabilizer fairings.
    2. Rear upholstery panel to tailcone.
    3. Front, center and rear carpet.
    4. Front and rear seats or; middle and aft seats (optional equipment).

**Removal of Trim Tab Actuator.** (See figure 6-3.)

- a. Refer to Section 3, remove rear upholstery panel to tailcone.
- b. Remove access hole cover from underside of the horizontal stabilizer beneath elevator trim tab actuator.
- c. Unsafety and loosen turnbuckle (10) to release tension on elevator trim control cables.
- d. Remove chain guard from elevator trim tab actuator (2) by removing nuts and screws, and disengage

chain from sprocket (4).

- e. Remove right elevator in accordance with elevator removal procedures.
- f. Remove elevator trim tab push-pull tube from the elevator trim tab actuator screw (1) by removing nut, washer and bolt.
- g. Remove clamps (3) by removing bolts, and remove elevator trim tab actuator.

**Disassembly of Elevator Trim Tab Actuator.** (See figure 5-5.)

The instructions for disassembly, overhaul and reassembly of the aileron trim tab actuator, given in Section 5, also applies to the elevator trim tab actuator.

**Installation of Elevator Trim Tab Actuator.** (See figure 6-3.)

- a. Insert elevator trim tab actuator through access hole, place in position, and install clamps (3) with bolts.
- b. Attach elevator trim tab push-pull tube to elevator trim tab actuator screw (1) with bolt, washer and nut.
- c. Install right elevator in accordance with installation procedures.
- d. Engage chain (5) with sprocket (4), and install the chain guard with screws and nuts.
- e. Rig elevator trim control system in accordance with rigging procedures.
- f. Install access hole cover on underside of horizontal stabilizer.
- g. Refer to Section 3, install rear upholstery panel to tailcone.

**Removal of Elevator Trim Control Wheel, Sprocket, and Indicator Assembly.** (See figure 6-3.)

- a. Remove rear curtain from baggage compartment.
- b. Unsafety and loosen turnbuckle (10) to release tension on elevator trim control system.
- c. Remove elevator trim control wheel (14) by removing four screws and washers.
- d. Remove upper left side panel from control pedestal.

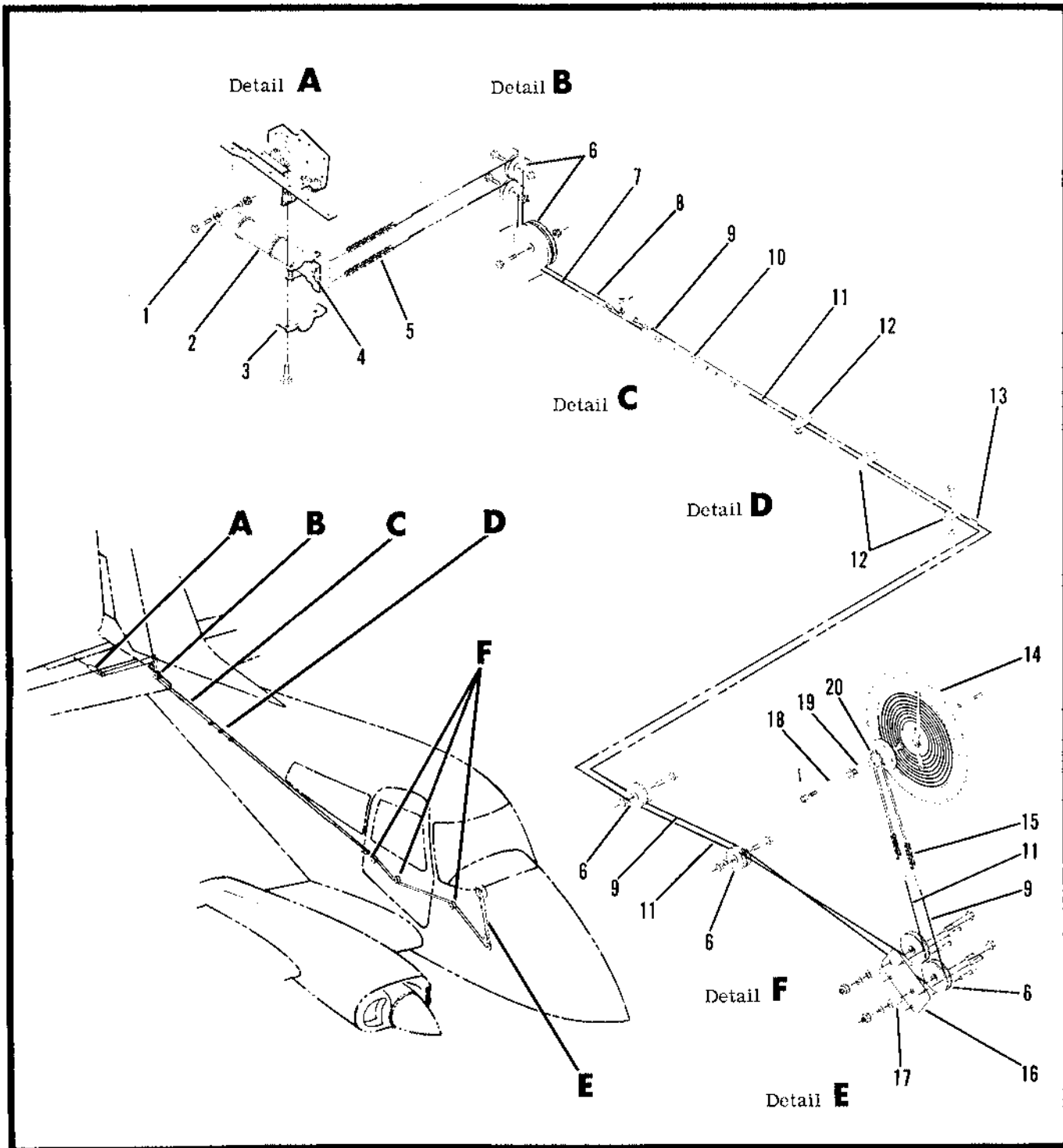
**NOTE**

To remove the elevator trim indicator assembly, the rivets around which the indicator pivots must be removed.

- c. Disengage chain (15) from sprocket (20), remove upper right side panel from control pedestal, and remove sprocket (20) by removing cotter pin, nut, washer, spacer (19) and bolt (18).

**Installation of Elevator Trim Control Wheel, Sprocket, and Indicator Assembly.** (See figure 6-3.)

- a. Install sprocket (20) with bolt (18), spacer (19),



1. Actuator Screw
2. Actuator
3. Clamp
4. Actuator Sprocket
5. Chain
6. Pulley
7. Right Elevator Trim Control Cable (Aft)
8. Left Elevator Trim Control Cable (Aft)
9. Left Elevator Trim Control Cable (Forward)
10. Turnbuckle

11. Right Elevator Trim Control Cable (Forward)
12. Stop Block
13. Bushing
14. Elevator Trim Control Wheel
15. Chain
16. Cable Guard Bracket
17. Spacer
18. Bolt
19. Spacer
20. Sprocket

Figure 6-3. Elevator Trim Control System

washer, nut and cotter pin.

- b. Install upper right side panel on control pedestal.
- c. Engage chain (15) with sprocket (20) and install upper left side panel on control pedestal.
- d. Rig the elevator trim control system in accordance with rigging procedure, and install the elevator trim control wheel (14) with four washers and screws.
- e. Install rear upholstery panel to tailcone.

Rigging of Elevator Trim Control System. (See figure 6-3.)

- a. Remove the rear curtain from the baggage compartment.
- b. Loosen stop blocks (12) by loosening nuts.
- c. Unsafety turnbuckle (10), adjust so that tension on the elevator trim control cables is 10 ± 3 pounds, and resafety turnbuckle.

#### NOTE

If an automatic pilot (optional equipment) is installed, adjust tension on elevator trim control cables to 16 ± 3 pounds.

- d. (See figure 6-1.) Disconnect elevator trim tab push-pull tube (3) from elevator trim tab horn (5) by removing attaching nut, washer and bolt.
- e. Rotate elevator trim control wheel (14) forward (nose down) until aft chain (5) and forward chain (15) have approximately two links clearing the sprockets.

#### NOTE

If the elevator trim indicator reaches its extreme travel during rigging, it can be relocated by removing elevator trim control wheel, moving the indicator, and reinstalling wheel.

- f. With the chains in the above position and the elevators in neutral, adjust actuator screw (1) by rotating push-pull tube so that aft bolt hole in push-pull tube aligns with bolt hole in the trim tab horn when the elevator trim tab is approximately 26 degrees up.
- g. (See figure 6-1.) Connect push-pull tube (3) to elevator trim tab horn (5) with attaching bolt, washer and nut.

#### NOTE

The threaded end of bolt attaching the eleva-

tor trim tab push-pull tube to actuator screw must be inboard; therefore, exact travel adjustment is not made by this means.

- h. Rotate elevator trim control wheel (14) so that elevator trim tab is 10° +1° -0° up, locate aft stop block (12) adjacent to cable terminal, and tighten. Slide the center stop block against aft stop block and tighten.

#### NOTE

If an automatic pilot (optional equipment) is installed, refer to Section 13 for rigging of stop blocks.

- i. Rotate elevator trim control wheel (14) so that the elevator trim tab is 26° +1° -0° down. Slide forward stop block against the center stop block and tighten.

j. When the elevator trim control system is in either extreme position, the elevator trim indicator should be in the same relative position to the NOSE UP and NOSE DOWN positions on the decal. To adjust the indicator, use the following procedure:

1. Rotate elevator trim control wheel (14) so that elevator trim control system is in the extreme NOSE DOWN position.
2. Remove elevator trim control wheel (14) by removing four screws and washers, and place the elevator trim indicator at the NOSE DOWN position on the decal.
3. While the elevator trim indicator is in this position, install the elevator trim control wheel (14) with four washers and screws.

#### NOTE

The elevator trim control wheel (14) can be installed in any one of four positions. Select the position which causes the least indicator movement as it engages with the wheel track.

#### WARNING

Insure that elevator trim tab moves in the proper direction when operated by the trim control wheel.

- k. Refer Section 3, install rear upholstery panel to tailcone.

## SECTION 7

## RUDDER AND TRIM CONTROL SYSTEMS

## Table of Contents

|                                                 | Page |                                                    | Page |
|-------------------------------------------------|------|----------------------------------------------------|------|
| RUDDER . . . . .                                | 7-1  | Installation of Rudder Pedal Assembly . . . . .    | 7-6  |
| Removal . . . . .                               | 7-1  | Rigging . . . . .                                  | 7-6  |
| Installation . . . . .                          | 7-1  | RUDDER TRIM CONTROL SYSTEM . . . . .               | 7-8  |
| RUDDER TRIM TAB . . . . .                       | 7-1  | Trouble Shooting . . . . .                         | 7-8  |
| Removal . . . . .                               | 7-1  | Removal of Rudder Trim Control                     |      |
| Installation . . . . .                          | 7-3  | Cables and Chains . . . . .                        | 7-9  |
| RUDDER CONTROL SYSTEM . . . . .                 | 7-3  | Installation of Rudder Trim Control                |      |
| Trouble Shooting . . . . .                      | 7-3  | Cables and Chains . . . . .                        | 7-10 |
| Removal of Rudder Control Cables . . . . .      | 7-3  | Removal of Rudder Trim Tab Actuator . . . . .      | 7-10 |
| Installation of Rudder Control Cables . . . . . | 7-4  | Disassembly, Overhaul and Assembly of              |      |
| Removal of Rudder Pedal Assembly . . . . .      | 7-4  | Rudder Trim Tab Actuator . . . . .                 | 7-10 |
| Disassembly of Rudder Pedal Assembly . . . . .  | 7-6  | Installation of Rudder Trim Tab Actuator . . . . . | 7-10 |
| Assembly of Rudder Pedal Assembly . . . . .     | 7-6  | Rigging . . . . .                                  | 7-10 |

## RUDDER

The all-metal rudder has a fiberglass tip which encloses a lead weight used for static balance. The rudder trim tab, located at the trailing edge of the rudder, is actuated by a push-pull tube which is routed through the rudder to an actuator in the vertical fin. The rudder, attached to the vertical fin with three hinges, is operated by cables attached to a bellcrank to the lower hinge.

## Removal of Rudder. (See figure 7-1.)

- Place a suitable support beneath the tailcone bumper.
- Refer to Section 3 and remove stinger in accordance with removal procedures.
- Remove nut, washer and bolt from rudder trim tab push-pull tube (11).
- Remove three nuts, washers and bolts attaching rudder torque tube (6) to bellcrank (7).
- Disconnect bonding straps (5) from vertical stabilizer.
- Support rudder and remove nuts (4), washers (3) and bolts (2) from center and upper hinges.
- Remove rudder from vertical stabilizer by pulling aft and guiding rudder trim tab push-pull tube (11) through rudder.

## Installation of Rudder. (See figure 7-1.)

- Place rudder into position, guide rudder trim tab push-pull tube (11) through rudder and align

mounting holes on upper and center hinges with vertical stabilizer.

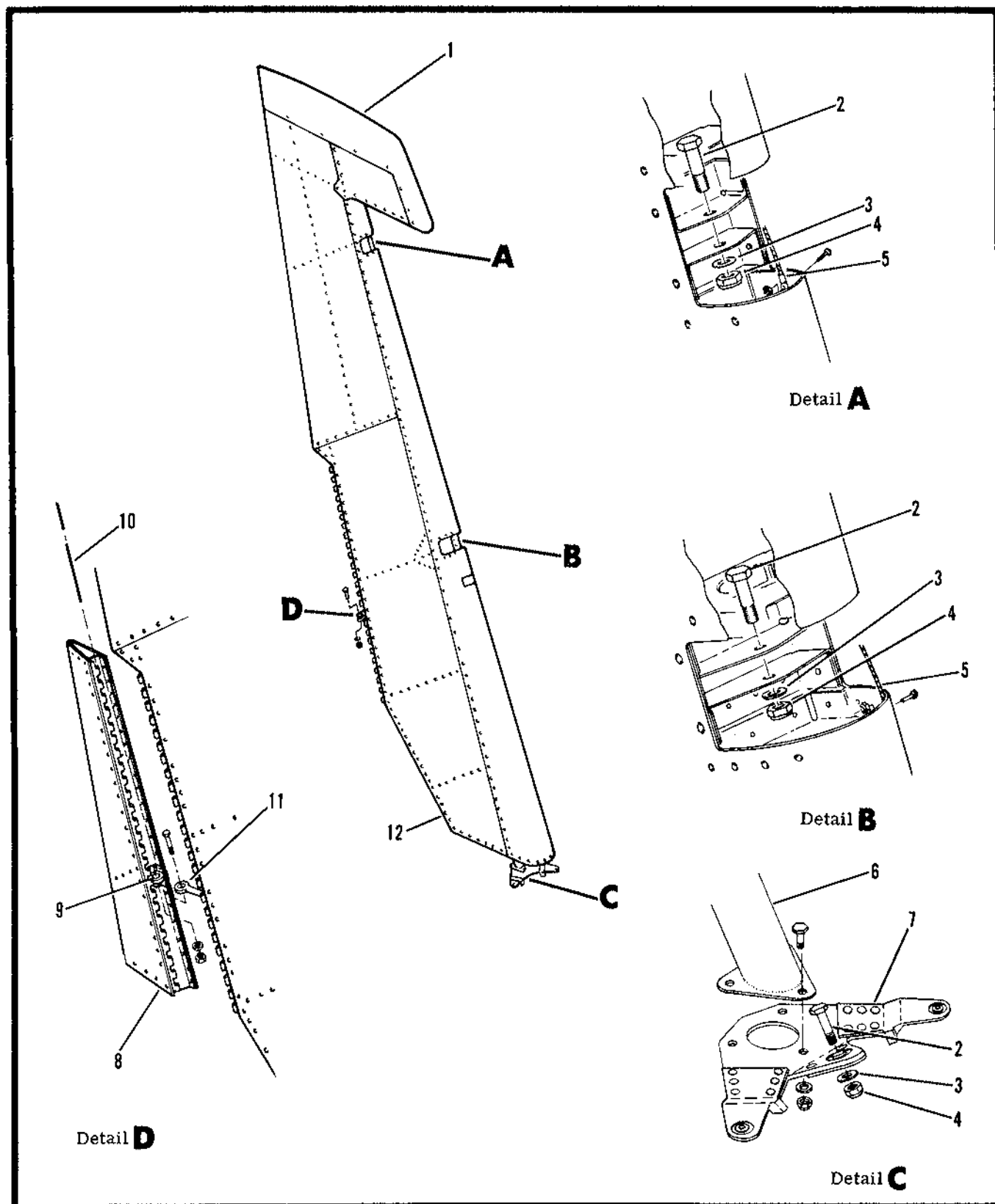
- Attach rudder to vertical stabilizer at the upper and center hinges with bolts (2), washers (3) and nuts (4).
- Attach rudder torque tube (6) to bellcrank (7) with three bolts, washers and nuts.
- Connect rudder trim tab push-pull tube (11) to trim tab horn (9) with bolt, washer and nut.
- Remove support from beneath tailcone bumper and check rudder and rudder trim tab for proper operation and correct travel. If rigging is necessary, rig in accordance with rigging procedures.
- Refer to Section 3 and install stinger in accordance with installation procedures.

## RUDDER TRIM TAB.

The all-metal rudder trim tab is operated by a push-pull tube extending through the rudder and attached to an actuator in the vertical fin. The tab is attached to the lower trailing edge of the rudder by a continuous hinge and is adjustable in flight.

## Removal of Rudder Trim Tab. (See figure 7-1.)

- Turn rudder trim control wheel on pedestal until indicator is pointing to full right position.
- Disconnect rudder trim tab push-pull tube (11) by removing nut, washer and bolt.
- Remove trim tab from rudder by removing cotter pins and hinge pin (10).



- |                   |                  |                    |
|-------------------|------------------|--------------------|
| 1. Fiberglass Tip | 5. Bonding Strap | 9. Trim Tab Horn   |
| 2. Bolt           | 6. Torque Tube   | 10. Hinge Pin      |
| 3. Washer         | 7. Bellcrank     | 11. Push Pull Tube |
| 4. Nut            | 8. Trim Tab      | 12. Rudder         |

Figure 7-1. Rudder and Rudder Trim Tab Installation

## NOTE

Any further disassembly or assembly of the rudder trim tab is not advisable.

Installation of Rudder Trim Tab. (See figure 7-1.)

- a. Attach rudder trim tab to rudder with hinge pin (10) and cotter pins.
- b. Connect rudder trim tab push-pull tube (11) to trim tab with bolt, washer and nut.
- c. Check rudder trim tab for proper operation and correct travel. If necessary, rig in accordance with rigging procedures.

## RUDDER CONTROL SYSTEM.

The rudder is operated by the movement of the pilot's rudder pedals (copilot's optional equipment). The pedals are connected to torque tubes which have link

arms for the attachment of the rudder cables. The rudder cables are attached to the torque link arms and routed forward over a pulley and then aft under the floorboards and through the tailcone by pulleys to the adjustable turnbuckles which are attached to the rudder bellcrank. The bellcrank is attached directly to the rudder torque tube and also provides the lower hinge for the rudder. The rudder travel stops, consisting of bolts mounted in brackets attached to the lower hinge bracket, are provided for the recommended travel adjustment. The position cable is attached to the left rudder torque tube and is routed aft around a pulley and then forward to right rudder torque tube to complete the rudder control cable system. The nose gear steering cables are attached to the right and left rudder torque tubes; routed forward to springs and then to the nose gear steering yoke.

Removal of Rudder Control Cables. (See figure 7-2.)

- a. Refer to Section 3 and remove the following items in accordance with removal procedures.

## Trouble Shooting Rudder Control System.

| TROUBLE                                              | PROBABLE CAUSE                                                    | CORRECTION                                                                                                |
|------------------------------------------------------|-------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|
| LOST MOTION BETWEEN RUDDER PEDALS AND RUDDER         | Cable tension too low.                                            | Adjust in accordance with rigging procedures.                                                             |
|                                                      | Broken pulley.                                                    | Replace pulley.                                                                                           |
|                                                      | Bolts attaching rudder to bellcrank are loose.                    | Tighten bellcrank bolts.                                                                                  |
| EXCESSIVE RESISTANCE TO RUDDER PEDAL MOVEMENT        | Cable tension too high.                                           | Adjust in accordance with rigging procedures.                                                             |
|                                                      | Pulleys binding or rubbing.                                       | Replace binding pulleys. Provide clearance if rubbing pulley brackets or cable guards.                    |
|                                                      | Rudder binding because of faulty bearings or bent hinges.         | Replace bearings and/or hinges.                                                                           |
|                                                      | Rudder pedal torque tube bearings misaligned or need lubrication. | Loosen bearing halves, lubricate and retighten. Refer to Section 2 for lubrication requirements.          |
|                                                      | Cables not in place on pulleys during installation.               | Install cables correctly.                                                                                 |
|                                                      | Bent rudder.                                                      | Repair or replace rudder.                                                                                 |
| RUDDER PEDALS NOT NEUTRAL WHEN RUDDER IS STREAMLINED | Aft rudder cables incorrectly rigged.                             | Rig in accordance with rigging procedures.                                                                |
| INCORRECT RUDDER TRAVEL                              | Rudder bellcrank stop incorrectly adjusted.                       | Adjust in accordance with rigging procedures.                                                             |
| CORRECT RUDDER TRAVEL CANNOT BE OBTAINED             | Rudder pedals contacting fuselage bulkhead.                       | Rig position cable, nose wheel, steering cables, and rudder cables in accordance with rigging procedures. |

1. Front and rear seats or; middle and aft seats (optional equipment).
2. Front, center and rear carpet.
3. Rear upholstery panel to tailcone.
4. Stabilizer fairings.
- b. Remove access covers on cabin floor as necessary to gain access to rudder cables, pulleys and attachment points.
- c. Disconnect rudder cables (5 and 6) from bellcrank (2) by unsafetying and disconnecting turnbuckles (3).
- d. Remove pulleys (4, 9 and 15) by removing attaching nuts, washers, spacers and bolts.

#### NOTE

Attaching nut and bolt for pulleys (15) must be removed from inside nose wheel well.

- e. Remove fairleads through which rudder cables pass at fuselage rear spar and fuselage station 132.00.
- f. Disconnect rudder centering springs (8) from cable clamps (7) by removing nuts, spacers, washers and bolts.
- g. Remove cable clamps (7) by removing attaching nuts and bolts.
- h. Disconnect rudder cables (5 and 6) from rudder pedal torque tubes (11 and 16) by removing cotter pins, nuts and bolts.
- i. Tie guide wires to forward ends of rudder cables (5 and 6) and remove cables from aircraft by routing them out through stabilizer fairing.

#### NOTE

If an automatic pilot (optional equipment) is installed, disconnect from rudder cables by removing attaching clamps.

- j. Release tension on nose wheel steering cables (12 and 14) as follows:
  1. Manually turn nose wheel to an extreme right or left position to release tension on spring (13).
  2. Disconnect nose wheel steering cables (12 and 14) by either separating nose wheel steering spring components or removing cotter pins, washers and pins.

#### CAUTION

Tension on nose wheel steering cables must be released before rudder position cable (10) is disconnected.

- k. Disconnect rudder position cable (10) from rudder pedal torque tube (11) by removing cotter pins and pins.
- l. Remove pulley (17) by removing nut and bolt.
- m. Tie guide wire on position cable (10) and route from underneath floorboard.

Installation of Rudder Control Cables. (See figure 7-2.)

- a. If removed, place rudder position cable (10) and install pulley (17) with pins and cotter pins.

- b. Connect rudder position cable to rudder pedal torque tube (11) with pins and cotter pins.

#### NOTE

The right nose wheel steering cable (14) must be connected to the rudder pedal torque tube at this time, because one pin is used to attach both steering cable and position cable at this point.

- c. Connect nose wheel steering cables (12 and 14) and springs (13) in accordance with the method used to release tension.
- d. Tie rudder cables (5 and 6) to guide wires, pull into position, and remove guide wires.
- e. Install forward pulleys (15) with bolt, spacers and nut.

#### NOTE

When installing pulleys (15), the pulleys and spacers must be aligned and held in position from inside the cabin while attaching bolt and nut are installed from inside the nose wheel well.

- f. Connect rudder cables (5 and 6) to rudder pedal torque tubes (11 and 16) and secure with bolt, nuts and cotter pin.
- g. Install pulleys (4 and 9) in fuselage and tailcone and secure with bolts, spacers and nuts.
- h. Connect rudder cables (5 and 6) to bellcrank (2) by installing turnbuckle on terminals and cables.
- i. Install fairleads through which rudder cables pass at fuselage station 132.00 and rear spar.
- j. Install cable clamps (7), attach centering springs (8), and rig springs in accordance with rigging procedures.
- k. Rig rudder cables in accordance with rigging procedures.

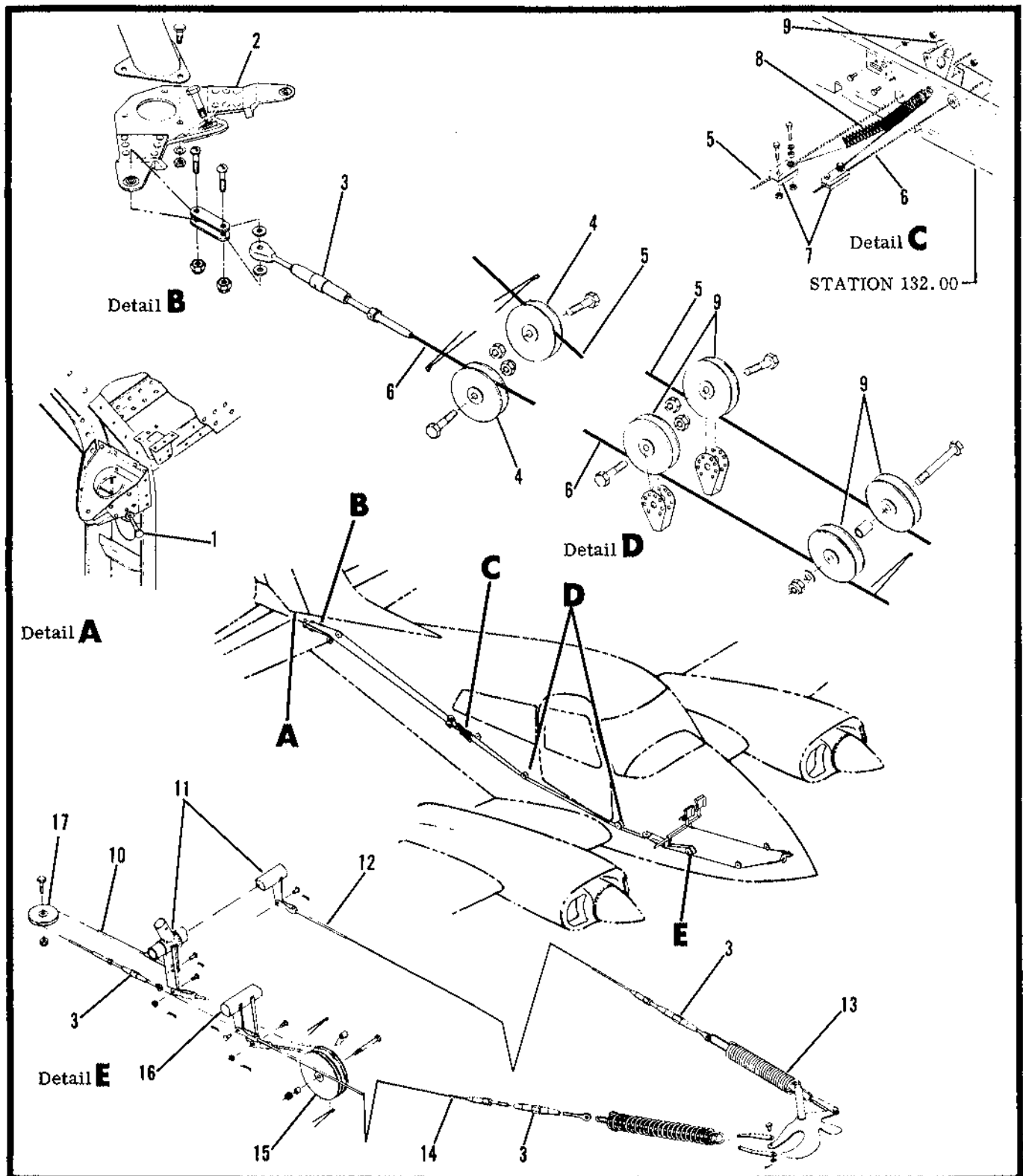
#### NOTE

If an automatic pilot (optional equipment) is installed, the automatic pilot cables must be connected to the rudder cables.

- l. Install access covers.
- m. Refer to Section 3 and install the following items in accordance with installation procedures:
  1. Stabilizer fairings.
  2. Rear upholstery panel.
  3. Front, center and rear carpets.
  4. Seats.

Removal of Rudder Pedal Assembly. (See figure 7-2.)

- a. Refer to Section 3 and remove front seats and front carpet in accordance with removal procedures.
- b. Remove boot, retainer and covers from lower control column.
- c. Remove access covers from forward cabin floorboards.
- d. Release tension on nose wheel steering cables as



- |                        |                            |                               |
|------------------------|----------------------------|-------------------------------|
| 1. Stop                | 6. Right Cable             | 12. Left Steering Cable       |
| 2. Rudder Bellcrank    | 7. Cable Clamps            | 13. Nose Gear Steering Spring |
| 3. Turnbuckle          | 8. Rudder Centering Spring | 14. Right Steering Cable      |
| 4. Aft Fuselage Pulley | 9. Center Fuselage Pulley  | 15. Forward Fuselage Pulley   |
| 5. Left Cable          | 10. Position Cable         | 16. Torque Tube (RH, forward) |
|                        | 11. Torque Tube (LH, aft)  | 17. Position Cable Pulley     |

Figure 7-2. Rudder Control System



described in Removal of Rudder Control Cables procedures.

- e. Disconnect rudder position cable (10) and right nose wheel steering cable (14) from torque tubes (11) by removing cotter pins and pins.
- f. Disconnect left nose wheel steering cable (12) from rudder pedal torque tube (11) by removing cotter pin and pin.
- g. Disconnect rudder cables (5 and 6) from rudder pedal torque tubes (11 and 16) by removing cotter pins, nuts and bolts.
- h. (See figure 7-3.) Accomplish the following steps:
  1. Disconnect brake master cylinders (24) from the pilot's rudder pedals by removing cotter pins (5) and pins (3).
  2. Disconnect two parking brake cables (17) and four brake links (8) from rudder pedal torque tubes (22 and 23) by removing cotter pins (15), spacers (18) and pins (16).
  3. Remove copilot's rudder pedals by removing nuts (20) and bolts (21).
  4. Remove upper and lower bearing halves (26 and 27) by removing eight bolts (25). Remove rudder pedal assembly from aircraft.

#### NOTE

The upper and lower halves of each bearing are matched parts and should be tagged and kept in pairs.

Disassembly of Rudder Pedal Assembly. (See figure 7-3.)

- a. Remove brake links (8) from rudder pedals (4) by removing cotter pins (1), washers (9) and pins (2).
- b. Remove rudder pedals by driving out roll pins (7) and removing springs (13), spacers (12) and pins (14).

#### NOTE

Springs (13) and spacers (12) are not used on copilot's rudder pedals.

- c. Remove couplings (28 and 29) from brake torque tubes by removing attaching cotter pins and pins.
- d. Remove brake torque tubes from rudder pedal torque tubes (22 and 23).

#### NOTE

Bearings (31) in rudder pedal torque tubes (23 and 22) and bearings (11) in rudder pedal torque tube arms (10) are a press fit and should be removed for replacement only.

Assembly of Rudder Pedal Assembly. (See figure 7-3.)

- a. Insert brake torque tubes into rudder pedal torque tubes (22 and 23).
- b. Install couplings (28 and 29) on ends of brake torque tubes with attaching pins and cotter pins.
- c. Install rudder pedals on rudder pedal torque tube

arms (10) with spacers (12), springs (13) and pins (14). Secure with roll pins (7).

#### NOTE

Springs (13) and spacers (12) are not used on copilot's rudder pedals.

- d. Attach brake links (8) to rudder pedals (4) with pins (2), washers (9) and cotter pins (1).

#### NOTE

To facilitate installation, do not attach copilot's rudder pedal assemblies to rudder pedal torque tubes prior to installation.

Installation of Rudder Pedal Assembly. (See figure 7-3.)

- a. Place rudder pedal assembly in position, remove identification tags from bearing halves (26 and 27), and install with eight bolts (25).

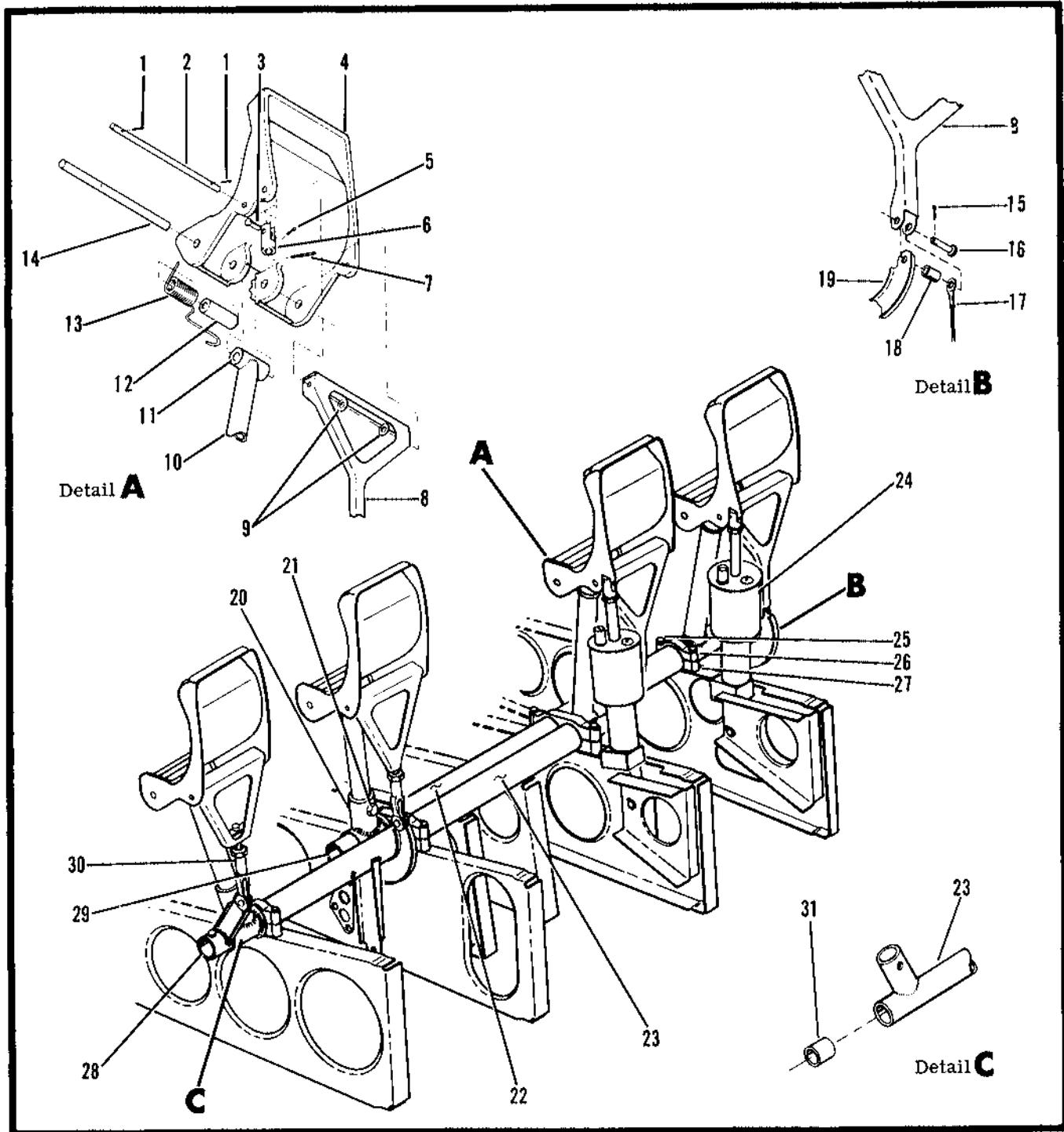
#### NOTE

When installing bearing halves, lubricate in accordance with Section 2. Rudder pedal torque tubes must rotate freely in bearings.

- b. Install copilot's rudder pedal assemblies on rudder pedal torque tubes (22 and 23) with bolts (21) and nuts (20).
- c. Connect two parking brake cables (17) and four brake links (8) to rudder pedal torque tubes (22 and 23) with pins (16), spacers (18) and cotter pins (15).
- d. Attach brake master cylinders (24) to pilot's rudder pedals with pins (3) and cotter pins (5).
- e. (See figure 7-2.) Accomplish the following steps:
  1. Attach rudder cables (5 and 6) to rudder torque tubes (11 and 16) and secure with bolts, nuts and cotter pins.
  2. Attach left nose wheel steering cable (12) to rudder pedal torque tube (11) and secure with pin and cotter pin.
  3. Attach right nose wheel steering cable (14) and rudder position cable (10) to rudder torque tube (11) with pins and cotter pins.
  4. Connect nose wheel steering cables (12 and 14) and springs (13) in accordance with the method used to release tension.
  - f. Rig rudder control system in accordance with rigging procedures.
  - g. Install access covers.
  - h. Install boot, retainer and cover on lower control column.
  - i. Refer to Section 3 and install front seats and front carpets in accordance with installation procedures.

Rigging of Rudder Control System. (See figure 7-2.)

- a. Refer to Section 3 and remove the front seats, front carpet and stabilizer fairings.
- b. Remove access covers on floorboard.
- c. Remove safety wire from any turnbuckle which



- |                     |                          |                              |
|---------------------|--------------------------|------------------------------|
| 1. Cotter Pin       | 11. Bearing              | 22. Left Rudder Torque Tube  |
| 2. Pin              | 12. Spacer               | 23. Right Rudder Torque Tube |
| 3. Pin              | 13. Spring               | 24. Brake Master Cylinder    |
| 4. Rudder Pedal     | 14. Pin                  | 25. Bolt                     |
| 5. Cotter Pin       | 15. Cotter Pin           | 26. Upper Bearing Half       |
| 6. Clevis Rod End   | 16. Pin                  | 27. Lower Bearing Half       |
| 7. Roll Pin         | 17. Parking Brake Cable  | 28. Torque Tube Coupling     |
| 8. Brake Link       | 18. Spacer               | 29. Torque Tube Coupling     |
| 9. Washer           | 19. Torque Tube Coupling | 30. Tie Rod                  |
| 10. Torque Tube Arm | 20. Nut                  | 31. Bearing                  |
|                     | 21. Bolt                 |                              |

Figure 7-3. Rudder Pedal Assembly

must be adjusted during rigging.

d. Position cable (10) is a "balance" cable, used to close the rudder system. Turnbuckle (3) should be adjusted so that the remaining cables can be correctly rigged and turnbuckles properly safetied.

#### NOTE

To facilitate rigging of the rudder system, adjust turnbuckle (3) so that approximately 5/8 inch of cable terminal is exposed between the terminal safety hole and the end of the turnbuckle barrel. This dimension may be varied as necessary to accomplish the desired result.

e. Place nose wheel in the neutral position and adjust nose wheel steering cable turnbuckles so that rudder pedals are in neutral and tension on nose wheel steering cables (12 and 14) is 85 pounds, plus zero and minus five pounds.

f. With nose wheel and rudder pedals in neutral, adjust aft rudder cable turnbuckles (3) so that rudder is in neutral (streamlined) and tension on rudder cables is 25  $\pm$  5 pounds, measured forward of centering springs at fuselage station 132 or 45  $\pm$  5 pounds aft of centering springs. With rudder in neutral, each centering spring should be extended 2  $\pm$  .10 inches, and clamped to rudder cables.

#### NOTE

The tension on the nose wheel steering cables and the aft rudder cables operates in the same direction. If either cables are adjusted, it will

be necessary to recheck the tension on the cables which were not adjusted.

g. Adjust rudder bellcrank stop bolts (1) so that rudder travel is 25 degrees left and 25 degrees right (measured along water line), plus one degree, minus zero degrees. Resafety bolts.

h. Safety all turnbuckles from which safety wire was removed.

i. (See figure 7-3.) Adjust clevis rod ends (6) on brake master cylinders (24) so the tips of the pilot's rudder pedals are aligned. Adjust right brake link tie rods (30) so that tips of copilot's rudder pedals are aligned.

#### WARNING

Insure that rudder moves in the proper direction when operated by the rudder pedals.

j. Install access covers.

k. Refer to Section 3 and install stabilizer fairings, carpets, and front seats in accordance with installation procedures.

#### RUDDER TRIM CONTROL SYSTEM.

The rudder trim control system is interconnected by chains, cables, sprockets, pulleys, miter gears, a torque tube, an actuator, and push-pull tube. The rudder trim control wheel, mounted on the aft side of the control pedestal, incorporates a track in which the indicator rides.

#### Trouble Shooting Rudder Trim Control System.

| TROUBLE                                             | PROBABLE CAUSE                                      | CORRECTION                                                                             |
|-----------------------------------------------------|-----------------------------------------------------|----------------------------------------------------------------------------------------|
| TRIM CONTROL WHEEL MOVES WITH EXCESSIVE RESISTANCE  | Cable tension too high.                             | Adjust tension in accordance with rigging procedures.                                  |
|                                                     | Defective miter gear assembly.                      | Repair or replace miter gear assembly.                                                 |
|                                                     | Defective trim tab actuator.                        | Repair or replace actuator.                                                            |
|                                                     | Pulleys binding or rubbing.                         | Replace binding pulleys. Provide clearance if rubbing pulley brackets or cable guards. |
|                                                     | Trim tab hinge binding.                             | Lubricate hinge. If necessary, replace.                                                |
|                                                     | Bent rudder trim torque tube in control pedestal.   | Replace torque tube.                                                                   |
|                                                     | Cables not in place on pulleys during installation. | Install cables correctly.                                                              |
| LOST MOTION BETWEEN TRIM CONTROL WHEEL AND TRIM TAB | Cable tension too low.                              | Adjust tension in accordance with rigging procedures.                                  |
|                                                     | Broken pulley.                                      | Replace pulley.                                                                        |

| TROUBLE                                                    | PROBABLE CAUSE                                                       | CORRECTION                                                |
|------------------------------------------------------------|----------------------------------------------------------------------|-----------------------------------------------------------|
| LOST MOTION BETWEEN TRIM CONTROL WHEEL AND TRIM TAB (CONT) | Excessive back lash in miter gear assembly.                          | Repair or replace miter gear assembly.                    |
|                                                            | Worn trim tab actuator.                                              | Repair or replace actuator.                               |
|                                                            | Worn universal joint in rudder trim torque tube in control pedestal. | Replace universal joint.                                  |
|                                                            | Cables not in place on pulleys.                                      | Install cables correctly. Check cable guards.             |
| TRIM INDICATOR FAILS TO INDICATE CORRECT TRIM POSITION     | Indicator incorrectly engaged with wheel track.                      | Engage in accordance with rigging procedures.             |
| INCORRECT TRIM TAB TRAVEL                                  | Travel stop blocks loose or incorrectly adjusted.                    | Adjust stop blocks in accordance with rigging procedures. |
| CORRECT TRAVEL CANNOT BE OBTAINED BY ADJUSTING STOP BLOCKS | Actuator screw incorrectly adjusted.                                 | Adjust in accordance with rigging procedures.             |

Removal of Rudder Trim Control Cables and Chains.  
(See figure 7-4.)

- a. Refer to Section 3 and remove the following items:
  1. Front seats.
  2. Front, center and rear carpets.
  3. Rear upholstery panel to tailcone.
  4. Right side panel from control pedestal.
  5. Stabilizer fairings.
- b. Remove access covers from vertical stabilizer adjacent to rudder trim tab actuator and floorboards.
- c. Unsafety turnbuckle and disconnect aft cables (6 and 7) from forward cables (9 and 11) by removing turnbuckle, cotter pin and pin.
- d. Remove aft pulleys (8) by removing nut, bolt and cable guard cotter pins. Pull cables aft into tailcone.
- e. Remove chain guard from rudder trim tab actuator (2) by removing nuts and screws.
- f. Disengage chain (5) from sprocket (4), attach a guide wire to the chain, and remove cables and chain from vertical fin. Disconnect guide wire and leave in vertical fin to facilitate installation.
- g. Remove stop blocks (12) by removing nuts, bolts and bushings (13).
- h. Remove three sets of pulleys (14) from forward cables (9 and 11) by removing nuts, washers and bolts.
- i. Disengage forward chain (15) from sprocket (16).

#### NOTE

Chain guards (18) are flexible enough to allow chain to be disengaged without removing chain guards.

- j. Remove forward cables (9 and 11) by pulling out through access hole in forward cabin floor.

#### NOTE

To facilitate installation, tie guide wires to aft ends of cables and leave guide wires in the fuselage.

- k. Remove upper chain (24) by disconnecting master link.

#### NOTE

If, during the removal or installation of the chain, the indicator reaches its extreme travel, disengage from the trim control wheel track by inserting a screwdriver beneath the indicator and prying out of track. This permits the indicator to be moved, or wheel to be turned, before indicator is re-engaged with track.

1. The above procedure does not include removal of rudder trim control wheel, indicator, torque tube or miter gear assembly, because their removal is not recommended. However, removal of these components is possible by the following methods:

1. Trim control wheel (27) and indicator (28) can be removed by drilling out the rivets which attach the wheel bracket to the control pedestal and the rivet around which the indicator pivots.
2. Torque tube (20) can be removed by removing upper roll pin and lower roll pin.

#### NOTE

To gain access to the lower roll pin, it may be necessary to remove the control pedestal, or to drill out the rivets which attach the lower right side panel.

3. Sprocket (23) and sprocket shaft (21) can be removed by removing the roll pin. Plate assembly (22) can be removed by removing nuts and screws.

4. Miter gear assembly can be removed by removing the control pedestal and drilling out enough attaching rivets to allow the section of the floor above the miter gear assembly to be lifted for access.

#### Installation of Rudder Trim Control Cables and Chains. (See figure 7-4.)

- a. Install upper chain (24) on sprockets (23 and 25) and connect with master link.
- b. Tie ends of cables (9 and 11) to the guide wires, pull into position, and remove guide wires.
- c. Rotate rudder trim control wheel (27) to center indicator (28), and engage forward chain (15) with sprocket (16) so that the ends of the chain are equal in length from the sprocket.
- d. Install three sets of pulleys (14) with bolts, washers and nuts, insuring that the cables are correctly in place as pulleys are installed.
- e. Tie the aft chain (5) to the guide wire, pull into position in the vertical fin, and remove the guide wire.
- f. Rotate actuator sprocket (4) so that rudder trim tab is in neutral, and engage chain (5) with sprocket (4) so that the ends of the chain are equal in length from the sprocket.
- g. Install the chain guard with screws and nuts.
- h. Install aft pulleys (8) with bolts, nut and cable guard cotter pins.
- i. Connect aft left cable (7) to forward left cable (9) with pin and cotter pin. Connect aft right cable (6) to forward right cable (11) with turnbuckle (10).
- j. Install the stop blocks (12) with bushings (13), bolts and nuts, and rig the rudder trim control system in accordance with rigging procedures.
- k. Install access covers on vertical fin and cabin floor.
- l. Refer to Section 3 and install the following items:
  1. Stabilizer Fairings.
  2. Right side panel on control pedestal.
  3. Rear upholstery panel to tailcone.
  4. Front, center, and rear carpets.
  5. Front seats.

#### Removal of Rudder Trim Tab Actuator. (See figure 7-4.)

- a. Refer to Section 3 and remove rear upholstery panel to tailcone.
- b. Remove access hole cover from vertical stabilizer adjacent to rudder trim tab actuator (2).
- c. Unsafety turnbuckle (10) and disconnect aft cables (6 and 7) from forward cables (9 and 11) by removing turnbuckle (10), cotter pin and pin.
- d. Remove chain guard by removing nuts and screws.
- e. Disengage chain (5) from sprocket (4) and tie chain to screw hole in vertical fin.
- f. Disconnect rudder trim tab push-pull tube from the actuator screw (1) by removing nut, washer and bolt.
- g. Remove clamps (3) by removing bolts and washers, and remove the rudder trim tab actuator (2).

#### Disassembly, Overhaul and Assembly of Rudder Trim Tab Actuator.

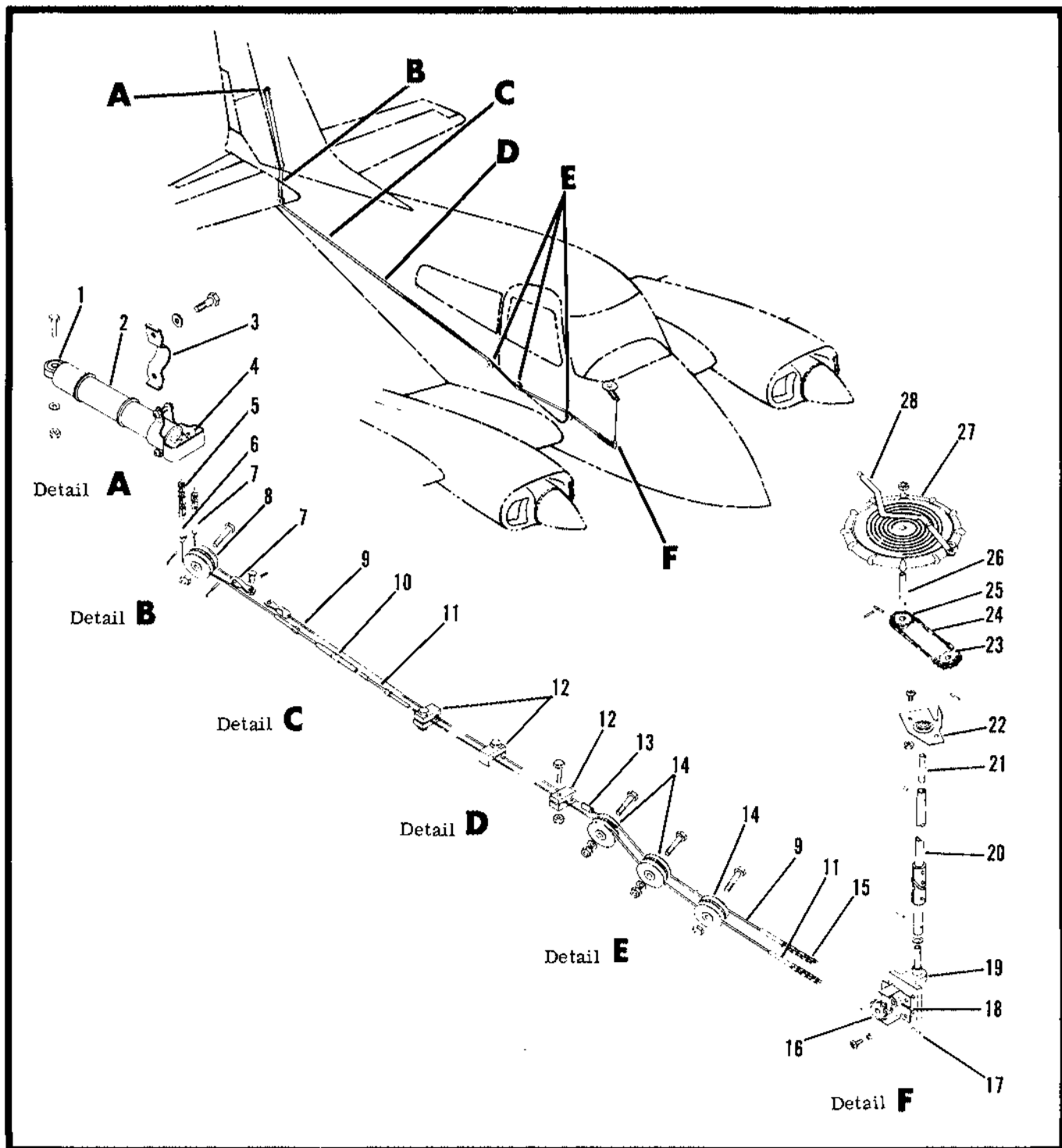
The instructions for disassembly, overhaul and assembly of the aileron trim tab actuator, given in Section 5, also applies to the rudder trim tab actuator.

#### Installation of Rudder Trim Tab Actuator. (See figure 7-4.)

- a. Insert the rudder trim tab actuator (2) into position in vertical stabilizer, and install clamps (3) with bolts and washers.
- b. Attach the rudder trim tab push-pull tube to the actuator screw (1) with bolt, washer and nut.
- c. Rotate actuator sprocket (4) so that rudder trim tab is in the neutral position, and engage chain (5) with sprocket (4) so that the ends of the chain are equal in length from the sprocket.
- d. Install the chain guard with screws and nuts.
- e. Connect the aft left cable (7) to forward left cable (9) with pin and cotter pin. Connect aft right cable (6) to forward right cable (11) with turnbuckle (10).
- f. Rig rudder trim control system in accordance with rigging procedures.
- g. Refer to Section 3 and install rear upholstery panel to tailcone.
- h. Install access hole cover on vertical stabilizer.

#### Rigging the Rudder Trim Control System. (See figure 7-4.)

- a. Refer to Section 3 and remove the following items:
  1. Front Seats.
  2. Front, center and rear carpets.
  3. Rear upholstery panel to tailcone.
- b. Remove floorboard access covers and cover from vertical stabilizer adjacent to rudder trim tab actuator.
- c. Remove access hole cover from vertical fin adjacent to rudder trim tab actuator.
- d. Remove safety wire from turnbuckle (10) connecting rudder trim control cables, adjust to 10 ±3 pounds tension, and resafety turnbuckle.
- e. Move rudder trim control system to neutral by rotating trim control wheel so that the ends of the chain (5) are equal in length from actuator sprocket (4), and the ends of chain (15) are equal in length from sprocket (16).
- f. Adjust the rudder trim indicator (28) to the neutral position by inserting a screwdriver beneath the indicator and prying out of track in the trim control wheel, moving the indicator to neutral, and re-engaging with the track.
- g. Remove nut, washer and bolt attaching push-pull tube to the rudder trim tab.
- h. Place the rudder and the rudder trim tab in neutral. Adjust actuator screw (1) so that the aft hole in the push-pull tube is aligned with the hole in the trim tab horn, attach with bolt, washer and nut.
- i. Loosen stop blocks (12) and move the rudder trim tab to 17° right (measured along water line). Locate



1. Actuator Screw
2. Rudder Trim Tab Actuator
3. Clamp
4. Actuator Sprocket
5. Aft Chain
6. Right Aft Cable
7. Left Aft Cable
8. Aft Pulley
9. Left Forward Cable

10. Turnbuckle
11. Right Forward Cable
12. Stop Block
13. Bushing
14. Forward Pulley
15. Forward Chain
16. Forward Sprocket (Lower)
17. Roll Pin
18. Lower Chain Guard
19. Gear Assembly

20. Torque Tube
21. Sprocket Shaft
22. Upper Chain Guard
23. Forward Sprocket (Upper)
24. Upper Chain
25. Control Wheel Sprocket
26. Sprocket Shaft
27. Rudder Trim Control Wheel
28. Indicator Arm

Figure 7-4. Rudder Trim Control System

aft stop block adjacent to cable (11) terminal and tighten. Slide center stop block against aft stop block and tighten.

j. Move the rudder trim tab to 22° left (measured along water line). Slide forward stop block against center stop block and tighten.

k. Install floorboard access covers and cover on vertical stabilizer adjacent to trim tab actuator.

l. Refer to Section 3 and install the following items:

1. Rear upholstery panel to tailcone.

2. Rear, center and front carpets.

3. Front seats.

m. Tolerance for rudder trim tab travel is plus one degree and minus zero degrees.

#### WARNING

Insure that the rudder trim moves in proper direction when operated by the trim control wheel.

## SECTION 8

## FLAP CONTROL SYSTEM

## Table of Contents

|                                                | Page |                                                  | Page |
|------------------------------------------------|------|--------------------------------------------------|------|
| FLAP CONTROL SYSTEM . . . . .                  | 8-1  | Installation of Flap Bellcrank . . . . .         | 8-3  |
| Trouble Shooting Flap Control System . . . . . | 8-1  | Removal and Installation of Flap                 |      |
| Removal . . . . .                              | 8-2  | Scissors Assembly . . . . .                      | 8-3  |
| Installation . . . . .                         | 8-2  | Removal of Flap Actuator Assembly . . . . .      | 8-6  |
| Removal of Flap Control Cables and             |      | Disassembly, Overhaul and Assembly               |      |
| Chains . . . . .                               | 8-2  | of Flap Actuator Assembly . . . . .              | 8-6  |
| Installation of Flap Control Cables            |      | Installation of Flap Actuator Assembly . . . . . | 8-6  |
| and Chains . . . . .                           | 8-3  | Rigging of Flap Control System . . . . .         | 8-8  |
| Removal of Flap Bellcrank . . . . .            | 8-3  |                                                  |      |

## FLAP CONTROL SYSTEM

The flap control system is operated by an electric motor which drives a gear reduction unit. Two sprockets, connected in tandem to the reduction unit output shaft by special rivets, drive four chain

connected cables which actuate the flap bellcranks. The four bellcranks in each wing are interconnected by push-pull tubes. A cam driven by a gear attached to the aft output shaft of the reduction unit, operates two limit switches.

## Trouble Shooting Flap Control System .

| TROUBLE                         | PROBABLE CAUSE                                              | CORRECTION                                 |
|---------------------------------|-------------------------------------------------------------|--------------------------------------------|
| FLAPS FAIL TO EXTEND OR RETRACT | Battery switch OFF.                                         | Turn switch ON.                            |
|                                 | Circuit breaker out.                                        | Reset circuit breaker.                     |
|                                 | Defective flap switch and/or limit switches.                | Replace flap switch and/or limit switches. |
|                                 | Defective flap motor.                                       | Replace flap motor.                        |
|                                 | Defective electrical circuit.                               | Replace defective wires.                   |
|                                 | Stripped or broken drive gear or flap motor.                | Replace flap motor.                        |
|                                 | Stripped or broken gears in reduction unit.                 | Replace reduction unit.                    |
|                                 | Drive sprockets not secured to reduction unit output shaft. | Replace rivets and/or sprockets.           |



| TROUBLE                                                     | PROBABLE CAUSE                                                                               | CORRECTION                                    |
|-------------------------------------------------------------|----------------------------------------------------------------------------------------------|-----------------------------------------------|
| FLAPS FAIL TO RETRACT                                       | UP limit switch incorrectly adjusted.                                                        | Adjust in accordance with rigging procedures. |
|                                                             | Incorrect rigging of flap cables, compensated for by incorrect adjustment of push-pull rods. | Rig in accordance with rigging procedures.    |
| FLAPS FAIL TO EXTEND COMPLETELY                             | DOWN limit switch incorrectly adjusted.                                                      | Adjust in accordance with rigging procedures. |
|                                                             | Incorrect rigging of flap cables, compensated for by incorrect adjustment of push-pull rods. | Rig in accordance with rigging procedures.    |
| FLAPS NOT SYNCHRONIZED OR FAIL TO FIT EVENLY WHEN RETRACTED | Incorrect adjustment of push-pull rods.                                                      | Adjust in accordance with rigging procedures. |
|                                                             | Bent push-pull rods.                                                                         | Straighten or replace.                        |
|                                                             | Incorrect adjustment of bellcrank interconnecting push-pull tubes.                           | Adjust in accordance with rigging procedures. |
|                                                             | Incorrect rigging of cables and chains.                                                      | Rig in accordance with rigging procedures.    |
|                                                             | Bent flap.                                                                                   | Repair or replace flap.                       |
| FLAPS ON ONE SIDE FAIL TO OPERATE                           | Drive sprocket for inoperative side not secured to reduction unit output shaft.              | Replace rivets and/or sprocket.               |
|                                                             | Broken chain, cable or attaching pin.                                                        | Replace broken parts.                         |

## Removal of Flap. (See figure 8-1.)

## NOTE

The following is a removal procedure for the left in-board flap. Remove the other flaps in a similar manner.

- Extend flaps.
- If inboard flap is being removed, remove lower aft wing fillet.
- Disconnect lower scissors link assemblies (17) by removing nuts, washers, spacers and bolts.
- Remove the safety from the bent end of the hinge pin (12) and detach flap by removing hinge pin.

## NOTE

If difficulty is encountered in removing out-board flap hinge pin, it may be necessary to remove aileron to gain better access to hinge pin.

## Installation of Flap. (See figure 8-1.)

- Attach flap to wing with hinge pin (12). Safety bent end of hinge pin (12).

To facilitate hinge pin installation, check the hinges and pin for distortion, lubricate hinge pin and taper end of hinge pin.

- Connect lower scissors link assemblies (17) to flap by installing bolts, spacers, washers and nuts.
- If lower aft wing fillet was removed, install with attaching screws.
- Check flap for proper operation and correct travel. See Rigging of Flap Control System for limits and tolerances.

## Removal of Flap Control Cables and Chains. (See figure 8-1.)

- Remove center seats and center carpet in accordance with Section 3.
- Remove access covers above and below flap motor.
- Remove aft wing root fillet and aft wheel wells access cover.
- Lower flaps several degrees to decrease tension on return cables, remove safety from four turn-

buckles (27), and disconnect turnbuckles.

e. Disconnect flap direct and return cables from bellcranks (20) by removing cotter pins, nuts and bolts.

f. Remove outboard pulleys (22) by removing nuts and bolts.

#### NOTE

Cable guard cotter pins are quite difficult to install and should be removed only for replacement.

g. Remove pulleys (19) and cable guards (24) by removing nuts and bolts.

h. Remove pulleys (25 and 26) by removing nuts, bolts and cable guard cotter pins.

i. Tie guide wires to flap cables, pull out through access hole in cabin floor, and disconnect guide wires.

j. (See figure 8-2.) Unsafety and remove four screws, remove chain guard (11), and disengage chains from sprockets (13).

Installation of Flap Control Cables and Chains. (See figure 8-1.)

a. Tie flap cables to guide wires and pull into position.

b. Attach flap direct and return cables (18, 21, 30 and 31) to links of bellcranks (20 and 35) with bolts, nuts and cotter pins.

c. Place return cables in position on pulleys (22 and 36) and install with bolts and nuts.

d. Install pulleys (19 and 34) and cable guards (24) with bolts and nuts.

e. Install pulleys (25, 26, 32 and 34) with bolts, nuts and cable guard cotter pins.

f. Engage chains (28 and 29) with reduction unit sprockets, connect to the cables with four turnbuckles (27), and rig in accordance with flap rigging procedures.

g. Install aft wing root fillet and aft wheel wells access cover.

h. Install access covers above and below flap actuator.

i. Install carpet and seats in accordance with Section 3.

Removal of Flap Bellcrank. (See figure 8-1.)

Eight bellcranks are used to operate the flaps. The following is a removal procedure for the left inboard bellcrank of the left inboard flap. Remove the other bellcranks in a similar manner.

a. Remove center seats and center carpet in accordance with Section 3.

b. Remove access cover from above flap actuator and aft wheel well.

c. Lower flaps several degrees to decrease tension on return cables, remove safety from turnbuckles (27), and loosen turnbuckles to release tension on cables which route to affected bellcrank only.

d. Disconnect flap cables (18 and 21) from bellcrank by removing cotter pins and pins.

#### NOTE

Steps "a" through "d" apply only to removal of the inboard bellcrank of each inboard flap. To remove any other bellcrank, remove access hole covers from underside of wing adjacent to affected bellcrank.

e. Disconnect push-pull rod (2) from bellcrank by removing attaching nut, spacers and bolt.

f. Disconnect interconnecting push-pull tube (7) from bellcrank by removing attaching nut and bolt.

g. Remove bellcrank by removing safety wire from bolt and removing bolt and washers, taking care that bushing (9) does not fall from bellcrank during removal.

#### NOTE

Access to bolt is gained by removing a plug button from the underside of the wing beneath the bolt.

Installation of Flap Bellcrank. (See figure 8-1.)

a. Insert bellcrank through access hole and install with washers and bolts. Safety bolts and install plug button on underside of wing beneath bolt.

#### NOTE

Washers and bushing (9) must be in place before installing bolt.

b. Attach interconnecting push-pull tube (7) to bellcrank with attaching bolt and nut.

c. Connect push-pull rod (2) to bellcrank with attaching bolt, spacers and nut.

d. Connect flap cables (18 and 21) to bellcrank (8) with bolts, nuts and cotter pins.

e. Rig flaps in accordance with rigging procedures.

f. Reinstall access covers.

g. Install carpet and seats in accordance with Section 3.

Removal and Installation of Flap Scissors Assembly. (See figure 8-1.)

a. Removal of flap scissors is as follows:

1. Extend flaps.
2. Disconnect upper and lower scissors links (14 and 17) by removing nuts, washers, spacers and bolts.

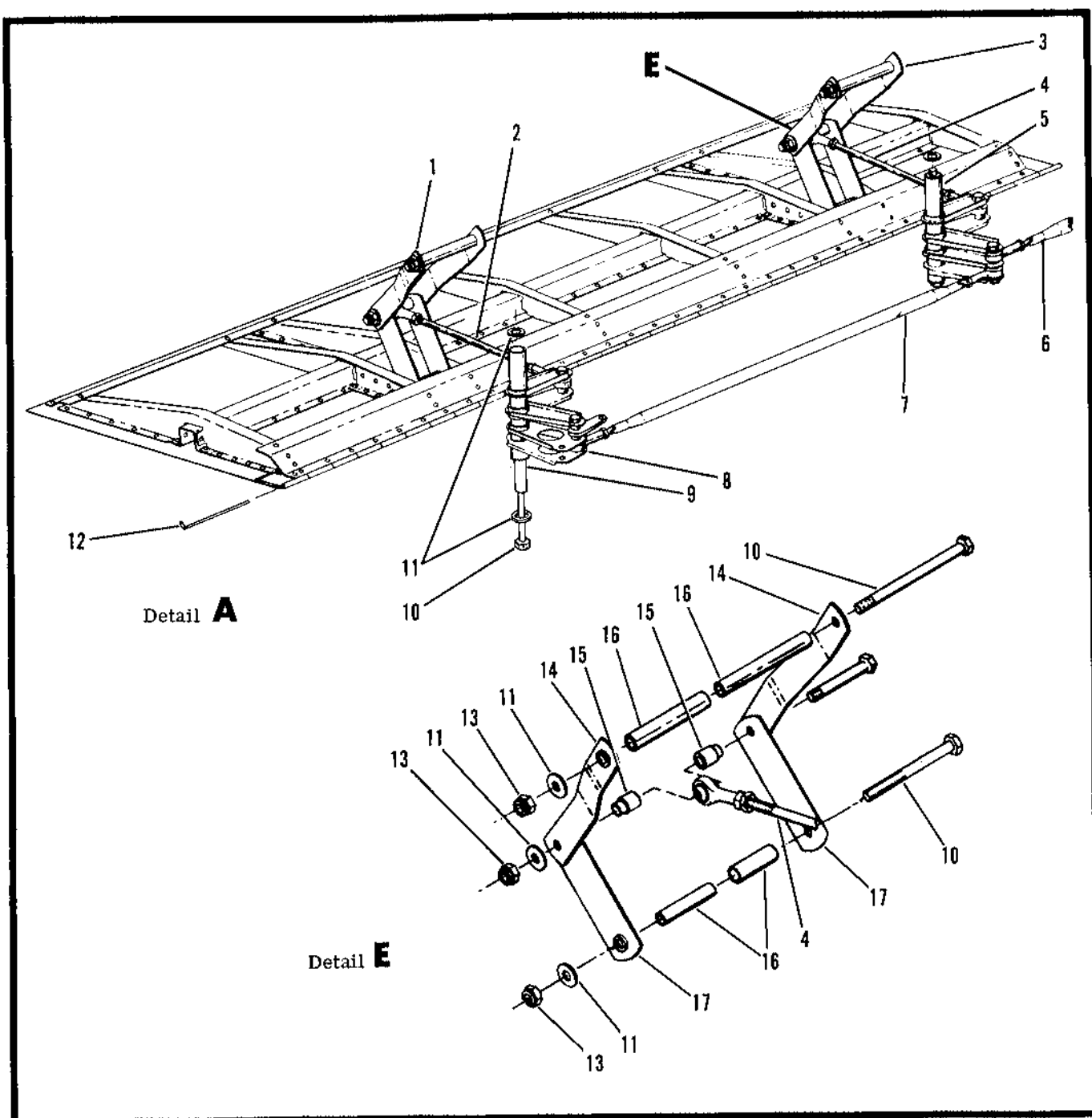
3. Remove scissor by removing nut, washers, spacers and bolts which attach scissor to push-pull rod.

b. Install flap scissors as follows:

1. Attach scissor links (14 and 17) to push-pull rod using bolt, spacers, washer and nut.

2. Connect upper and lower scissor links (14 and 17) using bolts, spacers, washers, and nuts.

3. Check flaps for proper operation and correct travel. See Rigging of Flap Control System for limits and tolerances.



1. Inboard Scissor Assembly
2. Inboard Push-Pull Rod
3. Outboard Scissor Assembly
4. Outboard Push-Pull Rod
5. Outboard Bellcrank
6. Center Interconnecting Push-Pull Tube
7. Inboard Interconnecting Push-Pull Tube
8. Inboard Bellcrank
9. Bushing
10. Bolt
11. Washer
12. Hinge Pin
13. Nut

14. Upper Link Assembly
15. Spacer
16. Spacer
17. Lower Link Assembly
18. Left Direct Cable
19. Pulley
20. Inboard Left Bellcrank
21. Left Return Cable
22. Pulley
23. Cable Attachment Link
24. Cable Guard
25. Pulley

26. Pulley
27. Turnbuckles
28. Left Flap Chain
29. Right Flap Chain
30. Right Direct Cable
31. Right Return Cable
32. Pulley
33. Pulley
34. Pulley
35. Inboard Right Bellcrank
36. Pulley
37. Chain Guard

Figure 8-1. Flap Installation and Control System (Sheet 1 of 2)

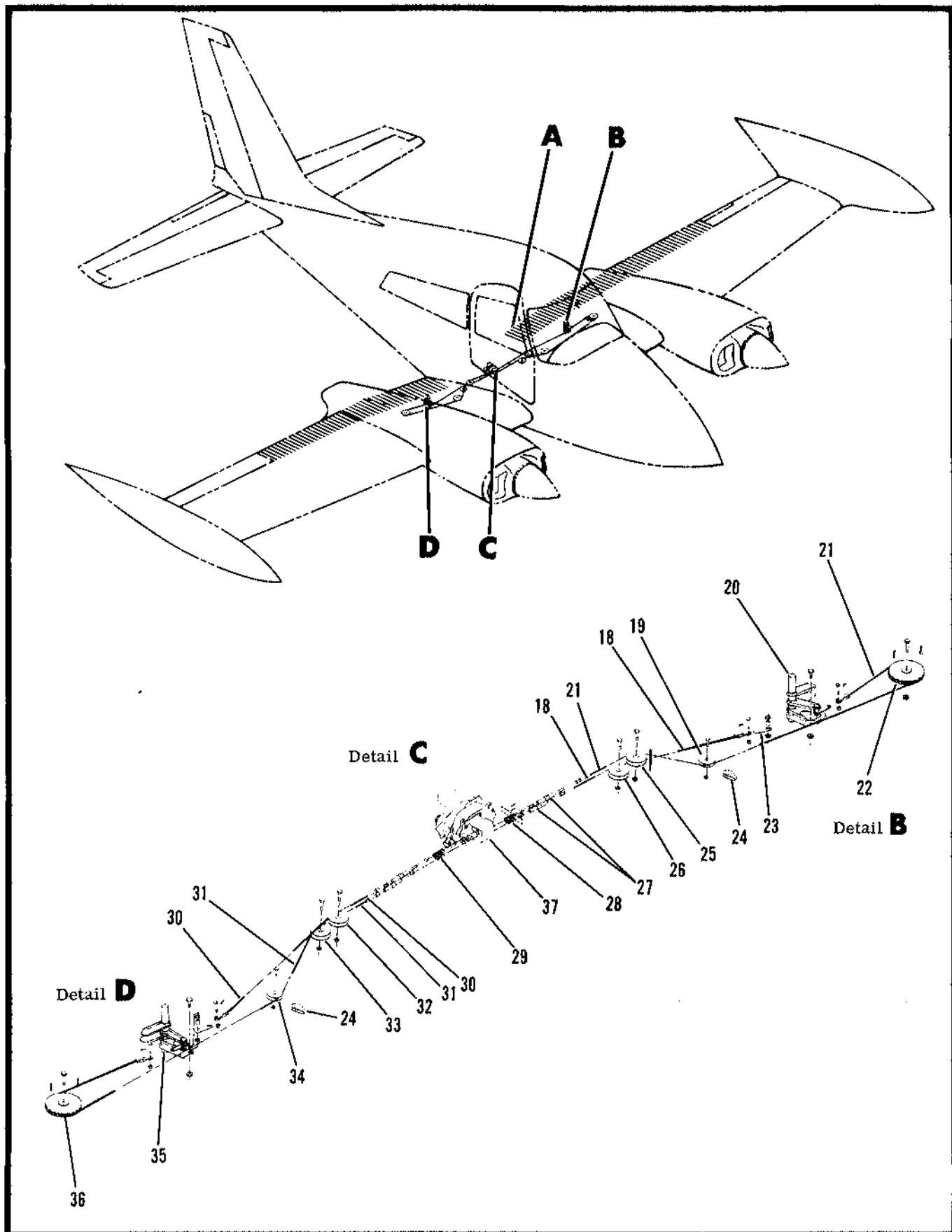


Figure 8-1. Flap Installation and Control System (Sheet 2 of 2)

Removal of Flap Actuator Assembly. (See figure 8-2.)

Flap motor and/or position transmitter can be removed without removing reduction unit; however, due to limited working space, it is desirable to remove reduction unit.

- a. Remove center seats and center carpet in accordance with Section 3.
- b. Remove access cover above flap actuator and underside at fuselage beneath flap motor.
- c. Disconnect electrical connector from position transmitter (27).
- d. Lower flaps several degrees to release tension on return cables, remove safety from turnbuckles (27, figure 8-1), and loosen enough to disengage chains.
- e. Unsafety and remove four screws (12), remove chain guard (11), and disengage chains from sprockets (13).
- f. Remove four nuts (8) and screws (9) attaching reduction unit to fuselage rear spar.
- g. Pull complete actuator assembly aft, tilt it, and remove through access hole.

#### NOTE

If an automatic pilot (optional equipment) is installed, disconnect automatic pilot cables from clamps attaching them to aileron cables, and separate beneath flap actuator to remove actuator from aircraft.

- h. Disconnect and tag wires leading from wire bundle to limit switches (22 and 24).

Disassembly, Overhaul and Assembly of Flap Actuator Assembly. (See figure 8-2.)

- a. Remove flap motor (2) and bracket (3) from reduction unit (7) by removing four bolts. Disconnect and tag wires leading from motor to limit switches and motor to ground.
- b. Loosen setscrew (6) and remove cam (19) from position transmitter shaft.
- c. Remove the position transmitter (27) from the bracket (3) by removing nut (5), screws and spacers.
- d. Remove limit switches (22 and 24), spacers (23) and switch actuators by removing nuts and screws.
- e. Remove pinion gear (17) from reduction unit (7) by removing roll pin (18).
- f. Remove sprockets (13) from reduction unit (7) by removing rivets (14).

#### NOTE

Sprockets are drilled on assembly. Mark each sprocket before disassembly and reassemble in the same position to assure proper mating of parts.

- g. Remove cover plate (16) from reduction unit (7) by removing remaining two screws. Two dowel pins (10) locate the cover plate.
- h. Remove gears from reduction unit and clean all component parts except sealed bearings with suitable solvent. Do not clean sealed bearings.

- i. Inspect all component parts for visible damage such as cracks, chipped or broken gear teeth, deep nicks or dents, and excessive wear. Check sealed bearings for smoothness of operation.

- j. Do not attempt to repair or replace the internal component parts of the reduction unit. If any item is defective, the complete reduction unit should be returned to the manufacturer for replacement.

- k. Coat gear teeth with MIL-G-23827 grease and install gears in reduction unit housing. Do not completely fill reduction unit housing with grease.

- l. Coat bearing surface of cover plate (16) with a thin layer of suitable sealing compound and attach to reduction unit housing with two screws, using the screw holes that are not utilized to attach chain guard (11).

#### NOTE

When assembling reduction unit, insure that no foreign material is left on gears or in reduction unit housing.

- m. Slide sprockets (13) on reduction unit output shaft as marked when removed and secure with rivets (14).
- n. Install pinion gear (17) with roll pin (18).
- o. Install limit switches (22 and 24), spacers (23) and switch actuators (21) with screws and nuts.

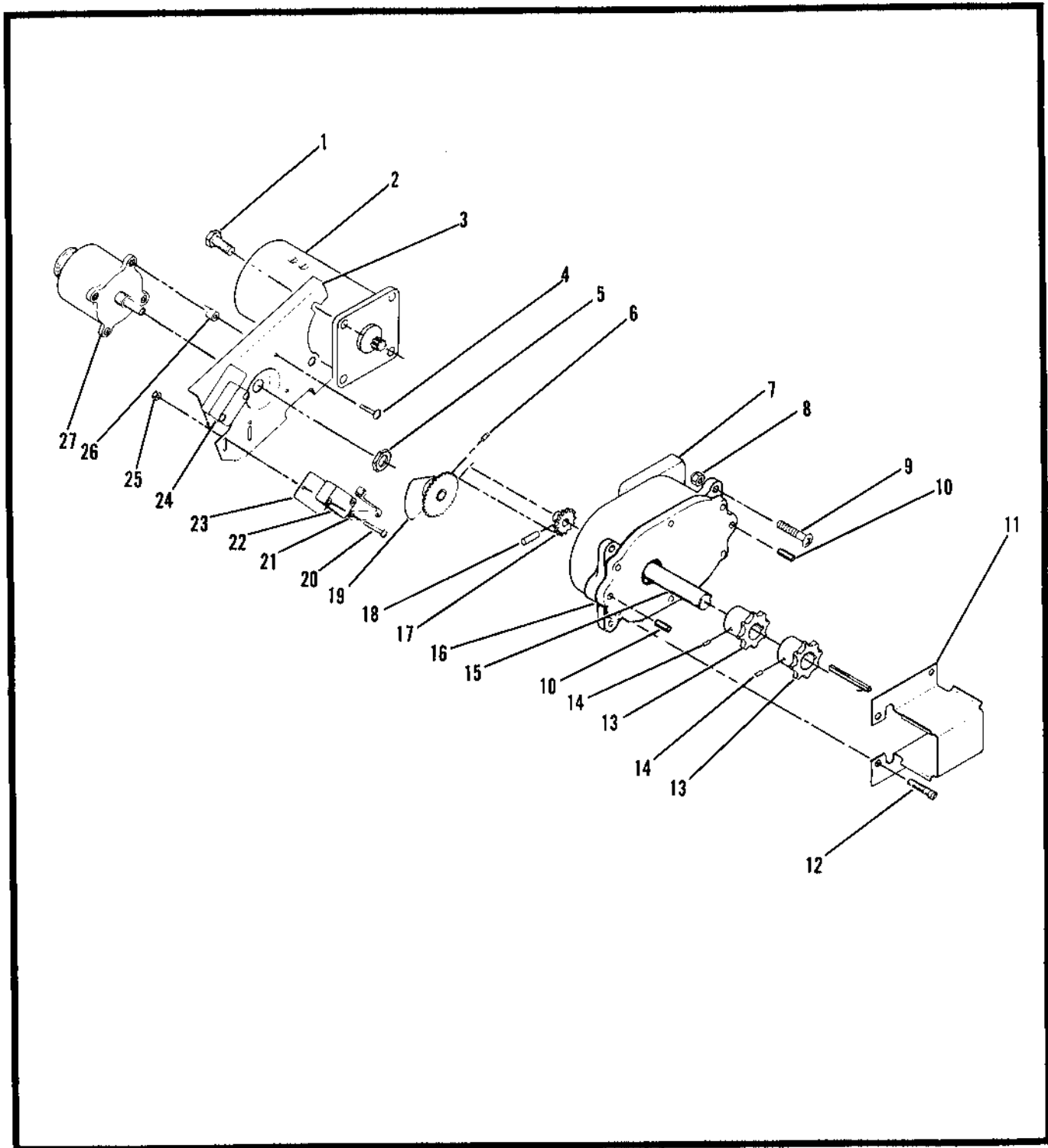
#### NOTE

Install limit switches at the end of the adjusting slot which is farthest from cam (19) to allow for travel when rigging

- p. Attach position transmitter (27) to bracket (3) with screws (4), spacers (26) and nut (5).
- q. Attach cam (19) to position transmitter shaft with setscrew (6).
- r. Attach flap motor (2) and bracket (3) to reduction unit (7) with four bolts.
- s. Attach wires from motor to limit switches and from motor to ground at their respective connections, and remove tags.
- t. Prior to installation, check flap actuator assembly as follows:
  1. Check flap motor, reduction unit, and position transmitter for proper operation.
  2. Check for positive clearance between reduction unit aft output shaft and cam. Clearance can be obtained by loosening setscrew (6), sliding cam slightly toward position transmitter, and tightening setscrew.
  3. Check that the reduction unit output shaft does not turn when 800 pound-inches torque is applied.
  4. Check limit switches for proper operation.

Installation of Flap Actuator Assembly. (See figure 8-2.)

- a. Place flap actuator assembly near access hole in underside of the fuselage, attach wires from wire bundle to respective limit switches (22 and 24), and remove tags.
- b. Insert actuator assembly through access hole and install with four screws and nuts.



- |                   |                                |                           |
|-------------------|--------------------------------|---------------------------|
| 1. Bolt           | 10. Dowel Pin                  | 19. Cam                   |
| 2. Flap Motor     | 11. Chain Guard                | 20. Screw                 |
| 3. Bracket        | 12. Screw                      | 21. Limit Switch Actuator |
| 4. Screw          | 13. Sprocket                   | 22. Limit Switch (UP)     |
| 5. Nut            | 14. Rivet                      | 23. Spacer                |
| 6. Setscrew       | 15. Output Shaft               | 24. Limit Switch (DOWN)   |
| 7. Reduction Unit | 16. Reduction Unit Cover Plate | 25. Nut                   |
| 8. Nut            | 17. Pinion Gear                | 26. Spacer                |
| 9. Screw          | 18. Roll Pin                   | 27. Position Transmitter  |

Figure 8-2. Flap Actuator Assembly

## NOTE

If an automatic pilot (optional equipment) is installed, connect the automatic pilot cables to the clamps which attach them to the aileron cables.

- c. Connect the electrical connector to the position transmitter (27).
- d. Engage chains with sprockets (13) and rig flap control system.
- e. Install access covers above and below flap actuator.
- f. Install carpet and seats in accordance with Section 3.

## Rigging of Flap Control System. (See figure 8-1.)

The flap control system can be rigged using the flap control switch in the aircraft; however, to facilitate rigging, a 24-volt external power source and a two-position momentary switch similar to the one installed in the aircraft should be attached to the wires from the flap motor so that the flaps may be observed while being operated during rigging. Use caution while operating flaps in this manner because limit switches are being bypassed.

- a. Remove center seats and center carpet in accordance with Section 3.
- b. Remove access hole covers from aft cabin.
- c. Check length of inboard push-pull rod (2) on each inboard flap and adjust to 10.45 inches.

## NOTE

Length of push-pull rods is measured between the centerline of rod and bolt holes.

- d. Check length of interconnected push-pull tubes and adjust, if necessary, to the following dimensions:

|                                          |              |
|------------------------------------------|--------------|
| Outboard interconnecting push-pull tubes | 33.35 inches |
| Center interconnecting push-pull tubes   | 23.80 inches |
| Inboard interconnecting push-pull tubes  | 23.80 inches |

- e. Adjust remaining push-pull rods from bellcranks to scissors so that flaps fit evenly when in the UP position.
- f. (See figure 8-2.) Adjust limit switches as follows:
  1. Loosen limit switches (22 and 24) and position them where they will be activated by the cam (19).
  2. With flaps in the UP position, flex flap switch bracket (3) aft to disengage cam (19) from pinion gear (17). Rotate cam to a point where it actuates the UP limit switch (22) and re-engage cam with pinion gear by releasing tension on bracket (3).
  - g. With flaps in the UP position, check for correct positioning of the flap chains on sprockets, and, if necessary, adjust as follows:
    1. Tape flaps in the UP position.
    2. Unsafety and loosen turnbuckles.
    3. Remove chain guard (37) and disengage chain from sprockets (13, figure 8-2).

4. (See figure 8-2.) Engage right chain with aft sprocket (13) so that approximately 3 1/2 links extend around bottom side of sprocket.

5. (See figure 8-2.) Engage left chain with forward sprocket (13) so that 3 links extend around the top side of sprocket.

6. Install chain guard (37) with four screws and safety.

7. Connect RH direct cable (30) to the long end of chain (top side of aft sprocket) and route over pulley (32) to bellcrank (35).

8. Connect RH return cable (31) to the short end of chain (bottom side of aft sprocket) and route over pulleys (33 and 34) around outboard pulley (36) and back to bellcrank (35).

9. Connect LH direct cable (18) to the long end of chain (bottom side of forward sprocket) and route over pulley (26) to bellcrank (20).

10. Connect LH return cable (21) to the short end of chain (top side of forward sprocket) and route over pulleys (25 and 19) around outboard pulley (22) and back to bellcrank (20).

11. With flaps secured in UP position, tighten turnbuckles until all slack is out of cables. Temporarily rig both return cables (21 and 31) with 185 pounds tension. Final tension on return cables should be 210 ±10 pounds with flaps in the UP position. The differential tension between left and right should not exceed 15 pounds.

## NOTE

At this point, recheck flap position as to being in proper position with respect to wing trailing edge. Should further adjustment of push-pull rods be necessary, this must be accomplished before final setting of cable tension.

12. Remove tape or other means of securing flaps in the UP position and lower flaps a few degrees at a time, observing for any unusual tension build-up in the cables or binding of the push-pull tubes and push-pull rods, until flaps reach their bottom position as measured with a protractor. Tolerance for flap travel is plus one degree, minus zero degree.

13. Rig both direct cables (18 and 30) with 85 pounds of tension. (Final tension of direct cables, with flaps DOWN should be 85 ±10 pounds, with the differential tension between left and right not exceeding 15 pounds).

14. Raise flaps and make final tension check of return cables (21 and 31) when stopped by the limit switch. (210 ±10 pounds.)

## NOTE

If the return cable tension is readjusted at this time, it will be necessary to recheck the direct cable tension with the flaps in the DOWN position and adjust as required. It will always be necessary to make the last tension adjustment on the direct cables with flaps DOWN.

15. (See figure 8-2.) Lower flaps to 35 degrees and adjust down limit switch (24) to actuate and stop flap travel at this point. Safety turnbuckles.

- h. If used, disconnect the switch and outside power source which were wired into the flap circuit.
- i. Reinstall access hole covers.

- j. Install center carpet and center seats in accordance with Section 3.



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## SECTION 9

## ENGINE

## Table of Contents

|                                             | Page |                                              | Page  |
|---------------------------------------------|------|----------------------------------------------|-------|
| GENERAL INFORMATION . . . . .               | 9-1  | ENGINE OIL SYSTEM . . . . .                  | 9-27  |
| Detail Engine Specifications . . . . .      | 9-2  | Trouble Shooting . . . . .                   | 9-27  |
| TROUBLE SHOOTING THE ENGINE . . . . .       | 9-3  | Oil Pressure System . . . . .                | 9-29  |
| ENGINE COWLS . . . . .                      | 9-6  | Removal and Installation of Oil              |       |
| Removal and Installation . . . . .          | 9-6  | Pressure Lines and Hoses . . . . .           | 9-29  |
| ENGINE . . . . .                            | 9-6  | Servicing Oil Pressure Lines . . . . .       | 9-29  |
| Removal Procedures . . . . .                | 9-6  | Cold Weather Servicing of Oil                |       |
| Disassembly and Assembly . . . . .          | 9-8  | Pressure Lines . . . . .                     | 9-29  |
| Inspection of Engine Assembly . . . . .     | 9-11 | Oil Filter Adapter . . . . .                 | 9-29  |
| Installation Procedures . . . . .           | 9-11 | Removal . . . . .                            | 9-29  |
| Inspection of Engine Installation . . . . . | 9-12 | Installation . . . . .                       | 9-29  |
| Operational Check . . . . .                 | 9-12 | Oil Temperature Adjustment . . . . .         | 9-30  |
| ENGINE SHOCK-MOUNTS . . . . .               | 9-14 | ENGINE BAFFLES . . . . .                     | 9-31  |
| Removal and Installation . . . . .          | 9-14 | Removal . . . . .                            | 9-31  |
| Cleaning and Inspection . . . . .           | 9-14 | Cleaning and Inspection . . . . .            | 9-31  |
| ENGINE CONTROL CABLES . . . . .             | 9-15 | Installation . . . . .                       | 9-31  |
| Removal . . . . .                           | 9-15 | AIR INDUCTION SYSTEM . . . . .               | 9-31  |
| Installation . . . . .                      | 9-15 | Induction Air Filter . . . . .               | 9-31  |
| Rigging . . . . .                           | 9-15 | Air Intake Box . . . . .                     | 9-32  |
| Rigging Procedures Chart . . . . .          | 9-18 | Removal of Air Intake Box . . . . .          | 9-32  |
| ENGINE CONTROL QUADRANT . . . . .           | 9-19 | Removal and Installation of Induction        |       |
| Removal and Installation . . . . .          | 9-19 | Air Filter . . . . .                         | 9-32  |
| Disassembly . . . . .                       | 9-20 | Removal and Installation of Induction        |       |
| Assembly . . . . .                          | 9-20 | Air Canister . . . . .                       | 9-32  |
| FUEL INJECTION SYSTEM . . . . .             | 9-20 | Installation of Air Intake Box . . . . .     | 9-32A |
| Trouble Shooting . . . . .                  | 9-20 | ENGINE IGNITION SYSTEM . . . . .             | 9-33  |
| FUEL-AIR CONTROL UNIT . . . . .             | 9-21 | Trouble Shooting . . . . .                   | 9-34  |
| Removal . . . . .                           | 9-22 | MAGNETOS . . . . .                           | 9-34  |
| Cleaning and Inspection . . . . .           | 9-22 | Removal . . . . .                            | 9-34  |
| Installation . . . . .                      | 9-22 | Inspection . . . . .                         | 9-35  |
| Adjustment . . . . .                        | 9-22 | Breaker Assembly Main Spring Check . . . . . | 9-35  |
| FUEL MANIFOLD . . . . .                     | 9-22 | Maintenance . . . . .                        | 9-35  |
| Removal . . . . .                           | 9-22 | Internal Timing . . . . .                    | 9-35  |
| Cleaning and Inspection . . . . .           | 9-23 | Installation and Timing . . . . .            | 9-37  |
| Installation . . . . .                      | 9-23 | Ignition Switches . . . . .                  | 9-38  |
| FUEL DISCHARGE NOZZLES . . . . .            | 9-23 | Ignition Cables . . . . .                    | 9-38  |
| Removal . . . . .                           | 9-23 | Removal . . . . .                            | 9-38  |
| Cleaning and Inspection . . . . .           | 9-23 | Cleaning and Inspection . . . . .            | 9-38  |
| Installation . . . . .                      | 9-23 | Installation . . . . .                       | 9-38  |
| FUEL INJECTION PUMP . . . . .               | 9-23 | Spark Plugs . . . . .                        | 9-38  |
| Removal . . . . .                           | 9-24 | Removal . . . . .                            | 9-38  |
| Installation . . . . .                      | 9-24 | Installation . . . . .                       | 9-39  |
| Fuel Mixture Check . . . . .                | 9-24 | Engine Exhaust System . . . . .              | 9-39  |
| Unmetered Fuel Test Hook-up, Check          |      | Removal . . . . .                            | 9-39  |
| and Adjustment . . . . .                    | 9-24 | Installation . . . . .                       | 9-40  |

## GENERAL INFORMATION.

Two Continental IO-470-VO engines are mounted on the aircraft. Each 260 horsepower, six-cylinder, horizontally opposed engine has an all metal, constant speed, full feathering propeller installed. The complete engine assembly consists of the engine, propeller, and the following Cessna installed items: Propeller governor, baffles, induction air filter and induction air box, vacuum pump and air-oil separator, tachometer generator, exhaust stack assemblies, cylinder head temperature

bulb, crankcase breather line and various other lines, hoses, fittings, and brackets necessary for the proper assembly and operation of the engine. In addition to above listed items, each engine has installed on it, two magnetos, twelve spark plugs, ignition harness and wiring, primer distribution lines and fittings, engine-driven fuel pump, low-pressure-multi-nozzle-continuous flow fuel injection system, pressure type intake manifold piping, integral oil pump and externally mounted oil cooler, starter and generator, and various adapters, clamps and brackets for mounting these items on engines.

## Detail Engine Specifications.

|                                                   |                                      |
|---------------------------------------------------|--------------------------------------|
| Model                                             | IO-470-VO                            |
| Rated Horsepower at 2625 RPM                      | 260                                  |
| Maximum Recommended Cruise Horsepower at 2450 RPM | 195                                  |
| Propeller Drive Ratio                             | Direct                               |
| Propeller Shaft Rotation (Looking Forward)        | Clockwise                            |
| Bore, Inches                                      | 5.00                                 |
| Stroke, Inches                                    | 4.00                                 |
| Displacement, Cubic Inches                        | 471                                  |
| Compression Ratio                                 | 8.6:1                                |
| Oil SAE Number Above 40°F                         | SAE #50                              |
| Below 40°F                                        | SAE 10W30 Multi-Viscosity or SAE #30 |
| Oil Sump Capacity (Without Filter)                | 12 Qts.                              |
| Fuel, Aviation Grade, Octane (Minimum)            | 100/130                              |
| Fuel System                                       | Continental Fuel Injection           |
| Fuel Injector                                     | Continental Fuel Injection           |
| Magneto Drive, Ratio to Crankshaft                | 1.5:1                                |
| Magnetos (See Section I)                          | Counterclockwise*                    |
| Tachometer Drive, Ratio to Crankshaft             | 0.5:1                                |
| Rotation                                          | Counterclockwise*                    |
| Starter Drive, Ratio to Crankshaft                | 32:1                                 |
| Rotation                                          | Counterclockwise*                    |
| Alternator Drive, Ratio to Crankshaft             | 3.5:1                                |
| Rotation                                          | Counterclockwise*                    |
| Vacuum Pump Drive, Ratio to Crankshaft            | 1.5:1                                |
| Rotation                                          | Clockwise*                           |
| Propeller Governor Drive, Ratio to Crankshaft     | 1:1                                  |
| Rotation                                          | Clockwise*                           |
| Spark Plug Type                                   | SL300A                               |
| Spark Occurs (Degrees BTC) Both Magnetos          | 20°                                  |
| Spark Plug Gap                                    | 0.016-0.018                          |
| Firing Order                                      | 1-6-3-2-5-4                          |
| Oil Pressure (Lbs. Per Sq. Inch)                  |                                      |
| Normal                                            | 30 to 60                             |
| Maximum                                           | 100                                  |
| Idling (Minimum)                                  | 10                                   |

\*Direction of rotation facing engine drive pad.

## Detail Engine Specifications (Continued).

|                                   |   |      |
|-----------------------------------|---|------|
| Oil Temperature (°F)              |   |      |
| Normal                            | . | 170° |
| Maximum                           | . | 225° |
| Cylinder Head Temperature (°F)    |   |      |
| Maximum                           | . | 460° |
| Cruise                            | . | 380° |
| Minimum (Takeoff)                 | . | 200° |
| Standard Engine Dry Weight (Lbs.) |   | 461  |

## TROUBLE SHOOTING THE ENGINE.

| TROUBLE                             | PROBABLE CAUSE                                        | CORRECTION                                                                                                                                |
|-------------------------------------|-------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| ENGINE WILL NOT START               | Fuel tank empty.                                      | Fill with correct grade of fuel.                                                                                                          |
|                                     | Improper starting procedure.                          | Refer to Pilot's Checklist for starting procedures and check for performance of each item.                                                |
|                                     | Cylinder overprimed.                                  | Place mixture levers in IDLE CUT-OFF position. Open throttle wide. Turn engine over several revolutions to clear cylinders.               |
|                                     | Induction system leak.                                | Tighten or replace loose or damaged hose connections.                                                                                     |
|                                     | Excessive starter slippage.                           | Replace starter adapter.                                                                                                                  |
|                                     | Fuel system malfunction.                              | Isolate cause and correct. (See Trouble Shooting the Fuel Injection System and refer to Section 11 for Trouble Shooting the Fuel System.) |
| ENGINE WILL NOT RUN AT IDLING SPEED | Ignition system malfunction.                          | Isolate cause and correct. (See Trouble Shooting the Ignition System.)                                                                    |
|                                     | Propeller levers set in high pitch (DECREASE RPM).    | Use low pitch (INCREASE RPM) position for all ground operations.                                                                          |
|                                     | Fuel injection system improperly adjusted.            | See Trouble Shooting the Fuel Injection System.                                                                                           |
|                                     | Air leak in intake manifold.                          | Tighten loose connection or replace damaged part.                                                                                         |
| ROUGH IDLING                        | Spark plugs fouled by oil escaping past piston rings. | Top overhaul.                                                                                                                             |
|                                     | Fuel injection system improperly adjusted.            | See Trouble Shooting the Fuel Injection System.                                                                                           |
|                                     | Mixture levers set for lean mixture.                  | Use FULL RICH position for all ground operation.                                                                                          |
|                                     | Fouled spark plugs.                                   | Remove and clean. Adjust gaps.                                                                                                            |

| TROUBLE                                                                       | PROBABLE CAUSE                                                    | CORRECTION                                                                                                                                                                                       |
|-------------------------------------------------------------------------------|-------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ROUGH IDLING<br>(CONTINUED)                                                   | Hydraulic lifters fouled.                                         | Remove and clean lifters. Inspect and clean oil filter at more frequent intervals.                                                                                                               |
|                                                                               | Burned or warped exhaust valves, worn seats, scored valve guides. | Top overhaul.                                                                                                                                                                                    |
| ENGINE RUNS TOO LEAN<br>AT CRUISING POWER                                     | Improper manual leaning procedure.                                | Operate in FULL RICH position below 5000 feet. Above 5000 feet, retard mixture levers until a slight drop in RPM is noted, then advance levers approximately one inch toward FULL RICH position. |
|                                                                               | Fuel flow reading too low.                                        | Check fuel strainer for clogging. Clean screen. (Refer to Section 11.)                                                                                                                           |
|                                                                               | Fuel injection malfunction.                                       | See Trouble Shooting the Fuel Injection System.                                                                                                                                                  |
| ENGINE RUNS TOO RICH<br>AT CRUISING POWER                                     | Restrictions in air intake passages.                              | Check passages and remove restrictions.                                                                                                                                                          |
| ENGINE RUNS TOO LEAN<br>OR TOO RICH AT THROTTLE<br>SETTINGS OTHER THAN CRUISE | Fuel injection malfunction.                                       | See Trouble Shooting the Fuel Injection System.                                                                                                                                                  |
| CONTINUOUS FOULING<br>OF SPARK PLUGS                                          | Piston rings excessively worn or broken.                          | Replace rings. Replace cylinder if damaged.                                                                                                                                                      |
|                                                                               | Piston rings inverted or not seated.                              | Install with side marked "TOP" toward piston head. Allow approximately 25 hours for new rings to "wear in."                                                                                      |
| ENGINE RUNS ROUGH<br>AT HIGH SPEED                                            | Loose mounting bolts or damaged mount pads.                       | Tighten mounting bolts. Replace mount pads.                                                                                                                                                      |
|                                                                               | Plugged nozzle.                                                   | Clean.                                                                                                                                                                                           |
|                                                                               | Propeller out of balance.                                         | Remove and repair.                                                                                                                                                                               |
|                                                                               | Ignition system malfunction.                                      | See Trouble Shooting the Ignition System.                                                                                                                                                        |
| REGULAR MISSING AT<br>HIGH SPEED                                              | Broken valve spring.                                              | Replace.                                                                                                                                                                                         |
|                                                                               | Plugged nozzle.                                                   | Clean.                                                                                                                                                                                           |
|                                                                               | Burned or warped valve.                                           | Top overhaul.                                                                                                                                                                                    |
|                                                                               | Hydraulic tappet dirty or worn.                                   | Remove and clean or replace.                                                                                                                                                                     |
| SLUGGISH OPERATION<br>AND LOW POWER                                           | Throttle not opening wide.                                        | Check and adjust linkage. (See Rigging of Mixture and Throttle Controls.)                                                                                                                        |
|                                                                               | Restrictions in air intake passages.                              | Check passages and remove restrictions.                                                                                                                                                          |
|                                                                               | Ignition system malfunction.                                      | See Trouble Shooting the Ignition System.                                                                                                                                                        |

| TROUBLE                                                                              | PROBABLE CAUSE                                                          | CORRECTION                                                                                                                 |
|--------------------------------------------------------------------------------------|-------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|
| SLUGGISH OPERATION AND LOW POWER (CONTINUED)                                         | Fuel injection malfunction.                                             | See Trouble Shooting the Fuel Injection System.                                                                            |
|                                                                                      | Valve seats worn and leaking.<br>Piston rings worn or stuck in grooves. | Top overhaul.                                                                                                              |
| HIGH CYLINDER HEAD TEMPERATURE                                                       | Low octane fuel.                                                        | Drain tanks and replace with correct grade of fuel. (Refer to Section 2.)                                                  |
|                                                                                      | Lean fuel/air mixture due to improper manual leaning procedure.         | See "CORRECTION" under "Engine runs too lean at cruising power."                                                           |
|                                                                                      | Cylinder baffles loose or bent.                                         | Check and correct.                                                                                                         |
|                                                                                      | Dirt between cylinder fins.                                             | Clean thoroughly.                                                                                                          |
|                                                                                      | Excessive carbon deposits in cylinder head and on pistons.              | Top overhaul.                                                                                                              |
|                                                                                      | Exhaust system gas leakage.                                             | Locate and correct.                                                                                                        |
|                                                                                      | Exhaust valves leaking.                                                 | Top overhaul.                                                                                                              |
| OIL LEAKS                                                                            | At front of engine: damaged crankshaft oil seal.                        | Replace.                                                                                                                   |
|                                                                                      | Around push rod housings: damaged push rod housing packing.             | Replace.                                                                                                                   |
|                                                                                      | Around propeller mounting flange: damaged hub O-ring seal.              | Replace. (Refer to Section 10.)                                                                                            |
|                                                                                      | Around plugs, fittings and gaskets due to looseness or damage.          | Tighten or replace.                                                                                                        |
| LOW COMPRESSION                                                                      | Piston rings excessively worn.                                          | Top overhaul.                                                                                                              |
|                                                                                      | Valve faces and seats worn.                                             | Top overhaul.                                                                                                              |
|                                                                                      | Excessively worn cylinder walls.                                        | Replace cylinders and piston rings.                                                                                        |
| ENGINE WILL NOT ACCELERATE PROPERLY                                                  | Unmetered fuel pressure too high.                                       | See Unmetered Fuel Pressure and Mixture Checkout and Adjustment.                                                           |
| SLOW ENGINE ACCELERATION ON A HOT DAY                                                | Mixture too rich.                                                       | Momentarily pull mixture control back until engine acceleration picks up, then move mixture control to full forward again. |
| ROUGH IDLE AT AIRFIELDS WITH GROUND ELEVATION OF 3500 FEET OR HIGHER                 | Mixture too rich.                                                       | Pull mixture control back to where the engine operates the smoothest at IDLE RPM.                                          |
| SLOW ENGINE ACCELERATION AT AIRFIELDS WITH A GROUND ELEVATION OF 3500 FEET OR HIGHER | Mixture too rich.                                                       | Pull mixture control back to where engine operates at IDLE RPM. Engine should accelerate normally.                         |

| TROUBLE                                                                   | PROBABLE CAUSE                        | CORRECTION                                                                                                                                                                                                                                                                                                                                                                    |
|---------------------------------------------------------------------------|---------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ENGINE WILL NOT STOP AT IDLE CUT-OFF                                      | Manifold valve not seating tightly.   | Repair or replace manifold valve.                                                                                                                                                                                                                                                                                                                                             |
| ENGINE WILL NOT START                                                     | Manifold valve sticking closed.       | Repair or replace manifold valve.                                                                                                                                                                                                                                                                                                                                             |
| HIGH ENGINE IDLE PRESSURE IMPOSSIBLE TO OBTAIN                            | Manifold valve sticking closed.       | Repair or replace manifold valve.                                                                                                                                                                                                                                                                                                                                             |
| ERRATIC ENGINE OPERATION                                                  | Manifold valve sticking, or not free. | Repair or replace manifold valve.                                                                                                                                                                                                                                                                                                                                             |
| CLIMBING TO ALTITUDES ABOVE 12,000 FEET, ENGINE QUILTS WHEN POWER REDUCED | Fuel vaporization.                    | Turn boost pumps ON when climbing to 12,000 feet, when climb completed, continue with boost pumps ON until vaporization possibility is eliminated. Lean mixture during climb to proper fuel flow for power being used. Engines may quit when throttles are brought back for power adjustment after leveling off. If this occurs, lean mixture and engines will pick up again. |

## ENGINE COWLS.

Removal and Installation of Engine Cowls. (See figure 9-1.)

## NOTE

This removal procedure is for the RH engine cowl, LH engine cowl is removed in a similar manner.

- Release fasteners retaining cowl doors (6 and 7) to upper cowl assembly (3).
- Release fasteners retaining upper cowl assembly (3) to engine nacelle structure and nose caps and remove upper cowl assembly (3) from aircraft.
- Remove screws attaching lower portion of cowls (8) to engine beam assembly.
- Release fasteners retaining nose cap assemblies (10 and 11) to forward engine beam assembly.
- Remove screws securing nose cap assemblies (10 and 11) together and remove nose cap assemblies.

## NOTE

To remove oil filler door (5) from upper cowl section, pull hinge pin (4).

- Install engine cowl by reversing removal procedures.

## ENGINE.

Engine Removal Procedures. (See figure 9-2.)

The removal procedure is the same for either engine. Although the routing of wire bundles, cables, lines, hoses and conduit varies between engines, the following description will be typical for either engine. Identify each item as it is disconnected to aid in re-installation. Cover the open ends of all lines and hoses to prevent entry of foreign materials.

## NOTE

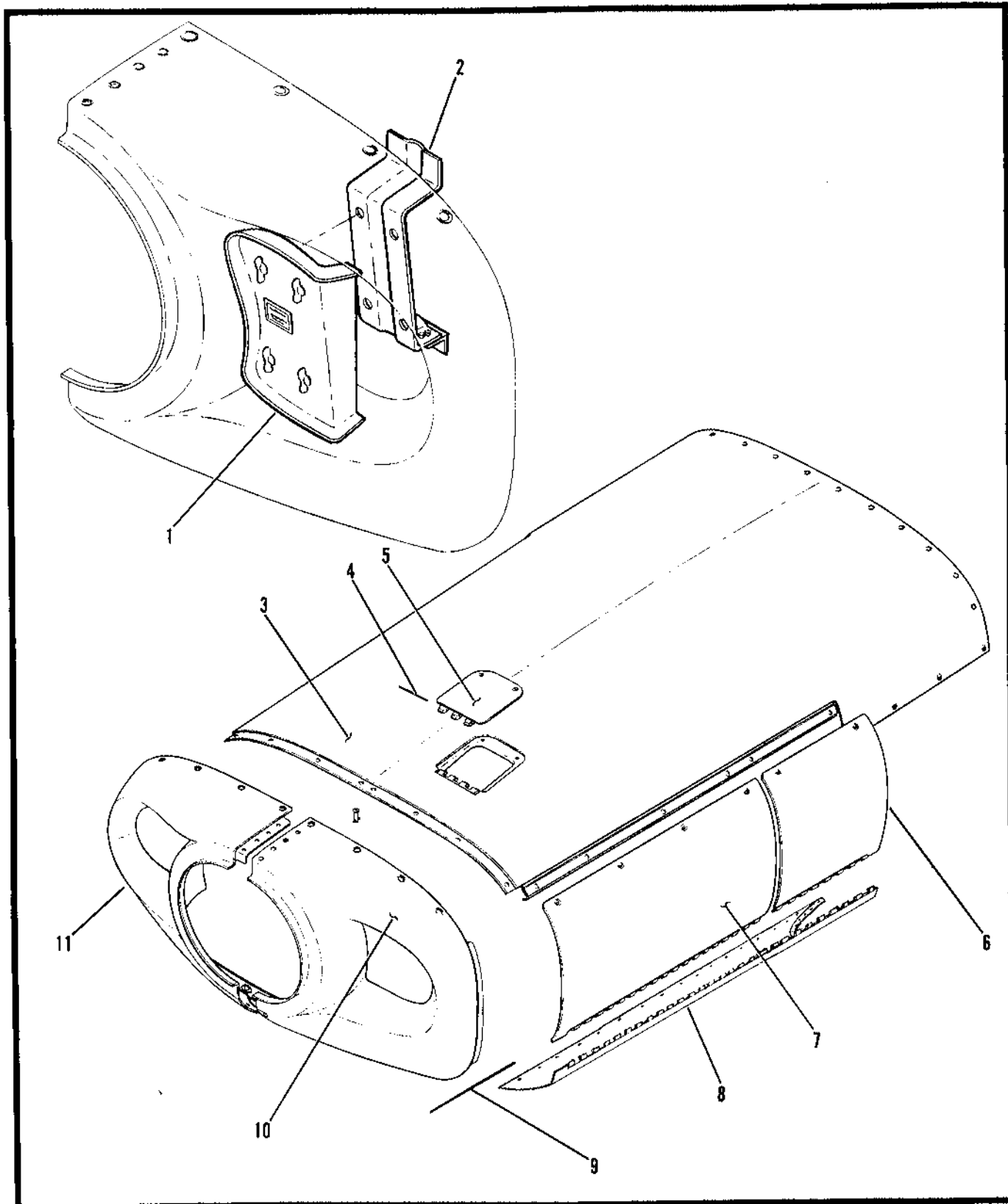
If engine is being removed to be placed in storage, proper preparatory steps as outlined in Section 2, "Extended Storage," must be observed. In addition to the above mentioned procedures, cover all engine and accessory vents and other openings, including the crankcase breather, with other vapor-proof material.

- Turn all cockpit switches and fuel selector valves OFF.
- Open the battery circuit by disconnecting the battery ground cable.
- Remove engine cowl in accordance with removal procedures.
- Disconnect magneto ground wires (33) at the magnetos and withdraw them aft through the right rear engine baffle (18).

## WARNING

These magnetos DO NOT have internal grounding springs. Ground the magnetos to the crankcase to prevent accidental firing.

- Drain the oil in accordance with Section 2. Re-



1. Winterization Baffle
2. Attaching Bracket
3. Upper Cowl Assembly
4. Hinge Pin

5. Oil Filler Door
6. Aft Cowl Door
7. Forward Cowl Door

8. Lower Cowl Assembly LH
9. Hinge Pin
10. Nose Cap Assembly - Left Half
11. Nose Cap Assembly - Right Half

Figure 9-1. Engine Cowling



place the drain plug.

- f. Remove the propeller in accordance with Section 10.
- g. Disconnect the engine controls as follows:
  1. Disconnect the induction air control (4), the mixture control (25), and the throttle control.
  2. Disconnect the propeller control (31) at the governor (27). Remove the propeller control bracket (32) from the intake manifold (21) by loosening the bracket clamps.
- h. (Refer to Section 13.) If installed, remove propeller unfeathering system hose at the governors.

#### CAUTION

The propeller unfeathering accumulator is normally pressurized, therefore, release accumulator pressure by referring to Section 10 before attempting to disconnect hose from governor.

- i. Disconnect wires and cables as follows:
  1. Disconnect oil temperature electrical connector (13) located directly below the oil cooler (15). Disconnect oil temperature ground wire.
  2. Disconnect tachometer generator (22) electrical connector.
  3. Disconnect starter cable (20).
  4. Remove the cylinder head temperature bulb (10) from No. 4 cylinder. Disconnect the cylinder head temperature ground wire.
  5. Disconnect alternator cables (52) and cable shielding ground.
  6. Disconnect fuel pressure switch (41) wiring.
  7. Disconnect wiring at radio noise filter (51).
  8. Remove all clamps attaching wires or cables to the engine. Pull all wires and cables aft to clear the engine assembly.
- j. Remove engine ground strap from engine mount assembly by removing existing bolt.
- k. Disconnect lines and hoses as follows:
  1. Separate crankcase breather line (34) at hose connector just aft of right rear engine baffle (18).
  2. Disconnect vacuum line (38) from vacuum pump (23).
  3. Disconnect fuel vapor return line (40) from the outboard nacelle rib.
  4. Disconnect the fuel pressure gage line (42) from the right rear engine baffle.
  5. Disconnect the manifold pressure hose (26) from the intake tube at the right rear of the engine.
  6. Disconnect oil pressure hose (46) at the inboard nacelle rib and remove the clamp which fastens it to the canted bulkhead. Pull the hose free of the canted bulkhead.
  7. Disconnect fuel pump supply line (44) at the fuel pump (50).

#### WARNING

Fuel and oil draining from lines and hoses is a fire hazard. Prevent fuel and oil from collecting in the engine nacelle.

8. Disconnect the two manifold drain hoses (24 and 45) from rear intake elbows.

#### NOTE

If oil dilution system is installed, disconnect oil dilution hose at crankcase fitting just below the fuel pump.

1. Disconnect exhaust stacks (39) from each cylinder by removing attaching nuts.
- m. Attach a hoist to the lifting eye at the top center of the engine crankcase. Lift the engine just enough to relieve its weight from the engine mounts.

#### CAUTION

Place a stand under the aircraft tailcone bumper before removing an engine. The loss of engine weight may allow the tail to drop.

- n. Remove engines as follows: (See figure 9-3.)
  1. Remove bolts (8).
  2. Hoist engine out of the nacelle and clear of the aircraft.

#### CAUTION

Hoist engine slowly and make certain that all wires, lines, and hoses have been disconnected.

3. Remove mount pads (3 and 6) and spacers (5) from engine mount bracket (4).

#### Disassembly and Assembly of Engine.

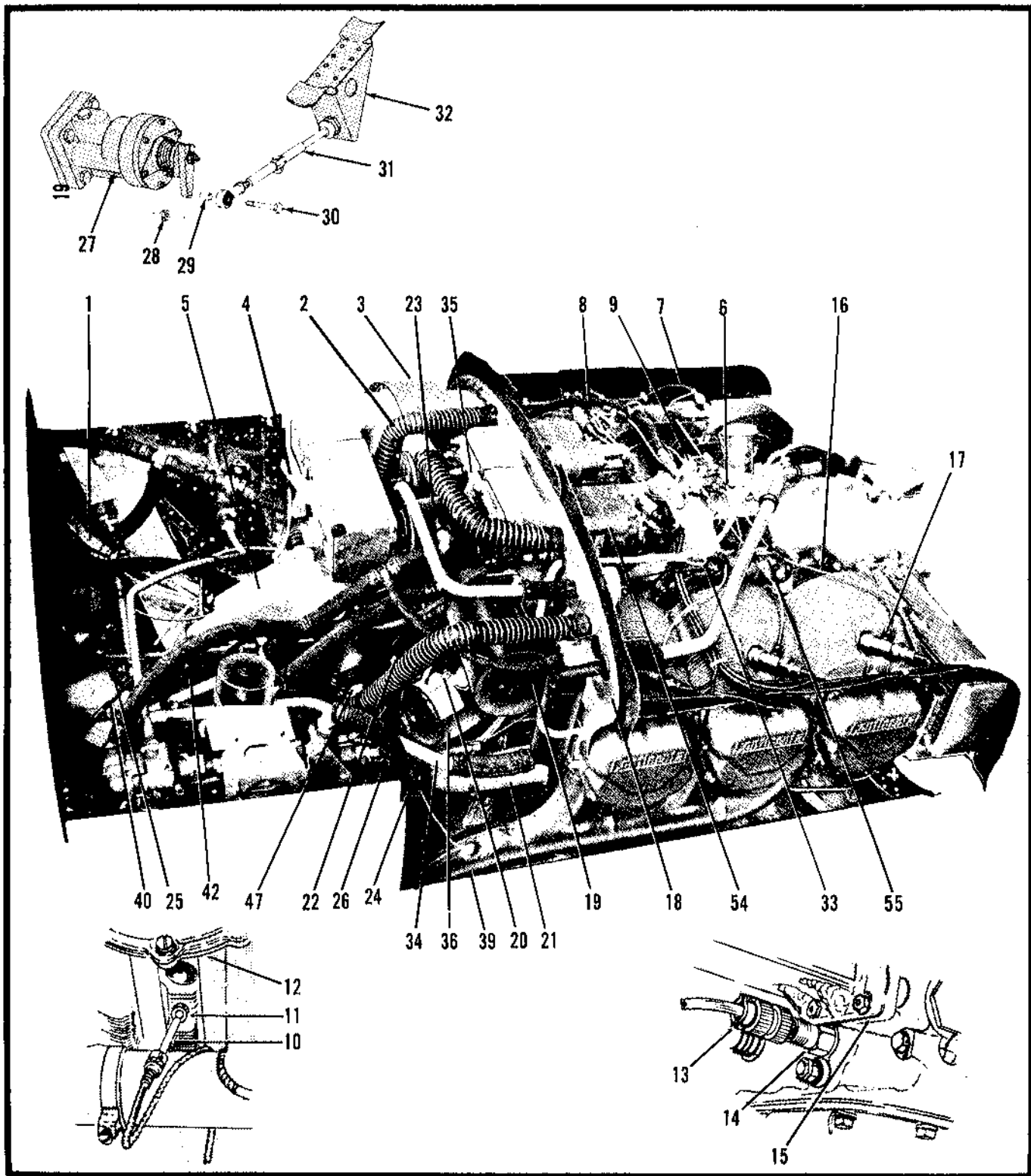
#### NOTE

The disassembly procedure is the same for either engine and is intended to cover only those items which could normally be expected to require removal or are not noted by Continental Motors Corporation "Engine Maintenance and Overhaul" manual for engine specified.

- a. Hoist engine assembly to a convenient working height.
- b. Clean engine assembly as prescribed by aforementioned engine maintenance and overhaul manual.

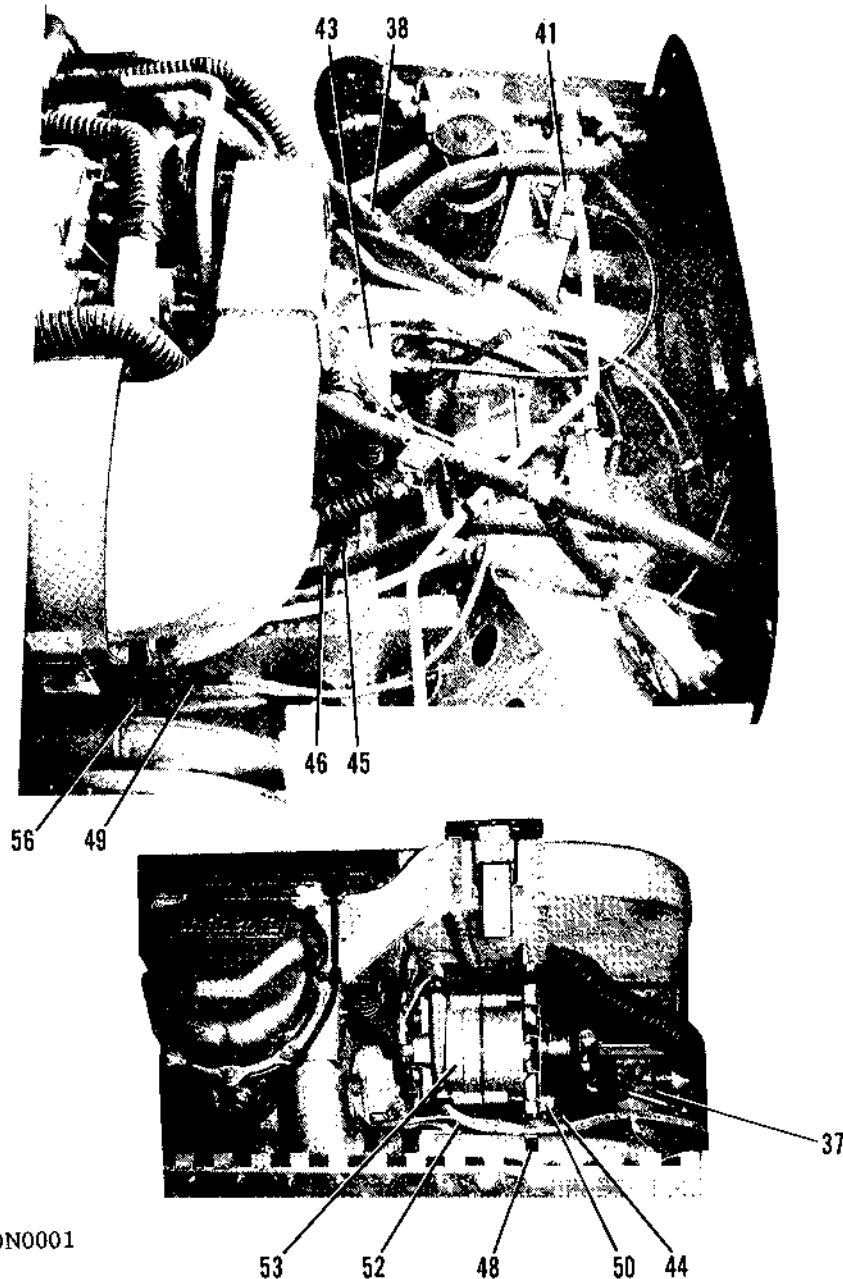
#### CAUTION

Particular care should be given to electrical components before cleaning. Solvents should not be allowed to enter magnetos, starters, alternators, voltage regulators and the like. Hence, these should be protected before saturating the engine with solvent. Any oil, fuel, and air openings on the engine and accessories should be covered before washing down the engine with solvent. Caustic cleaning solutions should be used cautiously and should always be properly neutralized after their use.



- |                                      |                                              |                                          |
|--------------------------------------|----------------------------------------------|------------------------------------------|
| 1. Wire Bundle                       | 8. Fuel Line (Fuel Control to Fuel Manifold) | 12. No. 4 Cylinder                       |
| 2. Fuel Pump Ram Air Tube            | 9. Fuel Manifold                             | 13. Oil Temperature Electrical Connector |
| 3. Air Filter                        | 10. Cylinder Head Temperature Bulb           | 14. Oil Temperature Bulb                 |
| 4. Induction Air Control             | 11. Cylinder Head Temperature Bulb Adapter   | 15. Oil Cooler                           |
| 5. Air Box Bracket                   |                                              | 16. Fuel Injection Line                  |
| 6. Fuel Pressure Gage Line (Forward) |                                              | 17. Fuel Injection Nozzle                |
| 7. Ignition Cable                    |                                              |                                          |

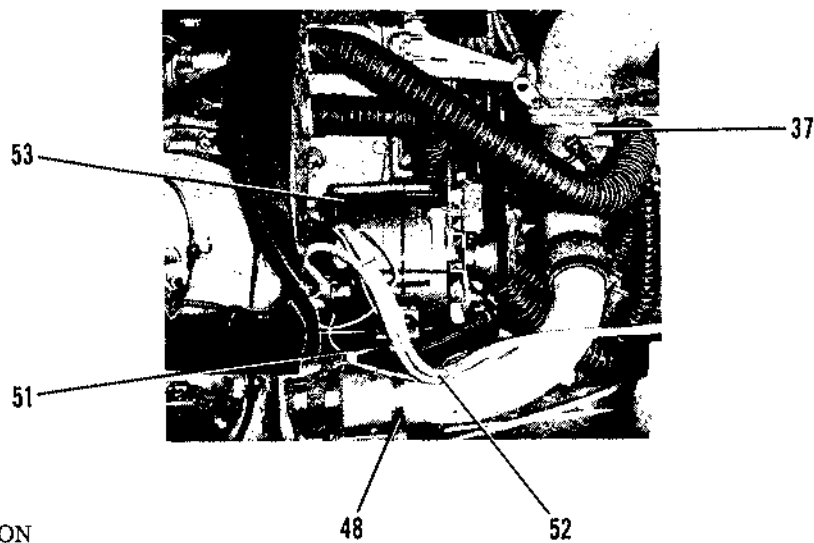
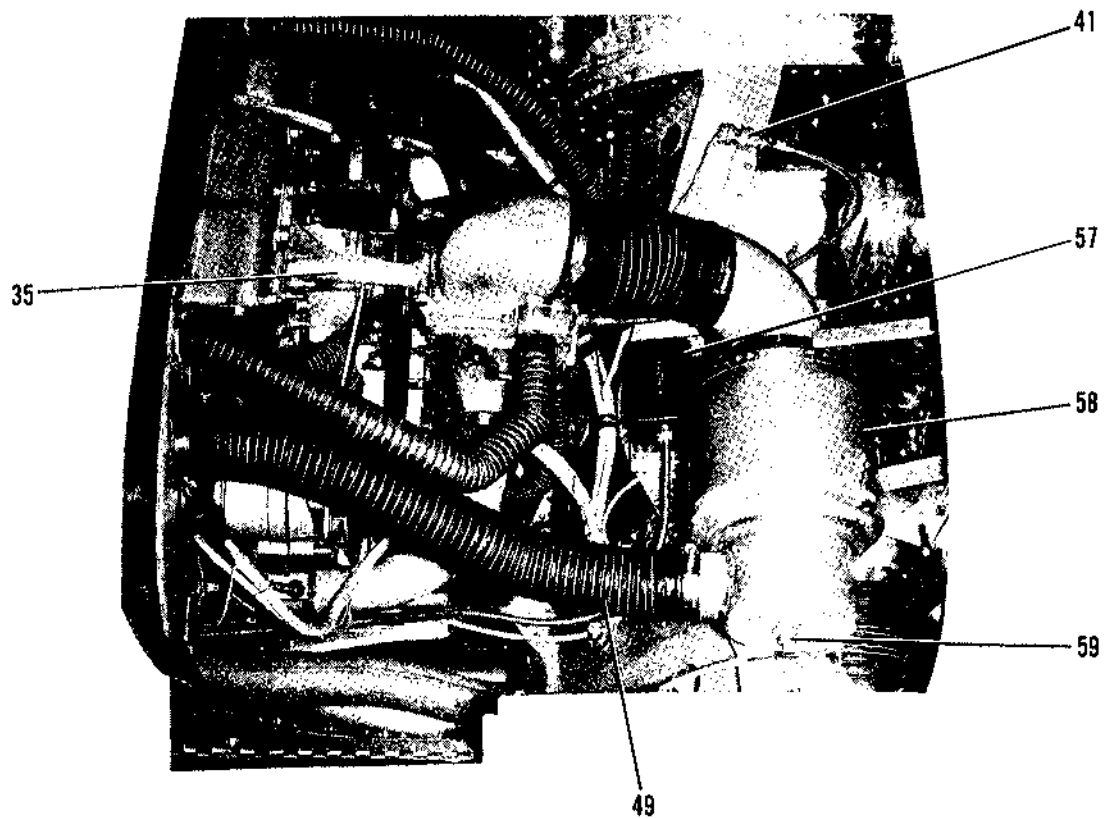
Figure 9-2. Engine Removal (Sheet 1 of 3)



310L0001 TO 310N0001

- |                              |                                   |                                   |
|------------------------------|-----------------------------------|-----------------------------------|
| 18. Right Rear Engine Baffle | 29. Spacer                        | 40. Fuel Vapor Return Line        |
| 19. Starter                  | 30. Bolt                          | 41. Fuel Pressure Switch          |
| 20. Starter Cable            | 31. Propeller Control Sliding End | 42. Fuel Pressure Gage Line (Aft) |
| 21. Intake Manifold          | 32. Propeller Control Bracket     | 43. Fuel Control Unit             |
| 22. Tachometer Generator     | 33. Magneto Ground Wires          | 44. Fuel Line (Strainer to Pump)  |
| 23. Vacuum Pump              | 34. Crankcase Breather Line       | 45. Manifold Drain Line           |
| 24. Manifold Drain Line      | 35. Fuel-Air Control Unit Support | 46. Oil Pressure Line             |
| 25. Mixture Control          | 36. Oil Filter                    | 47. Clamp                         |
| 26. Manifold Pressure Hose   | 37. Fuel-Air Control Unit         | 48. Clamp                         |
| 27. Propeller Governor       | 38. Vacuum Line                   | 49. Propeller Control Conduit     |
| 28. Nut                      | 39. Exhaust Stack                 | 50. Fuel Pump                     |

Figure 9-2. Engine Removal (Sheet 2 of 3)



310N0001 AND ON

51. Radio Noise Filter  
 52. Alternator Cable  
 53. Alternator

54. Magneto  
 55. Bracket  
 56. Engine Ground Strap

57. Propeller Sync Control Unit  
 58. Air Intake Canister  
 59. Air Intake Control

Figure 9-2. Engine Removal (Sheet 3 of 3)

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## NOTE

As each of the following items is removed from the engine, place a temporary cover over the hole left by the removal of the item. This procedure should prevent the accidental entry of foreign material which could cause engine damage or lead to a serious engine malfunction.

- c. Refer to Section 12, remove vacuum pump in accordance with removal procedures.
- d. Remove engine baffles in accordance with removal procedures.
- e. Remove the tachometer generator by removing four nuts and lifting tachometer generator free of drive adapter.
- f. Refer to Section 10, remove propeller governor in accordance with removal procedures.
- g. Remove all other fittings, hoses, lines and attaching parts necessary to facilitate maintenance of engine.
- h. To assemble the engine, reverse the engine disassembly procedures.

## Inspection of Engine Assembly.

## NOTE

Instructions concerning inspection of particular engine components, refer to applicable paragraph in "Engine Maintenance and Overhaul Manual," Continental Motors Corporation.

- a. Inspect all hoses for evidence of internal swelling, chafing, cuts or breaks.
- b. Inspect all fittings for thread damage, damage to chamfered seats and replace fittings as necessary.
- c. Inspect oil separators for evidence of restrictions and clean as necessary.
- d. Visually inspect the engine for loose nuts, bolts, cracks and fin damage. Make necessary corrections and repairs in accordance with best shop practices and in compliance with applicable FAA regulations.

## Engine Installation Procedures. (See figure 9-2.)

## NOTE

The installation procedure is the same for either engine. Although there is some difference in the routing of wire bundles, lines, hoses and conduit, the following procedure is typical for installation of either engine.

- a. Hoist engine to a point just above the nacelle.
- b. (See figure 9-3.) Install the engine mounts and engine as follows:
  1. Position upper mount (3) on engine mount bracket (4).
  2. Using a shop punch, or like instrument, as an aligning tool, guide engine on upper mount (3) and engine mount bracket (4).

## NOTE

Align exhaust stack assemblies with engine studs as engine is being lowered on mounts.

3. Assemble lock washer (7), lower mount (6) and bonded spacer (5) on bolt (8). Position these items on the engine mount bracket (4) and index lower mount (6) with aligning pin to notch in engine mount bracket.
4. Torque bolt (8) to 50 +0, -5 foot-pounds.
5. Safety bolt (8) by crimping the ears on lock washer over the flat surfaces of the bolt head.
- c. Fasten engine ground strap to the left aft engine mount bracket.
- d. Connect wires and cables as follows:
  1. Attach wire bundle (1) to right manifold intake pipe with two clamps, and alternator cables to left intake manifold pipe with two clamps.
  2. Route oil temperature wires forward along right side of engine, below cylinders and behind intake manifold pipe. Use a sump attachment bolt to attach a clip to the engine crankcase. Fasten the oil temperature wires to this clip with a wire clamp. Attach connector (13) to oil temperature bulb, located directly below oil cooler (15), and safety. Connect ground wire to nacelle, just below forward right engine mount bracket.
  3. Route magneto ground wires (33) forward through the right rear engine baffle (18).

## WARNING

These magnetos DO NOT have internal grounding springs. Ground the magnetos to the crankcase to prevent accidental firing. DO NOT connect the aircraft ground wires to the magnetos at this time.

4. Connect starter cable (20) to starter (19).
5. Attach the tachometer generator electrical connector to the tachometer generator (22) and safety.
6. Route the cylinder head temperature bulb wires forward along left side of engine, below the cylinders and behind the intake manifold pipe. Install cylinder head temperature bulb (10) in No. 4 cylinder. Attach cylinder head temperature bulb ground wire to nacelle just below left aft engine mount bracket.
7. Attach alternator cables (52) to alternator (53), and attach ground wire and cable shielding to ground.
8. Attach wiring at the fuel pressure switch (41).
- e. Connect lines and hoses as follows:
  1. Connect crankcase breather line (34).
  2. Connect vacuum line (38) to vacuum pump (23).
  3. Connect fuel vapor return line (40) and fuel pressure gage line (42).
  4. Connect the manifold pressure hose (26) and the two manifold drain lines (24 and 45).
  5. Route oil pressure hose (46) aft through lightening hole in canted bulkhead and attach to oil pressure fitting at inboard nacelle rib. Fasten oil pressure hose to canted bulkhead with a clamp.
  6. Connect fuel pump supply line (44) at fuel pump (50).

## NOTE

If oil dilution system is installed, connect the oil dilution hose at the crankcase fitting just below the fuel pump.

- f. Attach propeller control bracket (32) with two clamps. Connect the propeller control (31) at the governor. Rig the propeller control in accordance with rigging procedures.
- g. Connect the induction air control (4), the mixture control (25) and the throttle control. Rig these controls in accordance with rigging procedures.
- h. Install the exhaust stacks and torque nuts to 60 ±10 inch-pounds.
- i. Install the propeller in accordance with Section 10.
- j. Connect the battery ground cable in accordance with Section 14.
- k. Inspect installation for safeties, loose connections, missing bolts, clamps, screws, or nuts; proper routing of cables, hoses and lines, and for correct connection.
- l. Make a magneto switch ground-out and continuity check. Connect the magneto ground wires to the magnetos.
- m. Service the engine in accordance with Section 2.
- n. Install the engine cowling in accordance with installation procedures.

## Inspection of Engine Installation.

The following checklist may be used as a guide for inspecting the installation of either engine.

1. Propeller mounting bolts safetied.
2. Engine mounts secure.
3. Oil temperature bulb electrical connector secure and safetied, ground wire connection tight.
4. Oil pressure relief valve plug safetied.
5. Tachometer generator electrical connector secure and safetied.
6. Starter cable connection secure and insulating boot in place.
7. Cylinder head temperature bulb installed and ground wire connection tight.
8. Alternator cable connections secure and cable shielding grounded.
9. All wiring securely clamped in place.
10. Fuel pump connections tight.
11. Manifold pressure hose connections tight.
12. Oil pressure connections clamped and tight.
13. Fuel injection nozzles tight.
14. Fuel injection lines clamped and tight.
15. Fuel manifold secure.
16. All flexible tubing in place and clamped.
17. Crankcase breather line connections secure.
18. Return oil hose from air oil separator to crankcase secure.
19. Vacuum line and vacuum pump outlet hose connections secure.
20. Oil dilution hose connections tight (optional equipment).
21. Propeller deice electrical connections tight (optional equipment).
22. Engine controls properly rigged.
23. Oil drain plugs tight and safetied.

24. Oil quantity check, 12 quarts in each engine.
25. Hoses and lines secure at firewall.
26. Fuel-air control unit and air intake box secure.
27. Shrouds installed on engine-driven fuel pump and fuel control unit. Ram air tubes installed and clamped.
28. Induction system clamps tight.
29. Exhaust system secure.
30. Spark plugs tight. Ignition harness connections tight and harness properly clamped.
31. Magneto ground wires connected and safetied.
32. Engine nacelle for loose objects (tools, rags, etc.).
33. Cowling and access doors for security.

## Engine Operational Check.

## Before Starting Engines.

## CAUTION

Ground operation time should be held to a minimum to prevent overheating the engine. At no time should the engine temperatures be allowed to exceed their maximum limits. Do not operate the engine with cowling removed.

- a. Park aircraft with nose headed into prevailing wind.
- b. Install wheel chocks and position a fire extinguisher for easy access in event of engine fire.
- c. Clear area directly in front and to rear of aircraft of all objects that may be affected by propeller and propeller slipstream.

## CAUTION

Avoid engine runup with aircraft parked in a loose gravel area. The propeller will pick up small stones which may damage propeller blades.

- d. Release parking brake handle if previously set, and test-operate brakes, noting any sponginess or excessive pedal travel. Reset parking brake handle after test.

## CAUTION

Do not perform engine runup if brake action is not normal. If aircraft should jump chocks during runup, brakes will be needed.

- e. Position the following switches as indicated:

| Switch                     | Setting |
|----------------------------|---------|
| Ignition .....             | OFF     |
| Landing Gear .....         | DOWN    |
| Cabin Heater .....         | OFF     |
| Radio Switches .....       | OFF     |
| Auxiliary Fuel Pumps ..... | OFF     |
| Alternator Switches .....  | OFF     |
| Battery .....              | ON      |

- f. Check all circuit breakers.
- g. Check fuel quantity indicators for sufficient fuel.
- h. Set left engine fuel selector valve to LEFT MAIN.
- i. Set right engine fuel selector valve to RIGHT MAIN.
- j. Check landing gear down (green) light for illumination.

## NOTE

The battery switch should be turned OFF when an external power source is connected for use during starting. Weak batteries will drain off part of the current being supplied by the external power source, resulting in less electrical power available during the start.

## Starting Engines.

Although either engine may be started first and the starting procedure is identical for either engine, it is recommended that the left engine be started first. The battery cable is much shorter to this engine, thus permitting more electrical power to be delivered to the starter.

## WARNING

Immediately prior to starting the engines, call out CLEAR in a loud tone and do not start the engines until an answering CLEAR is received if there are people in the immediate area.

- a. Place propeller pitch levers in full INCREASE RPM.
- b. Set induction air controls to COLD (full in).
- c. Turn ignition switches ON.
- d. Open throttle approximately 1/2 inch.
- e. Set mixture lever to FULL RICH.
- f. Prime the engine being started by moving the prime switch to the left for left engine or to the right for right engine.
- g. Depress starter button to start the engine when fuel flow reaches 2 to 4 gal/hr.
- h. Release prime switch when engine runs smoothly.

## NOTE

If engine fails to start, it is probably loaded. Repeat starting procedure with throttle approximately 1/2 open, mixture lever in IDLE CUT-OFF, and prime switch OFF. As engine fires, move mixture lever to FULL RICH and decrease throttle to idle.

- i. Check for an oil pressure indication within 30 seconds in normal weather and 60 seconds in cold weather. If no indication appears, shut off engine and investigate.

## NOTE

During very hot weather, if there is an indication of vapor in the fuel system (fluctuating fuel flow), turn the auxiliary fuel pump ON until the system is purged.

- j. After both engines have started, disconnect the external power source, turn the battery switch and both alternator switches ON.

## NOTE

If an external power source has not been used, turn the alternator switch for the engine being operated ON. Start the other engine, then turn the alternator switch for that engine ON.

## Engine Warm-up and Operational Check.

- a. Set throttles at 800 to 1000 RPM.

## NOTE

The engines are set to idle at 600 RPM to insure satisfactory taxi control; however, prolonged idling should be done at 800 to 1000 RPM to insure satisfactory lubrication.

- b. Leave induction air controls in COLD (full in) position.
  - c. Perform magneto ground-out check as follows:
    - 1. Throttle engine back to idle (600 RPM).
    - 2. Momentarily switch both magnetos OFF.
- RESULT: The tachometer will indicate a sudden RPM drop when magnetos cease firing.

## CAUTION

If magneto switches are left OFF for a prolonged period, after firing may occur when they are switched back on. If the engine continues to run with the switches OFF, stop engine by placing control in IDLE CUT-OFF and check magneto ground.

- d. Advance throttle to 1700 RPM and perform a magneto check as follows:
    - 1. Place right magneto switch to OFF position and note RPM drop. Return switch to ON position. Repeat check with left magneto switch.
- RESULT: The RPM drop should not exceed 150 RPM with 50 RPM spread between engines.
- e. With engine at 1700 RPM, exercise the propeller.
    - 1. Retard the propeller pitch lever to obtain a 1000 RPM tachometer indication.
- RESULT: Exercise propeller and watch for any indication of sluggish or erratic operation.
- f. With RPM still at 1700, pull induction air control OUT.
- RESULT: Note drop in RPM. Return induction air control to COLD (full in) position.
- g. Make a mixture control check by slowly moving the mixture lever toward IDLE CUT-OFF.
- RESULT: When a slight drop in RPM is noted immediately return mixture lever to FULL RICH position.
- h. Place auxiliary fuel pump switches OFF before stopping engines.
  - i. Stop engine by placing mixture control in IDLE CUT-OFF. As soon as propeller has stopped turning, place ignition switches OFF. Turn all switches OFF.



## Engine Shock Mounts. (See figure 9-3.)

The bonded rubber and metal shock mounts are designed to reduce the transmission of engine vibrations to the airframe. This provides smoother aircraft operation and reduces the possibility of structural failure from vibration fatigue.

Removal and Installation of Engine Shock Mounts.  
(See figure 9-3.)

## NOTE

The engine must be supported with an engine hoist before attempting removal of shock mounts. If engine is going to be removed from aircraft, see Removal of Engine for the attaching parts to be disconnected.

- a. Remove necessary engine cowling in accordance with removal procedures.
- b. Place suitable support beneath tailcone.
- c. Remove bolt (8) and lock washer (7) from shock mounts (6 and 3).
- d. Disconnect fuel pump drain line.
- e. Hoist engine slowly to a height of 2 to 3 inches above normal mounting position.

## NOTE

Care should be taken not to introduce adverse stresses on other items attached to engine while hoisting engine.

- f. Remove upper mount (3), spacer (5) and lower mount (6) from engine mount bracket (4).
- g. Install engine shock mounts by reversing procedure steps above.

## NOTE

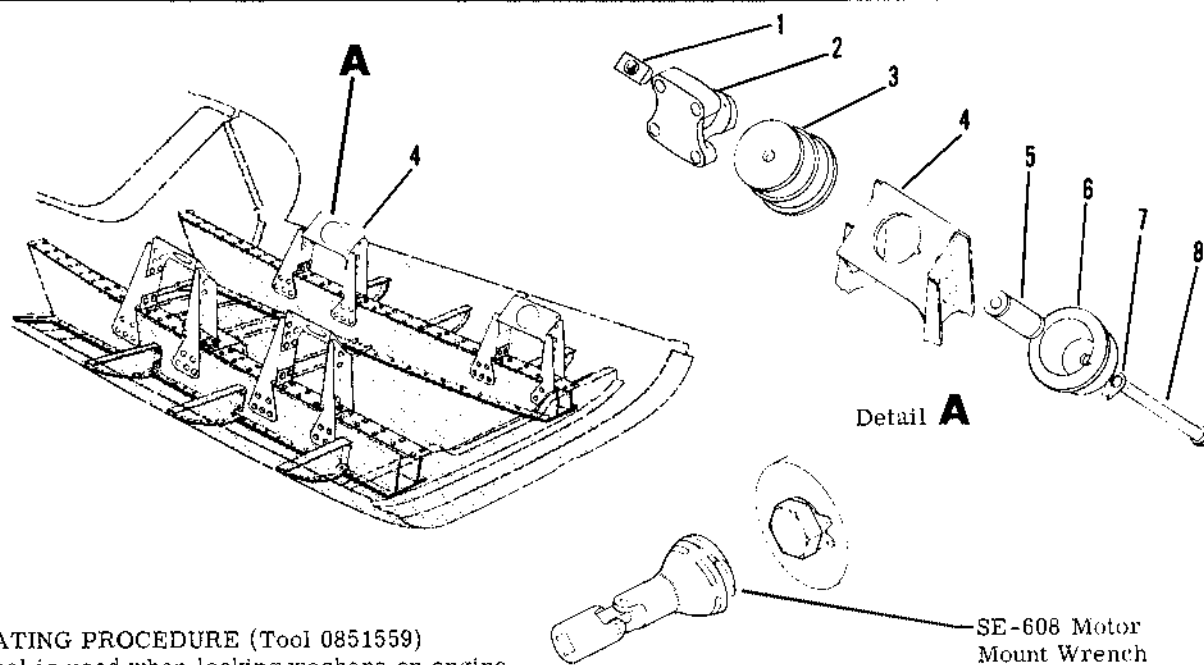
Torque bolts (8) to 50 +0, -5 foot-pounds.

## Cleaning and Inspection of Engine Shock Mounts.

All metal parts of the shock mount assemblies may be cleaned in a suitable dry cleaning solvent. The rubber pads should be wiped clean with a dry, clean cloth.

## NOTE

Do not clean the rubber pads with any type of solvent.



## OPERATING PROCEDURE (Tool 0851559)

This tool is used when locking washers on engine mount bolts.

1. Install tool on ratchet wrench or other suitable tool.
2. Position tool over bolt head making sure it seats flat against engine mount pad face.

3. Turn tool until ears are positioned flat against corners of flat of bolt.

## NOTE

Washer ears should either be splitting corners or on flat of bolt head.

1. Barrel Nut
2. Engine Mount
3. Mount Pad (Upper)

4. Engine Mount Bracket
5. Spacer

6. Mount Pad (Lower)
7. Washer
8. Bolt

Figure 9-3. Engine Shock Mounts

Inspect the metal parts for cracks and excessive wear. Replace all parts that show evidence of damage. Inspect the rubber pads for separation between pad and metal packing, swelling and cracking, or a pronounced set of the pad. Replace all rubber pads that show evidence of damage.

### ENGINE CONTROL CABLES.

Removal of Engine Control Cables. (See figure 9-4.)

- a. (Refer to Control Pedestal Installation in Section 3.) Remove elevator trim control wheel, cover plate, friction knob, upper RH panel and RH side panel.
- b. Disconnect throttle, propeller and mixture control cables from quadrant control levers by removing attaching clevis pins.
- c. Unthread bulkhead locknuts (1) from control cables at the control pedestal support bracket and nacelle firewall rib (4).
- d. Unthread and remove bulkhead locknuts (1) from propeller control cable on propeller control cable mounting bracket (7) and disconnect rod end (6) from governor (5) by removing nut, spacer and bolt. Remove rod end (6) from propeller cable.
- e. Remove clamps securing throttle and mixture control cables to aft firewall.
- f. Disconnect rod ends (6) from serrated levers (12) on mixture and throttle control cables by removing attaching nuts, washers and bolts.
- g. Remove rod ends (6) from control cables.
- h. Remove locknuts from throttle and mixture control cables at mounting bracket (11).
- i. Attach guide wires to control cables.
- j. Disconnect control cables from guide wires.

#### NOTE

To facilitate installation, leave guide wires in aircraft.

Installation of Engine Control Cables. (See figure 9-4.)

- a. Attach guide wires to the ends of control cables.
- b. Route the propeller, throttle, and mixture control cables to their proper location in the engine nacelle and the control pedestal.
- c. Remove guide wires from control cables.
- d. Install rod ends (6) on mixture and throttle control cables.

#### NOTE

Do not connect rod ends (6) to serrated levers (12) at this time.

- e. Secure control cables to nacelle firewall (4) and control pedestal support bracket with bulkhead locknuts (1).
- f. Connect control cables clevis ends to quadrant control levers with attaching clevis pins and safety in place with cotter pin.
- g. Route propeller cable through bracket (7) and

secure with bulkhead locknuts (1).

- h. Secure rod end (6) to propeller cable and connect rod end to propeller governor (5) with bolt, spacer and nut.
- i. (Refer to Section 10.) Rig propeller control in accordance with rigging procedures.
- j. Connect mixture and throttle rod ends (6) to serrated levers (12) with attaching bolts, washers, spacers and nuts. Rig in accordance with rigging procedures.

#### NOTE

Spacers (13) must be installed to prevent interference of throttle and mixture controls.

Rigging Mixture and Throttle Controls. (See figure 9-4.)

- a. Rig control cables on throttle valve and metering unit as follows:
  1. Find the neutral position of the throttle shaft by rotating the throttle shaft clockwise and then counterclockwise until the shaft comes to rest on the internal stops. Scribe an index mark on shaft and throttle body at these positions. Rotate throttle shaft to the midpoint between the marks and scribe a neutral position mark. The neutral position on the metering unit can be determined by visually positioning the pin on the metering unit shaft at the midpoint between the two stop pins. Position both the throttle and metering unit shafts to neutral.
  2. Align serrated spacers (14) on throttle and metering unit shafts so that serration lines on the face of the spacer are perpendicular to the neutral position of the shafts.

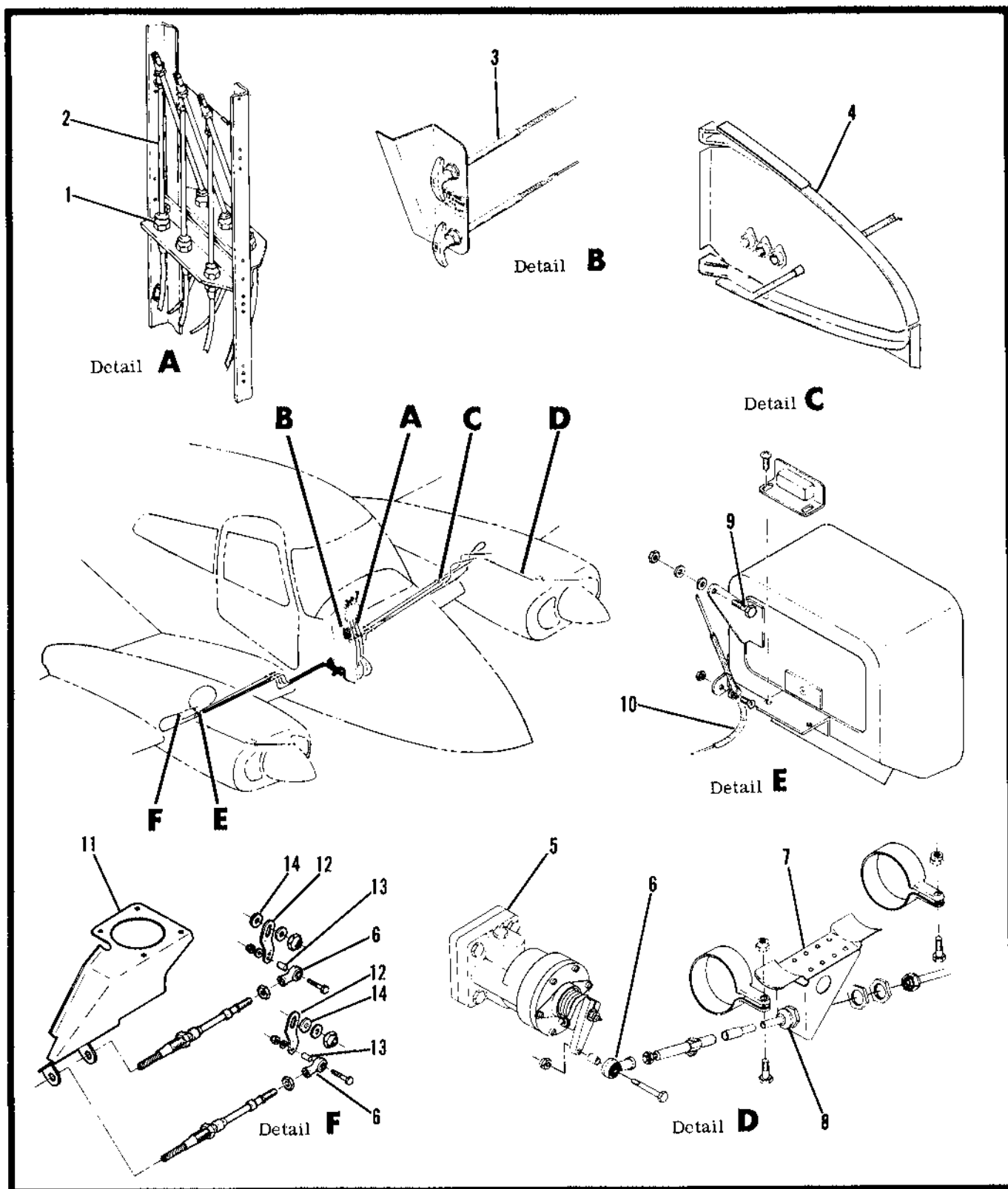
#### CAUTION

Care should be exercised in order to maintain original factory setting of serrated spacers on shafts.

3. Install levers (12) on spacers (14) aligning the serrations.
4. Secure levers (12) and spacers (14) to throttle and metering unit shafts with washers and nuts.
5. On the control quadrant, place throttle and mixture control levers at the midpoint between stops.
6. With the throttle and metering unit shafts in the NEUTRAL position and the throttle and mixture control levers on quadrant set at the midpoint, adjust control cables rod ends (6) so that when attached to levers (12), a 90 degree angle is formed between centerline of lever (12) and centerline of control cables.

#### NOTE

If throttle and mixture controls on the quadrant were not set at a true midpoint as described in step 5 above, the 1/4 inch tolerance as noted in following steps b and d will not be available. Readjustment for 1/4 inch travel (cushion) will be necessary and should be made as specified in Rigging Procedures Chart.

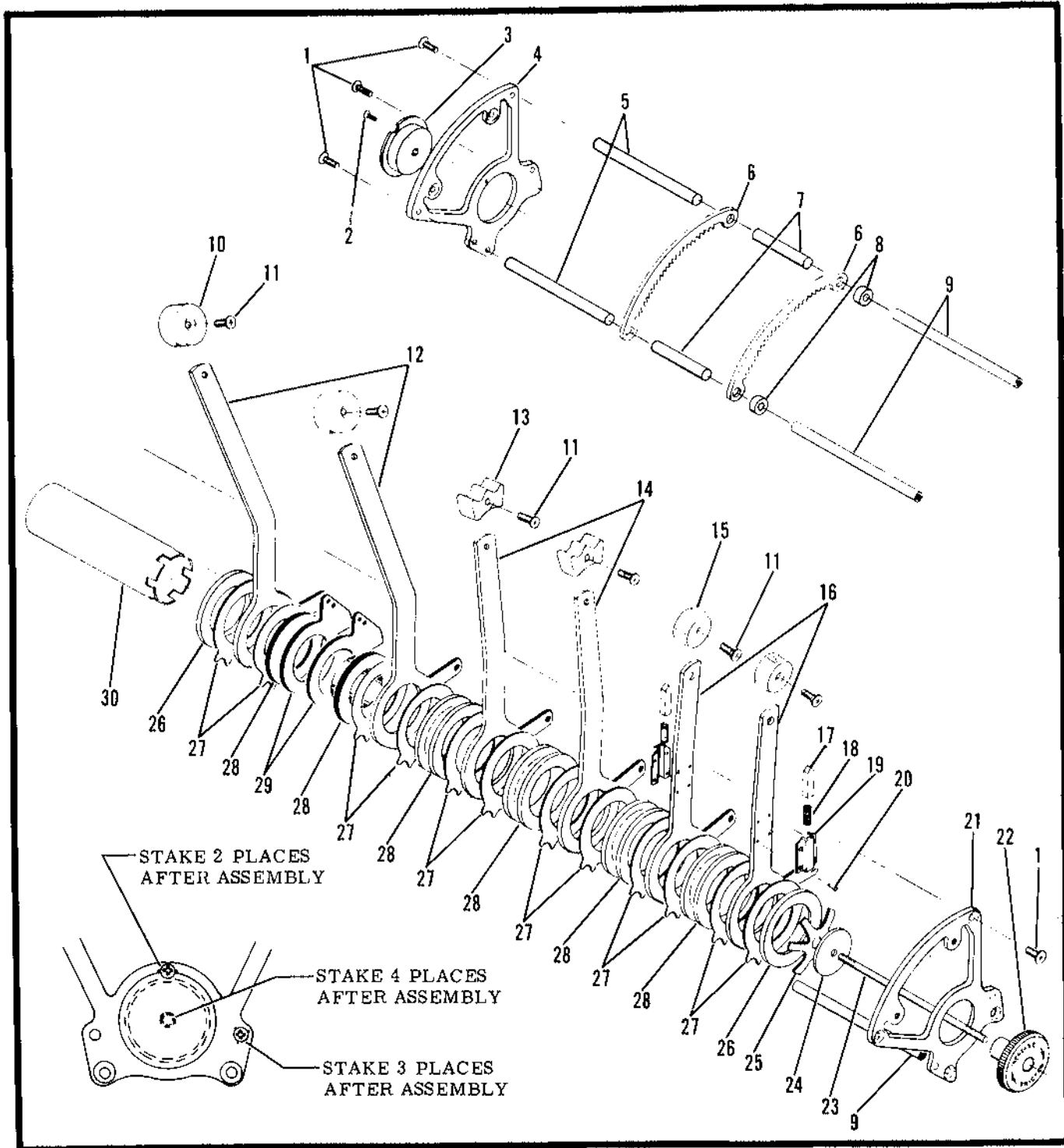


1. Locknut
2. Telescopic Unit
3. Alternate Air Control "T" Handles
4. Inboard Nacelle Rib
5. Propeller Governor

6. Rod End
7. Mounting Bracket
8. Swivel Connector
9. Bolt

10. Alternate Air Control Cable
11. Mounting Bracket
12. Serrated Lever
13. Spacers
14. Serrated Spacer

Figure 9-4. Engine Controls



- |                           |                              |                            |
|---------------------------|------------------------------|----------------------------|
| 1. Screw                  | 11. Screw                    | 21. Mounting Plate (Right) |
| 2. Lock Screw             | 12. Lever (Throttle Control) | 22. Friction Knob          |
| 3. Retainer               | 13. Knob (Pitch Lever)       | 23. Stud                   |
| 4. Mounting Plate (Left)  | 14. Lever (Pitch Control)    | 24. Washer                 |
| 5. Spacer                 | 15. Knob (Mixture Lever)     | 25. Spring                 |
| 6. Rack (Mixture Control) | 16. Lever (Mixture Control)  | 26. Spacer                 |
| 7. Spacer                 | 17. Ratchet Stop             | 27. Friction Disc          |
| 8. Spacer                 | 18. Spring                   | 28. Spacer                 |
| 9. Guide Rods             | 19. Housing                  | 29. Cam                    |
| 10. Knob (Throttle Lever) | 20. Screw                    | 30. Hub                    |

Figure 9-5. Control Quadrant Disassembly

b. Adjustment of the idle mixture is accomplished by the use of a locknut which is attached to the metering unit lever on the metering unit. Tightening locknut, to shorten the interconnecting linkage, provides a richer mixture. Adjust to obtain a slight and momentary gain in idle speed as the mixture control is moved toward IDLE CUT-OFF (if set too lean, idle speed will drop under the same condition). Mixture control levers in the cabin should end their travels approximately 1/4 of an inch before reaching the quadrant stops. At the same time, the metering unit levers on the engines should rest against the corresponding stops.

c. Metering unit levers should be uniform within

1/2 of a knob through the cruising range. This can be checked by adjusting both flow meter readings to an identical value at uniform RPM and manifold pressure on both engines.

d. Adjust the throttle control levers in the cabin so that their travel ends 1/4 of an inch before reaching the quadrant stops. At the same time the throttle levers on the engines should rest against the corresponding stops.

e. Throttle control levers should be uniform within 1/8 of an inch of the knobs through the entire travel. The rigging procedures chart provides corrective instructions in order to meet the above control requirements.

Rigging Procedures Chart for Mixture and Throttle Controls. (See figure 9-4.)

| TROUBLE                                                                                                                                                                             | PROBABLE CAUSE                           | CORRECTION                                                                                                                                |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| <p style="text-align: center;">NOTE</p> <p>Control actions must be corrected in the order presented in Rigging Chart. Start at the top of the chart and work toward the bottom.</p> |                                          |                                                                                                                                           |
| MIXTURE CONTROL LEVER REACHES QUADRANT BEFORE COVERING FULL TRAVEL                                                                                                                  | Insufficient control travel.             | (See figure 9-4.) Shorten travel of serrated lever (12) by resetting lever higher on serrated spacer (14).                                |
| MIXTURE CONTROL LEVER STOPS SHORT AT BOTH ENDS OF QUADRANT                                                                                                                          | Excessive control travel.                | (See figure 9-4.) Lengthen travel of serrated lever (12) by resetting lever lower on serrated spacer (14).                                |
| MIXTURE CONTROL LEVER STOPS SHORT AT ONE END OF TRAVEL AND STRIKES THE QUADRANT STOP AT THE OTHER END                                                                               | Uneven control travel adjustment.        | (See figure 9-4.) Disconnect rod end (6) from lever (12) and turn rod end until desired adjustment is achieved. Connect rod end to lever. |
| UNEVEN MIXTURE RESPONSE BETWEEN ENGINES (MORE THAN HALF KNOB DIFFERENCE AT BALANCED FLOW METER READINGS, RPM AND MANIFOLD PRESSURE)                                                 | Different mixture control sensitivities. | Refer to Rigging Mixture and Throttle Controls.                                                                                           |
| THROTTLE CONTROL LEVER REACHES QUADRANT STOPS BEFORE COVERING FULL TRAVEL                                                                                                           | Insufficient control travel.             | (See figure 9-4.) Shorten travel of serrated lever (12) by resetting lever higher on serrated spacer (14).                                |
| THROTTLE CONTROL LEVER STOPS SHORT AT BOTH ENDS OF QUADRANT                                                                                                                         | Excessive control travel.                | (See figure 9-4.) Lengthen travel of serrated lever (12) by resetting lever lower on serrated spacer (14).                                |
| THROTTLE CONTROL LEVER STOPS SHORT AT ONE END OF TRAVEL AND STRIKES THE QUADRANT STOP AT THE OTHER END                                                                              | Uneven control travel adjustment.        | (See figure 9-4.) Disconnect rod end (6) from lever (12) and turn rod end until desired adjustment is achieved. Connect rod end to lever. |

| TROUBLE                                                                                                                                                                                                                  | PROBABLE CAUSE                               | CORRECTION                                         |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|----------------------------------------------------|
| UNEVEN THROTTLE SETTING<br>RESPONSE BETWEEN ENGINES.<br>MORE THAN 1/8 INCH DIFFER-<br>ENCE BETWEEN KNOBS (AT<br>SAME FLOW METER MANIFOLD<br>PRESSURE AND RPM READINGS)                                                   | Different throttle control<br>sensitivities. | Refer to Rigging Mixture and<br>Throttle Controls. |
| <p style="text-align: center;"><b>NOTE</b></p> <p>If described corrective measures do not provide adequate throttle control operation, check throttle body, control valve operation and air intake system for leaks.</p> |                                              |                                                    |

### ENGINE CONTROL QUADRANT.

The engine control quadrant, mounted in the control pedestal, contains the throttle levers, propeller pitch levers, and mixture levers. The control quadrant components are fastened together in a manner which allows a friction control knob at the right side of the control quadrant to vary the amount of friction on the various control levers. This provides a means of locking the control levers in the desired position.

### Removal and Installation of Engine Control Quadrant. (See figure 9-5.)

- (Refer to Section 3, Control Pedestal Installation.) Remove elevator trim control wheel, cover plate, friction knob, upper panel and side panel.
- Remove cover box or autopilot control unit (optional equipment) from upper face of control pedestal by removing screws from support angles.
- Disconnect control cables from quadrant control

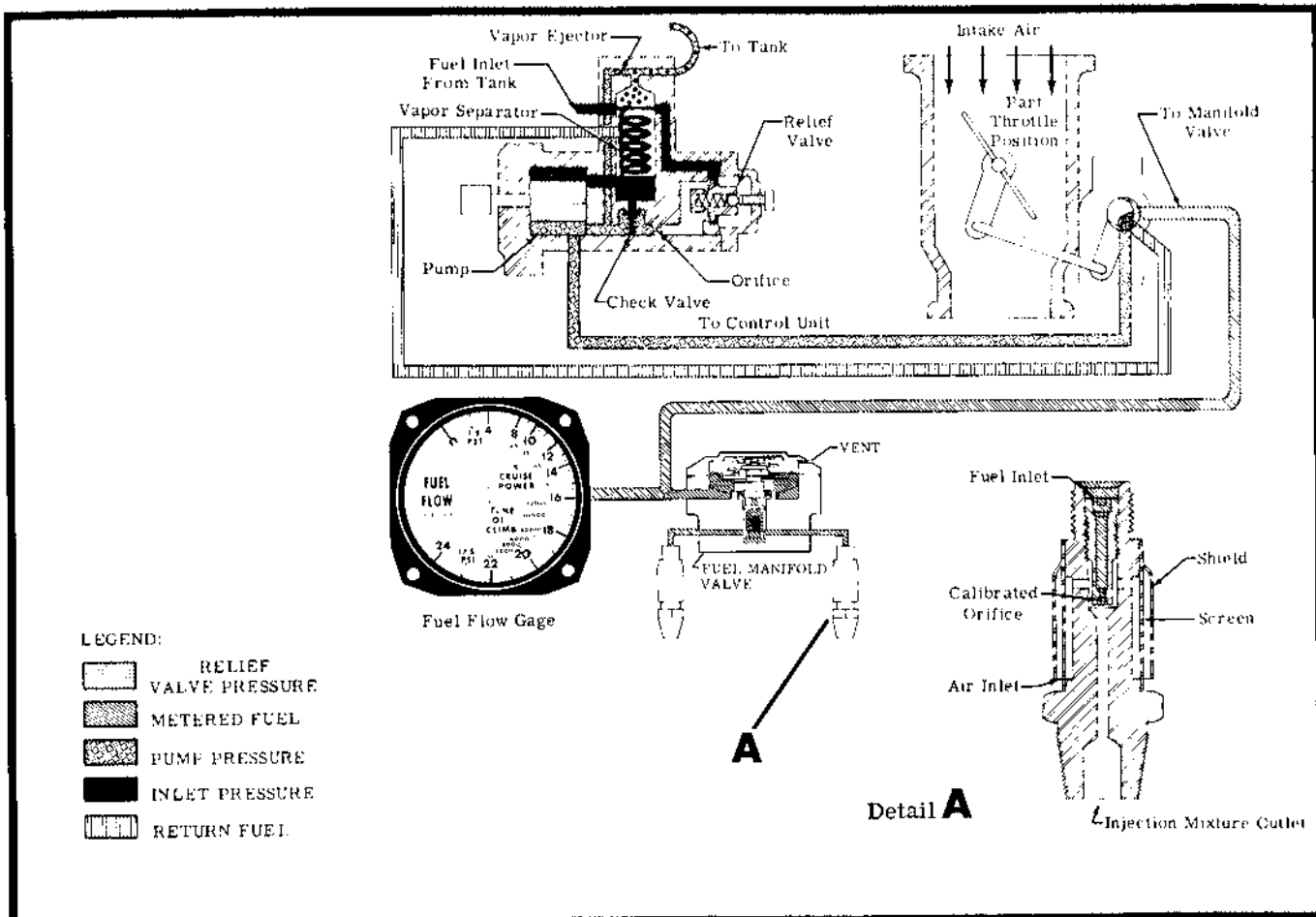


Figure 9-6. Fuel Injection Schematic

levers by removing the clevis pins. The clevis pins are safetied with cotter pins.

d. Remove control quadrant from control pedestal by removing attaching screws.

e. Install control quadrant by reversing steps a. through d., above.

#### Disassembly of Control Quadrant. (See figure 9-5.)

a. Remove three screws (1) attaching right mounting plate (21) to guide rods (9).

b. Remove washer (24) and spring (25) from end of center stud (23).

c. Remove rack (6) and spacers (8) from guide rods, then remove spacer (26), friction disc (27) and control lever (16) from hub (30). Follow this sequence and remove the remaining parts assembled on the guide rods and hub.

#### NOTE

The spacers are of different thicknesses.

d. Remove three screws (1) attaching rods to left mounting plate (4) and remove guide rods.

#### CAUTION

Hold the ratchet stop (17) on the mixture levers (16) down when removing the racks to prevent them from springing out of their housings.

e. Remove lock screw (2) from left mounting plate (4) and remove hub (30) from mounting plate.

f. Unscrew retainer (3) from hub (30) and center stud (23) from retainer, to complete disassembly.

#### Assembly of Control Quadrant. (See figure 9-5.)

a. Screw center stud (23) into retainer (3).

b. Screw retainer into hub (30) and install hub in left mounting plate (4). Secure hub to mounting plate with lock screw (2).

#### NOTE

Prick punch edge of lock screw after installing to prevent it from becoming loose and dropping out.

c. Install three guide rods (9) on left mounting plate (4) with three attaching screws (1).

d. Assemble control levers, spacers, guides, etc., on hub and guide rods as illustrated.

#### NOTE

Do not lubricate the parts to be assembled on the hub. These parts must remain dry for proper operation of the control friction lock.

e. Install right mounting plate (21) with three screws (1), attaching mounting plate to guide rods (9).

#### FUEL INJECTION SYSTEM.

The fuel injection is a simple, low pressure system of injecting fuel into the intake valve port in the cylinder head. It is a multi-nozzle, continuous flow type which controls fuel flow to match engine airflow. Any change in throttle position, engine speed, or a combination of both, causes changes in fuel flow in the correct relation to engine airflow. A manual mixture control and a flow gage, indicating metered fuel pressure, are provided for precise leaning at any combination of altitude and power setting. The continuous flow system uses a typical rotary vane fuel pump. There are no running parts in this system except for the engine-driven fuel pump.

#### Trouble Shooting the Fuel Injection System.

| TROUBLE                                                | PROBABLE CAUSE                     | CORRECTION                                                                                        |
|--------------------------------------------------------|------------------------------------|---------------------------------------------------------------------------------------------------|
| ENGINE WILL NOT START AND NO FUEL FLOW GAGE INDICATION | No fuel to engine.                 | Check tank fuel level.                                                                            |
|                                                        | Mixture control improperly rigged. | Check mixture control for proper rigging.                                                         |
|                                                        | Engine not primed.                 | Auxiliary pump switch in PRIME position.                                                          |
|                                                        | Selector valve in wrong position.  | Position selector valve to MAIN TANK position.                                                    |
| ENGINE WILL NOT START WITH FUEL FLOW GAGE INDICATION   | Engine flooded.                    | Reset throttle, clear engine of excess fuel, try another start.                                   |
|                                                        | No fuel to engine.                 | Loosen one line at nozzle. If no fuel shows, with fuel flow on gage, replace fuel manifold valve. |

| TROUBLE                                                | PROBABLE CAUSE                                       | CORRECTION                                                                                                                     |
|--------------------------------------------------------|------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|
| ROUGH IDLE                                             | Nozzle restricted.                                   | Remove nozzles and clean.                                                                                                      |
|                                                        | Improper idle mixture.                               | Adjust fuel-air control unit in accordance with adjustment procedures.                                                         |
| POOR ACCELERATION                                      | Idle mixture incorrect.                              | Adjust fuel-air control unit in accordance with adjustment procedures.                                                         |
|                                                        | Unmetered fuel pressure too high.                    | Lower unmetered fuel pressure.                                                                                                 |
|                                                        | Worn linkage.                                        | Replace worn elements of linkage.                                                                                              |
| ENGINE RUNS ROUGH                                      | Restricted nozzle.                                   | Remove and clean all nozzles.                                                                                                  |
|                                                        | Improper mixture.                                    | Improper pump pressure, replace.                                                                                               |
| LOW FUEL FLOW GAGE INDICATION                          | Restricted flow to metering valve.                   | Check mixture control for full travel. Check for clogged fuel filters.                                                         |
|                                                        | Inadequate flow from fuel pump.                      | Adjust engine-driven fuel pump.                                                                                                |
| HIGH FUEL FLOW GAGE INDICATION                         | Restricted flow beyond metering valve.               | Check for restricted nozzles or fuel manifold valve. Clean or replace as required.                                             |
|                                                        | Restricted recirculation passage in fuel pump.       | Replace engine-driven fuel pump.                                                                                               |
| FLUCTUATING OR ERRONEOUS FUEL FLOW INDICATIONS         | Vapor in system, excess fuel temperature.            | If not cleared with auxiliary pump, check for clogged ejector jet in vapor separator cover. Clean only with solvent, no wires. |
|                                                        | Air in fuel flow gage line. Leak at gage connection. | Repair leak and purge line.                                                                                                    |
| POOR IDLE CUT-OFF                                      | Engine getting fuel.                                 | Check mixture control is in full idle cut-off. Check auxiliary pump is OFF. If neither, replace manifold valve.                |
| UNMETERED FUEL PRESSURE RAISE                          | Internal orifices plugged.                           | Clean internal orifices in injector pump.                                                                                      |
| UNMETERED FUEL PRESSURE DROP                           | Relief valve stuck open.                             | Repair or replace injector pump.                                                                                               |
| VERY HIGH IDLE AND FULL THROTTLE FUEL PRESSURE PRESENT | Relief valve stuck closed.                           | Repair or replace injector pump.                                                                                               |
| NO FUEL PRESSURE                                       | Check valve stuck open.                              | Repair or replace injector pump.                                                                                               |

#### FUEL-AIR CONTROL UNIT.

The fuel-air control unit consists of the throttle body and the metering body. This unit occupies the position ordinarily used for a carburetor at the intake manifold inlet. The function of this unit is to control engine air intake and to set the metered fuel pressure for proper fuel-air ratio. There are three control

elements in this unit, one for air and two for fuel, one of which is for fuel mixture and the other for fuel metering. Main fuel enters the control unit through a strainer and passes to the metering valve. The position of the metering valve controls the fuel passed to the manifold valve and nozzles. A linkage connecting the metering valve to the air throttle proportions airflow to fuel flow. The position of the



mixture valve determines the amount of fuel returned to the fuel pump. The fuel control portion of the fuel-air control is enclosed in a shroud and is blast air cooled to help prevent vapor lock. A fuel pressure switch, connected to fuel control unit, actuates to cause the auxiliary fuel pump to operate at a high speed if the engine-driven fuel pump pressure drops below 4 to 5 psi. The auxiliary fuel pump switch must be ON for the fuel pressure switch to operate.

#### Removal of Fuel-Air Control Unit.

- a. Remove the engine cowl.
- b. Place the fuel selector valve handles OFF.
- c. Loosen clamp on ram air tube at the metering body and slide tube clear of hose connection.
- d. Remove sheet metal screws retaining cover on metering body cooling shroud.
- e. Disconnect hose to the fuel pressure switch.
- f. Slide cooling shroud cover aft and down to expose the three hose connections at the metering body. These hoses are to be disconnected at this time.

#### NOTE

Plug or cap all open lines, hoses and fittings.

- g. Loosen the clamps which secure the throttle body to both the right and left intake manifold.
- h. Remove the air intake box in accordance with removal procedures.
- i. Remove two forward bolts attaching throttle body to upper support.
- j. Remove two nuts attaching throttle body to the lower support braces.
- k. Disconnect the throttle and mixture controls.
- l. Remove fuel-air control unit.

#### NOTE

The metering body may be removed from the throttle body by removing the three special bolts which are safetied with tang washers.

#### Cleaning and Inspection of Fuel-Air Control Unit.

- a. Check control connections, levers, and linkages for tight attaching parts, for safetying, and for lost motion due to wear.
- b. Remove the fuel strainer and clean the screen in fresh cleaning solvent. Reinstall and safety.
- c. Check the throttle body for cracks and the metering body for overall condition.

#### Installation of Fuel-Air Control Unit.

- a. Place the fuel-air control unit in position on the engine.
- b. Temporarily install upper support bolts to obtain the correct position for the fuel-air control unit.
- c. Install two lower support braces and install lock-washers and nuts.
- d. Install hose connectors and clamps which secure the unit to the intake manifold.

- e. Install the air intake box in accordance with installation procedures.

#### NOTE

When replacing fuel lines, use only a fuel soluble lubricant (such as engine oil) on the fitting threads. DO NOT USE ANY OTHER FORM OF THREAD COMPOUND.

- f. Attach the unmetered fuel hose, the metered fuel hose, and the vapor return hose to the metering body.
- g. Slide cooling shroud cover into place and attach with sheet metal screws.
- h. Connect hose from fuel pressure switch.
- i. Slide ram air tube onto metering body cooling shroud and secure with clamp.
- j. Connect throttle and mixture controls.
- k. Inspect completed installation.
- l. Rig the engine controls in accordance with rigging procedure.
- m. Install engine cowl.

#### Fuel-Air Control Unit Adjustments.

The idle speed adjustment is a conventional spring-loaded screw located in the air throttle lever. The idle mixture adjustment is accomplished by the lock-nut at the metering valve end of the linkage. Tightening the nut to shorten the linkage provides a richer mixture. A leaner mixture is obtained by backing off the nut to lengthen the linkage. With engine running at 1000 RPM and auxiliary pumps set to the LOW position, adjust idle mixture as rich as possible without obtaining an increase in engine RPM when mixture control is slowly moved toward IDLE CUT-OFF. Check idle mixture with auxiliary pumps off to assure that idle mixture has not changed.

#### FUEL MANIFOLD.

From the fuel control unit, fuel is delivered to the fuel manifold which provides a central point for dividing fuel to the individual cylinders. In the fuel manifold, a diaphragm and plunger valve raises or lowers, by fuel pressure, to open or close the individual cylinder fuel supply port simultaneously. A fine mesh screen is included in the fuel manifold as additional protection of the injection nozzles against dirt or foreign matter. The fuel manifold is calibrated to operate at 4 PSI.

#### Removal of Fuel Manifold. (See figure 9-2.)

#### NOTE

Plug or cap all disconnected lines, hoses and fittings.

- a. Disconnect fuel hose (8) at the fuel manifold (9).
- b. Disconnect the six fuel injection lines at the fuel manifold.
- c. Disconnect fuel pressure line (6).
- d. Remove the fuel manifold (9) by removing the

crankcase bolts which secure it.

#### Cleaning and Inspection of Fuel Manifold.

- a. Hold the top cover down against internal spring until all four attaching screws have been removed, then gently lift off the cover. Use care not to damage the spring-loaded diaphragm below it.
- b. Remove the upper spring and lift the diaphragm assembly straight up.

#### NOTE

If the valve attached to the diaphragm is stuck in the bore of the body, grasp the center nut and rotate and lift at the same time to work gently out of the body.

#### WARNING

Do not attempt to remove needle or spring from inside valve. Removal of these items from the valve will disturb the 4 PSI factory calibration.

- c. Remove the flushing plug located opposite the inlet fitting.

#### CAUTION

The filter screen is a tight fit and may be damaged if removal is attempted. It should be removed only if a new screen is to be installed.

- d. Using clean gasoline, flush out the chamber below the screen.
- e. Flush above the screen and inside the center bore making sure that outlet passages are open. Use only a gentle stream of compressed air to remove dust and dirt and to dry.
- f. Replace flushing plug.
- g. Clean the diaphragm valve, top cover and springs in the same manner.
- h. Carefully replace diaphragm and valve in manifold body. Check that valve works freely.
- i. Place upper spring in position.
- j. Align mounting holes in body, diaphragm and top cover locating the small vent hole in the cover to the side. Hold the cover down against the spring while installing and tightening all four attaching screws. Safety the screws.

Installation of Fuel Manifold. (See figure 9-2.)

#### NOTE

When replacing fuel lines, use only a fuel soluble lubricant (such as engine oil) on the thread fittings. **DO NOT USE ANY OTHER FORM OF THREAD COMPOUND.**

- a. Install the fuel manifold (9).
- b. Connect fuel pressure line (6).
- c. Connect fuel line (8) at the fuel manifold (9).

- d. Connect the six fuel injection lines at the fuel manifold.
- e. Inspect the completed installation.

#### FUEL DISCHARGE NOZZLES.

From the fuel manifold, individual fuel lines carry the metered fuel to the fuel discharge nozzles, one for each cylinder. These nozzles are installed in the cylinder heads outside each intake valve. An air bleed arrangement is incorporated in each nozzle. The air bleed arrangement aids in vaporization of fuel and, by breaking the high vacuum at idle, maintains the fuel lines solidly filled and ready for instant acceleration of the engine. Nozzles are stamped with a letter on the hex of the nozzles body. Each engine has matched (same letter) nozzles. Replacement nozzles must match but a matched set of another letter may be used.

Removal of Fuel Discharge Nozzles. (See figure 9-2.)

- a. Disconnect the fuel injection lines at the fuel discharge nozzles.

#### NOTE

Plug or cap all disconnected lines and fittings.

- b. Remove fuel discharge nozzles from cylinders.

Cleaning and Inspection of Fuel Discharge Nozzles.

To clean nozzles, immerse in fresh cleaning solvent. Use compressed air to dry. Do not remove shield to clean air screens in nozzle. Do not use a wire or other object to clean orifices.

Installation of Fuel Discharge Nozzles. (See figure 9-2.)

#### NOTE

When replacing fuel lines, use only a fuel soluble lubricant (such as engine oil) on the fitting threads. **DO NOT USE ANY OTHER FORM OF THREAD COMPOUND.**

- a. Install the fuel discharge nozzles in the cylinders.
- b. Connect fuel injection lines at the fuel discharge nozzles.
- c. Check installation for crimped lines and loose fittings.

#### FUEL INJECTION PUMP.

The fuel pump is a positive-displacement, rotating vane type. It has a splined shaft for connection to the accessory drive section of the engine. Fuel enters the pump at the swirl well of the vapor separator. Here, vapor is separated by a swirling motion

so that only liquid fuel is fed to the pump. The vapor is drawn from the top center of the swirl well by a small pressure jet of fuel and is fed into the vapor return line and returned to the fuel tank. Since the pump is engine-driven, changes in engine speed affect total pump flow proportionally. The pump supplies more fuel than is required by the engine, therefore, a relief valve is provided to maintain a constant fuel pump pressure. A check valve is provided so that auxiliary pump pressure can bypass the engine-driven pump for starting. In case of engine-driven fuel pump failure, the auxiliary fuel pump will operate automatically when the auxiliary fuel pump switch is ON.

#### Removal of Fuel Injection Pump. (See figure 9-2.)

- a. Place fuel selector valve handles OFF.
- b. Remove the engine cowling.
- c. Remove the alternator (53) drive belt.
- d. Tag and disconnect all lines and fittings attached to the fuel pump (50).

#### NOTE

Plug or cap all disconnected lines, hoses and fittings.

- e. Remove the shroud surrounding the fuel pump (50).
- f. Remove the four nuts and washers attaching the pump to the engine.
- g. Remove fuel pump and gasket.

#### WARNING

Residual fuel draining from lines and hoses is a fire hazard. Use care to prevent the accumulation of such fuel when lines or hoses are disconnected.

- h. If a replacement pump is not being installed immediately, a temporary cover should be installed on the fuel pump mount pad.

#### Installation of Fuel Injection Pump. (See figure 9-2.)

- a. Position a new gasket and fuel pump (50) on the four mounting studs with the fuel pump inlet to the left.
- b. Secure pump to engine with four plain washers, four internal tooth lockwashers, and nuts.

#### NOTE

When replacing fuel lines, use only a fuel soluble lubricant (such as engine oil) on the fitting threads. **DO NOT USE ANY OTHER FORM OF THREAD COMPOUND.**

- c. Install the cooling shroud on the fuel pump.
- d. Install all fittings and connect all lines as tagged at removal.
- e. Replace the alternator (53) drive belt and tighten the bolt on the adjusting arm so that the belt is tight,

then safety bolt.

- f. Replace the engine cowling.
- g. Check unmetered fuel pressures in accordance with Unmetered Fuel Test Hook-up, Check and Adjustment paragraph.

#### Fuel Mixture Check.

- a. Perform a fuel mixture check as follows:
  1. Warm-up engine, move throttle back to idle position (600 RPM).
  2. Place mixture control to full rich and propeller control full forward.
  3. Position auxiliary fuel pump to LOW, advance throttle to 1000 RPM and slowly reduce mixture control, if both the fuel mixture control unit and fuel injection pumps are set properly, NO RPM rise will occur when the mixture control is gradually moved towards IDLE CUT-OFF.
  4. Using the above procedure set throttle to 1300 RPM and reduce mixture control slowly. If mixture control and fuel injection pumps are properly set, RPM should increase 10 RPM when mixture control is gradually moved towards IDLE CUT-OFF.

#### NOTE

If RPM increases when mixture is reduced, fuel mixture is too rich; conversely, if RPM diminishes rapidly when mixture is reduced, fuel mixture is too lean.

- b. If fuel mixture check indicates a too rich or too lean idle condition, refer to Fuel-Air Control Unit Adjustments paragraph and adjust as necessary.

#### Unmetered Fuel Test Hook-up, Check and Adjustment. (See figure 9-7.)

The following procedures for checking and adjusting the unmetered fuel pressure are factory recommended and must be followed to insure the engines are properly adjusted.

#### CAUTION

Excessive leaning is difficult to detect unless these procedures are followed.

- a. Connect test gage to fuel pump as follows:
  1. Place fuel selector valves in the OFF position.
  2. Attach hose (8) to aft side of gage (5).
  3. Install tee (7) in line (8).
  4. Attach test hose (6) to tee (7).
  5. Disconnect unmetered fuel pressure hose (4) from the fuel pump fitting located at the rear underside of pump.
  6. Connect the unmetered fuel pressure hose (4) to tee (7).
  7. Connect test hose (6) to the fuel pump fitting located at the rear underside of pump.
- b. Adjust unmetered fuel pressure as follows:
  1. Allow engine to warm-up, then set idle RPM to 600 and check unmetered fuel pressure. Pressure should indicate 7.0 PSI on test hook-up pressure gage.

## NOTE

The test gage should be placed as near the same level as the fuel pump as possible or erroneous readings will result.

If pressure does not indicate 7.0 PSI, the high end setting must be turned in 1-1/2 to 3 turns and the low setting must be adjusted to 7.0 PSI. After correct unmetered fuel pressure is obtained, position auxiliary fuel pump to LOW, observe that fuel pressure does not exceed 7.2 PSI. If fuel pressure exceeds 7.2 PSI, the auxiliary fuel pump may require adjusting. See Section 11 for Adjusting Procedures.

2. Allow oil temperature to reach an indication in the upper 1/3 of the green arc of the oil temperature indicator, run engine at full throttle (2600 to 2625) and check fuel flow gage on instrument panel for a reading of (20.1 to 22.7 GPH, 310L0001 to 310N0001; 21.6 to 22.8 GPH, 310N0001 and ON) or a metered fuel pressure reading of (15.0 to 18.1 PSI, 310L0001 to 310N0001; 18.6 to 20.0 PSI, 310N0001 and ON). If these readings are not in prescribed tolerance, turn high setting adjusting screw located on the lower left

side of fuel pump (turn IN to increase pressure or turn OUT to decrease fuel pressure) until proper fuel pressure is obtained.

3. The engines, when well warmed, should respond to a rapid throttle acceleration without hesitation with boost pump off and on and mixture full rich.

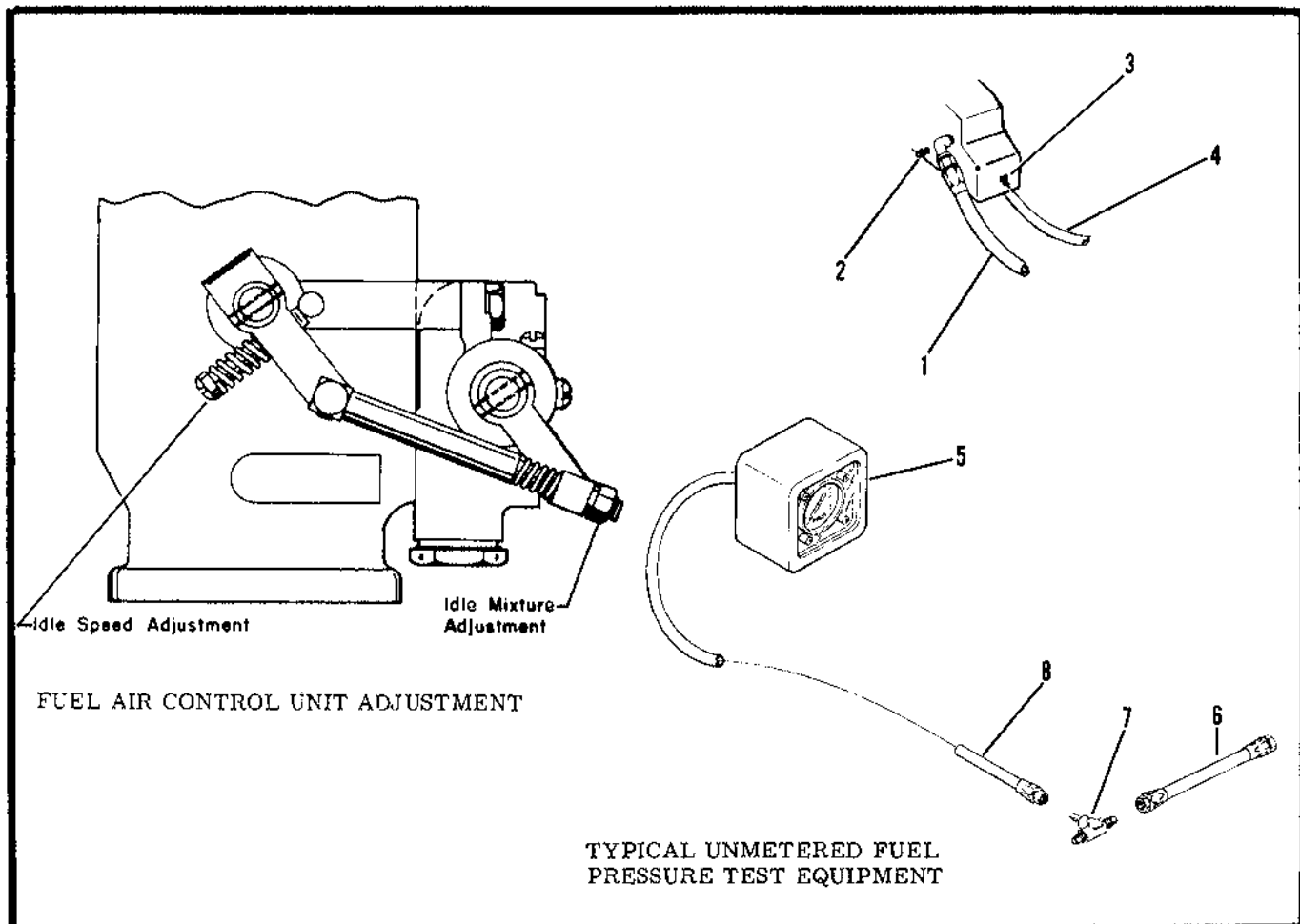
4. After adjusting unmetered fuel pressure, check idle RPM and idle mixture in accordance with Fuel Mixture Check.

5. After completion of unmetered fuel adjustments, with test equipment removed and fuel lines connected in normal position, it may be necessary to purge air from the fuel pressure lines to prevent indicator needle fluctuations or erroneous readings.

6. Purge air from fuel pressure hoses in the following manner:

## WARNING

Considerable fuel will run from the intake drain under each nacelle during purging procedures. An appropriate receptacle should be provided to prevent a pool of raw fuel from accumulating under each nacelle.



1. Fuel Inlet Hose
2. Adjusting Screw (High Setting)
3. Adjusting Screw (Low Setting)

4. Unmetered Fuel Pressure Hose
5. Gage

6. Test Hose
7. Tee
8. Gage Hose

Figure 9-7. Fuel-Air Control Unit and Unmetered Fuel Pressure Test Hook-up

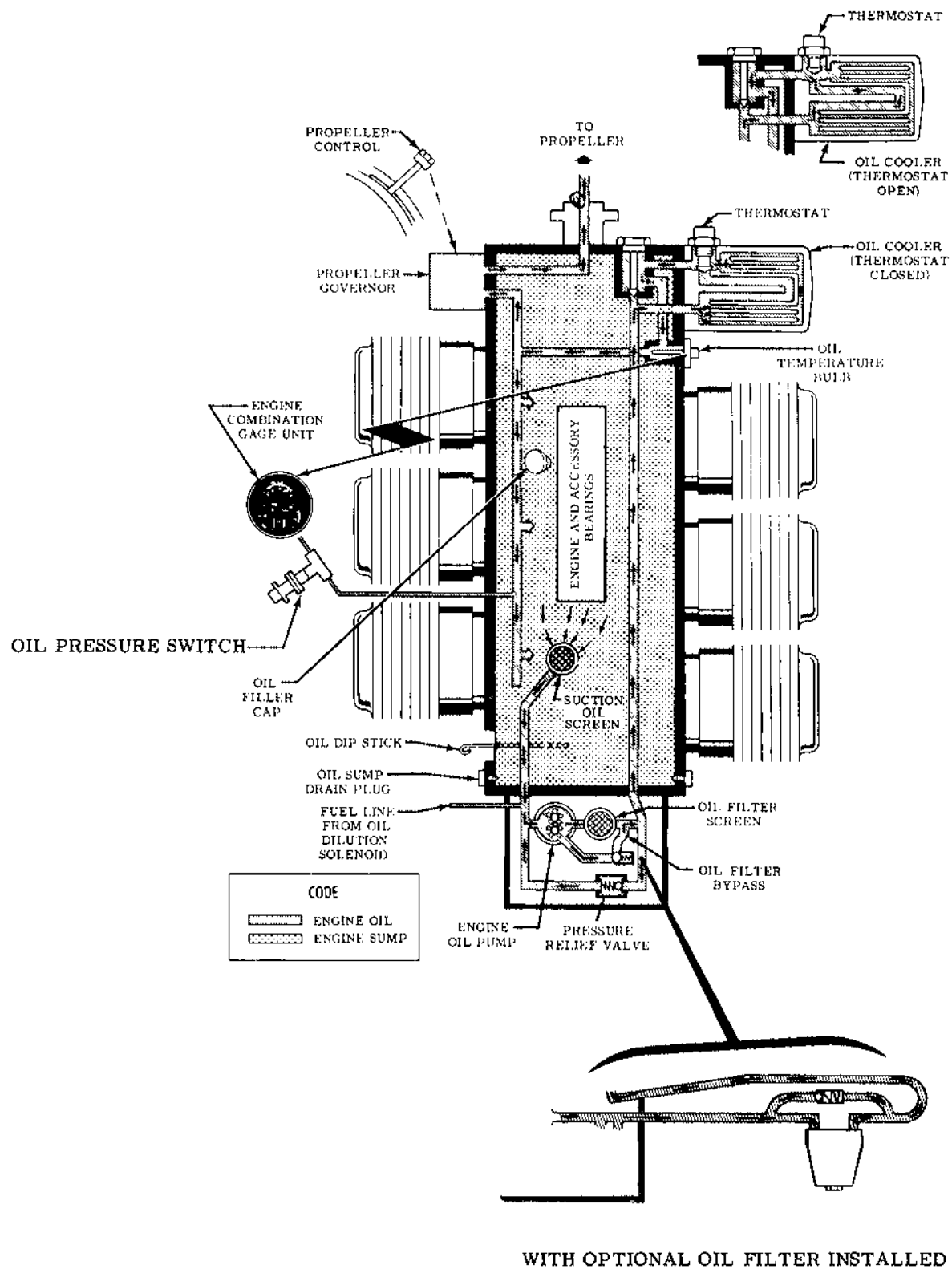


Figure 9-8. Engine Oil Systems Schematic (With Non-Congeaing Oil Cooler)

- a. Place throttle to full open position and mixture to full rich.
- b. Disconnect fuel pressure hoses at fuel flow gage, operate auxiliary fuel pump (primer switch) until at least one (1) pint of fuel has discharged from each pressure hose.
- c. Reconnect hoses to flow gage, tightening "finger tight" then backing off one-half (1/2) turn.
- d. Operate auxiliary pump (primer switch) until solid fuel is discharged from gage connection. Tighten connection, with pump still operating, then turn pump off.

#### ENGINE OIL SYSTEM. (See figure 9-8.)

The Continental engines installed in the aircraft have wet sump, pressure lubrication systems. Oil temperature in each engine is controlled by a thermally operated valve which either bypasses the oil around

the externally mounted cooler or routes it through the cooler passages for cooling. Drilled and cored internal passages route the oil to all moving engine parts which require lubrication. Oil furnished to the propeller governor for propeller operation is also routed through internal passages. This completely internal oil system eliminates all difficulties associated with external oil lines. Engine oil is filtered through an internally mounted screen filter or optional externally mounted oil filter. A bypass valve will route the oil around this filter if it should become clogged. Oil pressure is maintained by a spring-loaded pressure relief valve which is adjustable.

Oil temperature is sensed through a heat variable resistor type temperature bulb which is located in the main oil passage of the crankcase directly below the oil cooler. Changes in oil temperatures are transmitted from the oil temperature bulb to the oil temperature gage through a single electrical wire.

#### Trouble Shooting Engine Oil System.

| TROUBLE                         | PROBABLE CAUSE                                            | CORRECTION                                                                                                                                                        |
|---------------------------------|-----------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| HIGH OIL TEMPERATURE INDICATION | Low oil supply.                                           | Replenish.                                                                                                                                                        |
|                                 | Cooler air passages clogged.                              | Clean thoroughly.                                                                                                                                                 |
|                                 | Cooler core plugged.                                      | Remove cooler and flush thoroughly.                                                                                                                               |
|                                 | Thermostat damaged or held open by solid matter.          | Remove, clean valve and seat. If still inoperative, replace.                                                                                                      |
|                                 | Oil viscosity too high.                                   | Drain and refill with correct seasonal weight. (See Section 2.)                                                                                                   |
|                                 | Prolonged ground operation.                               | Limit ground operation to a minimum.                                                                                                                              |
|                                 | Malfunctioning gage or bulb unit.                         | Check wiring. Check bulb unit. Check gage. Replace defective parts.                                                                                               |
| LOW OIL PRESSURE INDICATION     | Low oil supply.                                           | Replenish.                                                                                                                                                        |
|                                 | Oil viscosity too low.                                    | Drain and refill with correct seasonal weight. (See Section 2.)                                                                                                   |
|                                 | Foam in oil due to presence of alkaline solids in system. | Drain and refill with fresh oil. (it may be necessary to flush cooler core if presence of alkaline solids is due to a previous cleaning with alkaline materials.) |
|                                 | Defective pressure pump.                                  | Replace pump.                                                                                                                                                     |
|                                 | Malfunctioning pressure gage.                             | Check gage. Clean plumbing. Replace if required.                                                                                                                  |
|                                 | Weak or broken oil pressure relief valve spring.          | Replace spring. Adjust pressure to 30-60 psi by adjusting screw.                                                                                                  |
|                                 | Clogged oil filter.                                       | Replace oil filter.                                                                                                                                               |

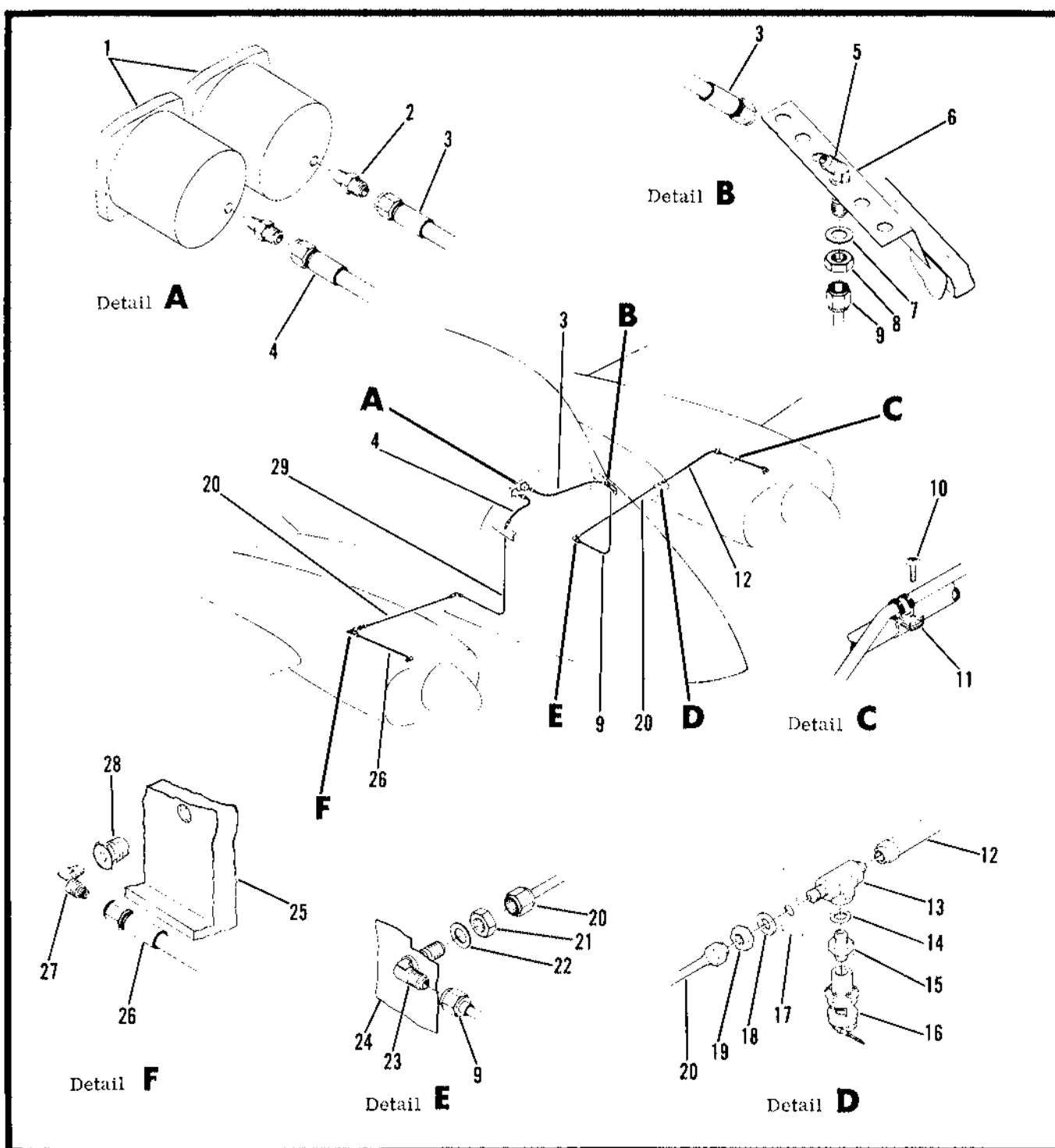


Figure 9-9. Oil Pressure System

### Oil Pressure System.

The oil pressure system consists of plumbing that attaches to the lower left portion of each engine crankcase between No. 2 and No. 4 cylinders. The plumbing is routed through the wings, into the cabin, and to the forward side of the instrument panel. Here it connects to a separate engine gage unit for each engine. A restrictor is incorporated in the elbow of the engine fittings to protect the gages from pressure surges and to limit the loss of engine oil in case of a plumbing failure.

### Removal and Installation of Oil Pressure Lines and Hoses. (See figure 9-9.)

#### NOTE

Cap all openings and lines on removal.

- a. Disconnect oil pressure hoses (12 and 26) at inboard nacelle ribs (17) and allow all fluid to drain from oil pressure lines.

#### NOTE

It may be necessary to loosen both hoses (3 and 4) at back of engine gage units (1) to facilitate complete draining of oil pressure lines.

- b. To remove hoses (3 and 4) from between engine gage units (1) and support brackets (6), disconnect hoses at each end and remove from behind instrument panel.
- c. To remove lines (9 and 29) from between support brackets (6) and fuselage skin (24), remove upholstery side panels below instrument panel and back to main wing spar in accordance with upholstery removal procedures. Disconnect lines at both ends and push lower sections forward through routing holes in bulkhead until ends of lines are free of routing holes, then remove them from under instrument panel.
- d. To remove lines (20) from between fuselage skin (24) and inboard nacelle ribs (17) remove forward wing fillets and three access hole covers located on underside of each wing leading edge between fuselage and engine nacelle. Disconnect lines at each end and remove them through access hole nearest to each engine nacelle.

#### NOTE

It may be necessary to bend the lines slightly to facilitate removal, however, excessive bending should be avoided.

- e. To remove hoses (12 and 26) from between inboard nacelle ribs (17) and each engine crankcase (25), remove left exhaust stack assemblies from the engines. Disconnect hoses at each end.

#### NOTE

The left exhaust stack assemblies are removed to provide access to the crankcase oil pressure connections.

- f. Install oil pressure lines and hoses by reversing removal procedures.

#### CAUTION

Make certain that the oil pressure hoses are connected to the proper fittings at the engine gage units.

### Servicing Oil Pressure Lines.

With all connections tightened, start the engines and allow time for the engine pumps to fill the oil pressure lines. After a positive indication of oil pressure has been noted, loosen the hose fittings on the rear of the engine gage units, and allow a few drops of oil to leak from the fittings. This will bleed the trapped air from the lines and provide an accurate oil pressure indication.

### Cold Weather Servicing of Oil Pressure Lines. (See figure 9-9.)

Disconnect engine hoses (12 and 26) at inboard nacelle ribs (17) and loosen connections at rear of engine gage units (1). Allow time for the oil lines to completely drain.

#### NOTE

To facilitate draining in cold weather, the airplane should either be stored in a heated hangar or the engines operated before the lines are disconnected.

Attach a small hand pump filled with kerosene or instrument oil to a nacelle fitting (13) and force the fluid through the oil pressure line until a few drops leak around the engine gage fitting. Tighten the hose at the gage fitting, remove pump and attach engine hose to inboard nacelle rib fitting. Repeat procedure for other engine.

### Oil Filter Adapter.

#### Removal of Oil Filter Adapter.

- a. Remove safety wire from case.
- b. Loosen bolt and disassemble case, element, cover, and gaskets from adapter.
- c. Unscrew and loosen adapter nut on adapter; remove adapter and packing from engine assembly.

#### Installation of Oil Filter Adapter.

- a. Assemble packing and adapter nut on adapter. Install adapter on engine assembly and torque adapter nut to 55±5 foot-pounds.



## NOTE

After adapter nut has been properly torqued, check adapter for looseness (easily moved by hand). If loose, further checking of the adapter and case threads for deformation is recommended.

## WARNING

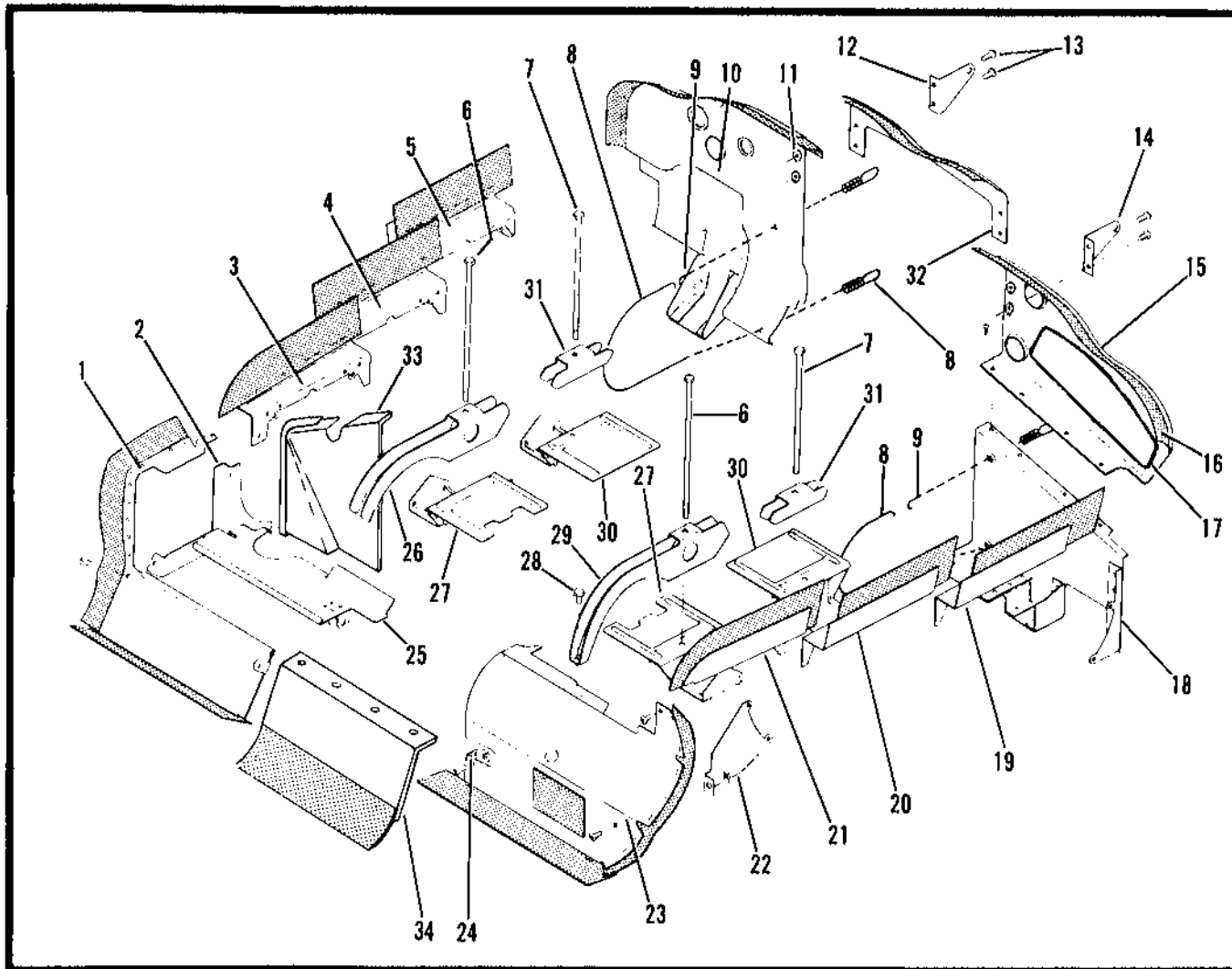
Undertorque of the adapter nut can lead to improper sealing of packing, resulting in

an oil leak. Destruction of the engine case threads due to adapter movement can result from undertorque.

- b. Safety adapter nut to engine assembly.
- c. Install oil filter assembly in accordance with installation procedures.

## Oil Temperature Adjustment.

The oil temperature indications on the engine combi-



- |                                 |                                |                                                |
|---------------------------------|--------------------------------|------------------------------------------------|
| 1. Forward Oil Cooler Baffle    | 13. Screws                     | 25. Aft Oil Cooler Baffle                      |
| 2. Support Bracket              | 14. Support Bracket            | 26. Forward Right Intercylinder Baffle Support |
| 3. Forward Right Baffle         | 15. Upper Rear Baffle          | 27. Forward Intercylinder Baffle Assembly      |
| 4. Center Right Baffle          | 16. Seal                       | 28. Bolt                                       |
| 5. Aft Right Baffle             | 17. Stiffener                  | 29. Forward Left Intercylinder Baffle Support  |
| 6. Bolt                         | 18. Lower Rear Baffle          | 30. Aft Intercylinder Baffle Assembly          |
| 7. Bolt                         | 19. Left Aft Baffle            | 31. Aft Intercylinder Baffle Support           |
| 8. Rear Baffle Fastener (lower) | 20. Center Left Baffle         | 32. Rear Center Baffle                         |
| 9. Rear Baffle Fastener (upper) | 21. Forward Left Baffle        | 33. No. 5 Cylinder Head Baffle                 |
| 10. Right Rear Engine Baffle    | 22. Support Bracket            | 34. Forward Center Baffle                      |
| 11. Nut                         | 23. Forward Left Engine Baffle |                                                |
| 12. Support Brackets            | 24. Support Tab                |                                                |

Figure 9-10. Engine Baffles

nation gages can vary between the right and left hand engines. The temperature indications can be adjusted by adding vernatherm gaskets between the vernatherm control assembly and the oil cooler case on which ever engine is indicating the coolest oil temperature. The above procedure will cause a delay in heated oil to be routed through the cooler passages, thus allowing the oil temperature to be raised.

### ENGINE BAFFLES.

The sheet metal baffles installed on each engine direct the flow of air around the cylinders and other engine components. These baffles incorporate rubber-asbestos composition seals at points of contact with the engine nacelle to help confine and direct the airflow to the desired area. It is very important to engine cooling that the baffles are installed correctly.

#### Removal of Engine Baffles. (See figure 9-10.)

- a. Remove engine cowling in accordance with removal procedures.
- b. To remove right and left baffles (3, 4, 5, 19, 20, and 21), remove the upper rocker box cover screws and nuts with which they are attached.
- c. To remove the oil cooler baffles (1 and 25), remove the four attaching screws and nuts and the two oil cooler mounting bolts which hold them in place.
- d. To remove the left front baffle (23), remove the three attaching screws and bolts.
- e. To remove the right and left forward intercyylinder baffles (27) and the right and left intercyylinder baffle supports (26 and 29), remove bolts (6 and 28).
- f. To remove the right and left rear intercyylinder baffles (20) and the rear intercyylinder baffle supports (31), remove bolts (7).

#### NOTE

The cylinder fuel lines and spark plug leads are attached to support brackets which are secured to the engine by bolts (6 and 7). It is not necessary to remove these lines, leads, or brackets to remove the baffles.

- g. Remove upper rear baffle (15) by removing screws (13) and five screws attaching baffle (15) to baffle (18).
- h. To remove the lower left rear baffle (18):
  1. Remove the alternator in accordance with removal procedures.
  2. Disconnect the left rear baffle fasteners (8 and 9) and work the lower fastener free of the cylinder.
  3. Remove fuel supply line.
  4. Loosen clamps and remove ram air fuel control and fuel strainer hoses.
  5. Remove the two rocker box cover screws and remove the lower left rear baffle (18).
  - i. To remove the rear center baffle (32) remove the screws from support brackets (12 and 14).
  - j. To remove the right rear baffle (10):
    1. Disconnect the magneto ground wires and withdraw them aft, through the baffle.

2. Loosen the clamps on crankcase breather line hose connectors and remove the crankcase breather line.
3. Disconnect ram air fuel strainer hose.
4. Loosen air-oil separator.
5. Remove engine breather air-oil separator.
6. Disconnect the starter cable and remove the starter by removing the two mounting nuts and washers and pulling the starter straight out.
7. Disconnect the right rear baffle fasteners (8 and 9) and work the lower fastener free of the cylinder.
8. Remove the right rear baffle.
- k. Support brackets (2 and 22) may be removed by removing the rocker box cover screws which attach them. After removing support bracket (2) also remove No. 5 cylinder head baffle (33).
1. To remove the rear baffle support brackets (12 and 14) and aft support, crankcase thru-bolt must be removed.

#### NOTE

In removing the upper crankcase thru-bolt, use care to prevent damaging the O-ring seals installed on the bolt.

1. To remove the forward center baffle (34) remove the four pan bolts.

#### Cleaning and Inspection of Engine Baffles.

The engine baffles should be cleaned with a suitable solvent to remove oil and dirt.

#### NOTE

The rubber asbestos seals are oil and grease resistant but should not be soaked in solvents for long periods.

Inspect for cracks in the metal and for loose and/or torn seals. Replace defective parts.

#### Installation of Engine Baffles. (See figure 9-10.)

- a. Install engine baffles by reversing removal procedures.

#### Air Induction System.

Ram air enters the air box at the left rear engine baffle, continues through the air box, where it passes through an air filter before entering the throttle assembly. A manually controlled alternate air door with a magnetic latch is provided to admit alternate air (heated engine compartment air), should the air induction filter become clogged, or if a requirement for heated air arises.

#### Induction Air Filter.

The air maze filter, located in the air inlet box, re-

moves dust particles from the ram air by collecting them on oil coated filtering units. Air filter maintenance and service, particularly in areas where dust is prevalent, is very important to the service life of the engine.

#### Air Intake Box.

The air intake box is mounted between the left rear baffle and the throttle assembly. The air box is of metal and fiberglass construction, and contains an alternate air door and provides for the mounting of an air maze filter.

#### Removal of Air Intake Box (310L0001 to 310N0001). (See figure 9-11.)

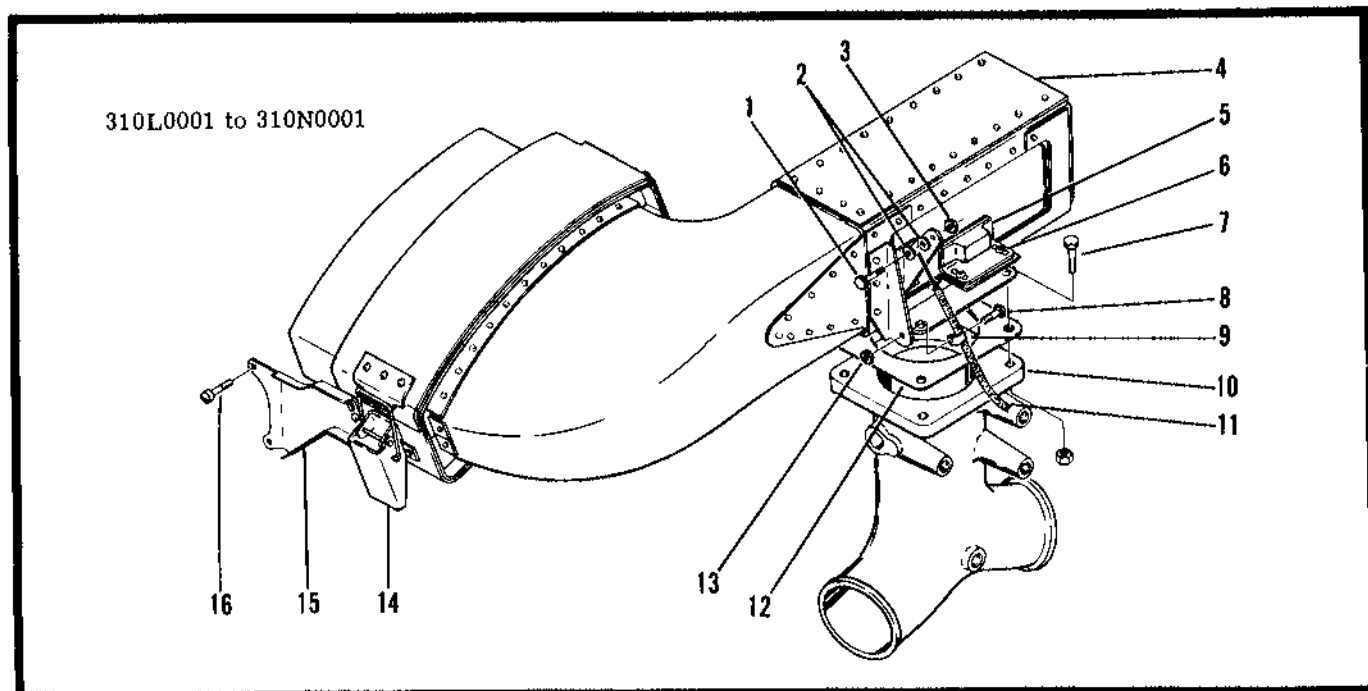
- a. Remove engine cowling in accordance with removal procedures.
- b. Disconnect control cable (11) from air intake box (4) by loosening nut (3) on bolt (1) and routing end of cable assembly (11) from bolt. Disconnect cable assembly (11) from bracket by removing nut (13), clamp (9) and screw (8).
- c. Remove safety wire and four bolts (7) securing air intake box (4) to throttle body (10).
- d. Remove two screws (16) securing support (15) to engine rocker cover.
- e. Route air intake box (4) aft to clear engine baffle and remove air intake box from engine nacelle.

#### Removal and Installation of Induction Air Filter. (See figure 9-11.)

- a. Release fastener (14), raise cover, and remove filter by pulling straight up.
- b. Install induction air filter by reversing the above procedure.

#### Removal of Induction Air Canister Assembly (310N0001 and ON). (See figure 9-11A.)

- a. Remove engine cowling in accordance with removal procedures.
- b. Disconnect control cable (6) from canister assembly (4) by loosening nut on bolt (7) and routing end of cable from bolt. Disconnect cable assembly from bracket by removing nut and screw.
- c. Disconnect induction air ducts (1) and alternate air duct (2) by removing clamps securing hoses to canister.
- d. Remove valve end of canister to remove filter (8), remove three bolts (10) securing canister to support (3).
- e. Remove clamp (9) securing canister to support and remove canister assembly from aircraft.
- f. Install induction air canister assembly by reversing the removal procedures.
- g. Add or remove washers (12) to spacer (11) as necessary to align cable assembly with control arm.
- h. Clamp cable assembly (6) so that the cable housing is  $3.50 \pm .125$  inches from the control arm when in the closed position. Clamp cable assembly to bolt (7) so that the control handle is .06 to .09 inch from panel.
- i. Check control cable (6) for proper operation.



1. Bolt (Clamping)
2. Washer
3. Nut
4. Air Intake Box
5. Magnet
6. Screw

7. Bolt
8. Screw
9. Clamp
10. Throttle Body
11. Cable Assembly

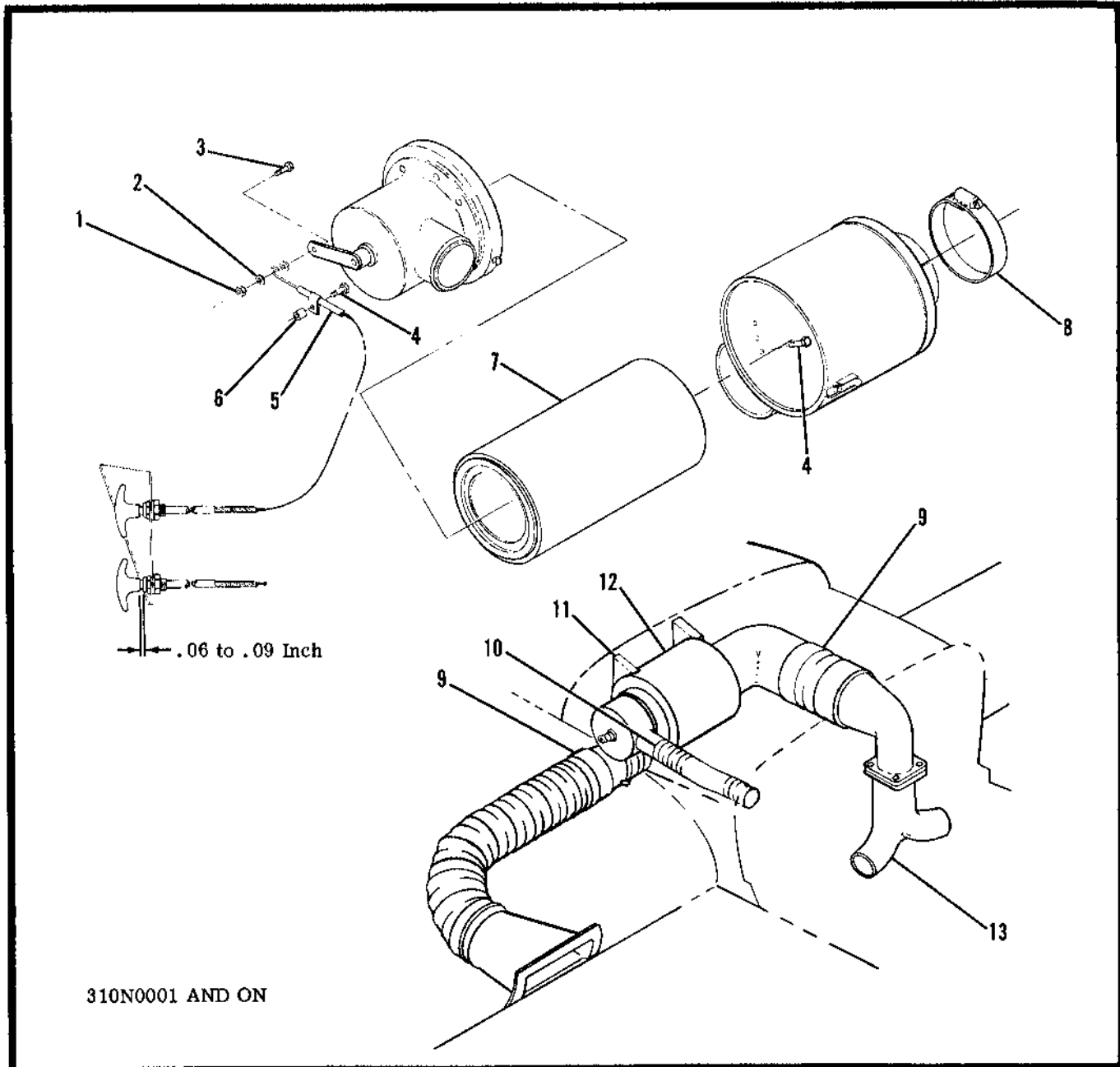
12. Gasket
13. Nut
14. Fastener
15. Support
16. Screw

Figure 9-11. Air Intake Box

## Installation of Air Intake Box. (See figure 9-11.)

- a. Route air intake box (4) into position on baffle. Attach support (15) to rocker arm cover with two screws (16).
- b. Secure air intake box (4) to throttle body (10) with bolts (7) and safety with wire.
- c. Attach cable assembly (11) to bracket on air intake box (4) with screw (8), clamp (9) and nut (13).

- d. Route end of control cable (11) between washers (2) and thru bolt (1). Secure cable end by tightening nut.
- e. Adjust magnetic latch by loosening screws on mounting bracket and position magnet so that the door is held tightly against the air box.
- f. Clamp control housing to air box bracket so that the control cable travel is limited to  $2.3 \pm .10$  inches.
- g. Rig controls to have .06 to .09 cushion at the handle when the alternate air box door is closed.



1. Nut
2. Washer
3. Bolt (Clamping)
4. Bolt

5. Cable Assembly
6. Spacer
7. Filter
8. Clamp
9. Inducting Air Duct

10. Alternate Air Duct
11. Support
12. Canister Assembly
13. Throttle Body

Figure 9-11A. Induction Air Canister

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## ENGINE IGNITION SYSTEM.

Engine ignition for the aircraft is provided by two Bendix Scintilla magnetos mounted on each engine. The left magnetos on each engine fires the upper

spark plugs on the left bank of the cylinders and the lower spark plugs on the right bank. The right magneto fires the remaining spark plugs on that engine. There are magneto and starter switches mounted on the instrument panel.

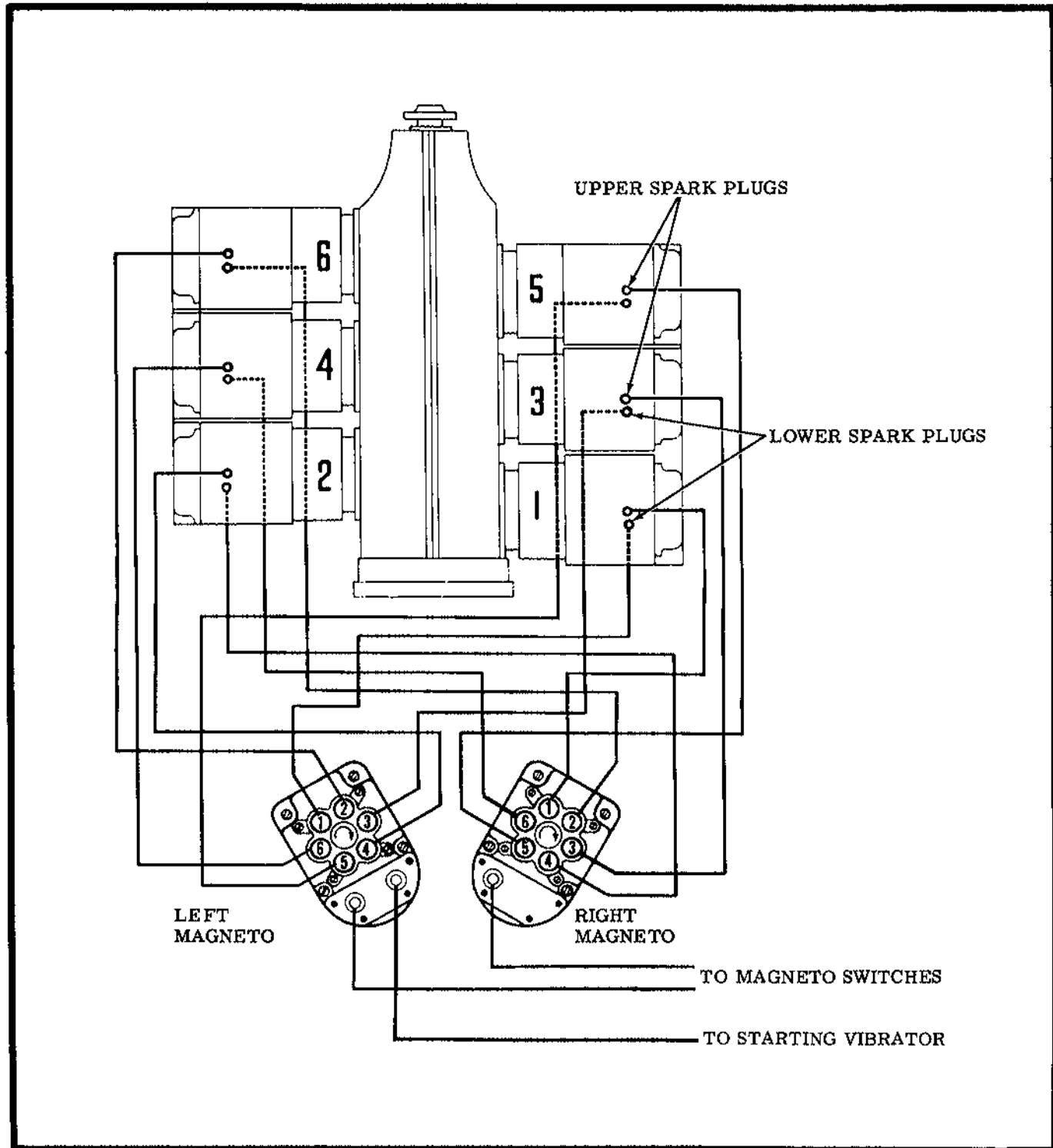


Figure 9-12. Ignition System

## Trouble Shooting the Ignition System.

| TROUBLE                                             | PROBABLE CAUSE                                                                | CORRECTION                                                                         |
|-----------------------------------------------------|-------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| ENGINE FAILS TO START<br>DUE TO IGNITION<br>TROUBLE | Ignition switch OFF or grounded switch wires.                                 | Flip switch ON. Check for grounded wires.                                          |
|                                                     | Spark plugs fouled, improperly gapped, or loose.                              | Remove and clean. Adjust to proper gap. Tighten to specified torque.               |
|                                                     | Magnetos improperly timed to engine.                                          | Refer to Installation of Magnetos and Ignition Timing for timing procedures.       |
|                                                     | Shorted condenser.                                                            | Replace condenser.                                                                 |
|                                                     | Magneto internal timing incorrect or timed for opposite rotation.             | Install correctly timed magneto.                                                   |
| ROUGH IDLING                                        | Spark plugs fouled or improperly gapped.                                      | Clean spark plugs. Adjust spark plug gap.                                          |
|                                                     | Weak condenser.                                                               | Replace condenser.                                                                 |
| ROUGH AT SPEEDS ABOVE<br>IDLE                       | Loose or improperly gapped spark plugs.                                       | Tighten to specified torque. Adjust to proper gap.                                 |
|                                                     | High tension leak in ignition harness.                                        | Check for faulty insulation.                                                       |
|                                                     | Weak or burned out condenser as evidenced by burned or pitted breaker points. | Replace points and condenser.                                                      |
| SLUGGISH OPERATION<br>AND/OR EXCESSIVE<br>RPM DROP  | Fouled or dead spark plugs.                                                   | Clean spark plugs. Replace dead spark plugs.                                       |
|                                                     | Improperly gapped spark plugs.                                                | Adjust to proper gap.                                                              |
|                                                     | Magnetos out of time with engine.                                             | Refer to Installation of Magnetos and Ignition Timing for proper timing procedure. |
|                                                     | Damaged magneto breaker points or condenser.                                  | Replace points and condenser.                                                      |

## MAGNETOS.

The Bendix-Scintilla S6RN-200 series magnetos consist of a retard breaker, main breaker, starting vibrator and uses a single switch. The starting vibrator is used in conjunction with the retard breaker to obtain voltage necessary at cranking speeds which eliminates the need for impulse couplings.

## Removal of Magnetos.

The magneto removal procedure is identical for removing either magneto from either engine.

- Remove the engine cowling in accordance with removal of engine cowl procedure.
- Detach the magneto ground wires from both magnetos and tag for identification when reinstalling.

## CAUTION

Magnetos are not grounded when ground wires have been removed.

- Detach the high tension outlet plate from the magneto to be removed.
- Rotate the propeller by hand in the normal direction of rotation until the No. 1 cylinder is coming up on its compression stroke.

## NOTE

To facilitate installation of a replacement magneto, it is good practice to position the crankshaft at the advance firing angle for No. 1 cylinder during this step. Any standard timing device or method can be used, or if the magneto being removed is correctly

timed to the engine, the crankshaft can be rotated to a position at which the breaker points will be just opening to fire No. 1 cylinder.

- e. Remove the two magneto flange clamp nuts, washers, and clamps. Pull the magneto forward from the crankcase mounting pad.

#### NOTE

As the magneto flange clears the crankcase hole, watch the rubber drive bushings and steel retainer in the gear hub to make sure they will not drop out.

#### Inspection of Magnetos.

- a. Inspect the rubber drive bushings in the drive gear hub for deformation. Replace with new parts if they will not fit the magneto coupling lugs closely.
- b. Remove the magneto breaker cover plate and inspect the points. They should have a gray, frosty appearance. If burning or pitting is apparent, determine the cause and correct it before replacing the points. If the breaker points are oily, they can be cleaned with clear unleaded gasoline. Avoid getting any gasoline on the breaker felt as this will wash away the lubricant.

#### Breaker Assembly Main Spring Check. (See figure 9-13.)

- a. Check the main springs of the breaker assemblies for proper tension. Tension must be between 12 and 24 ounces at the instant the breaker opens.
- b. Check that the cam follower is securely riveted to the follower spring and that the screw which holds the parts of the breaker is tight. Torque breaker assembly screw for 10 to 12 inch-pounds.
- c. Examine the contact points for excessive wear or burning.

#### NOTE

Normal points will show a dull, slightly rough contact surface. Points which have deep pits or excessively burned areas should be discarded. If any part of the breaker is defective, the complete breaker assembly must be replaced.

#### Maintenance.

At the first 50-hour inspection and at each 100-hour inspection thereafter, the breaker compartment should be inspected.

#### NOTE

If ignition trouble should develop, spark plugs and ignition wiring should be checked first. If the trouble appears definitely to be associated with a magneto, the following may be

used to help disclose the source of trouble without overhauling the magneto.

#### a. Moisture Check.

- (1) Remove the high-tensions cable outlet plate cables, and rubber grommets, and inspect these parts for moisture.
- (2) Inspect the distributor block high-tension outlet side for moisture.
- (3) If any moisture is evident, lightly wipe with a soft, dry, clean, lint-free cloth.

#### CAUTION

Do not use gasoline or any other solvent as these will remove the wax coating on some parts and could cause electrical leakage.

#### Internal Timing. (See figure 9-14.)

- a. In each side of the breaker compartment there are five timing marks. The marks on the left-hand side, viewed from the breaker compartment are for clockwise rotation viewed from the drive end. The marks on the right-hand side are for counterclockwise rotation. The timing marks indicate "O" position, "E" gap, and various degrees of magneto retard.

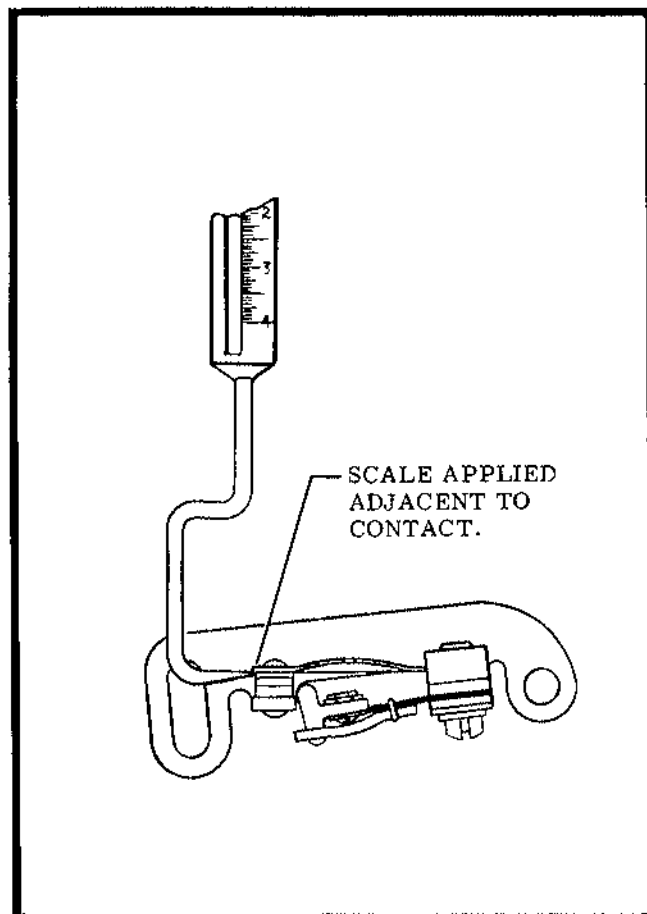


Figure 9-13. Checking Breaker Main Spring Tension



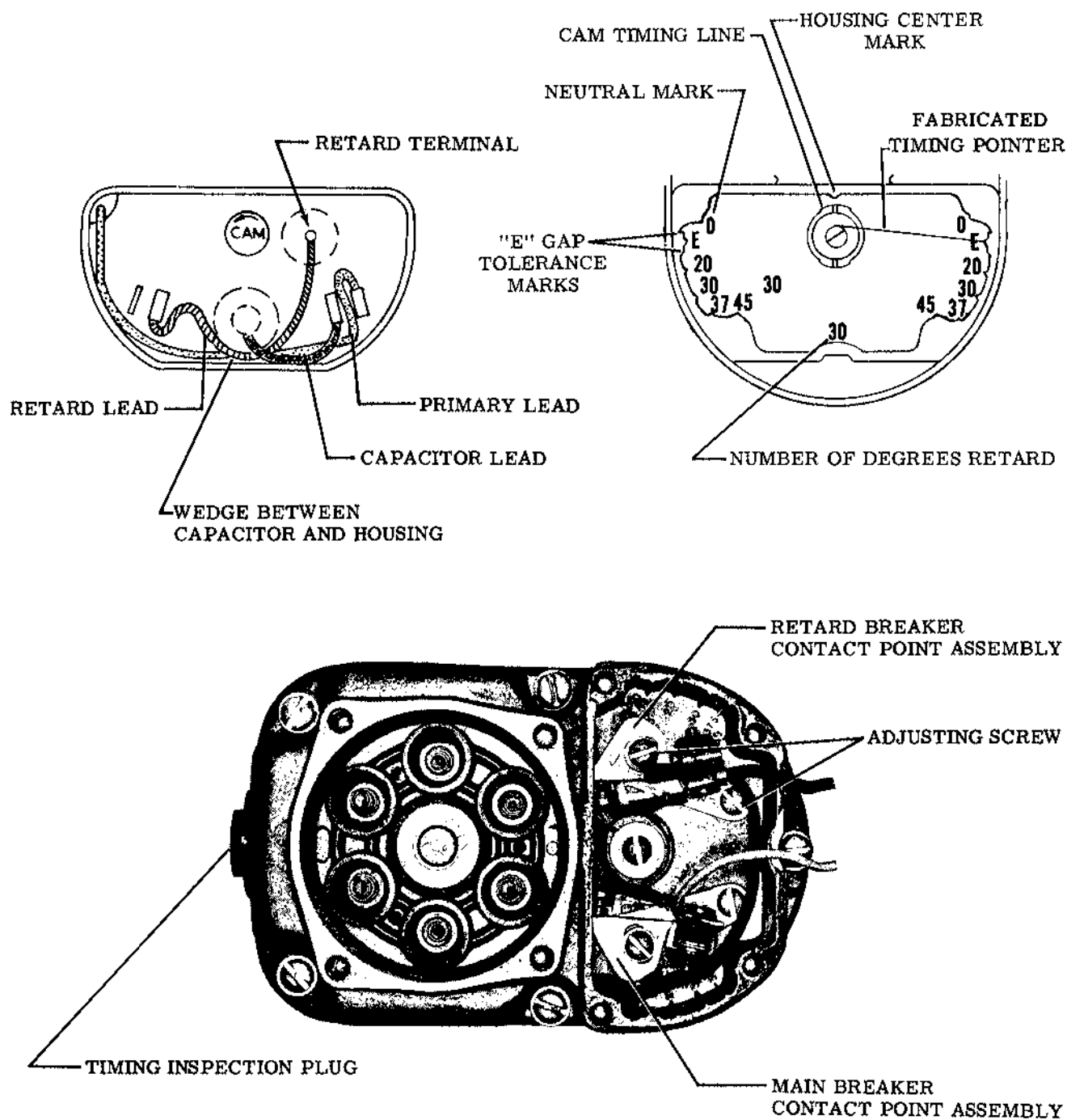


Figure 9-14. Magneto Timing Adjustment

(See figure 9-14.) The point in the center of the "E" gap boss indicates the exact "E" gap position. The width of the boss on either side of the point is the allowable tolerance of  $\pm 4^\circ$ . In addition to these marks, the cam has an indented line across its end for locating neutral position. The number of degrees retard for a particular magneto is stamped at the bottom of the breaker compartment.

#### NOTE

When  $25^\circ$  retard is required, advance pointer until it is over the  $20^\circ$  mark. Then turn rotor until pointer is over the  $45^\circ$  mark. This will give a total of  $25^\circ$  retard.

b. Turn rotor in direction of rotation until painted chamfered tooth of distributor gear is just becoming visible in timing window. Continue turning rotor of magneto until line on end of cam is aligned with neutral mark in housing.

c. Fabricate a timing pointer from a piece of wire (approximately 2-1/2 inches) as follows:

1. Remove the cam screw and flat washer from cam.
2. Bend one end of the wire around the threads of the screw, loose enough to allow wire to be rotated.
3. At the outside diameter of the large washer, bend wire straight up parallel to the screw.
4. Install assembly on cam shaft and tighten screw just enough to hold wire in position and yet allowing it to be rotated.
5. At a height sufficient to clear breaker housing, make a right angle bend in the wire.

#### NOTE

Pointer should be over timing marks, but not touching the housing.

6. With the indented slot on cam aligned with the mark at top of breaker housing and painted chamfered tooth on large distributor gear visible in timing window, set pointer on center of "E" gap mark.

7. Connect the 11-851 timing light, or equivalent, across main breaker.

8. Adjust main breaker contacts to open at this point or over any portion of the "E" gap boss.

9. Turn rotor until cam follower is on the high point of cam lobe, measure contact clearance. It should be  $0.018 \pm 0.006$ . Readjust breaker and recheck to be sure that contacts will open within "E" gap tolerance.

#### NOTE

Replace breaker assembly if "E" gap tolerance and contact clearance cannot be obtained.

d. On retard breaker magnetos, it is necessary to set the retard breaker to open a predetermined number of degrees after the main breaker opens within  $\pm 2^\circ$ ,  $-0^\circ$ . The number of degrees retard for a particular magneto is stamped at the bottom of the breaker compartment. After main breaker has been set to open at "E" gap ( $10^\circ \pm 4^\circ$ ) move pointer back until it is over the zero mark without moving rotor

from its position where main breaker just opened. Turn rotor until pointer is over correct retard mark. Using a timing light, adjust retard breaker contacts to open at this point. A tolerance of 1/16 inch past the point can be used to get proper contact clearance. Continue rotating rotor until cam follower is on the high point of the lobe. Measure contact clearance. It should be  $0.018 \pm 0.006$ . If not, readjust breaker and recheck to be sure that contacts will open within retard degree tolerance. Replace breaker assembly if retard degree tolerance and contact clearance cannot be obtained.

#### NOTE

Extreme care must be taken not to move the rotor from the main breaker opening position when returning the pointer back to the zero mark.

#### Magneto Installation and Timing to Engine.

- a. Remove either the upper or lower spark plug from No. 1 cylinder.
- b. Rotate propeller to align engine timing points and marks located on alternator sheave.

#### NOTE

All starter adapters and alternator sheaves furnished on engines have timing marks stamped on the face. If it is necessary to replace these parts, they will not be furnished with the timing marks. Therefore, it will be necessary to use a top dead center indicator or an inclinometer on the propeller spinner to locate the  $20^\circ$  BTC position for timing magnetos to engines. When it is assured that the No. 1 cylinder is at  $20^\circ$  BTC, it is permissible to index the new starter adapter and sheave.

- c. With inspection hole plug and breaker cover removed, check magneto to see that it is internally timed for right-hand drive rotation.

#### NOTE

The magneto installation procedure is identical for installing either magneto on either engine.

d. Place the magneto on the crankcase accessory mounting pad and temporarily secure in place with clamps, washers and nuts.

e. Attach a timing light to the magneto in accordance with timing light manufacturer's instructions.

f. If timing light indicator light is OFF, rotate magneto housing in direction of its magneto rotation a few degrees beyond point where indicator light comes ON. Slowly rotate magneto in opposite direction until indicator light goes OFF. At this point the magneto should be timed to the engine.

g. Tighten magneto clamp nuts to prevent any further movement of the magneto.

**CAUTION**

Do not attempt to adjust breaker points to compensate for ignition timing. Breaker point adjustment is to be used only for internal magneto timing. The effect of adjusting the magneto points to compensate for ignition timing will ultimately produce a weak ignition spark and reduce engine performance.

h. After clamp nuts are tightened, recheck timing as follows:

1. Rotate propeller in opposite direction of normal rotation for a few degrees after light goes ON.
2. Rotate propeller in direction of normal rotation until light goes OFF. If timing mark is visible through magneto inspection hole and the engine timing points are aligned with marks on alternator sheave, the magneto is correctly timed with engine.
- i. Repeat timing procedure for other magneto if applicable.

**NOTE**

Attach timing light indicator to both magnetos and assure that the magnetos are synchronized (breaker points opening simultaneously). If both indicator lights do not come ON at the same time, loosen the attaching clamps slightly on either magneto and rotate magneto in required direction until indicator lights will come ON at the same time while slowly rotating the propeller shaft to the 20° BTC position.

- j. Remove timing light from the magneto and engine.
- k. Replace magneto timing inspection hole plug and attach high tension outlet plate to magneto.
- l. Attach the magneto ground wire to magneto.
- m. Replace the removed spark plug.
- n. Install the engine cowling.

**Ignition Switches.**

The four magneto ground circuits are controlled by four magneto switches. The switches are located on the left-hand side of the stationary instrument panel.

**IGNITION CABLES.** (See figure 9-12, for Schematic Wiring Diagram.)

The ignition harness for each engine consists of 12 shielded, high tension cable assemblies with attaching brackets. Six cables are routed from the left magneto, three going to the upper spark plugs on the left bank of cylinders, and the other three are routed between No. 1 and No. 3 cylinders to the lower spark plugs on the right bank of cylinders. The remaining six cables are similarly routed from the right magneto, with three cables going to the upper spark plugs on the right bank of cylinders and the remaining three being routed between No. 2 and No. 4 cylinders to the lower left spark plugs.

**Removal of Ignition Cables.**

- a. Remove engine cowling in accordance with removal procedure.
- b. To remove any ignition cable:
  1. Remove the cables from the spark plug and withdraw the contactor from the spark plug barrel.
  2. Loosen attaching clamps.
  3. Remove screws which secure high tension plate to magnetos.
  4. Remove the slotted-head screw and brass washer from plate grommet base which is in line with cable to be detached.
  5. Withdraw cable.

**Cleaning and Inspection of Ignition Cable.**

- a. Inspect the cable for damaged insulation. Replace the cable if the insulation shows any evidence of deterioration.

**Installation of Ignition Cable.****NOTE**

If a new cable is being installed, check it for correct length by comparing it with the cable which is being replaced. All cables can be installed in the same manner.

- a. Connect cable to high tension outlet.
  1. Insert cable end with ferrule and coupling nut in place, through high tension cable outlet plate and into proper hole in outlet plate grommet.
  2. Fasten cable in place with cable piercing screw and brass washer.

**CAUTION**

Do not over-tighten screws.

3. Attach high tension outlet plate, with cables in place, to the magneto with four attachment screws.
4. Replace cable on proper spark plug.
5. Replace cowling.

**SPARK PLUGS.**

There are two spark plugs in each cylinder. The spark plugs are 18mm short reach type and screw into heli-coil inserts in the cylinders. The spark plugs are shielded to prevent radio interference and have an internal resistor to provide longer gap life. An average life of 200 hours can be expected, however, this time will vary with operating conditions. The correct gap setting is .015 to .018 inch. Torque spark plugs to 350 ± 30 pound-inch.

**Removal of Spark Plugs.**

- a. To remove any spark plug, loosen the coupling nut on the ignition cable and lift the terminal sleeve out of the spark plug shielding barrel well.

**CAUTION**

When removing terminal sleeve from spark plug, use extreme care to keep the cable terminal sleeve straight in the shielding barrel well. Any misalignment could scratch or break the sleeve or the ceramic insulation in the spark plug, necessitating replacement of either or both.

b. Unscrew the spark plug from the cylinder using a deep socket wrench of suitable size. Make certain that the copper gasket is removed with the spark plug.

**Installation of Spark Plugs.**

a. To install a spark plug, first make certain that the heli-coil insert in the cylinder is undamaged and that the old copper gasket was removed along with the spark plug.

**NOTE**

If there is any damage to the heli-coil insert, it should be replaced before installing a spark plug.

b. Apply anti-seize compound sparingly to spark plug threads, being careful not to allow any compound to get on the ground electrodes. A good practice is to leave the bottom two threads of the spark plug uncoated. The anti-seize compound is electrically conductive and any of this material on the electrodes would short out the spark plug.

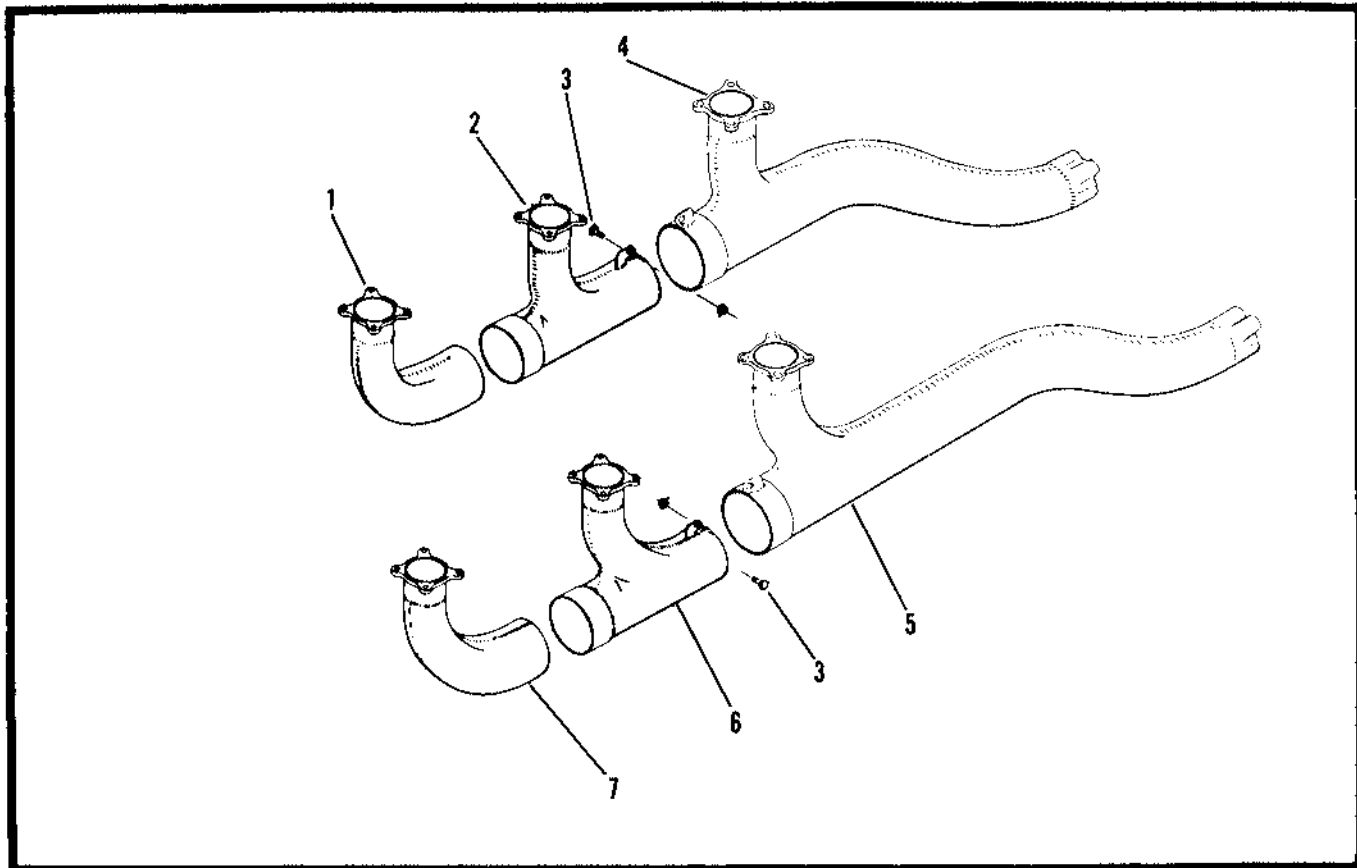
c. Screw the spark plug into the cylinders, first installing a new copper gasket or an old one which has been annealed and is in good condition. The plugs should be tightened to the specified torque value using a deep socket wrench with a torque indicating handle.

**CAUTION**

Make certain that the socket is properly seated on the spark plug hexagon as damage to the plug could result if the wrench is cocked to one side when pressure is applied.

**ENGINE EXHAUST SYSTEM.**

Removal of Engine Exhaust System. (See figure 9-15.)



1. Right Forward Riser
2. Right Center Riser

3. Bolt
4. Right Aft Riser and Stack
5. Left Aft Riser and Stack

6. Left Center Riser
7. Left Forward Riser

Figure 9-15. Exhaust Stacks

## NOTE

Removal of LH exhaust system is given, RH exhaust system is removed in a similar manner.

- a. Remove engine cowling in accordance with removal procedures.

## NOTE

The lower portion of the lower nacelle can be removed by simply removing attaching screws. This will greatly ease exhaust assembly removal.

- b. If exhaust temperature system (optional equipment) is installed, disconnect probes.
- c. Remove the four nuts holding each riser to its cylinder.
- d. Work risers down and free of cylinder studs. Separate risers and remove from nacelle.

## NOTE

If difficulty is encountered in removing an exhaust stack assembly, follow the engine

removal procedure and raise the engine from its mounts far enough to provide the necessary clearance.

Installation of Engine Exhaust System. (See figure 9-15.)

- a. Assemble and install the exhaust stack assemblies on each engine using one steel gasket between each riser and its mounting pad on the cylinder.
- b. Install four nuts on cylinder studs at each riser.
- c. Torque four nuts on each exhaust riser to 60 ± 10 inch-pounds.
- d. Install bolts (3) and nuts which attach center risers (2 and 6) to aft risers (4 and 5).

## NOTE

Do not over-tighten bolts (3). It should be possible to rotate the bolts by hand after tightening to provide clearance for thermal expansion of the exhaust stack assembly.

- e. Inspect exhaust system for leaks.

## SECTION 10

## PROPELLER SYSTEM

## Table of Contents

|                             | Page |                                             |      |
|-----------------------------|------|---------------------------------------------|------|
| PROPELLER . . . . .         | 10-1 | Checking and Setting Blade Angles . . . . . | 10-7 |
| Repairs . . . . .           | 10-1 | PROPELLER GOVERNOR . . . . .                | 10-7 |
| Trouble Shooting . . . . .  | 10-2 | Removal . . . . .                           | 10-7 |
| Removal . . . . .           | 10-4 | Installation . . . . .                      | 10-7 |
| Installation . . . . .      | 10-6 | Rigging of Propeller Controls . . . . .     | 10-7 |
| Operational Check . . . . . | 10-6 |                                             |      |

## PROPELLER.

The Model 310 is equipped with all metal, two bladed (standard equipment) or three bladed (optional equipment), constant-speed, full-feathering, single-acting, and governor regulated propellers. Each propeller utilizes hydraulic pressure which opposes the forces of springs and counterweights to obtain the correct pitch for engine load. Hydraulic pressure from the engine-mounted governor urges blades toward low pitch (increasing rpm) while the springs and counterweights urge blades toward high pitch (decreasing rpm). The source of hydraulic pressure for propeller operation is furnished by the engine oil system, boosted in pressure by the governor gear pump, and supplied to the propeller hub through engine shaft flange. When the engine is not in operation, the high pitch latch mechanism prevents the propeller blades from moving into the feathered position. To feather the propeller blades, the propeller control levers on the control pedestal must be placed in the feathered position. Unfeathering the propeller is accomplished by positioning the propeller control levers to increase rpm position and rotating the blades to the low pitch position, or by starting the engine. If installed, the optional unfeathering system uses accumulator air and oil to force the propeller to the low pitch condition.

## NOTE

Federal Aviation Regulations define major and minor repairs and alterations and who may accomplish them. This Section may be used as a guide, but the Federal Aviation Regulations and the propeller manufacturer's instructions must be observed.

## Repairs.

Repair of metal propellers first involves evaluating the damage and determining whether the repair will

be a major or a minor one and, in accordance with Federal Aviation Regulations, who is permitted to accomplish the repair.

## a. General Repair Considerations:

Under no circumstances are the raised edges of defects to be corrected by peening. No welding, soldering or compounds of any nature are to be used to fill or correct defects. All repair is to be in accordance with standard approved and accepted practice.

More than one defect on blade is not cause for considering blade not airworthy if repair is within indicated limits. A reasonable number of repairs per blade is permissible if their location with respect to each other is not such as to form a continuous line that may materially weaken the blade. Any transverse crack shall be cause for considering blade not airworthy.

Repair necessitating the removal of an appreciable amount of metal shall be reason to check horizontal and vertical balance.

The repair of defects is permissible providing the treatment does not materially weaken the blade, reduce its weight, or impair its performance.

## b. Defects on Thrust Face or Chamber Side:

Repair by removal of metal to form shallow, large radius, round bottomed depressions. Periodic inspection during repair should be made to avoid removal of excessive amounts of metal. All raised edges should be carefully smoothed out to reduce the area of the defect and the amount of metal to be removed. Repair with suitable fine cut files and coarse grain emery cloth and smooth all edges and surfaces with fine grain emery cloth. Any blade repair on these

surfaces which necessitates a depression that exceeds the manufacturer's tolerances or those listed in CAM 18 shall be cause for considering blade not airworthy.

c. Defects on Leading and Trailing Edge:

Repair defects as outlined in "b" above with suitable half round file and emery cloth. Carefully smooth all edges of repaired defect. Any blade repair on leading and trailing edges which necessitates metal removal that exceeds the manufacturer's tolerances or those listed in CAM 18 shall be cause for considering blade not airworthy.

Blades that have leading or trailing edges pitted from normal wear may be reworked by removing sufficient metal to eliminate the pitting. Start well back from the edge and work over the edge in such a manner that the contour of the blade remains substantially the same. Avoid abrupt section changes and blunt edges. Permissible reductions in blade thickness and width, listed in the manufacturer's publications or CAM 18, must be observed.

d. Tip Damage:

Damage on blade tips may be removed in accordance with "b" and "c" listed above, as long as metal removal is within the tolerances specified. Damage which cannot be repaired by local removing of metal may be repaired by removing metal

so as to shorten blades, although shortening blades is a propeller major repair. Any shortening of one blade requires an identical shortening of the other one, and any change in tip plan form or contour of one blade requires an identical change on the other one. Limitations concerning shortening of blades are specified in the manufacturer's publications or CAM 18.

e. Refinishing:

Prior to corrosion protection treatments, all repair areas should be smoothly polished out and blended in to finish repair and improve appearance. Whenever possible, all repaired blades should be anodized in a sulfuric acid anodize bath. The blades must be anodized with loose blade retention hardware on shank end; therefore, the blade must be supported vertically with steel hardware out of the solution and suitably protected to be unaffected by fumes. The same holds true for caustic baths.

When anodizing is not readily available, local repaired or inspected areas may be treated by other approved methods for corrosion protection; so-called chromodizing, alodine solution, painting, etc. It is doubtful that the finish of these treatments, other than sulfuric acid anodize, will blend in with regard to appearance. If desired, both camber and thrust face sides may be painted with zinc chromate primer and black lacquer to improve appearance. The thrust face side should always be painted.

Trouble Shooting the Propellers.

| TROUBLE                                                                                  | PROBABLE CAUSE                                                   | CORRECTION                                                     |
|------------------------------------------------------------------------------------------|------------------------------------------------------------------|----------------------------------------------------------------|
| PROPELLER DOES NOT RESPOND TO MOVEMENT OF PROPELLER PITCH LEVER OR FAILS TO CHANGE PITCH | Control linkage disconnected.                                    | Check visually, connect or replace control linkage.            |
|                                                                                          | Governor not correct for propeller.                              | Check that correct governor is installed.                      |
|                                                                                          | Governor speeder spring broken.                                  | Overhaul or replace governor.                                  |
|                                                                                          | Screen in governor mounting gasket clogged.                      | Remove governor and replace gasket.                            |
|                                                                                          | Governor drive shaft sheared.                                    | Overhaul or replace governor.                                  |
| FAILURE TO CHANGE PITCH FULLY                                                            | Defective pitch changing mechanism, or excessive blade friction. | Check propeller manually, repair or replace parts as required. |
|                                                                                          | Improper rigging of governor control.                            | Check that arm on governor has full travel and rig correctly.  |
|                                                                                          | Defective governor.                                              | Overhaul or replace governor.                                  |
| SLUGGISH PROPELLER MOVEMENT TO EITHER HIGH OR LOW PITCH                                  | Excessive propeller blade friction.                              | Overhaul propeller.                                            |

| TROUBLE                                                 | PROBABLE CAUSE                                                              | CORRECTION                                                                                                                                                                                              |
|---------------------------------------------------------|-----------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ENGINE SPEED WILL NOT STABILIZE                         | Governor relief valve sticking.                                             | Overhaul or replace governor.                                                                                                                                                                           |
|                                                         | Excessive clearance in pilot valve.                                         | Overhaul or replace governor.                                                                                                                                                                           |
|                                                         | Air trapped in propeller actuating cylinder.                                | Trapped air should be purged by exercising the propeller several times prior to takeoff, after the propeller has been reinstalled or has been idle for an extended period.                              |
|                                                         | Excessive friction in pitch changing mechanism or excessive blade friction. | Check propeller manually, repair or replace parts as required.                                                                                                                                          |
| EXCESSIVE RPM CHANGES WITH AIRSPEED OR POWER CHANGES    | Excessive governor oil pump clearance.                                      | Overhaul or replace governor.                                                                                                                                                                           |
|                                                         | Sludge in governor.                                                         | Remove and clean governor. Drain engine oil, clean oil filter, service engine with new oil.                                                                                                             |
| FAILURE OF PROPELLER TO GO TO FULL LOW PITCH (HIGH RPM) | Improper rigging of governor control system.                                | Refer to Operational Check of Propellers.                                                                                                                                                               |
|                                                         | Governor arm reaches stop before maximum rpm is obtained.                   | Adjust in accordance with Operational Check of Propellers.                                                                                                                                              |
|                                                         | Defective governor.                                                         | Overhaul or replace governor.                                                                                                                                                                           |
| STATIC RPM TOO HIGH                                     | Incorrect propeller or incorrect low pitch blade angle.                     | Install correct propeller, with correct blade angle.                                                                                                                                                    |
| STATIC RPM TOO LOW                                      | Governor high rpm stop set too low.                                         | See Note 1 at the end of this chart and rig.                                                                                                                                                            |
|                                                         | Defective governor.                                                         | See Note 2 at the end of this chart.                                                                                                                                                                    |
|                                                         | Incorrect propeller or incorrect low pitch blade angle.                     | Install correct propeller, with correct blade angle.                                                                                                                                                    |
| PROPELLER FEATHERS DURING ENGINE SHUTDOWN               | Latching mechanism does not engage.                                         | Due to unusual circumstances, a propeller may occasionally feather during engine shutdown. If this occurs repeatedly, the latching mechanism is defective. Propeller repair or replacement is required. |
| FAILURE TO FEATHER                                      | Defective governor.                                                         | See Note 2 at the end of this chart.                                                                                                                                                                    |
|                                                         | Defective pitch changing mechanism or excessive blade friction.             | Check propeller manually, repair or replace parts as required.                                                                                                                                          |
|                                                         | Incorrect rigging of governor control.                                      | Check that arm on governor has full travel and rig.                                                                                                                                                     |
|                                                         | Defective latching mechanism inside propeller.                              | Propeller repair or replacement is required.                                                                                                                                                            |
|                                                         | Attempting to feather from too low an engine rpm.                           | Increase rpm and attempt to feather again. (See feathering procedures.)                                                                                                                                 |



| TROUBLE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | PROBABLE CAUSE                                                                   | CORRECTION                                                                                      |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| FAILURE TO FEATHER<br>(CONT)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Feathering spring weak or broken.                                                | Overhaul propeller.                                                                             |
| OIL LEAKAGE AT<br>MOUNTING FLANGE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Damaged O-ring seal between engine and propeller.                                | Check visually for oil leakage and replace O-ring seal.                                         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Foreign material between engine and propeller mating surfaces or nuts not tight. | Check visually for oil leakage and clean propeller and engine mating and tighten nuts properly. |
| OIL OR GREASE LEAKAGE<br>AT ANY OTHER PLACE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Defective seals, gaskets, etc., or incorrect assembly.                           | Check visually for oil or grease leakage, repair or replace propeller as required.              |
| <p>NOTE 1. It is possible for either the propeller low pitch (high rpm) stop or the governor high rpm stop to be the high rpm limiting factor. It is desirable for the governor stop to limit the high rpm at the maximum rated rpm. Due to climatic conditions, field elevation, low pitch blade angle, and other considerations, an engine may not reach rated rpm on the ground. It may be necessary to readjust the governor stop after test flying to obtain maximum rated rpm when airborne.</p> <p>NOTE 2. When trouble shooting a propeller-governor combination, it is recommended that a governor known to be in good condition be installed to check whether the propeller or the governor is at fault. Removal and replacement, high-speed stop adjustment, desludging, and replacement of the mounting gasket are not major repairs and may be accomplished in the field. Repairs to governors are classed as propeller major repairs in Federal Aviation Regulations, which also defines who may accomplish such repairs.</p> |                                                                                  |                                                                                                 |

#### Removal of Propellers. (See figure 10-1.)

##### NOTE

See Section 13 for removal of optional three bladed propeller.

The removal procedure is the same for either propeller. Before removing the propeller it should be placed in the FEATHERED position. This will allow the oil in the blade actuating cylinder to drain back into the engine and will protect the blade actuating cylinder wall from damage during the removal procedure.

- Feather the propeller by either the normal or the optional procedure.

#### Normal Feathering Procedure:

- Start engine in accordance with "Pilot's Checklist."
- Operate engine at normal idle (600 rpm).
- Place the propeller pitch lever in the FEATHER position and at the same time place the mixture lever in the IDLE CUT-OFF position.

##### CAUTION

Do not feather from a high rpm as this will cause excessive manifold pressure and possible damage to the engine. If the propeller fails to feather at idling (600 rpm), increase the rpm slightly and attempt to feather again.

#### Feathering Procedures with Optional Unfeathering System Installed:

- After the propeller has been feathered and the engine shutdown, move propeller control out of the FEATHER position until blades start to unfeather, then quickly pull the control back into FEATHER.
- Continue to "milk" pressure out of the system with the propeller control until the propeller blades will no longer move. This may require from 15 to 20 movements of the propeller control.

##### NOTE

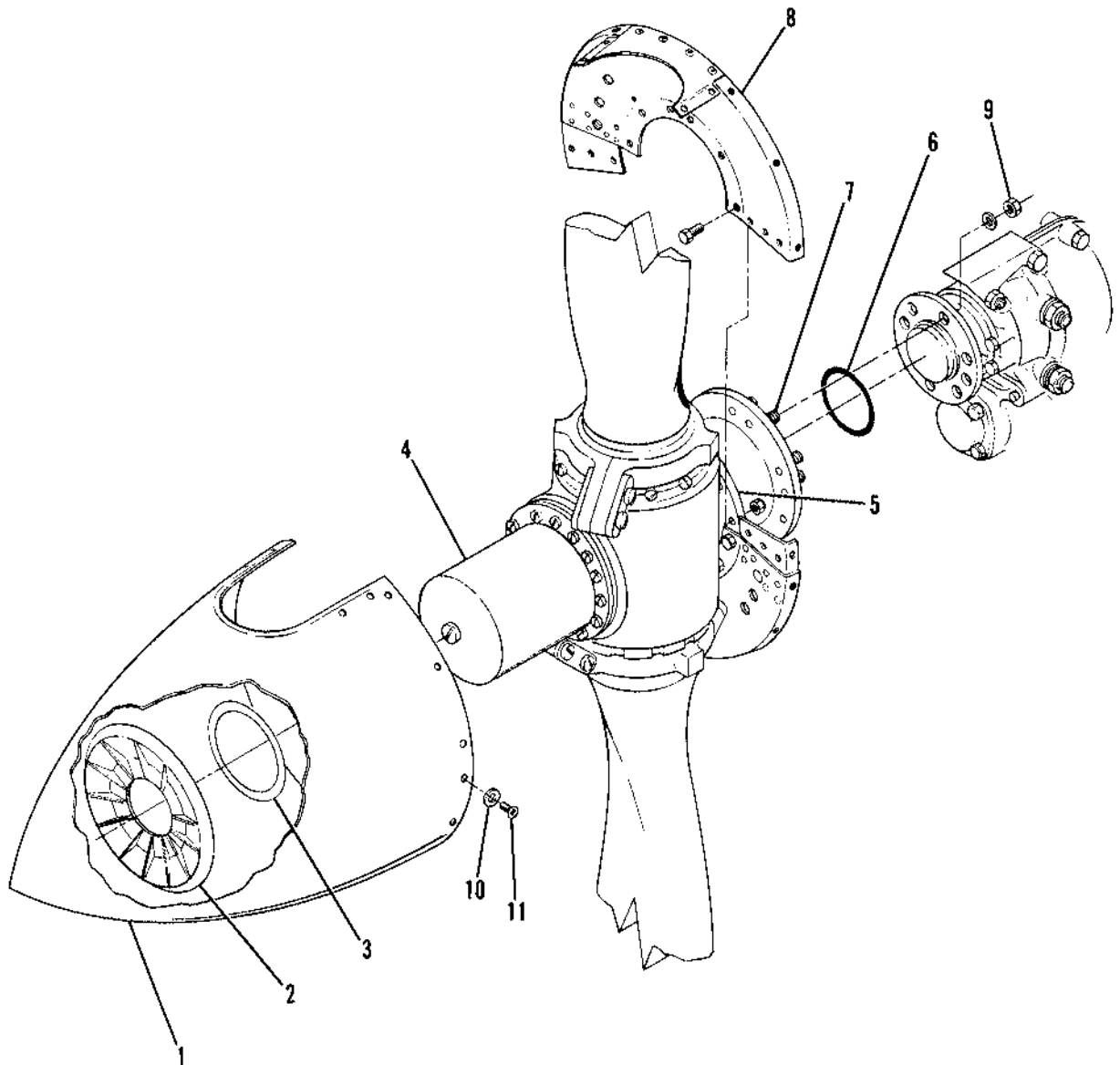
Do not allow propeller blades to rotate far enough to let high pitch latches engage, or engine will have to be restarted, propeller feathered again, and the procedure repeated.

- Remove cowling in accordance with Section 9.
- Remove screws attaching spinner (1) to spinner bulkhead (8). Retain all spacers (3) from behind support (2).

##### NOTE

The propeller spinner and propeller bulkhead are indexed to each other by having one attaching bolt larger than the others.

- Remove six attaching nuts securing the propeller hub to engine crankshaft.



1. Spinner
2. Support
3. Spacer
4. Propeller Cylinder

5. Propeller Hub
6. O-Ring Seal
7. Stud

8. Spinner Bulkhead
9. Nut
10. Screw
11. Washer

Figure 10-1. Propeller Installation

**CAUTION**

Support the propeller before removing the last nut, to prevent the possibility of dropping propeller.

- e. Remove propeller from engine crankshaft.

**NOTE**

If the aircraft is equipped with a propeller deice system, loosen the deice wires from terminal strip.

- f. Remove spinner bulkhead (8) from propeller hub.

**NOTE**

The split spinner bulkhead is a matched set and should be marked on removal.

Installation of Propellers. (See figure 10-1.)

**NOTE**

Refer to Section 13 for installation of optional three bladed propeller.

- a. Clean the propeller hub (5) and engine crankshaft flange with crocus cloth.
- b. Wipe dust and foreign particles from the propeller hub, crankshaft flange and oil passages with a clean rag.

**NOTE**

Inspect O-ring seal (6) in propeller hub flange for damage and replace as necessary.

- c. Place spinner bulkhead (8) on forward side of propeller hub (5) and secure with bolt, washers and nuts. Torque attaching nuts to  $80 \pm 5$  pound-inches.

**CAUTION**

If the propeller is equipped with a deice system, connect the wires by connecting to terminal strip.

- d. Secure propeller to engine crankshaft by six self-locking nuts (9).

**NOTE**

Torque nuts (9) from 55 to 65 ft/lbs.

- e. Install spinner support (2) tightly inside spinner (1) and shim as required with spacers (3) until attaching holes on the spinner bulkhead (8) and spinner (1) are aligned.
- f. Secure spinner (1) to spinner bulkhead (8) with washers and screws.
- g. Replace engine cowling in accordance with Section 9.

- h. If optional propeller unfeathering system is installed, charge accumulator in accordance with Section 2.

Operational Check of Propellers. (See figure 10-2.)

**NOTE**

Anytime the propeller or propeller governor has been removed, the following check should be performed after reinstallation. This will insure that the engine-propeller-governor combination is in good operating adjustment and will give maximum performance.

- a. Start engines and perform normal ground runup in accordance with Section 9.

**CAUTION**

Avoid running up engines where loose stones or cinders can be sucked up by inflow of air and damage the propeller blades.

- b. Check tachometer indication during power check. Static rpm should be 2575 to 2600 rpm.

1. If static rpm is too high, reduce by adjusting governor stop screw. Turn clockwise one revolution for each 25 rpm decrease. This reduction prevents possible overspeed at takeoff.

2. If static rpm is too low, it is possible that either the governor stop or the propeller low pitch stop is the limiting factor. Proceed with the following procedures:

- (a) Replace governor with one which is known to be in good condition and perform another power check.
- (b) If static rpm still remains below desired limits; feather propeller, remove propeller cylinder and add shims as necessary in accordance with McCauley Industrial Corporation Service Manual No. 630901.

3. If maximum obtainable rpm is reached at the same time as the governor stop is reached, the governor is the limiting factor. Correct by adjusting governor stop screw by turning counterclockwise one revolution for each 25 rpm increase.

**CAUTION**

Do not allow engine temperatures to exceed operating limits while these checks are being performed.

- c. Check flight rpm after making static rpm adjustments. Tachometer indications during takeoff should not exceed 2625 rpm. If the maximum obtainable in-flight rpm is found to be less than 2625 rpm and the governor stop has not been reached, the propeller low pitch stop is the limiting factor. Necessary adjustments to propeller low pitch stop and blade angles as referenced in step 2. (b) above, should be made only by an authorized propeller overhaul station.

### Checking and Setting Blade Angles.

- a. Remove propeller from aircraft in accordance with removal procedures.
- b. To check and set blade angles, refer to applicable McCauley Industrial Corporation Service Manual No. 630901.

#### NOTE

Checking and setting the blade angles should only be performed by qualified personnel at recognized repair and overhaul stations.

- c. Install propeller in accordance with installation procedures.

### PROPELLER GOVERNORS.

A lever head, base-mounted, constant-speed single-acting Woodward governor is installed on each engine to control the propeller pitch. The governors are engine-driven and mounted on the left side of the crankcase just below the forward cylinder. A gear type pump and relief valve is incorporated in each governor to boost engine oil pressure which, regulates aircraft engine speed by varying the pitch of the propeller to match load torque to engine torque in response to changing conditions of flight. Internal

flyweights are attached to a pilot valve that directs high pressure oil to the propeller piston or allows oil to drain from the piston.

Removal of Propeller Governors. (See figure 10-2.)

#### NOTE

The removal procedure is the same for either propeller governor.

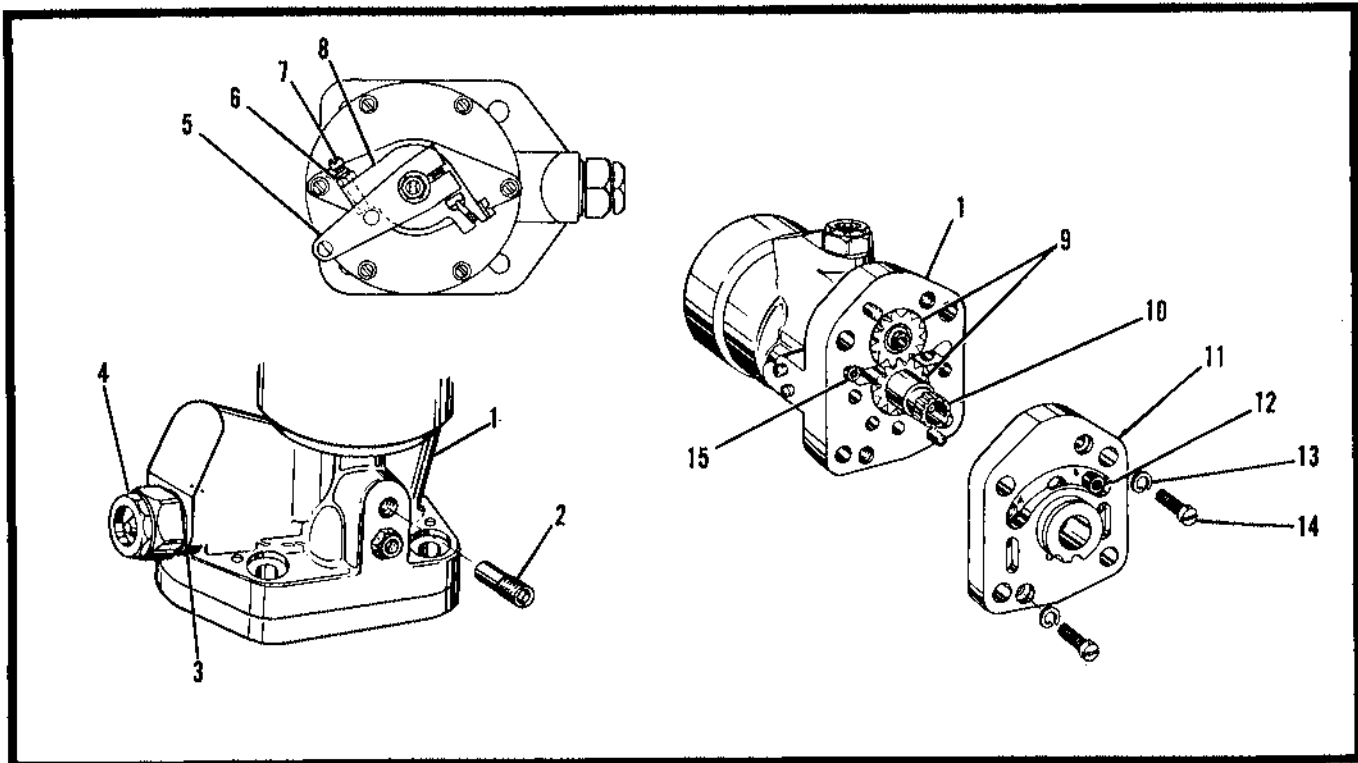
a. Refer to Section 9, remove engine cowling and baffles as necessary to gain access to propeller governor.

b. Remove rod end from governor control arm by removing attaching nut, bushing and bolt.

#### CAUTION

If aircraft is equipped with optional unfeathering system, release accumulator pressure prior to removal of governor.

c. Remove governor and mounting gasket by removing the four nuts, internal tooth lockwashers, plain washers, and the forward left engine baffle support tab.



1. Body
2. Bypass Plug
3. Gasket
4. Cap
5. Governor Arm

6. Lock Nut
7. Governor Stop Screw
8. Stop Ring
9. Pump Gears
10. Splined Drive

11. Base
12. Base Plug
13. Lockwasher
14. Screw
15. Body Plug

Figure 10-2. Propeller Governor

Installation of Propeller Governors. (See figure 10-2.)

- a. Place the mounting gasket over the governor mount studs with the raised surface of gasket screen facing away from the engine.
- b. Align the splines on the governor shaft with the engine drive, and slide the governor into position.
- c. Secure the governor in place with the four plain washers and nuts on the governor mount studs. The forward left engine baffle support tab should be fastened to the lower forward governor mount stud.
- d. Rig propeller in accordance with rigging procedures.
- e. Refer to Section 9, install engine baffles and cowling in accordance with installation procedures.
- f. Perform an operational check of propellers.
- g. If optional propeller unfeathering system is installed, charge accumulator in accordance with Section 2.

Rigging Propeller Controls. (See figure 10-2.)

- a. Disconnect the propeller control rod end at the governor arm by removing nut, bushing and bolt.
- b. Place propeller pitch lever in the control pedestal in FULL INCREASE RPM position against the

forward stop. Retard the lever approximately 1/4 inch from stop and lock lever in this position by tightening the friction knob on the right side of the control quadrant.

- c. Place governor arm in the full forward position against the stop (FULL INCREASE RPM).
- d. Loosen rod and lock on propeller control sliding end and adjust the position of the control rod end by screwing in or out until bolt can be inserted through the rod end and governor arm without binding.

#### NOTE

Do not allow propeller pitch lever or propeller governor arm to move from position during adjustment of the control rod end.

- e. Install bolt with bushing between rod end and governor arm. Tighten lock nut securing rod end in place.
- f. Unlock propeller pitch lever in control pedestal. Move the pitch to the FEATHER position (full aft). Check to see that the propeller governor arm is against its stop in the full aft position. With the governor arm against either stop, the pitch lever should be approximately 1/4 inch from the quadrant stop. This unused travel provides the necessary cushion to assure full travel of the governor arm.

## SECTION 11

## FUEL SYSTEM

## Table of Contents

|                                                            | Page  |                                                                           | Page  |
|------------------------------------------------------------|-------|---------------------------------------------------------------------------|-------|
| FUEL SYSTEM . . . . .                                      | 11-1  | Removal of Auxiliary Fuel Pump . . . . .                                  | 11-14 |
| Trouble Shooting . . . . .                                 | 11-1  | Installation of Auxiliary Fuel Pump . . . . .                             | 11-14 |
| Wing Tip Tank . . . . .                                    | 11-3  | Auxiliary Fuel Pump Low Adjustment . . . . .                              | 11-16 |
| Removal . . . . .                                          | 11-3  | Ground Check of Fuel Pressure Switch<br>and Oil Pressure Switch . . . . . | 11-17 |
| Disassembly . . . . .                                      | 11-3  | FUEL INDICATOR SYSTEM . . . . .                                           | 11-17 |
| Assembly . . . . .                                         | 11-3  | Removal of Main Fuel Quantity<br>Sending Unit . . . . .                   | 11-17 |
| Installation . . . . .                                     | 11-3  | Installation of Main Fuel Quantity<br>Sending Unit . . . . .              | 11-17 |
| Sniffle Valve . . . . .                                    | 11-3  | Fuel Quantity Sending Units Operational<br>Check . . . . .                | 11-17 |
| Removal . . . . .                                          | 11-3  | Removal of Auxiliary Fuel Quantity<br>Sending Unit . . . . .              | 11-17 |
| Installation . . . . .                                     | 11-6  | Installation of Auxiliary Fuel Quantity<br>Sending Unit . . . . .         | 11-19 |
| Removal of Main Fuel Lines . . . . .                       | 11-6  | Trouble Shooting the Fuel Quantity<br>Indicator System . . . . .          | 11-19 |
| Installation of Main Fuel Lines . . . . .                  | 11-7  | WING LOCKER FUEL TANKS . . . . .                                          | 11-19 |
| Removal of Auxiliary Fuel Tank . . . . .                   | 11-7  | Removal . . . . .                                                         | 11-19 |
| Installation of Auxiliary Fuel Tank . . . . .              | 11-7  | Installation . . . . .                                                    | 11-19 |
| Removal of Auxiliary Fuel and Vent Lines . . . . .         | 11-7  | WING LOCKER PLUMBING . . . . .                                            | 11-20 |
| Installation of Auxiliary Fuel and<br>Vent Lines . . . . . | 11-10 | Removal . . . . .                                                         | 11-20 |
| Selector Valves . . . . .                                  | 11-10 | Installation . . . . .                                                    | 11-20 |
| Removal . . . . .                                          | 11-10 | FUEL VENT HEATER . . . . .                                                | 11-21 |
| Installation . . . . .                                     | 11-10 |                                                                           |       |
| Fuel Selector Control System . . . . .                     | 11-10 |                                                                           |       |
| Removal . . . . .                                          | 11-13 |                                                                           |       |
| Installation . . . . .                                     | 11-13 |                                                                           |       |
| Rigging . . . . .                                          | 11-13 |                                                                           |       |
| Operational Check . . . . .                                | 11-14 |                                                                           |       |

## FUEL SYSTEM.

The standard fuel system consists of one integrally sealed (wet) tank mounted to each wing tip. An auxiliary fuel system (optional equipment) is available which is comprised of the standard fuel tanks and one synthetic rubber cell installed in each wing. Individual fuel capacities for the main fuel tank and the auxiliary fuel cell are specified on the Principal Dimension Chart in Section 1. An electrically operated fuel boost pump, used as an emergency pump and to provide fuel pressure for starting, is contained in the bottom of each main fuel cell. The fuel boost

pump feeds fuel to the selector valve, located out-board of the engine nacelle. A vapor return line is installed to return unused fuel from the engine-driven fuel pump to the main fuel tanks. A line from each auxiliary cell carries fuel to its respective fuel selector valve. The auxiliary cells are not equipped with fuel boost pumps, as are the main tanks. Quick drain valves are provided throughout the system and are easily accessible for draining of trapped moisture and sediment. The system is vented to a common vent located on the underneath side of each tip tank and incorporates a sniffle valve located aft of the filler cap on each tip tank.

## Trouble Shooting the Fuel System.

| TROUBLE                     | PROBABLE CAUSE                                | CORRECTION                            |
|-----------------------------|-----------------------------------------------|---------------------------------------|
| NO FUEL QUANTITY INDICATION | Fuel tank empty.                              | Fill tank with correct grade of fuel. |
|                             | Fuel quantity indicator circuit breaker open. | Reset circuit breaker.                |
|                             | Loose connections or open circuit.            | Tighten connections and check wiring. |
|                             | Defective fuel quantity indicator.            | Replace fuel quantity indicator.      |
|                             | Defective fuel quantity sending unit.         | Replace fuel quantity sending unit.   |

| TROUBLE                                                                                                                 | PROBABLE CAUSE                                                 | CORRECTION                                                                                           |
|-------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|------------------------------------------------------------------------------------------------------|
| FUEL DRIPS FROM NACELLE                                                                                                 | Mixture lever not in IDLE CUT-off.                             | Place mixture lever in IDLE CUT-OFF.                                                                 |
|                                                                                                                         | Mixture lever not in IDLE CUT-OFF due to improper rigging.     | Rig mixture control in accordance Section 9, Rigging Mixture and Throttle Controls.                  |
|                                                                                                                         | Broken fuel line or loose fitting.                             | Check fuel lines and fittings.                                                                       |
| AUXILIARY FUEL PUMP INOPERATIVE                                                                                         | Master switch OFF.                                             | Turn master switch ON.                                                                               |
|                                                                                                                         | Circuit breaker open.                                          | Reset circuit breaker.                                                                               |
|                                                                                                                         | Open circuit or loose connections.                             | Check circuit and repair.                                                                            |
|                                                                                                                         | Defective fuel pump.                                           | Replace fuel pump.                                                                                   |
|                                                                                                                         | Defective fuel pressure switch.                                | Replace fuel pressure switch.                                                                        |
| AUXILIARY FUEL PUMP RUNS AT HIGH SPEED WHEN SWITCH IS MOVED TO "ON" POSITION WITH ENGINES RUNNING                       |                                                                |                                                                                                      |
| AUXILIARY FUEL PUMP RUNS AT SLOW SPEED WITH MASTER SWITCH "ON", AUXILIARY FUEL PUMP SWITCH "ON" AND ENGINES NOT RUNNING | Defective fuel pressure switch.                                | Replace fuel pressure switch.                                                                        |
|                                                                                                                         | Defective oil pressure switch.                                 | Replace oil pressure switch.                                                                         |
| ENGINE WILL NOT START OR CONTINUE TO RUN AFTER STARTING                                                                 | Fuel tank empty.                                               | Fill tank with correct grade of fuel.                                                                |
|                                                                                                                         | Fuel selector valve in OFF position.                           | Move fuel selector valve to main tank desired.                                                       |
|                                                                                                                         | Mixture in IDLE CUT-OFF.                                       | Set mixture to FULL RICH.                                                                            |
|                                                                                                                         | Engine overprimed.                                             | Place mixture control in IDLE CUT-OFF, turn engine over several revolutions with throttle WIDE OPEN. |
|                                                                                                                         | Fuel strainer in fuel control unit dirty.                      | Clean fuel control unit strainer.                                                                    |
|                                                                                                                         | Auxiliary fuel pump switch not in PRIME position.              | Place auxiliary fuel pump switch in PRIME position.                                                  |
|                                                                                                                         | Plugged fuel cap vent.                                         | Clean vent.                                                                                          |
|                                                                                                                         | Bypass valve in engine-driven fuel pump stuck.                 | Replace engine-driven fuel pump.                                                                     |
| VERY HIGH FUEL FLOW INDICATION AT FULL THROTTLE AFTER RAPID ENGINE ACCELERATION ON GROUND                               | Gage vent restricted, or plugged.                              | Clean, or replace vent.                                                                              |
|                                                                                                                         | Restricted flow beyond metering valve.                         | Check for restricted nozzles or fuel manifold valve. Clean or replace as required.                   |
| LOW FUEL FLOW                                                                                                           | Fuel control lever does not contact the full rich stop.        | Rig mixture control in accordance with Section 9, Rigging Mixture & Controls.                        |
| ROUGH AND ERRATIC ENGINE SHUTDOWN                                                                                       | Fuel control lever does not contact idle-cut-off stops firmly. | Rig mixture control in accordance with Section 9, Rigging Mixture & Throttle Controls.               |

| TROUBLE                                       | PROBABLE CAUSE                                                    | CORRECTION                                                                              |
|-----------------------------------------------|-------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| FUEL SHUT-OFF INCOMPLETE                      | Misaligned linkage or fuel control levers hitting stops too hard. | Align linkage or rig mixture in accordance with Section 9, Rigging & Throttle Controls. |
| FUEL FLOW INCREASES ENGINE DIES AT IDLE SPEED | Pressure switch set too high.                                     | Reset fuel pressure switch to actuate between 4 to 5 PSI.                               |
|                                               | Pressure switch stuck.                                            | Replace pressure switch.                                                                |
| AUXILIARY PUMP WILL NOT SWITCH TO HIGH SPEED  | Pressure switch stuck.                                            | Replace pressure switch.                                                                |

### WING TIP TANK

Removal of Wing Tip Tank. (See figure 11-2.)

#### NOTE

The removal procedure is the same for either wing tip tank.

- Remove sump door, cut safety wire between drain valve and drain plug.
- Remove fairings, tail cap and rear access cover to gain access to retaining nut.
- Drain fuel by removing drain plug and opening drain valve.
- Disconnect hoses, electrical connections and remove bolts from mounts and remove wing tip tank.

#### Disassembly of Wing Tip Tanks.

Disassemble wing tip tanks in accordance with figure 11-2.

#### Assembly of Wing Tip Tanks.

- Assemble wing tip tank in accordance with figure 11-2.
- Seal and check tanks as follows:
  - Clean all surfaces to be sealed with a low moisture solvent using a lintless cloth for solvent application.

#### NOTE

Do not allow cleaning solvent to evaporate; wipe dry.

2. Mix Pro-Seal EP711 and apply with a spatula over all seams, rivets, fittings and possible leak areas.

#### 3. Inspect tank as follows:

- Seal off all hoses and access holes in tanks. Close vent hole by covering inside with tape.
- Saturate a clean rag with 25 cubic centimeters of household ammonia. Insert rag in fuel tank and close filler cap.
- Pressurize fuel tank to a maximum of 2 PSI.
- Saturate a large clean cloth with indicated solution (1/2 gallon distilled water, 1/2 gal-

lon denatured alcohol and 1/2 ounce of phenolphthalein crystal or powder) and spread smoothly on tank surface.

- A leak will appear as a pink spot on the cloth. Repair all leaks and repeat testing until tank surface has been tested.

#### WARNING

Remove tape from filler cap, rag from inside fuel tank and allow fuel cell to air out before using.

Installation of Wing Tip Tanks. (See figure 11-2.)

#### NOTE

The installation procedure is the same for either wing tip tank.

- Install wing tip tank by reversing removal procedures.
- Torque wing tip tank attaching nuts to 60 = 10 inch-pounds.

Sniffle Valve. (See figure 11-2.)

The sniffle valve is located in the top of each main tank aft of the filler cap. This valve will vent the tank should the overboard vent become clogged or obstructed.

Removal of Sniffle Valve. (See figure 11-2.)

The removal procedures are the same for either tank.

#### CAUTION

Care should be taken to guard against foreign matter entering tank.

- Defuel tip tank in accordance with defueling procedures.
- Remove screw securing cover.
- Remove tip tank filler cap in accordance with removal procedure.
- Holding top half of valve, remove bottom of valve



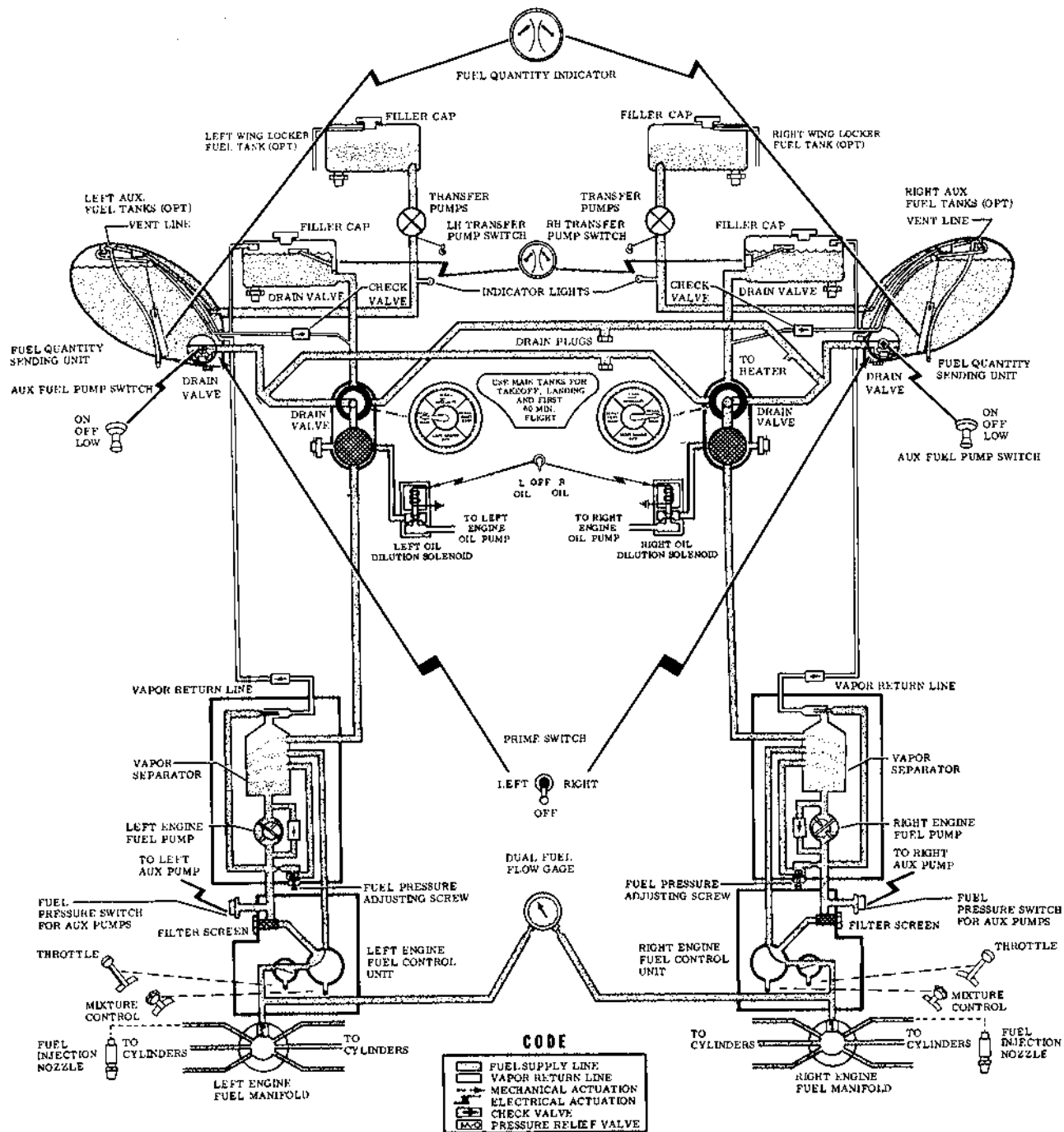


Figure 11-1. Fuel System Schematic

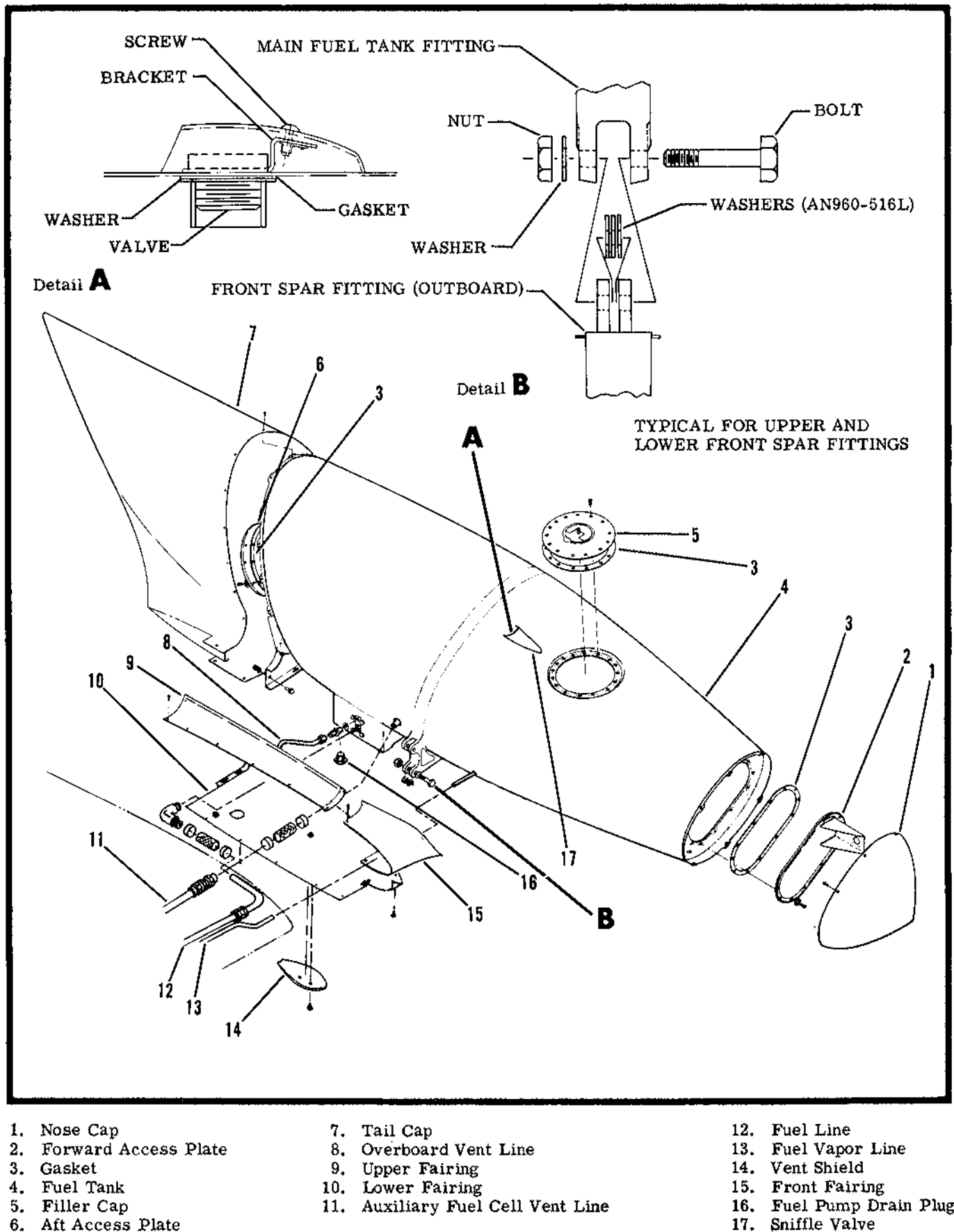


Figure 11-2. Main Tip Tank Installation

washer and gasket.

e. Remove snaffle valve.

Installation of Snaffle Valve. (See figure 11-2.)

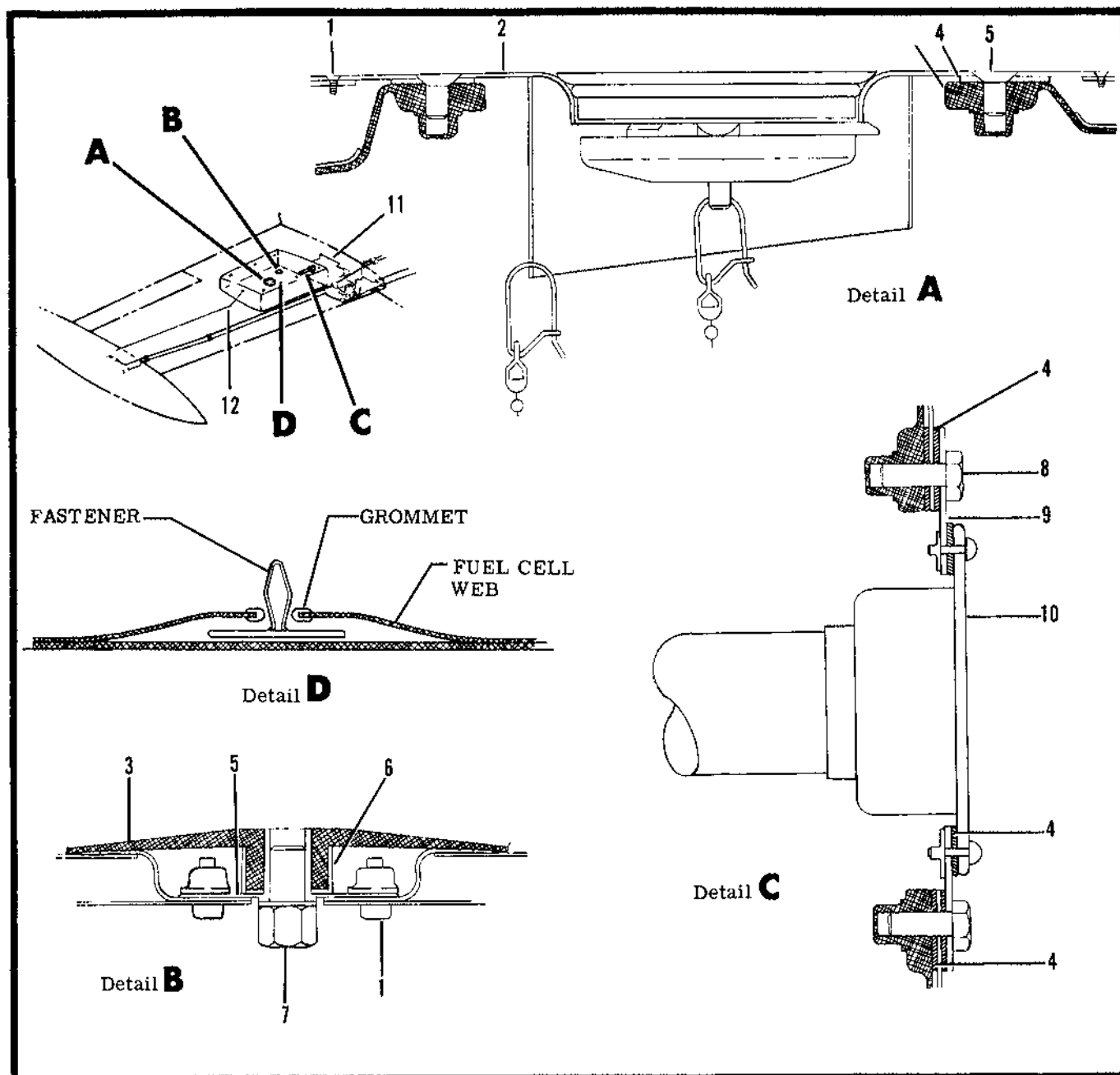
Install snaffle valve by reversing removal procedure.

Removal of Main Fuel Lines. (See Figure 11-4.)

a. Defuel aircraft in accordance with Section 2.

### CAUTION

During all defueling, tank purging and tank re-pairing operations, two ground wires, from different points on the aircraft, to separate approved grounding stakes, shall be used to prevent ungrounding of the aircraft due to accidental disconnection of one ground wire.



1. Screw
2. Adapter Assembly
3. Fuel Cell
4. Gasket

5. Adapter Assembly
6. Clamp
7. Drain
8. Bolt

9. Adapter
10. Fuel Quantity Sending Unit
11. Fuel Quantity Sending Unit
12. Vent Line

Figure 11-3. Auxiliary Fuel Cell Installation

## NOTE

Removal procedure given is for the left wing; however, the right wing is essentially the same with the exception of heater fuel tee and line.

- b. Remove the access covers from underside of the wing.
- c. Remove wing gap covers and tip tank fairings.
- d. Remove main fuel tip tank in accordance with removal procedures.
- e. Remove the clamps securing lines.
- f. Disconnect line (6) from union and check valve (9) route from wing.
- g. Remove vapor return line (10) and check valve (9) from nacelle rib fitting.
- h. Loosen line (5) at tee (17).
- i. Route line (5) from wing by pulling outboard.

## NOTE

Lines (14, 18, 20 and 21) are not recommended for removal. If removal is necessary, perform steps j. thru n.

- j. Remove wing in accordance with Section 3.
- k. From union (19) and lines (20 and 21) disconnect lines (14 and 18).
- l. Disconnect line (14) from selector valve (16) and route from wing.
- m. Disconnect line (18) from tee (17) route line from wing.
- n. Disconnect lines (20 and 21) from unions (19) on left hand side and drain fittings (25) on right hand side. Remove lines from fuselage.

## NOTE

Lines (20 and 21) are crossed in the fuselage section. Extreme care should be used to assure that the lines are not damaged on removal, and that the lines are marked so they will be connected to their proper fittings on reinstallation.

Installation of Main Fuel Lines. (See figure 11-4.)

## NOTE

Installation procedure given is for the left wing; however, the right wing is the same with the exception of heater fuel line and tee. Use a fuel soluble thread lubricant on male threads of all fittings only.

- a. If fuselage crossfeed lines were removed, install as follows:
  1. With wing removed, install lines (20 and 21), secure in position, assuring the lines are crossed in the fuselage and that they are connected to the proper fittings.
  2. With wing removed, route lines (14 and 18) through wing, connect line (14) to selector valve (16) and line (18) to tee (17).
  3. Check all lines and fittings for tightness and security, then install wing in accordance with

## Section 3.

- b. Route line (5) through wing and connect to tee (17).
- c. Route vapor return line (10) and check valve (9) through wing and connect to nacelle rib fitting.
- d. Route line (6), union (7) and line (8) through wing and connect to check valve (9).
- e. Install tip tank in accordance with installation procedures and service aircraft with fuel.
- f. Check all lines and valves for leakage and proper operation.
- g. Install all tip tank fairings, wing gap covers and access covers on underside of wing.
- h. Start engines and perform operational check of fuel selector valve per operational check procedures.

Removal of Auxiliary Fuel Tank. (See figure 11-3.)

## NOTE

Removal procedure is the same for either auxiliary fuel cell.

- a. Remove the fuel quantity sending unit (10) in accordance with removal procedures.
- b. Remove adapter (9) and gaskets (4) by removing bolts.
- c. Loosen clamp and disconnect fuel supply line (11) from fuel cell (3).
- d. Loosen clamp and disconnect vent line (12) from fuel cell.
- e. Remove two screws securing adapter (5) to lower wing skin.
- f. Remove cap and adapter assembly (2) by removing the twenty-four attaching screws.
- g. Disconnect the seven fasteners and remove the fuel cell through the upper wing opening vacated by adapter assembly (2).

Installation of Auxiliary Fuel Tank. (See figure 11-3.)

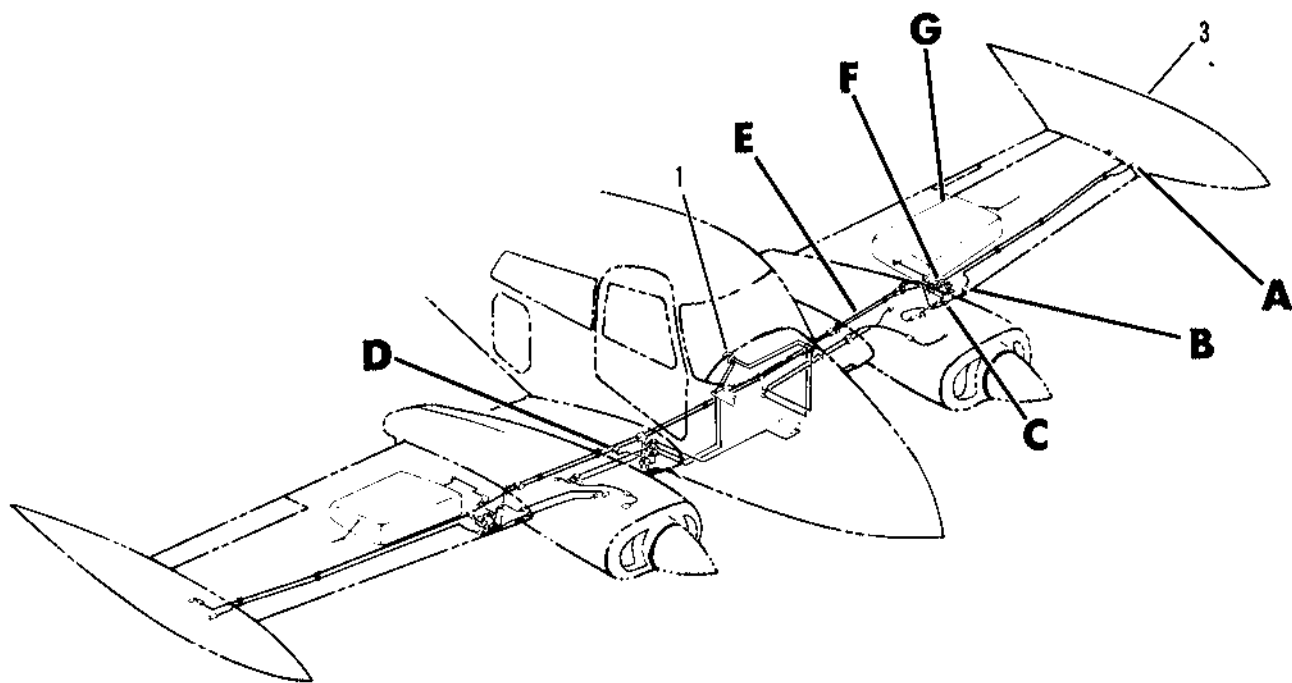
## NOTE

The installation procedure is the same for either auxiliary fuel cell.

- a. Insert the fuel cell through the upper wing opening and arrange the cell in the correct position.
- b. Secure the fuel cell with seven fasteners.
- c. Attach quick-drain adapter assembly (5) to the lower wing skin with attaching screws.
- d. Position adapter (9) and gaskets (4) and secure with bolts.
- e. Install cap and adapter assembly (2) and gasket (4) with attaching screws.
- f. Install fuel quantity sending unit (10) in accordance with installation procedures.

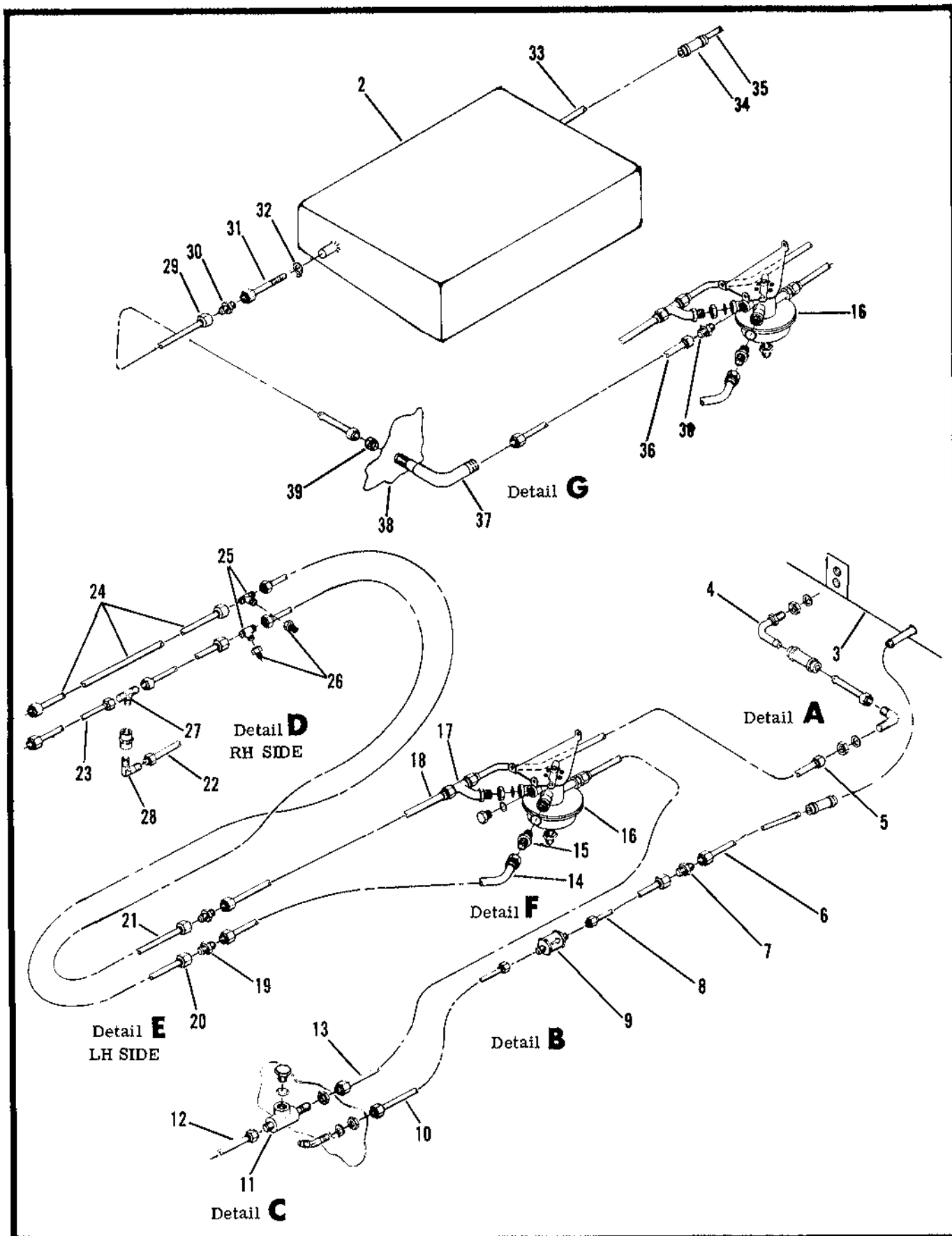
Removal of Auxiliary Fuel and Vent Lines. (See figure 11-4.)

- a. Refer to Section 2, and defuel aircraft in accordance with defueling procedures.



- |                                             |                                                    |
|---------------------------------------------|----------------------------------------------------|
| 1. Fuel Flow Gage                           | 21. LH Crossover line                              |
| 2. Auxiliary Fuel Tank                      | 22. Heater fuel line                               |
| 3. Main Fuel Tank                           | 23. Line Assembly (Selector valve to tee)          |
| 4. Elbow                                    | 24. Line Assembly (Selector valve to union)        |
| 5. Line Assembly (Main tank)                | 25. Drain Fittings                                 |
| 6. Vapor Return Line (Outboard)             | 26. Drain Valves                                   |
| 7. Reducer                                  | 27. Heater Fuel Supply Tee                         |
| 8. Vapor Return Line (Center)               | 28. Elbow                                          |
| 9. Check Valve                              | 29. Line Assembly (Auxiliary fuel cell to elbow)   |
| 10. Vapor Return Line (Inboard)             | 30. Union                                          |
| 11. Tee                                     | 31. Auxiliary Fuel Cell Strainer                   |
| 12. Line (Engine supply)                    | 32. Clamp                                          |
| 13. Line (Strainer to nacelle tee)          | 33. Line Assembly (Fuel vent, auxiliary fuel cell) |
| 14. Line Assembly (Selector valve to union) | 34. Hose (Interconnecting)                         |
| 15. Reducer                                 | 35. Vent Line (Main fuel tank)                     |
| 16. Selector Valve                          | 36. Line Assembly (Fuel selector valve to elbow)   |
| 17. Tee                                     | 37. Elbow                                          |
| 18. Line Assembly (Tee to wing root)        | 38. Front Wing Spar                                |
| 19. Union                                   | 39. Nut                                            |
| 20. RH Crossover line                       |                                                    |

Figure 11-4. Fuel System Plumbing (Sheet 1 of 2)



**CAUTION**

During all defueling, tank purging and tank repair operations, two ground wires from different points on the aircraft to separate approved grounding stakes shall be used to prevent ungrounding of the aircraft due to accidental disconnection of one ground wire.

- b. Remove the access covers from underside of the wing.
- c. Disconnect line (29) from auxiliary fuel cell strainer (31) and elbow fitting (39), remove line (29) from wing.

**NOTE**

It may be necessary to bend lines slightly during removal. Sharp bends must be avoided.

- d. Disconnect line (38) from elbow fitting (39) and union (30) at fuel selector valve (37) remove line (38) from wing.
- e. Remove main fuel tank in accordance with removal procedures.
- f. Loosen clamps attaching line (34) to auxiliary tank (33), remove line (34) from wing.

Installation of Auxiliary Fuel and Vent Lines. (See figure 11-4.)

- a. Route line (34) thru wing to auxiliary fuel cell (33), clamp line (34) to fuel cell (33).
- b. Install main fuel tank in accordance with installation procedures.
- c. Route line (38) thru wing and connect to union (30) on fuel selector (37) and elbow fitting (39).
- d. Route line (29) thru wing and connect to fuel cell strainer (31) and elbow fitting (39).
- e. Service auxiliary fuel cell in accordance with Section 2 and check for leaks.
- f. Install access covers.

**SELECTOR VALVES.**

One fuel selector valve is located in each wing just forward of the main spar, and outboard of the nacelle. Each valve is cam operated from the cabin thru flex cables. Each valve has four positions which allows fuel to flow to the respective engine from the left tank, the right tank, the auxiliary tank, or stops all fuel flow thru the valve. Each fuel selector valve has a fuel strainer located on the bottom of the valve and a quick-drain is provided to remove moisture and sediment.

**Removal of Fuel Selector Valves**

The removal of the fuel selector valves is essentially the same for either valve; however, there are left and right brackets which mount the valve into position.

- a. Drain all fuel from wing.
- b. Remove upper and lower access cover plates.
- c. Disconnect lines and fittings.

**CAUTION**

Plug or cap all open lines or fittings.

- d. Disconnect selector linkage at valve arm.
- e. Remove the three bolts securing valve and remove the valve from wing.

**Installation of Fuel Selector Valves**

The installation of the fuel selector valves is essentially the same for either valve; however, there are left and right brackets which mount the valve into position.

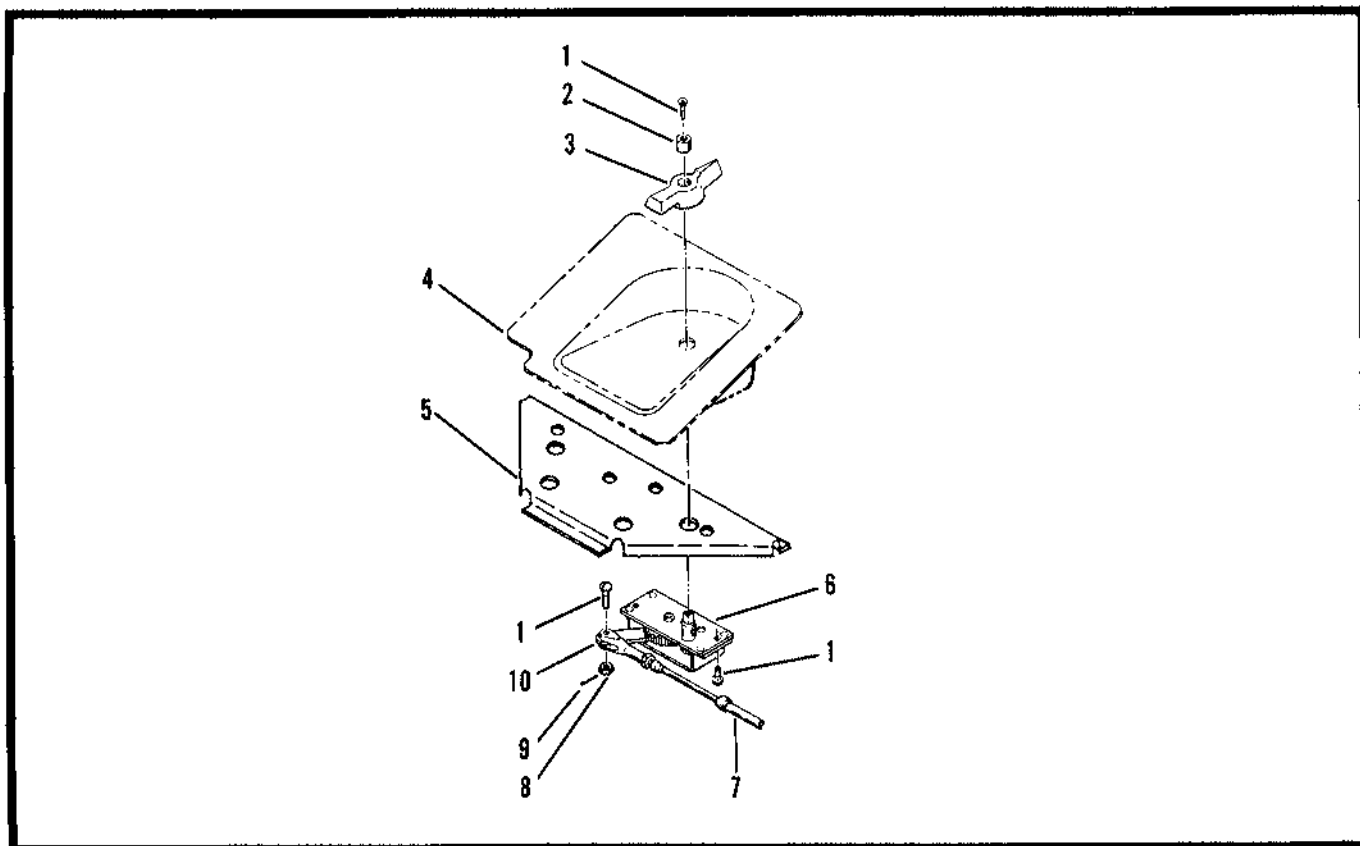
- a. Install fittings in valve and clock to correct position.
- b. Install valve, securing in position with three bolts, then connect lines.
- c. Connect selector linkage and safety.

**WARNING**

Residual fuel draining from the lines and hoses is a fire hazard. Care should be exercised in disposal of such fuel when lines or hoses are disconnected to prevent its accumulation in the wing.

**FUEL SELECTOR CONTROL SYSTEM.**

The fuel selector valve controls handles are located between the front seats on the cabin floor. The control valve handle on the right controls fuel flow to the right engine by allowing fuel to be used from the right main tank, right auxiliary tank or through the crossfeed system, from left main tank. The control valve handle on the left controls fuel flow to the left engine by allowing fuel to be used from the left main tank, left auxiliary tank, or through the crossfeed system from the right main tank. The handles are of rotary-type and are operated mechanically through a 270° range by a gear arrangement and a flex cable connected to the fuel selector valve assemblies mounted outboard of the engine nacelles in the leading edge of the wing. The four valve positions which are marked on the "metalcals" are: LEFT MAIN, RIGHT MAIN, LEFT AUXILIARY and OFF; RIGHT MAIN, LEFT MAIN, RIGHT AUXILIARY and OFF. The fuel selector valve handles indicate the position



1. Screw
2. Spacer
3. Handle
4. Floorboard

5. Bracket
6. Gear Box
7. Cable
8. Cotter Pin

9. Nut  
10. Terminal

Figure 11-5. Fuel Selector Control Handle and Gear Box

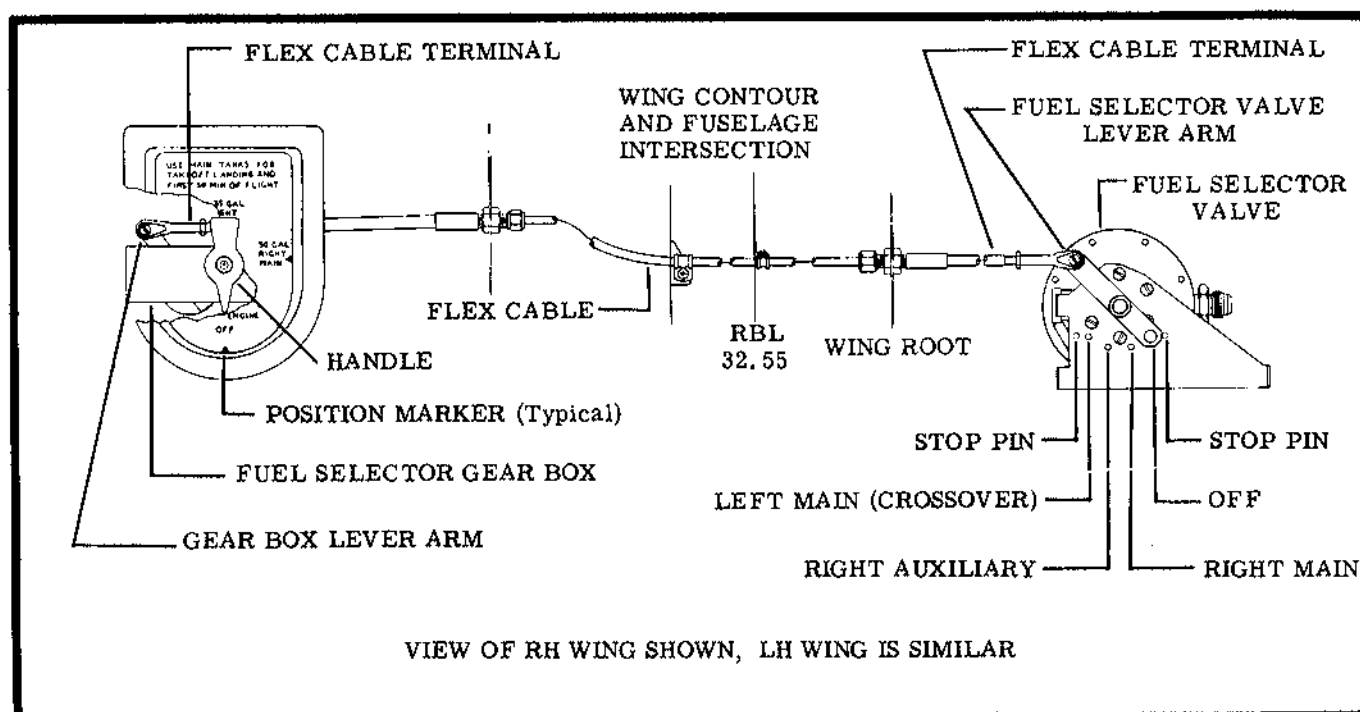
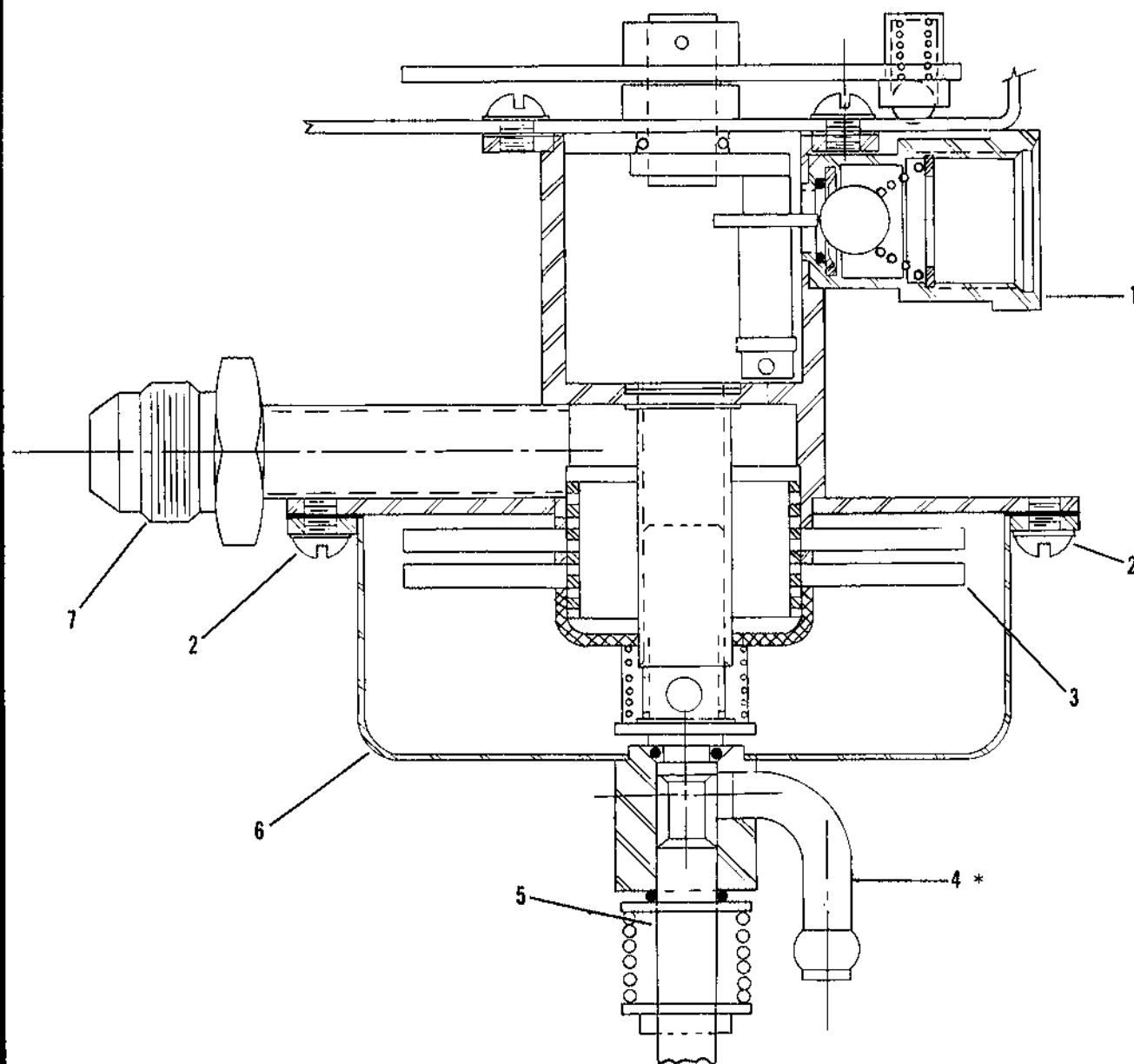


**Figure 11-6. Fuel Selector Rigging Schematic**





\*REMOVED ON 310L0140 and ON

- |               |                         |                  |
|---------------|-------------------------|------------------|
| 1. Fuel Inlet | 3. Filter               | 6. Sediment Bowl |
| 2. Screw      | 4. Drain Tube           | 7. Fuel Outlet   |
|               | 5. Drain Valve Push-Rod |                  |

Figure 11-7. Fuel Selector Valve and Strainer

of the fuel selector valves. The valve handles are protected by a guard to prevent the possibility of switching or movement by pilot's or copilot's feet.

#### Removal of Fuel Selector Control System.

Removal of fuel selector control system is the same for either selector.

- a. Fuel selector valve handles - OFF.
- b. Remove fuel selector valve handle.
- c. Remove carpet aft of the control pedestal to gain access to gear box through the access hole provided.
- d. Disconnect linkage and remove gear box.
- e. Remove cable fittings and clamps securing cable to stringers.
- f. Remove cable from aircraft.

#### Installation of Fuel Selector Control System.

- a. Route cable through stringers and clamp.
- b. Connect cable ends to selector valve and gear box and safety.
- c. Install gear box to bracket.
- d. Install bracket and gear box through pan; then install valve handle.
- e. Check operation for binding and smooth actuation through the full 270° range.

#### NOTE

Support and security of the fuel selector flex cables is most essential to provide the optimum fuel selector valve operation. Inspect the fuel selector cable support joints for adequate tightness and security.

#### Rigging the Fuel Selector Valve. (See figure 11-6.)

- a. Remove carpet retainer and fold back carpet just enough to remove floorboard access plate per upholstery removal procedures.
- b. (See figure 1-3.) Remove wing access plates (45 and 46).
- c. Position lever arm on fuel selector valve in wing to the most outboard detent and resting against the stop pin.

#### NOTE

Observe that the attachment hole in lever arm is pointing inboard.

- d. Connect terminal on flex cable to the fuel selector valve lever arm with attaching bolt, nut and cotter pin.
- e. On the cabin floorboard, rotate (counterclockwise for LH and clockwise for RH) the handle on the

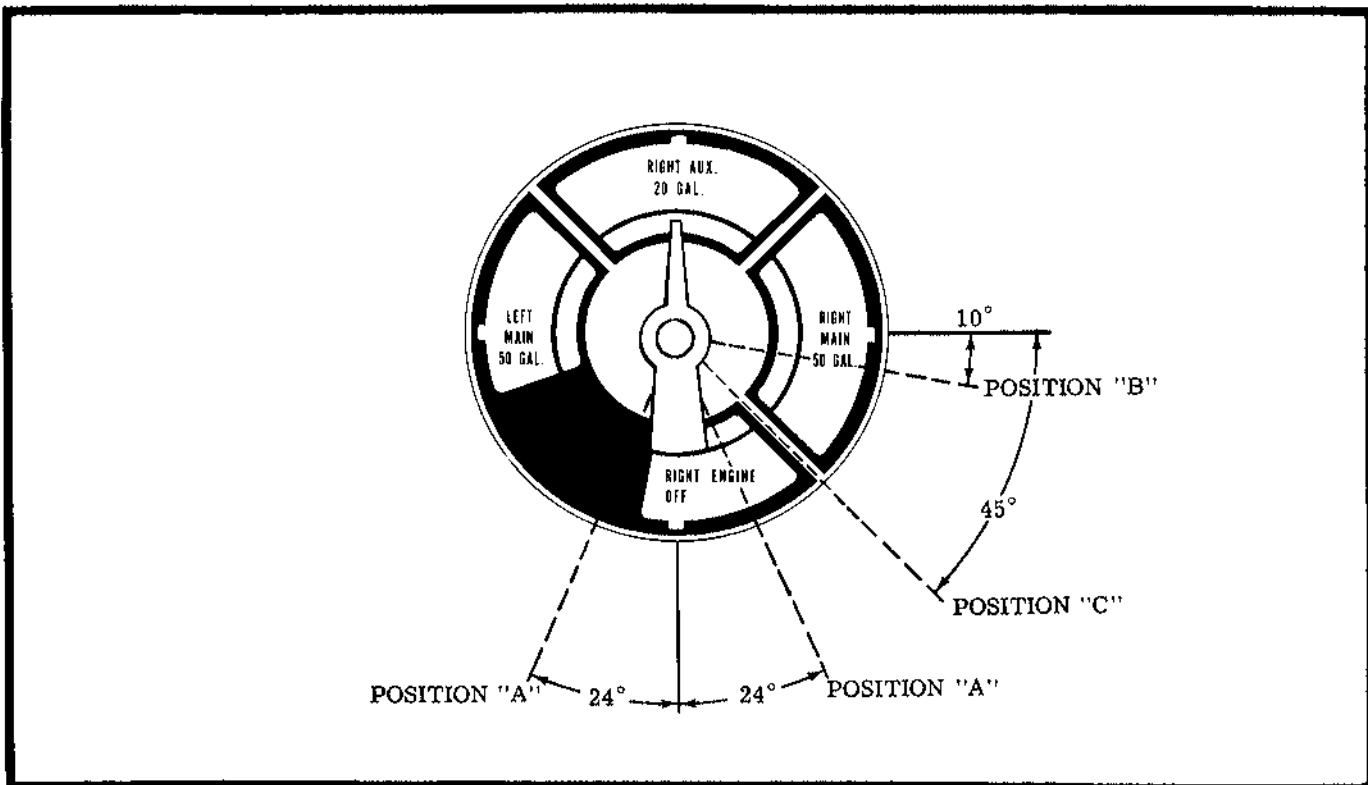


Figure 11-8. Fuel Selector Valve Handle

gear box until lever arm comes to rest against gear box bracket.

f. Rotate handle (clockwise for LH and counter-clockwise for RH) approximately 5° until a pointer on the handle is aligned with the OFF position marker.

#### CAUTION

Observe that the handle is parallel with the centerline of aircraft and pointer on handle is indexed to the OFF position (aft).

g. With the handles in the position described in step f. above, adjust terminal and flex cable until attach holes on gear box lever arm and terminal are aligned.

h. Connect terminal to gear box lever arm with attaching screw, nut and cotter pin.

i. Start from the OFF position and rotate (clockwise for LH and counterclockwise for RH) the handles to the LEFT MAIN and RIGHT MAIN positions respectively.

j. Observe that the pointer end of handle nearly aligns with marker on placard after traveling approximately 90° from the OFF position and the fuel selector valve lever arm seats in the respective main tank detent on the fuel selector valve.

k. If the fuel selector valve lever arm has not seated in proper detent after handle has been rotated 90° from the OFF position, lengthen or shorten terminals and/or flex cables as necessary to achieve proper rigging.

l. Continue from the LEFT MAIN and RIGHT MAIN position, rotate handles to the LEFT AUXILIARY and RIGHT AUXILIARY positions respectively.

m. Observe that the pointer end of handle nearly aligns with marker on placard after traveling approximately 180° from the OFF position and the fuel selector valve lever arm seats in the respective auxiliary tank detent on the fuel selector valve.

n. If the fuel selector valve lever arm has not seated in proper detent after handle has been rotated 180° from the OFF position, lengthen or shorten terminals and/or flex cable as necessary to achieve proper rigging.

o. Continue from the LEFT AUXILIARY and RIGHT AUXILIARY position, rotate LH handle to the RIGHT MAIN (crossover) and RH handle to LEFT MAIN (crossover).

p. Observe that the pointer end of handle nearly aligns with marker on placard after traveling approximately 270° from the OFF position and the fuel selector valve lever arm seats in the respective in-board crossover tank detent on the fuel selector valve and against pin stop.

q. If the fuel selector valve lever arm has not seated in proper detent after handle has been rotated 270° from the OFF position, lengthen or shorten terminals and/or flex cable as necessary to achieve proper rigging.

#### NOTE

If terminal and/or flex cable adjustments have been made at one of the fuel selector positions, repeat steps i, j, l, m, o and p to verify correct rigging and make further adjustments as necessary.

#### Operational Check

Place the left fuel selector valve handle in the LEFT MAIN position, and the right fuel selector valve handle in the OFF position. Start the left engine. When the engine is sufficiently warmed up, advance the throttle to 1500 RPM. Observe the fuel flow gage to assure there are no radical fluctuations and for proper fuel flow. Observe the engine for a proper short continuous run. Place the left selector valve handle to the RIGHT MAIN position, repeat the above steps and observations. With engine at idle RPM place the left fuel selector valve handle to the OFF position. The engine should run momentarily, then fail. Check the right fuel selector valve by placing the right fuel selector valve handle in the RIGHT MAIN position, and left fuel selector valve handle in the OFF position. Start the right engine and check the right selector valve in accordance with above procedures for the left fuel selector valve.

#### NOTE

The crossfeed system allows fuel to be used from the opposite main tanks only. There are no provisions to crossfeed fuel from auxiliary fuel tanks.

#### Removal of Auxiliary Fuel Pump. (See figure 11-9.)

The removal procedure is the same for either auxiliary fuel pump.

- a. Make sure fuel selector valve handles are OFF.
- b. Drain fuel in main tank affected.

#### CAUTION

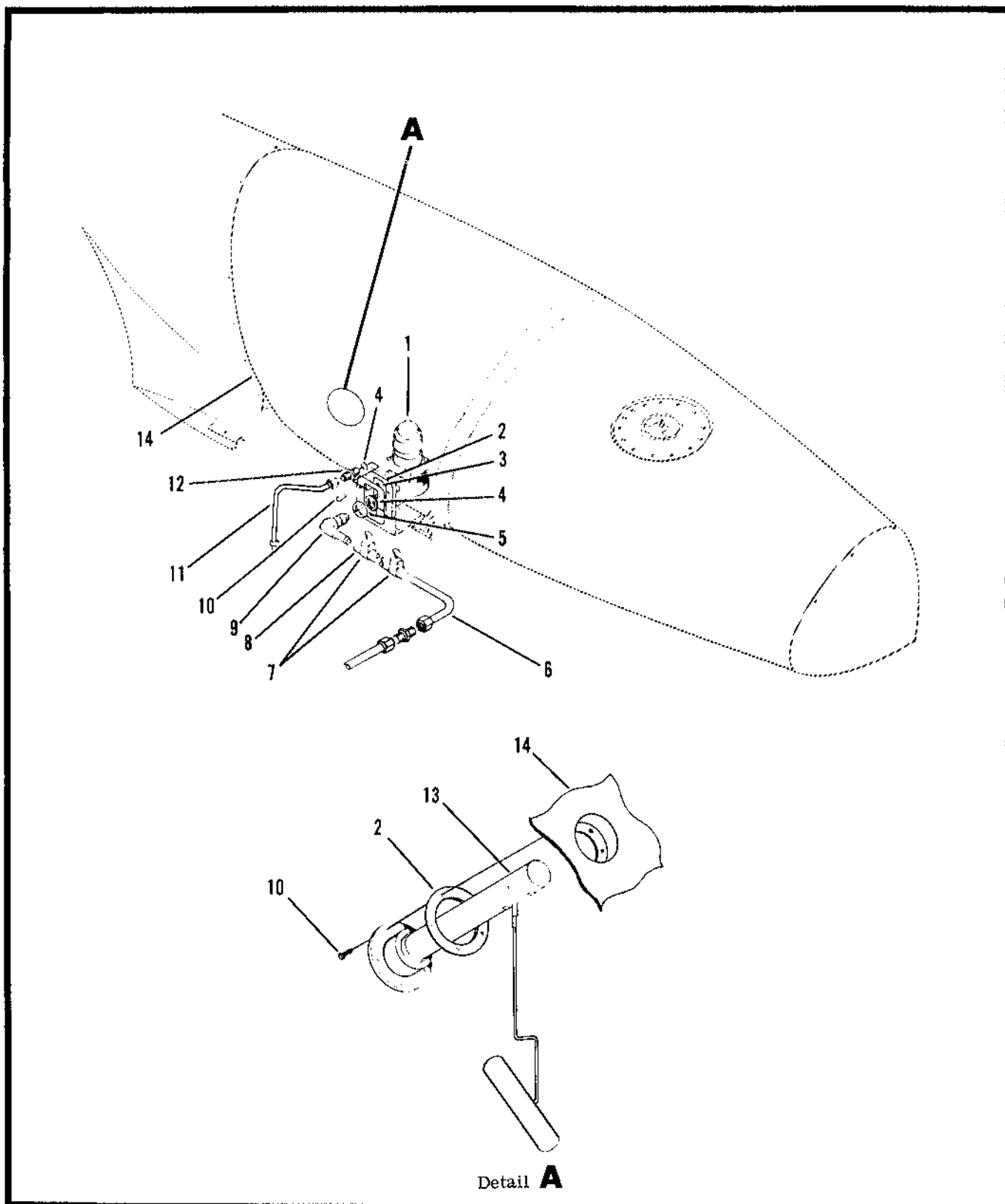
During all defueling, tank purging and tank repairing operations, two ground wires, from different points on the aircraft to separate approved grounding stakes, shall be used to prevent ungrounding of the aircraft due to accidental disconnecting of one ground wire.

- c. Remove tip tank and wing fairing.
- d. Loosen hose clamps (7) and remove hose (8).
- e. Disconnect fuel pump drain line (11) and remove.
- f. Remove nipple (12), elbow (9), nut (5) and O-ring (4).
- g. Remove tip tank tail cap, rear access plate and gasket.
- h. Remove four bolts (10), gaskets (2) and remove auxiliary fuel pump (1) from inside the fuel tank.

#### Installation of Auxiliary Fuel Pump. (See figure 11-9.)

Installation of auxiliary fuel pump is the same for either auxiliary fuel pump.

- a. Install auxiliary fuel pump (1) inside tip tank through rear access hole; use new gasket (2). Secure in place with bolts (10).
- b. Install O-ring (4), nut (5) and elbow (9) in fuel pump.
- c. Install nipple (12), drain line (11), hose (8) and clamps (7). Connect to line (6).



1. Auxiliary Fuel Pump
2. Gasket
3. Doubler
4. O-Ring
5. Nut

6. Fuel Supply Line
7. Clamp
8. Hose
9. Elbow

10. Bolt
11. Fuel Pump Drain Line
12. Nipple
13. Fuel Quantity Sending Unit
14. Fuel Tank

Figure 11-9. Fuel Quantity Sending Unit and Auxiliary Fuel Pump

- d. Install rear access plate and new gasket.
- e. Connect electrical leads.
- f. Fuel aircraft and check for leaks.
- g. Turn on auxiliary fuel pump and check for operation and leaks.
- h. Replace tip tank tail cap and wing fairings.

#### Auxiliary Fuel Pump Low Adjustment.

- a. Service aircraft in accordance with Section 1.
- b. Disconnect the electrical leads to the oil pressure switch at the quick disconnect. Connect the two leads together to close the electrical circuit.

#### NOTE

A normally open oil pressure switch has been added to the oil pressure indicator line and is electrically connected in series with the auxiliary fuel pump switch. The auxiliary fuel pump will not operate (except by the primer switch) if the respective engine is not running or oil pressure is below approximately 20 PSI. With the engine running and oil pressure above 20 PSI the respective oil pressure switch will be actuated to the closed position, allowing the auxiliary fuel pump to function normally as required by the position of the auxiliary fuel pump switch and available fuel pressure.

- c. Place fuel selector valve handles to the desired tank.
- d. Place mixture lever to IDLE CUT-OFF.
- e. Connect a test pressure gage at engine-driven pump inlet line.
- f. Connect a 28 volt dc auxiliary power unit to aircraft or run opposite engine at 1500 RPM with no other electrical equipment on to assure full electrical bus voltage.
- g. Position auxiliary fuel pump to LOW for engine being checked and check test pressure gage connected to engine-driven inlet line for 5.5 PSI of fuel pressure.
- h. If fuel pressure is not 5.5 PSI, remove wing root fairing and adjust resistor (see figure 11-10) until required boost pump pressure is obtained.

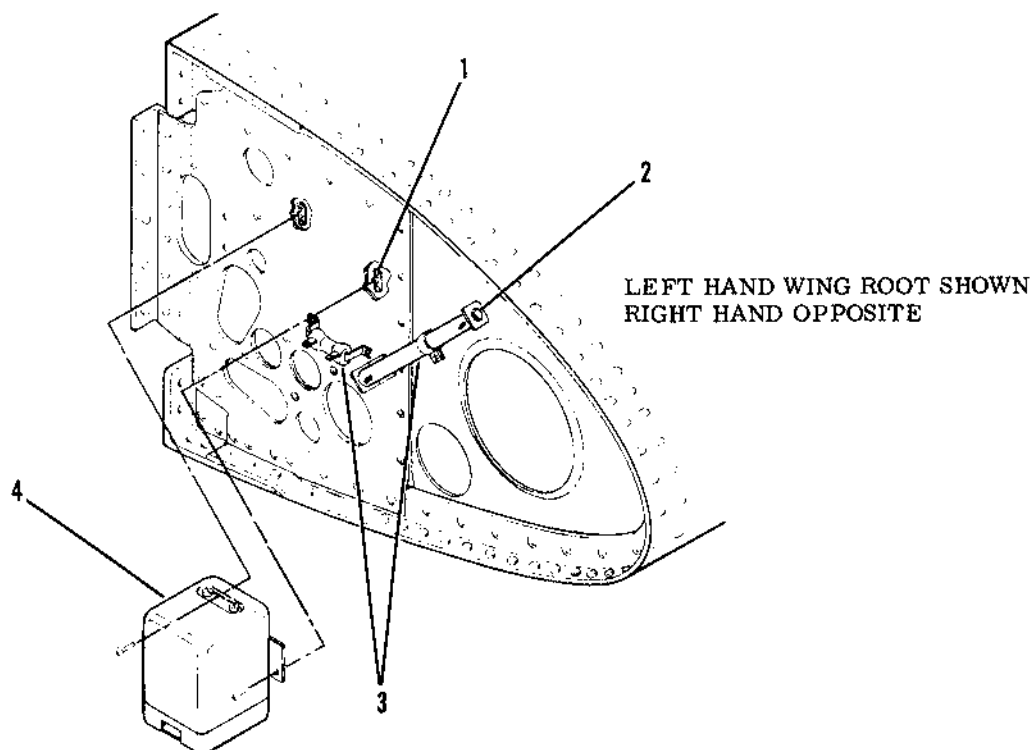
#### NOTE

Keep dropping resistor cool with air blast.

- i. Turn all switches OFF, place fuel selector valve handle to OFF position, remove test pressure gage and replace fairing.
- j. Connect the electrical leads to the oil pressure switch.

#### NOTE

Procedures given apply to either right or left auxiliary fuel pump.



- 1. Nutplate
- 2. Bolt

- 3. Resistor
- 4. Relay

Figure 11-10. Auxiliary Fuel Pump Relay and Resistor Installation

### Ground Check of Fuel Pressure Switch and Oil Pressure Switch .

- a. Turn master switch ON.
- b. Turn auxiliary fuel pump switch ON - auxiliary fuel pump should not run.
- c. Start engine and run at 1000 RPM - check oil pressure above 20 PSI.
- d. Position auxiliary fuel pump switch to LOW position - make audio check of pump for low speed operation.
- e. Position auxiliary fuel pump switch to ON position - recheck pump operation for low speed.

#### NOTE

If audio check indicates pump is running, the oil pressure switch is functioning normally.

- f. Momentarily position mixture lever to IDLE CUT-OFF - make audio check for pump going to high speed.

#### NOTE

If pump goes to high speed, fuel pressure switch is functioning normally.

- g. Turn auxiliary fuel pump switch OFF when pump goes to high speed.

#### NOTE

If auxiliary fuel pump does not go into high speed, proceed with the following steps.

- h. Auxiliary fuel pump switch - OFF.
- i. In the engine nacelle, jumper the oil pressure switch electrical leads to close the circuit.
- j. With the engine not running, momentarily position the auxiliary fuel pump switch to ON - make audio check of pump for high speed operation.

#### NOTE

If auxiliary fuel pump goes into high speed, the fuel pressure switch and pump are functioning normally.

- k. Position master switch to OFF and disconnect jumper from oil pressure switch electrical leads.

### Fuel Indicator System.

The main and auxiliary fuel systems have individual indicators and each fuel tank has an individual sending unit. The two systems are float arm actuated, variable resistor type sending unit, powered by the aircraft electrical system, which sends an electrical signal to the fuel quantity indicators in the cabin.

### Removal of Main Fuel Quantity Sending Unit.

The removal procedure is the same for either main fuel quantity sending unit.

- a. Defuel aircraft in accordance with Section 2.

### CAUTION

During all defueling, tank purging and tank repairing operations, two ground wires from different points on the aircraft to separate approved grounding stakes shall be used to prevent ungrounding of the aircraft due to accidental disconnection of one ground wire.

- b. Remove main tip tank tail cap.
- c. Tag and disconnect electrical wires.
- d. (See figure 11-9) Remove bolts (10), gaskets (2) and fuel quantity sending unit (13).

### Installation of Main Fuel Quantity Sending Unit.

The installation procedure is the same for either tank.

- a. (See figure 11-9) Install fuel quantity sending unit (13) and gasket (2) with bolts (10).
- b. Connect electrical wires and remove tags.
- c. Install main tip tank tail cap.
- d. Check operation of main fuel quantity sending unit by performing an operational check.

### Fuel Quantity Sending Units Operational Check.

The procedure for checking the operation of fuel quantity sending units is the same for either unit and either system auxiliary or main fuel quantity sending units.

- a. With fuel tanks completely drained, close the drain valves.
- b. Turn battery switch to the ON position.
- c. Add 1/2 gallon of fuel to tank (the amount determined as unusable fuel) and the fuel quantity indicator should read empty (E).
- d. Add fuel in five gallon increments until the total capacity of the tank is reached. Check fuel quantity indicator for each five gallons of fuel added.

#### NOTE

Slight adjustment can be made by bending the float arm on the fuel quantity sending unit.

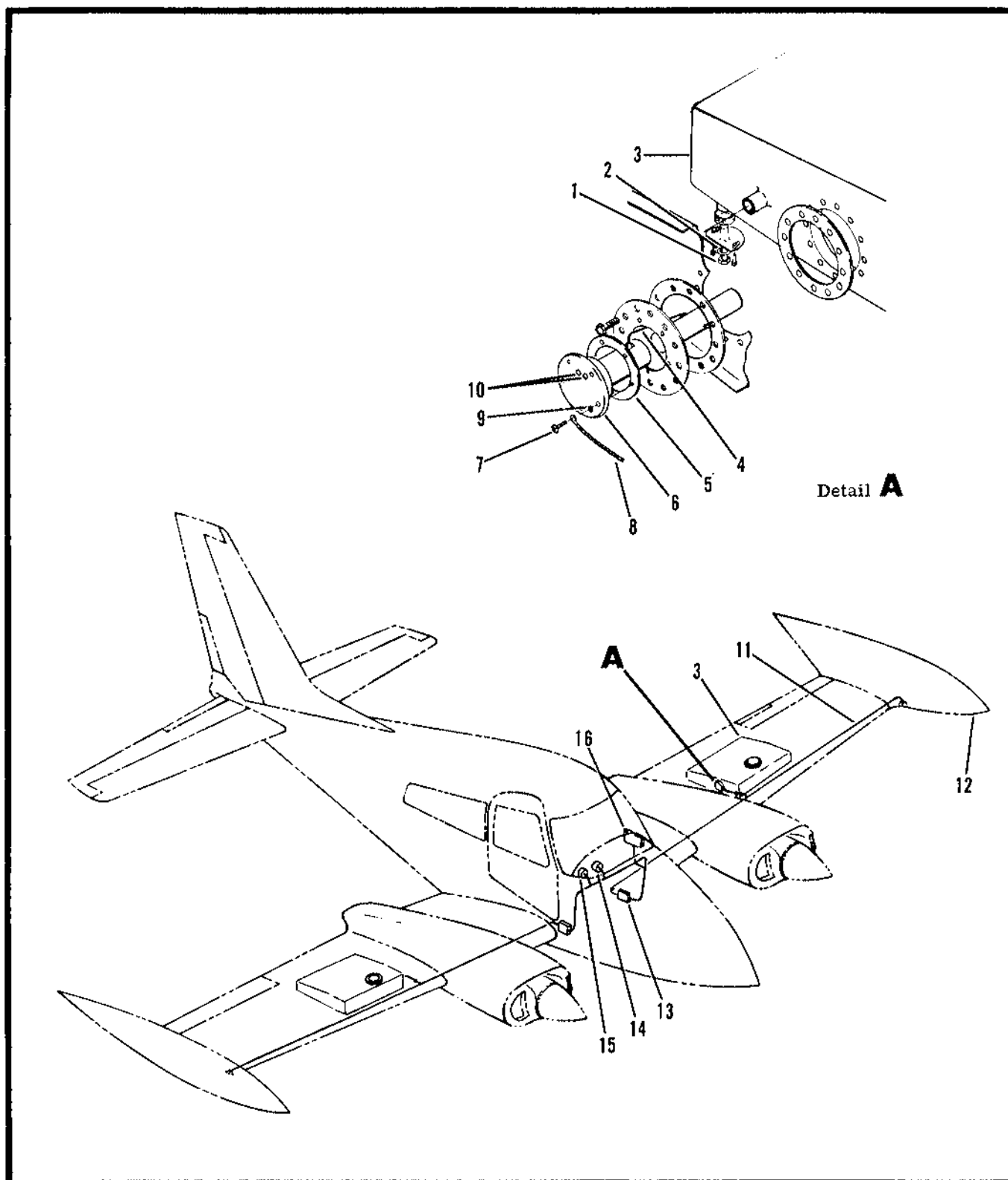
### Removal of Auxiliary Fuel Quantity Sending Units. (See figure 11-11.)

The removal procedure for the auxiliary fuel quantity sending units is the same for either side. However, on the left side the battery box must be removed.

- a. Remove the access cover located just outboard of the engine nacelle on the upper surface of the wing.
- b. Defuel aircraft in accordance with Section 2.

### CAUTION

During all defueling, tank purging and tank repairing operations, two ground wires from different points on the aircraft to separate approved grounding stakes shall be used to prevent ungrounding of the aircraft due to accidental disconnecting of one ground wire.



- |                        |                               |                              |
|------------------------|-------------------------------|------------------------------|
| 1. Quick Drain Plug    | 6. Fuel Quantity Sending Unit | 12. Main Fuel Tank           |
| 2. Gasket              | 7. Screw                      | 13. Electrical Junction Box  |
| 3. Auxiliary Fuel Tank | 8. Bonding Strap              | 14. Main Tank Fuel Gage      |
| 4. Float Arm           | 9. Seal Washer                | 15. Auxiliary Tank Fuel Gage |
| 5. Gasket              | 10. Electrical Terminals      | 16. Circuit Breaker Panel    |
|                        | 11. Wire Bundle               |                              |

Figure 11-11. Auxiliary Fuel Quantity Sending Unit

- c. Tag and disconnect electrical wires.
- d. Remove the five screws (7) securing the auxiliary fuel tank sending unit and remove the unit from the aircraft.

**WARNING**

Residual fuel accumulation in the wing is a fire hazard. Use care to prevent the accumulation of such fuel.

Installation of Auxiliary Fuel Quantity Sending Units.  
(See figure 11-9.)

The installation procedure for the installation of the auxiliary fuel quantity sending units is the same for either side.

- a. Install the fuel quantity transmitter (13) and gasket (2) and secure with five attaching screws (10) and seal washers.
- b. Connect electrical wires.
- c. Service tank with proper grade of fuel and check for leaks.
- d. Replace cover plates and check operation of the auxiliary fuel quantity sending unit per operational check procedure.

Trouble Shooting the Fuel Quantity Indicator System. (The trouble shooting chart is the same for either system.)

| TROUBLE                                | PROBABLE CAUSE                                        | CORRECTION                                                                                                                                                                                                                                       |
|----------------------------------------|-------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| INCORRECT QUANTITY INDICATION          | Defective wiring.<br><br>Defective sending unit.      | Replace or repair defective wiring.<br><br>Remove wires at the sending unit and attach an ohmmeter to unit terminals. Operate float by hand. If the unit is good, the meter should read approximately 15 ohms when empty and 180 ohms when full. |
| NO INDICATION ON GAGE AND TANK IS FULL | Circuit breaker out.<br><br>Defective circuit breaker | Reset circuit breaker.<br><br>Replace circuit breaker.                                                                                                                                                                                           |

**WING LOCKER FUEL TANKS (OPTIONAL).**

The optional wing locker fuel tanks are mounted in the forward nacelle baggage area of each wing. The tank is a synthetic rubber cell held in place by button fasteners. Each wing locker tank has an overboard vent and drain tube. A fuel transfer pump, mounted on the rib outboard of the nacelle, transfers fuel from the wing locker tank to the respective wing main tank. Each tank has a total capacity of 20.3 U. S. Gallons.

Removal of Wing Locker Fuel Tanks (Optional).  
(See figure 11-12.)

The removal procedure is the same for either left-hand or right-hand wing locker tank.

- a. Defuel wing locker tank to be removed by transferring fuel to main fuel tank and opening drain valve to drain remaining fuel.
- b. Turn off all power.

**CAUTION**

During all defueling, tank purging and tank repair operations, two ground wires from different points on the aircraft to separate approved grounding stakes, shall be used to prevent ungrounding of the aircraft due to accidental disconnecting of one ground wire.

- c. Refer to figure 1-3 and remove access panels (63 and 65) and wing locker fuel tank filler (95).
- d. Loosen clamp and remove strainer (6) from wing locker fuel cell.
- e. Loosen clamp and remove drain line (3) from wing locker fuel cell (5).
- f. Loosen clamp and disconnect vent line (20) from wing locker fuel cell (5).
- g. Pull fasteners down; carefully fold the cell and remove cell through the filler cap opening.

**WARNING**

Residual fuel draining from lines and hoses is a fire hazard. Use care to prevent accumulation of the fuel in the bottom of the nacelle and wing area when lines and fuel cell are removed.

Installation of Wing Locker Fuel Tanks (Optional).  
(See figure 11-12.)

- a. Make sure fuel cell area is clean, free from dirt and foreign material.
- b. Carefully insert fuel cell through the filler opening and arrange the cell in the correct position by fastening the fasteners in place.
- c. Install fuel strainer (6) into fuel cell and tighten clamp.
- d. Install drain line (3) in fuel cell (5) and tighten clamp.



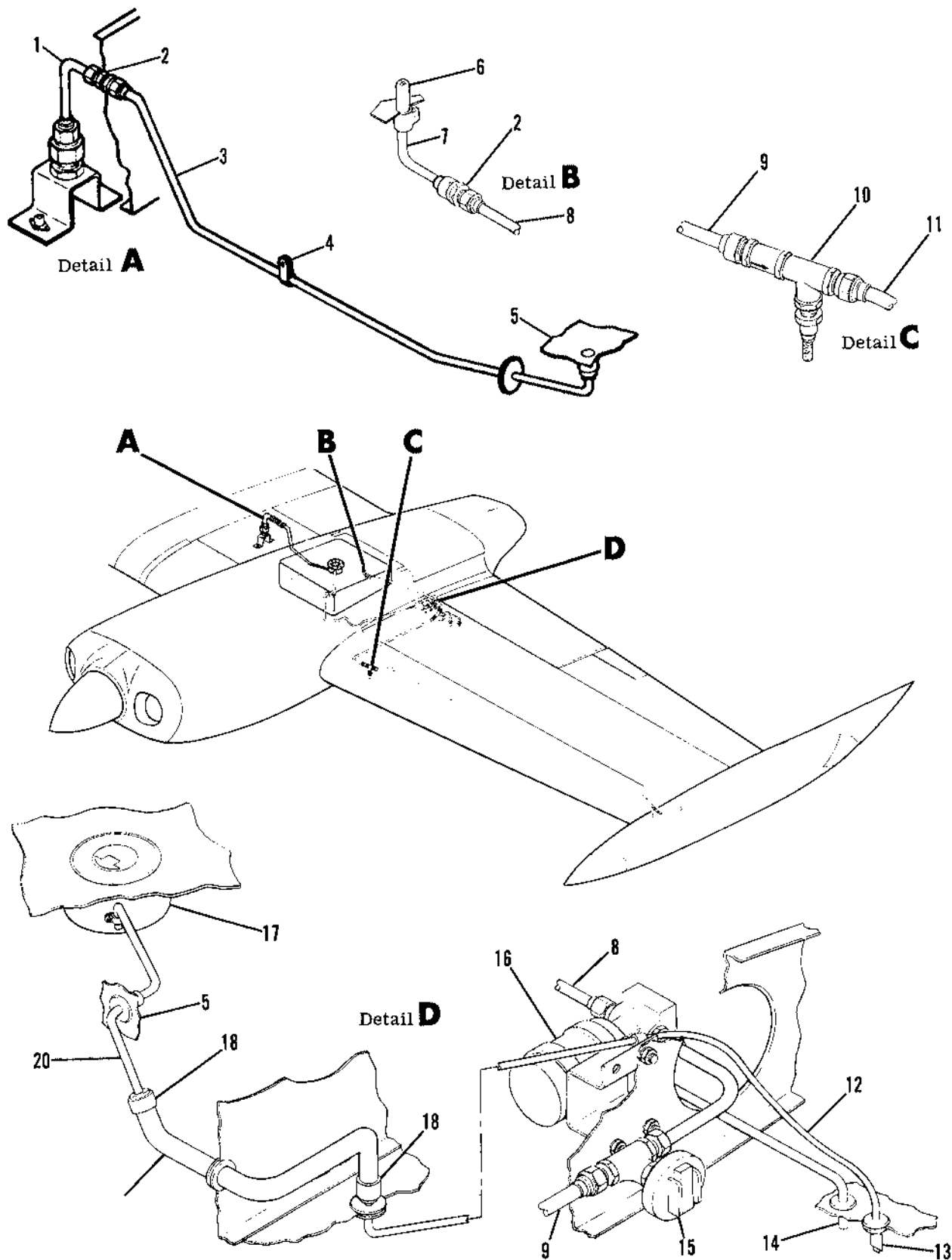


Figure 11-12. Wing Locker Fuel

Figure 11-12. Wing Locker Fuel Callouts

- |                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                   |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ol style="list-style-type: none"> <li>1. Drain Line (Union to Drain Valve)</li> <li>2. Union</li> <li>3. Drain Line (Fuel Cell to Union)</li> <li>4. Clamp</li> <li>5. Wing Locker Fuel Cell</li> <li>6. Fuel Strainer</li> <li>7. Fuel Line (Tank to Union)</li> <li>8. Fuel Line (Union to Transfer Pump)</li> <li>9. Fuel Line (Transfer Pump to Drain Valve)</li> <li>10. Fuel Drain</li> </ol> | <ol style="list-style-type: none"> <li>11. Fuel Line (Drain Valve to Main Fuel Tank)</li> <li>12. Vent Line</li> <li>13. Vent Heater</li> <li>14. Transfer Pump Drain</li> <li>15. Transfer Light Pressure Switch</li> <li>16. Transfer Pump</li> <li>17. Fuel Filler</li> <li>18. Clamp</li> <li>19. Vent Hose</li> <li>20. Vent Line</li> </ol> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

e. Install vent line (20) in wing locker fuel cell (5) and tighten clamp.

#### NOTE

When installing clamps, be careful not to over-torque.

#### WING LOCKER FUEL PLUMBING.

Removal of Wing Locker Fuel Plumbing (Optional).  
(See figure 11-12.)

The removal procedures are the same for either side of the wing locker fuel system plumbing.

- a. Defuel wing locker fuel system to be removed by transferring fuel to main fuel tank and opening drain valve to drain remaining fuel.
- b. See figure 1-3 and remove access panels, tip tank fairing and wing gap fairing.
- c. Remove wing locker fuel tank in accordance with removal procedures.

#### CAUTION

During all defueling, tank purging and tank repair operation, two ground wires from different points on the aircraft to separate approved grounding stakes, shall be used to prevent ungrounding of the aircraft due to accidental disconnecting of one ground wire.

- d. Tag and disconnect electrical wires to vent heater (13), remove clamp and disconnect hose (19), loosen clamps and remove vent line (20). To remove vent line (12), vent hose (19) and vent line (20), it will be necessary to remove the firewall access cover.
- e. Disconnect fuel drain line (14) from transfer pump (16).
- f. Loosen clamp on fuel strainer (6), disconnect line (7) from union (2) and fuel line (8) from transfer pump (16) and carefully work lines out through the access holes.
- g. Disconnect fuel line (9) from drain valve (10) and transfer pump (16) and remove.

#### WARNING

Residual fuel draining from lines and hoses is a fire hazard. Use care to prevent accumulation of the fuel in the bottom of nacelle and wing area when lines and fuel cell are removed.

- h. Removal of fuel line (11) is not recommended; however, fuel line (11) may be removed as follows:
  1. Remove main fuel tank in accordance with removal procedures.
  2. Remove access covers from underside of wing.
  3. Remove clamps and pull fuel line (11) straight out.
- i. Tag and disconnect transfer pump wiring, remove clamp securing transfer pump by removing nut washer and bolts.
- j. Disconnect drain line (1) from mounting bracket and union (2) and remove from wing gap area.
- k. Loosen clamp from wing locker fuel cell (5), remove clamp (4) and remove drain line (3) from wheel well area.

Installation of Wing Locker Fuel Plumbing (Optional).  
(See figure 11-12.)

- a. Installation of the wing locker fuel plumbing is the reversal of the removal procedures.

#### FUEL VENT HEATERS.

Vent heaters installed on each vent tube prevent the vent from freezing of vapors. During removal and installation, care must be used to prevent damage to the wiring and heaters.

- a. Removal of the vent heater is not recommended; if heater is removed, replace as follows:
  1. Clean vent tube surface in the area where heater is to be installed with 280 grit sandpaper and Ketone (MEK).
  2. (See figure 11-2.) Bond vent heater to vent tube using epoxy cement Epon 834 with curing agent TTA in accordance with the manufacturer's instructions.
  3. Pot heater wires with EC2273 to prevent from damage. Mix parts A and B in accordance with manufacturer's instructions.

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## SECTION 12

## INSTRUMENTS AND RELATED SYSTEMS

## Table of Contents

|                                                     | Page  |                                                  | Page  |
|-----------------------------------------------------|-------|--------------------------------------------------|-------|
| GENERAL . . . . .                                   | 12-1  | Installation of Vacuum Pump . . . . .            | 12-11 |
| INSTRUMENTS . . . . .                               | 12-1  | Removal and Installation of Vacuum               |       |
| Vacuum System Instruments . . . . .                 | 12-1  | Air Filter . . . . .                             | 12-11 |
| Pitot-Static System Instruments . . . . .           | 12-2  | Replacement of Vacuum Air Filter                 |       |
| Engine Instruments . . . . .                        | 12-2  | Element . . . . .                                | 12-11 |
| Miscellaneous Instruments . . . . .                 | 12-2  | Removal and Installation of Vacuum               |       |
| Typical Instrument Removal . . . . .                | 12-5  | Relief Valve . . . . .                           | 12-11 |
| Typical Instrument Installation . . . . .           | 12-5  | Adjustment of Vacuum Relief Valve . . . . .      | 12-11 |
| Removal of Stall Warning Transmitter . . . . .      | 12-5  | Removal of Vacuum System Plumbing . . . . .      | 12-13 |
| Installation of Stall Warning Transmitter . . . . . | 12-5  | Installation of Vacuum System Plumbing . . . . . | 12-13 |
| Removal of Magnetic Compass . . . . .               | 12-6  | PITOT-STATIC SYSTEM . . . . .                    | 12-13 |
| Installation of Magnetic Compass . . . . .          | 12-6  | Removal Pitot Tube . . . . .                     | 12-13 |
| Typical Bulb Removal and Installation . . . . .     | 12-6  | Installation of Pitot Tube . . . . .             | 12-13 |
| Trouble Shooting the Instruments . . . . .          | 12-6  | Removal of Pitot-Static Lines . . . . .          | 12-13 |
| INSTRUMENT PANELS . . . . .                         | 12-9  | Installation of Pitot-Static Lines . . . . .     | 12-13 |
| Removal of Shock-Mounted                            |       | Testing the Pitot Pressure Lines . . . . .       | 12-14 |
| Instrument Panel . . . . .                          | 12-9  | Testing the Static Pressure System . . . . .     | 12-14 |
| Installation of Shock-Mounted                       |       | Blowing out Pitot or Static Lines . . . . .      | 12-16 |
| Instrument Panel . . . . .                          | 12-9  | MANIFOLD PRESSURE SYSTEM . . . . .               | 12-16 |
| VACUUM SYSTEM . . . . .                             | 12-10 | Removal of Manifold Pressure Lines . . . . .     | 12-19 |
| Trouble Shooting the Vacuum System . . . . .        | 12-10 | Installation of Manifold Pressure                |       |
| Removal of Vacuum Pump . . . . .                    | 12-11 | Lines . . . . .                                  | 12-19 |

## GENERAL.

The stationary instrument panel is a part of the fuselage structure and is ordinarily not considered removable. The two individual shock-mounted panels, either of which may be removed individually, are attached to the stationary panel by the use of shock-mounts, an angle assembly, nuts and screws. The LH shock-mounted panel houses the flight instruments while the RH panel houses the radio controls, fuel and engine operation instruments. Individual instruments are positioned behind and secured to each panel with bolts and nuts. Since all instruments are mounted in a similar manner, a description of a typical removal and installation is provided as a guide for all removals and installations.

## INSTRUMENTS.

## Vacuum System Instruments.

a. The Directional Gyro. A flight instrument incorporating an air-driven gyro stabilized in the vertical plane. The gyro is rotated at high speed by lowering the pressure in the airtight case with the engine-driven vacuum pumps and simultaneously allowing air at atmospheric pressure to enter against the gyro buckets. Due to gyroscopic inertia, the spin axis continues to point in the same direction, even though the aircraft yaws to the left or right.

This relative motion between the gyro and the instrument case is shown on the instrument dial which is similar to a compass card. The dial, when set to agree with the aircraft's magnetic compass, provides a "dead beat" azimuth indicator that is free from "swing."

b. The Horizontal Gyro is essentially an air-driven gyroscope rotating in a horizontal plane, operated by the same supply of vacuum as the directional gyro. Due to gyroscopic inertia, the spin axis continues to point in the vertical direction providing a constant visual reference to the attitude of the aircraft relative to its pitch and roll axis. A bar across the face of the indicator represents the horizon and a miniature adjustable aircraft is mounted to the case. Aligning the miniature aircraft to the horizon bar simulates the alignment of the aircraft to the actual horizon and any deviation simulates the deviation of the aircraft from the true horizon. The indicator is marked from zero to 90 degrees.

c. The Suction Gage is calibrated in inches of mercury and indicates the amount of vacuum created by the engine-driven vacuum pumps. The vacuum gage has three connecting lines. The upper line is routed directly to the directional gyro to monitor vacuum. The lower lines are attached to the vacuum system manifold for the purpose of monitoring vacuum pump function.

d. Directional and Attitude Gyro Precession. Acceptable limits for gyro drift is 4° in either direction from a heading during a ten minute period. Excessive gyro precession can be caused by low vacuum

system pressure; therefore, the following items should specifically be checked prior to gyro removal and/or replacement.

1. Vacuum system lines for kinks or leaks.
2. Central air filter or instrument filter for dirt. The filter should be cleaned and/or replaced.
3. Suction gage for proper operation.
4. Vacuum relief valve for proper adjustment. Adjustment instructions are outlined in Adjustment of Vacuum Relief Valve Procedures.

#### NOTE

A gage reading of 5.3 inches of mercury is desirable for gyro instruments; however, a range of 4.75 to 5.25 inches of mercury is acceptable.

5. Vacuum pump for proper operation.

#### Pitot-Static System Instruments.

- a. The Sensitive Altimeter is a pressure instrument that measures the change in static pressure and by means of an indicator, translates this change into altitude above sea level. A barometric scale is incorporated in the instrument. The barometric pressure scale is calibrated in inches of mercury and is set manually by a knob on the lower left hand corner of the altimeter case. Three pointers on the dial of the instrument indicate altitude in units of 100 feet, 1,000 feet and 10,000 feet.
- b. The Airspeed Indicator measures the differential between ram, or impact air pressure taken at the pitot tube, and static air pressure. The instrument dial is calibrated in both knots and miles per hour. Should airspeed indicator require maintenance and recalibration, recalibrate in accordance with FAA TSO-2C.
- c. The Vertical Velocity Indicator measures the rate of change in static pressure when the aircraft is climbing or descending. By means of a pointer and dial it indicates the rate of ascent and descent of the aircraft in feet per minute.

#### Engine Instruments.

- a. A Fuel Quantity Indicator with two pointers on the dial, one for each wing tip tank, is located in the upper right hand portion of the instrument panel. The fuel quantity indicator receives electrical signals from the variable resistor type fuel quantity sending units located inside the wing tip tanks and indicates, in gallons, the amount of remaining useable fuel.
- b. The Dual Fuel Flow Gage senses the pressure at which fuel is delivered to the fuel injection nozzles. The gage is marked as a flowmeter. Two pointers indicate the fuel-flow for the left and right engines. The gage is a direct reading pressure gage.
- c. The manifold Pressure Gage is a direct reading gage used to indicate the pressure of the fuel-air mixture in the engine intake system. Two pointers indicate the manifold pressure in inches of mercury absolute.
- d. The Engine Combination Gages, (Cylinder Head

Temperature, Oil Temperature, and Oil Pressure) one for each engine are remote electrical indicators. Each gage is connected electrically to a cylinder head temperature bulb located underneath the number four cylinder of the respective engine. As the temperature of the bulb changes, the combination gage measures the change and the pointer indicates the temperature in degrees Fahrenheit. The oil temperature is electrically received from the oil temperature bulb, located in the engine oil passage and calibrated in degrees Fahrenheit. Oil pressure is taken directly from the pressurized engine oil passage. It is routed through small lines and hoses to the combination gage which calibrates the pressure to pounds per square inch.

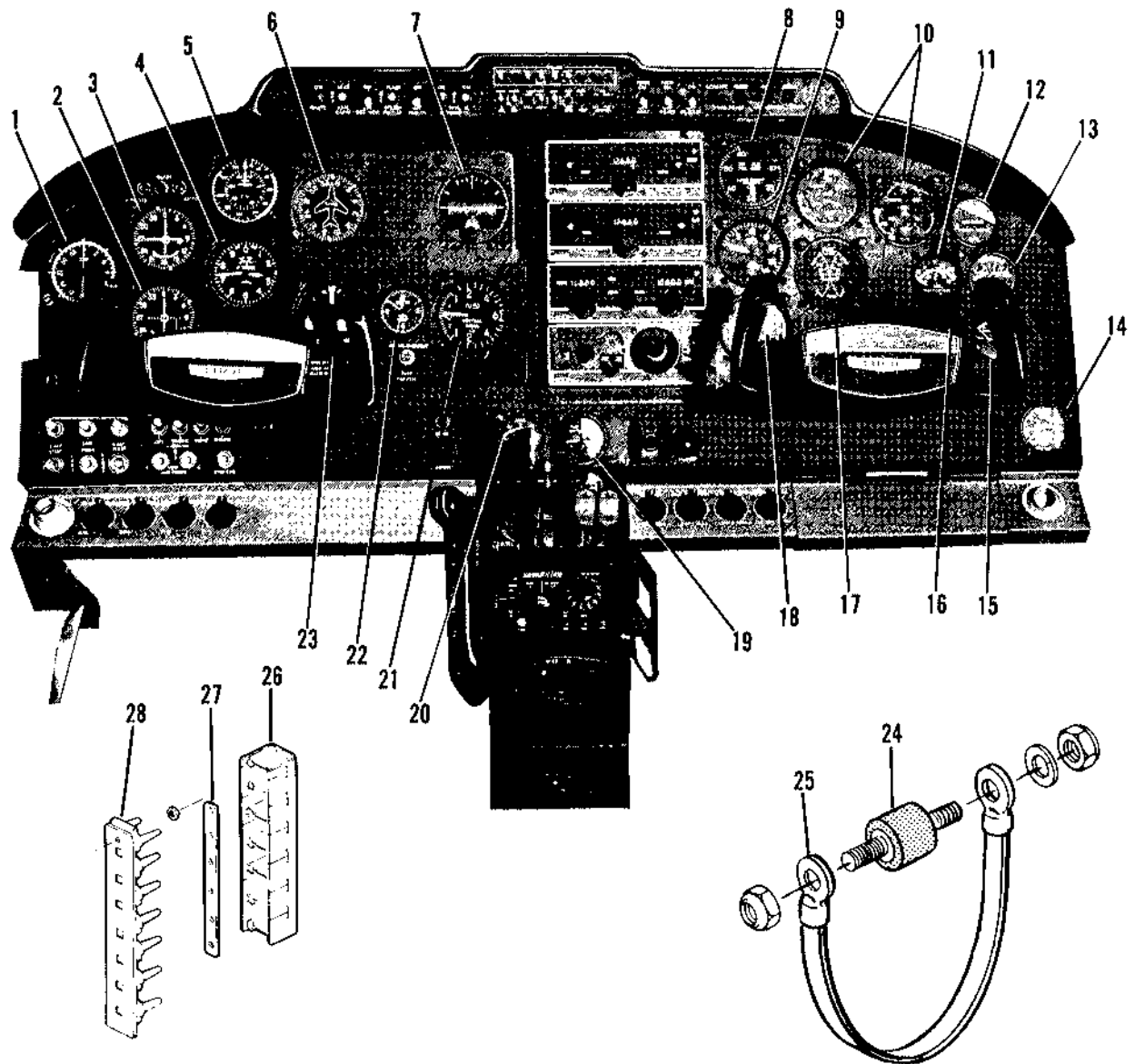
e. The Dual Tachometer is a remote electrical instrument that is connected by electrical leads to a tachometer generator on each engine. The tachometer calibrates electrical current from the tachometer generator to revolutions per minute. The pointers, one marked for each engine, are concentrically mounted so that the engines may be synchronized visually by over-lapping the pointers.

f. Economy Mixture Indicator (Optional Equipment) is an exhaust gas temperature (EGT) sensing device which is used to aid the pilot in selecting the most desirable fuel-air mixture for cruising flight of less than 75% power. EGT varies with the ratio of fuel-to-air mixture entering the engine cylinders. Refer to Section 13 for removal, installation and calibration procedures.

#### Miscellaneous Instruments.

- a. The Turn-and-Bank Indicator is a combination instrument. The turn indicator is an electrically-driven gyro mounted in a horizontal gimbal that is attached to a pointer which indicates the rate of turn. The slip indicator consists of a curved, liquid-filled glass tube in which an inclinometer ball, moving with dampened motion, changes positions according to the gravitational and centrifugal force acting upon the aircraft.
- b. The Ammeters measure the current received, or current drain on the battery, one being used for alternators the other for optional propeller deice system.
- c. The Magnetic Compass is located on the windshield. It consists of a pair of parallel magnetic bars surrounded by a circular calibrated compass card visible through a window in the compass case. The compass case is a metal bowl filled with liquid to dampen dial oscillation. Lighting is integral and controlled by a rheostat on the switch panel. The compass has two adjusting set screws, one for N-S headings and one for E-W headings. These set screws are located on lower face of compass behind the metal disc.
- d. The Stall Warning Horn is mounted behind the instrument panel on the left hand side. A stall warning transmitter, mounted on the leading edge of the left wing, energizes the electrical circuit when the aircraft approaches a stall and causes the horn to operate. The stall warning transmitter incorporates a heater element, operated by the pitot heater switch, to prevent ice from hampering its operation.

310L0001 TO 310N0001



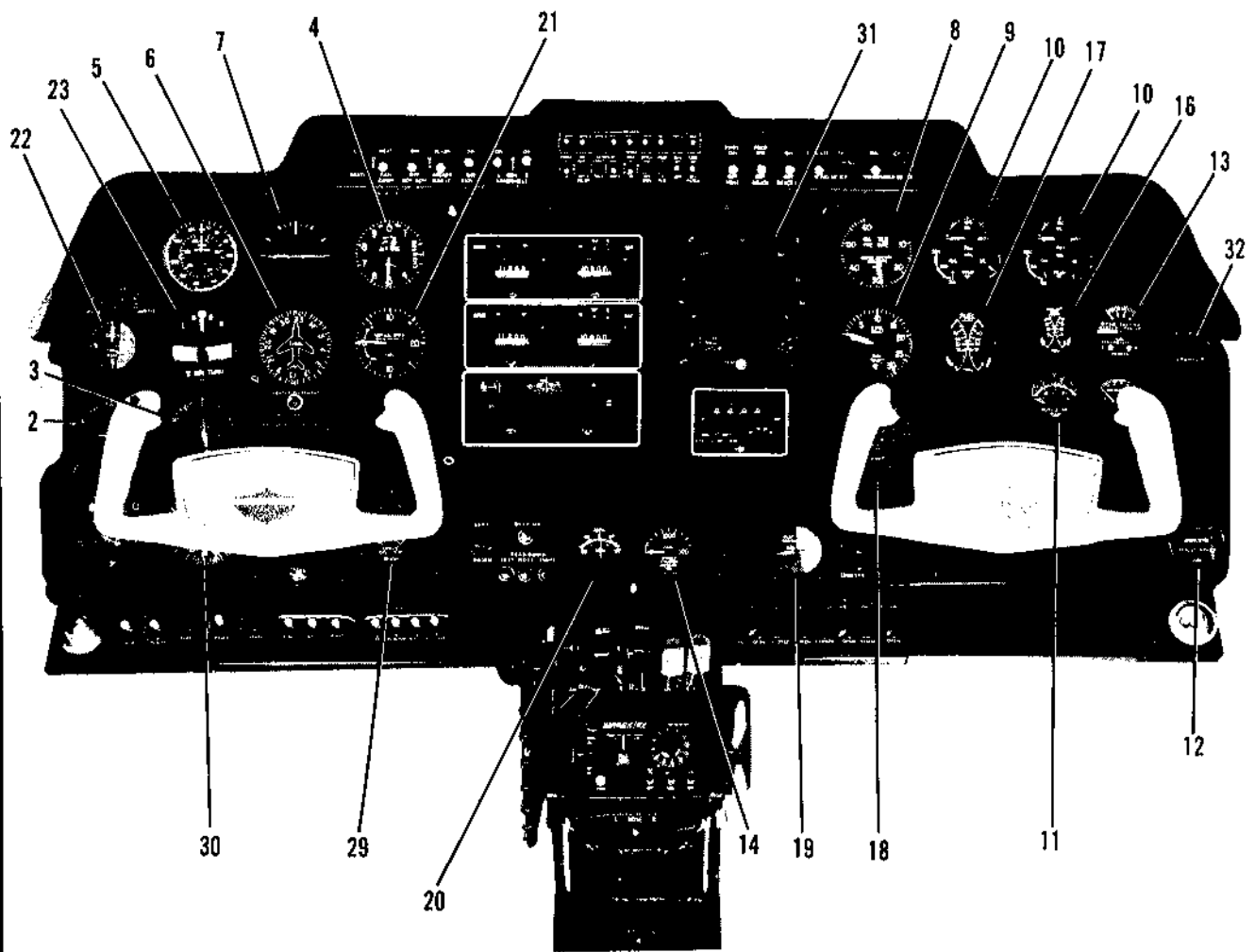
1. ADF Indicator
2. Number 2 Omni Course Selector Indicator
3. Number 1 Omni Course Selector Indicator
4. Altimeter
5. Airspeed Indicator
6. Directional Gyro
7. Horizontal Gyro
8. Manifold Pressure Gage
9. Tachometer
10. Engine Combination Gages

11. Outside Air Temperature Gage
12. Flight Hour Recorder (Optional)
13. Vacuum Gage
14. Oxygen Gage (Optional)
15. Propeller Deice Ammeter (Optional)
16. Auxiliary Fuel Quantity Indicator (Optional)
17. Fuel Quantity Indicator
18. Fuel Flow Gage
19. Flap Position Indicator
20. Ammeter

Figure 12-1. Instruments and Instrument Panel (Sheet 1 of 2)

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310N0001 AND ON



- 21. Vertical Speed Indicator
- 22. Clock
- 23. Turn and Bank Indicator
- 24. Shock Mount
- 25. Bonding Strap
- 26. Terminal Cover

- 27. Terminal Bus
- 28. Terminal Strip
- 29. Fuel Economy Indicator (Optional)
- 30. Course Selector (Optional)
- 31. Radar Display Indicator (Optional)
- 32. Autopilot Pump Fail Lights (Optional)

Figure 12-1. Instrument and Instrument Panel (Sheet 2 of 2)



e. The Outside Air Temperature Gage is located in the lower right portion of the instrument panel. It is calibrated in degrees Fahrenheit and operated electrically from a free air temperature bulb located in the fresh air duct in the nose of the fuselage.

f. The Flap Position Indicator is electrically operated and indicates the position of the flaps from zero to 35 degrees. The indicator operates in conjunction with a flap position transmitter located just aft of the fuselage rear spar. Refer to Section 8 for flap position, transmitter removal and installation procedures.

g. The Clock is a standard eight-day aircraft clock

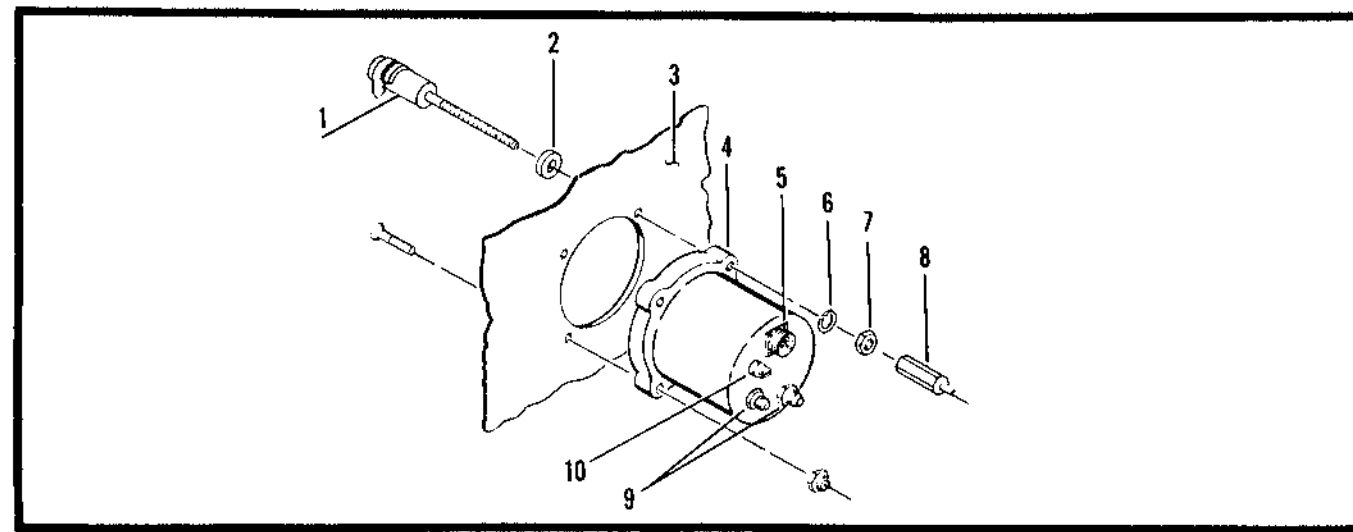
with a sweep second hand. A winding stem is provided in the lower left hand portion of the case.

Typical Instrument Removal. (See figure 12-2.)

#### NOTE

For steps "a" through "d" refer to figure 12-1.

a. Remove screws attaching instrument panel section, in which instrument is attached, to angle assem-

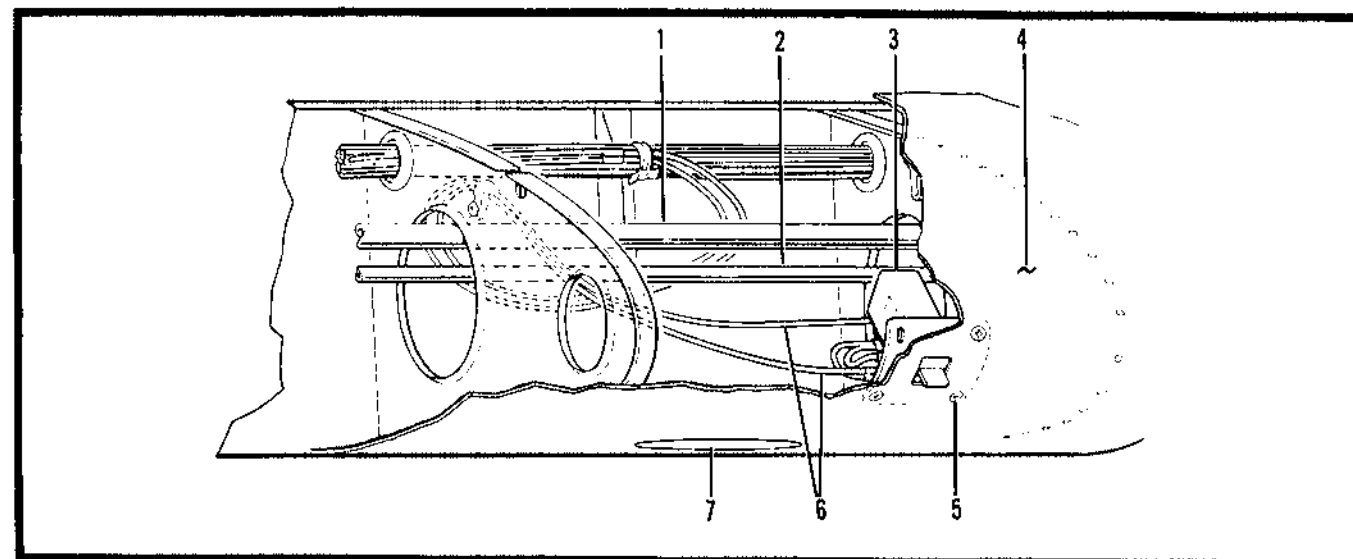


- 1. Lighting Fixture
- 2. Rubber Washer
- 3. Instrument Panel

- 4. Instrument
- 5. Electrical Connector
- 6. Lockwasher
- 7. Nut

- 8. Connector
- 9. Hose Fittings
- 10. Vent Plug

Figure 12-2. Typical Instrument Installation



- 1. Left Fuel Supply Line
- 2. Vapor Return Line

- 3. Stall Warning Transmitter
- 4. Wing Skin
- 5. Screw

- 6. Electrical Wires
- 7. Access Hole Cover

Figure 12-3. Stall Warning Transmitter

- bly
- Remove nuts from upper portion of instrument panel section.
  - Hinge instrument panel section aft on the lower shock mount.
  - Tag and disconnect electrical wires and hoses from back of instrument being removed.
  - Plug all hoses and cap fittings to prevent the entry of foreign matter.
  - Remove the connectors (8), nuts (7), and lockwashers (6).
  - Remove lower attaching nuts and bolts.

## NOTE

If the instrument is to be replaced, remove the hose fittings or electrical connector and install the replacement unit.

Typical Instrument Installation. (See figure 12-2.)

## NOTE

Lubricate straight threads with VV-P-236 petrolatum; tapered threads with JAN-A-669 anti-seize compound. Apply lubricant to male threads only, omitting the first two threads.

- Position instrument on back of instrument panel and secure with lower attaching bolts and nuts illustrated in figure 12-2.

- Install lighting fixtures (1) and rubber washers (2), secure with lockwashers (6) and nuts (7).
- Attach connectors (8) to lighting fixtures (1).
- Connect hoses or electrical connector as tagged at removal.
- Hinge instrument panel section forward on lower shock mounts and secure to stationary instrument panel with screws.

Removal of Stall Warning Transmitter. (See figure 12-3.)

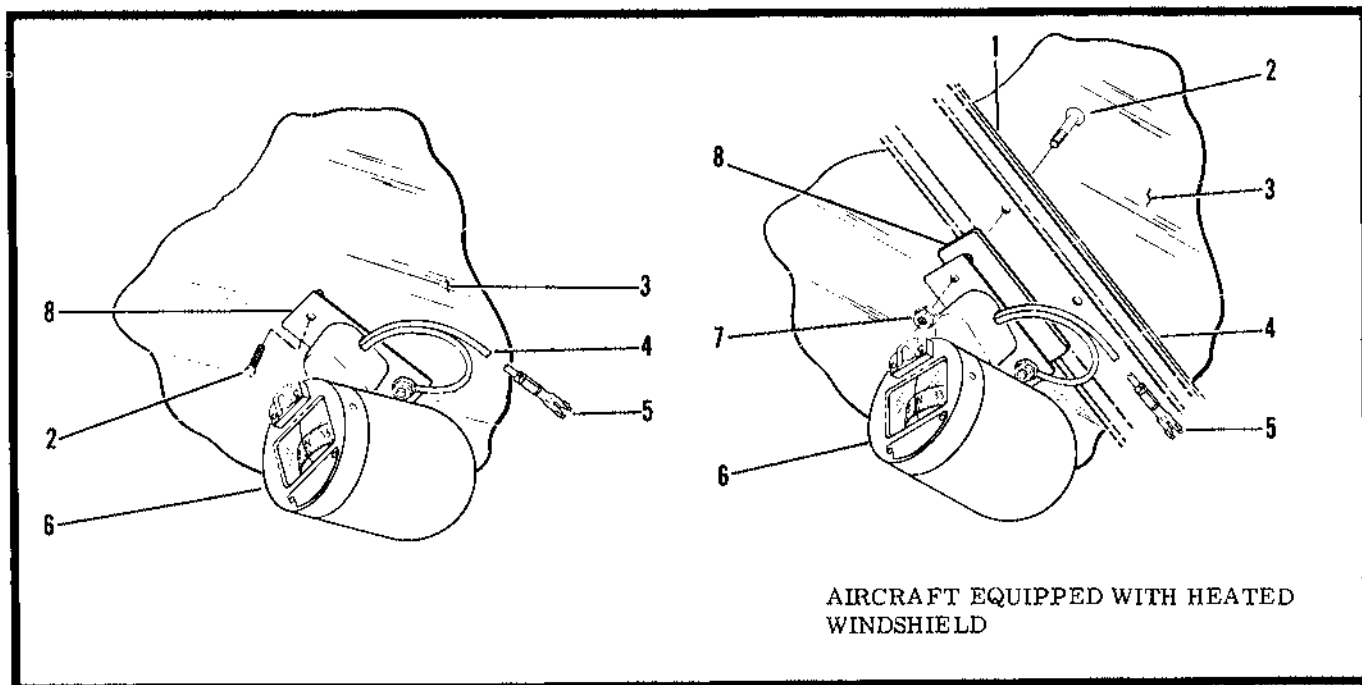
## NOTE

Before removal of stall warning transmitter, it is important that the exact fore-aft location of the vane be marked on the wing so that the replacement unit may be adjusted identically.

- Remove access hole cover (7).
- Remove four screws (5) attaching stall warning transmitter (3) to wing skin (4).
- Tag and disconnect electrical wires (6) and remove stall warning transmitter (3).

Installation of Stall Warning Transmitter. (See figure 12-3.)

- Attach electrical wires (6) as tagged at removal.
- Secure stall warning transmitter (3) to wing skin (4) with four attaching screws (5).



- |                           |                     |
|---------------------------|---------------------|
| 1. Windshield Centerstrip | 5. Wrist Lock       |
| 2. Bolt                   | 6. Magnetic Compass |
| 3. Windshield             | 7. Nut              |
| 4. Compass Light Wire     | 8. Mounting Bracket |

Figure 12-4. Magnetic Compass

- c. Replace access hole cover (7).

Removal of Magnetic Compass. (See figure 12-4.)

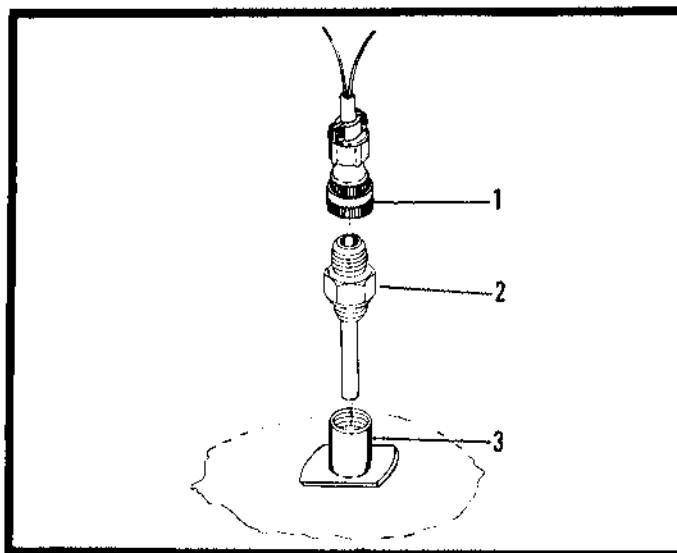
- a. Remove two screws securing compass to bonded base plate.
- b. Uncouple wrist lock (5) provided on compass light wire (4).

Installation of Magnetic Compass. (See figure 12-4.)

The installation of the magnetic compass is the reversal of the removal procedure.

Typical Bulb Removal and Installation. (See figure 12-5.)

- a. Tag and disconnect electrical connector (1).
- b. Remove bulb (2).
- c. Install bulb by reversing removal procedures.



1. Electrical Connector 2. Bulb 3. Flange

Figure 12-5. Indicator Bulb

Trouble Shooting Instruments.

| TROUBLE                                                                                                                                                                                                                                                   | PROBABLE CAUSE                                                                                                                        | CORRECTION                                                                                                                      |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| BOTH VACUUM INSTRUMENTS<br>MALFUNCTIONING<br><br>ONE VACUUM INSTRUMENT<br>MALFUNCTIONING, OTHER<br>VACUUM INSTRUMENT<br>OPERATING NORMAL<br><br>INDICATING POINTERS<br>FAIL TO RESPOND<br><br>EXCESSIVE POINTER<br>VIBRATION<br><br>ERRONEOUS INDICATIONS | <u>VACUUM SYSTEM INSTRUMENTS</u><br><br>Dirty filter element. Restricted airflow or improper adjustment.<br><br>Defective instrument. | Clean and replace filter.<br>Adjust vacuum relief valve.<br><br>Replace instrument.                                             |
|                                                                                                                                                                                                                                                           | <u>SENSITIVE ALTIMETER</u><br><br>Static line obstructed.                                                                             | Disconnect static line from all instruments and altitude hold on autopilot computer, and blow out line with dry compressed air. |
|                                                                                                                                                                                                                                                           | Excessive vibration of static line or hose.                                                                                           | Secure to aircraft structure or components.                                                                                     |
|                                                                                                                                                                                                                                                           | Water or foreign matter in static line.                                                                                               | Disconnect static line from all instruments and altitude hold on autopilot computer, and blow out line with dry compressed air. |
|                                                                                                                                                                                                                                                           | Loose static line connection.                                                                                                         | Test and repair in accordance with testing static pressure line.                                                                |
| POINTER FAILS TO RESPOND                                                                                                                                                                                                                                  | Defective instrument.                                                                                                                 | Replace instrument.                                                                                                             |
|                                                                                                                                                                                                                                                           | <u>AIRSPEED INDICATOR</u><br><br>Clogged pitot line.                                                                                  | Disconnect tube from instru-                                                                                                    |

| TROUBLE                                       | PROBABLE CAUSE                                                                               | CORRECTION                                                                                                                                    |
|-----------------------------------------------|----------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| POINTER FAILS TO RESPOND (CONT)               | Clogged pitot line.                                                                          | ment and blow out line with dry compressed air.                                                                                               |
| ERRONEOUS INDICATIONS                         | Water or restriction in pitot and/or static line.                                            | Disconnect tube from all pitot static system instruments and altitude hold on autopilot computer and blow out line with dry compressed air.   |
|                                               | Leak in pitot and/or static line.                                                            | Test and repair in accordance with testing of pitot pressure line.                                                                            |
|                                               | Pitot and/or static line improperly connected.                                               | Connect lines as illustrated in figure 12-8.                                                                                                  |
|                                               | <u>VERTICAL SPEED INDICATOR</u>                                                              |                                                                                                                                               |
| POINTER FAILS TO RESPOND                      | Water or restriction in static line.                                                         | Disconnect static line from all pitot static system instruments and altitude hold on autopilot computer and blow out with dry compressed air. |
|                                               | Defective instrument.                                                                        | Replace instrument.                                                                                                                           |
|                                               | <u>TURN-AND-BANK INDICATOR</u>                                                               |                                                                                                                                               |
|                                               | NOTE                                                                                         |                                                                                                                                               |
|                                               | To operate any of the electrical instruments, the battery switch must be in the ON position. |                                                                                                                                               |
| BALL OFF CENTER                               | Incorrectly mounted.                                                                         | Mount correctly.                                                                                                                              |
|                                               | Defective instrument.                                                                        | Replace instrument                                                                                                                            |
| TURN INDICATED                                | Open circuit.                                                                                | Reset circuit breaker. Check and repair circuit.                                                                                              |
|                                               | Defective instrument.                                                                        | Replace instrument.                                                                                                                           |
|                                               | <u>DUAL TACHOMETER</u>                                                                       |                                                                                                                                               |
| ERRONEOUS INDICATION OR INDICATOR INOPERATIVE | Defective circuit.                                                                           | Check and repair circuit.                                                                                                                     |
|                                               | Defective instrument.                                                                        | Replace instrument.                                                                                                                           |
|                                               | Defective tachometer generator.                                                              | Replace tachometer generator.                                                                                                                 |
|                                               | <u>DUAL FUEL QUANTITY INDICATOR</u>                                                          |                                                                                                                                               |
| NO INDICATION                                 | Sunken float.                                                                                | Replace float.                                                                                                                                |
|                                               | Open circuit.                                                                                | Reset circuit breaker. Check and repair circuit.                                                                                              |
|                                               | Defective fuel quantity sending unit.                                                        | Replace fuel quantity sending unit.                                                                                                           |
|                                               | Defective indicator.                                                                         | Replace indicator.                                                                                                                            |
| ERRONEOUS INDICATOR                           | Damaged float.                                                                               | Replace float.                                                                                                                                |

| TROUBLE                                                   | PROBABLE CAUSE                                           | CORRECTION                                                 |
|-----------------------------------------------------------|----------------------------------------------------------|------------------------------------------------------------|
| ERRONEOUS INDICATOR<br>(CONT)                             | Defective circuit.                                       | Check and repair circuit.                                  |
|                                                           | Malfunctioning fuel quantity sending unit.               | Check in accordance with Section 11. Replace if necessary. |
|                                                           | Defective indicator.                                     | Replace indicator.                                         |
|                                                           | <u>FLAP POSITION INDICATOR</u>                           |                                                            |
| NO INDICATION WITH<br>FLAPS DOWN                          | Open circuit.                                            | Reset circuit breaker. Check and repair circuit.           |
|                                                           | Defective indicator.                                     | Replace indicator.                                         |
|                                                           | Defective transmitter.                                   | Replace transmitter.                                       |
| ERRONEOUS INDICATION<br>WITH FLAPS DOWN                   | Improper engagement of transmitter cam with pinion gear. | Rig in accordance with Section 8.                          |
|                                                           | Defective circuit.                                       | Check and repair circuit.                                  |
|                                                           | Defective indicator.                                     | Replace indicator.                                         |
|                                                           | Defective transmitter.                                   | Replace transmitter.                                       |
|                                                           | <u>O. A. T. INDICATOR</u>                                |                                                            |
| POINTER FAILS TO RES-<br>POND                             | Open circuit.                                            | Reset circuit breaker. Check and repair circuit.           |
| ERRONEOUS INDICATION                                      | Defective circuit.                                       | Check and repair circuit.                                  |
|                                                           | Defective air temperature bulb.                          | Replace air temperature bulb.                              |
|                                                           | Defective indicator.                                     | Replace indicator.                                         |
|                                                           | <u>STALL WARNING INDICATOR</u>                           |                                                            |
| HORN FAILS TO OPERATE                                     | Open circuit.                                            | Reset circuit breaker. Check and repair circuit.           |
|                                                           | Defective transmitter.                                   | Replace transmitter.                                       |
|                                                           | Defective horn.                                          | Replace horn.                                              |
|                                                           | <u>COMBINATION GAGES</u>                                 |                                                            |
| NO INDICATION ON OIL<br>TEMPERATURE GAGE                  | Open circuit.                                            | Reset circuit breaker. Check and repair circuit.           |
|                                                           | Defective oil temperature bulb.                          | Replace oil temperature bulb.                              |
|                                                           | Defective instrument.                                    | Replace instrument.                                        |
| ERRONEOUS INDICATION<br>OF CYLINDER TEMPERA-<br>TURE GAGE | Defective circuit.                                       | Check and repair circuit.                                  |
|                                                           | Defective cylinder head temperature bulb.                | Replace cylinder head temperature bulb.                    |
|                                                           | Defective instrument.                                    | Replace instrument.                                        |
| ERRONEOUS OIL PRESSURE<br>INDICATION                      | Defective instrument.                                    | Replace instrument.                                        |
|                                                           | Broken or restricted oil pressure line.                  | Repair or replace oil pressure line.                       |

| TROUBLE                                  | PROBABLE CAUSE                        | CORRECTION                                                                                |
|------------------------------------------|---------------------------------------|-------------------------------------------------------------------------------------------|
| ERRONEOUS OIL PRESSURE INDICATION (CONT) | Defective oil pressure relief valve.  | Repair or replace relief valve.                                                           |
|                                          | <u>MANIFOLD PRESSURE GAGE</u>         |                                                                                           |
| SLUGGISH POINTER OPERATION               | Damaged or restricted lines.          | Remove line from instrument and blow out restriction. Replace line or hoses as necessary. |
|                                          | Defective instrument.                 | Replace instrument.                                                                       |
|                                          | <u>MAGNETIC COMPASS</u>               |                                                                                           |
| EXCESSIVE COMPASS ERROR                  | Improper compensation.                | Compensate the compass.                                                                   |
|                                          | External magnetic interference.       | Locate the interference and eliminate if possible.                                        |
| FAILURE TO RESPOND TO COMPENSATION       | Compensating magnets demagnetized.    | Replace instrument.                                                                       |
|                                          | <u>FUEL FLOW GAGE</u>                 |                                                                                           |
| ERRONEOUS FUEL PRESSURE INDICATION       | Clogged or restricted fuel lines.     | Clean fuel lines and fuel strainer.                                                       |
|                                          | Broken or restricted fuel flow lines. | Replace fuel flow lines.                                                                  |
|                                          | Defective fuel pump.                  | Replace fuel pump.                                                                        |
|                                          | Defective instrument.                 | Replace instrument.                                                                       |
|                                          | <u>AMMETER</u>                        |                                                                                           |
| NO INDICATION ON AMMETER                 | Defective ammeter.                    | Check/replace ammeter.                                                                    |
|                                          | Defective ammeter leads.              | Check/repair or replace.                                                                  |
|                                          | <u>PROPELLER DEICE AMMETER</u>        |                                                                                           |
| NO INDICATION ON AMMETER                 | Defective ammeter.                    | Check/replace ammeter.                                                                    |
|                                          | Defective ammeter leads.              | Check/repair or replace.                                                                  |

## INSTRUMENT PANELS.

Removal of Shock-Mounted Instrument Panels. (See figure 12-1.)

- a. Disconnect tubing and lines to instruments and tag.

## NOTE

Most hose fittings are more accessible if disconnected from the forward bulkhead.

- b. Remove screws attaching center of panel to support angle.  
c. Remove nuts from shock mounts and pull shock-mounted panel away from stationary panel enough to disconnect electrical leads from terminal block.  
Tag all electrical leads.

- d. Plug hoses and cap all fittings to prevent entry of foreign matter.

- e. Remove shock-mounted panel from aircraft.

Installation of Shock-Mounted Instrument Panel. (See figure 12-1.)

- a. Inspect rubber shock mounts (24) and bonding straps (25) for deterioration and cracks. If either is damaged, replace before installing instrument panel.  
b. Position shock-mounted panel in place on mounts.  
c. Remove plugs and caps in all lines and fittings.  
d. Connect electrical leads to instruments and terminal strip (28). Remove tags.  
e. Connect all hoses and lines to instruments.  
f. Secure shock panel to support angle with screws and tighten nuts on shock mounts.

## VACUUM SYSTEM.

A dry vacuum pump, which requires no lubrication of any kind, is located on the aft right accessory mount pad of each engine. The pump outlets are exhausted into the engine nacelle. The vacuum line plumbing is routed from the vacuum pumps through the nacelles and wings to the relief valves. The adjustable relief valves are provided to give the desired vacuum system pressure. From the relief valve, the lines are routed to the vacuum manifold located on the left side of the forward cabin bulkhead. The manifold has check valves included to prevent reverse flow, in the event of failure of either vacuum pump. Hoses are routed from the manifold to the directional gyro, horizontal gyro, and suction gage. Other hoses connect the gyros to the vacuum air filter and suction gage. The suction gage indicates the amount of vacuum present

in the system; also provided are inoperation indicator buttons for each pump. The vacuum air filter is provided to remove dust particles and vapor from the air, providing dry, clean air for the instruments.

## NOTE

All flexible and fixed line fittings, clamps, relief valves, and filters must be cleaned and suitably protected by caps or bags until installed in aircraft. The vacuum system shall not be open while awaiting the remaining parts to be installed. Prior to running of the vacuum pumps, the lines shall be flushed with air to approximately seven cubic feet per minute while alternately closing off the ends of the lines. This will create pressure pulses to dislodge and eject foreign matter.

## Trouble Shooting the Vacuum System.

| TROUBLE                                                | PROBABLE CAUSE                                  | CORRECTION                                                                                                          |
|--------------------------------------------------------|-------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|
| NO SUCTION INDICATED<br>AT ONE SOURCE                  | Defective vacuum pump.                          | Check suction at pump.<br>Replace pump.                                                                             |
|                                                        | Disconnected, broken or plugged lines or hoses. | Check suction through lines and hoses. Clean or replace lines and hoses.                                            |
|                                                        | Defective relief valve.                         | Check suction to and from relief valve. Replace relief valve.                                                       |
|                                                        | Defective suction gage.                         | Check suction at applicable line to test indicator buttons. Replace suction gage.                                   |
| NO SUCTION INDICATED,<br>BUT GYROS OPERATE<br>NORMALLY | Defective suction gage.                         | Check suction to gage. Replace gage.                                                                                |
| LOW SUCTION                                            | Defective vacuum pump.                          | Check suction at pump. Replace pump.                                                                                |
|                                                        | Leaking or restricted lines or hoses.           | Clean or replace lines and hoses. Check suction through lines and hoses.                                            |
|                                                        | Defective or improperly adjusted relief valves. | Check suction to relief valves. Adjust relief valve in accordance with adjusting procedures. Replace if defective.  |
|                                                        | Defective check valves.                         | Check operation of check valves. Replace manifold assembly.                                                         |
| HIGH SUCTION                                           | Relief valve air filters dirty.                 | Check operation with filters removed. Clean or replace filters.                                                     |
|                                                        | Defective or improperly adjusted relief valves. | Check suction to relief valves. Adjust relief valves in accordance with adjusting procedures. Replace if defective. |

| TROUBLE                 | PROBABLE CAUSE          | CORRECTION                                                                                       |
|-------------------------|-------------------------|--------------------------------------------------------------------------------------------------|
| SUCTION GAGE FLUCTUATES | Excessive vibration.    | Visually check for panel, gage, or plumbing vibration. Determine cause of vibration and correct. |
|                         | Defective suction gage. | Check for fluctuating suction to gage. Replace gage.                                             |

## Removal of Vacuum Pump. (See figure 12-6.)

- Remove upper nacelle cowls.
- Loosen the two hose clamps securing hose between line assembly (15) and vacuum pump (16).
- Remove vacuum pump (16) by removing four attaching nuts and washers.

## NOTE

Do not clean vacuum pump (16) in solvent. Clean by wiping with a clean cloth.

## Installation of Vacuum Pump. (See figure 12-6.)

## NOTE

If a new vacuum pump is being installed, remove the serviceable fittings from the old pump and install the fittings on the new pump. Use no oil of any sort, no thread lubricant of any description on any fitting used on the inlet side of the vacuum pumps.

- Align splines on the vacuum pump drive with splines on the engine drive and slide vacuum pump into position so the ports are facing to the right.
- Secure vacuum pump (16) to the engine with four washers and nuts.
- Slide coupling hose (17) over line assembly (15) and secure with clamp.
- Slide coupling hose over fitting onto "in" port on vacuum pump (16) and secure with clamp.
- Install upper nacelle cowl.

## Removal and Installation of Vacuum Air Filter. (See figure 12-6.)

- Disconnect filter hoses (9 and 10) from filter (11).
- Remove vacuum air filter (11) from forward cabin bulkhead, left hand side, by removing attaching bolts and washers.
- Install vacuum air filter (11) by reversing procedures as outlined in steps "a" and "b" above.

## Replacement of Vacuum Air Filter Element. (See figure 12-6.)

## NOTE

It is not required to remove air filter to replace the element.

- Remove wing nut from bottom of vacuum air filter assembly (11).
- Remove vacuum air filter element.
- Install new vacuum air filter element.
- Fasten element in place using wing nut.

## Removal and Installation of Vacuum Relief Valve. (See figure 12-6.)

- Remove wing root fillets by removing attaching screws.
- Refer to Section 3, remove the following items:
  - Front seats.
  - Front carpet.
  - Lower center upholstery panel.
- Remove clamps attaching hoses (12) and (14) to relief valve (13).
- Remove relief valve (13) from fuselage skin by removing attaching washer and nut.
- Install vacuum relief valve (13) by reversing procedures as outlined in steps "a" thru "d" above.

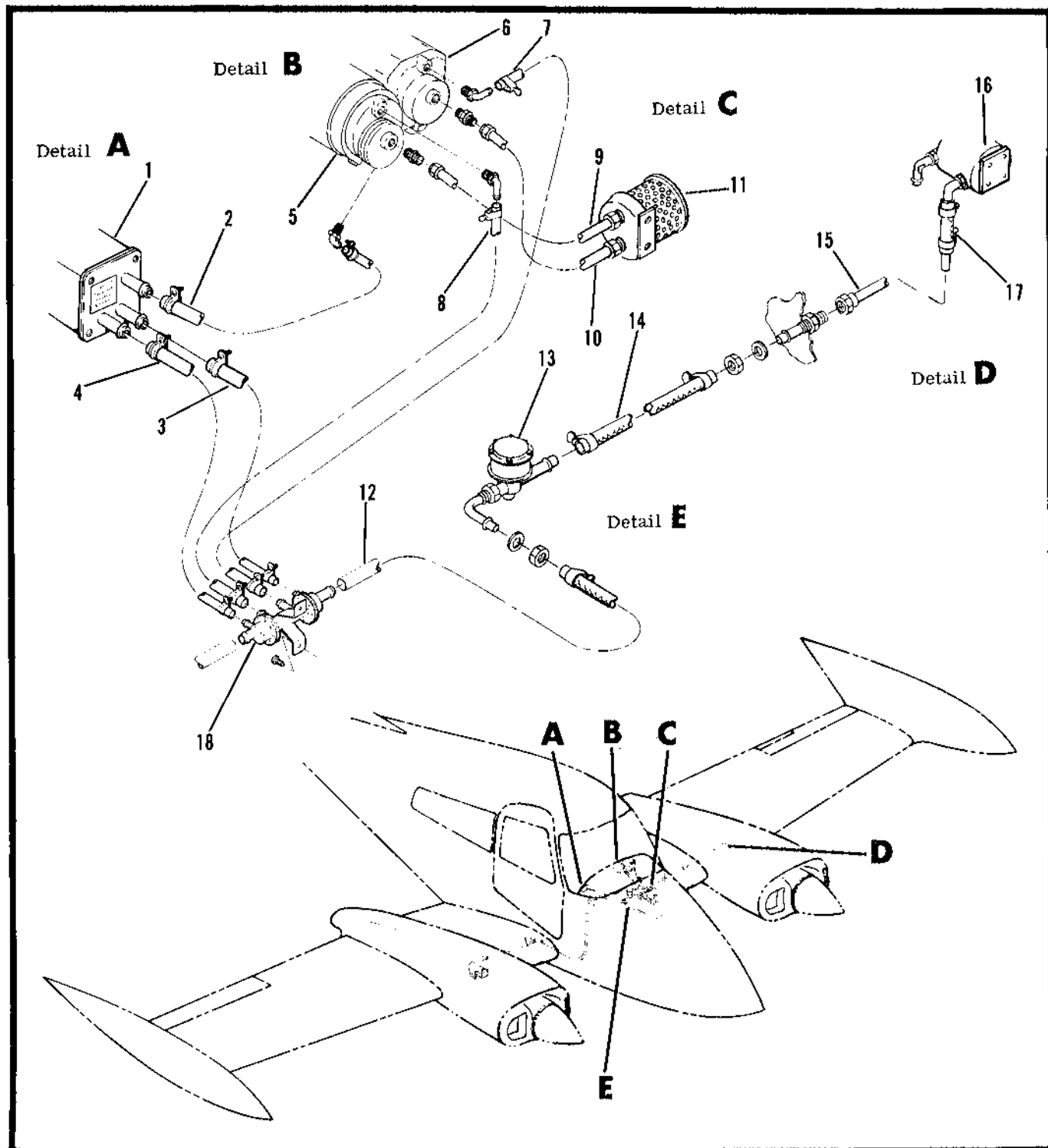
## Adjustment of Vacuum Relief Valve.

## NOTE

Since a relief valve is used for each vacuum source, each relief valve must be adjusted separately.

- Remove wing fairings by removing attaching screws.
- Start the engines and idle the right engine.
- With left engine operating and tachometer reading 1700 RPM, the suction gage should read 5.00 inches of mercury.
- Adjust the left relief valve by loosening the knurled screw locknut and adjusting to obtain the desired vacuum reading, clockwise rotation of the adjusting screw increases the vacuum.
- Idle the left engine and operate the right engine so tachometer reads 1700 RPM.
- Adjust the right relief valve by loosening the knurled screw locknut and adjusting to obtain the 5.00 vacuum reading. Clockwise rotation of the adjusting screw increases the vacuum.
- With both engines operating at tachometer RPM of 1700, the suction gage should read 5.00  $\pm$  .25 inches of mercury. If the gage reading is not within these limits, the relief valves should be readjusted to these limits.
- Shutdown both engines and check that the locknuts on the knurled adjusting screw are tight.
- Install wing fairings.





1. Suction Gage
2. Suction Gage to Horizontal Gyro Hose
3. Suction Gage to LH Manifold Hose
4. Suction Gage to RH Manifold Hose
5. Horizontal Gyro
6. Directional Gyro
7. Directional Gyro to Manifold Hose
8. Horizontal Gyro to Manifold Hose
9. Filter to Horizontal Gyro Hose

10. Filter to Directional Gyro Hose
11. Vacuum Air Filter Assembly
12. Manifold to Regulator Valve Hose
13. Regulator Valve
14. Regulator Valve to Engine Nacelle Hose
15. Engine Nacelle Line Assembly
16. Vacuum Pump
17. Coupling Hose
18. Manifold

Figure 12-6. Vacuum System Installation

Removal of Vacuum System Plumbing. (See figure 12-6.)

#### NOTE

Removal procedures will be given for left engine installation only. Removal of right engine installation is basically the same.

- a. Refer to Section 9 and remove engine nacelle cowl.
- b. Refer to Section 3 and remove the following items:
  1. Front and rear seats; or middle seats (optional equipment).
  2. Center carpet.
  3. Lower center upholstery panel.
- c. Disconnect engine nacelle line assembly (15) from vacuum pump (16) by removing clamps and coupling hose (17).
- d. Disconnect line assembly (15) from bulkhead fitting and remove line from engine nacelle.
- e. Remove three wing access covers from underside of wing.
- f. Loosen clamps on hose (14) at relief valve (13) and bulkhead fitting on engine nacelle. Route hose (14) from wing using outboard access openings.
- g. Loosen clamps and disconnect hose (12) from relief valve (13) and manifold (18) and remove hose from fuselage.
- h. Loosen clamps and disconnect hoses (3, 4, 7 and 8) from manifold (18).
- i. Loosen clamps and disconnect hoses (3 and 4) from vacuum gage and hoses (7 and 8) from directional gyro (6) and horizontal gyro (5) respectively. Remove hoses from fuselage.
- j. Loosen clamps on hose (2) and disconnect from vacuum gage and directional gyro. Remove hose from fuselage.
- k. Disconnect hose assemblies (9 and 10) from air filter (11), directional gyro (6) and horizontal gyro (5). Remove hose assemblies from aircraft.

Installation of Vacuum System Plumbing. (See figure 12-6.)

#### NOTE

Use no oil of any sort, no thread lubricant of any description on any fitting used on the inlet side of the vacuum pumps.

- a. Reverse the vacuum system plumbing removal procedures, except do not install access panels and upholstery until system check is completed.
- b. Check vacuum system and adjust relief valves if system vacuum gage indication is not within specified limits.
- c. Install access covers, upholstery, carpets, seats and engine nacelle cowling.

#### PITOT-STATIC SYSTEM

A pitot tube, with an electrical heating element to prevent ice from obstructing passage of ram air

pressure, is mounted in the nose of the fuselage. The ram air pressure is routed from the pitot tube to the airspeed indicator through hose and line assemblies. Static pressure is routed from two static pressure flanges, mounted on opposite sides of the aft fuselage, to the airspeed indicator, altimeter, and vertical velocity indicator by a series of hoses, tees, and line assemblies. A drain line and drain valve assembly, located in forward left hand cabin area, is provided to release accumulated moisture and serve as the alternate static pressure source.

Removal of Pitot Tube. (See figure 12-8.)

- a. Remove three screws attaching pitot tube (18) from mount tube (16).
- b. Remove nose cap by removing attaching screws.
- c. Disconnect pitot pressure line (12) from pitot tube (18).
- d. Tag and disconnect pitot tube heating element wires.
- e. Slide pitot tube (18) forward from mount tube (16).

Installation of Pitot Tube. (See figure 12-8.)

- a. Slide pitot tube (18) into mount tube (16).

#### NOTE

Position pitot tube so drain hole is downward.

- b. Attach pitot pressure line (12) to pitot tube (18).
- c. Attach heater element wires as tagged at removal.
- d. Install nose cap and attaching screws.
- e. Install three screws attaching pitot tube (18) to mount tube (16).

#### CAUTION

The pitot heater should not be operated on the ground as it will overheat and damage the heating element.

Removal of Pitot and Static Lines. (See figure 12-8.)

The locations of all pitot and static lines are shown in figure 12-8. All lines are standard aluminum tubing except for the flexible hoses attached to the instruments. All the lines and hoses are equipped with conventional fittings and may be removed when necessary.

#### NOTE

Static line (3) must be cut to facilitate removal and should only be removed if replacement is necessary.

Installation of Pitot and Static Lines. (See figure 12-8.)

Install lines as illustrated in figure 12-8 using petroleum to lubricate all male fittings, omitting the first two threads.

**NOTE**

Install static line (3) through grommets. Install nut (23) and sleeve (22) on static line (3) before flaring forward end of line.

Testing the Pitot Pressure Lines. (See figure 12-8.)

The pitot pressure line, which carries impact pressure to the airspeed indicator, is tested as follows:

- a. Connect a pressure source to opening in pitot tube assembly (18).
- b. Apply pressure slowly until airspeed indicator reads 150 MPH. Shut off pressure, seal opening, and wait one minute.

**CAUTION**

The amount of pressure required for a 150 MPH indication is less than 1/2 psi. Avoid high pressures as instrument damage will result.

- c. If airspeed indicator drops more than 10 MPH in one minute, disconnect hose from airspeed indicator.
- d. Plug hose and apply pressure.
- e. Coat lines and connections with a solution of soap and water to locate leak.

- f. Tighten or repair faulty connections. Connect hose to instrument and repeat step "b" to be certain connections and lines do not leak.

**CAUTION**

Do not apply suction to pitot pressure line.

Testing the Static Pressure System. (See figure 12-8.)

- a. Set altimeter to read 1500 feet by rotating pressure setting knob.

**NOTE**

Check to see that static drain valve is closed.

- b. Seal static opening (1) on one side of fuselage with masking tape.
- c. Connect a suction source to static opening (1) on opposite side of fuselage.

**NOTE**

If autopilot is installed, the autopilot static line must be disconnected and plugged during testing.

- d. Slowly apply suction until altimeter shows a 2000 foot increase in altitude (3500 feet reading), "pinch off" tube and hold for one minute.

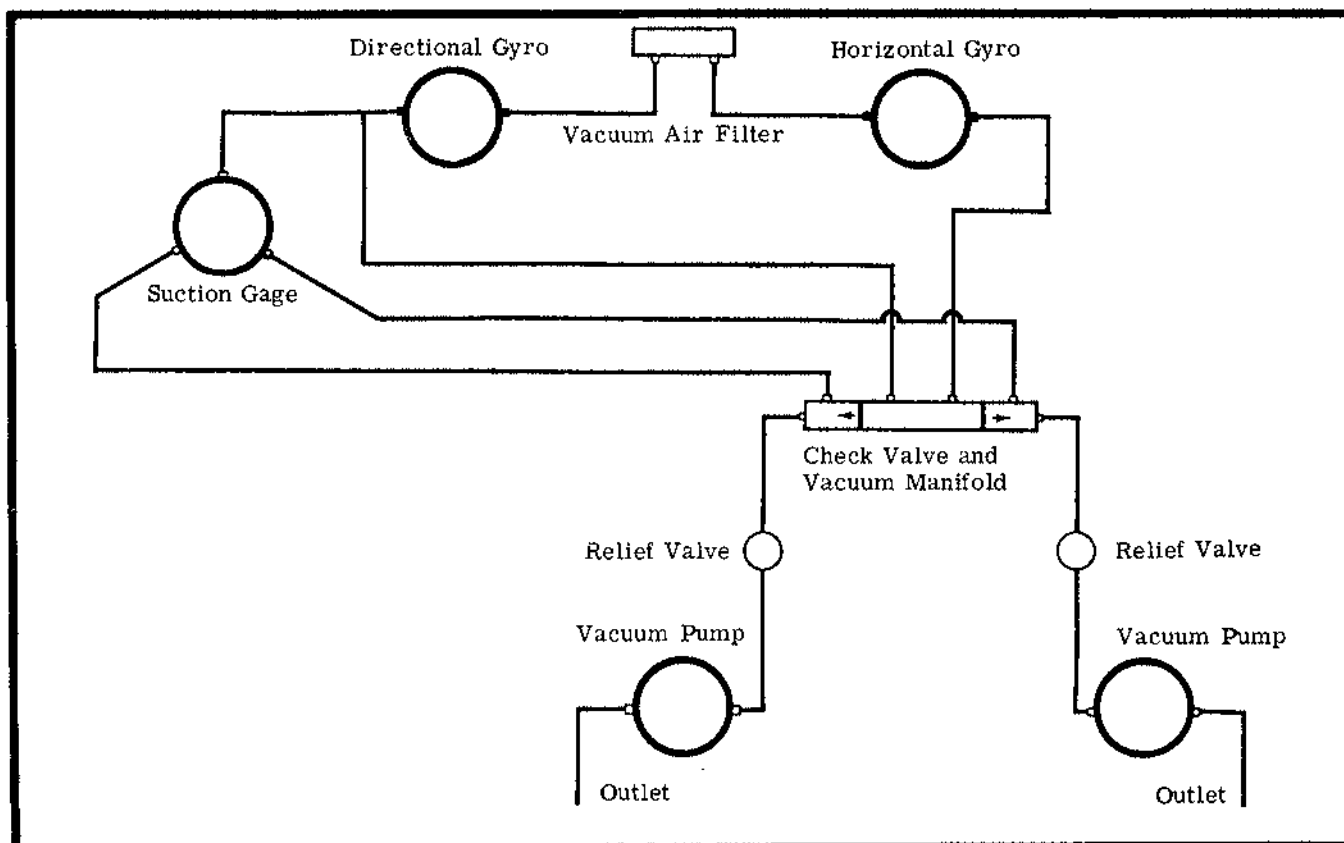
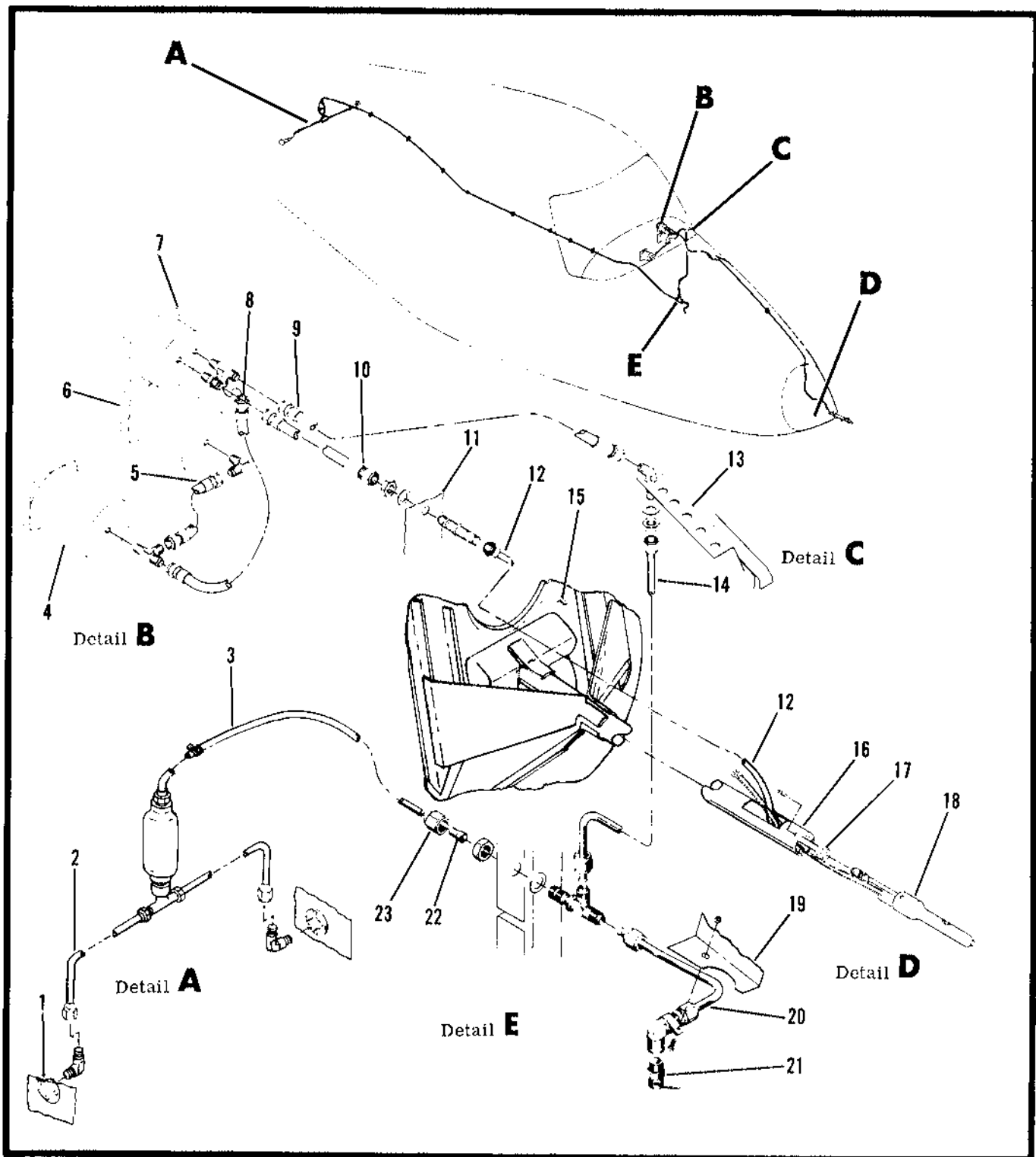


Figure 12-7. Vacuum System Schematic



- |                                          |                                 |                           |
|------------------------------------------|---------------------------------|---------------------------|
| 1. Static Opening                        | 9. Hose (Airspeed to Bracket)   | 16. Mount Tube            |
| 2. Static Crossover Line                 | 10. Hose (Airspeed to Bulkhead) | 17. Pitot Extension Line  |
| 3. Static Line                           | 11. Forward Cabin Bulkhead      | 18. Pitot Tube            |
| 4. Vertical Velocity Indicator           | 12. Pitot Pressure Line         | 19. Parking Brake Bracket |
| 5. Hose (Vertical Velocity to Altimeter) | 13. Tube Support Bracket        | 20. Static Drain Line     |
| 6. Altimeter                             | 14. Forward Static Line         | 21. Drain Valve           |
| 7. Airspeed Indicator                    | 15. Nose Bulkhead               | 22. Sleeve                |
| 8. Hose (Vertical Velocity to Airspeed)  |                                 | 23. Nut                   |

Figure 12-8. Pitot-Static System Installation

## CAUTION

When applying or releasing suction, take care not to exceed rate range of vertical velocity indicator.

- e. The leak down rate should not exceed 100 feet of altitude in one minute (3400 feet reading).
- f. If leak down rate exceeds 100 feet per minute, slowly remove suction source and proceed as follows:
- g. Disconnect static lines from altimeter, vertical velocity indicator and airspeed indicator. Plug static lines and attach a source of pressure to static opening (2).

## CAUTION

Do not apply positive pressure to static lines with instruments connected. Be sure that the altitude hold on autopilot computer is disconnected.

- h. Apply a slight pressure and coat lines with a mild solution of soap and water to locate leak.
- i. Tighten or repair faulty connections or replace damaged lines. Remove line plugs and pressure source and reconnect hoses to respective units.
- j. Repeat steps "c" through "e" to be sure instruments are connected correctly and do not leak.
- k. If scale drop of altimeter pointer is less than 100 feet in one minute, leak is negligible. Slowly remove static suction source.
- l. Remove masking tape from static opening (2).

## Blowing Out Pitot or Static Lines.

Although the pitot system is designed to drain down to the pitot tube opening, condensation may collect at other points in the system and produce a partial obstruction. To clear the line, disconnect it at the airspeed indicator and, using low pressure air, blow from the indicator end of the line toward the pitot tube.

## CAUTION

Never blow through the pitot or static lines toward the instruments. Doing so may damage them.

Like the pitot lines, the static pressure lines must be kept clear and the connections tight. The system has static source sumps that collect moisture and keep the system clear. However, when necessary, disconnect the static line at the first instrument to which it is connected, then blow the line clear with low pressure air. Check all static pressure line connections for tightness. Replace hoses which have cracked, hardened or show other signs of deterioration.

## MANIFOLD PRESSURE SYSTEM.

The manifold pressure system consists of a dual manifold pressure gage mounted in the instrument panel. The manifold pressure lines are routed from

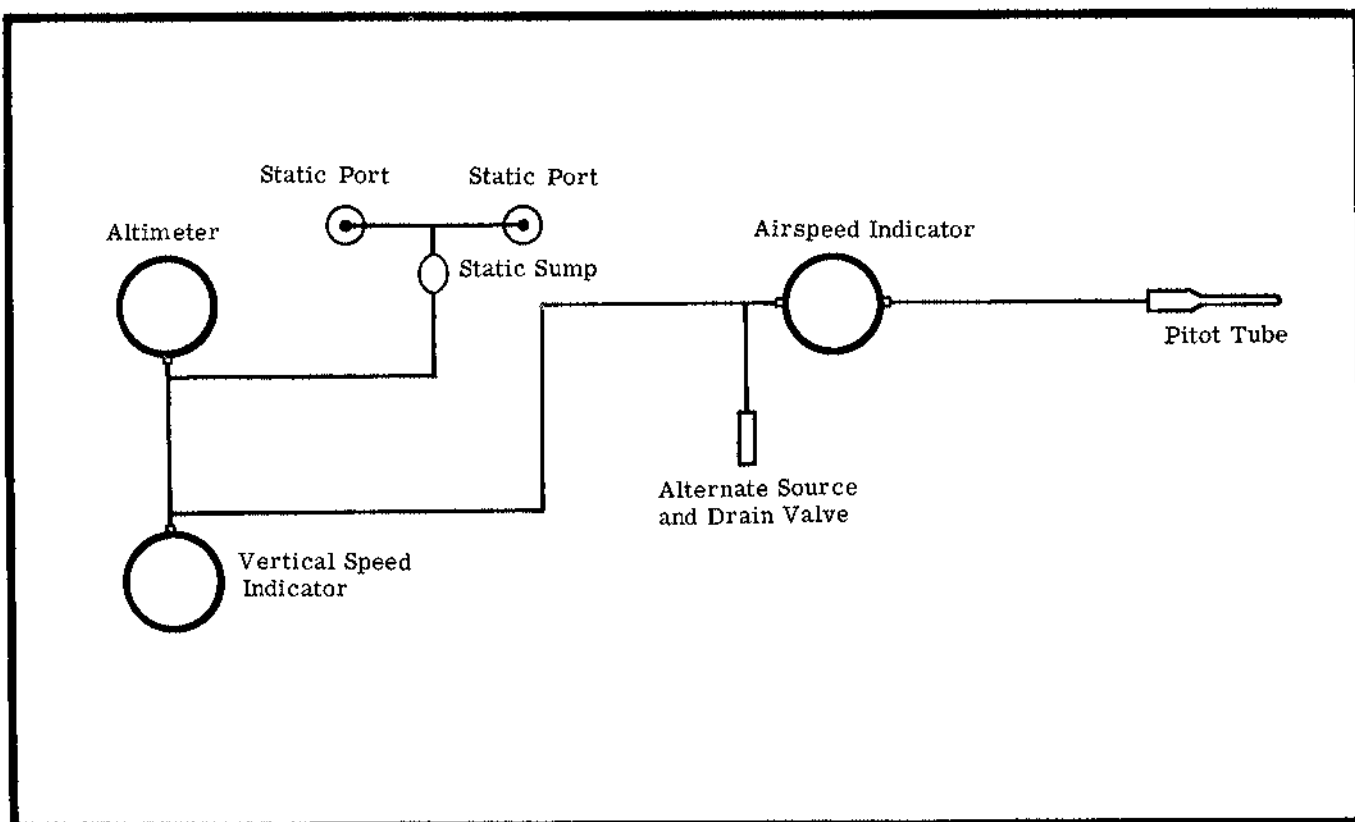
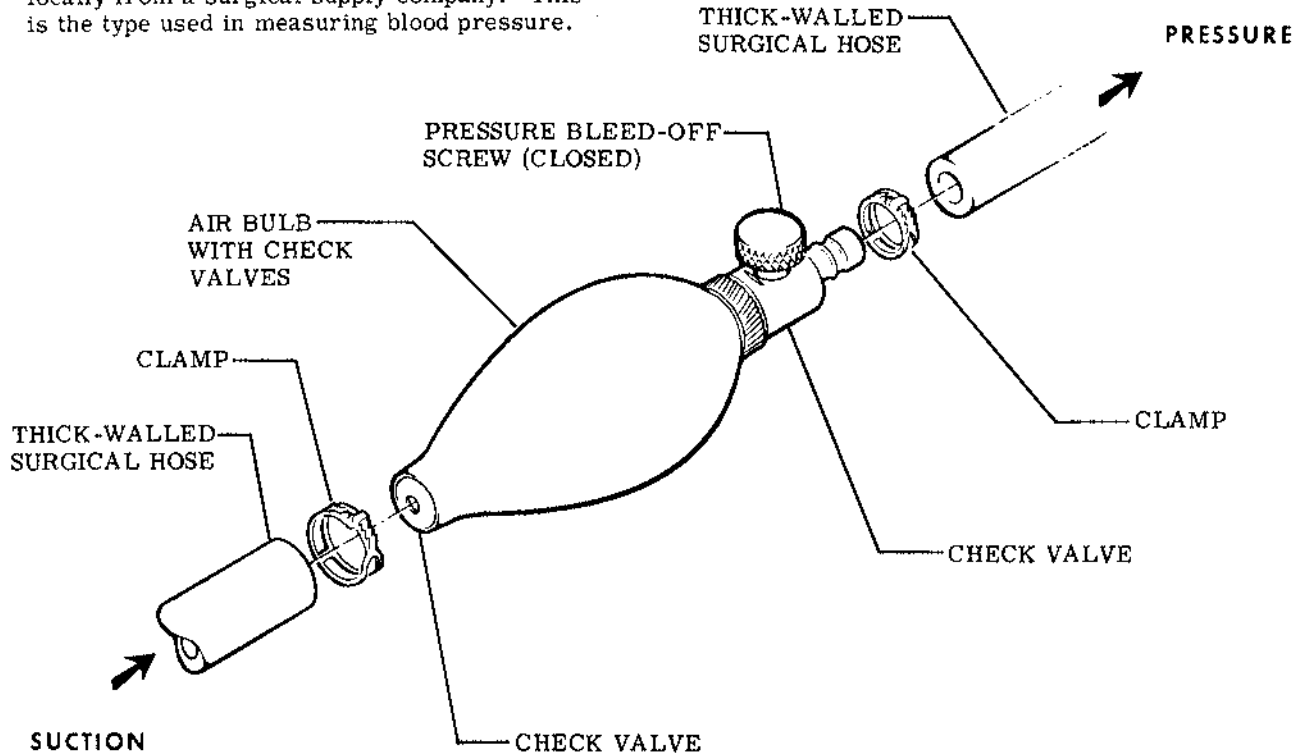


Figure 12-9. Pitot Static System Schematic

## NOTE

Air bulb with check valves may be obtained locally from a surgical supply company. This is the type used in measuring blood pressure.



## TO APPLY SUCTION:

1. Squeeze air bulb to expel as much air as possible.
2. Hold suction hose firmly against static pressure source opening.
3. Slowly release air bulb to obtain desired suction, then pinch hose shut tightly to trap suction in system.
4. After leak test, release suction slowly by intermittently allowing a small amount of air to enter static system. To do this, tilt end of suction hose away from opening, then immediately tilt it back against opening. Continue to admit this small amount of air intermittently until all suction is released, then remove test equipment.

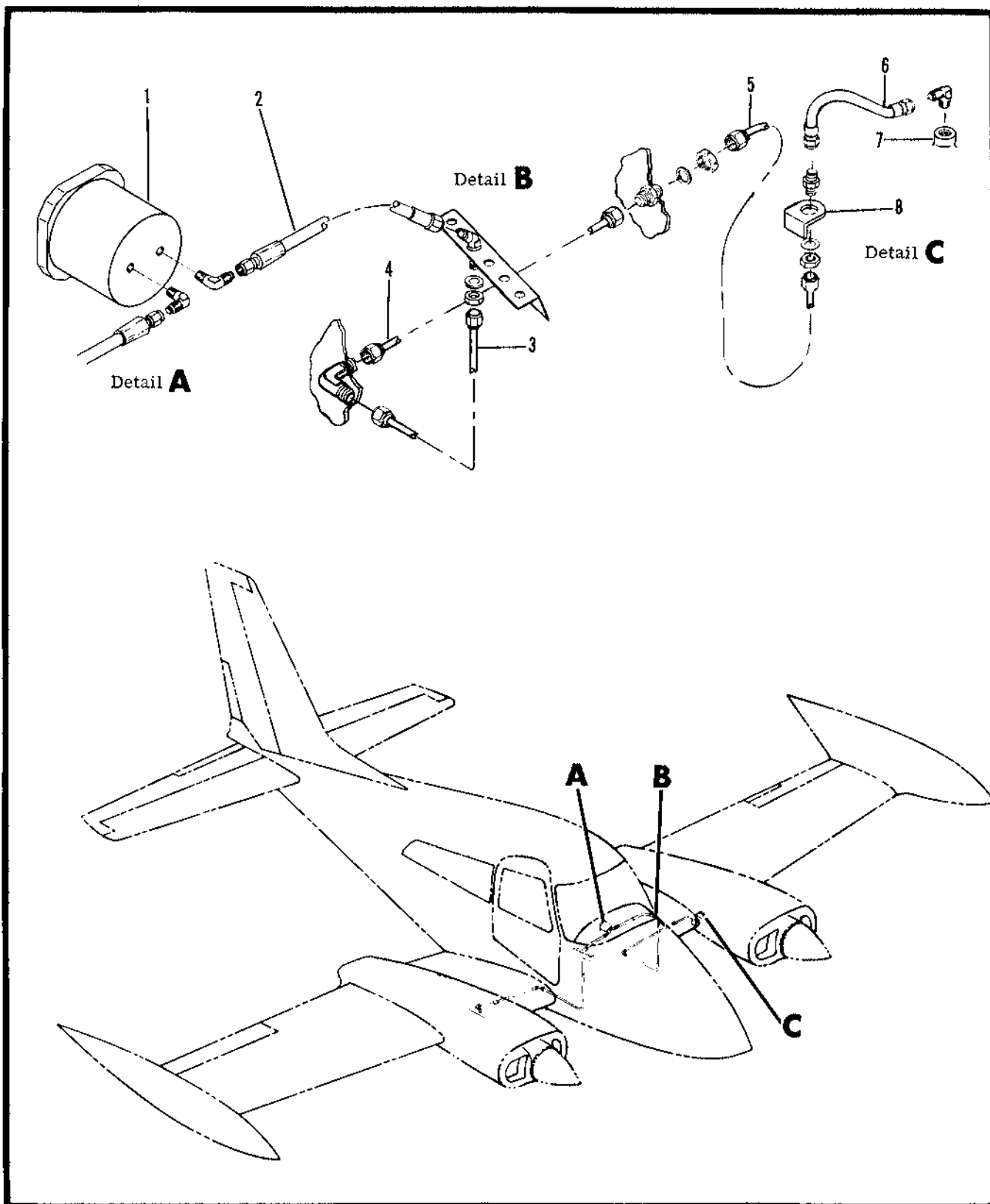
## TO APPLY PRESSURE:

**CAUTION**

Do not apply positive pressure with airspeed indicator connected into static system.

1. Hold pressure hose firmly against static pressure source opening.
2. Slowly squeeze air bulb to apply desired pressure to static system. Desired pressure may be maintained by repeatedly squeezing bulb to replace any air escaping through leaks.
3. Release pressure by slowly opening pressure bleed-off screw, then remove test equipment.

Figure 12-10. Static System Test Equipment



- |                                                 |                                           |
|-------------------------------------------------|-------------------------------------------|
| 1. Manifold Pressure Gage                       | 5. Line Assembly (Nacelle Rib to Bracket) |
| 2. Hose Assembly (Gage to Bracket)              | 6. Hose Assembly (Bracket to Manifold)    |
| 3. Line Assembly (Bracket to Fuselage Skin)     | 7. Intake Manifold                        |
| 4. Line Assembly (Fuselage Skin to Nacelle Rib) | 8. Bracket                                |

Figure 12-10. Manifold Pressure System Installation

## RELATED SYSTEMS

the intake manifold of each engine to separate connections at the back of the gage. The gage is calibrated in inches of mercury, it indicates the absolute pressure in the intake manifold of each engine.

**Removal of Manifold Pressure Lines. (See figure 12-10.)**

- a. Refer to Section 9 and remove engine cowls.
- b. Refer to Section 3 and remove the following items:
  1. Front seats.
  2. Front carpet.
  3. Lower center upholstery panel.
- c. Disconnect hose assembly (2) from manifold gage (1) and bracket.
- d. Disconnect line assembly (3) from bracket and elbow at fuselage skin.
- e. Disconnect line assembly (4) from elbow at fuselage skin and union at nacelle root rib. Route line assembly from wing.

**NOTE**

It may be necessary to bend the line slightly to facilitate removal, however, excessive bending should be avoided to prevent possible damage to line.

- f. Disconnect line assembly (5) from unions on nacelle root rib and bracket (8) and remove line assembly from engine compartment.
- g. Disconnect hose assembly (6) from union on bracket (8) and intake manifold (7).

**Installation of Manifold Pressure Lines. (See figure 12-10.)**

- a. Install manifold pressure lines by reversing removal procedures.

**NOTE**

Apply a small amount of suitable thread lubricant to male threads of all fittings before installation. Slight bending of the manifold pressure lines may be required to facilitate installation, however, excessive bending should be avoided.



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## SECTION 13

## UTILITY AND OPTIONAL SYSTEMS

## Table of Contents

|                                                                               | Page  |                                                                  | Page  |
|-------------------------------------------------------------------------------|-------|------------------------------------------------------------------|-------|
| HEATING, VENTILATING AND DEFROSTING SYSTEM . . . . .                          | 13-3  | Removal and Installation . . . . .                               | 13-24 |
| Heater . . . . .                                                              | 13-3  | Calibration . . . . .                                            | 13-24 |
| Removal . . . . .                                                             | 13-3  | POWER FRONT SEAT . . . . .                                       | 13-24 |
| Disassembly and Assembly . . . . .                                            | 13-3  | Removal . . . . .                                                | 13-24 |
| Trouble Shooting the Heater . . . . .                                         | 13-4  | Installation . . . . .                                           | 13-24 |
| Installation . . . . .                                                        | 13-6  | NAV-O-MATIC 400 AUTOPILOT . . . . .                              | 13-25 |
| Heater Fuel System Components . . . . .                                       | 13-6  | Removal of Control Cables . . . . .                              | 13-26 |
| Removal . . . . .                                                             | 13-6  | Installation of Control Cables . . . . .                         | 13-26 |
| Installation . . . . .                                                        | 13-6  | Removal and Installation of Actuators and Computer . . . . .     | 13-26 |
| Cabin Warm Air Vents and Ducting . . . . .                                    | 13-6  | Removal and Installation of Gyros . . . . .                      | 13-26 |
| Removal . . . . .                                                             | 13-6  | Removal and Installation of Switches . . . . .                   | 13-26 |
| Installation . . . . .                                                        | 13-6  | Removal and Installation of Controller Rigging . . . . .         | 13-27 |
| Cabin Cool Air Vents and Ducting . . . . .                                    | 13-6  | NAV-O-MATIC 800 AUTOPILOT . . . . .                              | 13-27 |
| Removal . . . . .                                                             | 13-6  | Removal and Installation of Autopilot Aileron Cables . . . . .   | 13-27 |
| Installation . . . . .                                                        | 13-8  | Rudder Cables . . . . .                                          | 13-27 |
| Heater Switch . . . . .                                                       | 13-8  | Elevator Cables . . . . .                                        | 13-27 |
| Removal and Installation . . . . .                                            | 13-8  | Elevator Trim Extension Cable . . . . .                          | 13-27 |
| Temperature Control . . . . .                                                 | 13-8  | Removal and Installation of Pneumatic System . . . . .           | 13-29 |
| Removal . . . . .                                                             | 13-8  | Removal and Installation of Servos . . . . .                     | 13-35 |
| Installation . . . . .                                                        | 13-8  | Removal and Installation of Computer . . . . .                   | 13-35 |
| Airflow Controls . . . . .                                                    | 13-8  | Removal and Installation of Controller . . . . .                 | 13-35 |
| Removal . . . . .                                                             | 13-8  | Removal and Installation of Miscellaneous Components . . . . .   | 13-35 |
| Installation . . . . .                                                        | 13-8  | Rigging of Autopilot Control Cables . . . . .                    | 13-35 |
| Air Spill Vent Tube . . . . .                                                 | 13-8  | Autopilot Pressure Check and Adjustment . . . . .                | 13-37 |
| Removal and Installation . . . . .                                            | 13-10 | OXYGEN SYSTEM . . . . .                                          | 13-37 |
| SURFACE DEICE SYSTEM . . . . .                                                | 13-10 | Trouble Shooting . . . . .                                       | 13-38 |
| Trouble Shooting . . . . .                                                    | 13-10 | Maintenance . . . . .                                            | 13-38 |
| Removal and Installation . . . . .                                            | 13-10 | Removal of Oxygen Cylinder-Regulator Assembly . . . . .          | 13-38 |
| Surface Deice System Check . . . . .                                          | 13-10 | Installation of Oxygen Cylinder-Regulator Assembly . . . . .     | 13-39 |
| Cold Patch Repair of Deice Boots . . . . .                                    | 13-12 | Removal of Pressure Gage . . . . .                               | 13-39 |
| PROPELLER DEICE SYSTEM . . . . .                                              | 13-13 | Installation of Pressure Gage . . . . .                          | 13-39 |
| Removal and Installation of Slip Rings . . . . .                              | 13-13 | Removal of Filler Valve . . . . .                                | 13-39 |
| Brush Holder Assembly . . . . .                                               | 13-15 | Installation of Filler Valve . . . . .                           | 13-39 |
| Removal and Installation of Brush Holder Assembly and Mount Bracket . . . . . | 13-15 | Charging . . . . .                                               | 13-42 |
| Inspection and Testing . . . . .                                              | 13-15 | Leak Testing . . . . .                                           | 13-42 |
| Adjustment of Brush Holder Assembly . . . . .                                 | 13-17 | Servicing and Inspection . . . . .                               | 13-42 |
| Removal and Installation of Timer Unit . . . . .                              | 13-17 | Inspection Criteria for Acceptance of Oxygen Cylinders . . . . . | 13-43 |
| Removal and Installation of Deice Ammeter . . . . .                           | 13-18 | Purging . . . . .                                                | 13-43 |
| Removal and Replacement of Switch and Circuit Breaker . . . . .               | 13-18 | Functional Testing . . . . .                                     | 13-44 |
| Trouble Shooting . . . . .                                                    | 13-18 | OIL DILUTION SYSTEM . . . . .                                    | 13-44 |
| PROPELLER UNFEATHERING SYSTEM . . . . .                                       | 13-18 | System Operation . . . . .                                       | 13-44 |
| Removal . . . . .                                                             | 13-18 | Removal . . . . .                                                | 13-45 |
| Installation . . . . .                                                        | 13-18 | Installation . . . . .                                           | 13-45 |
| Operational Check . . . . .                                                   | 13-18 | HEATED WINDSHIELD . . . . .                                      | 13-45 |
| PROPELLER SYNCHRONIZER SYSTEM . . . . .                                       | 13-19 | Trouble Shooting . . . . .                                       | 13-45 |
| Operation . . . . .                                                           | 13-19 | Removal . . . . .                                                | 13-45 |
| Removal . . . . .                                                             | 13-19 | Installation . . . . .                                           | 13-45 |
| Installation . . . . .                                                        | 13-20 | Removal and Installation of Components . . . . .                 | 13-45 |
| Adjustment . . . . .                                                          | 13-20 | Radio Shelf Curtain . . . . .                                    | 13-46 |
| Functional Test . . . . .                                                     | 13-20 |                                                                  |       |
| THREE BLADED PROPELLER . . . . .                                              | 13-23 |                                                                  |       |
| Removal . . . . .                                                             | 13-23 |                                                                  |       |
| Installation . . . . .                                                        | 13-23 |                                                                  |       |
| CESSNA ECONOMY MIXTURE INDICATOR . . . . .                                    | 13-24 |                                                                  |       |
| Trouble Shooting the EGT System . . . . .                                     | 13-24 |                                                                  |       |

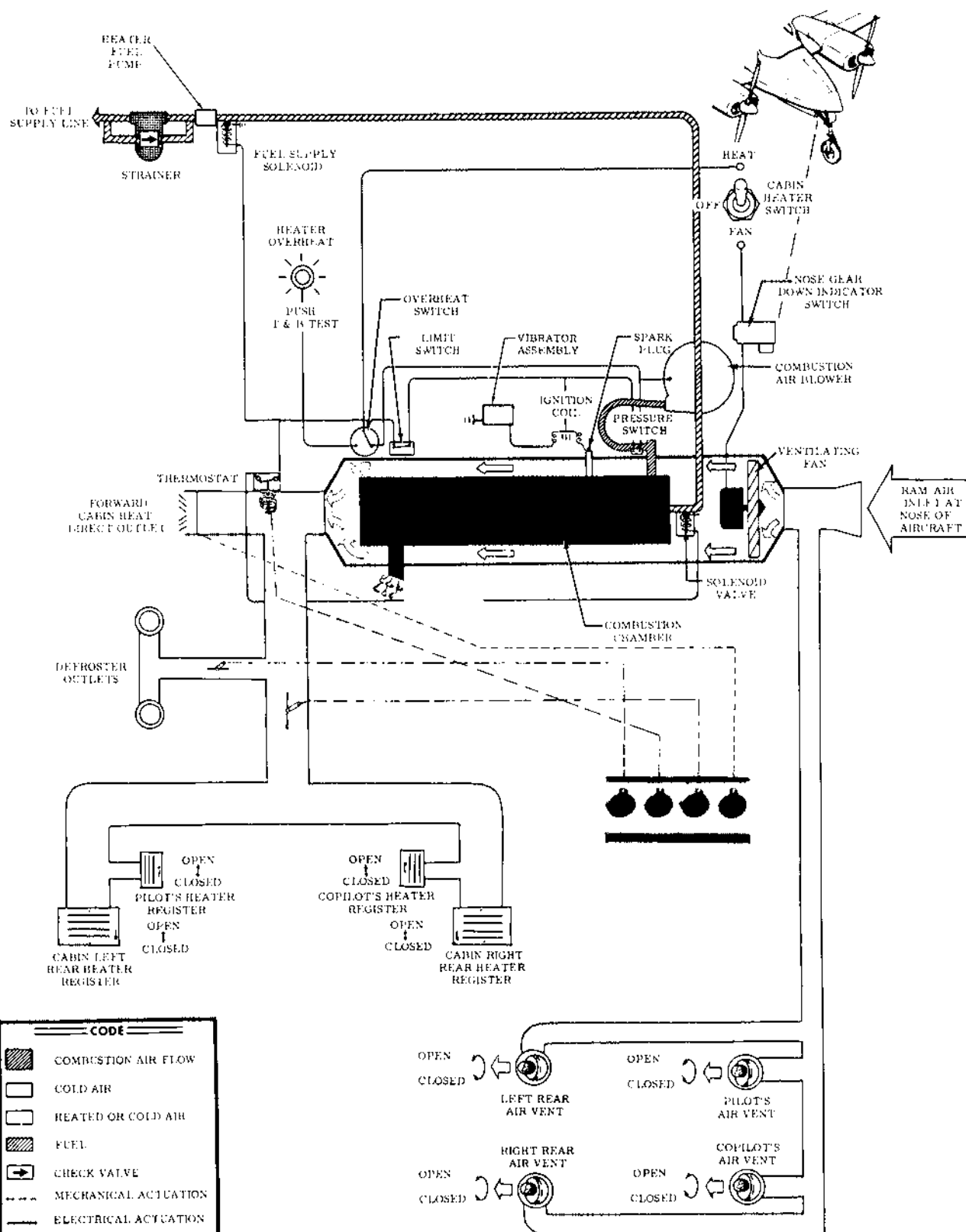


Figure 13-1. Heating, Ventilating and Defrosting Schematic

**HEATING, VENTILATING AND DEFROSTING SYSTEM.** (See figure 13-1.)

The heating and ventilating system provides controlled air, either heated or cool, to all areas of the cabin. Air is supplied to the heater through a ram air opening in the nose of the aircraft. From the heater, air is ducted to seven controllable heat outlets in the cabin. Two heat outlets are located at the base of the windshield for defrosting purposes, two are located in the forward upholstery side panels (left and right) slightly aft of the rudder pedals, two are on the aft face of the main spar beneath the pilot's and copilot's seat, and a direct air outlet located on the firewall. To insure a sufficient supply of air when ram air cannot be utilized, a ventilating fan is incorporated in the heater which will deliver either cool or heated air, depending on the heater switch. The electrical circuit leading to the ventilating fan is controlled by the nose gear down indicating switch which allows it to operate only when the landing gear is extended. In addition to the ventilation provided by the heating system, a separate ducting system routes ram air to four adjustable wemacs; two are located on the lower corners of the instrument panel and two on the side walls of the aft cabin compartment. Air in the cabin is not recirculated. Fresh air continually enters the system and cabin air is continually exhausted into the slipstream through a spill vent which is located in the baggage compartment.

**Description of Heater and Basic Components.**

The heater is a gasoline combustion type and is mounted in the right side of the nose section. Fuel is routed from a tee in the fuel crossfeed line through a filter and pulsating pump to the solenoid valve-regulator which regulates the fuel pressure to 7 psi. Fuel from the solenoid valve-regulator is routed through the fuel line assembly to the heater. The heater fuel line assembly fitting, at the heater, is enclosed in a metal housing. The housing is vented and drained as a precaution against fire in the event of a fitting leakage. Fuel routed through the fuel line assembly enters the heater solenoid valve which allows fuel to pass through the combustion chamber spray nozzle. Electrical current is supplied to the combustion air blower, combustion air pressure switch and ignition coil when the heater switch is placed in the HEAT position. When the nose gear is in the DOWN position, electrical current is also supplied to the ventilating fan. As the combustion air flow increases, the combustion air pressure switch closes and actuates the ignition coil and heater solenoid valve. Fuel then flows through the heater solenoid valve into the combustion chamber spray nozzle which injects a conical shaped spray cone of fuel into the combustion chamber where the spark plug is already sparking, thus combustion occurs. As the heated air flowing from the heater to the cabin exceeds the thermostat setting, the thermostat automatically closes the solenoid valve, stopping fuel flow into the heater. As the heater cools, the thermostat opens the solenoid valve, allowing fuel to flow and combustion takes place since the spark plug

is continually sparking. By cycling on and off, the heater maintains an even air temperature in the cabin. The heater combustion chamber is completely separate from the ventilating system to prevent any exhaust gases from contaminating the cabin air. All exhaust gases are vented overboard through an exhaust tube directly beneath the heater.

**Removal of the Heater.** (See figure 13-2.)

- a. Tag and disconnect all electrical wires from the combustion air blower motor (3) and from heater terminal strip.
- b. Loosen clamps and slide hoses from fuel inlet shroud (9).
- c. Loosen clamp (6) attaching fuel inlet shroud to heater assembly (16), separate shroud halves by removing two attaching screws.
- d. Disconnect fuel line assembly (10) from heater assembly (16) at the fitting.

**CAUTION**

A small amount of fuel will drain from fuel line assembly (10). Wipe away fuel with rags.

- e. Disconnect combustion air blower outlet tube (5) from heater elbow by removing attaching nut and bolt.
- f. Disconnect combustion air blower inlet tube (18) from inlet assembly (17) by removing attaching nut and bolt.
- g. On the underside of heater assembly, loosen support clamp and disconnect drain line (14) from heater assembly (16).
- h. Remove four screws attaching clamp (2) to support assembly (4) and remove combustion air blower and motor assembly (3) from aircraft through RH nose access door.
- i. Remove four screws and clamp attaching heater assembly (16) to heater control assembly (20).

**NOTE**

To facilitate removal of blower and motor assembly (3), remove blower inlet tube (18) and outlet tube (5) from blower by removing attaching nuts and bolts.

- j. If (optional equipment) radio shelves and radio equipment are installed, remove as follows:
  1. Tag cable assemblies and remove radio equipment.
  2. Drill out rivets attaching angles and angle assemblies to nose bulkheads.
  3. Work radio shelves out of nose section through the nose wheel well.
- k. Remove clamp retaining ram air inlet hose (13) to forward inlet of heater assembly and disconnect hose.
- l. Remove heater assembly (16) from aircraft by working out through nose wheel well.

**Disassembly and Assembly of Heater Components.**

For disassembly and assembly of heater components, see heater service and parts manual.

## Trouble Shooting the Heater.

| TROUBLE                                  | PROBABLE CAUSE                                                                                    | CORRECTION                                                                                                                                  |
|------------------------------------------|---------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| HEATER FAILS TO<br>LIGHT                 | Heater switch or circuit breaker open.                                                            | Position heater switch to HEAT or close circuit breaker.                                                                                    |
|                                          | Low voltage.                                                                                      | Connect to auxiliary power supply.                                                                                                          |
|                                          | No fuel to system.                                                                                | Turn on fuel shutoff valve.                                                                                                                 |
|                                          | Insufficient fuel pressure caused by faulty fuel pump or no pump current.                         | Correct faulty fuel pump wiring or repair or replace fuel pump.                                                                             |
|                                          | Fuel pump operating but not building up sufficient pressure.                                      | Remove and repair or replace fuel pump.                                                                                                     |
|                                          | Fuel nozzle clogged in heater.                                                                    | Remove the nozzle and clean or replace it.                                                                                                  |
|                                          | Fuel heater solenoid not operating.                                                               | Remove and check solenoid. Replace it if faulty.                                                                                            |
|                                          | Fuel lines clogged or broken.                                                                     | Inspect all lines and connections. It may be necessary to disconnect lines at various points to determine where the restriction is located. |
|                                          | Fuel filter clogged.                                                                              | Clean fuel filter element.                                                                                                                  |
|                                          | Breaker points defective.                                                                         | Repair or replace                                                                                                                           |
|                                          | Manual reset limit switch open.                                                                   | Press reset button and recheck to determine reason for switch opening.                                                                      |
|                                          | Combustion air pressure switch open. (From defective switch or low combustion-air blower output.) | Check for low blower output and correct it. If switch is defective, replace it.                                                             |
|                                          | Cycle switch open.                                                                                | Replace if defective.                                                                                                                       |
|                                          | Thermostat switch open.                                                                           | Operate control to see if switch will come on. Replace switch if defective.                                                                 |
| VENTILATING AIR<br>BLOWER FAILS TO RUN   | Heater switch OFF. Broken or loose wiring to motor.                                               | Turn heater switch to FAN. Check and repair wiring.                                                                                         |
|                                          | Circuit breaker out.                                                                              | Close circuit breaker.                                                                                                                      |
|                                          | Worn motor brushes.                                                                               | Replace motor brushes.                                                                                                                      |
|                                          | Blower wheel jammed.                                                                              | Remove and repair the ventilating-air blower.                                                                                               |
|                                          | Motor burned out.                                                                                 | Remove blower assembly and replace defective motor.                                                                                         |
| COMBUSTION AIR<br>BLOWER FAILS TO<br>RUN | Defective radio-noise capacitor.                                                                  | Replace capacitor.                                                                                                                          |
|                                          | Faulty wiring to motor.                                                                           | Inspect and replace faulty wiring.                                                                                                          |
|                                          | Poor ground connection.                                                                           | Tighten ground screw.                                                                                                                       |
|                                          | Worn motor brushes.                                                                               | Replace motor brushes.                                                                                                                      |
|                                          | Blower wheel jammed. (Usually indicated by hot motor housing.)                                    | Overhaul the combustion-air blower.                                                                                                         |

| TROUBLE                                       | PROBABLE CAUSE                                                                                                                           | CORRECTION                                                                                                                             |
|-----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| COMBUSTION AIR BLOWER FAILS TO RUN (CONT.)    | Short-circuited radio-noise capacitor.                                                                                                   | Replace capacitor.                                                                                                                     |
|                                               | Faulty or burned-out motor.                                                                                                              | Remove combustion air blower for overhaul or replacement.                                                                              |
| HEATER FIRES BUT BURNS UNSTEADILY             | Insufficient fuel supply.                                                                                                                | Inspect fuel supply to heater, including shutoff valve, solenoid valve, fuel filter, fuel pump and fuel lines. Make necessary repairs. |
|                                               | Spark plug partially fouled.                                                                                                             | Replace spark plug.                                                                                                                    |
|                                               | Loose primary connection at ignition assembly.                                                                                           | Tighten connection.                                                                                                                    |
|                                               | Faulty vibrator.                                                                                                                         | Replace vibrator.                                                                                                                      |
|                                               | Combustion-air blower speed fluctuates. (Can be caused by low fluctuating voltage, loose blower wheel, worn brushes or defective motor.) | Remove and overhaul the combustion air blower assembly as required.                                                                    |
|                                               | High-voltage leak in lead between ignition assembly and spark plug.                                                                      | Replace ignition assembly.                                                                                                             |
|                                               | Defective ignition assembly.                                                                                                             | Replace ignition assembly.                                                                                                             |
|                                               | Restriction in fuel nozzle orifice.                                                                                                      | Remove nozzle for cleaning or replacement.                                                                                             |
|                                               | Nozzle loose in retainer or protruding improper spray angle.                                                                             | Tighten or replace the nozzle as required.                                                                                             |
| HEATER STARTS THEN GOES OUT                   | Lack of fuel at heater.                                                                                                                  | Check fuel supply through all components from the tank to the heater. Make necessary corrections.                                      |
|                                               | Defective combustion-air pressure switch.                                                                                                | Replace switch assembly.                                                                                                               |
|                                               | Damaged overheat switch.                                                                                                                 | Replace the switch.                                                                                                                    |
|                                               | Damaged cycling switch.                                                                                                                  | Adjust or replace the switch.                                                                                                          |
|                                               | Fouled spark plug.                                                                                                                       | Replace spark plug.                                                                                                                    |
| HEATER FAILS TO SHUTOFF                       | Fuel solenoid valve in heater stuck open.                                                                                                | Remove and replace solenoid assembly.                                                                                                  |
|                                               | Defective heater switch.                                                                                                                 | Replace the heater switch.                                                                                                             |
| COLD HEATER OUTPUT AT HIGH AIR SPEEDS         | Combustion air supply is low.                                                                                                            | Perform functional check of air pressure switch with voltmeter.                                                                        |
|                                               | Defective thermostat.                                                                                                                    | Perform functional check of thermostat.                                                                                                |
|                                               | Defective pressure switch.                                                                                                               | Replace pressure switch.                                                                                                               |
| INSUFFICIENT HEATER OUTPUT AT HIGH AIR SPEEDS | Malfunction in heater fuel supply.                                                                                                       | Perform checks in accordance with functional check of heater fuel supply and heater fuel nozzle. Replace components as necessary.      |

### Installation of Heater. (See Figure 13-2.)

- Install in reverse order of removal.
- If optional radio shelves were removed, install in reverse order of removal.

### Heater Fuel System Components.

These components are a fuel pump, solenoid valve and a filter, mounted on right wing spar web outboard of Sta. 38.16. The fuel pump supplies fuel pressure through the filter to the solenoid valve, which in turn regulates fuel pressure that is supplied to the heater. If an overheat condition exists in the heater, the heater fuel pump and solenoid valve will automatically be shut off.

#### NOTE

Heater fuel pressure is regulated by the solenoid valve which has been pre-set by the manufacturer. If it becomes necessary to adjust heater fuel pressure, see Heater Parts and Service Manual.

### Removal of Heater Fuel System Components.

- Defuel right tip tank in accordance with defueling procedures in Section 11.
- Remove access hole covers from lower leading edge at right wing station 38.16.
- Disconnect electrical leads from pump and solenoid valve, disconnect and tag all fuel lines to insure proper reinstallation.
- Remove bolts attaching pump, filter, and solenoid valve to spar web, route components from wing.

### Installation of Heater Fuel System Components.

- Install in reverse order of removal.
- Service right main tank as specified in Section 2.
- Check for leaks, install covers on wing.

### Cabin Warm Air Vents and Ducting. (See figure 13-3.)

The cabin is heated by five warm air vents. The warm air is routed through warm air ducting and expelled through the heat registers and the forward cabin direct outlet. These registers are controlled by knobs on the right switch and control panel. They also have individual air control knobs which regulate the amount of warm air entering the cabin through the register.

### Removal of Cabin Warm Air Vents and Ducting. (See figure 13-3.)

- Remove copilot's seat in accordance with Section 3.
- Remove right and left warm air registers from

heat ducts by removing attaching screws.

- Remove forward floorboard carpeting in accordance with Section 3.
- Remove applicable access covers and loosen ducting clamps securing right and left warm air ducting to the heat ducts and the heat control assembly.
- Remove right and left cover plate rubber shields and work right and left rear seat ducting out through the nose wheel well opening.

### Installation of Cabin Warm Air Vents and Ducting. (See figure 13-3.)

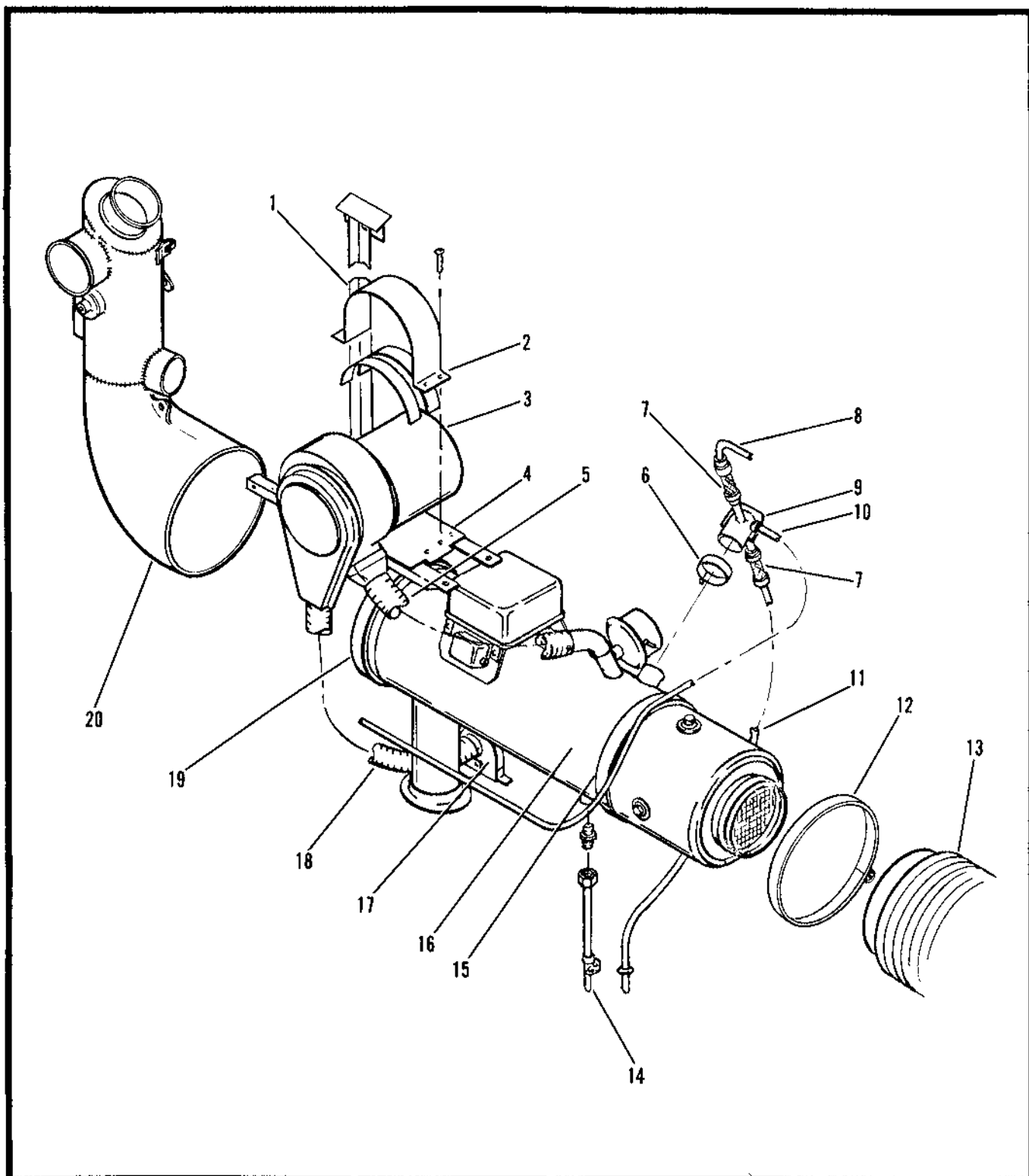
- Work right and left rear seat ducting in through nose wheel well opening and replace right and left cover plate rubber shield.
- Secure right and left ducting clamps to the heat ducts and heat control assembly, replace access covers.
- Replace forward floorboard carpeting in accordance with Section 3.
- Replace right and left warm air registers by positioning over heat ducts and securing with screws.
- Replace copilot's seat in accordance with Section 3.

### Cabin Cool Air Vents and Ducting.

Fresh cool air is routed through the ventilating ducting and expelled through individual wemac valves positioned by each seat. These wemac valves are individually controlled to regulate the amount of fresh air entering each position.

### Removal of Cabin Cool Air Vents and Ducting. (See figure 13-3.)

- Loosen clamps securing forward air vent ducting to air vent tees and forward air vent adapters. Remove ducting from behind the instrument panel.
- Remove forward air vents and forward air vent adapters from the stationary instrument panel, by removing the four attaching screws and nuts.
- Loosen clamp securing each end of cool air supply duct and work duct forward and remove.
- Loosen clamp securing right warm air duct at each end and remove duct.
- Loosen clamps securing crossover duct to air vent tees and remove duct.
- Remove front and rear carpets in accordance with Section 3.
- Remove upholstery side panels in accordance with Section 3.
- Remove outboard access hole covers and cover plates from floorboards by removing attaching screws.
- Loosen clamps at the aft end of right and left floorboard ducting and work ducting with supply duct tee and left air vent tee attached, forward and out through routing holes in forward cabin bulkhead.
- Loosen clamps at each end of aft air vent ducting and remove ducting.
- Remove aft air vent adapters by removing the attaching screws.



- |                                             |                        |                             |
|---------------------------------------------|------------------------|-----------------------------|
| 1. Support                                  | 7. Hose                | 14. Drain Line              |
| 2. Strap Assembly                           | 8. Vent Air Inlet Line | 15. Strap                   |
| 3. Combustion Air Blower and Motor Assembly | 9. Fuel Inlet Shroud   | 16. Heater Assembly         |
| 4. Support Assembly                         | 10. Fuel Line Assembly | 17. Inlet Assembly          |
| 5. Blower Outlet Tube                       | 11. Fuel Drain Line    | 18. Blower Inlet Tube       |
| 6. Clamp                                    | 12. Clamp              | 19. Clamps                  |
|                                             | 13. Ram Air Inlet Hose | 20. Heater Control Assembly |

Figure 13-2. Heater Installation



### Installation of Cabin Cool Air Vents and Ducting. (See figure 13-3.)

- a. Attach forward end of left floorboard duct to air vent tee and work duct into position through routing hole in forward cabin bulkhead. Secure duct to floorboard adapter with clamp.
- b. Attach forward end of right floorboard duct to supply duct tee and work duct into position through routing hole in forward cabin bulkhead. Secure duct to floorboard adapter with clamp.
- c. Position aft air vent adapters and secure with attaching screws.
- d. Install aft air vent ducting and attach to aft air vent adapters and secure with clamps.
- e. Install side panels in accordance with Section 3.
- f. Install front and rear carpet in accordance with Section 3.
- g. Install forward air vents and forward air vent adapters and secure with attaching screws and nuts.
- h. Install forward cool air supply duct and attach to nose duct adapter and supply duct tee with clamps.
- i. Install crossover duct and attach to the air vent tees with clamps.

### Heater Switch.

The heater fan is controlled by a three-position toggle switch located on the decorative hood. The positions of the switch are HEAT (up position), OFF (middle position), and FAN (down position). The HEAT position starts and maintains heater operation, delivering warm air to all heat and defrosting outlets. The OFF position allows the heater ducting to be used as a ventilating system while the aircraft is in flight. The FAN position provides ventilating air to the cabin while the aircraft is on the ground.

### Removal and Installation of Heater Switch.

Remove and replace heater switch in accordance with Section 14.

### Temperature Control.

The temperature control is located below and slightly to the left of the right control column. It is a rotary type knob and is labeled TEMP CONTROL, LOW (counterclockwise position), and MAX (clockwise position). Clockwise rotation of the temperature control knob increases cabin temperature and counterclockwise rotation decreases it. This knob mechanically controls the setting of a thermostat located within the outlet adapter just aft of the heater. The thermostat in turn cycles the heater to maintain the cabin temperature setting selected with the control knob.

If this switch is set for ground operating comfort, it may be necessary to reset it after airborne, since ram air will increase the ventilating airflow and heater output.

### Removal of Temperature Control.

- a. Loosen screw securing control wire to thermostat actuating arm.
- b. Remove clamp securing coil wire housing to the thermostat.
- c. Remove control knob by removing knob set screw.
- d. Remove nut securing temperature control assembly to the stationary instrument panel. Slide temperature control assembly forward until free of stationary instrument panel and then aft beneath stationary panel until coiled wire housing is removed from forward cabin bulkhead.

### Installation of Temperature Control.

- a. Route temperature control wire housing through forward cabin bulkhead and attach to thermostat with attaching clamp.
- b. Insert temperature control assembly through hole in stationary instrument panel and secure with nut.
- c. Place control knob on temperature control assembly and secure with set screw.
- d. With control knob turned to the LOW position and the thermostat arm forward, secure arm to the control wire by tightening clamp screw.

### Airflow Controls.

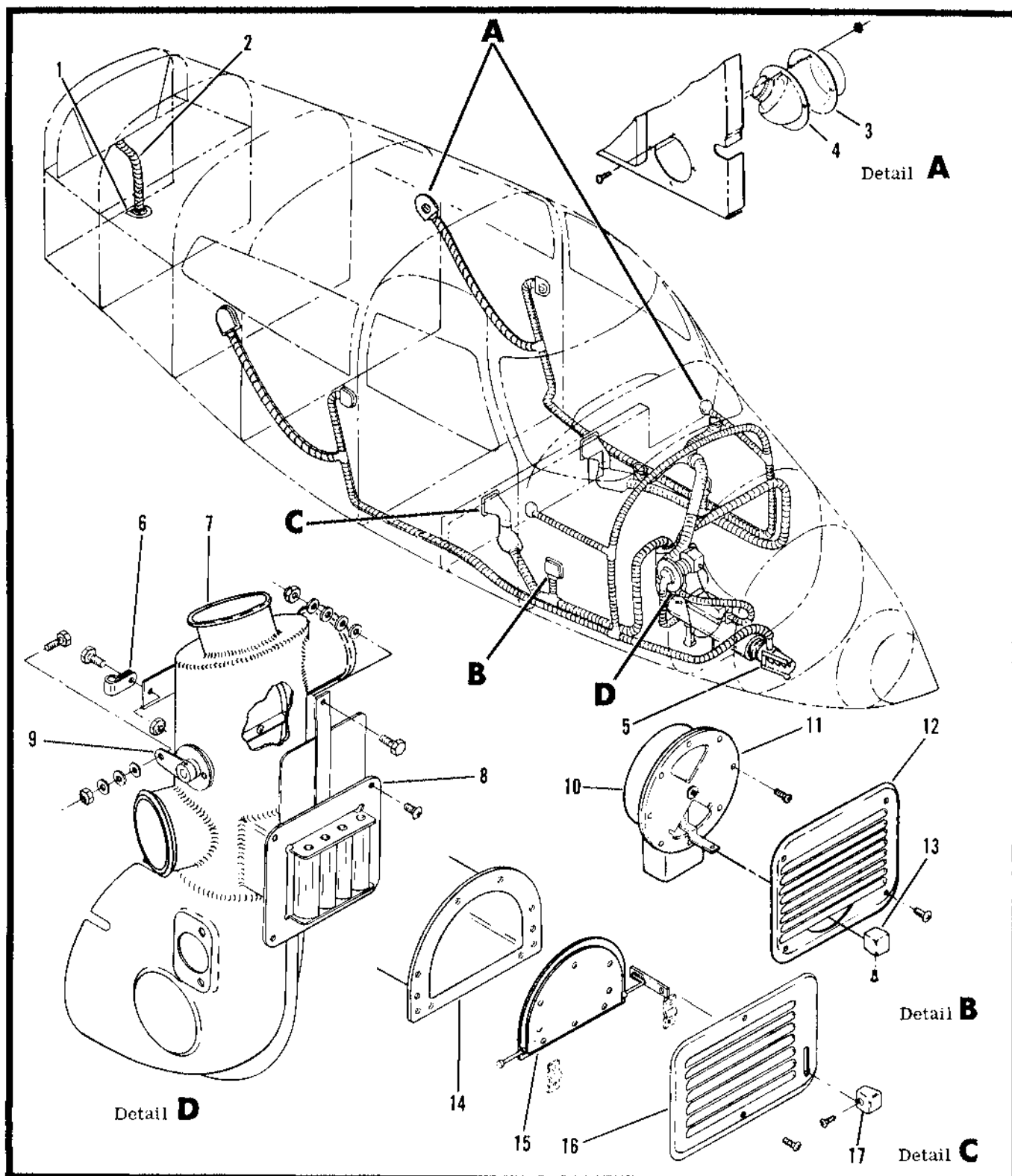
#### Removal of Airflow Controls.

- a. Loosen clamp and nuts securing control wires to the cabin air defroster valve arms.
- b. Work cabin air control coiled wire housing from routing bracket.
- c. Work defroster control coiled wire housing from routing bracket supporting it to forward cabin bulkhead.
- d. Loosen nuts securing control assemblies to lower instrument panel and slide assemblies aft through mounting holes.

#### Installation of Airflow Controls.

- a. Insert control assemblies through mounting holes in lower instrument panel.
- b. Slide lockwashers and nuts over coiled wire housings and secure control assemblies to lower instrument panel by tightening nuts onto threaded fittings on control ends.
- c. Route defroster control through bracket on forward cabin bulkhead, and cabin air control through routing bracket.
- d. With control knobs locked in the CLOSED position and plenum chamber valves closed, insert the control wires through the valve actuating arm clamps and secure by tightening clamp nuts.

### Air Spill Vent Tube.



1. Clamp
2. Cabin Air Spill Tube
3. Adapter
4. Wernac Valve
5. Nose Inlet Adapter
6. Clamp

7. Heat Control Assembly
8. Outlet
9. Arm Assembly
10. Adapter
11. Valve

12. Grill
13. Knob
14. Heat Outlet
15. Valve and Rod Assembly
16. Grill
17. Knob

Figure 13-3. Heating, Ventilating and Defrosting System Installation

Removal and Installation of Air Spill Vent Tube.  
(See figure 13-3.)

- a. Refer to Section 3, remove rear upholstery panels.
- b. Loosen clamps (1) and remove cabin air spill vent tube (2) by sliding from upper and lower adapters.
- c. Install cabin air spill vent tube (2) by reversing removal procedures.

## SURFACE DEICE SYSTEM.

The optional light-weight deicing system consists of inflatable rubber deice boots cemented to the leading edges of the outer wing panels and horizontal stabilizers. Air for inflation of the boots is supplied by the pressure side of the vacuum pump. A left wing light is incorporated on the outboard side of the left engine nacelle to provide an aid in observing ice formations during night operation.

Operation of the deicing system is through six-second delay action control, labeled WING DEICE ACTUATE, located on the left hand instrument panel. When the control is positioned to ACTUATE, the control valve closes its overboard air valve and redirects the air from the pressure side of the vacuum pump through a filter, shuttle valve and into the deice boots for the inflation cycle. After the six-second inflation cycle is complete, the system returns to its off position. Everytime an inflation cycle is desired, the control must be momentarily positioned to ACTUATE. After a six-second inflation is completed the deflation cycle begins. Air pressure returns through the system and overboard through the control valve. When the shuttle valve has less than 1 psi against it, it closes and the vacuum side of the vacuum pump holds the boots in a deflated position. The system indicator light (amber) should light when the control is moved to ACTUATE. The pressure indicator light (green) should light when the system reaches 10 psi.

## Trouble Shooting Surface Deice System.

| TROUBLE                                                        | PROBABLE CAUSE                                             | CORRECTION                                 |
|----------------------------------------------------------------|------------------------------------------------------------|--------------------------------------------|
| DEICE BOOTS DO NOT INFLATE OR INFLATE SLOWLY                   | Pressure regulator valve set too low or valve malfunction. | Reset or replace pressure regulator valve. |
|                                                                | Solenoid valve malfunction.                                | Replace solenoid valve.                    |
|                                                                | Shuttle valve malfunction.                                 | Replace shuttle valve.                     |
|                                                                | Loose or missing gasket.                                   | Tighten fitting or replace gasket.         |
|                                                                | Loose or faulty hose.                                      | Replace hose.                              |
|                                                                | Loose or faulty wiring.                                    | Tighten or replace wiring.                 |
| NOTE                                                           |                                                            |                                            |
| If the vacuum pump malfunctions, this system will not operate. |                                                            |                                            |
| DEICE BOOTS DO NOT DEFLATE OR DEFLATE SLOWLY                   | Solenoid valve or control valve malfunction.               | Replace valve.                             |

Removal and Installation of Surface Deice System.  
(See figure 13-4.)

- a. For removal and installation of deice system refer to figure 13-4.

## Surface Deice System Check.

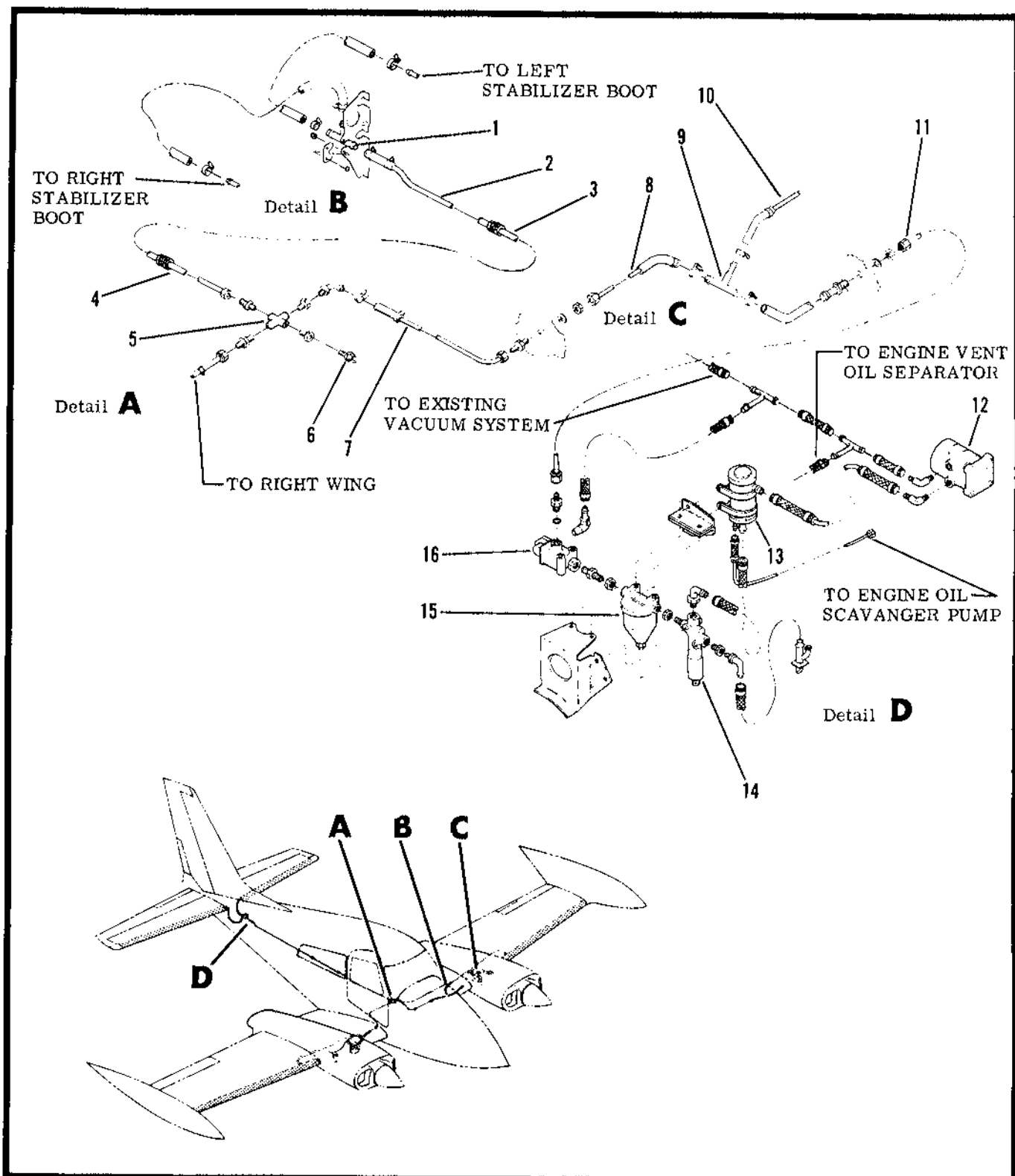
- a. Electrical Test:
  1. Position deice control to OFF position.
  2. Position aircraft battery switch to ON position.
  3. Press indicator light to check light circuit and bulb.

4. Position deice control to ACTUATE and repeat step 3.

5. If indicator light does not function in step 3 and 4, the circuit breaker may have opened. Check for short in the system. Reset circuit breaker and re-check step 3.

- b. Air Leakage Test:

1. This test can be performed in either the left or right nacelles. The following steps refer to the left nacelle.
2. Disconnect pressure hose from the control valve inlet fitting.
3. Disconnect tube from overboard port and cap the port with an AN929-10 cap assembly.



1. Tee
2. Aft Tailcone Line
3. Forward Tailcone Line
4. Center Fuselage Line
5. Cross

6. Pressure Switch
7. Fuselage Line (Cross to Wing)
8. Wing Line (To Nacelle Tee)
9. Tee
10. Wing Line (To Wing Boot)
11. Nacelle Line

12. Vacuum Pump
13. Oil Separator
14. Pressure Control Valve
15. Air Filter
16. Shuttle Valve

Figure 13-4. Surface Deice Installation

4. Connect a source of clean air to the control valve inlet port. It is necessary that the inlet pressure be a minimum of 18-20 PSIG to perform this test. Include a pressure gage in the air line to observe the system pressures.

5. Apply 18 PSIG pressure to the system and by means of a hand-operated valve, trap the pressure on the deice system. Observe the system for leakage. The leakage rate should not exceed a pressure drop of 4.0 PSIG per minute.

6. To check the pressure switch, turn on the aircraft battery switch while the deice system is under pressure. The indicator light should glow.

7. Remove test equipment, lubricate all threads, and replace all system components.

8. Disassembly or rework of the operating equipment in this system should not be attempted, replace any unit which does not function correctly.

#### Cold Patch Repair of Deice Boots.

There are four types or areas of damage that are most common to the deice boots. An outline of the cold patch repair procedure for each follows:

##### NOTE

When repairing the deice boots and replacement layers are being installed, exercise care to prevent trapping air beneath the replacement layers. If air blisters appear after material is applied, remove them with a hypodermic needle.

a. Scuff or Surface Damage. This type of damage is the most commonly encountered and is usually caused by scuffing the outer surface of the deice boots while using scaffolds, refueling hoses, ladders, etc. Repair is generally not necessary because the thick outer veneer provides protection to the natural rubber underneath. If the scuff is severe and has caused removal of the entire thickness of veneer (exposing the brown natural rubber underneath) the damage should be repaired as outlined below:

1. Select a patch (Part Number 3306-1, 3306-2, or 3306-3) of ample size to cover the damaged area.

2. Clean the area to be repaired with a cloth dampened slightly with solvent.

3. Buff the area around the damage with steel wool so that the area is moderately but completely roughened.

4. Wipe the buffed area clean with a cloth slightly dampened in solvent to remove all loose particles.

5. Apply one even thorough coat of cement (Part Number 3306-16) to the patch and to the corresponding damaged area of the deice boot. Allow cement to set until it becomes tacky.

6. Apply patch to the deice boot with an edge or the center adhering first, then work the remainder of the patch down, being careful to avoid trapping air pockets.

7. Roll the patch thoroughly with a stitcher-roller (Part Number 3306-10) and allow to set for ten to fifteen minutes.

8. Wipe the patch and surrounding area from the center of the patch outward, with a cloth slightly

dampened with solvent.

9. Apply one light coat of A-56-B conductive cement (Part Number 3306-13) to the patched area.

##### NOTE

Satisfactory adhesion should be obtained in four hours; however, if the patch is allowed to cure for a minimum of 20 minutes, the deice boots may be inflated to check the repair.

b. Damage to Tube Area. This type of damage consists of cuts, tears, or ruptures to the inflatable tube area and a fabric reinforced patch must be used for this repair. Damage to the tube area should be repaired as outlined below:

1. Select a patch (Part Number 3306-4, 3306-5, or 3306-6) of ample size to extend at least 5/8 inch beyond the damaged area.

##### NOTE

If none of these patches are of proper size, one may be cut to the size desired from one of the larger patches. If this is done, the edge should be beveled by cutting with the shears at an angle. These patches are manufactured so they will stretch in one direction only. Be sure to cut the patch selected so that the stretch is in the widthwise direction of the inflatable tubes.

2. Clean the area to be repaired with a cloth dampened slightly with solvent.

3. Buff the area around the damage with steel wool so that area is moderately but completely roughened.

4. Wipe the buffed area clean with a cloth slightly dampened in solvent to remove all loose particles.

5. Apply one even thorough coat of cement (Part Number 3306-16) to the patch and the corresponding damaged area of the deice boot. Allow cement to set until it becomes tacky.

6. Apply the patch to the deice boot with the stretch in the widthwise direction of the inflatable tubes, sticking edge of patch in place first and working remainder down with a very slight pulling action so the rupture is closed. Use care not to trap air between patch and deice surface.

7. Roll the patch thoroughly with a stitcher-roller (Part Number 3306-10) and allow to set for ten to fifteen minutes.

8. Wipe the patch and surrounding area, from the center of the patch outward, with a cloth slightly dampened with solvent.

9. Apply one light coat of A-56-B conductive cement (Part Number 3306-13) to restore conductivity.

##### NOTE

Satisfactory adhesion of patch to deice boot should be reached in four hours; however, if the patch is allowed to cure for a minimum of 20 minutes, the deice boots may be inflated to check the repair.

c. Damage to Fillet Area. This includes any tears

or cuts to the tapered area aft of the inflatable tubes. Damage to the fillet area should be repaired as outlined below.

1. Trim damaged area square and remove excess material. Cut must be sharp and clean to permit good butt joint of inlay.
2. Cut inlay from tapered fillet (Part Number 3306-7) to match cutout area.
3. Using solvent, loosen edges of the deice boot around area approximately 1-1/2 inch from all edges.
4. Clean the area to be repaired with a cloth dampened slightly with solvent.
5. Lift back edges of cutout and apply one coat of EC-1403 cement to the underneath side of loosened portion of the boot.
6. Apply one coat of EC-1403 cement to the wing skin underneath the loosened edges of the deice boot and extending 1-1/2 inch beyond edges of deice boot into the cutout area.
7. Apply second coat of cement to underneath side of deice boot as outlined in step 5.
8. Apply one coat of EC-1403 cement to one side of a 2-inch wide neoprene coated fabric tape (Part Number 3306-8) and allow to dry and trim to size.
9. Reactivate cemented surfaces with solvent and apply reinforcing tape to wing skin, using care to center tape under all edges of cutout.
10. Roll down tape on wing skin with stitcher-roller (Part Number 3306-10) to assure good adhesion, being careful to avoid air pockets.
11. Apply one coat of EC-1403 cement to top surface of tape and allow to dry approximately 5 to 10 minutes.
12. Reactivate cemented surfaces with solvent. Working toward cutout, roll down the edges of the loosened deice boot, being careful to avoid trapping air pockets. The edges should overlap on the tape approximately 1 inch.
13. Roughen back surface of inlay repair material (Part Number 3306-7, previously cut to size) with steel wool. Clean with solvent and apply one coat of EC-1403 cement.
14. Apply one coat of EC-1403 cement to wing skin inside of the cutout area and allow to dry.
15. Apply the second coat of EC-1403 cement to back side of inlay material and allow to dry.
16. Reactivate cemented surfaces with solvent and carefully insert inlay material with feathered edge aft. Working from the leading edge of wing aft, roll down the inlay material carefully to avoid trapping air.
17. Roughen area on outer surface of deice boot and inlay with steel wool 1-1/2 inch on each side of the splice. Clean with solvent and apply one coat of EC-1403 cement to this area.
18. Apply one coat of EC-1403 cement to one side of 2-inch wide neoprene coated fabric tape (Part Number 3306-8) trim to size and center tape over splice on all three sides.
19. Roll down tape on deice boot with stitcher-roller (Part Number 3306-10) to assure good adhesion, being careful to avoid air pockets.
20. Apply one light coat of A-56-B conductive cement (Part Number 3306-13) to restore conductivity.
- d. Damaged Veneer - Loose from Deice Boot. If the veneer should become loosened from the deice boot, repairs should be made as outlined below.

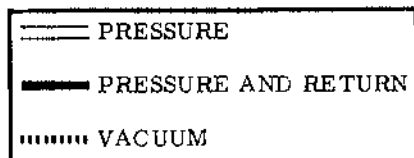
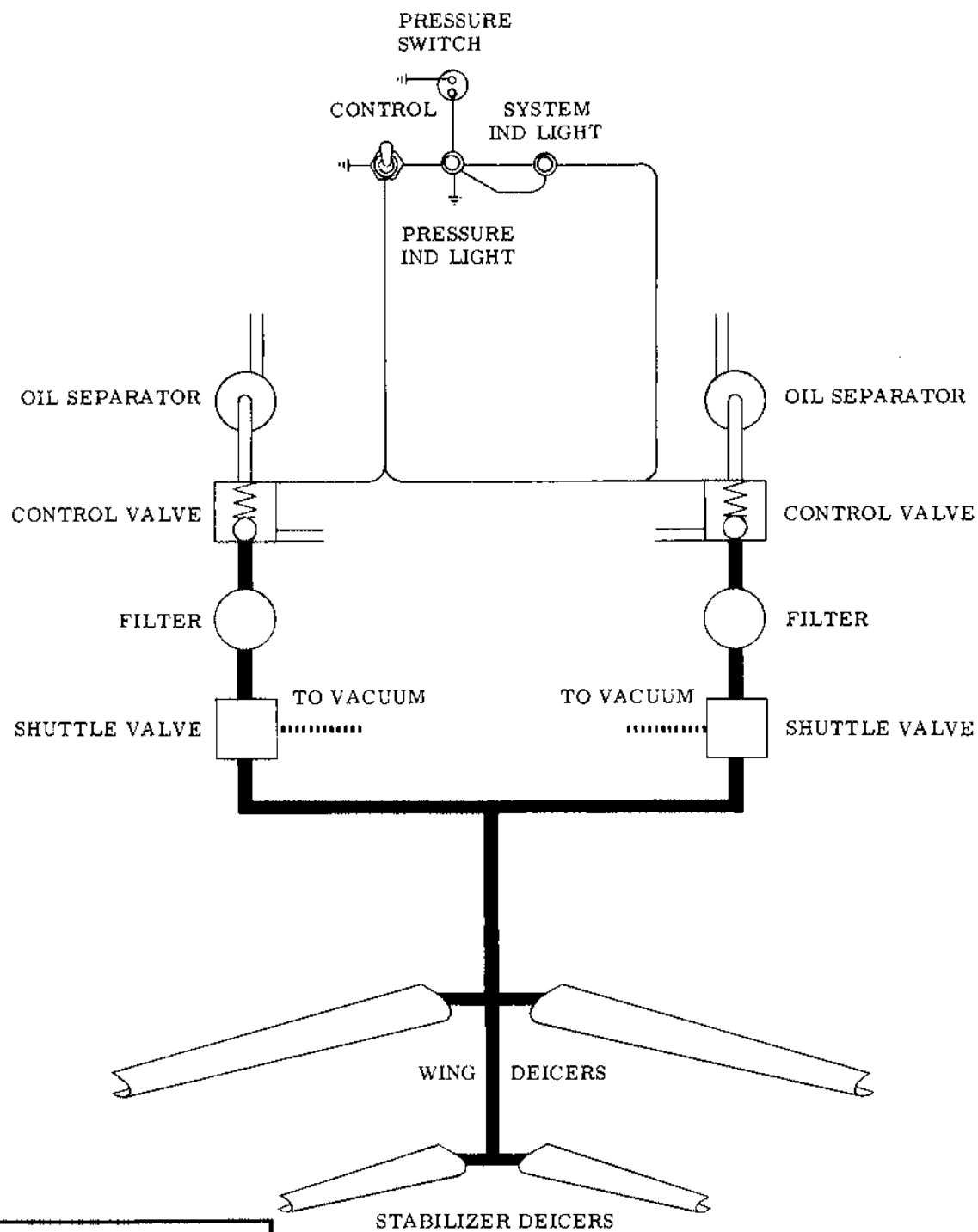
1. Peel and trim the loose veneer to the point where the adhesion of veneer to the deice boot is good.
2. Roughen the area in which veneer is removed with steel wool, rubbing parallel to cut edge of veneer ply to prevent loosening it.
3. Taper edges of veneer down to the tan rubber ply by rubbing parallel to the edges with steel wool and solvent.
4. Cut a piece of veneer material (Part Number 3306-9) to cover the damaged area and extend at least 1 inch beyond in all directions.
5. Mask off an area 1/2 inch larger in length and width than the size of veneer patch.
6. Apply one coat of EC-1403 cement to the damaged area and one coat to the veneer ply. Allow cement to set until it becomes tacky.
7. Roll the veneer ply to the deice boot with a 2-inch rubber roller, applying a slight tension on the veneer ply when applying to prevent trapping air.
8. Wipe the patch and surrounding area, from the center of the patch outward, with a cloth slightly dampened with solvent.
9. Apply one light coat of A-56-B conductive cement (Part Number 3306-13) to restore conductivity.

#### PROPELLER DEICE SYSTEM.

The propeller deice system is the electrothermal type. It consists of the following components added to the propeller installation: propeller blade deice boots bonded to the propeller blades, slip ring assembly mounted to engine crankshaft, brush holder assembly mounted to the engine crankcase, a repeat cycle timer, ammeter mounted in the instrument panel, a switch and circuit breaker. The propeller blade deice boots are designed to remove ice under all probable icing conditions. Deicing is accomplished by raising the temperature of the ice and deice boot interface to a point at which centrifugal force removes the ice. The cycle timer used on the deicing system heats the propeller deice boots from 28 to 40 seconds. For example: if the timer should start on cycle number 1, the deicing system heats the outer element on the right propeller from 28 to 40 seconds (the timer pauses one second between cycles), then proceeds into cycle number 2, which heats the inner element on the right propeller from 28 to 40 seconds. It then cycles to the outer element on the left propeller from 28 to 40 seconds and to the inner element for 28 to 40 seconds to complete cycles numbers 3 and 4. The cycling is done in order to maintain a balance between the left and right propellers and reduce power drain on the electrical system.

Removal and Installation of Slip Rings. (See figure 13-6.)

- a. Remove propeller spinner from aircraft in accordance with Section 10.
- b. Tag and disconnect electrical leads at terminal strip (7).
- c. Remove bolts attaching wire supports to spinner bulkheads, push grommets and wires through spinner



SCHEMATIC FOR AIRCRAFT  
EQUIPPED WITH LIGHT WEIGHT  
DEICE SYSTEM

Figure 13-5. Surface Deice Schematic

bulkhead.

d. Remove propeller from aircraft in accordance with Section 10.

e. Remove four bolts attaching slip ring, supports, and wires to aft propeller flange.

f. Install slip ring (3), propeller and propeller spinner by reversing removal procedures.

#### Brush Holder Assembly.

Contact pressure of the brushes in the slip rings is provided by means of a spring in back of each brush. The spring is designed to provide a maximum of brush life consistent with obtaining sufficient contact pressure of the brushes against the slip rings to provide good operating characteristics. The average life of the brushes is approximately 500 hours.

#### Removal and Installation of Brush Holder Assembly and Mount Bracket. (See figure 13-6.)

a. Disconnect electrical connector from brush holder assembly (5).

b. Remove brush holder assembly (5) from bracket (4) by removing nuts, spacers (6), washers and bolts.

c. If required, remove mounting bracket (4) from engine assembly by removing attaching nuts, washers, spacers and bolts.

d. Install mounting bracket (4) and brush holder assembly (5) by reversing removal procedures.

#### NOTE

When installing brush holder, hold the brushes back in the holder until the mounting bolts have been inserted through the crankcase. Be careful not to apply any side loading on the brushes during installation.

#### Inspection and Testing of Propeller Deice System.

a. Visually check the completed installation.

1. Check propeller deicers for wrinkling or loose spots.

2. Check wiring connections for correctness and tightness.

3. Check continuity of wiring. Remove plug from timer. Using ohmmeter, check continuity from:

(a) Pin C of the plug to Terminal A of one prop shoe on the right engine.

(b) Pin D of the plug to Terminal B of one prop shoe on the right engine.

(c) Pin E of the plug to Terminal A of one prop shoe on the left engine.

(d) Pin F on the plug to Terminal B of one prop shoe on the left engine.

(e) Pin G of the plug to ground.

(f) Terminal C of one prop shoe on the right engine to ground.

(g) Terminal C of one prop shoe on the left engine to ground.

b. System Tests.

1. Propeller Deicer Resistance Check:

(a) Using an ohmmeter, check the resistance

between terminals A-C, B-C of prop shoes in both engines. Resistance should be 2.23 to 2.58.

#### 2. Timer Tests:

(a) Connect a jumper wire from Pin B of the timer receptacle to Terminal B of the connector plug and from Pin G of the timer receptacle to ground.

(b) Place the prop deicing system switch in the "ON" position.

(c) Using a voltmeter check the DC volts to ground from Pin B of the timer. This should be approximately 24 volts DC.

(d) Check DC volts to ground from Pins, C, D, E, F; these are the points at which the system voltage is applied in sequence to cycle power to the propeller deicers. The following cycling action of the timer should be:

(1) Timing sequence Pin C, 30 seconds, right engine propeller outboard halves.

(2) Timing sequence Pin D, 30 seconds, right engine propeller inboard halves.

(3) Timing sequence Pin E, 30 seconds, left engine propeller outboard halves.

(4) Timing sequence Pin F, 30 seconds, left engine propeller inboard halves.

#### NOTE

On time is approximately 30 seconds when operating on alternator voltage. When operating on battery voltage as in this checkout procedure, on time may be longer.

#### NOTE

The timer does not reposition itself to start at Pin C when the system is turned off, but will begin its cycling at the same position in which it was last turned off. Cycling will then proceed in the order of C, D, E, F, as shown.

#### NOTE

Check Pins C, D, E, F, until a voltage reading of approximately 24 volts DC is obtained. Hold the voltmeter probe on the pin until the voltage drops to 0. Move the probe to the next pin in the sequence C, D, E, F. Check volts DC at each pin in sequence, 24 volts DC should be measured at each pin in the sequence C, D, E, F. When correctness of the cycling sequence is established, turn prop deicing system switch off at the beginning of one of the on time periods and record the letter of the pin at which the voltage supply is present.

#### 3. Propeller Deicer Heat Test:

(a) Remove the jumper wire installed in paragraph b. 2. (a), and replace the connector plug in the timer receptacle.

(b) Referring to the position in which the timer was left in paragraph b. 2. (d), have an assistant place the prop deice system switch in the "ON" position. As the switch is



turned on, place a hand on each of the two deicer areas which should be heated per paragraph b. 2. (d).

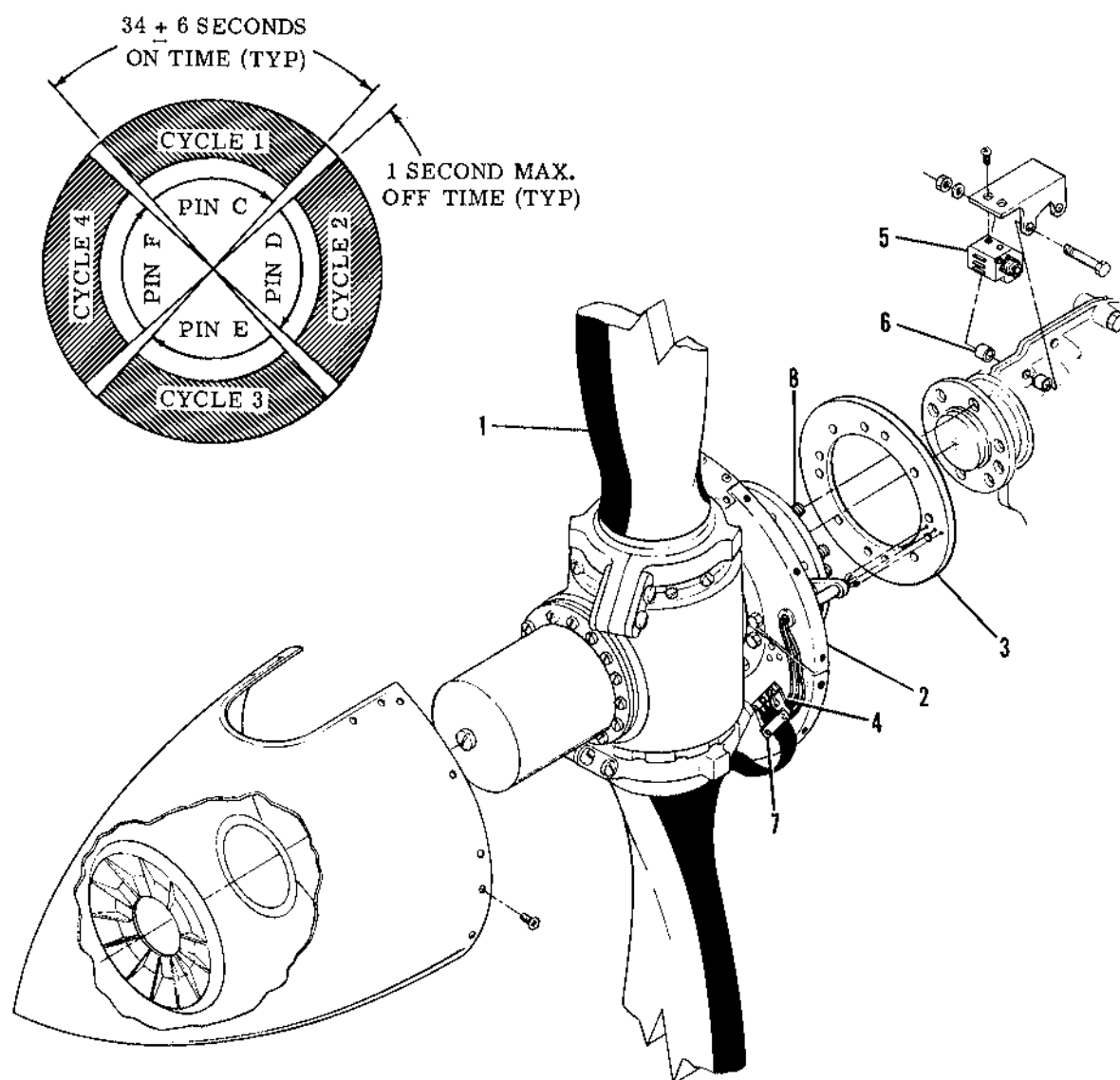
- (c) The assistant in the cabin should note and record the prop deicer system ammeter reading. This should be from 8 to 12 amps (for two bladed propellers) or 11 to 18 amps (for three bladed propellers). Keep a close watch on the ammeter needle. The ammeter needle will deflect every 30 seconds because of the switching action of the timer. Each deflection will indicate a change in the heating areas of the prop deicers.

## NOTE

The observer in the cabin should call out these 30 second interval deflections and the inspector at the propellers should change the position of his hands on the prop deicers accordingly, to check proper heating sequence of the prop deicer areas.

## NOTE

If any irregularities are noted, recheck the wiring from the timer to the brush holder



1. Deice Boot
2. Bulkhead
3. Slip Ring

4. Mounting Bracket
5. Brush Holder Assembly

6. Spacer
7. Terminal Strip
8. Lugs

Figure 13-6. Propeller Deice Installation

assembly and the prop deicer terminal connections. Make corrections as necessary and retest.

c. Slip Ring and Holder Assembly Check.

1. Check for out of flatness:

- (a) Allowable tolerance is .008. If .008 is exceeded, shim under mounting bolts to bring within tolerance.

NOTE

Ground checkout of the system is allowed, with the engines not running.

Allow a minimum of 5 hours of engine running time to allow the brushes to become seated before turning on the propeller deice system.

Adjustment of Brush Holder Assembly. (See figure 13-7.)

- a. When a chattering or screeching noise is emitted from the brush slip ring area, the probable cause is the improper alignment of the brushes and slip ring.

NOTE

If this chattering or screeching is noticed over idling engine noises, the trouble is severe and should be remedied immediately.

A less severe chattering or screeching may be detected by pulling each propeller through slowly in the direction of rotation.

b. The brush holder assembly should be positioned as follows:

1. Loosen screws through bracket assembly and brush holder.
2. Adjust brush holder assembly by twisting brush holder assembly in brackets so that the brushes are perpendicular to the slip ring surfaces.
3. Check each brush for correct alignment with the slip ring surfaces through 360° rotation.
4. Check for a .08 inch (nominal) clearance between the main body of the brush holder assembly and the slip ring through 360° rotation.
5. Check flatness of slip ring as follows:
  - (a) Mount a dial indicator on engine.
  - (b) Rotate slip ring through 360° of rotation.
  - (c) Observe dial indicator for a T.I.R. (Total Indicator Reading) of .012 to .015.
  - (d) If reading is not in tolerance, replace slip ring.

Removal and Installation of Timer Unit.

- a. Locate timer unit on shelf in upper left hand nose section, just forward of cabin bulkhead.
- b. Disconnect electrical connector from timer unit.
- c. Remove timer unit from shelf by removing four attaching screws and nuts.
- d. Install timer unit by reversing removal procedures.

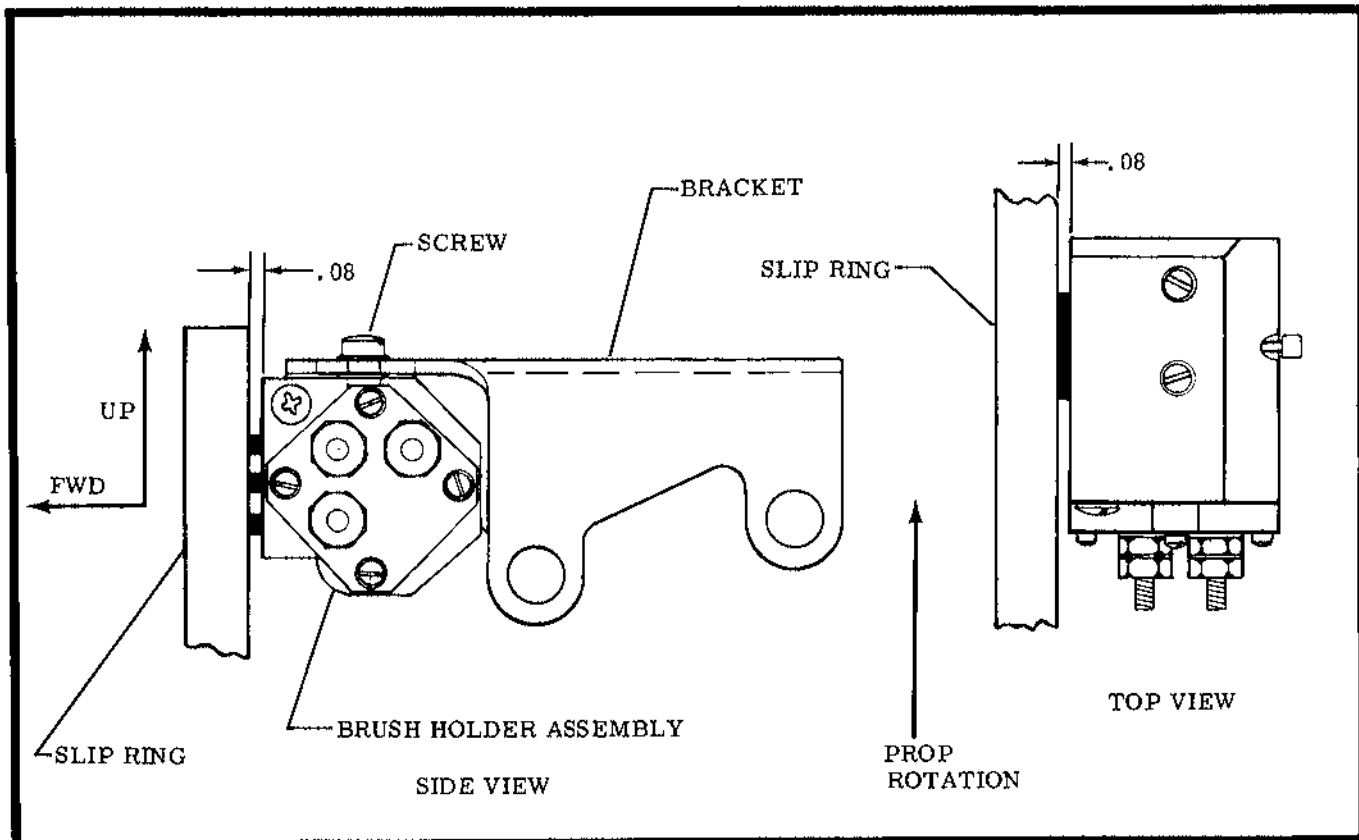


Figure 13-7. Brush Holder Adjustment

## Removal and Installation of Deice Ammeter.

- a. To remove and install ammeter, refer to Section 12.

## Removal and Replacement of Switch and Circuit

## Breaker.

- a. Turn battery switch off.
- b. Remove hood retaining switches.
- c. Loosen decorative nut securing switch, and remove switch from panel.
- d. To replace switch, reverse this procedure.

## Trouble Shooting the Propeller Deice System.

| TROUBLE                            | PROBABLE CAUSE                        | CORRECTION                                                          |
|------------------------------------|---------------------------------------|---------------------------------------------------------------------|
| ELEMENTS DO NOT HEAT               | Open circuit.                         | Reset circuit breaker.                                              |
|                                    | Defective switch.                     | Replace switch.                                                     |
|                                    | Brushes not adjusted properly.        | Readjust brushes.                                                   |
|                                    | Broken ground.                        | Reground.                                                           |
|                                    | Defective brushes.                    | Replace brushes.                                                    |
|                                    | Defective timer.                      | Replace timer.                                                      |
| ELEMENTS HEAT IN<br>ERRATIC MANNER | Defective timer.                      | Replace timer.                                                      |
|                                    | Defective slip ring.                  | Replace slip ring.                                                  |
|                                    | Defective brushes.                    | Replace or readjust brushes.                                        |
| FOUR ELEMENTS HEAT                 | Defective timer.                      | Replace timer.                                                      |
| CHATTERING OR<br>SCREECHING        | Alignment of brush block<br>assembly. | Replace brushes and adjust in accordance with adjusting procedures. |

## PROPELLER UNFEATHERING SYSTEM.

## CAUTION

Each optional unfeathering system consists of a dry air or nitrogen-charged accumulator, a special governor, and a hose running between the governor and the accumulator. The governor contains a spring-loaded check valve which is unseated while the propeller control is in any position except FEATHER, thus permitting governor-pressurized oil to flow to and from the accumulator. When the propeller control is moved to the FEATHER position, the check valve is seated and oil under governor-pressure is trapped in the accumulator and hose. As the propeller control is moved out of the FEATHER position, the trapped oil flows back through the governor to the propeller to unfeather it.

## CAUTION

Always leave propeller control in the unfeathered position when the aircraft is on the ground. This procedure prevents the possibility of heat causing trapped oil to expand to pressures which could damage the accumulator.

Removal of Propeller Unfeathering System. (See figure 13-8.)

Release system pressure by placing propeller control in UNFEATHER position and release accumulator pressure through the filler valve.

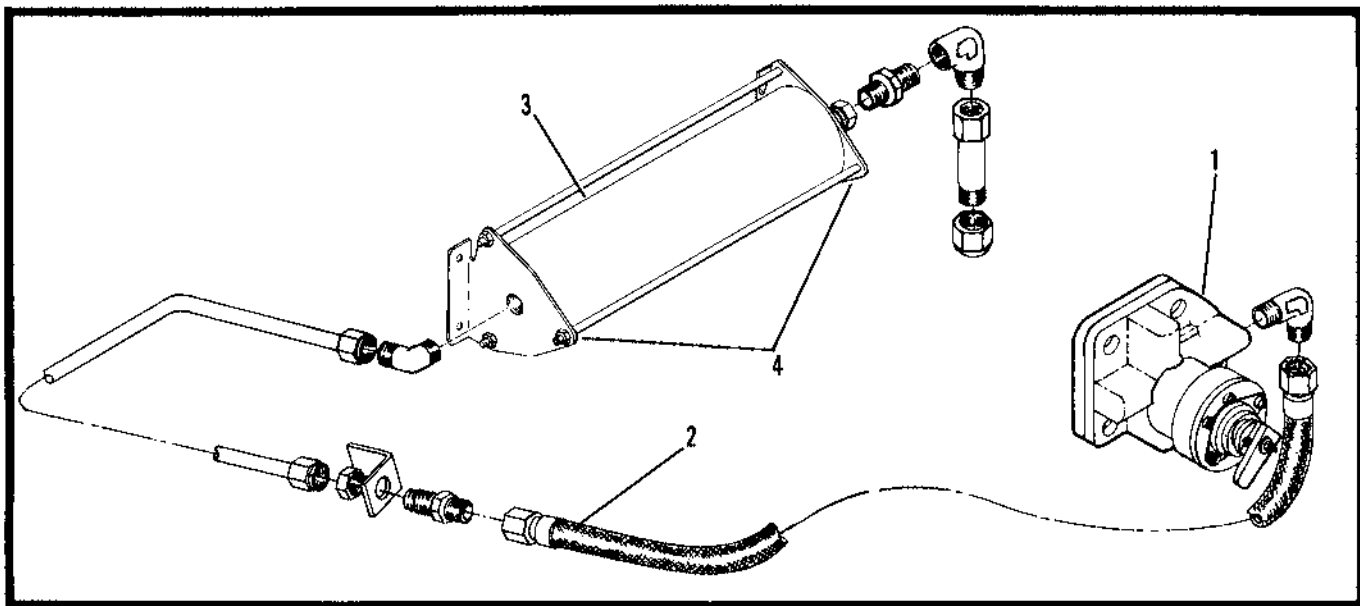
- a. Disconnect hose (2) from governor (1) and accumulator (3).
- b. Remove accumulator by removing four bolts attaching brackets (4) to the engine beam assembly.
- c. Remove governor (1) by removing attaching nuts.

Installation of Propeller Unfeathering System. (See figure 13-8.)

- a. Install propeller unfeathering system by reversing removal procedures.
- b. Refer to Section 2 and service accumulator.

## Operational Check of Propeller Unfeathering System.

- a. With engines operating at 2000 RPM, move propeller controls to the FEATHER position, then position mixture to IDLE CUT-OFF. The propellers should move to the feathered position.
- b. Move propeller controls to an unfeathered position.



1. Governor

2. Hose Assembly

3. Accumulator

4. Accumulator Bracket

Figure 13-8. Propeller Unfeathering System

tion. Propellers should unfeather.

c. If propellers do not unfeather, check system for leaks and proper pressure.

#### NOTE

When propellers do not unfeather sufficiently to engage high pitch stop pins, bleed off accumulator pressure to 100-110 psi, then re-check operation.

#### PROPELLER SYNCHRONIZER SYSTEM.

The component parts of the propeller synchronizer system are two electrical pulse pickups, trimmer assembly, actuator motor assembly, switch, interconnecting electrical cable assemblies, and an indicator light. The control box assembly, located just forward of the cabin door (310L0001 to 310N0001) and on the underside of the glove compartment box (310N-0001 and On), contains an all transistorized circuitry. The actuator motor is a stepping-type that operates on command from the control box and is located in the right engine nacelle. The flexible rotary shaft is connected to the actuator motor and trimmer assembly to trim the right engine speed setting. Magnetic pickups are mounted in each propeller governor to provide engine speed indications to the control box assembly. The function of the propeller synchronizer system is to automatically match the RPM between the two engines; therefore, the left engine is designated as the "master" engine while the right engine is termed the "slave" engine. The electrical pulse from both magnetic pickups are fed into the control box from the governors. Any difference in these pulse rates will cause the control box assembly to run the actuator motor and through the flexible shaft, trim the "slave" engine governor speed setting to exactly match the "master" engine RPM. Normal

governor operations and functions are unchanged but the synchronizer system will continuously monitor engine RPM and reset the "slave" engine governor as required. The limited range feature prevents the "slave" engine losing more than a fixed amount of RPM in case the "master" engine is feathered with the synchronizer on.

#### Operation of Propeller Synchronizer System.

Electrical pulses from the magnetic pickup in each governor are fed into the control box (figure 13-9). As any difference in the number of pulses is detected, a signal is sent from the control box to the actuator, which trims the slave governor speed to match that of the master engine exactly. Normal governor operation is unaffected. The synchronizer will continuously monitor the engine speeds and reset the slave engine speed setting as required. Operating range of the actuator is approximately  $\pm 50$  RPM.

#### Removal of Synchronizer System Components. (See figure 13-10.)

- a. Remove flexible shaft (4) as follows:
  1. Disconnect flexible shaft (4) from actuator motor (9) and trimmer assembly (3).
  2. Remove the lock ring and hex nut from either end of flexible shaft.
  3. Remove flexible shaft from engine nacelle by routing through guide tube.
- b. Remove trimmer assembly (3) from governor (2) by disconnecting flexible shaft (4), propeller control cable (5) and attaching nut, spacer and bolt.
- c. Remove actuator motor (9) by disconnecting flexible shaft (4) and electrical cable (10). Remove four

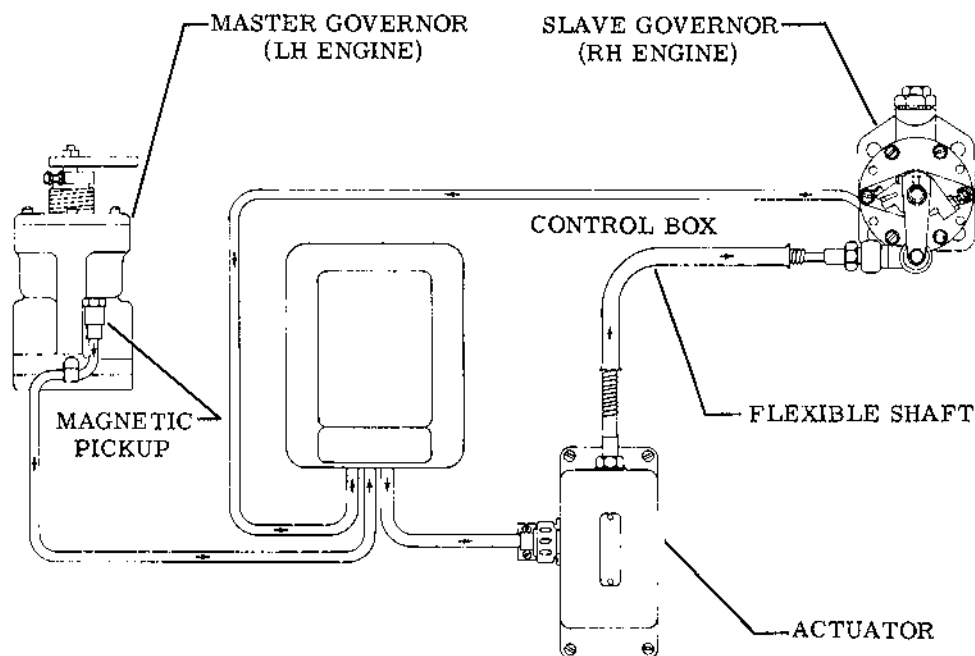


Figure 13-9. Schematic Diagram of Synchronizer Operation

screws attaching motor to brackets.

d. Remove control box assembly (12) as follows:

1. Refer to Section 3 and remove forward cabin side upholstery.
2. Disconnect electrical cable (13) from synchronizer switch (14) and indicator light (15) and route from stationary instrument panel to control box assembly.
3. Disconnect control box electrical cable at electrical plug (11).
4. Remove four screws attaching control box assembly (12) to bracket.
- e. Remove switch (14) and indicator light (15) as follows:
  1. Remove four screws attaching upper pedestal panel (16) to pedestal.
  2. Disconnect electrical wiring.
  3. Remove switch and light in accordance with removal procedures outlined in Section 14.

Installation of Synchronizer Components. (See figure 13-10.)

- a. Install components by reversing removal procedures.
- b. Adjust in accordance with adjusting procedures.

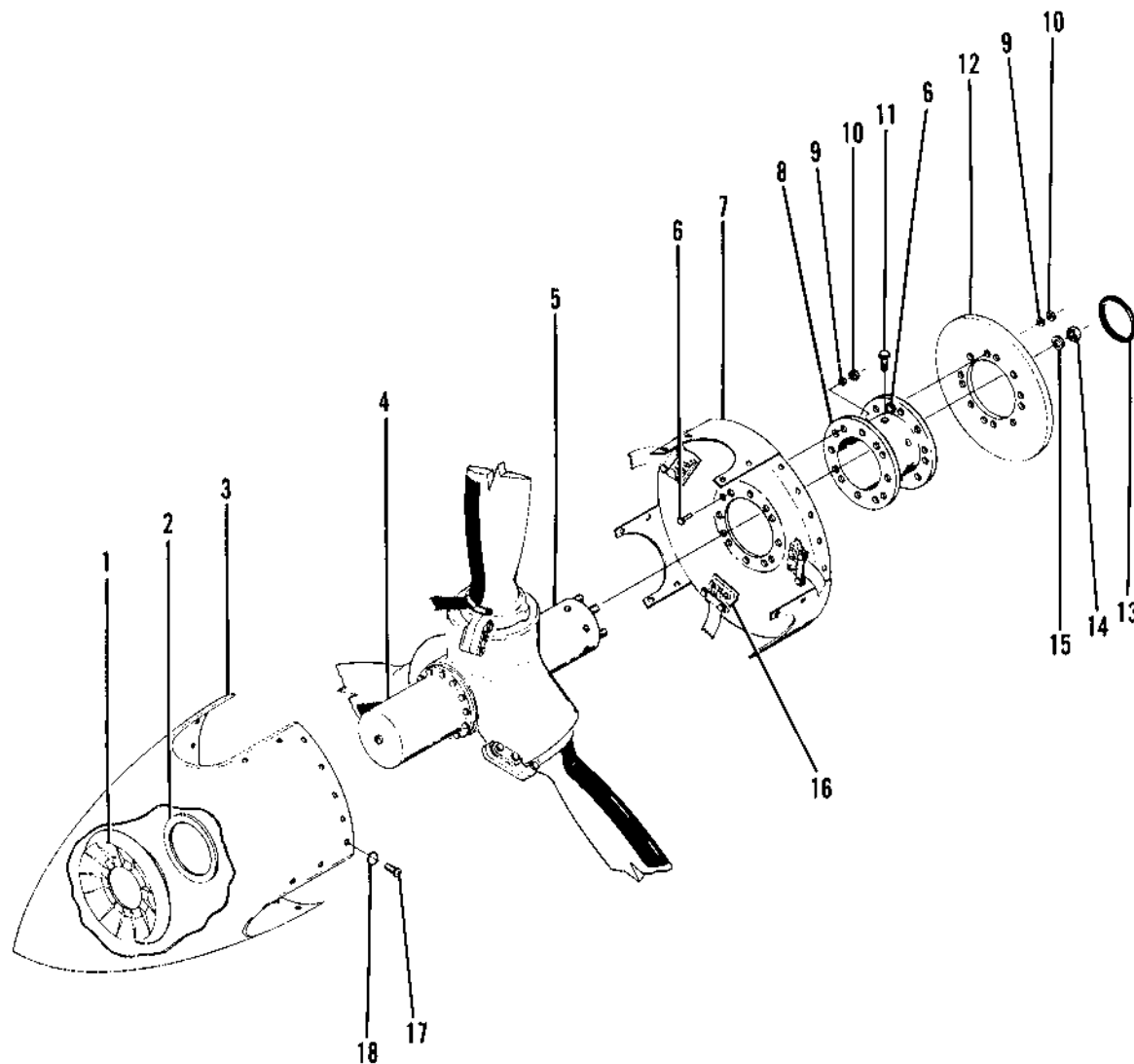
Adjustment of the Propeller Synchronizer System.  
(See figure 13-10.)

- a. Start rigging procedures by disconnecting flexible shaft (4) from actuator motor (9).
- b. Rotate free end of flexible shaft (4), counting total turns available on the "slave" governor trimmer assembly (3).
- c. Return trimmer assembly (3) to its center range.
- d. When trimmer assembly (3) is centered, rig governor (2) and control cable (5) in accordance with Rigging Propeller Controls.
- e. Manually rotate trimmer assembly (3) to either end of its travel.
- f. Move propeller pitch levers (17) on the pedestal through its entire range, observing the governor speed adjusting lever to be certain it travels to the maximum and minimum RPM limits.
- g. Manually rotate the trimmer assembly (3) to opposite end of its travel.
- h. Perform step f. again.
- i. Recenter the trimmer assembly (3).
- j. Insert a squared shaft into drive of actuator motor (9) and count total turns available.
- k. Place actuator motor (9) in its center range.
- l. With both actuator motor (9) and trimmer assembly (3) centered, connect the flexible shaft (4) to actuator motor.
- m. Check flexible shaft (4) for binding and a clearance of 7.75 inches in the full RPM position.

Functional Test of Synchronizer System.

To test the operation of the synchronizer in flight,





- 1. Spinner Support
- 2. Spacer
- 3. Spinner Dome
- 4. Propeller Cylinder
- 5. Propeller Hub
- 6. Bolt

- 7. Propeller Bulkhead
- 8. Hub Adapter
- 9. Washer
- 10. Nut
- 11. Bolt
- 12. Slip Ring (Deice)

- 13. O-Ring
- 14. Nut
- 15. Washer
- 16. Terminal Block
- 17. Screw
- 18. Washer

Figure 13-11. Three Bladed Propeller Installation

first synchronize propellers manually and turn the synchronizer switch ON. Then slowly adjust the master engine propeller governor control lever, in small increments, to increase or decrease RPM. The RPM range over which the slave engine will remain synchronized with the master engine is the limited range mentioned above. With the synchronizer ON, move the master engine propeller governor control lever to a point which is close to the end of this limited travel. Turn the synchronizer OFF. An unsynchronized condition will develop as the actuator moves to its mid-position. When the synchronizer is turned ON again, synchronization will result. If the units do not become synchronized, the actuator has reached the end of its travel and must be recentered in this manner:

- Turn the switch OFF.
- Synchronize the engines manually.
- Turn the switch ON.

### THREE BLADED PROPELLER.

Removal of Propellers. (See figure 13-11.)

- Place propeller in the feathered position.
- Refer to Section 9 and remove engine cowling in accordance with removal procedures.
- Remove six attaching nuts (14) and washers (15) securing the propeller hub to engine crankshaft.

### CAUTION

Support the propeller before removing the last nut to prevent the possibility of dropping propeller.

- Carefully remove propeller from engine crankshaft.

Installation of Propellers. (See figure 13-11.)

- Clean the propeller hub (5) and engine crankshaft flange with crocus cloth.
- Wipe dust and foreign particles from the propeller hub, crankshaft flange, and oil passages with a clean rag.

### NOTE

Inspect O-ring seal (13) in propeller hub flange for damage and replace as necessary.

- Secure propeller to engine crankshaft by six self-locking nuts (14) and washers (15).

### NOTE

Torque nuts (14) from 55 to 65 ft/lbs.

- Replace engine cowling in accordance with Sec-

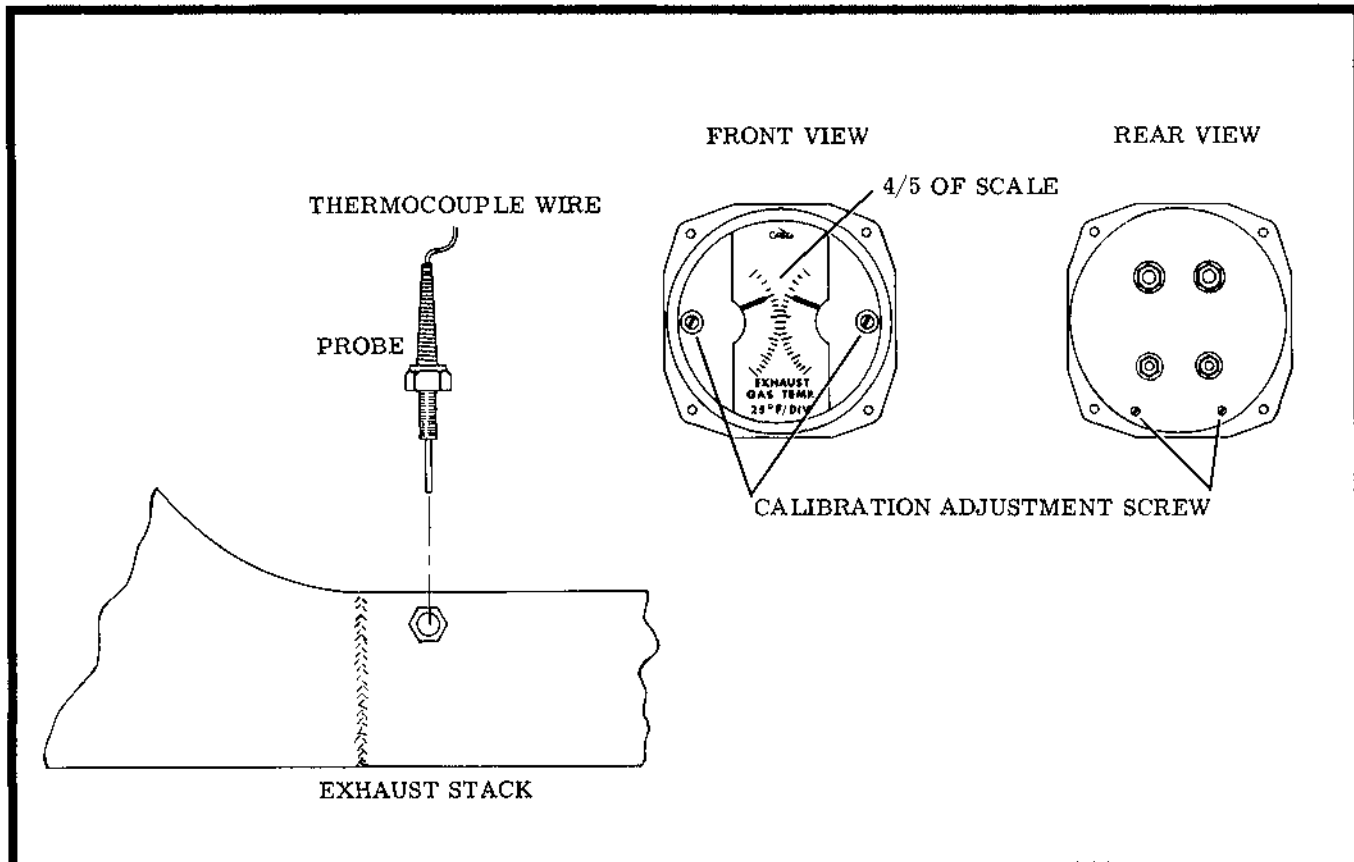


Figure 13-12. Exhaust Gas Temperature System Installation



tion 9.

e. Refer to Section 10 and perform and Operational Check.

#### CESSNA ECONOMY MIXTURE INDICATOR.

The exhaust gas temperature (commonly referred to

Trouble Shooting the EGT System.

| TROUBLE             | PROBABLE CAUSE                           | CORRECTION                                                  |
|---------------------|------------------------------------------|-------------------------------------------------------------|
| GAGE INOPERATIVE    | Defective gage, probe or wiring.         | Isolate defective circuit, replace defective probe or gage. |
| INCORRECT READING   | Indicator needs calibrating.             | Calibrate in accordance with calibrating procedure.         |
| FLUCTUATING READING | Loose, frayed or broken electrical lead. | Tighten connections, and repair or replace defective leads. |

Removal and Installation of EGT System. (See figure 13-12.)

- Tag and disconnect electrical leads on indicators.
- Refer to Section 14 and remove two light assemblies attached to indicator and stationary panel.
- Remove indicator by removing two remaining screws and nuts.
- Route electrical wires from cabin, through wing, to probe in engine nacelle.
- Remove probe from exhaust manifold.
- Install components by reversing the removal procedures.

#### NOTE

Do not alter length of electrical wires.

Calibration of EGT System. (See figure 13-12.)

- To check calibration, obtain an average cruise condition of 65% power at 7500 feet and lean mixture to peak exhaust temperature on indicator.

#### NOTE

To obtain peak exhaust temperature, lean out mixture control slowly enough for pointer to follow. When the pointer stops going up and starts a downward movement, enrich mixture enough to regain peak reading.

- Record reading achieved after system has stabilized.
- Repeat step a. several times to insure a positive reading has been achieved.
- Lean mixture to a setting of not less than 25° below peak exhaust gas temperature.
- Use adjust screw on face of indicator and position pointer to 4/5 scale.

as EGT) sensing device is used to aid the pilot in selecting the most economical fuel-air mixture for cruising flight at a power setting of 75% or less. Exhaust gas temperature (EGT) varies with the ratio of fuel-to-air mixture entering the engine cylinders. Refer to the appropriate aircraft Owner's Manual for correct operation procedures of system.

#### NOTE

Adjustment should not exceed  $\pm 75^{\circ}\text{F}$  or three divisions.

- If adjustment for more than  $\pm 75^{\circ}\text{F}$  is required, perform the following steps:
  - Gain access to rear of indicator.
  - Viewing meter from rear, turn calibration screws one turn clockwise for increase in indicator reading of  $25^{\circ}\text{F}$  (one division) or one turn counter-clockwise for decrease.

#### POWER FRONT SEAT.

Removal of Power Front Seat. (See figure 13-13.)

- Raise seat to the full UP position.
- Pull plunger on circuit breaker (9) out to OPEN electrical circuit, disconnect aircraft power cord (11) from terminal block located on forward seat base.
- Locate seat stop block on inboard seat track, remove two screws and stop block from seat track.
- Pull up on the adjustment handle (6) and slide the seat aft to clear seat support (10).
- Remove seat from the aircraft.

Installation of Power Front Seat. (See figure 13-13.)

- Check seat for the full UP position.
- Pull up on the adjustment handle (6) and slide seat onto seat support (10).
- Install seat stop block on inboard seat track by installing two screws through seat track and seat block.
- Connect power cord (11) to seat terminal block located on forward seat base.
- Push IN on circuit breaker plunger to CLOSE

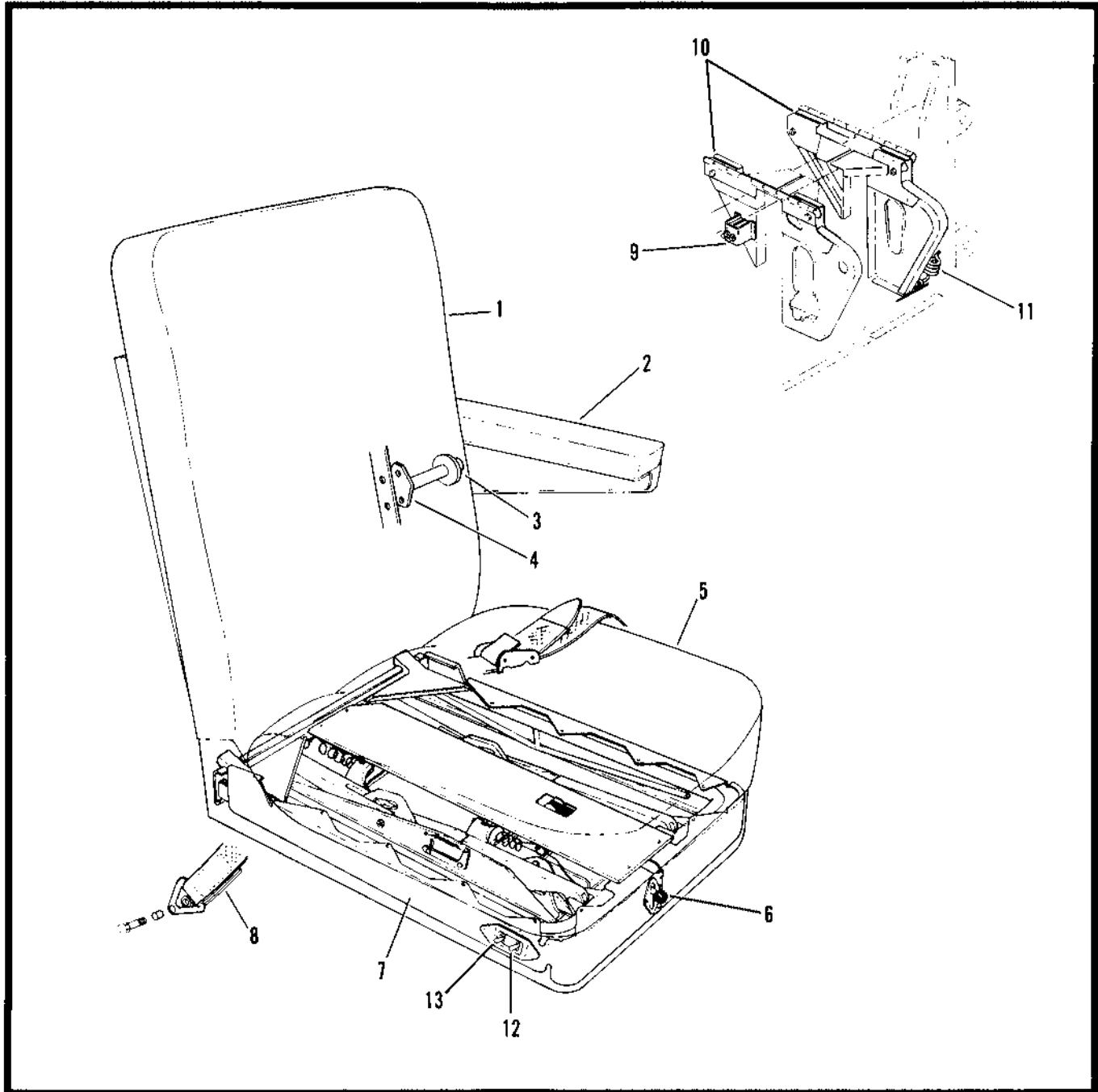
electrical circuit and functionally test seat for proper operation.

### WARNING

After seat has been installed, insure that stop block has been installed properly and that the seat adjustment mechanism functions properly.

### NAV-O-MATIC 400 AUTOPILOT.

Refer to Cessna Nav-O-Matic 400 Service and Parts Manual for general description of components and trouble shooting procedures. Refer to Section 15 for aircraft electrical wiring diagrams.



- 1. Seat Back Assembly
- 2. Armrest
- 3. Nut and Washer
- 4. Armrest Assembly

- 5. Seat Bottom Assembly
- 6. Adjustment Handle
- 7. Power Assembly
- 8. Seat Belt
- 9. Circuit Breaker

- 10. Seat Support
- 11. Power Cord
- 12. Switch (Forward Bridge)
- 13. Switch (Aft Bridge)

Figure 13-13. Power Front Seat Installation

## Removal of Control Cables. (See figure 13-14.)

- a. Refer to Section 3 and remove the following items:
  1. Rear upholstery panel for access to tailcone.
  2. Rear reclining, middle individual or fifth and sixth seats (optional equipment).
  3. Rear carpet.
  4. Stabilizer fairings.
- b. Remove floorboards above aileron bellcrank and autopilot pulleys.
- c. In the aileron bellcrank area, disconnect turnbuckle (21) and clevis connecting cables (12 and 13) to terminal ends and tie guide wire to cables.
- d. Remove three sets of autopilot pulleys by removing attaching nuts, bolts and cotter pins.
- e. At the roll actuator (15), separate cables (12 and 13) from chain (14) by removing master link on chain.
- f. At the elevator bellcrank (1), disconnect turnbuckles connecting cables (3 and 4) to bellcrank.
- g. At the pitch actuator (5), separate cables (3 and 4) from chain (14) by removing master link on chain.
- h. Tag cables (3, 4, 12 and 13) for identification, route through fuselage and remove through the baggage door.

## Installation of Control Cables. (See figure 13-14.)

- a. Route cables (3, 4, 12 and 13) through baggage door and tie cables (12 and 13) to guide wires.
- b. At the pitch actuator (5), secure cables (3 and 4) to chain (14) with master link.
- c. Route cables (3 and 4) to elevator bellcrank (1) and attach cables to terminal ends with turnbuckle and clevis.
- d. Route cables (12 and 13) forward through fuselage, connect cable ends to terminals which are attached to cable clamp (20) with turnbuckle (21).
- e. At the roll actuator (15), secure cables (12 and 13) to chain (14) with master link.
- f. Install three sets of pulleys at fuselage stations 132.00, 109.37 and 89.25 with attaching bolts, nuts and cotter pins.

## NOTE

Install pulleys so that cable (12) is routed beneath the upper pulley at fuselage station 132.00 and beneath left-hand pulleys at fuselage stations 109.37 and 89.25. Likewise, cable (13) is routed beneath lower and right-hand pulleys.

- g. Rig cables in accordance with rigging procedures.

## NOTE

After rigging is complete, turn on autopilot and verify that the control surfaces respond in the correct direction. Assist the movement of the elevator by pulling back on control wheel, this will aid in overcoming the counterbalance of the elevator bob-weight.

- h. Install floorboards.

- i. Refer to Section 3 and install the following items:
  1. Rear upholstery panel.
  2. Rear carpet and seats.
  3. Install stabilizer fairings.

## Removal and Installation of Actuators and Computer. (See figure 13-14.)

- a. Refer to Section 3 and remove the following items:
  1. Remove rear seats and upholstery panel.
  2. Stabilizer fairings.
  - b. Remove pitch actuator (5) as follows:
    1. Relieve tension on cables (3 and 4) by loosening turnbuckles at elevator bellcrank (1).
    2. Disengage cables (3 and 4) and chain (14) from sprocket on actuator (5).
    3. Disconnect electrical cable assembly (10) from pitch actuator (5).
    4. Remove four screws, washers and lockwashers attaching pitch actuator (5) to shelf.
    5. Remove pitch actuator from tailcone.
  - c. Remove roll actuator (15) as follows:
    1. Relieve tension on cables (12 and 13) by loosening turnbuckle (21) near cable clamp (20).
    2. Disengage cables (12 and 13) and chain (14) from sprocket on actuator (15).
    3. Disconnect electrical cable assembly (9) from roll actuator (15).
    4. Remove four screws, washers and lockwashers attaching roll actuator (15) to shelf.
    5. Remove roll actuator from tailcone.
  - d. Remove computer (7) as follows:
    1. Disconnect line assembly (6) from computer (7).
    2. Disconnect electrical cable assemblies (8, 9 and 10) from computer (7).
    3. Remove four nuts and screws attaching computer (7) to shelf.
    4. Remove computer from tailcone.
  - e. Install computer (7), roll actuator (15) and pitch actuator (5) by reversing removal procedures. Rig cables in accordance with rigging procedures.

## Removal and Installation of Gyros.

- a. Refer to Section 12 for typical removal and installation.

## Removal and Installation of Switches.

- a. Refer to Section 14 for typical removal and installation of electrical switches.

## Removal and Installation of Controller. (See figure 13-14.)

- a. Disconnect electrical cable assembly from controller (27).
- b. Remove controller (27) and bezel (26) from retainer (28).
- c. Install controller (27) by reversing removal procedures.

Rigging Nav-O-Matic 400 Autopilot Control Cables.  
(See figure 13-14.)

- a. Rig aileron control cables as follows:
  1. Verify that aileron control system is properly rigged.
  2. Using a clamp or other locking device, lock ailerons in the neutral position.
  3. Place chain (14) evenly over sprocket on actuator (15). Slide cable clamps (20) outboard from bracket (16) until slack is removed from cables (12 and 13). Tighten cable clamps (20) in place.

#### NOTE

Cable clamps (20) must be equal distance from bracket (16) to properly rig aileron cables.

4. Rig the aileron actuator cables (12 and 13) to 12 ± 3 inch-pounds tension by tightening turnbuckle.
5. Remove locking device from aileron control surfaces and move aileron through entire travel. Observe chain (14) on actuator (15) for sufficient remaining links at the extreme travel limits.
6. Safety turnbuckles.
- b. Rig elevator control cables as follows:
  1. Verify that aileron control system is properly rigged.
  2. Using a clamp or other locking device, lock elevator in the neutral position.
  3. With elevator control surface in the neutral position, place chain (14) evenly over sprocket on actuator (5) and attach cables (3 and 4) to links (2) on bellcrank (1).
  4. Rig the elevator actuator cables (3 and 4) to 12 ± 3 inch-pounds tension by tightening the turnbuckles.
  5. Remove locking device from elevator control surfaces and move elevator through entire travel. Observe chain (14) on actuator (5) for sufficient remaining links at the extreme travel limits.
  6. Safety turnbuckles.

#### NAV-O-MATIC 800 AUTOPILOT.

Refer to Cessna Nav-O-Matic 800 Service and Parts Manual for general descriptions of components and trouble shooting procedures. Refer to Section 15 for aircraft electrical wiring diagrams.

Removal and Installation of Autopilot Aileron Cables.  
(See figure 13-16.)

- a. Refer to Section 3 and remove the following items:
  1. Front seats, rear, middle and aft rear seats (optional equipment).
  2. Rear carpet.
  3. Rear upholstery panel.
  4. Floorboards over aileron bellcrank and pulleys.
- b. Disconnect turnbuckle (2) and clevis attaching autopilot aileron cable (11) to links (12).
- c. Remove cable guard pins from pulley brackets at fuselage stations 89.25 and 109.37.

- d. Route cable ends aft to aileron servo.
- e. Disengage cable (11) from aileron servo as shown in Cessna Nav-O-Matic 800 Service and Parts Manual.
- f. Install autopilot aileron cable (11) by reversing removal procedures.
- g. Rig cable (11) in accordance with rigging procedure.

Removal and Installation of Autopilot Rudder Cable.  
(See figure 13-16.)

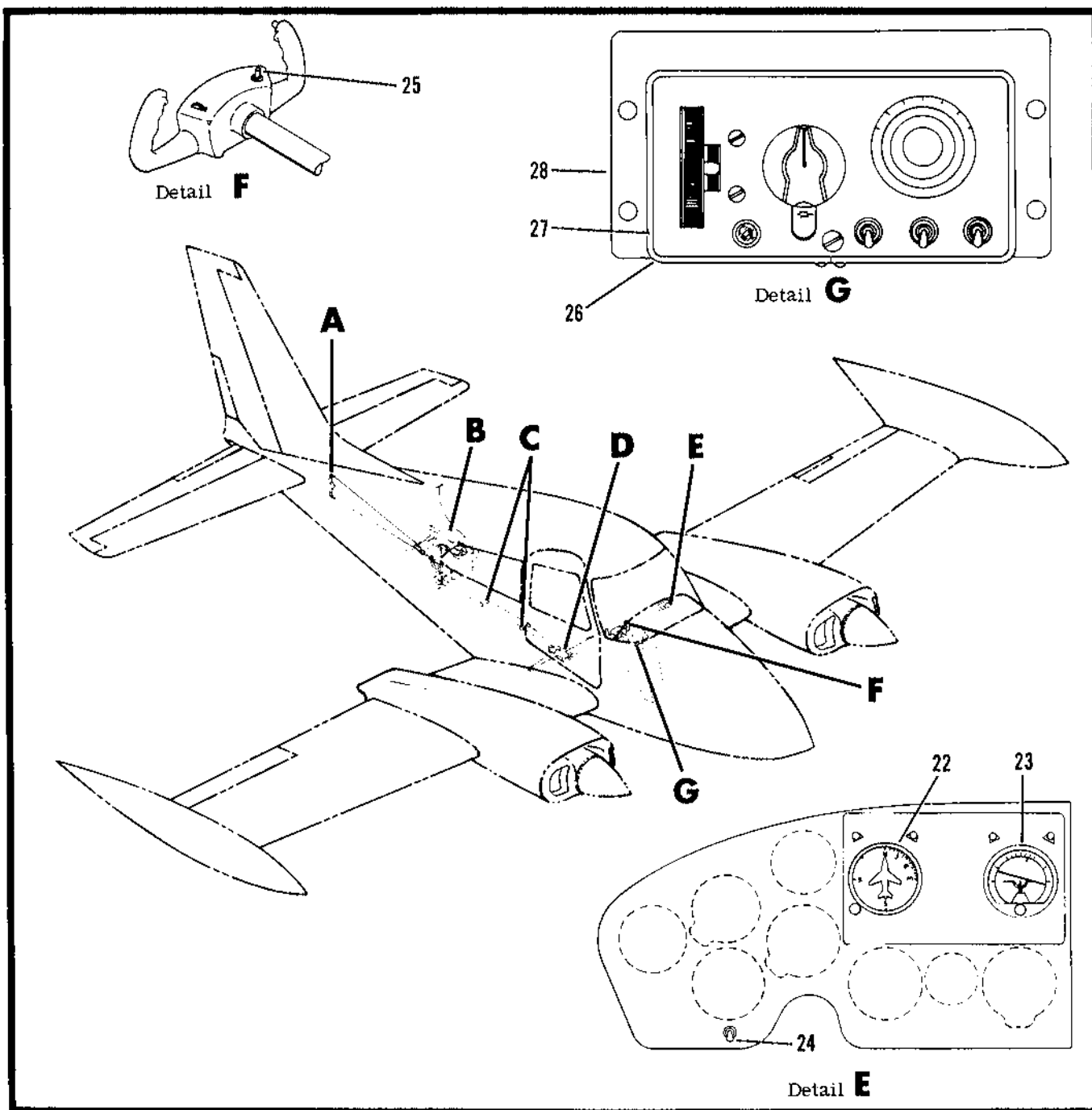
- a. Refer to Section 3 and remove the following items:
  1. Rear seats and upholstery panel.
  2. Stabilizer fairing.
- b. Refer to Section 2 and support tailcone.
- c. Disconnect turnbuckle (2) connecting LH autopilot rudder cable (4) to link (1) at bellcrank (3).
- d. Disconnect clevis end of autopilot cable (4) from link (1) by removing attaching nut, washers and bolts.
- e. Remove cable guard pins from pulley bracket.
- f. Route autopilot rudder cable (4) forward to rudder servo.
- g. Disengage cable (4) from servo as shown in Cessna Nav-O-Matic 800 Service and Parts Manual.
- h. Install cable (4) by reversing removal procedures.
- i. Rig cable (4) in accordance with rigging procedures.

Removal and Installation of Autopilot Elevator Cables.  
(See figure 13-16.)

- a. Refer to Section 3 and remove the following items:
  1. Rear upholstery panel.
  2. Stabilizer fairing.
- b. Refer to Section 2 and support tailcone.
- c. Disconnect turnbuckle (2) connecting lower autopilot elevator cable (9) to links (8) at elevator bellcrank (7).
- d. Disconnect clevis end of cable (9) from link (8) by removing attaching nut, spacer and bolt.
- e. Route cable (9) forward to elevator servo.
- f. Disengage cable (9) from aileron servo as shown in Nav-O-Matic 800 Service and Parts Manual.
- g. Remove cable (9) from aircraft.
- h. Install autopilot elevator cable (9) by reversing removal procedures.
- i. Rig cable (9) in accordance with rigging procedures.

Removal and Installation of Autopilot Elevator Trim Extension Cable. (See figure 13-16.)

- a. Refer to Section 3 and remove the following items:
  1. Rear upholstery panel.
  2. Stabilizer fairing.
  3. Stinger.
- b. Release tension on elevator trim control system by referring to Section 6 and loosening turnbuckle.
- c. Disconnect autopilot extension cable (19) from elevator trim cable (18) by removing nuts and bolts.
- d. Remove autopilot extension cable (19) from air-



1. Elevator Bellcrank
2. Link
3. Elevator Cable (Upper, Actuator to Bellcrank)
4. Elevator Cable (Lower, Actuator to Bellcrank)
5. Pitch Actuator
6. Line Assembly (Computer to Static Line)
7. Computer Amplifier
8. Cable Assembly (Computer to Controller)
9. Cable Assembly (Roll Actuator to Computer)
10. Cable Assembly (Pitch Actuator to Computer)
11. Pulley
12. Cable Assembly (Top, Actuator to Aileron Cable)
13. Cable Assembly (Bottom, Actuator to Aileron Cable)
14. Chain Assembly

15. Roll Actuator
16. Bracket
17. Left Aileron Cable
18. Aileron Bellcrank Assembly
19. Right Aileron Cable
20. Cable Clamp
21. Turnbuckle
22. Directional Gyro
23. Horizontal Gyro
24. Selector Switch
25. Disengage Switch
26. Bezel
27. Controller
28. Retainer

Figure 13-14. Nav-O-Matic 400 (Sheet 1 of 2)

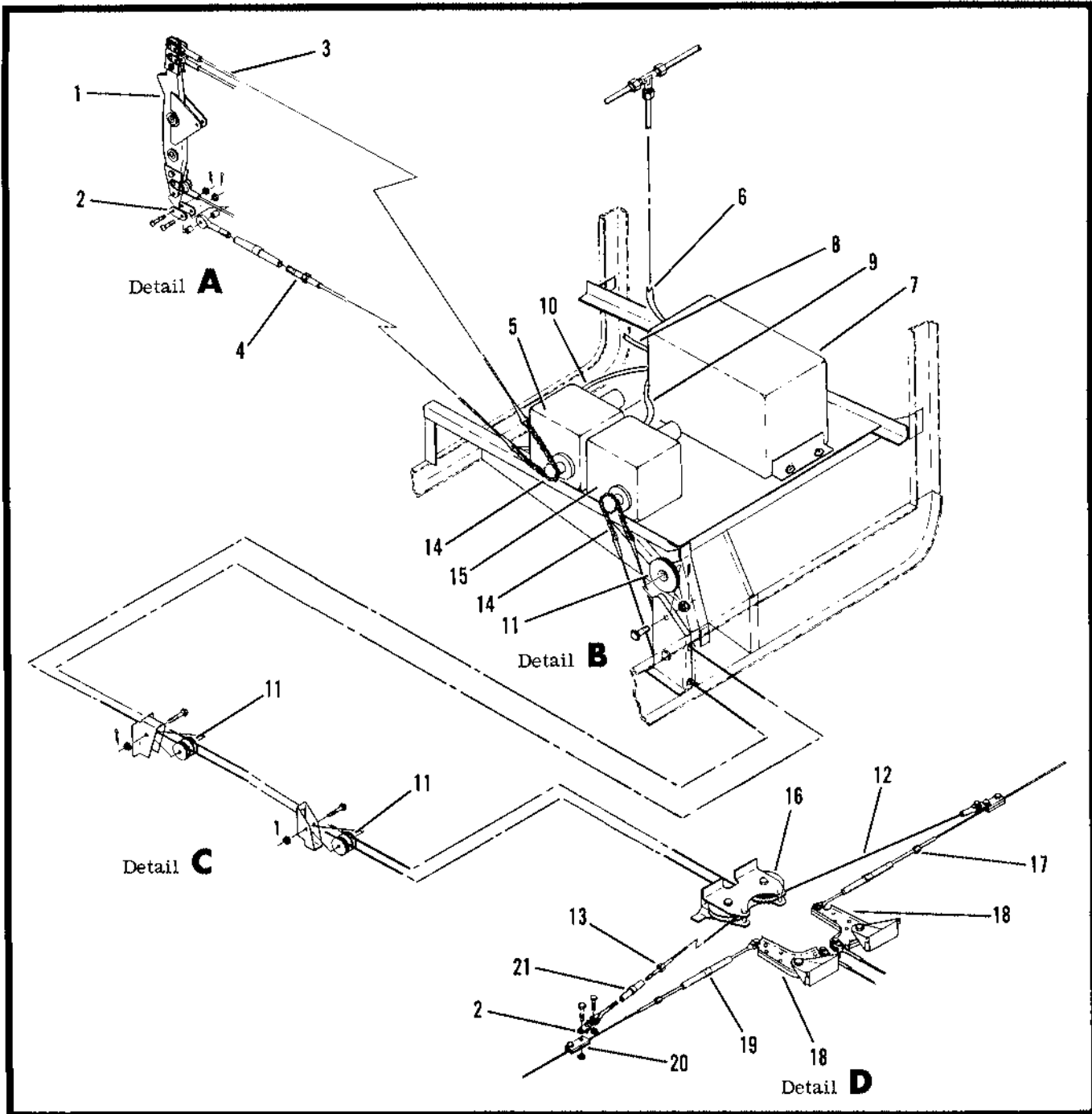


Figure 13-14. Nav-O-Matic 400 (Sheet 2 of 2)

craft.

e. Install autopilot extension cable (19) by reversing removal procedures.

f. Rig elevator trim cable in accordance with autopilot rigging procedures.

#### Removal and Installation of Pneumatic System.

a. Remove and install pneumatic system components, line assemblies and hoses as shown in figure 13-17.

#### NOTE

Line assembly (23) can be removed from wing without removing wing. Accomplish removal of line assembly (23) by carefully bending line assembly and route through wing gap area. Line assembly (25) is assembled into the wing nacelle and should not be removed.

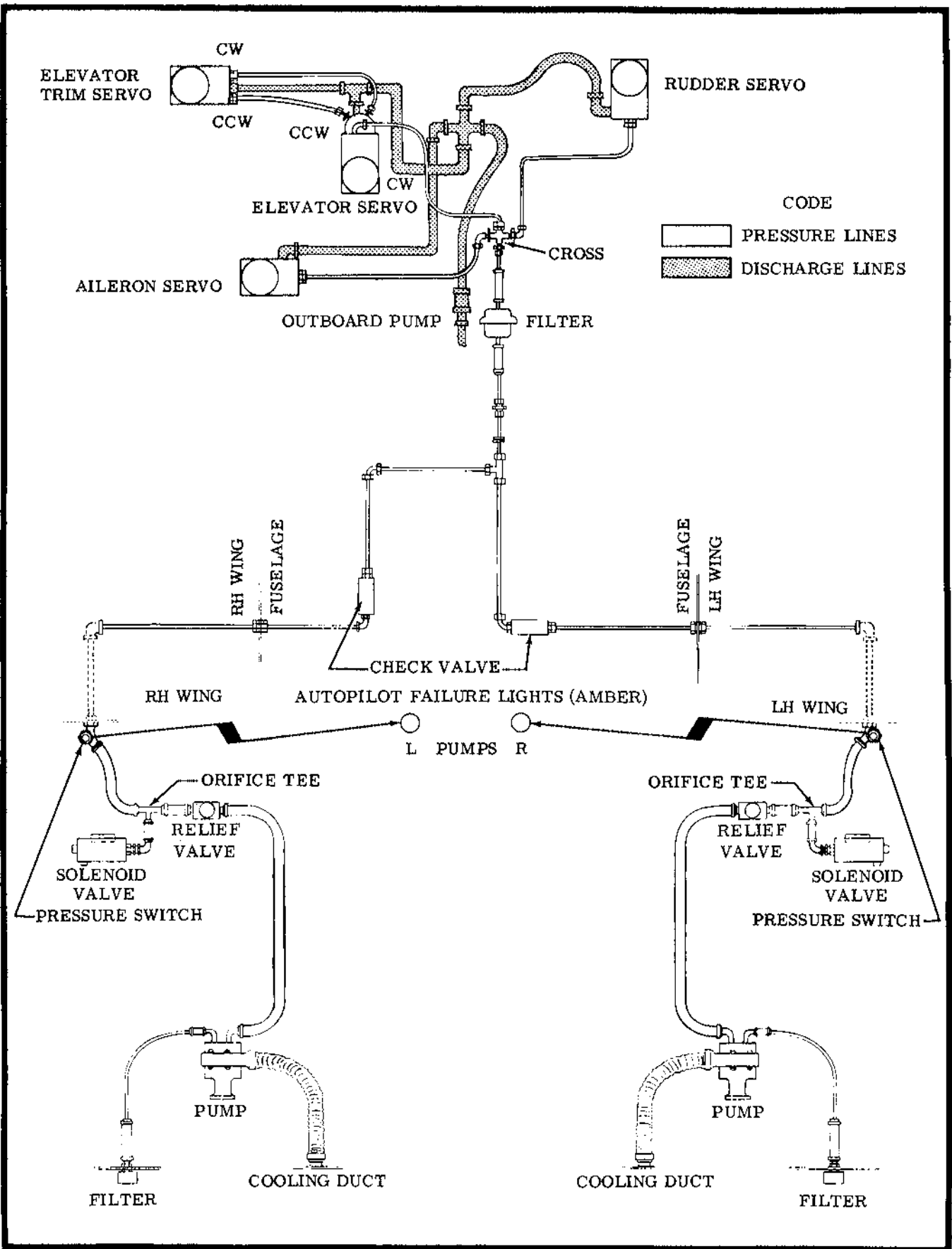
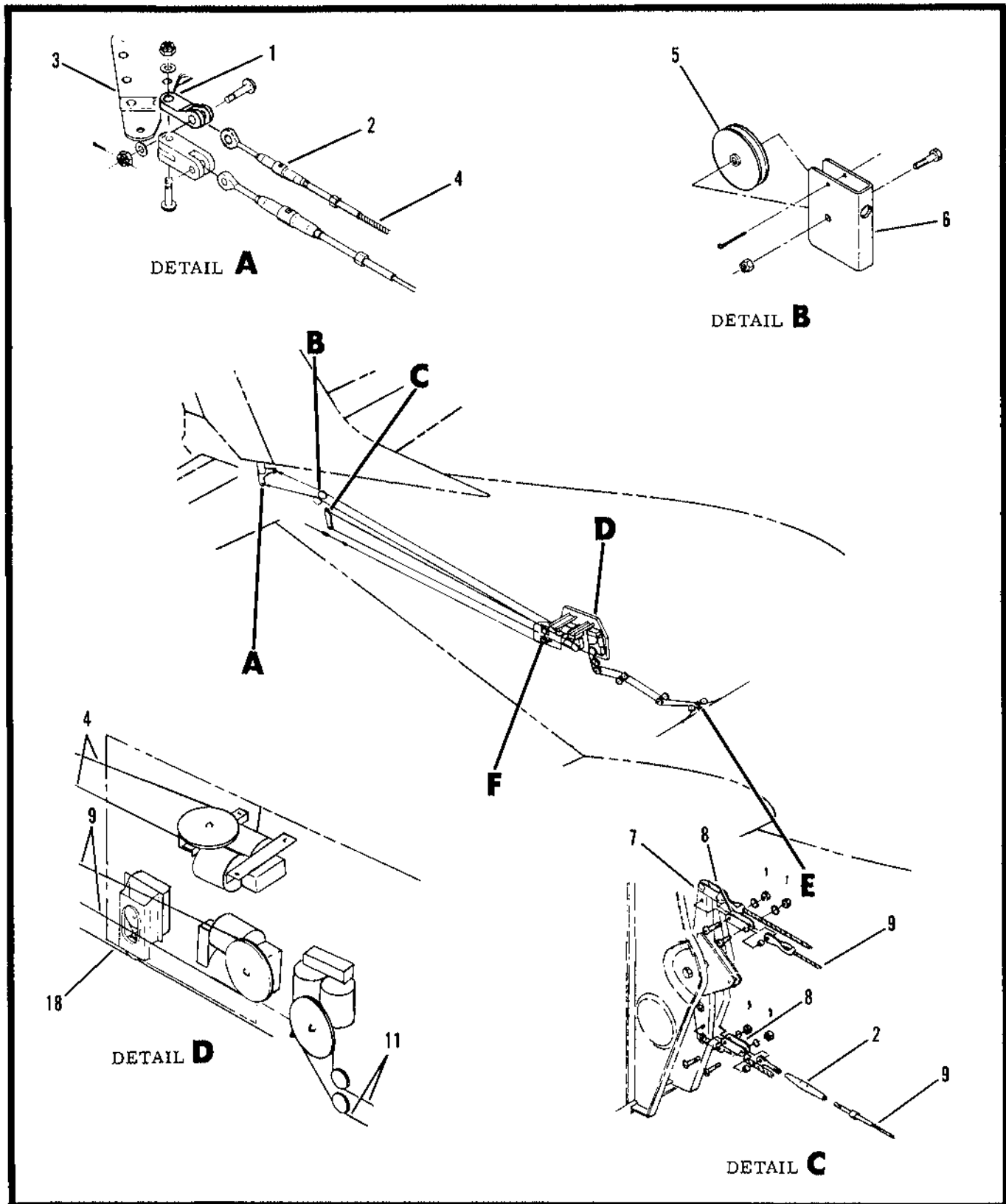


Figure 13-15. Nav-O-Matic 800 Pneumatic System Schematic

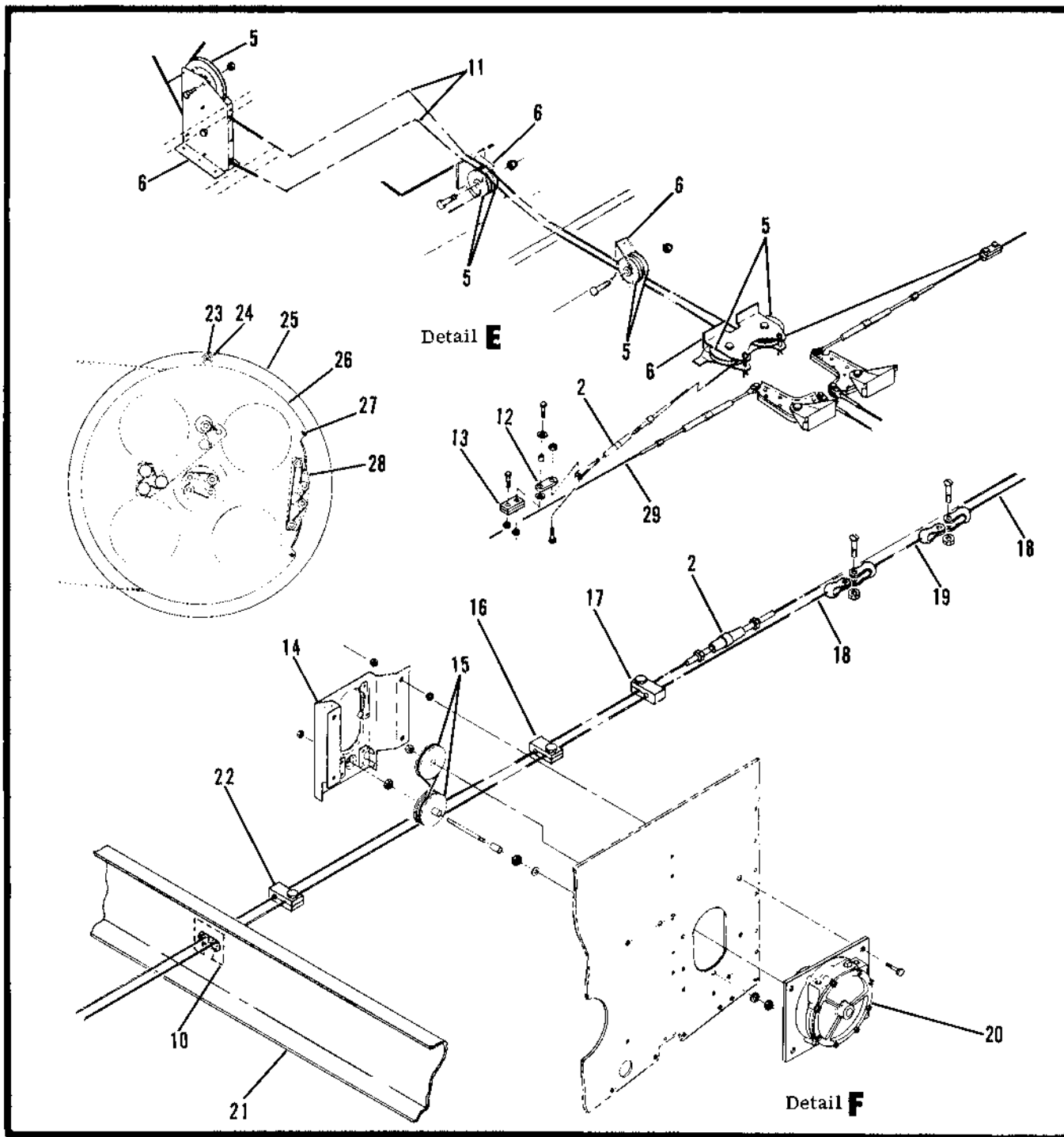


1. Link(Rudder)
2. Turnbuckle
3. Rudder Bellcrank
4. Rudder Cable Assembly (Servo to Bellcrank)

5. Pulley
6. Pulley Bracket
7. Elevator Bellcrank
8. Link (Elevator)

Figure 13-16. Nav-O-Matic 800 Servos and Cable Installation (Sheet 1 of 2)

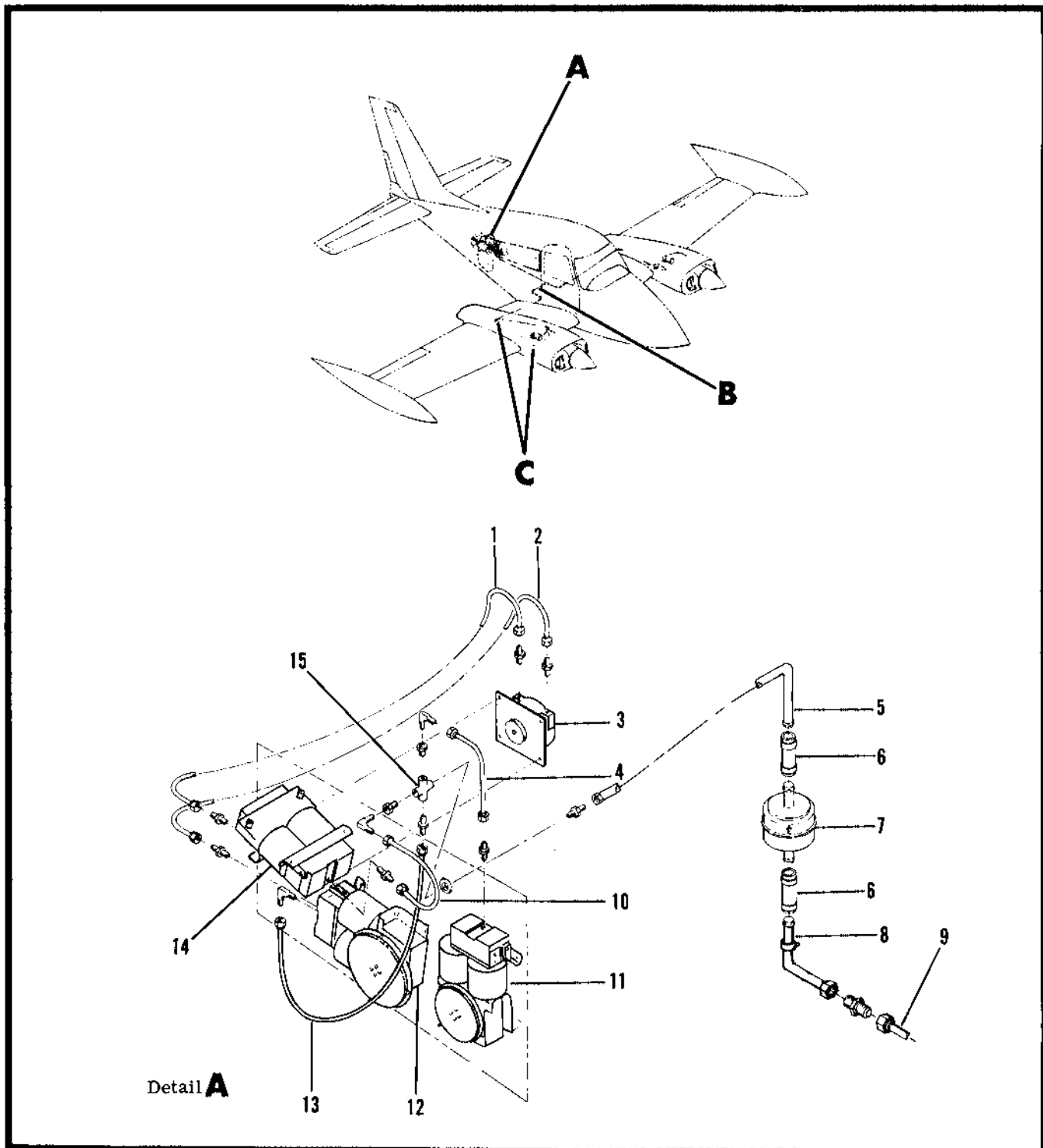




- 9. Elevator Cable Assembly (Servo to Bellcrank)
- 10. Fairlead
- 11. Aileron Cable Assembly (Servo to Aileron System)
- 12. Link (Aileron)
- 13. Cable Clamps
- 14. Pulley Bracket Assembly
- 15. Pulley (Elevator Trim)
- 16. Trim Stop Block (Center)
- 17. Trim Stop Block (Aft)
- 18. Elevator Trim Cable

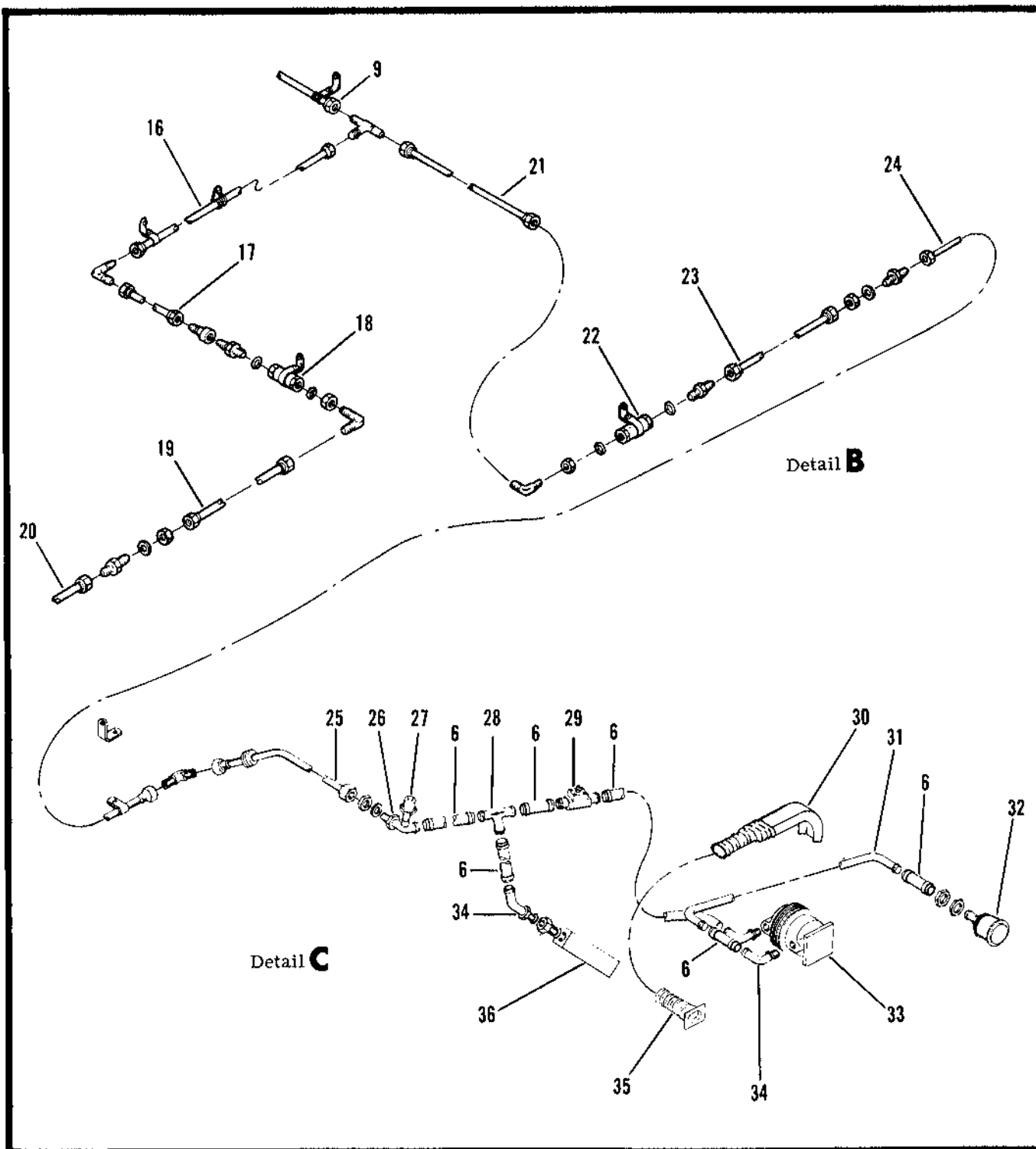
- 19. Elevator Trim Extension Cable (Autopilot)
- 20. Elevator Trim Servo
- 21. Bulkhead (Station 132.00)
- 22. Trim Stop Block (Forward)
- 23. Screw
- 24. Spacer
- 25. Cable Guard
- 26. Cable Drum
- 27. Cotter Pin
- 28. Cable Clamp
- 29. Aileron Control Cable

Figure 13-16. Nav-O-Matic 800 Servos and Cables Installation (Sheet 2 of 2)



- |                                  |                                    |
|----------------------------------|------------------------------------|
| 1. Line (CCW to Elevator Servo)  | 10. Line (Cross to Rudder Servo)   |
| 2. Line (CW to Elevator Servo)   | 11. Aileron Servo                  |
| 3. Elevator Trim Servo           | 12. Elevator Servo                 |
| 4. Line (Cross to Aileron Servo) | 13. Line (Cross to Elevator Servo) |
| 5. Line (Cross to Filter)        | 14. Rudder Servo                   |
| 6. Hose (Interconnecting)        | 15. Cross                          |
| 7. Filter Assembly               | 16. Line (Tee to Elbow, RH Wing)   |
| 8. Line (Filter to Cabin Line)   | 17. Line (Elbow to check Valve)    |
| 9. Line (Cabin to Tee)           | 18. Check Valve (RH Wing)          |

Figure 13-17. Nav-O-Matic 800 Pneumatic System Installation (Sheet 1 of 2)



- 19. Line (Check Valve to Fuselage Skin)
- 20. Line (RH Wing)
- 21. Line (Center Cabin to Check Valve)
- 22. Check Valve (LH Wing)
- 23. Line (Check Valve to Fuselage Skin)
- 24. Line (LH Wing)
- 25. Line (Aft Nacelle to Firewall)
- 26. Adapter (Pressure Switch)
- 27. Pressure Switch

- 28. Tee (Restrictor)
- 29. Pressure Relief Valve
- 30. Shroud
- 31. Line (Air Filter to Pump)
- 32. Air Filter
- 33. Pump
- 34. Elbow Adapter
- 35. Ram Air Hose
- 36. Solenoid Valve

Figure 13-17. Nav-O-Matic 800 Pneumatic System Installation (Sheet 2 of 2)

Removal and Installation of Servos. (See figure 13-17.)

- a. Remove autopilot aileron servo (11) as follows:
  1. Remove seats, carpet, rear upholstery panel and floorboards necessary to gain access to turnbuckle on autopilot aileron cables.
  2. Relieve tension on autopilot aileron cables by loosening turnbuckle.
  3. Disengage autopilot aileron cable from servo drum as shown in the Nav-O-Matic 800 Service and Parts Manual.
  4. Disconnect line assembly (4) and electrical cable from aileron servo (11).
  5. Remove four nuts and bolts attaching aileron servo (11) to shelf assembly and remove servo from aircraft.
  6. Install aileron servo (11) by reversing removal procedures.
  7. Rig autopilot aileron cables in accordance with rigging procedures.
- b. Remove autopilot elevator servo (12) as follows:
  1. Remove rear upholstery panel and stabilizer fairings.
  2. Relieve tension on autopilot elevator cables by loosening turnbuckle.
  3. Disengage autopilot elevator cable from servo drum as shown in the Nav-O-Matic 800 Service and Parts Manual.
  4. Disconnect line assemblies (1, 2 and 13) and electrical cable from elevator servo (12).
  5. Remove four nuts and bolts attaching elevator servo (12) to shelf assembly and remove servo from aircraft.
  6. Install elevator servo (12) by reversing removal procedures.
  7. Rig autopilot elevator cables in accordance with rigging procedures.
- c. Remove autopilot rudder servo (14) as follows:
  1. Remove rear upholstery panel and stabilizer fairings.
  2. Relieve tension on autopilot rudder cable by loosening turnbuckle.
  3. Disengage autopilot rudder cable from servo drum as shown in the Nav-O-Matic 800 Service and Parts Manual.
  4. Disconnect line assembly (10) and electrical cable from rudder servo (14).
  5. Remove four nuts and bolts attaching rudder servo (14) to support assemblies and remove servo from aircraft.
  6. Install rudder servo (14) by reversing removal procedures.
  7. Rig autopilot rudder cables in accordance with rigging procedures.
- d. Remove autopilot elevator trim servo (3) as follows:
  1. Remove rear upholstery panel, stabilizer fairing, and stinger.
  2. Relieve tension on elevator trim system by loosening turnbuckle.
  3. (See figure 13-16.) Disconnect cable (18) from cable (19) by removing attaching nut and bolt. Remove pulley bracket assembly (14) from shelf and elevator trim servo by removing five nuts and four bolts.
  4. Remove elevator trim cable from pulleys.

5. (See figure 13-17.) Tag and disconnect line assemblies (1 and 2) from elevator trim servo (3).
6. Remove elevator trim servo from shelf assembly.
7. Install elevator trim servo by reversing removal procedures.
8. Rig elevator trim cables in accordance with rigging procedures.

Removal and Installation of Computer. (See figure 13-18.)

- a. Remove rear upholstery panel.
- b. Disconnect electrical wiring cable from computer.
- c. Disconnect hose assembly (3) from elbow on computer (4).
- d. Loosen thumb screws retaining computer to shock mount and remove computer.
- e. Install computer by reversing removal procedures.

Removal and Installation of Controller. (See figure 13-18.)

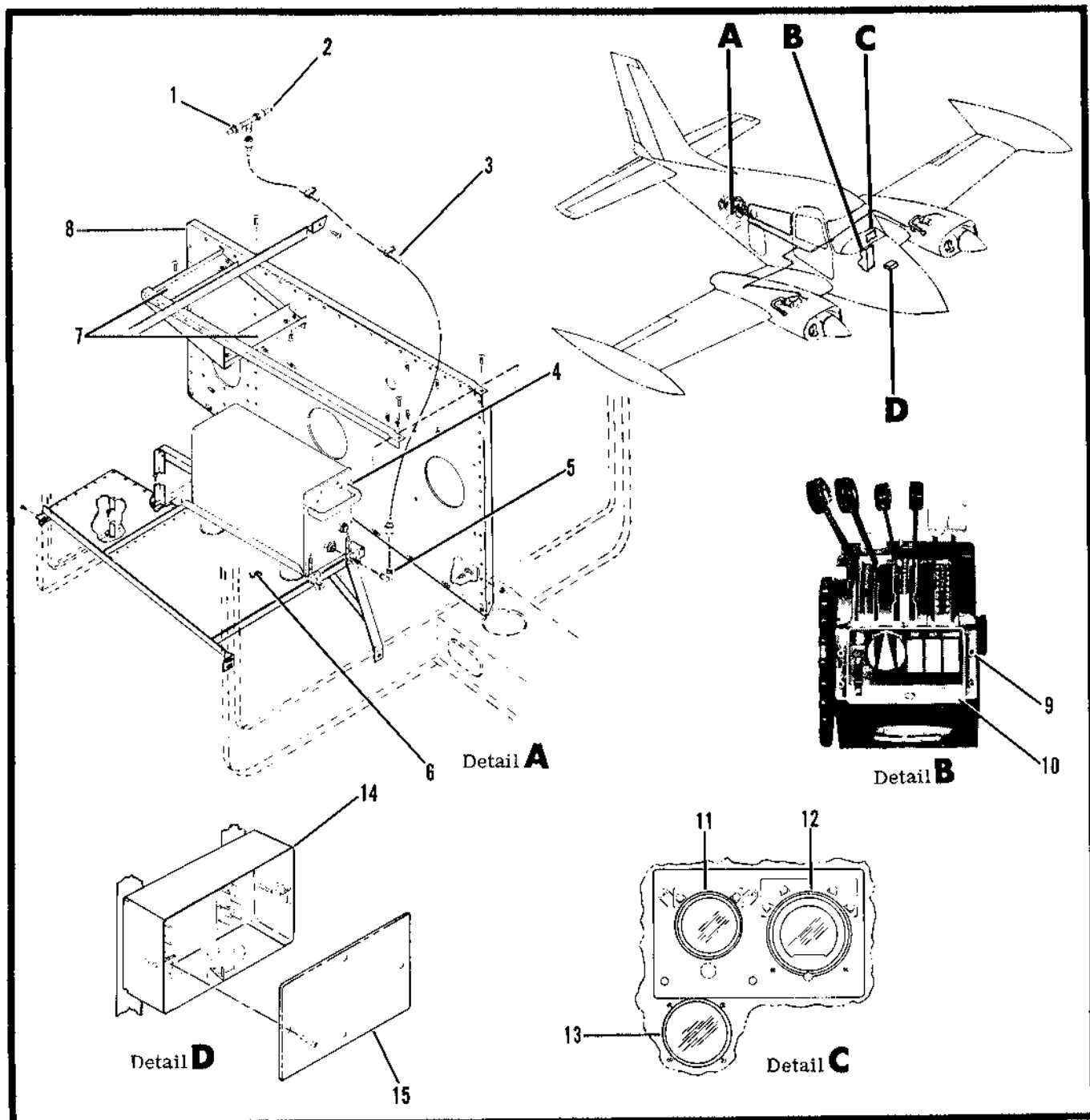
- a. Remove four screws (9) attaching controller (10) to pedestal.
- b. Lift controller (10) from pedestal and disconnect electrical plug from controller.
- c. Install controller by reversing removal procedures.

Removal and Installation of Miscellaneous Components. (See figure 13-18.)

- a. Refer to Section 12, remove and install gyros in accordance with removal and installation procedures.
- b. Remove and install support channels (7) and panel (8) as shown in illustration.
- c. Remove and install computer shelf (6) as shown in illustration.

Rigging Autopilot Control Systems. (See figure 13-16.)

- a. Rig autopilot aileron control system as follows:
  1. Refer to Section 5 and verify that the aileron control system is rigged properly.
  2. Place aileron control surfaces to the NEUTRAL position and secure with suitable clamping device.
  3. Insure that cable (11) is properly routed on pulleys and check installation of cable guard pins.
  4. Install cable clamps (13) on aileron control cables (29), attach cable (11) to cable clamps (13).
  5. Thread cable (11) over cable drum (26) and through cable clamp (28). Loosely affix cable clamp (28) to cable drum (26) in such a manner that cable (11) can slip when cable drum is rotated.
  6. Install three cable guard screws and spacers, rotate aileron servo cable drum through entire travel limits and return servo to NEUTRAL position.
  7. Slide cable clamps (13) along aileron control cables (29) until slack in cable (11) is removed, ob-



- |                                         |                                                                   |                             |
|-----------------------------------------|-------------------------------------------------------------------|-----------------------------|
| 1. Line Assembly (Tee to static source) | 6. Computer Shelf                                                 | 11. Directional Gyro        |
| 2. Line Assembly (Tee to instruments)   | 7. Channel Assembly (Rudder servo)                                | 12. Horizontal Gyro         |
| 3. Hose Assembly (Tee to computer)      | 8. Panel Assembly (Aileron servo, Elevator, Elevator trim servos) | 13. Turn and Bank Indicator |
| 4. Computer                             | 9. Screw                                                          | 14. Network Loading Box     |
| 5. Elbow                                | 10. Controller                                                    | 15. Cover                   |

Figure 13-18. Nav-O-Matic 800 Components and Shelves Installation

serve that cable clamps (13) are equal distances from pulleys (5). Secure cable clamps to aileron control cable (29).

8. Rotate cable drum (26) a few degrees clockwise from the NEUTRAL position and tighten cable clamp (28) to cable drum (26), install cotter pins (27), and safety.

9. Rig control cable (11) to a tension of  $12 \pm 3$  pounds by tightening turnbuckle (2), observe that cable drum (26) has returned to the NEUTRAL position.

10. Remove clamping device from aileron control surface, observe that the surfaces remain aligned with trailing edge of wing.

11. Safety wire turnbuckle (2) on cable (11) and install floorboards, carpets, rear upholstery panel and seats.

b. Rig autopilot rudder control system as follows:

1. Refer to Section 7 and verify that the rudder control system is rigged properly.

2. Place rudder to the NEUTRAL position and secure with suitable clamping device.

3. Insure that cable (4) is properly routed on pulleys in tailcone and check installation of cable guard pins.

4. Thread cable (4) over cable drum (26) and through cable clamp (28). Loosely affix cable clamp (28) to cable drum (26) in such a manner that cable (4) can slip when cable drum is rotated.

5. Install three cable guard screws and spacers, rotate rudder servo cable drum through entire travel limits and return servo to NEUTRAL position.

6. With rudder cable (4) attached to bellcrank (3), rotate cable drum (26) a few degrees clockwise (referenced when looking up at cable drum) from the NEUTRAL position and tighten cable clamp (28) to cable drum (26), install cotter pins (27), and safety.

7. Rig control cable (4) to  $15 \pm 5$  pounds tension by tightening turnbuckle (2), observe that cable drum (26) has returned to the NEUTRAL position.

8. Remove clamping device from rudder control surface, observe that the rudder control surface is aligned with the vertical stabilizer.

9. Safety wire turnbuckle (2) on cable (4) and install rear upholstery panel and seats.

c. Rig autopilot elevator control system as follows:

1. Refer to Section 6 and verify that the elevator control system is rigged properly.

2. Place elevator control surface to the NEUTRAL position and secure with suitable clamping device.

3. Thread cable (9) over cable drum (26) and through cable clamp (28). Loosely affix cable clamp (28) to cable drum (26) in such a manner that cable (9) can slip when cable drum is rotated.

4. With elevator cable (9) attached to bellcrank (7), rotate cable drum (26) a few degrees clockwise (referenced when looking directly at servo drum) from the NEUTRAL position and tighten cable clamp (28) to cable drum (26), install cotter pins (27), and safety.

5. Rig control cable (9) to  $15 \pm 5$  pounds tension by tightening turnbuckle (2), observe that cable drum (26) has returned to the NEUTRAL position.

6. Remove clamping device from elevator surface, safety wire turnbuckle (2), and install fairings, rear upholstery panel and seats.

d. Rig autopilot elevator trim control system as follows:

1. Refer to Section 6 and rig trim control system in accordance with rigging procedures.

#### NOTE

Refer to figure 13-16 for proper cable routing on servo pulleys, and assure that the cable tension is set to  $16 \pm 3$  pounds.

2. Position stop blocks as follows:

(a) Rotate elevator trim tab to full NOSE DOWN position, slide stop block (22) against aft side of bulkhead (21).

(b) Rotate elevator trim tab to full NOSE UP position, slide stop blocks (16 and 17) together and locate at a point where stop block (16) will not come in contact with servo pulleys when the trim tab is positioned to NOSE DOWN.

Autopilot Pressure Check and Adjustment. (See figure 13-17.)

a. Disconnect line assembly (5) from filter (7).

b. Connect a pressure gage to filter outlet.

c. Start one engine and run at cruise RPM.

d. Pressure at the filter outlet should read  $10 \pm .75$ , -0 PSI.

e. If pressure obtained is below prescribed tolerance, adjust pressure relief valve (29) in engine compartment to obtain correct pressure.

f. Start other engine and perform same check and adjust as necessary.

#### OXYGEN SYSTEM.

The standard oxygen system is designed to supply regulated oxygen for the pilot, copilot and three passengers. The standard system is used only with aircraft having a standard seating arrangement. Optional oxygen systems are also provided, these systems supply oxygen for the pilot, copilot and two passengers, or: pilot, copilot and four passengers. The oxygen system consists of an oxygen cylinder-regulator, filler valve, plumbing, pressure gage, outlets and mask assemblies. High pressure oxygen is routed from the cylinder-regulator through a capillary line to the pressure gage. Low pressure oxygen is routed from the cylinder-regulator to each individual outlet. A continuous flow of oxygen to the oxygen masks is provided whenever the control knob on the stationary panel is pulled to the ON position and the mask hoses are engaged into the outlets. Each outlet contains a spring-loaded valve which prevents the flow of oxygen until the mask hose is engaged with the outlet. The mask hose contains a flow indicator for visual proof of oxygen flow. The masks, rubber hoses and flow indicators are stored in the oxygen case on the baggage shelf, when not in use.

## Trouble Shooting the Oxygen System.

| TROUBLE                                                   | PROBABLE CAUSE                                    | CORRECTION                                                                                                                                                                                                                                                                                                             |
|-----------------------------------------------------------|---------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| NO PRESSURE INDICATION<br>ON PRESSURE GAGE                | Leak in system has exhausted pressure.            | Visually check pressure gage. Charge system and use detector fluids, Type CG-1, MIL-25567A, or its equivalent, to check lines and fittings. Tighten or replace fittings as necessary.                                                                                                                                  |
|                                                           | Defective pressure gage.                          | Pull knob out, insert mask hose into outlet and note flow indicator. Replace gage.                                                                                                                                                                                                                                     |
| PRESSURE INDICATION<br>NORMAL BUT OXYGEN<br>FAILS TO FLOW | Defective oxygen cylinder-<br>regulator assembly. | Replace oxygen cylinder-regulator assembly.                                                                                                                                                                                                                                                                            |
| OXYGEN DURATION TOO<br>SHORT                              | Leak in system.                                   | Draw a line on gage cover glass directly over pointer with a grease pencil. Loss of oxygen should not exceed one percent of total supply for a 24-hour period. Charge system and use detector fluids, Type CG-1, MIL-25567A, or its equivalent, to check lines and fittings. Tighten or replace fittings as necessary. |

## WARNING

Oil, grease, or other lubricants in contact with oxygen create a serious fire hazard, and such contact must be avoided. Do not permit smoking or open flame in or near aircraft while work is performed on oxygen system, or when the system is in operation. Guard against inadvertently turning the master switch on.

## Maintenance.

Before and during maintenance on oxygen systems, the following general rules must be followed.

- Clean hands, tools and working area.
- Keep oil, grease, water and all foreign matter from system.
- Keep all lines dry and capped until installed.
- All compounds used on fittings must conform to MIL-C-5542. No compound shall be used on aluminum alloy flared fittings. Compounds are used only on the first three threads of male fittings. No compound is used on coupling sleeves, or outside of tube flares.
- Inspection of the cylinder is required before charging. Do not attempt to charge the cylinder if any of the following conditions exist:
  - Contaminated or corroded fitting on cascade cylinder or filler valve.
  - Cylinder out of hydrostatic test date.
  - Cylinder bears no I. C. C. designation.
  - Cylinder completely empty. Must be completely disassembled and inspected in an FAA approved facility before charging.
- Fabrication of pressure lines is not recom-

mended. Lines should be replaced from factory by part number.

g. Lines and fittings shall be clean and dry. One of the following methods may be used to clean lines.

- A vapor degreasing solution of stabilized tri-chlorethylene conforming to Specification MIL-T-7003 followed by blowing tubing clean and dry with a stream of clean, dry, filtered air.

## CAUTION

Most air compressors are oil lubricated, and a minute amount of oil may be carried by the air stream. A water lubricated compressor should be used to blow tubing clean.

- Flush with naphtha conforming with Specification TT-N-95, then blow clean and dry with clean, dry, filtered air. Flush with anti-icing fluid conforming to MIL-F-5566 or anhydrous ethyl alcohol. Rinse thoroughly with fresh water and dry with clean, dry, filtered air.

- Flush with hot inhibited alkaline cleaner until free from oil and grease. Rinse with fresh water and dry with clean, dry, filtered air.

## NOTE

Cap lines at both ends immediately after drying to prevent moisture from entering.

Removal of Oxygen Cylinder-Regulator Assembly.  
(See figure 13-20.)

- Pull oxygen control knob (14) to ON position.

**WARNING**

The oxygen system incorporates the pressure regulator with the oxygen cylinder eliminating a shutoff valve on the cylinder. Before disconnecting any line assembly from the cylinder-regulator, insert a blunt object into an outlet coupling and bleed off all pressure in the oxygen cylinder. Extreme care must be taken when working around or removing cylinder-regulator from aircraft to prevent damaging the cylinder. The slightest scratch, nick or dent is cause for immediate condemnation of the cylinder.

**NOTE**

Cap all lines to prevent contamination.

- b. Disconnect three line assemblies (4, 5 and 11) from oxygen cylinder-regulator assembly (10).
- c. Disconnect control cable (8) from oxygen cylinder-regulator assembly (10).
- d. Remove control mounting clamp (9) from oxygen cylinder-regulator assembly (10).
- e. Remove safety wire and loosen wing nuts securing mounting straps (15) around oxygen cylinder-regulator assembly (10).
- f. Lower oxygen cylinder-regulator assembly and remove through nose wheel well opening.

Installation of Oxygen Cylinder-Regulator Assembly. (See figure 13-20.)

**WARNING**

Extreme care must be taken when installing or working near the cylinder-regulator to prevent damaging the cylinder. The slightest scratch, nick or dent is cause for immediate condemnation of the cylinder.

- a. Install oxygen cylinder-regulator assembly (10) through nose wheel well into position in mounting straps (15).
- b. Align oxygen cylinder-regulator assembly (10) with control cable (8) and three line assemblies (4, 5 and 11), tighten wing nuts on mounting straps (15) and secure with safety wire.
- c. Install three line assemblies (4, 5 and 11) on the oxygen cylinder-regulator assembly (10).
- d. Install control mounting clamp (9) on the oxygen cylinder-regulator assembly (10) and connect the control cable (8) to the control actuator with a cotter pin (7).

Removal of Pressure Gage. (See figure 13-20.)

- a. Pull oxygen control knob (14) to ON position.

**NOTE**

Insert a blunt object into an outlet coupling and bleed off all pressure in the oxygen cylinder.

- b. Disconnect pressure gage line (4) from nipple in back of pressure gage (16).
- c. Remove light assembly in accordance with Section 14.
- d. Remove pressure gage (16) by removing three securing screws.

Installation of Pressure Gage. (See figure 13-20.)

- a. Position pressure gage (16) in mounting hole and secure with three attaching screws.
- b. Install light assembly in the lower inboard position.
- c. Connect pressure gage line (4) to nipple in back of pressure gage (16).

Removal of Filler Valve. (See figure 13-20.)

- a. Pull oxygen control knob (14) to ON position.

**NOTE**

Insert a blunt object into an outlet coupling and bleed off all pressure in the oxygen system.

- b. Disconnect the filler valve line (11) from the filler valve (12).
- c. Remove filler valve protective cap (13).
- d. Remove filler valve (12) by removing three nuts and bolts.

Installation of Filler Valve. (See figure 13-20.)

- a. Position filler valve (12) in mounting bracket and secure with three attaching bolts and nuts.
- b. Replace filler valve protective cap (13).
- c. Connect filler valve line (11) to filler valve (12).

**TABLE OF FILLING PRESSURES**

Initial temperature refers to ambient temperature in filling room. A rise of approximately 25°F may be expected as a result of compression. The cylinder should be filled as quickly as possible and allowed to cool by ambient air only.

| Initial Temp.<br>°F | Filling Pressure<br>Psig | Initial Temp.<br>°F | Filling Pressure<br>Psig |
|---------------------|--------------------------|---------------------|--------------------------|
| 0                   | 1,600                    | 70                  | 1,925                    |
| 10                  | 1,650                    | 80                  | 1,950                    |
| 20                  | 1,675                    | 90                  | 2,000                    |
| 30                  | 1,725                    | 100                 | 2,050                    |
| 40                  | 1,775                    | 110                 | 2,100                    |
| 50                  | 1,825                    | 120                 | 2,150                    |
| 60                  | 1,875                    | 130                 | 2,200                    |



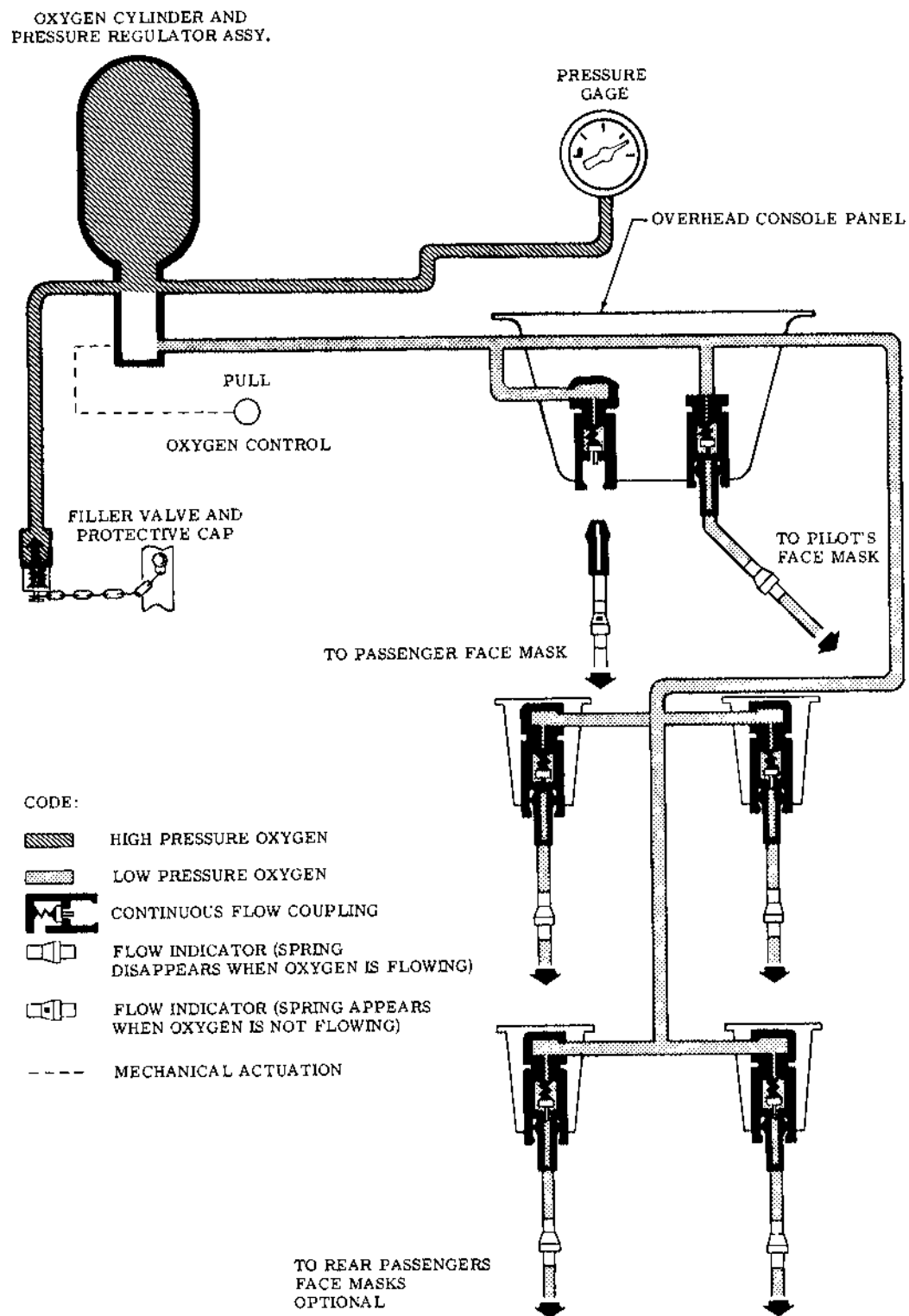
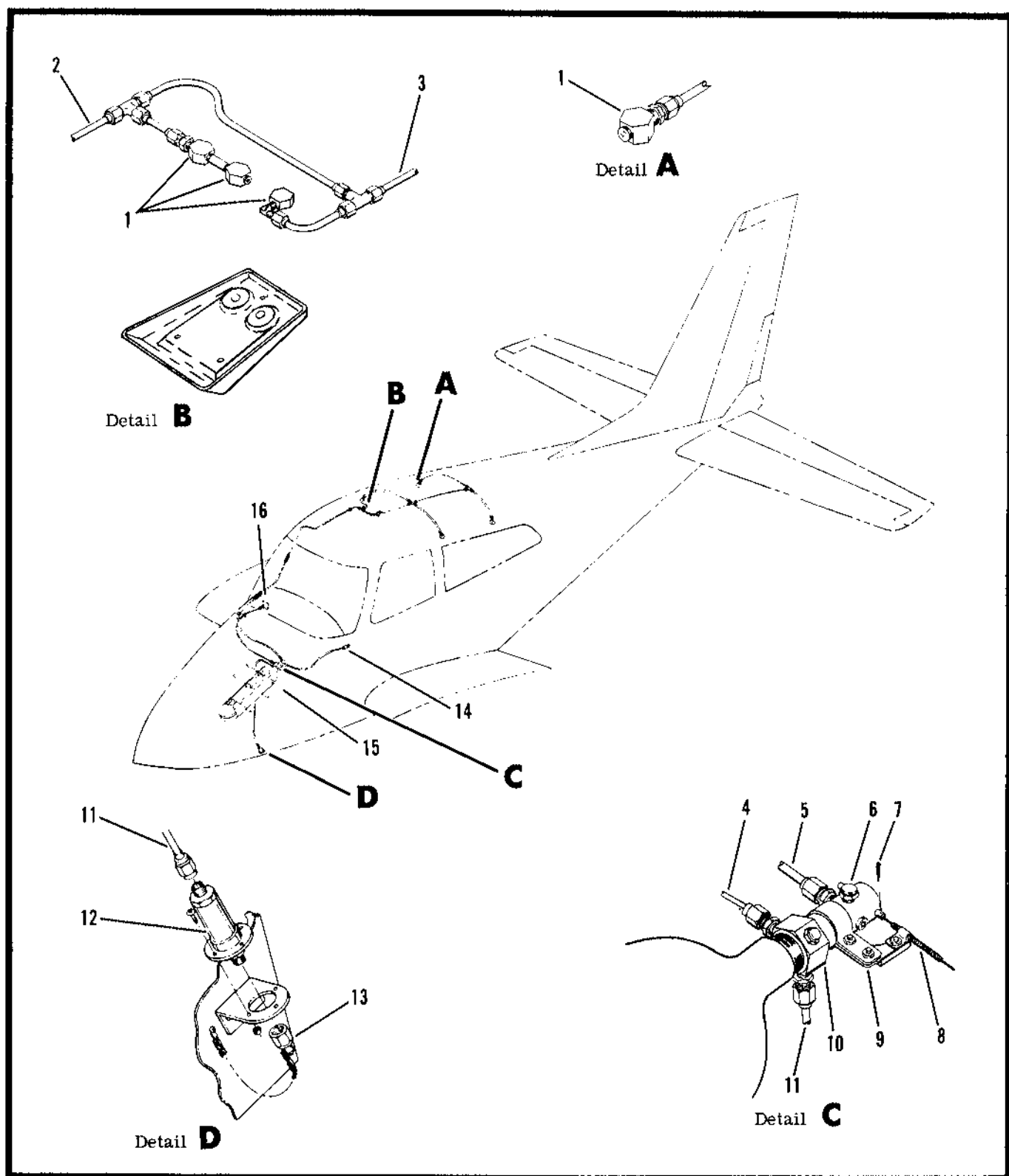


Figure 13-19. Oxygen Supply Systems Schematic



- |                                       |                                               |                               |
|---------------------------------------|-----------------------------------------------|-------------------------------|
| 1. Oxygen Outlet                      | 7. Cotter Pin                                 | 12. Filler Valve              |
| 2. Line Assembly (Tee to union)       | 8. Control Cable                              | 13. Cap                       |
| 3. Line Assembly (Port to cross)      | 9. Control Cable Mounting Clamp               | 14. Control Knob              |
| 4. Line Assembly (To pressure gage)   | 10. Cylinder-Regulator Assembly               | 15. Mounting Strap (Cylinder) |
| 5. Line Assembly (Regulator to union) | 11. Line Assembly (Regulator to filler valve) | 16. Pressure Gage             |
| 6. Pressure Relief Valve              |                                               |                               |

Figure 13-20. Oxygen System Installation

## Charging the Oxygen System.

The following procedure may be used in conjunction with the table of pressure/temperature values for charging the cylinder.

- a. Connect the cascade connection to filler valve.
- b. Slowly open valve on cascade cylinder having lowest pressure and allow pressure to equalize.
- c. Close cylinder valve on cascade cylinders, and slowly open valve on cylinder with next highest pressure until cylinder has been charged in accordance with chart.

## Leak Testing the Oxygen System.

Test the oxygen system for leakage by applying detector fluids, Type CG-1 solution per Specification MIL-L-25567A, or its equivalent, to each fitting and observe for formation of bubbles. No visible leakage should occur. Remove all traces of solution and repair or replace leaky fittings and repeat preceding procedure. Further test the oxygen system for leakage by pressurizing it to service pressure. The leak rate should not exceed one per cent of total supply

per 24-hour period.

## NOTE

Oxygen installations utilize a standard filler valve. To attach to this valve, the oxygen service cart must be equipped with an AN805-3 nut.

## Servicing and Inspection of Oxygen System.

Servicing and inspection of oxygen system components shall be accomplished as follows:

- a. Oxygen Cylinder - 1800 psi; 48.3 cu. in., check the hydrostatic test date on the neck of the cylinder. ICC 3HT 1800 cylinder shall be hydrostatically tested to 5/3 its working pressure every three years and must be retired from service after twelve years or 4380 cycles, whichever occurs first.
- b. A careful examination of the cylinder must be performed. If any bad dents, scratches, or areas of corrosion are found, the cylinder must be carefully checked per the Criteria in Table 1.

Each interconnected series of oxygen cylinders is equipped with a single gage. The trailer type cascade may also be equipped with a nitrogen cylinder (shown reversed) for filling landing gear struts, accumulators, etc. Cylinders are not available for direct purchase, but are usually leased and refilled by a local compressed gas supplier.

Service Kit SK310-32 (available from the Cessna Service Parts Center) contains an adapter, a pressure gage, hose, lines, and fittings for equipping two oxygen cylinders to service oxygen systems. As noted in the Service Kit, a tee (Part No. 11844) and a pigtail (Part No. 1243-2) should be ordered for each additional cylinder to be used in the cascade of cylinders. Be sure to ground the aircraft and ground servicing equipment before use.

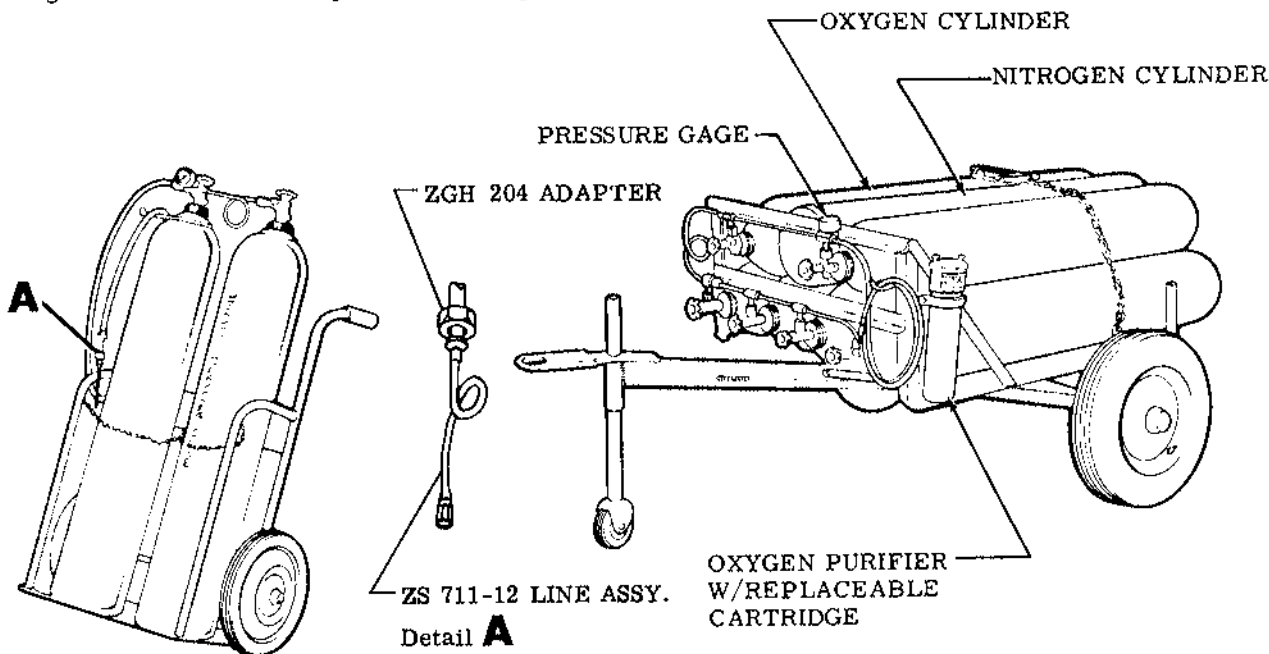


Figure 13-21. Typical Portable Oxygen Cascades.

## INSPECTION CRITERIA FOR ACCEPTANCE OF OXYGEN CYLINDERS

The following data may be used to determine that oxygen cylinders are acceptable for service. This criteria should be used prior to charging cylinders.

| Discrepancies                                           | Cylinder Classification |      |   |
|---------------------------------------------------------|-------------------------|------|---|
|                                                         | ICC-3HT                 | 1800 |   |
| Isolated pitting or corrosion<br>(Depth)                | .010                    | 2    | 3 |
| Local pitting or corrosion or line corrosion<br>(Depth) | .005                    | 3    | 4 |
| General corrosion                                       | Not allowed             |      | 5 |
| Cuts, Digs, Gouges<br>(Depth)                           | .005                    | 6    |   |
| Dents (Depth)                                           | .031                    | 7    |   |
| Fire damage                                             | Not allowed             |      | 8 |
| Bulges                                                  | Not allowed             |      | 9 |

- Isolated pits of small cross section involving loss of wall thickness by corrosive media. Small isolated pits with a maximum depth as shown are acceptable.
- If depth exceeds figure shown, cylinder must be returned to the manufacturer for disposition.
- Local pitting or corrosion or line corrosion involving loss of wall thickness by corrosive media with a pattern of pits which are connected to others in a band or line. A small area with a minimum depth as shown is acceptable. Areas extending beyond 3 inches in diameter or 4 inches long shall be considered general corrosion.
- General corrosion (sometimes accompanied by pitting) involving loss of wall thickness by corrosive media covering a considerable area. Cylinder must be returned to the manufacturer for hydrostatic testing.
- Deformations caused by contact with a sharp object cutting or upsetting the material of the cylinder, decreasing the wall thickness. Maximum defect permissible without corrective action. If this depth is exceeded, the cylinder must be returned to the manufacturer for removal of defects and verification of cylinder strength by hydrostatic testing.
- Deformations caused by contact with blunt objects in such manner that the thickness of the metal is not materially impaired. The major diameter of the dent must be equal to or greater than 32 times the depth of the dent. Sharper dents (or deeper dents) than this are considered too abrupt and must be returned to the cylinder manufacturer for disposition.
- Fire damage is indicated by charring or burning or sintering of the metal, charring or burning of the paint, distortion of the cylinder, functioned safety relief devices, melting of valve parts, etc. Cylinders must be returned to the cylinder manufacturer for disposition.
- Bulged cylinders are not acceptable. Cylinders must be returned to the cylinder manufacturer for disposition.

TABLE I

## NOTE

If the acceptability of the cylinder is questionable when the Criteria is applied, the cylinder shall be returned to the manufacturer.

- c. Regulator - Inspected every 3 years or 1000 hours, whichever occurs first.
- d. Pressure Gage - Inspected every 2 years or during major aircraft overhaul.
- e. High Pressure Lines - None required unless trouble is indicated. Lines should be tested to not less than 3000 psi, if trouble is indicated.

## WARNING

Whenever components have been removed and replaced or oxygen system has been allowed to deplete to below 50 psi, the system must be purged.

## Purging the Oxygen System.

- a. Charge the oxygen system in accordance with charging procedures.
- b. Plug all masks into all outlets and purge system by allowing the oxygen to flow for at least 10 minutes. Smell the oxygen flowing from the outlets and con-

tinue to purge until the oxygen is odorless. Refill cylinder as required during and after purging.

#### Functional Testing the Oxygen System.

Whenever the oxygen system regulator (or regulator-cylinder assembly) has been replaced or overhauled, perform the following flow and internal leakage tests to check that the system functions properly.

- Fully charge the oxygen system per charging instructions.
- Install an oxygen outlet adapter (Cessna Part Number C166005-0506) into a pressure gage (gage should be calibrated in one-pound increments from 0 to 100 PSI), and insert adapter into an oxygen outlet. Place control lever in the "ON" position. The gage pressure should be  $75 \pm 10$  PSI.
- Insert adapters (or mask and line assemblies if they are operating properly) into all remaining outlets. With oxygen flowing from all outlets, the pressure should still be  $75 \pm 10$  PSI.
- Place oxygen control lever in the "OFF" position and allow pressure to fall to 0 PSI. Remove all adapter assemblies except the one with the pressure gage. The pressure must not rise above 0 PSI when observed for one minute. Remove pressure gage and adapter from oxygen outlet.

#### NOTE

If pressure specified in the foregoing procedures are not obtained, the oxygen regulator is not operating properly. Remove and replace cylinder-regulator assembly with another unit and repeat test procedure.

- Connect oxygen masks to each outlet and check each mask for proper operation.
- After checking, return all masks to mask case.
- Recharge oxygen system as required.

#### OIL DILUTION SYSTEM (OPTIONAL EQUIPMENT). (See figure 13-22.)

The oil dilution system consists of two solenoid valves, one mounted on the firewall of each engine compartment. Each valve is connected to the main fuel supply line, and to each engine crankcase at an oil passage on the suction side of the engine oil pump. The valves are operated electrically by placing the oil dilution switch in either the left or right position. When the switch is depressed, oil in the selected engine will be diluted. When the switch is released, it automatically returns to the OFF position.

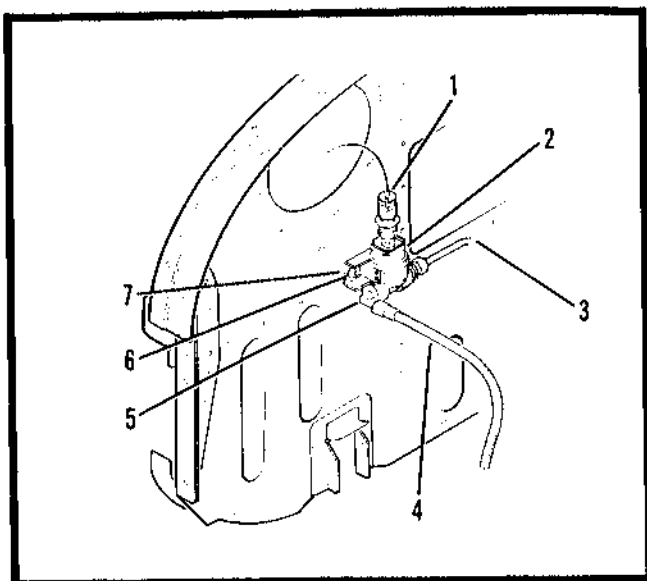
#### Oil Dilution System Operation.

If oil dilution is required, dilute the oil with the engines operating at 1000 RPM and the auxiliary fuel pump switch in ON or LOW position. Hold the oil dilution switch on either L or R for necessary dilution time. Fuel will flow into the oil pump of the engine being diluted at the rate of four quarts every two minutes. Diluting oil in each engine for two minutes (4 quarts of fuel) is the maximum dilution that should be used. Oil dilution longer than two minutes per engine will exceed the sump capacity of the engines. When diluting, watch the oil pressure closely. A slight, gradual pressure drop is to be expected as the oil is thinned. Stop the engine if any sharp fluctuation in pressure is observed, it may be caused by an oil screen being clogged with sludge washed down by the fuel. On starting and warm-up after diluting the oil, watch the oil pressure closely for an indication of sludge blocking the oil screens. If the full dilution time was used, starting with full sumps, run the engines long enough to evaporate some of the fuel and lower the sump level to 12 quarts before takeoff. To avoid progressive dilution of the oil, flights of at least one hour duration should be conducted between oil dilution operations.

#### NOTE

When the dilution system is used for the first time each season, it is recommended that the oil be changed and the oil screens cleaned to remove sludge accumulations washed down by the fuel. Use the full oil dilution period, drain the oil, clean the screens, refill with new oil and redilute as required for anticipated temperature.

On starting and warm-up after diluting the oil, watch the oil pressure closely for an indication of sludge blocking the oil screens. If the full dilution time was used, starting with full sumps, run the engines long enough to evaporate some of the fuel and lower the sump level to 12 quarts before takeoff. To avoid progressive dilution of the oil, flights of at least one hour duration should be conducted between



- |                                |            |
|--------------------------------|------------|
| 1. Electrical Connector        | 5. Elbow   |
| 2. Oil Dilution Solenoid Valve | 6. Screw   |
| 3. Fuel Line                   | 7. Bracket |
| 4. Oil Dilution Hose           |            |

Figure 13-22. Oil Dilution Solenoid Valve

oil dilution operations.

Removal of Oil Dilution Solenoid Valve. (See figure 13-22.)

- a. Disconnect oil dilution hose (4) and fuel line (3).
- b. Disconnect oil dilution electrical connector (1).
- c. Remove two screws (6), clamp and bracket (7) attaching the solenoid valve (2) to engine firewall, and remove solenoid valve (2) from firewall.

Installation of Oil Dilution Solenoid Valve. (See figure 13-22.)

- a. Attach solenoid valve to engine firewall as shown in figure 13-22.
- b. Connect electrical connector (1) to the solenoid valve and secure with safety wire.
- c. Connect fuel line (3) from main fuel supply line. Connect oil dilution hose (4) to solenoid valve.

#### HEATED WINDSHIELD.

Trouble Shooting the Heated Windshield.

| TROUBLE                       | PROBABLE CAUSE                        | CORRECTION                        |
|-------------------------------|---------------------------------------|-----------------------------------|
| WINDSHIELD WILL NOT HEAT      | Open circuit.                         | Reset circuit breaker.            |
|                               | Defective relay.                      | Replace relay.                    |
|                               | Defective temperature controller.     | Replace temperature controller.   |
|                               | Loose or faulty wiring.               | Check, tighten or replace wiring. |
|                               | Defective switch.                     | Replace switch.                   |
|                               | Defective windshield sensing element. | Replace windshield.               |
| WINDSHIELD HEATS CONTINUOUSLY | Defective relay.                      | Replace relay.                    |
|                               | Defective temperature controller.     | Replace temperature controller.   |
|                               | Defective windshield sensing element. | Replace windshield.               |

Removal of Heated Windshield.

- a. Disconnect electrical wiring to magnetic compass. Remove screw, nut and compass.
- b. Tag and disconnect windshield wiring.
- c. Refer to Section 3 and remove windshield in accordance with removal procedures.

Installation of Heated Windshield.

- a. Refer to Section 3 and install windshield in

The electrically heated windshield (optional equipment) is provided to maintain the pilot's windshield at predetermined temperature level. A temperature controller, relay, circuit breakers, switch, light assembly, and necessary wiring make up the electric windshield system. The temperature controller and relay are mounted on the timer shelf in the LH nose section, while the switch and circuit breakers are located on the instrument panel. When the switch is actuated to the ON position, the controller senses the windshield temperature, should the windshield temperature not be within the selected controller temperature setting ( $100 \pm 10^\circ\text{F}$ ), the relay will close and supply power to the heating elements embedded in the windshield. An external adjusting potentiometer on the controller is provided to allow the selection of desired operating temperature. To prevent the rapid on and off cycling during cold operating temperatures, the controller allows the windshield to vary 10 degrees above and below the setting on the potentiometer. When the temperature of the windshield rises to the upper limit of  $110^\circ\text{F}$ , the relay will de-energize and power will be removed from the heating element.

accordance with installation procedures.

- b. Connect wiring and remove tags.
- c. Install magnetic compass and connect wiring.
- d. Check operation of heated windshield.

Removal and Installation of Heated Windshield Components. (See figure 13-23.)

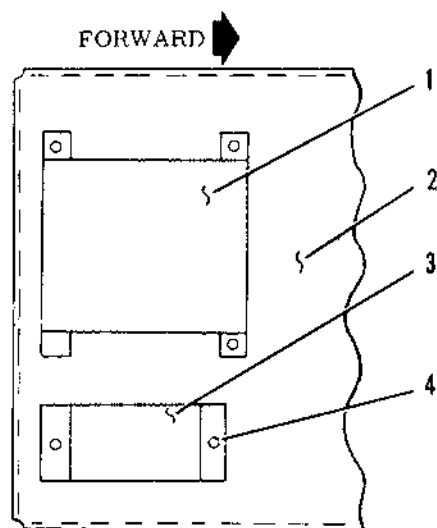
- a. Tag electrical wires, remove temperature controller (1) from timer shelf (2) by removing four attaching screws and nuts.

b. Tag electrical wires, remove relay (3) from timer shelf by removing two attaching screws and nuts.

c. To install heated windshield components, reverse the above procedures.

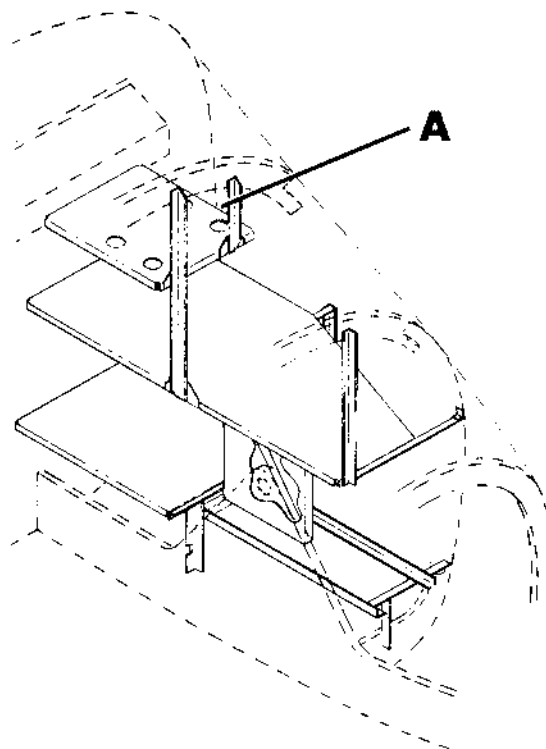
#### RADIO SHELF CURTAIN

A radio shelf curtain may be installed in the nose section to protect the radio equipment from weather. Hooks and snaps provide means of installation and access to radio equipment.



TOP VIEW

Detail **A**



- 1. Temperature Controller
- 2. Timer Shelf

- 3. Relay
- 4. Screw and Nut

Figure 13-23. Heated Windshield Components Installation

## SECTION 14

## ELECTRICAL SYSTEMS

## Table of Contents

|                                                      | Page |                                                                      | Page   |
|------------------------------------------------------|------|----------------------------------------------------------------------|--------|
| <b>POWER DISTRIBUTION</b>                            | 14-1 | <b>LIGHTS</b>                                                        | 14-11  |
| Trouble Shooting the Battery and Starter Circuit     | 14-2 | Removal of Landing Gear Switch and Indicator Lights                  | 14-11  |
| Removal of Batteries                                 | 14-2 | Installation of Landing Gear Switch and Indicator Lights             | 14-11  |
| Installation of Batteries                            | 14-2 | Removal and Installation of Interior Lights Rheostat                 | 14-12  |
| Removal of Battery Box                               | 14-3 | Removal and Installation of Instrument Lights                        | 14-12  |
| Installation of Battery Box                          | 14-3 | Electroluminescent Panel Lights                                      | 14-12  |
| Removal of External Power Receptacle                 | 14-4 | Removal                                                              | 14-12  |
| Installation of External Power Receptacle            | 14-5 | Installation                                                         | 14-12  |
| <b>ALTERNATORS AND REGULATORS</b>                    | 14-5 | Removal of Fuel Selector Valve Light                                 | 14-12  |
| Trouble Shooting the Alternator and Regulator System | 14-5 | Installation of Fuel Selector Valve Light                            | 14-12  |
| Removal of Alternator                                | 14-7 | Removal and Installation of Front Dome and Individual Reading Lights | 14-12  |
| Installation of Alternator                           | 14-7 | Removal and Installation of Wing Navigation Lights                   | 14-12  |
| Removal and Installation of Voltage Regulator        | 14-7 | Removal and Installation of Tail Navigation Light                    | 14-12  |
| Removal and Installation of Circuit Breaker Panel    | 14-8 | Trouble Shooting Exterior Lights                                     | 14-13  |
| Removal and Installation of Junction Box             | 14-8 | Removal and Installation of Rotating Beacons                         | 14-13  |
| <b>BATTERY MASTER SWITCH AND ALTERNATOR SWITCHES</b> | 14-8 | Removal of Landing Light                                             | 14-13  |
| Removal of Battery and Alternator Switches           | 14-8 | Installation of Landing Light                                        | 14-14A |
| Installation of Battery and Alternator Switches      | 14-8 | Adjustment of Landing Light                                          | 14-17  |
| <b>LEFT HAND SWITCH PANEL SWITCHES</b>               | 14-8 | Removal and Installation of Taxi Light                               | 14-18  |
| Typical Switch Removal                               | 14-8 | Adjustment of Taxi Light                                             | 14-18  |
| Typical Switch Installation                          | 14-8 | Removal and Installation of Deice Light                              | 14-18  |
| Removal and Installation of Ignition System Switches | 14-8 | <b>POWER DISTRIBUTION SCHEMATIC</b>                                  | 14-19  |
|                                                      |      | <b>ELECTRICAL LOADING CHART</b>                                      | 14-20  |
|                                                      |      | <b>WIRING DIAGRAM</b>                                                | 14-21  |
|                                                      |      | Wiring Diagram Index                                                 | 14-21  |

**POWER DISTRIBUTION.**

Electrical energy for the aircraft is supplied by a 24 volt, direct current, single wire, negative ground electrical system. Two 12 volt storage batteries wired in series supply power for starting, and furnish a reserve source of power for electrical components in the event of alternator failure. The two batteries are contained in a battery box located in the left-hand wing outboard of the engine nacelle. The battery box contains a vent and drain tube which vents underneath the wing outboard of the landing gear. Two belt-driven alternators supply the current needed to operate the electrical equipment and to charge the storage battery. The standard alternator system includes two 50 ampere alternators, the optional system includes two 66 ampere alternators. Both standard and optional systems have two voltage regulators. One voltage regulator is used for regulation of the

system, the second is used as a spare in the event of regulator failure. The system is protected by a circuit breaker, three fuses, and an overvoltage relay. The alternator switches are mounted on the stationary instrument panel. The electrical circuits are protected by circuit breakers housed in a circuit breaker panel located on the left cabin wall forward of the pilot's seat. The aircraft is equipped with standard navigation lights and rotating beacons. The navigation lights will remain on steady when the navigation light switch is in the FLASHING position and the rotating beacon switch is ON. When the rotating beacon switch is OFF, the navigation lights will flash. The retractable landing light is located in the tail cap of the left tip tank. The cabin lighting consists of a map light in each control wheel, a console light, and a left and right reading light above the third and fourth seats. The reading lights for the fifth and sixth seats are optional. A fuel selector valve handle light is



located on the front spar between the pilot's and co-pilot's seats. Post lights provide lighting for the switch panel and instruments. Lighting for the com-

pass and radio control units are contained within the units. Other optional lighting equipment consists of a right landing light and wing deice light.

#### Trouble Shooting the Battery and Starter Circuit.

| TROUBLE                                   | PROBABLE CAUSE                             | CORRECTION                                       |
|-------------------------------------------|--------------------------------------------|--------------------------------------------------|
| SLOW ENGINE CRANKING SPEED                | Partially discharged battery.              | Charge or change battery.                        |
|                                           | Low capacity battery.                      | Cycle battery to improve capacity or replace it. |
|                                           | Faulty battery cell.                       | Replace battery.                                 |
|                                           | Loose or corroded terminals.               | Clean and tighten terminals.                     |
|                                           | Burned starter solenoid switch contacts.   | Replace solenoid.                                |
|                                           | Starter motor drags.                       | Overhaul starter motor.                          |
| STARTER ENGAGES BUT WILL NOT CRANK ENGINE | Partially discharged battery.              | Charge or change battery.                        |
|                                           | Faulty battery cells.                      | Replace battery.                                 |
|                                           | Damaged or shorted starter motor.          | Overhaul starter motor.                          |
|                                           | Faulty armature or field in starter motor. | Overhaul starter motor.                          |
| STARTER WILL NOT ENGAGE                   | Battery fully discharged.                  | Replace or charge battery.                       |
|                                           | Disconnected battery cable.                | Replace faulty cable.                            |
|                                           | Shorted or open starter solenoid.          | Replace solenoid.                                |
|                                           | Defective starter switch.                  | Replace starter switch.                          |

#### Removal of Batteries. (See figure 14-1.)

- Release the fasteners securing the battery access cover and remove cover.
- Remove battery box lid.
- Disconnect the ground cable from the negative battery terminal on the rear battery.

#### CAUTION

Always remove the ground cable first and install it last to prevent accidental short circuits.

- Disconnect the power cable from the positive terminal on the forward battery.
- Remove the battery bus bar that connects the negative terminal of the forward battery with the positive terminal of the rear battery.
- Lift the batteries from the battery box.

#### Installation of Batteries. (See figure 14-1.)

- Place batteries in the battery box with the

terminal-post sides of the batteries together.

- Coat battery terminals, bus bar and cable terminals with a light coating of grease.
- Place bus bar across the two outboard battery terminals (positive post of rear battery and negative post of forward battery) and secure with battery wing nuts.
- Attach the battery power cable marked "+" (the forward cable) to the forward battery terminal.
- Attach the ground cable marked "-" to the rear battery terminal.

#### NOTE

When attaching the battery cables to the battery, be sure cable grommets are properly placed over the edges of the battery box.

#### CAUTION

Make sure battery Master Switch is OFF. Use voltmeter to determine polarity. Reverse polarity will damage diodes in the alternators.

- f. Install the battery box lid.
- g. Replace the battery access hole cover and secure with fasteners.

from the wing.

#### Installation of Battery Box. (See figure 14-1.)

#### Removal of Battery Box. (See figure 14-1.)

- a. Remove batteries in accordance with battery removal procedure.
- b. Push the battery cables through the grommets in the battery box until the terminals are just protruding from the wing rib.
- c. Remove the access panel located between the external power receptacle and engine nacelle.
- d. Disconnect the rubber hose through the grommet into the battery compartment.
- e. Remove the eight screws securing the battery box to the wing structure, and lift the battery box

- a. Inspect the battery compartment to insure that the battery cables will not obstruct the installation of the battery box.
- b. Tilt the battery box into the battery compartment and start the rubber hose and battery cables through the grommets. Lower the battery box down into the compartment while guiding the hose through the grommet.
- c. Attach the rubber hose to the battery drain tube that extends to the trailing edge of the wing and replace the hose clamp.
- d. Replace and secure the access hole cover be-

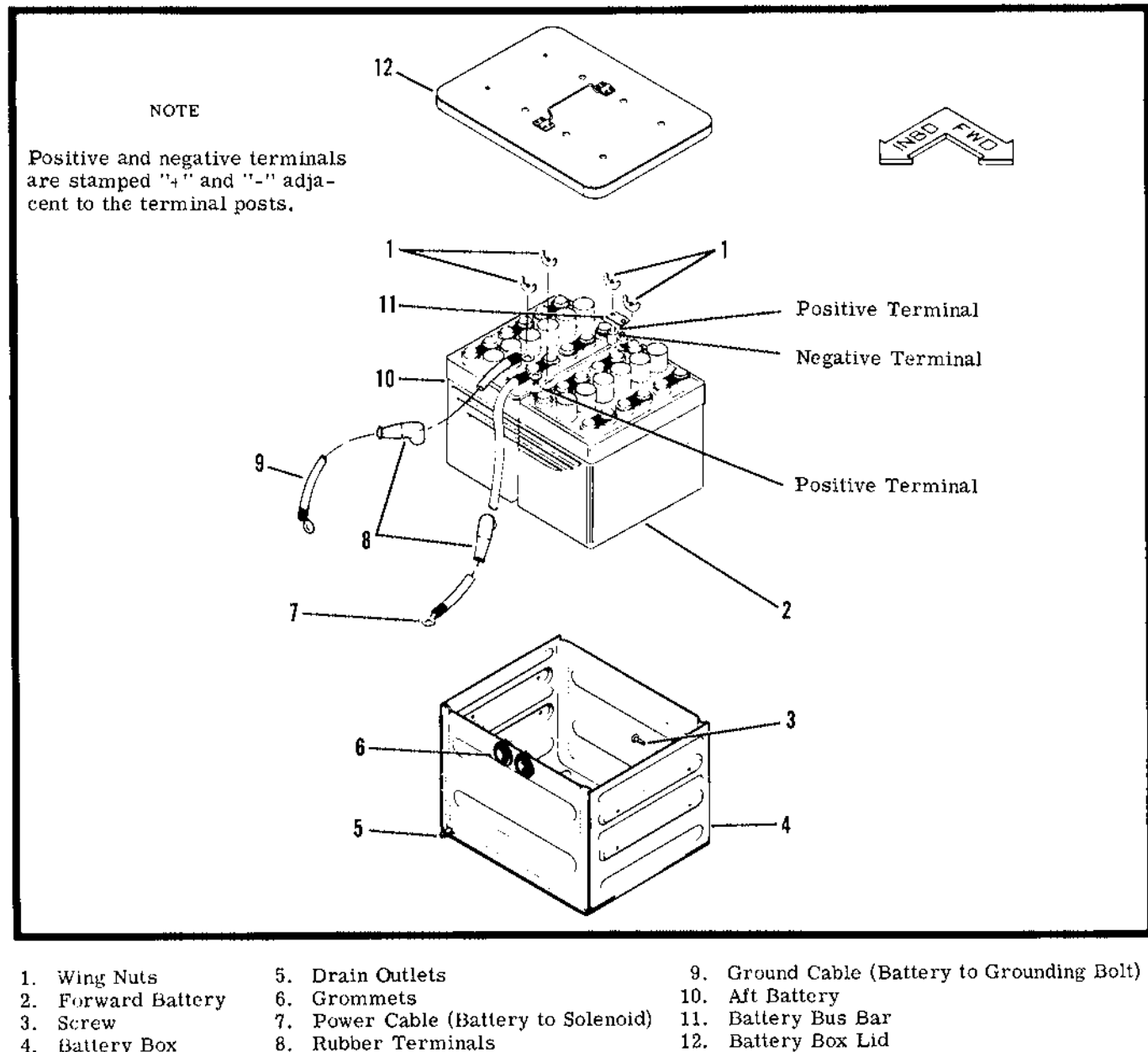


Figure 14-1. Battery and Battery Box Installation

tween the external power receptacle and the engine nacelle.

e. Install the eight screws that secure the battery box in place.

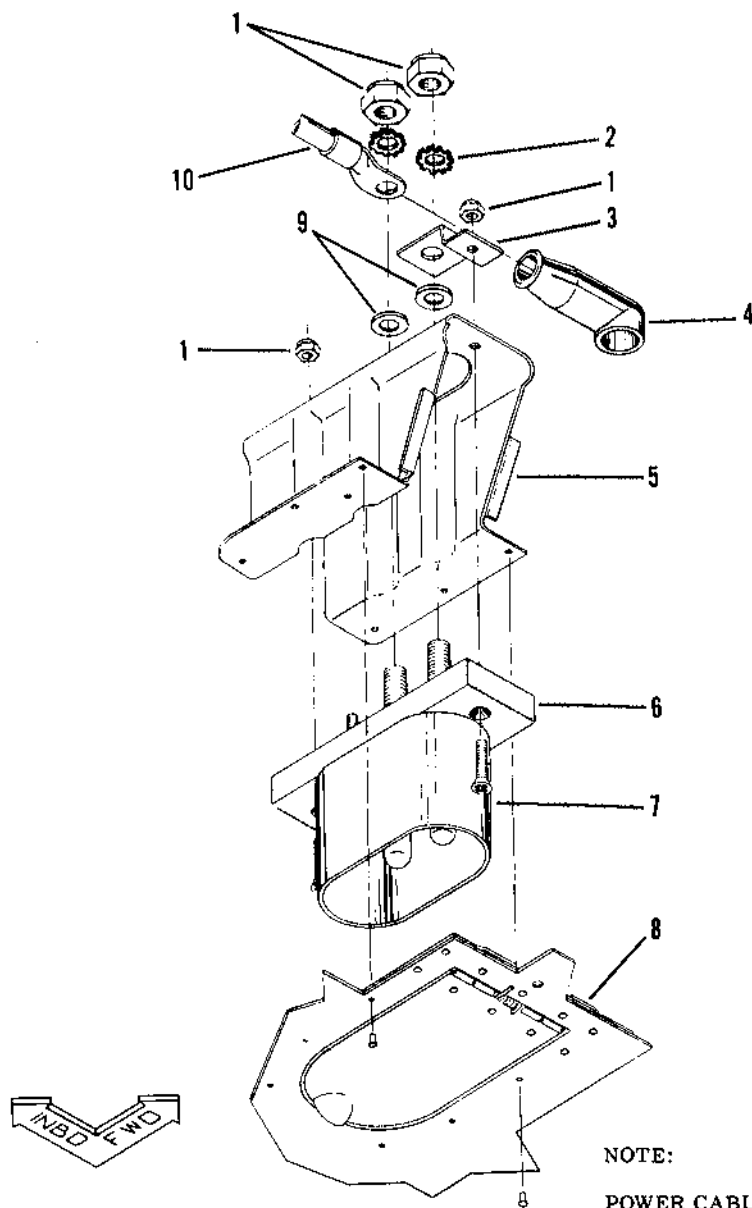
f. Feed the battery cables through the grommets into the battery box.

g. Install the batteries in accordance with battery installation procedure.

Removal of External Power Receptacle. (See figure 14-2.)

a. Remove the access hole cover located between the external power receptacle and engine nacelle.

b. Remove the nuts and lockwashers retaining the power cable and ground strap.



NOTE:

POWER CABLE (11) CONNECTS THE EXTERNAL POWER RECEPTACLE TO THE BATTERY SOLENOID LOCATED IN THE LEFT ENGINE NACELLE.

1. Nut
2. Lockwasher
3. Ground Strap

4. Rubber Nipple
5. Bracket
6. Receptacle
7. Screw

8. Access Door
9. Washer
10. Power Cable

Figure 14-2. External Power Receptacle

**CAUTION**

The battery switch must remain in the OFF position while the external power receptacle is being removed or installed. If there is any possibility of the switch being turned ON during this procedure, it is advisable to disconnect the ground cable from the battery.

- c. Disassemble receptacle from the bracket according to figure 14-2 and remove receptacle from wing.

**NOTE**

The bracket is riveted to the wing structure and should not be removed unless it is damaged.

Installation of External Power Receptacle. (See figure 14-2.)

- a. Place a plain washer on each terminal stud of the receptacle.
- b. Open the receptacle access door and place the receptacle into position on the bracket.
- c. Hold the receptacle in position and place the ground strap on the negative terminal stud.
- d. Install the screws and nuts to secure the receptacle to the bracket, making sure the screw near the negative terminal post also secures the ground strap to the bracket.
- e. Secure the ground strap to the receptacle terminal with a lockwasher and nut.
- f. Secure the power cable on the positive terminal with the lockwasher and nut and position the rubber shield over the terminal.
- g. Replace the access hole cover between the power receptacle and the engine nacelle. Replace the battery cable, if it was disconnected.

**ALTERNATORS AND REGULATORS.**

The alternator is designed and constructed to give long periods of trouble-free service with a minimum amount of maintenance. The rotor is mounted on a ball bearing at the drive end, and each bearing has a grease reservoir. Only two brushes are required to carry through the two slip rings to the field coil which is mounted on the rotor. The brushes are

extra long and under normal operating conditions will provide long periods of service.

The stator windings are assembled on the inside of a laminated core that forms part of the alternator frame. Six rectifier diodes are mounted in the slip ring end frame and are connected to the stator windings. The six diodes replace the separately mounted rectifier as used in other applications, and they act to change the alternator AC voltages to DC voltage which appears at the battery terminals on the alternators. The transistor regulator is an assembly composed principally of transistors, diodes, condensers and resistors to form a completely static unit containing no moving parts. The transistor is an electrical device which limits the alternator voltage to a preset value by controlling the alternator field current. The diodes, condensers, and resistors act together to aid the transistors in performing this function, which is the only function that the regulator performs in the charging circuit. The voltage at which the alternator operates is determined by the regulator adjustment. Once adjusted, the voltage remains almost constant, since the regulator is unaffected by either length of service, by change in temperature or by changes in the alternator output and speed.

There are two regulators installed on the aircraft; however, only one regulator is used, the second is a spare. In the event of a regulator failure, the regulator switch can be positioned to STANDBY. Should adjustment be required on the voltage regulator, an allen screw must be removed in the top of the regulator to gain access to the regulator adjustment screw. (See figure 14-3.)

**NOTE**

Any problem which seems to be in the voltage regulator or the overvoltage protector may be quickly isolated by simply switching the voltage regulator switch to STANDBY position. If the system then operates properly, the problem is with the main voltage regulator, overvoltage relay, fuses or other wiring. If the same problem still exists, the problem can then be assumed to be in some other portion of the system, probably in the alternators themselves.

**Trouble Shooting Alternator and Regulator System.**

| TROUBLE                          | PROBABLE CAUSE                           | CORRECTION        |
|----------------------------------|------------------------------------------|-------------------|
| BOTH ALTERNATORS FAIL TO OPERATE | Regulator power circuit breaker open.    | Reset.            |
|                                  | Switch faulty.                           | Replace.          |
|                                  | Overvoltage protector tripped or faulty. | Reset or replace. |
|                                  | Regulator faulty.                        | Replace.          |

| TROUBLE                                                                                             | PROBABLE CAUSE                                   | CORRECTION                                                                                                                                                                                                                                                                                                  |
|-----------------------------------------------------------------------------------------------------|--------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| BOTH ALTERNATORS FAIL TO OPERATE (CONT)                                                             | Regulator faulty.                                | Replace.                                                                                                                                                                                                                                                                                                    |
|                                                                                                     | Alternator defective.                            | Replace.                                                                                                                                                                                                                                                                                                    |
| ALTERNATOR OUTPUT CONTINUOUSLY HIGH                                                                 | Faulty wiring.                                   | Correct as required.                                                                                                                                                                                                                                                                                        |
|                                                                                                     | Regulator set too high.                          | Adjust to 27.5 VDC.                                                                                                                                                                                                                                                                                         |
|                                                                                                     | Regulator faulty.                                | Replace.                                                                                                                                                                                                                                                                                                    |
| BATTERY CONSUMES WATER RAPIDLY                                                                      | Faulty battery.                                  | Replace.                                                                                                                                                                                                                                                                                                    |
|                                                                                                     | Regulator set too high.                          | Adjust to 27.5 VDC.                                                                                                                                                                                                                                                                                         |
| BATTERY DOES NOT COME UP TO FULL CHARGE - ALTERNATORS OPERATING                                     | Faulty battery.                                  | Replace.                                                                                                                                                                                                                                                                                                    |
|                                                                                                     | Faulty wiring.                                   | Correct as required.                                                                                                                                                                                                                                                                                        |
|                                                                                                     | Regulator set too low.                           | Adjust to 27.5 VDC.                                                                                                                                                                                                                                                                                         |
| AMMETER SHOWS HIGH DISCHARGE WHEN ALTERNATOR SWITCH & BATTERY SWITCH TURNED ON (ENGINE NOT RUNNING) | Shorted diode inside alternator.                 | Disconnect negative battery terminal. Connect a #313 light bulb in series with a 24 volt battery. Connect test leads from battery and bulb to output terminal of alternator and alternator case. Reverse leads - light should light on one polarity only. If no diodes are shorted. Replace shorted diodes. |
| REGULATOR POWER CIRCUIT BREAKER OPENS                                                               | Short in regulator or overvoltage protector.     | Switch to standby regulator. Reset regulator power breaker. If breaker does not reopen, determine and replace faulty regulator or overvoltage protector.                                                                                                                                                    |
|                                                                                                     | Faulty wiring (opens in standby regulator also). | Locate and repair.                                                                                                                                                                                                                                                                                          |
| ALTERNATOR FIELD FUSE OPENS                                                                         | Wiring shorted.                                  | Locate and repair.                                                                                                                                                                                                                                                                                          |
|                                                                                                     | Alternator field shorted.                        | Replace alternator.                                                                                                                                                                                                                                                                                         |
| OVERVOLTAGE PROTECTOR TRIPS                                                                         | Regulator set too high.                          | Adjust to 27.5 VDC.                                                                                                                                                                                                                                                                                         |
|                                                                                                     | Protector faulty.                                | Replace.                                                                                                                                                                                                                                                                                                    |
| NO OUTPUT FROM ONE ALTERNATOR WITH BOTH ALTERNATOR SWITCHES ON                                      | Alternator field fuse blown.                     | Replace.                                                                                                                                                                                                                                                                                                    |
|                                                                                                     | Alternator brushes worn.                         | Replace.                                                                                                                                                                                                                                                                                                    |
|                                                                                                     | Faulty wiring.                                   | Repair.                                                                                                                                                                                                                                                                                                     |
|                                                                                                     | Faulty switch.                                   | Replace.                                                                                                                                                                                                                                                                                                    |
| ONE ALTERNATOR OUTPUT LOW                                                                           | Faulty wiring.                                   | Repair.                                                                                                                                                                                                                                                                                                     |
|                                                                                                     | Faulty alternator field.                         | Replace alternator.                                                                                                                                                                                                                                                                                         |
|                                                                                                     | Faulty alternator diode.                         | Replace diode.                                                                                                                                                                                                                                                                                              |

### Removal of Alternators.

The alternator removal procedure is same for either engine.

- a. Remove the engine cowling in accordance with removal of engine cowl procedures.
- b. Disconnect and tag electrical leads.
- c. Disconnect ram air tube.
- d. Remove safety wire and bolt from alternator at slotted upper brace.
- e. Remove belt from alternator sheave.
- f. Remove nut and washer from bolt attaching alternator to lower mount.
- g. Support alternator while pulling attaching bolt aft.
- h. Remove alternator from mounting bracket.

### Installation of Alternators.

The alternator installation procedure is same for either engine.

- a. Position alternator in mount. Be sure that bushing is installed in aft ear of mount.
- b. Install bolt through mount and alternator.
- c. Place alternator drive belt on driving and drive sheaves.
- d. Start bolt in alternator at slotted upper brace.

- e. Adjust alternator belt tension by exerting a force of 12 pounds on belt at a point midway between the sheaves. Move alternator away from crankcase until force results in a 3/8" deflection of belt. While holding this tension, tighten bolt attaching alternator to upper brace, then safety wire bolt.
- f. Connect electrical leads and remove tags.

### CAUTION

Make sure wires are connected to the proper terminals. Reversed polarity will damage alternator diodes.

- g. Connect ram air tube.
- h. Install engine cowling in accordance with installation procedures.

### Removal and Installation of Voltage Regulators.

- a. Remove copilot's seat (see Section 3).
- b. Remove electrical plug from regulator.
- c. Remove the three screws securing the regulator to the support bracket.
- d. Remove the regulators from the aircraft.
- e. Install by reversing the removal procedures.

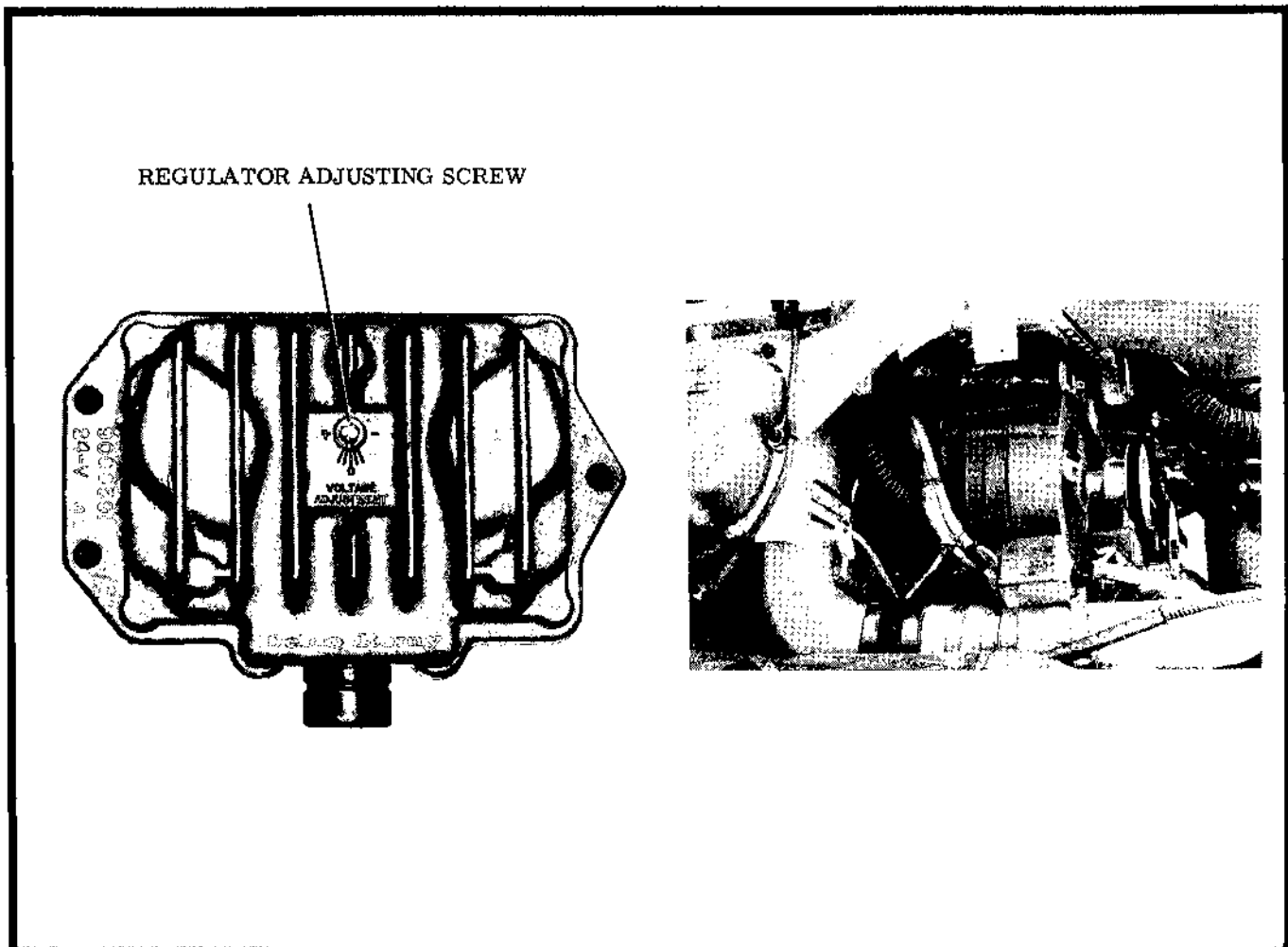


Figure 14-3. Alternator and Regulator Installation

**Removal and Installation of Circuit Breaker Panel.**

- a. Master switch OFF.

**CAUTION**

When removing the circuit breaker panel, the master switch must remain in the OFF position or ground cable should be disconnected from the battery.

- b. Remove the four screws from the front of the circuit breaker panel.
- c. Pull the panel away from the side of the cabin. If complete removal of the panel is desired, remove the breakers from the panel or disconnect the wiring from the breakers and bus bar.
- d. Installation of the circuit breaker panel is accomplished by reversing removal procedures.

**Removal and Installation of Junction Box. (See figure 14-4.)**

- a. Access to the left junction box is accomplished by grasping the upholstery panel (small panel containing the map pocket and pushing it down to disengage it from the upholstery along the left cabin wall.
- b. Access to the right junction box is accomplished by removing three screws along the forward end of the upholstery retaining strip (adjacent to the lower cabin door jamb) and pulling the small upholstery panel from under the retaining strip and away from the right cabin wall.
- c. Remove the junction box covers by removing the four screws securing each cover and pulling the cover from the box.
- d. Remove the bundled electrical leads from the junction box by removing the small nuts securing the leads to the terminal strip. Pull the bundled leads from the junction box.
- e. Remove the wing fairing to gain access to the four screws that secure the left junction box to the fuselage. Removing the screws will allow the left junction box to be removed. The four screws that mount the right junction box are accessible from inside the cabin.
- f. Installation of the left and right junction boxes is accomplished by reversing the removal procedure.

**BATTERY MASTER SWITCH AND ALTERNATOR SWITCH.**

A battery master switch is located between the left and right alternator switches on the left side of the stationary panel. A switch bar is installed across the top of the three switches to permit simultaneous shutoff. When the battery switch is placed in the ON position, it actuates a heavy duty relay which connects the battery to the bus bar.

The alternator switches are connected electrically in the alternator field excitation circuit.

**Removal of Battery and Alternator Switches. (See figure 14-6.)**

- a. Remove cotter pin and pin securing switch bar to bracket.
- b. Remove nut securing switch to left control panel.
- c. Tag and remove the wires from the switch.

**CAUTION**

During removal of any switch except the battery switch, the battery switch must remain OFF. When removing the battery switch, disconnect the ground cable from the aft battery to prevent an accidental short circuit.

**Installation of Battery and Alternator Switches. (See figure 14-6.)**

- a. Connect the wires to the proper switches and remove tags.
- b. Insert switch in proper position in the switch panel and secure with nut.
- c. Install switch bar using pin and cotter pin.

**LEFT-HAND SWITCH PANEL.**

All switches mounted on the left-hand switch panel are a two position, one hole mounting, toggle-type switch, except the starter switches, which are a button-type switch with a safety guard. Rheostats mounted on the switch panel include the flight instruments and radio, engine instruments, switch panel and fuel selector and compass lights. Post lights and overhead flood lights illuminate the switch panel.

**SWITCHES.****Typical Switch Removal. (See figure 14-6.)**

- a. Loosen and remove the decorative nut securing switch to the switch panel and remove switch from the panel.
- b. Tag and remove the wires from the switch.

**Typical Switch Installation. (See figure 14-6.)**

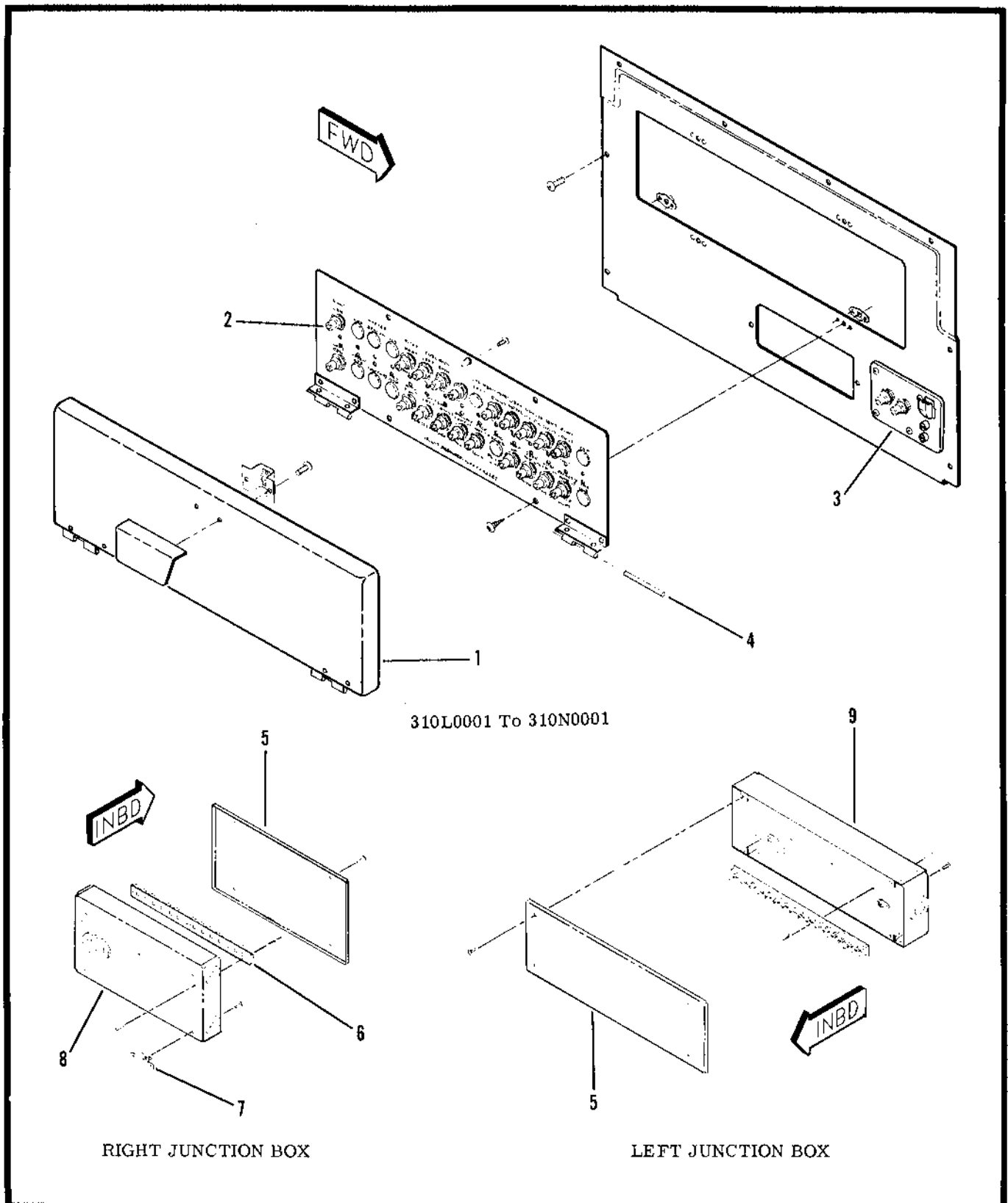
- a. Install wires on switch and remove tags.
- b. Install switch in panel and secure with decorative nut.

**Removal and Installation of Ignition Switches.**

- a. Loosen switch guard and remove nut securing guard and switch to panel.
- b. Tag and remove wires from the switch.

**CAUTION**

When removing starter switches, it is advisable to remove negative cable from the bat-



1. Door
2. Circuit Breaker
3. Alternator Fuse and Switch Panel

4. Hinge Pin
5. Cover
6. Terminal Block

7. Bracket
8. RH Junction Box
9. LH Junction Box

Figure 14-4. Circuit Breaker and Junction Box Installations (Sheet 1 of 2)



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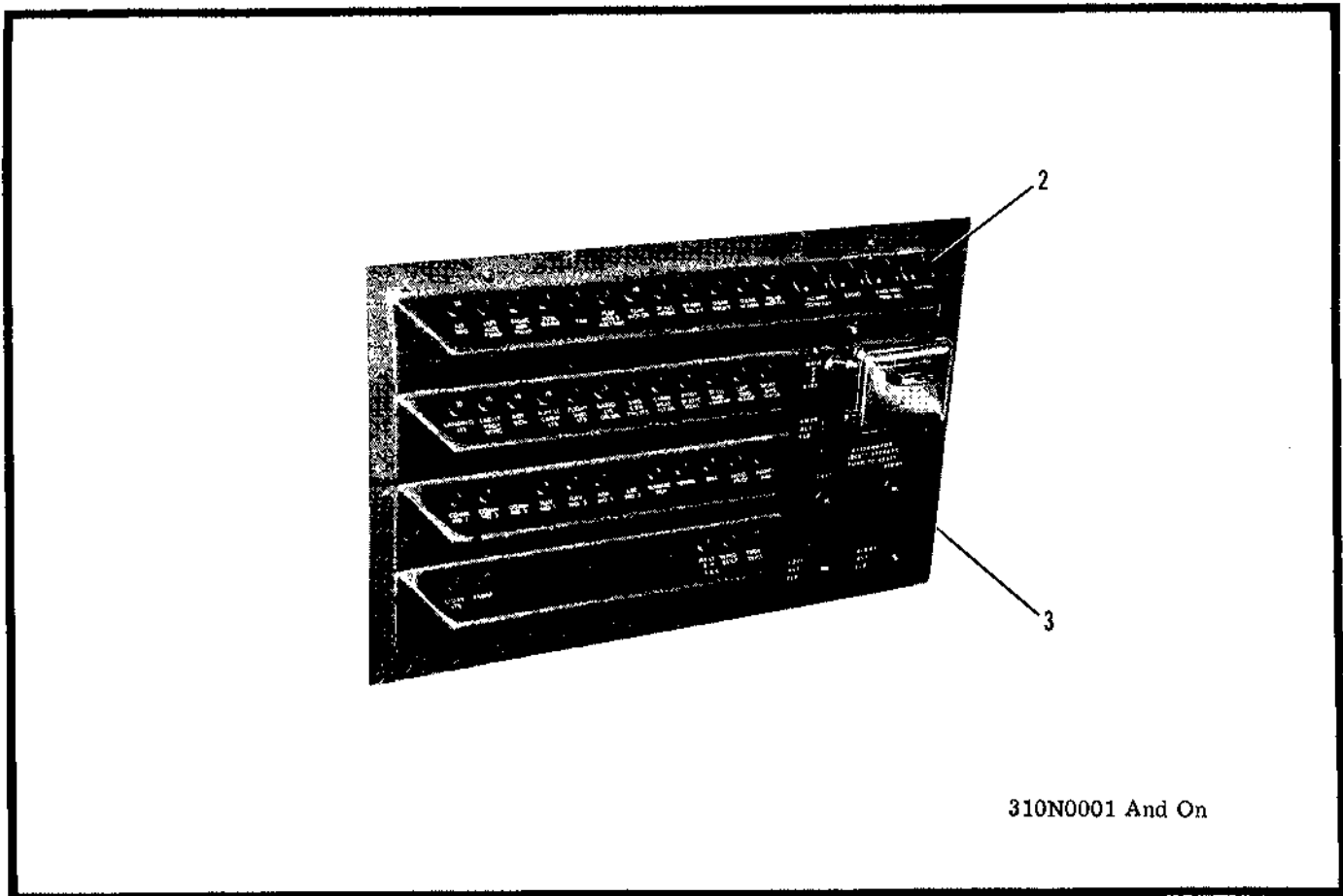
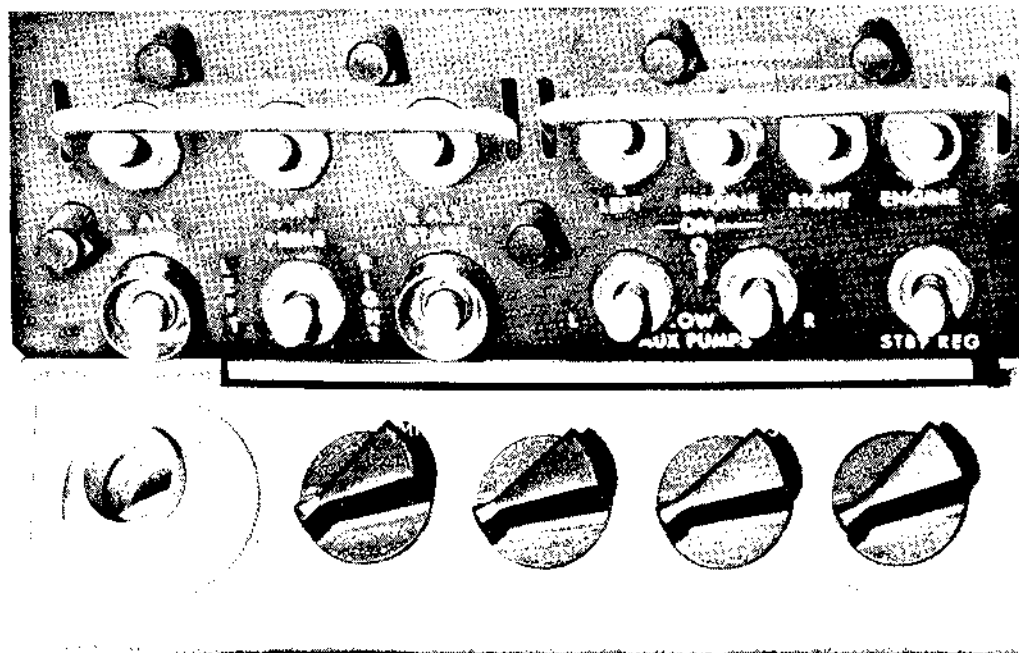
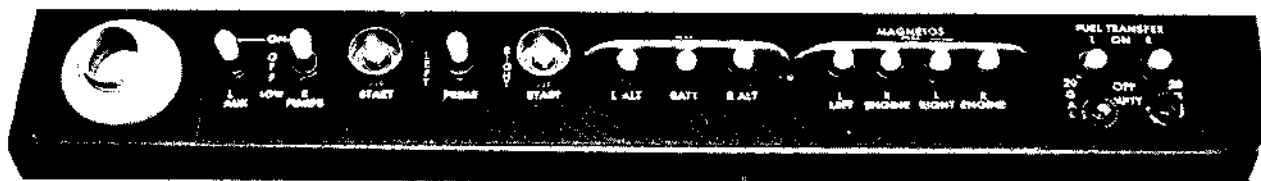


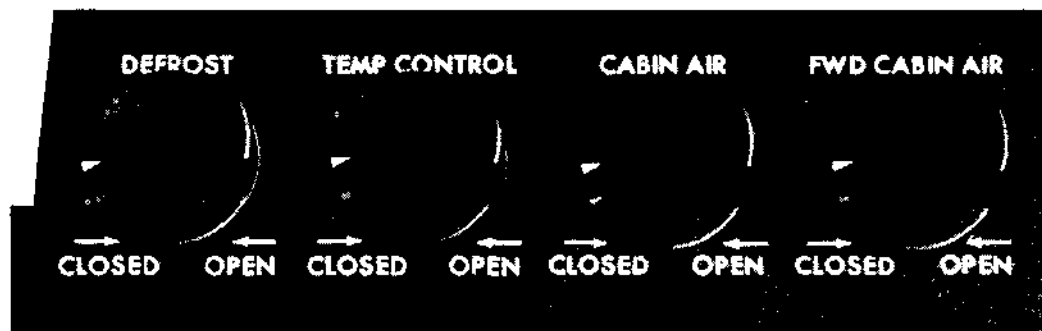
Figure 14-4. Circuit Breaker and Junction Box Installations (Sheet 1 of 2)



310L0001 To 310N0001

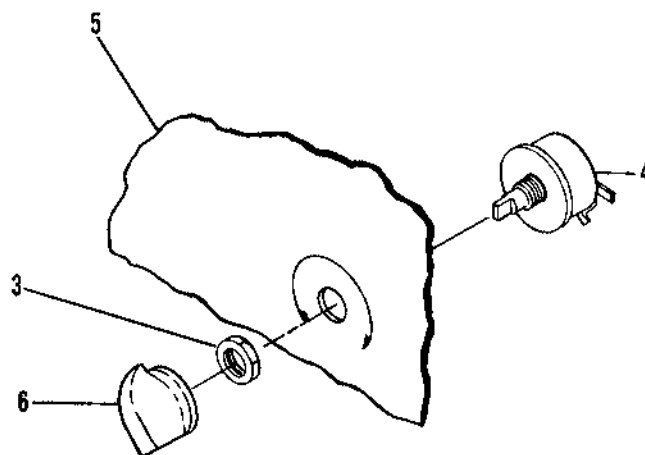


310N0001 And ON

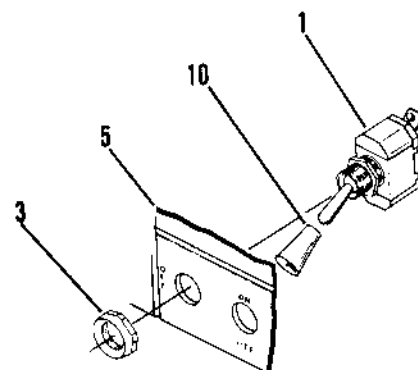


310N0001 And ON

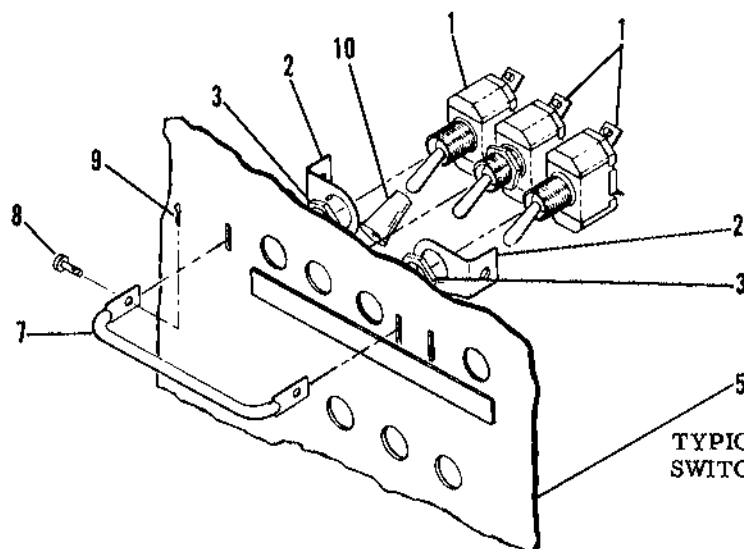
Figure 14-5. Left Hand and Stationary Panel Switches



TYPICAL RHEOSTAT  
INSTALLATION



TYPICAL SWITCH  
INSTALLATION



TYPICAL BATTERY AND ALTERNATOR  
SWITCH INSTALLATION

1. Switch
2. Switch Bar Bracket
3. Nut

4. Rheostat
5. Instrument Panel
6. Knob
7. Switch Bar

8. Pin
9. Cotter Pin
10. Decorative Knob

Figure 14-6. Typical Switch and Rheostat Installations

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tery to prevent the starter circuit from becoming energized during removal of switch.

- c. To install ignition switch, connect the wires to the switch and remove tags.
- d. Install switch in the panel, secure with guard and nut.

## LIGHTS.

Removal of Landing Gear Switch and Indicator Light. (See figure 14-7.)

- a. Unscrew and remove wheel shaped knob from switch.
- b. Unsnap switch gate retainer ring and remove switch gate.
- c. Remove the nut holding switch to the panel and pull the switch from the rear of the panel.
- d. Tag and disconnect the wires from the switch.
- e. To remove the indicator lights, remove the lens and bulb.
- f. Loosen nut securing light to panel and pull light aft from panel.
- g. Unsolder and tag wires from light.

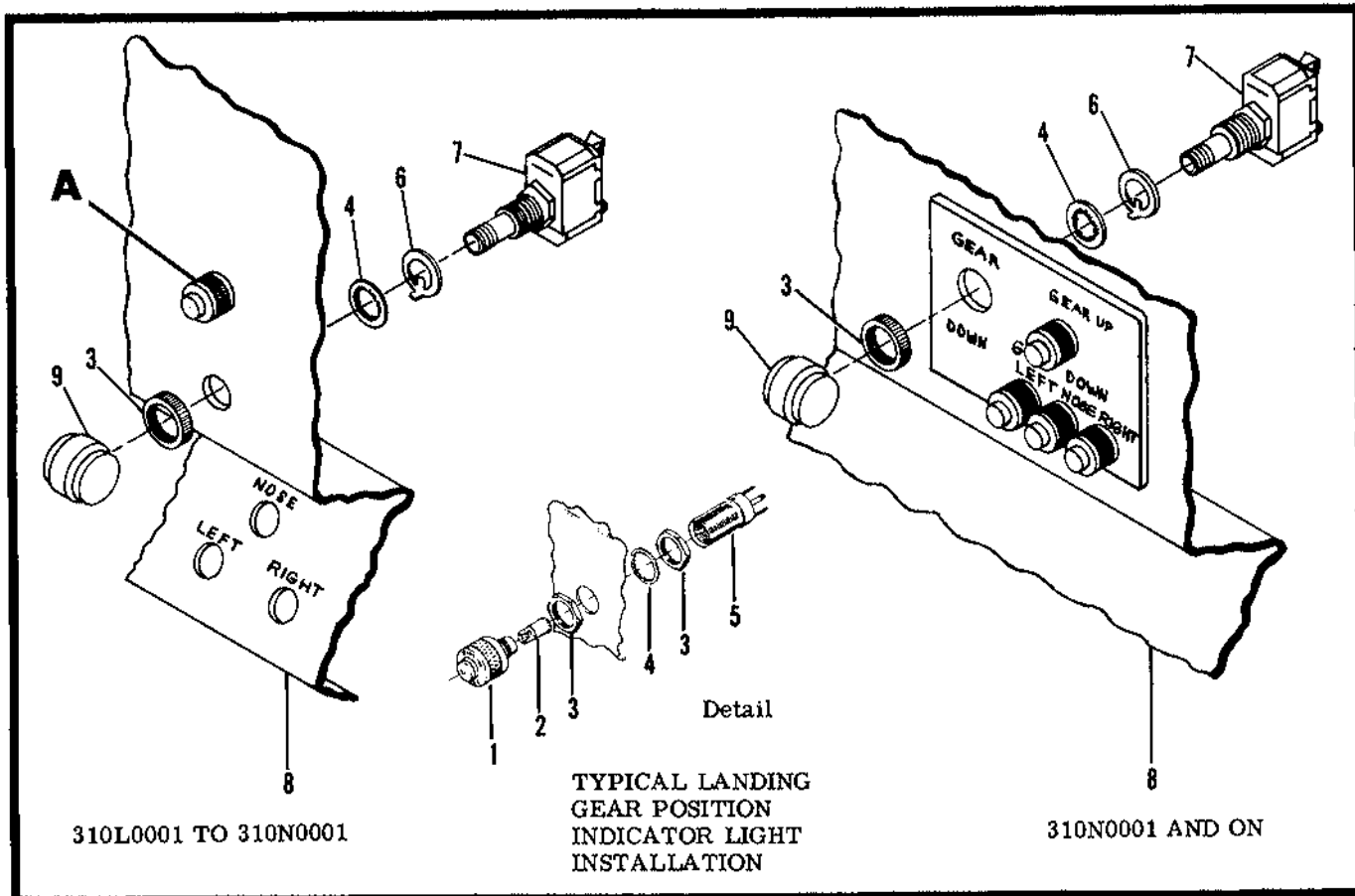
Installation of Landing Gear Switch and Indicator Light. (See figure 14-7.)

- a. To install the indicator light, solder wires to light and remove tags.
- b. Install light in panel and secure with nut.
- c. Install bulb and lens.
- d. To install landing gear switch, connect wires to switch and remove tags from wires.
- e. Place two nuts on the switch shaft and run them down finger-tight against the switch body.
- f. Place the keyed washer on the switch shaft and position the switch on the instrument panel.
- g. Place another nut on the switch shaft from front of the instrument panel. Tighten only finger-tight.
- h. Position the gate halves on the switch shaft and lock into place with gate retainer clip.

## NOTE

One gate half is keyed to fit the keyway on the switch shaft.

- i. Tighten the nut on the front side of the panel (counterclockwise) against gate.
- j. Tighten nuts on back side of panel (counterclockwise) on switch shaft until the switch is secured



1. Lens Cap
2. Bulb
3. Nut

4. Lockwasher
5. Light Body
6. Keyed Washer

7. Switch
8. Instrument Panel
9. Knob

Figure 14-7. Landing Gear Switch and Position Indicator Installation

against panel. Be sure the keyed washer mates the small hole in the panel below switch mounting hole.

- k. Screw the wheel shaped knob on the switch toggle.

#### Removal and Installation of Interior Lights Rheostat. (See figure 14-6.)

- a. Loosen setscrew securing rheostat knob using a 3/32 inch allen wrench, then remove rheostat knob.
- b. Remove nut securing rheostat to left switch control panel and remove rheostat from panel.
- c. Tag and remove the wires by unsoldering from the rheostat connections.
- d. To install the interior light rheostat, reverse this procedure.

#### Removal and Installation of Instrument Lights. (See figure 14-8.)

- a. To remove Type C or D post instrument lights, remove wire connector from light and remove nut, lockwasher and spacer (if used) securing light to stationary instrument panel.
- b. To install post instrument light, reverse the above procedure.
- c. To remove the eyebrow type instrument light, cut the wire to the light and remove the two screws securing the light to the instrument panel.
- d. To install an eyebrow type instrument light, feed the light wire through the hole in the instrument panel and secure the light to the panel with two screws.

#### Electroluminescent Panel Lights (310N0001 and ON).

The electroluminescent panel emanates light from crystalline powders, or phosphors, sandwiched between two electrically conducted surfaces, of which one surface is translucent. When the panel lights are turned on, the powders absorb electrical AC energy and convert it to light without the use of starters, or ballasts and with minimal heat.

#### Removal of Electroluminescent Panels. (See figure 14-8.) (310N0001 and ON)

1. Turn off power.
2. Remove the necessary switch circuit breaker nuts.
3. Lift panel off and tag and disconnect wiring.

#### NOTE

Operational checks on the electroluminescent panels should be performed using 120 volt, 400 cycle AC. However, panel will operate without damage on 120 volt, 60 cycle AC.

#### Installation of Electroluminescent Panels. (See figure 14-8.) (310N0001 and ON)

1. The installation procedure for the electroluminescent panels is the reversal of the removal procedures.

#### Removal of Fuel Selector Valve Light.

- a. Loosen and remove the two screws securing the selector valve light cover to the spar. Remove the cover.
- b. Push the bulb up and twist to the left to unlock it, and remove the bulb from the socket.
- c. Straighten the tabs of the bulb socket, and push the socket down and out of the socket bracket.
- d. Loosen the small screw securing the electrical lead to the socket. Pull the lead from the socket.

#### Installation of Fuel Selector Valve Light.

- a. Position the socket of the fuel selector valve light so that the two tabs of the socket fit up into slots provided in the socket bracket on the front spar. Bend or twist the tabs of the socket to secure it in place.
- b. Insert the end of the light electrical lead into the socket and tighten the small lead securing the screw.
- c. Push the bulb up into the socket and twist it to the right to lock into position.
- d. Position the fuel selector valve light cover and install two screws to secure it in place.

#### Removal and Installation of Front Dome and Individual Reading Lights. (See figure 14-8.)

- a. To remove the overhead console lights, remove the four screws and oxygen caps from the console and lower the console approximately eight inches for minor repair.
- b. If a complete removal is necessary, tag wires and unsolder rheostats.
- c. The individual reading lights are removed by removing the two screws securing the switch and removing the cap from the oxygen outlet. Then remove the cover.
- d. Remove the four screws securing light to bracket and tag wires and disconnect.
- e. Installation of front dome and individual reading lights is accomplished by reversing this procedure.

#### Removal and Installation of Wing Navigation Lights. (See figure 14-9.)

- a. Remove the tip tank nose cap.
- b. (See figure 14-9.) Remove and install navigation light in sequence as shown.

#### Removal and Installation of Tail Navigation Lights. (See figure 14-9.)

- a. Two screws secure the tail light assembly to the stinger. Removing these two screws and disconnecting the electrical connector from the rear of the light assembly will allow the tail light to be removed. If the tail light wiring is to be removed, the stinger assembly must be removed to disconnect the wires at the rear fuselage bulkhead. To replace the tail light, reverse the above procedure.

## Trouble Shooting Exterior Lights.

| TROUBLE                                    | PROBABLE CAUSE                                | CORRECTION                                                       |
|--------------------------------------------|-----------------------------------------------|------------------------------------------------------------------|
| ONE NAVIGATION LIGHT IS OUT                | Lamp burned out.                              | Replace lamp.                                                    |
|                                            | Defective wiring.                             | Inspect wiring from J-box to light.                              |
|                                            | Defective lamp socket.                        | Replace light assembly.                                          |
| ALL NAVIGATION LIGHTS ARE OUT              | Circuit breaker out.                          | Check/reset circuit breaker.                                     |
|                                            | Defective wiring or navigation lights switch. | Check/repair or replace wiring.<br>Replace switch.               |
| NAVIGATION LIGHTS DO NOT BLINK             | Defective flasher unit.                       | Replace flasher unit.                                            |
| LANDING LIGHT EXTENDS BUT DOES NOT LIGHT   | Circuit breaker out.                          | Check/reset circuit breaker.                                     |
|                                            | Lamp burned out.                              | Replace lamp.                                                    |
|                                            | Defective wiring.                             | Check/repair or replace wiring.                                  |
| LANDING LIGHT WILL NOT EXTEND              | Circuit breaker out.                          | Check/reset circuit breaker.                                     |
|                                            | Defective wiring or switch.                   | Check/repair or replace wiring.<br>Replace landing light switch. |
| LANDING LIGHT WILL NOT RETRACT             | Circuit breaker out.                          | Check/reset circuit breaker.                                     |
|                                            | Defective wiring.                             | Check/repair or replace wiring.                                  |
| ROTATING BEACON LIGHTS BUT DOES NOT ROTATE | Defective jumper wire.                        | Check/repair or replace jumper.                                  |
|                                            | Defective motor.                              | Replace motor.                                                   |
| TAXI LIGHT DOES NOT OPERATE                | Circuit breaker out.                          | Check/reset circuit breaker.                                     |
|                                            | Defective wiring or switch.                   | Check/repair or replace wiring.<br>Replace taxi light switch.    |
|                                            | Lamp burned out.                              | Replace lamp.                                                    |

Removal and Installation of Rotating Beacon. (See figure 14-9.)

- To remove the vertical fin mounted rotating beacon, remove the screws in the fiberglass mount and lift rotating beacon out.
- Disconnect electrical plug.
- Installation of the rotating beacon may be accomplished by reversal of the above procedures.

Removal of Landing Light. (See figure 14-10.)

- Support the light assembly and remove screws which secure lamp housing to retainer band.
- Lower the light assembly out of the tip tank tail cap and place on a stand of suitable height.

## NOTE

The wiring to the light contains sufficient

slack to permit the light assembly to be brought down below the tip tank tail cap for removal of light wiring.

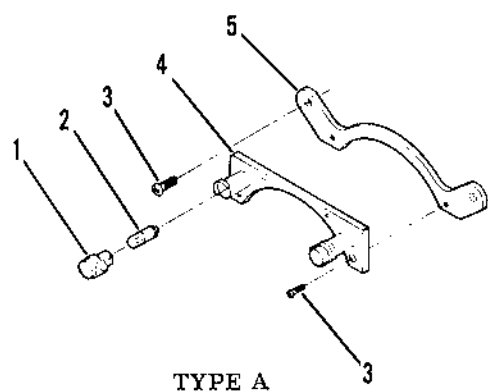
- Tag and remove the wires from the terminal block on the light.
- To remove the lamp from the landing light, extend the light approximately 60 degrees and remove the lamp retainer ring. Pull the lamp from the inner canopy and disconnect the wires from the lamp.

## NOTE

When the light assembly is removed from the aircraft, the light may be extended by applying a 28 volt power source across the OPEN and ground terminals.

- Remove the two screws securing the power unit to the housing.



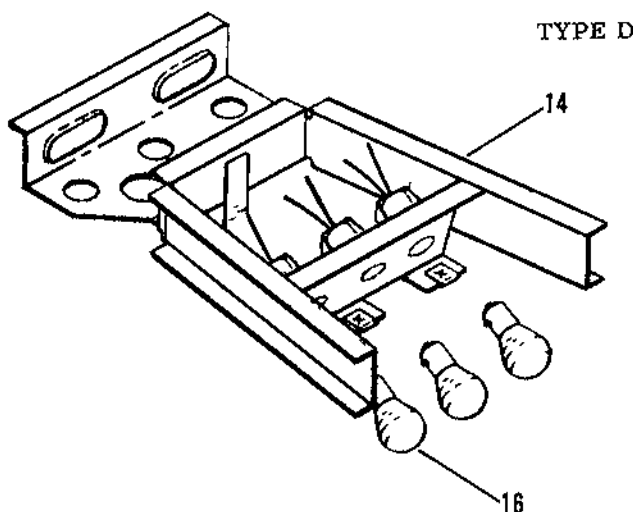
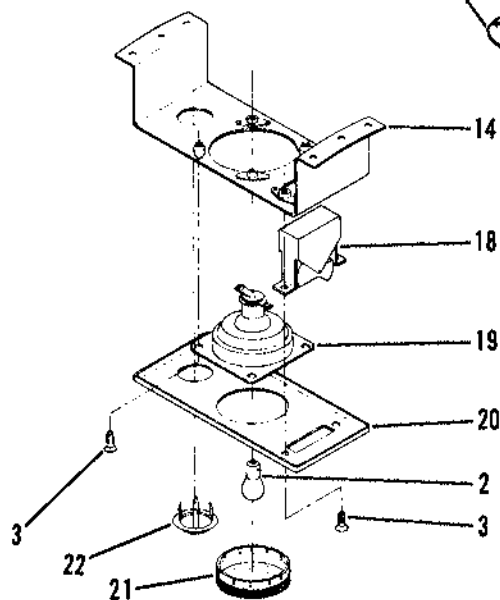
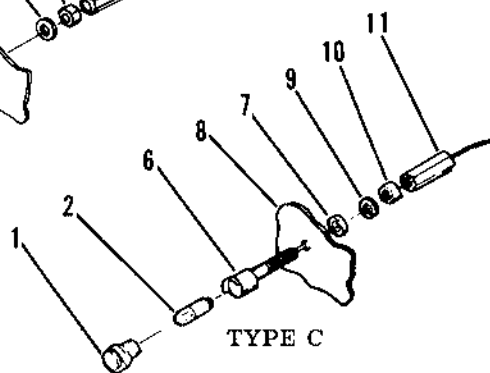
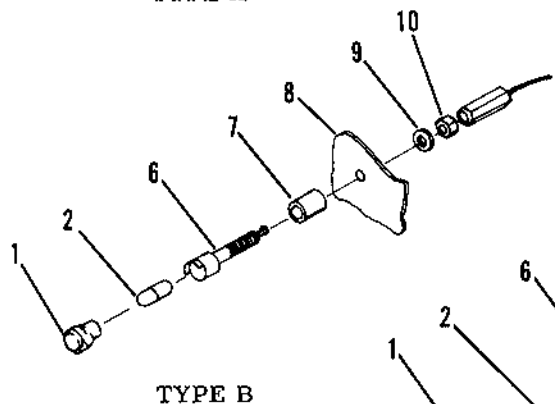


## DETACHABLE (TYPE A &amp; D)

Unscrew nylon attach and remove as shown.

## NON-DETACHABLE (TYPE B &amp; C)

The lead must be severed before removal. Upon re-installation, a line splice is required (quick-disconnect, permanent splice, etc.). Use adequate insulation on the splice. Protect the end of the lead during removal to prevent accidental shorting.

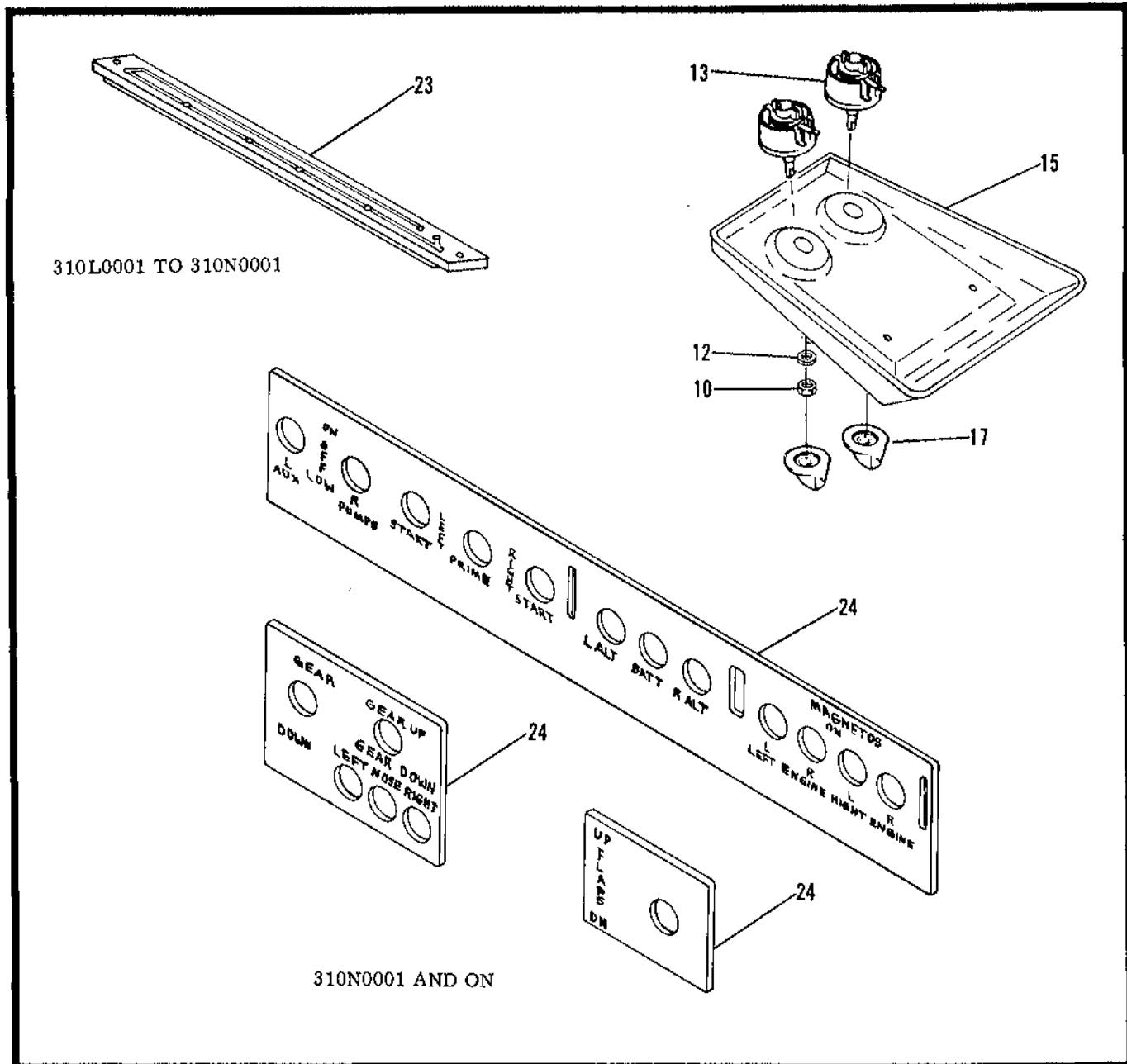


1. Hood
2. Bulb
3. Screw
4. Cover Plate
5. Mounting Plate
6. Socket

7. Spacer
8. Instrument Panel
9. Washer
10. Nut
11. Connector
12. Washer

13. Rheostat
14. Bracket
15. Console Cover
16. Flood Light
17. Knob
18. Switch

Figure 14-8. Instrument Panel, Front Dome and Individual Reading Light (Sheet 1 of 2)



19. Reading Light  
20. Cover

21. Lens  
22. Oxygen Port Cover

23. Lighting Strip  
24. Electroluminescent Panel

Figure 14-8. Instrument Panel, Front Dome and Individual Reading Lights (Sheet 2 of 2)

Installation of Landing Light. (See figure 14-10.)

- a. Position power unit within drive housing of light assembly and secure with two screws.
- b. To install a new lamp, connect the wires to the lamp and position the lamp within the canopy with the filament shield inboard. Position the lamp retainer band over the edges of the lamp and canopy with the flat side toward the apex of the canopy. Using needle nose pliers, pull the retainer band tight

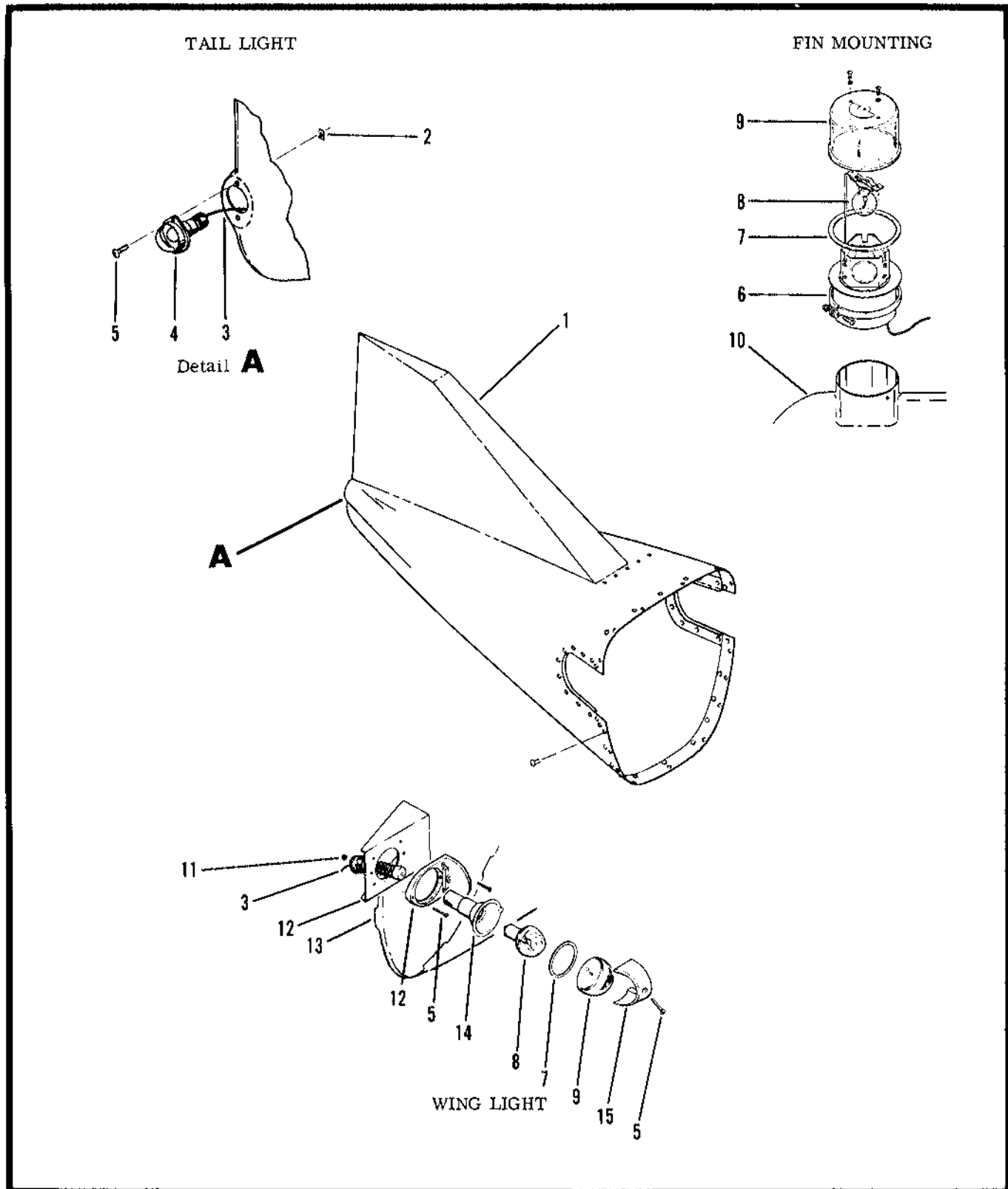
around the lamp and canopy and fasten the clip on the band.

#### NOTE

Before installing a new lamp, it will be necessary to extend the light approximately 60 degrees to gain access to the retainer band.

- c. Position the retainer ring inside the tip tank tail

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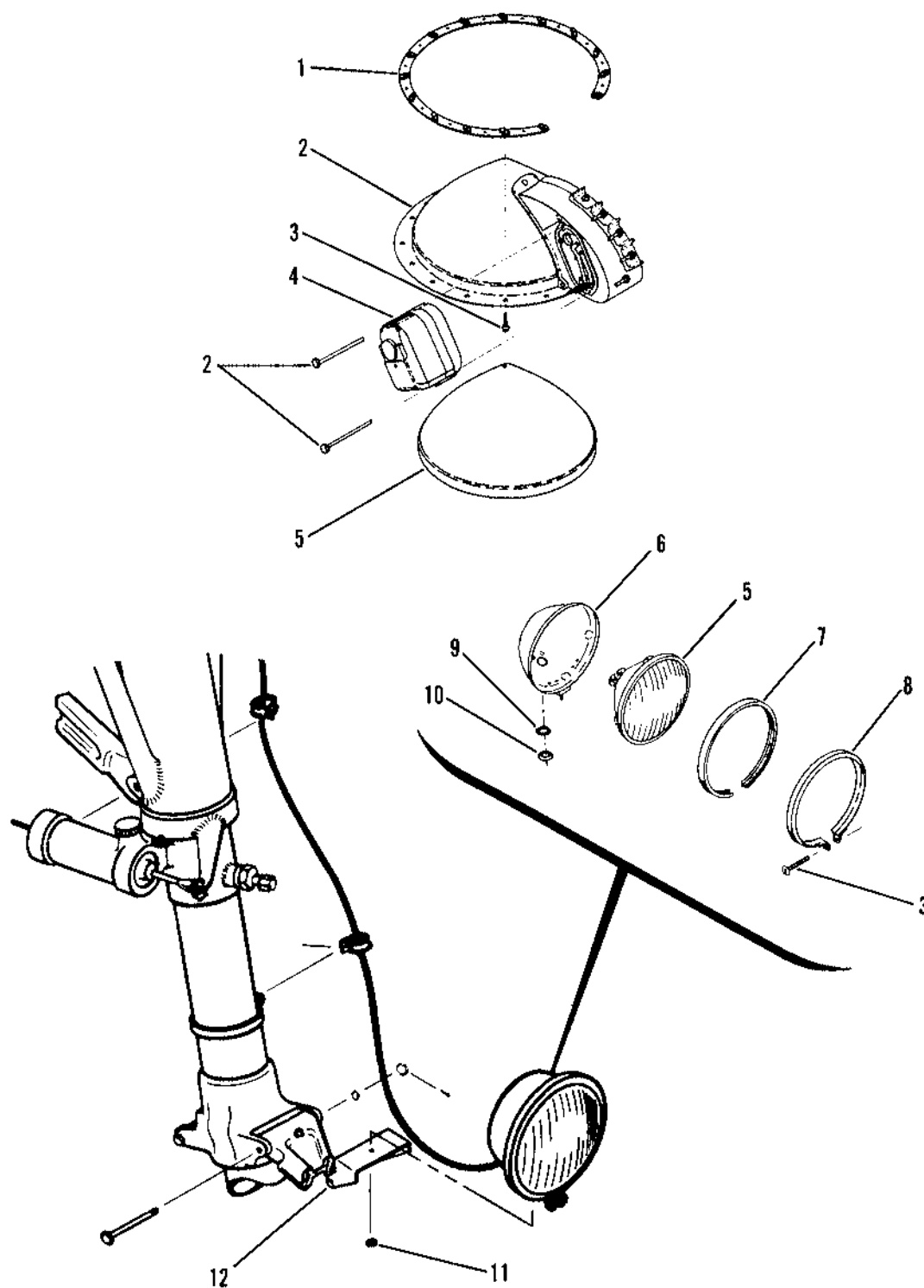


1. Stinger Assembly
2. Tinnerman Nut
3. Wire
4. Tail Light Assembly
5. Screw

6. Beacon
7. Gasket
8. Bulb
9. Lens
10. Fin Mount

11. Nut
12. Bracket
13. Tip Tank
14. Socket
15. Lens Retainer

Figure 14-9. Rotating Beacon, Wing and Tail Navigation Lights Installation



1. Retainer Band
2. Lamp Housing
3. Screw
4. Power Unit

5. Lamp
6. Canopy
7. Gasket
8. Retainer Band

9. Grommet
10. Knurled Nut
11. Locknut
12. Bracket

Figure 14-10. Landing and Taxi Light Installation

cap with the open side forward and tape it to the tip tank tail cap to hold it in position temporarily while the light assembly is installed.

d. Connect the wires to the light assembly and remove the identification tags.

e. Place the light assembly into the wing and secure with screws.

#### NOTE

Start all screws through the nutplates on the retainer band before attempting to tighten any of them to prevent distortion or misalignment of the band.

Adjustment of Landing Light. (See figure 14-11.)

Landing lights are adjusted in the factory to extend to an angle of 90 degrees from the fully retracted

position. The angle of extension may be altered by means of an adjustment screw as illustrated in figure 14-11.

#### NOTE

Do not turn the adjusting screw counterclockwise more than three full turns without closing and opening the light before further adjustment. Excessive turns of the screw in a counterclockwise direction will distort an actuator contact within the assembly, thus changing the fixed setting which controls the light retract position.

The angle of extension of the landing light may be checked with a bubble protractor. Check the degree of opening according to the following steps:

a. Retract the landing light and place the flat surface of the protractor across the retainer band which

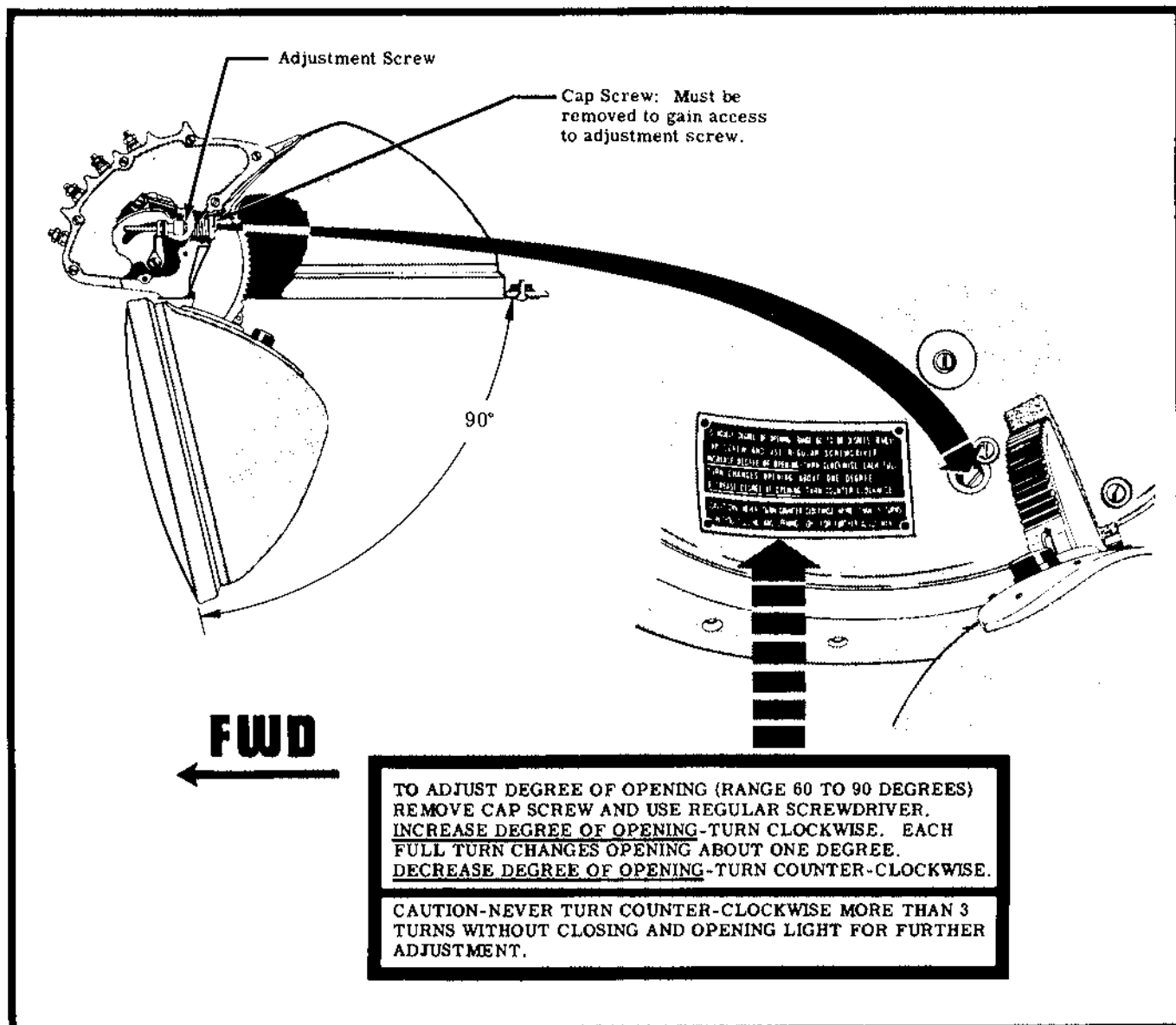


Figure 14-11. Adjustment of Landing Light

secures the lamp within the inner canopy.

#### NOTE

Two blocks of equal thickness may be placed on the retainer band to raise the protractor so it will clear the surface of the lamp for a more positive location of the protractor.

b. Run the landing light full down and measure the angle of extension. If the light has not reached the desired degree of extension, turn the landing light adjustment screw in the direction necessary to achieve the desired angle of extension.

c. Retract the light to the full up position, fully extend the light, and check the angle of extension.

**Removal and Installation of Taxi Light.** (See figure 14-10.)

- a. Remove screw securing lamp and move lamp.
- b. Tag and disconnect wires; then loosen knurled nut.
- c. Remove nut securing light to strut bracket.
- d. Installation of taxi light is a reversal of this procedure.

**Adjustment of Taxi Light.**

The taxi light should be adjusted to an angle of ap-

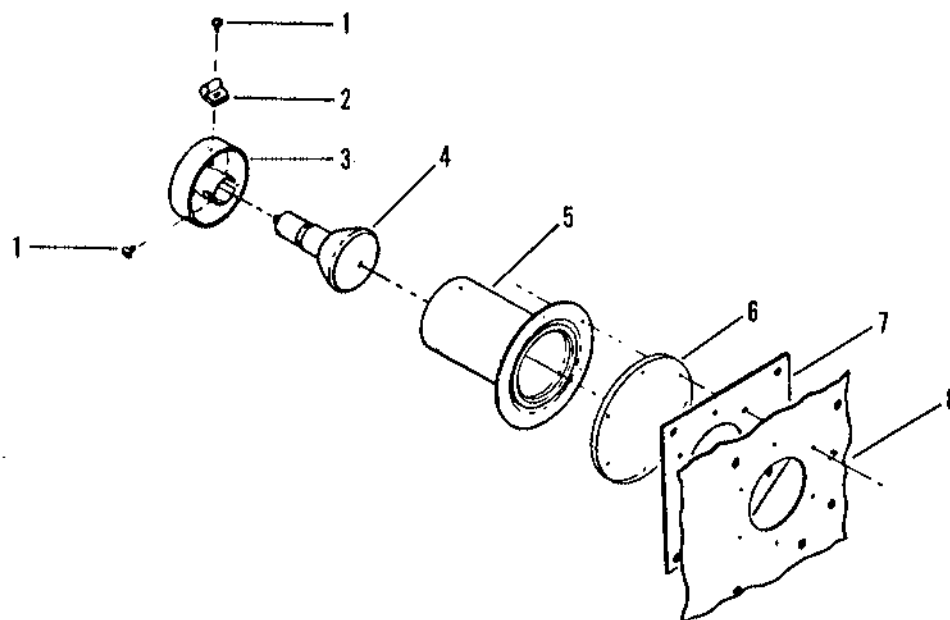
proximately three degrees below horizontal. The light should also be adjusted to point in the direction of the nose wheel. The fore and aft positions of the light may be adjusted by removing the cotter pin and loosening the nut to free the mounting bracket. The light may be aligned with the nose wheel by loosening the mounting nut and pivoting the light on the mounting bracket.

#### CAUTION

After adjustment, make sure the nut securing light to the bracket is tight and the bolt securing the bracket is tight and cotter pin installed.

**Removal and Installation of Deice Light.** (See figure 14-12.)

- a. Remove upper cowling from left engine.
- b. Remove screws securing socket assembly and clamp holding wires.
- c. Pull socket assembly apart from lamp shield to remove bulb.
- d. If further disassembly is required, tag and remove wires. Drill out rivets securing shield assembly to nacelle skin.
- e. Installation of deice light is accomplished by reversing this procedure.



1. Screw
2. Plastic Clamp

3. Socket Assembly
4. Lamp

5. Shield
6. Lens

7. Doubler
8. Nacelle Skin

Figure 14-12. Wing Deice Light Installation

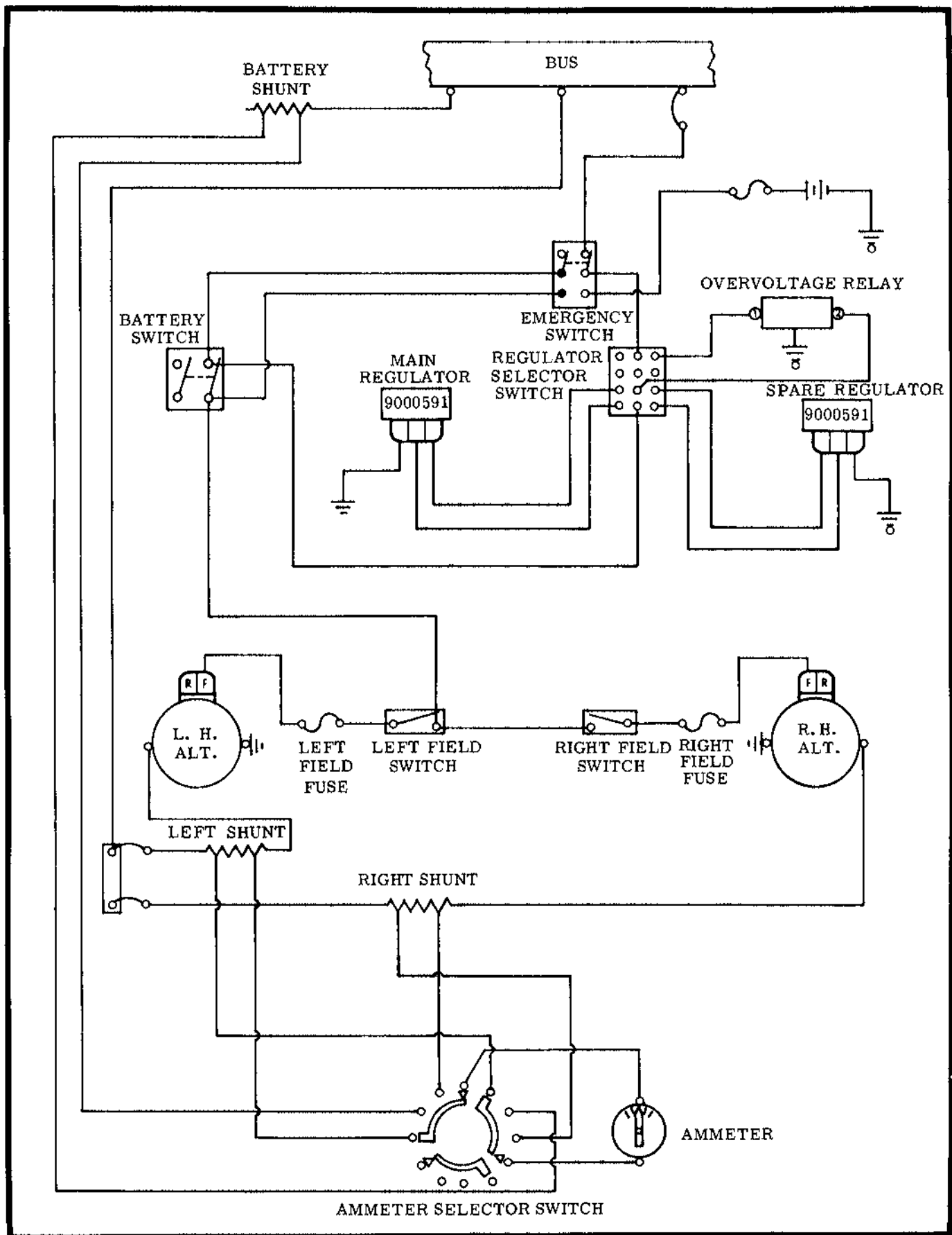


Figure 14-13. Power Distribution Schematic



## ELECTRICAL LOADING CHART.

## CONTINUOUS ELECTRICAL LOAD CHART

|                                                | Amps Required |
|------------------------------------------------|---------------|
| Rotating Beacon . . . . .                      | 6.50          |
| Pitot Heat . . . . .                           | 3.00          |
| Stall Warning Heat . . . . .                   | 3.00          |
| Fuel Gage . . . . .                            | 0.15          |
| Engine Gage Units . . . . .                    | 0.32          |
| Turn and Bank . . . . .                        | 0.15          |
| Gear Indicator Lights . . . . .                | 0.04          |
| Flap Position Indicator . . . . .              | 0.08          |
| Cabin Heater . . . . .                         | 6.00          |
| Compass Light . . . . .                        | 0.17          |
| Navigation Lights . . . . .                    | 2.90          |
| Fuel Selector Light . . . . .                  | 0.19          |
| Flight Instrument Lights . . . . .             | 0.60          |
| Engine Instrument Lights . . . . .             | 0.64          |
| Switch Panel Lights . . . . .                  | 0.64          |
| Battery Solenoid . . . . .                     | 0.60          |
| Outside Air Temperature . . . . .              | 0.08          |
| Flight Hour Indicator . . . . .                | 0.04          |
| Auxiliary Fuel Gage . . . . .                  | 0.20          |
| Goodrich Electrical Propeller Deicer . . . . . | 13.00         |

## NON-CONTINUOUS ELECTRICAL LOAD CHART

|                                      | Amps Required |
|--------------------------------------|---------------|
| Flaps . . . . .                      | 7.8           |
| Landing Gear . . . . .               | 17.5          |
| Cabin Dome Light . . . . .           | 1.2           |
| Landing Light (Left) . . . . .       | 10.0          |
| Console Lights . . . . .             | 5.2           |
| Cigarette Lighter (Each) . . . . .   | 7.5           |
| Fuel Boost Pumps (Total) . . . . .   | 10.0          |
| Gear Warning . . . . .               | 1.0           |
| Stall Warning . . . . .              | 1.3           |
| Ice Light . . . . .                  | 0.7           |
| Taxi Light . . . . .                 | 5.4           |
| Landing Light (Right) . . . . .      | 10.0          |
| Oil Dilution . . . . .               | 1.2           |
| Goodrich Wing Deice System . . . . . | 2.8           |
| Chart Light (Each) . . . . .         | 0.5           |
| Starting Vibrator . . . . .          | 2.5           |
| Starting Solenoid (Each) . . . . .   | 0.6           |

## NOTE

Total continuous load should not exceed 80% of the total rated alternator capacity.

# WIRING DIAGRAMS

## NOTE

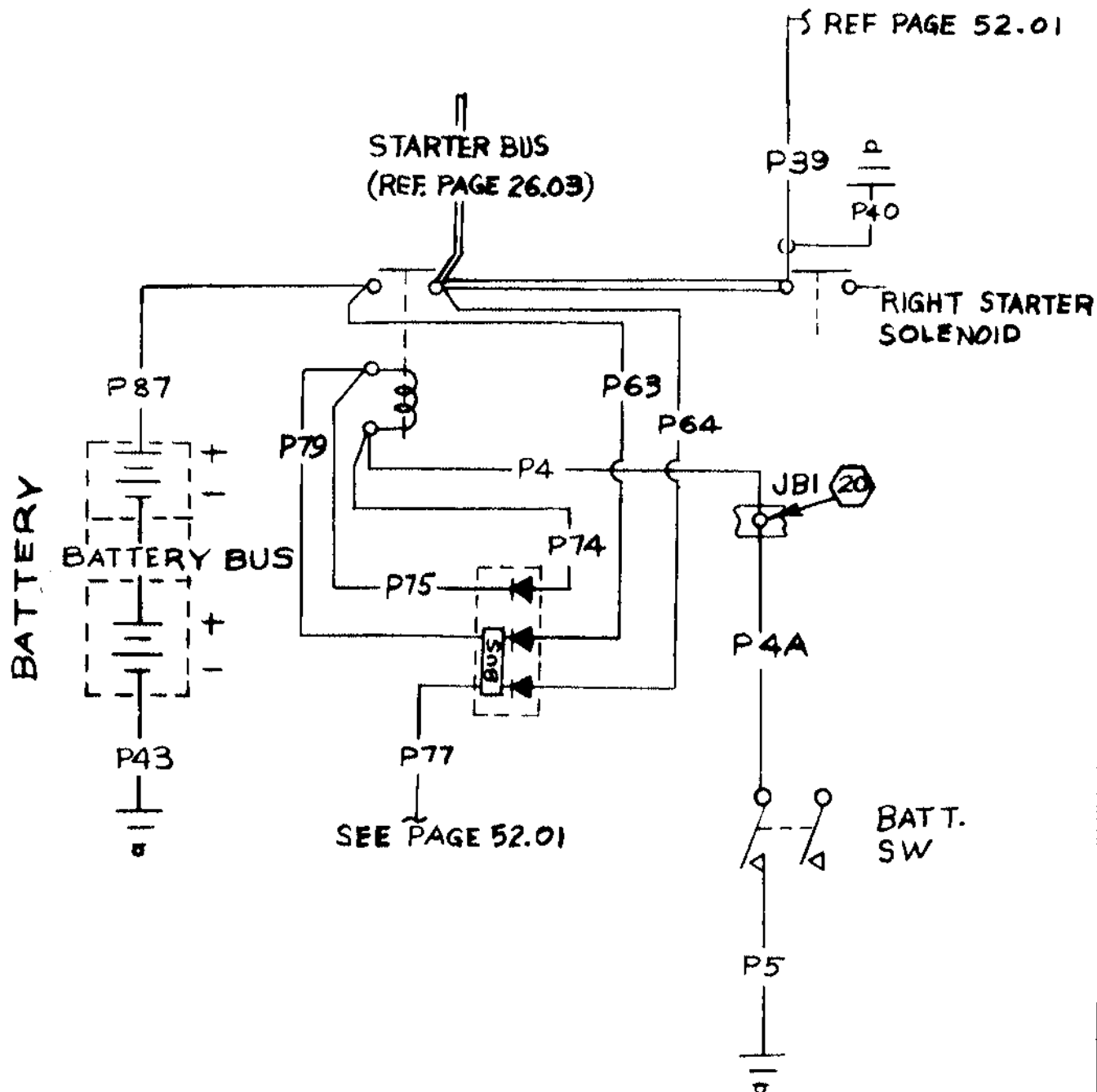
The page numbering method in this portion of Section 14 differs from that of the rest of the manual. All referenced page numbers appearing in the wiring diagram index can be found within the title block of each wiring diagram. These page numbers are in numerical order, but may appear in broken sequence.

## WIRING DIAGRAM INDEX.

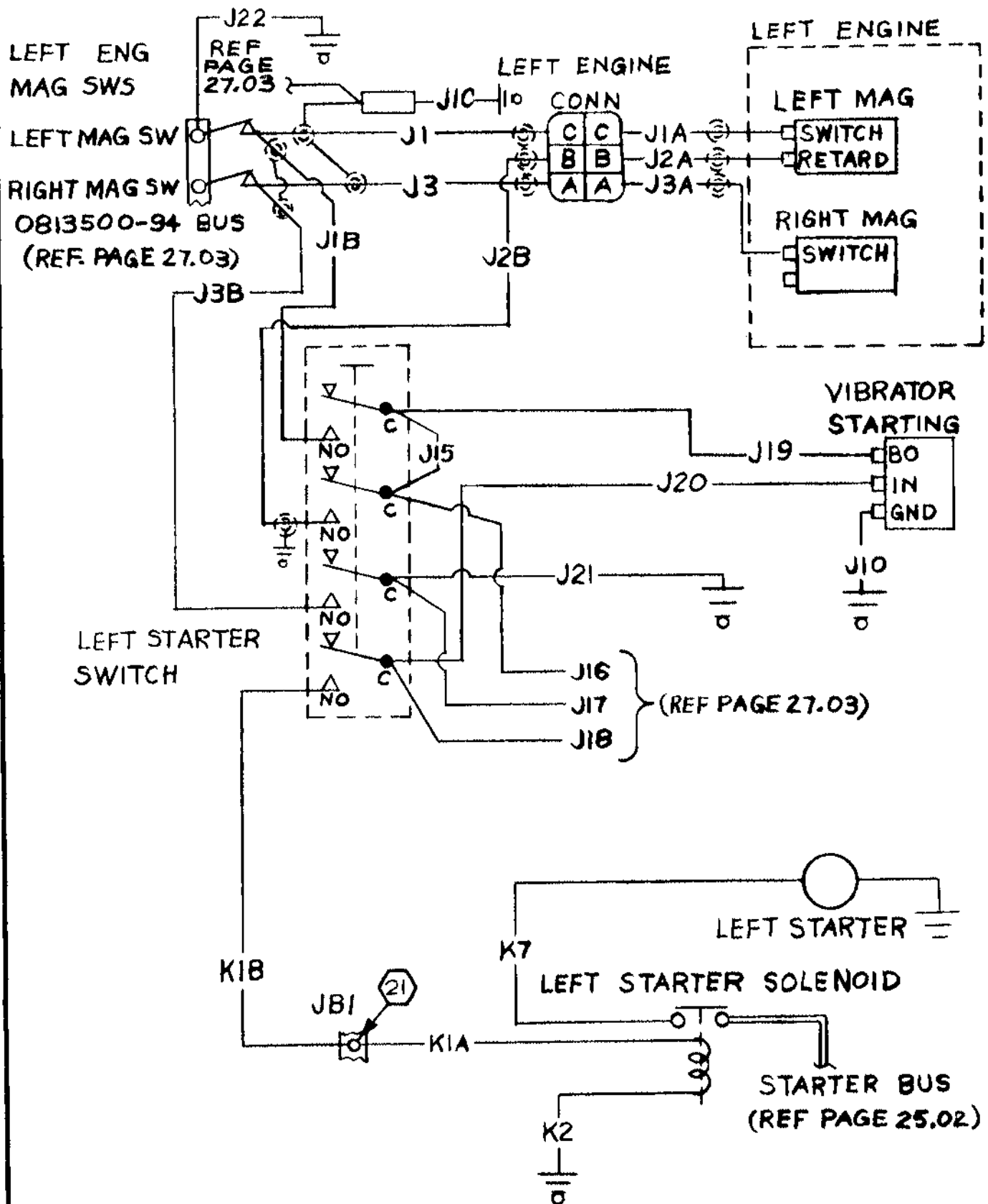
| Title                                                                   | Page  |
|-------------------------------------------------------------------------|-------|
| Battery and External Power Receptacle . . . . .                         | 25.02 |
| Start and Ignition - Left Engine . . . . .                              | 26.03 |
| Start and Ignition - Right Engine . . . . .                             | 27.03 |
| Left and Right Oil Dilute . . . . .                                     | 28.02 |
| Rotating Beacon - Tail . . . . .                                        | 29.01 |
| Navigation Light . . . . .                                              | 30.01 |
| Landing Light - Left Wing, Right Wing, and Taxi Light . . . . .         | 31.00 |
| Landing Light - Left Wing, Right Wing (Opt. ), and Taxi Light . . . . . | 31.01 |
| Instrument and Panel Light . . . . .                                    | 32.02 |
| Instrument and Panel Light . . . . .                                    | 32.03 |
| Instrument and Panel Light . . . . .                                    | 32.04 |
| Cabin Lighting . . . . .                                                | 33.04 |
| Cabin Lighting . . . . .                                                | 33.05 |
| Deice Light . . . . .                                                   | 34.00 |
| Landing Gear Warning Light . . . . .                                    | 35.02 |
| Landing Gear Warning Light . . . . .                                    | 35.03 |
| Warning Horn - Landing Gear . . . . .                                   | 36.02 |
| Landing Gear Actuator . . . . .                                         | 37.01 |
| Landing Gear Actuator . . . . .                                         | 37.02 |
| Flap Actuator . . . . .                                                 | 38.01 |
| Flap Position Indicator System . . . . .                                | 39.00 |
| Flap Position Indicator System . . . . .                                | 39.01 |
| Turn and Bank Indicator and Test Light . . . . .                        | 40.00 |
| Turn and Bank Indicator and Test Light . . . . .                        | 40.01 |
| Cabin Heat System . . . . .                                             | 41.04 |
| Stall Warning System . . . . .                                          | 42.01 |
| Stall Warning System . . . . .                                          | 42.02 |
| Pitot Heat System . . . . .                                             | 43.00 |
| Pitot Heat System . . . . .                                             | 43.01 |
| Left and Right Engine Gage System . . . . .                             | 44.00 |
| Dual Fuel Gage System . . . . .                                         | 45.00 |
| Right Auxiliary Pump System . . . . .                                   | 46.03 |
| Left Auxiliary Pump System . . . . .                                    | 47.02 |
| Left Auxiliary Pump System . . . . .                                    | 47.03 |
| Outside Air Temperature System . . . . .                                | 48.00 |
| Outside Air Temperature System . . . . .                                | 48.01 |
| Alternator and Ammeter System . . . . .                                 | 52.01 |
| Cigar Lighters - Front and Rear . . . . .                               | 53.00 |
| Dual Tachometer System . . . . .                                        | 54.00 |
| Speaker Circuit . . . . .                                               | 55.00 |
| Phone Jack Circuit . . . . .                                            | 56.00 |
| Auxiliary Fuel Indication System . . . . .                              | 57.00 |
| Prop Deice System - Goodyear (Opt. ) . . . . .                          | 58.01 |
| Prop Deice System . . . . .                                             | 58.02 |

| Title                                                       | Page  |
|-------------------------------------------------------------|-------|
| Right Junction Box Connections . . . . .                    | 59.04 |
| Left Junction Box Connections . . . . .                     | 60.04 |
| Left Junction Box Connections . . . . .                     | 60.05 |
| Left Junction Box Connections . . . . .                     | 60.06 |
| External Power Receptacle . . . . .                         | 61.02 |
| Mike Jack Circuit . . . . .                                 | 62.00 |
| Mike Jack Circuit . . . . .                                 | 62.01 |
| Circuit Breaker Connections . . . . .                       | 63.04 |
| Circuit Breaker Connections . . . . .                       | 63.05 |
| Circuit Breaker Connections . . . . .                       | 63.06 |
| Alternate Connections for Row #4 Circuit Breakers . . . . . | 63.07 |
| Hood Light Circuit . . . . .                                | 64.01 |
| Electro Luminescent Lamp Circuit (Opt.) C/B Panel . . . . . | 64.02 |
| Chart Light - Control Wheel . . . . .                       | 65.00 |
| Flight Hour Recorder . . . . .                              | 66.00 |
| Wing Deice System . . . . .                                 | 67.02 |
| Electrical Suppressor . . . . .                             | 69.00 |
| Electric "Aircon" Windshield . . . . .                      | 70.01 |
| Propeller Synchronizer . . . . .                            | 71.00 |
| Electric Seat (Opt.) . . . . .                              | 72.00 |
| Electric Seat (Opt.) . . . . .                              | 72.01 |
| Tip Tank Vent Heat . . . . .                                | 73.00 |
| Static Source Heat . . . . .                                | 74.00 |
| Static Source (Opt.) . . . . .                              | 74.01 |
| Auxiliary Fuel Transfer Pump (Opt.) . . . . .               | 75.00 |
| Auxiliary Fuel Transfer Pump . . . . .                      | 75.01 |
| Auxiliary Fuel Transfer Vent Heater (Opt.) . . . . .        | 76.00 |
| Auxiliary Fuel Transfer Vent Heater (Opt.) . . . . .        | 76.01 |

## EFF. SERIALS

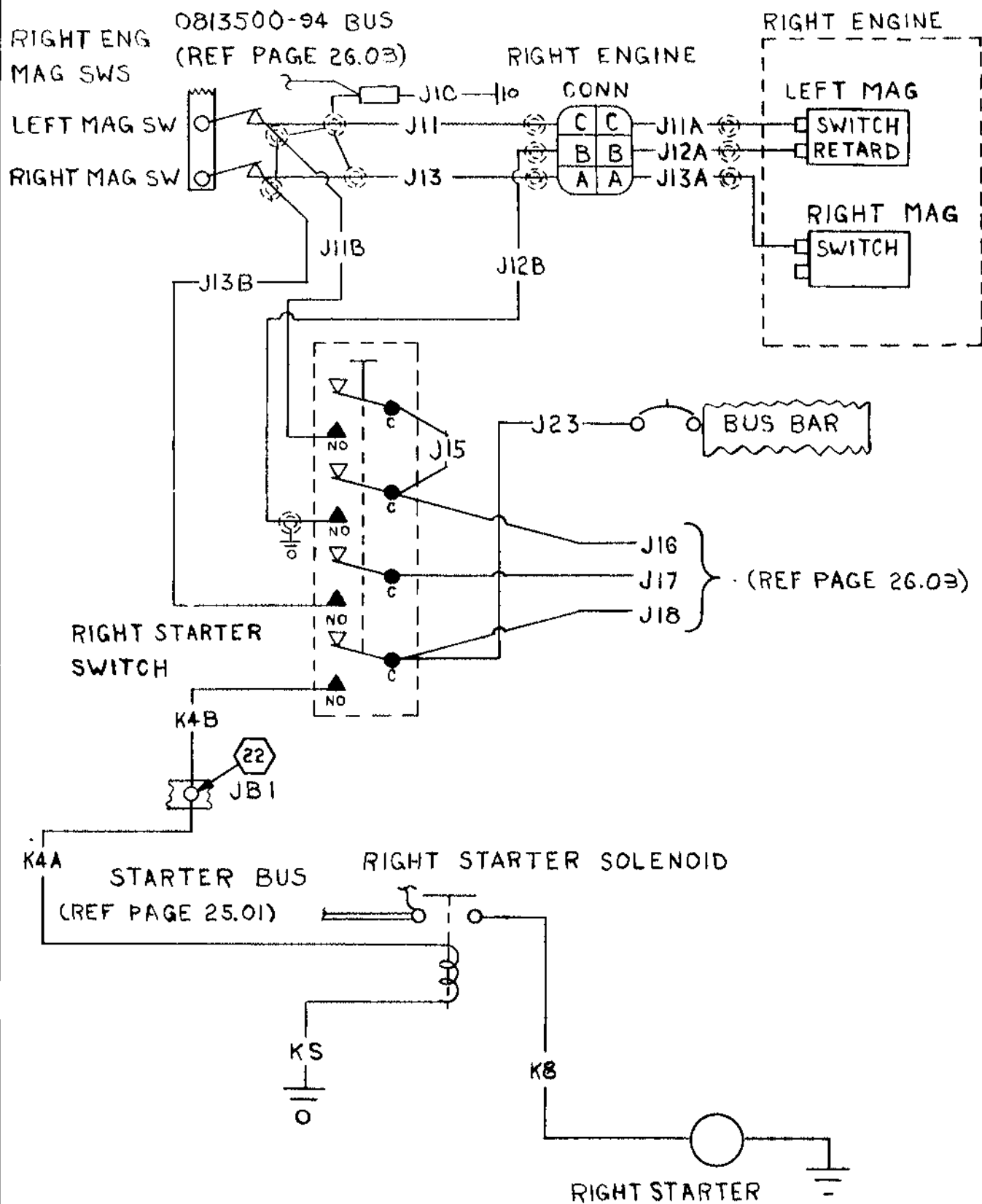


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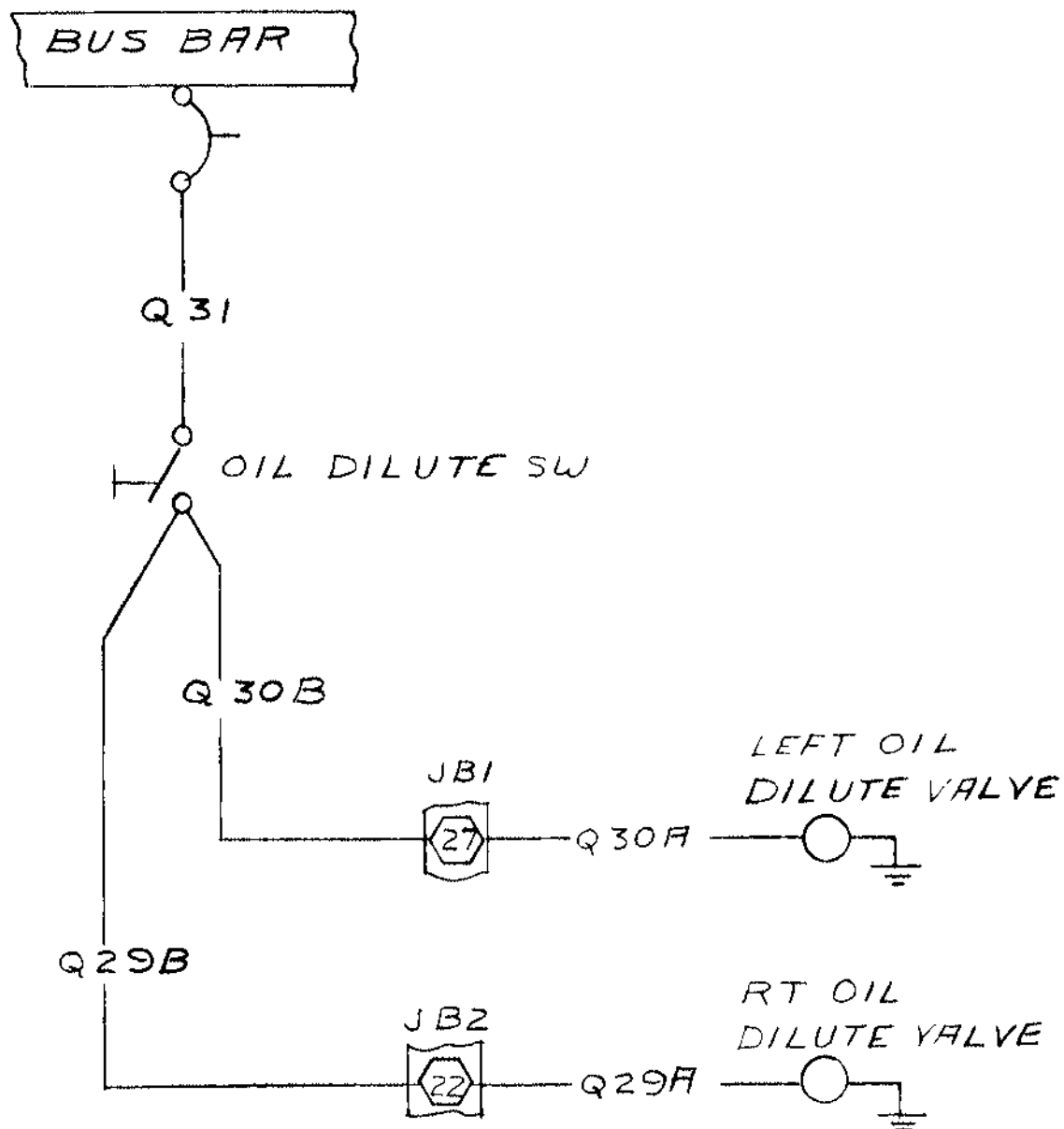
START & IGNITION - RIGHT ENGINE

EFF. SERIALS



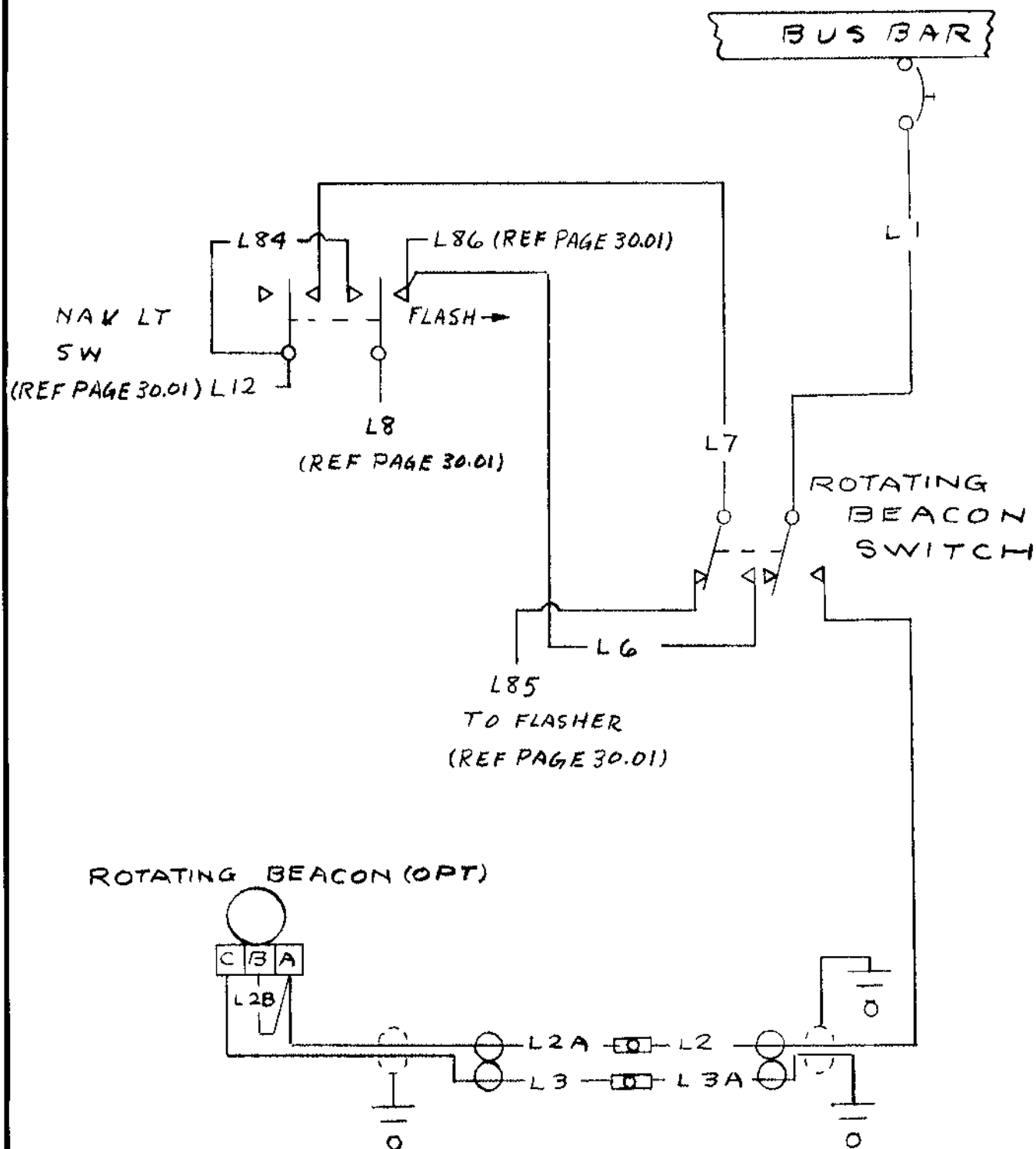
LEFT & RIGHT OIL DILUTE (OPT):

EFF. SERIALS



ROTATING BEACON - TAIL (OPT)

EFF. SERIALS



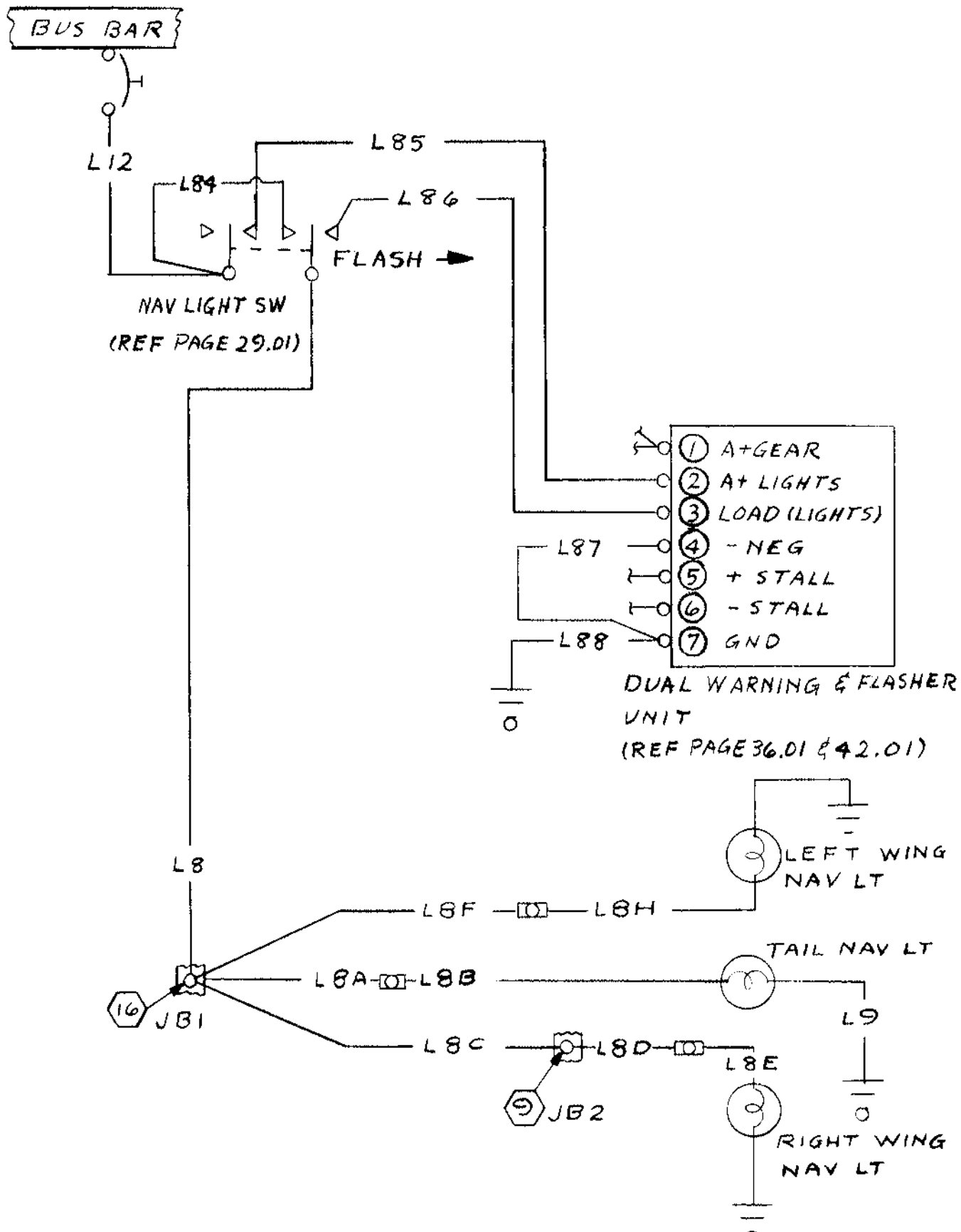
NOTE:

RECONNECT L85 FOR THIS OPT



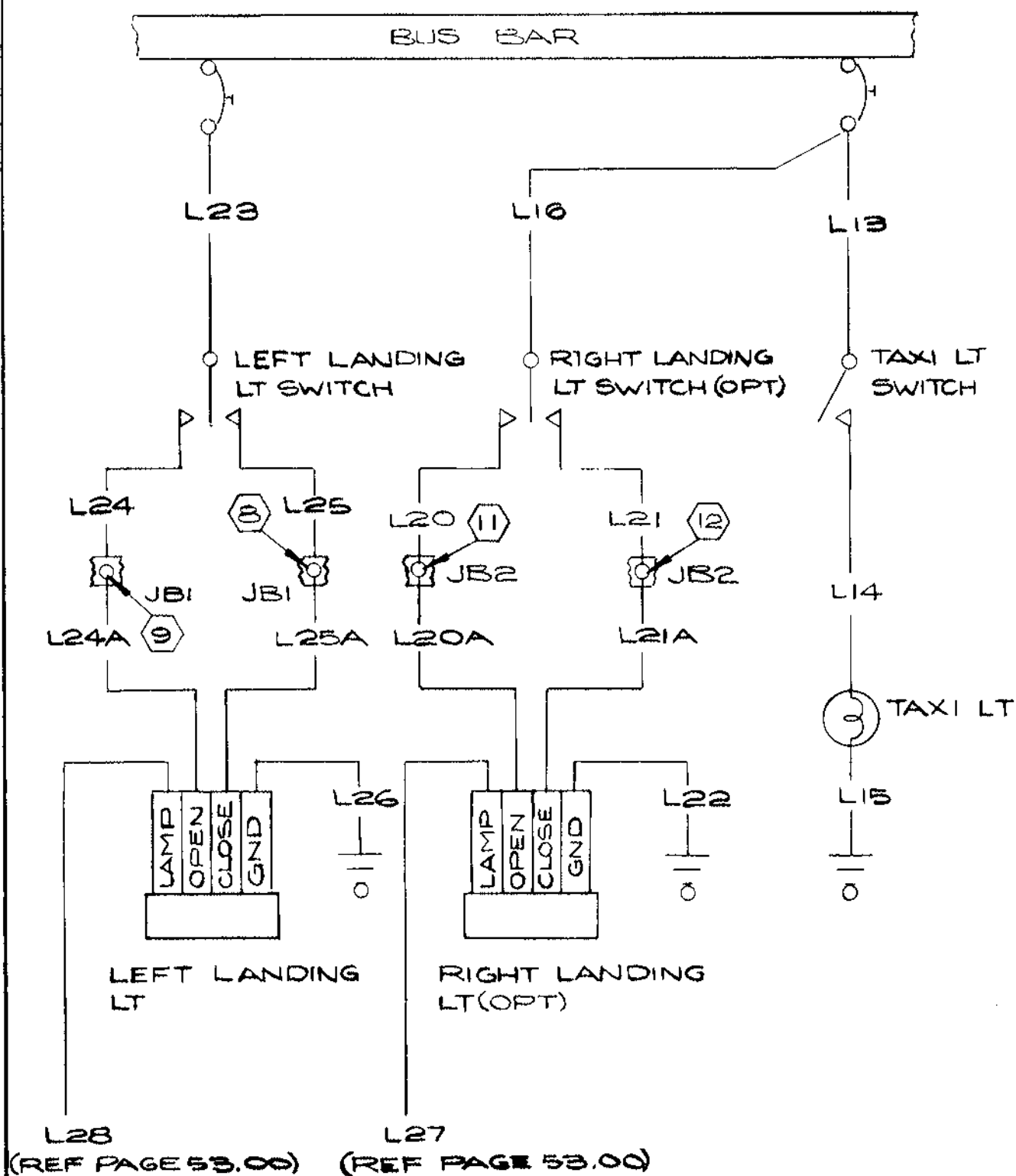
NAVIGATION LIGHTS

EFF. SERIALS



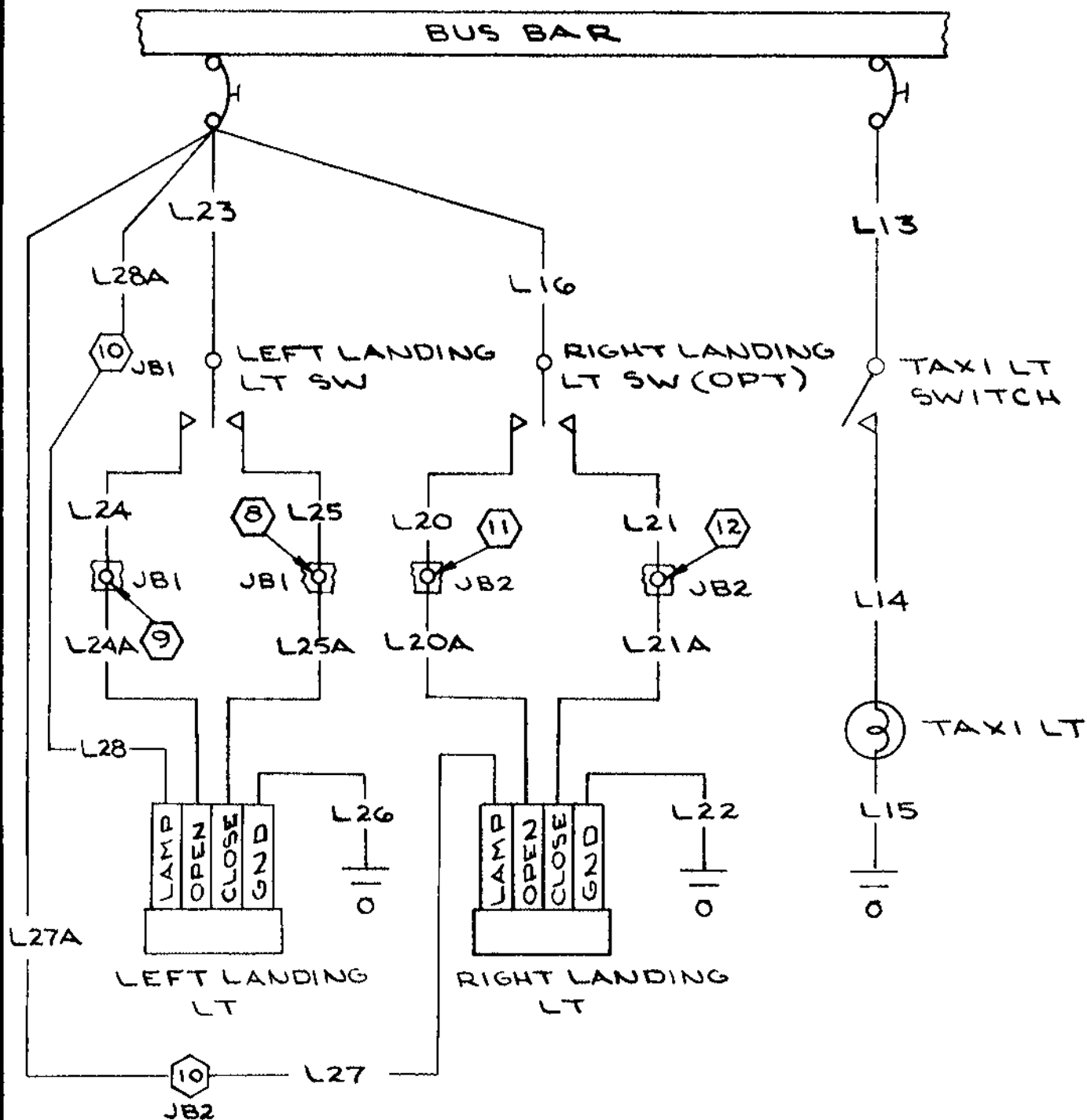
LANDING LIGHT-LEFT WING, RIGHT WING (OPT), AND TAXI LIGHT

PAGE EFFECTIVE



LANDING LIGHT - LEFT WING, RIGHT WING (OPT.) & TAXI LIGHT

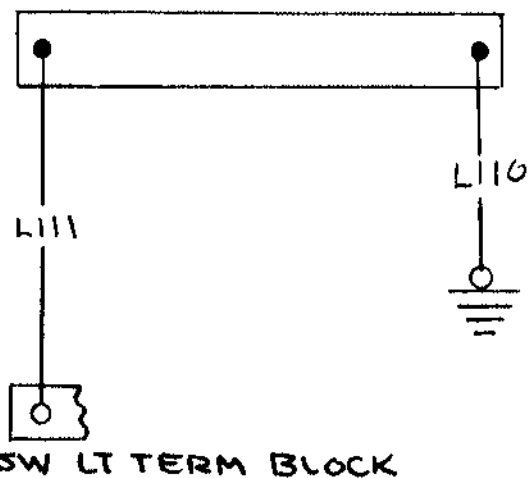
EFF. SERIALS 310N0001 & ON



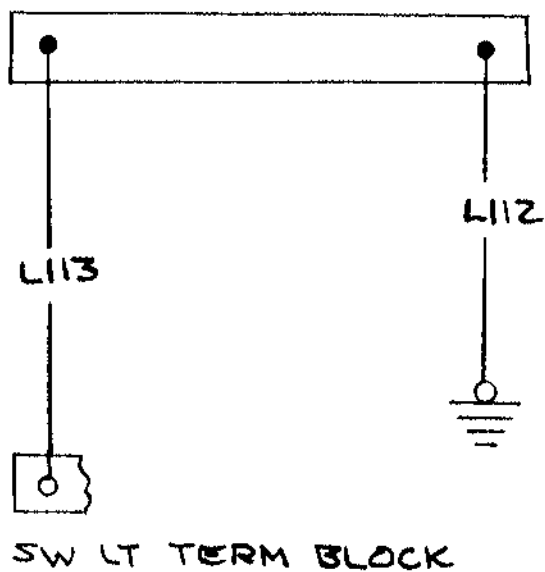
INSTRUMENT & PANEL LIGHTING

EFF. SERIALS 310L0001 TO 310N0001

L.H. RHEOSTAT LIGHTING STRIP

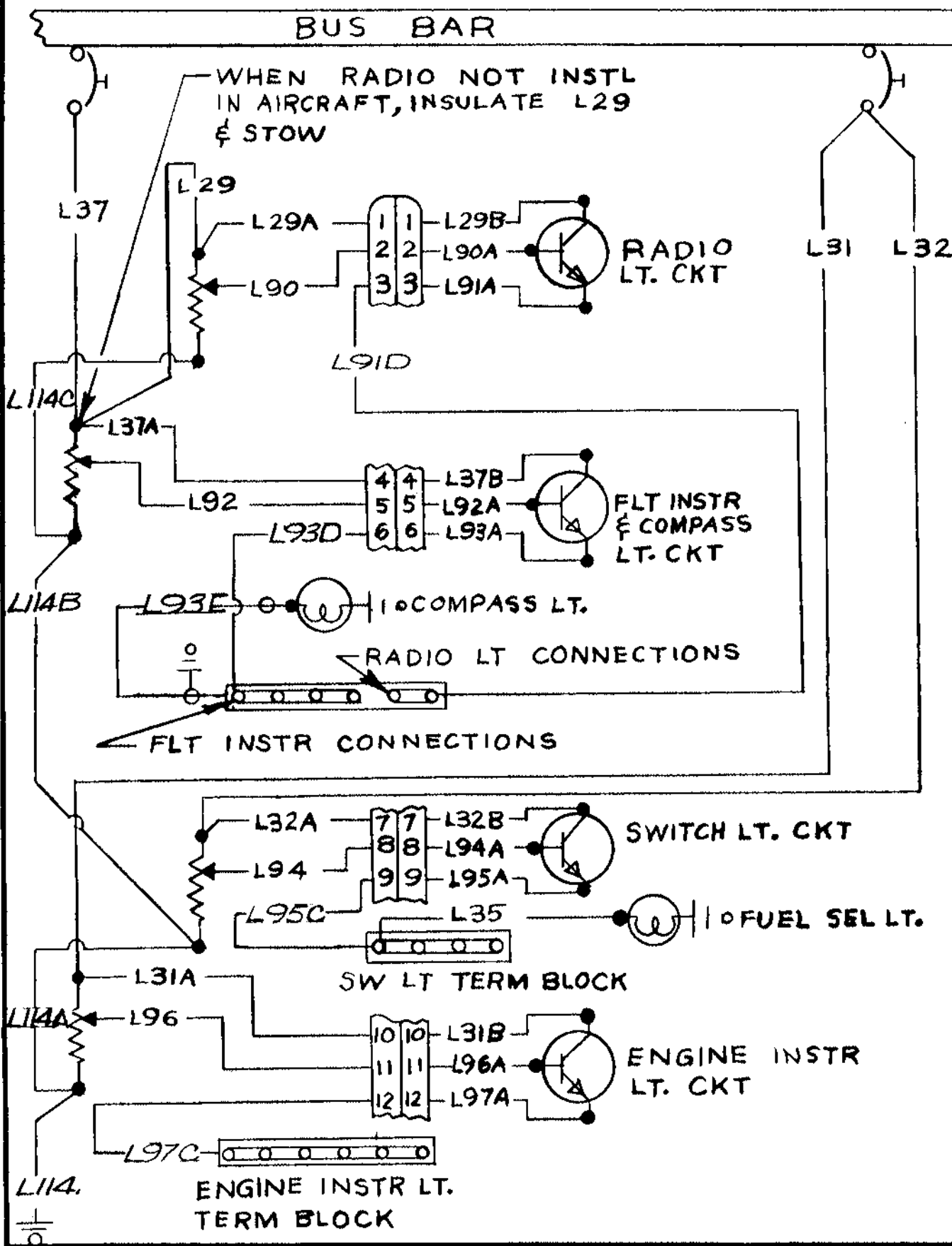


R.H. RHEOSTAT LIGHTING STRIP



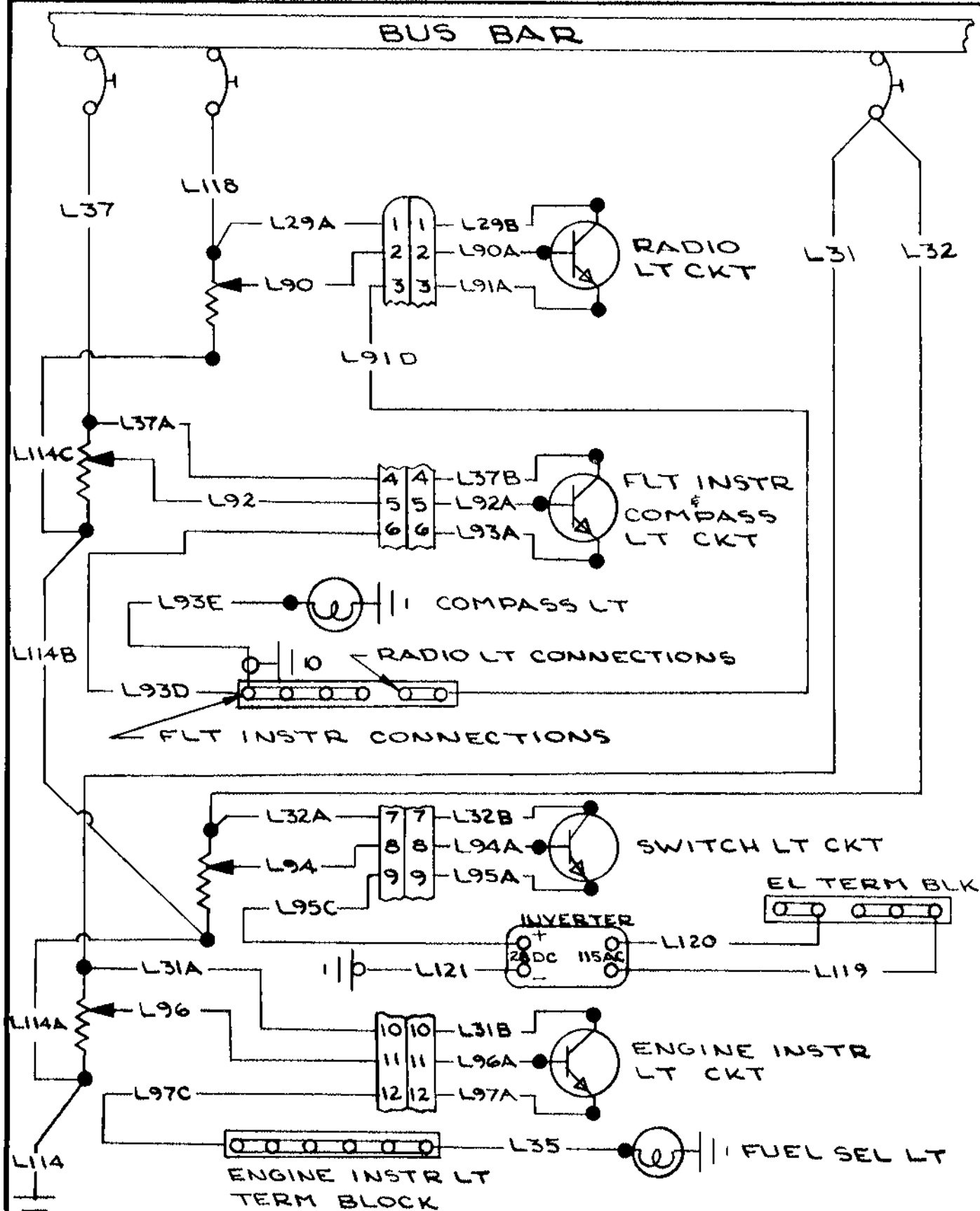
## INSTRUMENT &amp; PANEL LIGHTING

EFF. SERIALS 310L0001 TO 310N0001



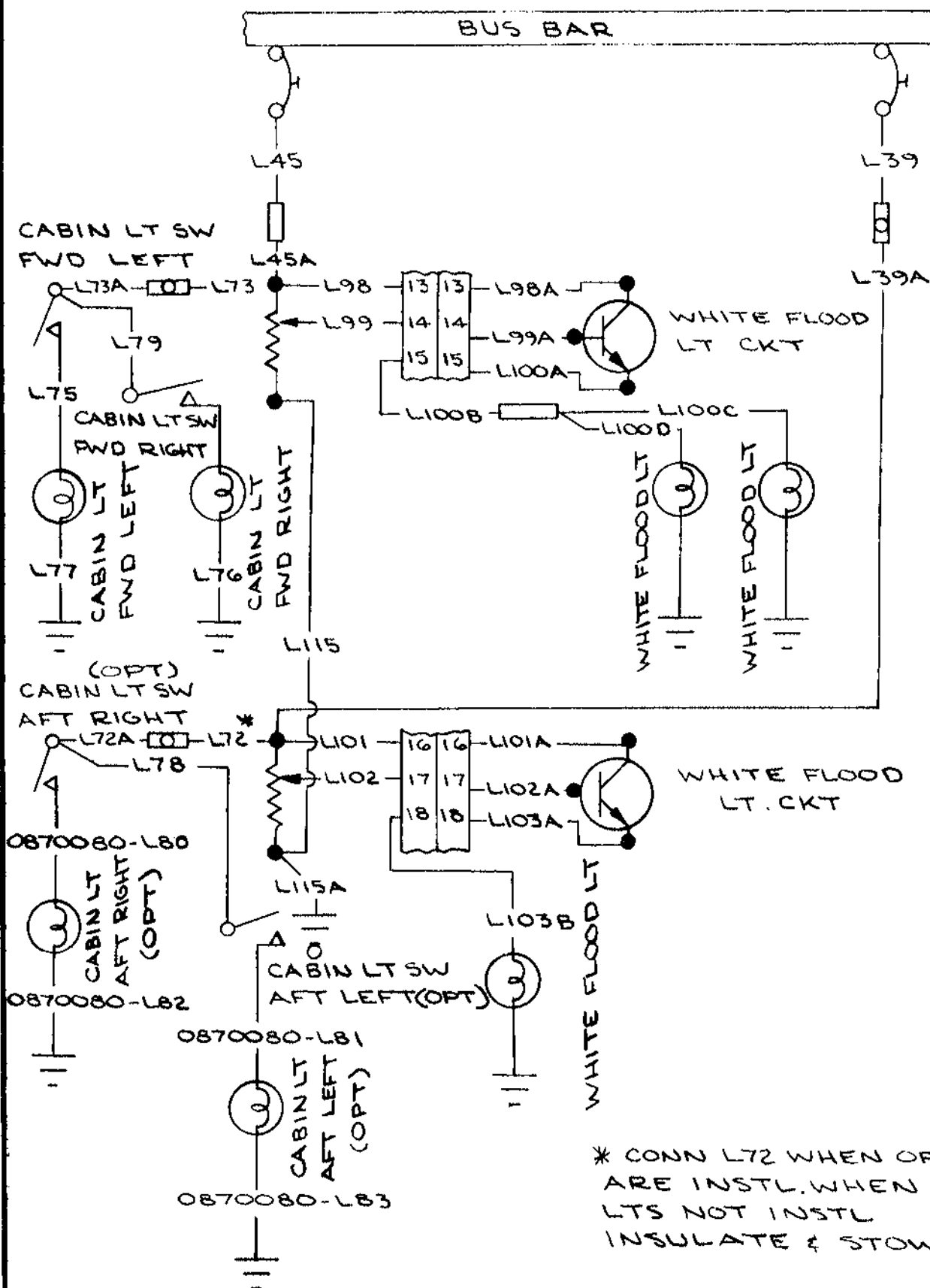
INSTRUMENT & PANEL LIGHTING

EFF. SERIALS 310N0001 & ON



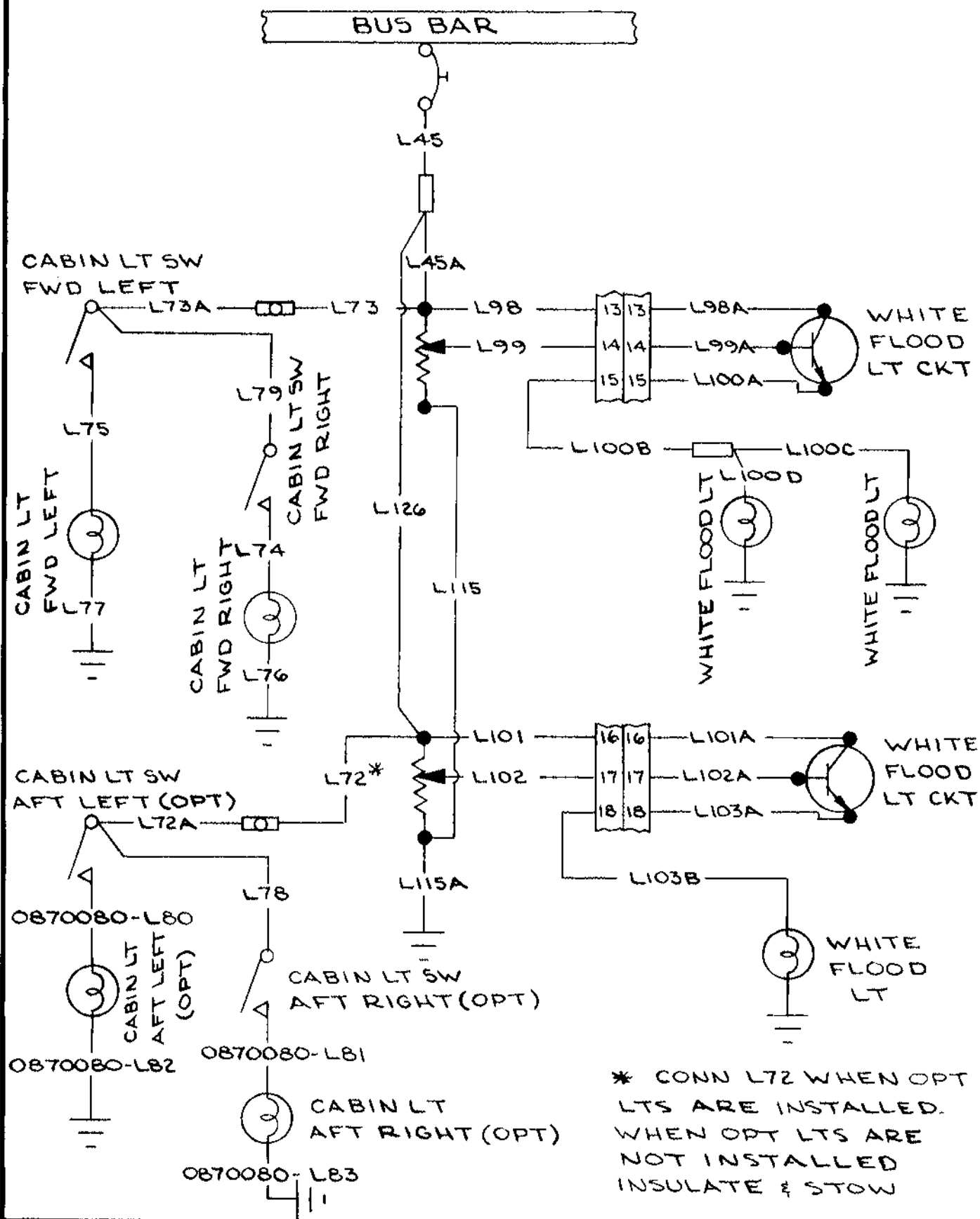
CABIN LIGHTING

EFF. SERIALS 310L0001 TO 310N0001



## CABIN LIGHTING

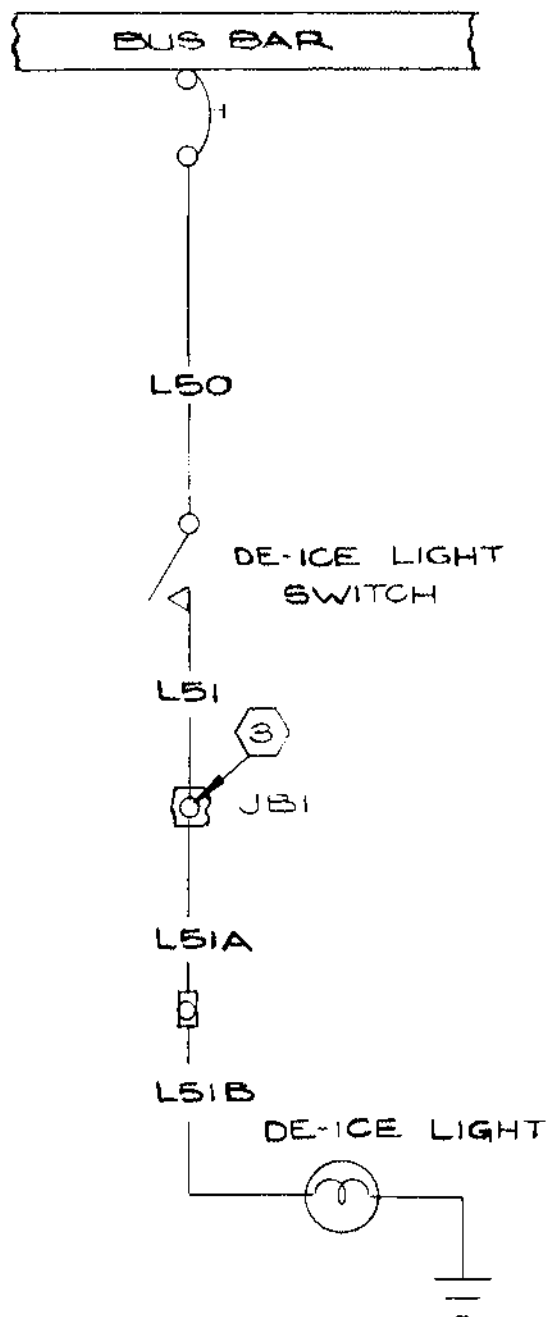
EFF. SERIALS 310N0001 &amp; ON





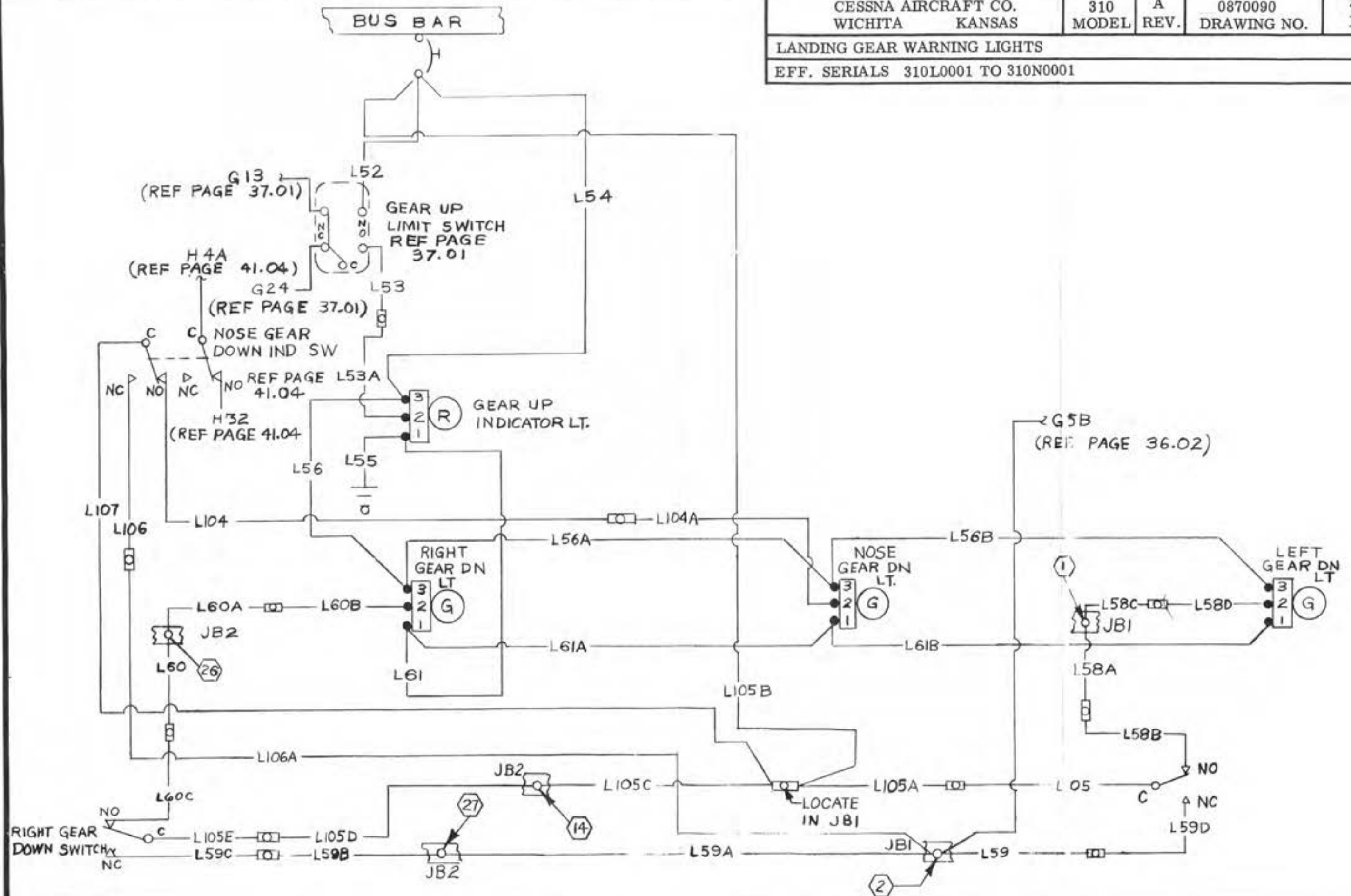
DEICE LIGHT (OPT)

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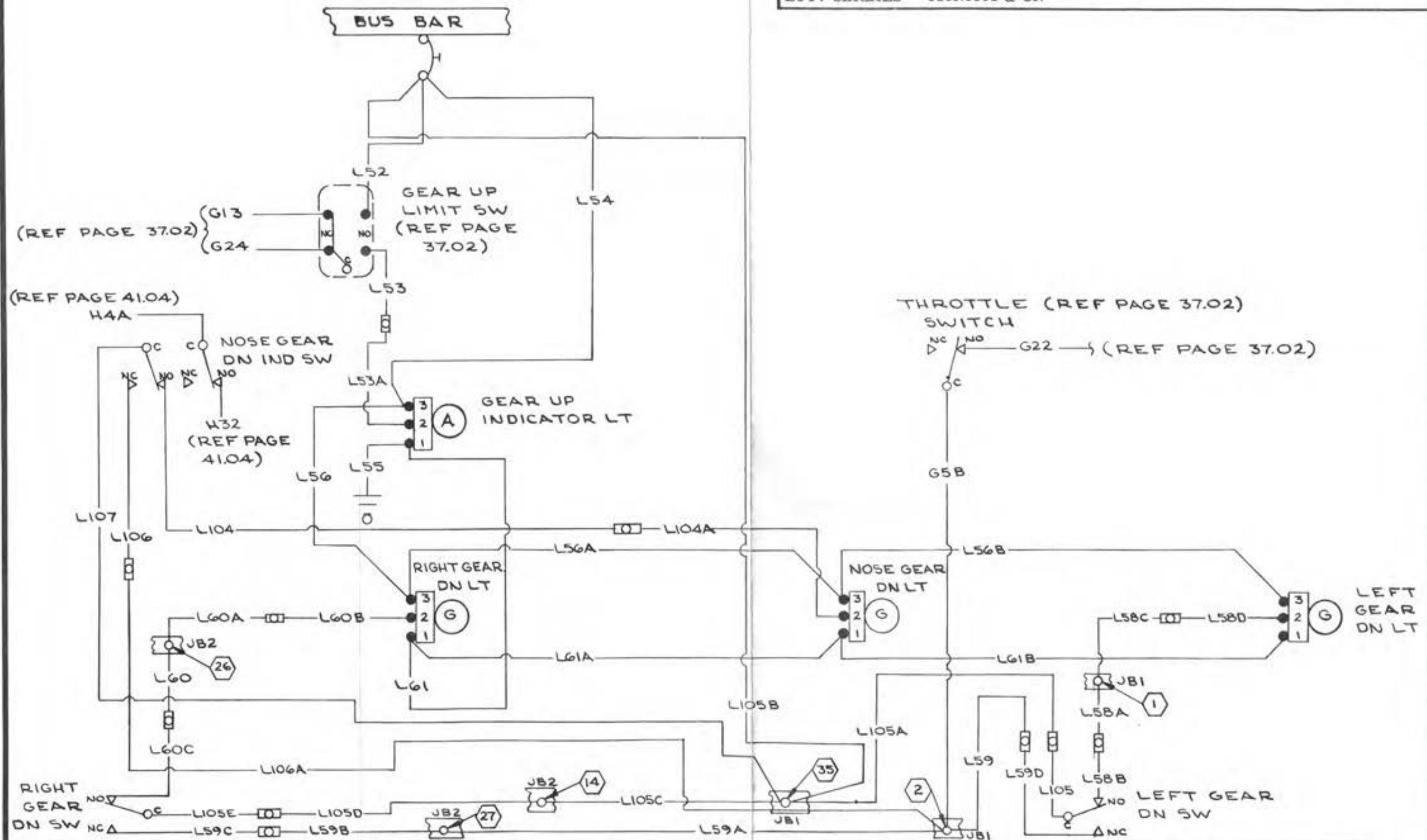
LANDING GEAR WARNING LIGHTS

EFF. SERIALS 310L0001 TO 310N0001



LANDING GEAR WARNING LIGHTS

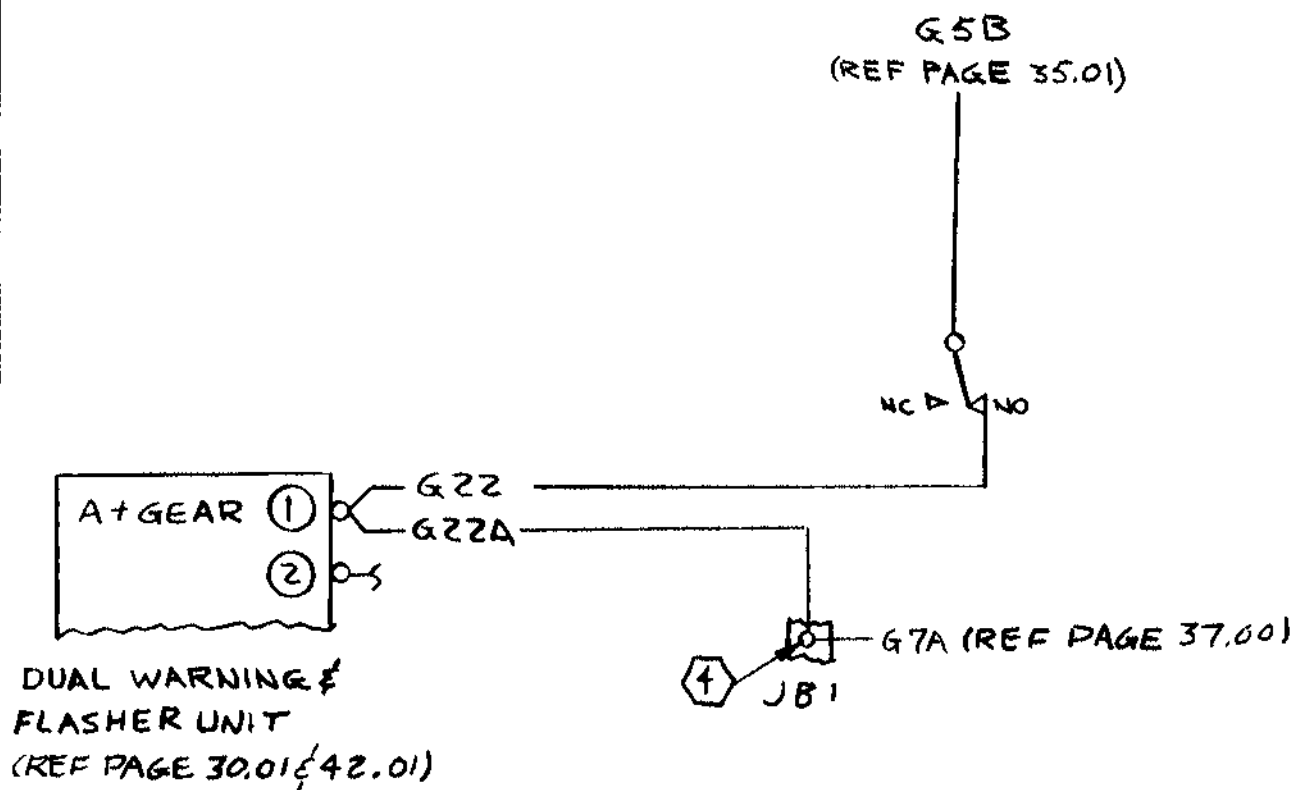
EFF. SERIALS 310N0001 & ON



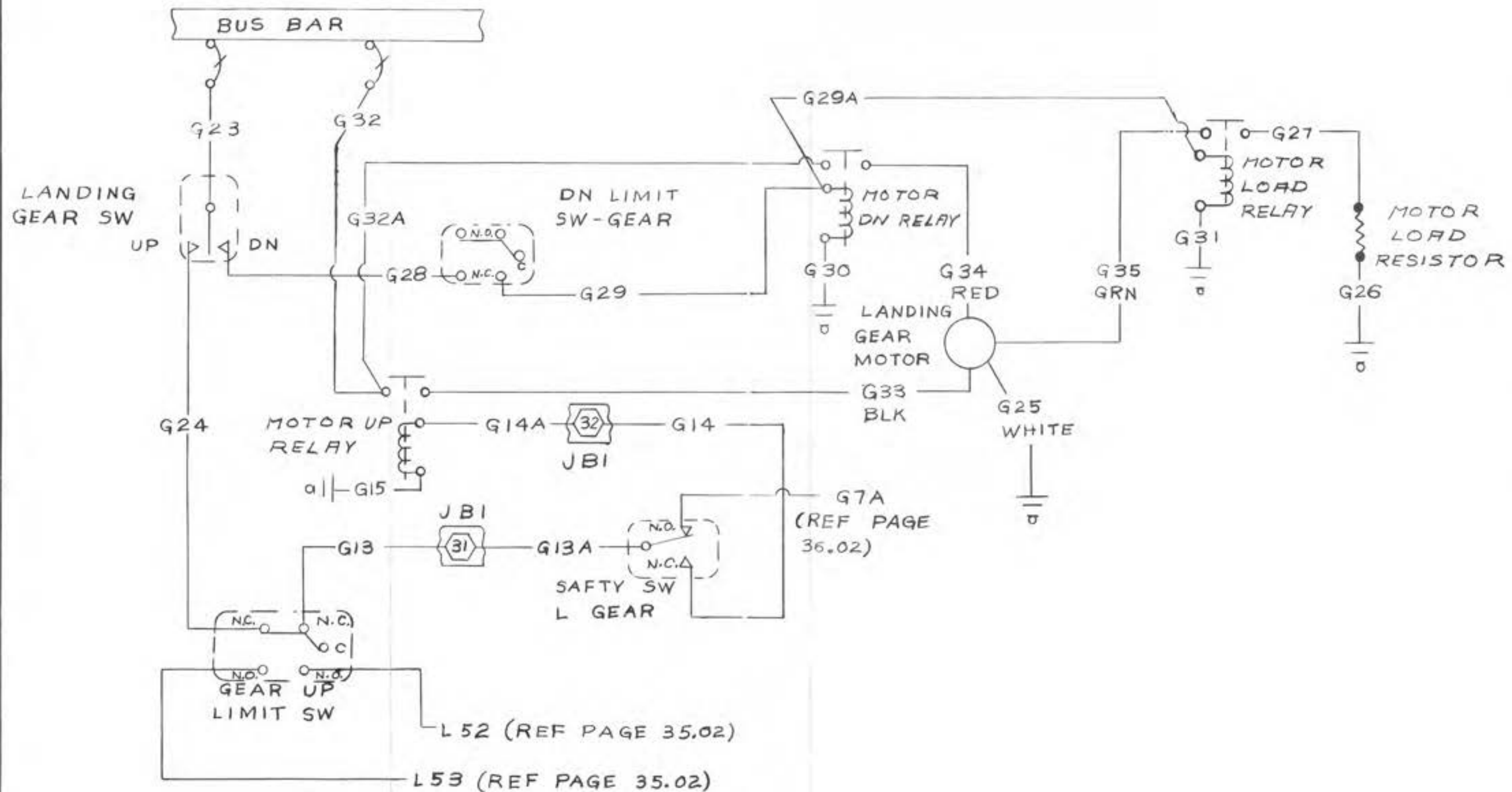
WARNING HORN - LANDING GEAR

EFF. SERIALS 310L0001 TO 310N0001

INFO TAKEN TO PAGE 37.02

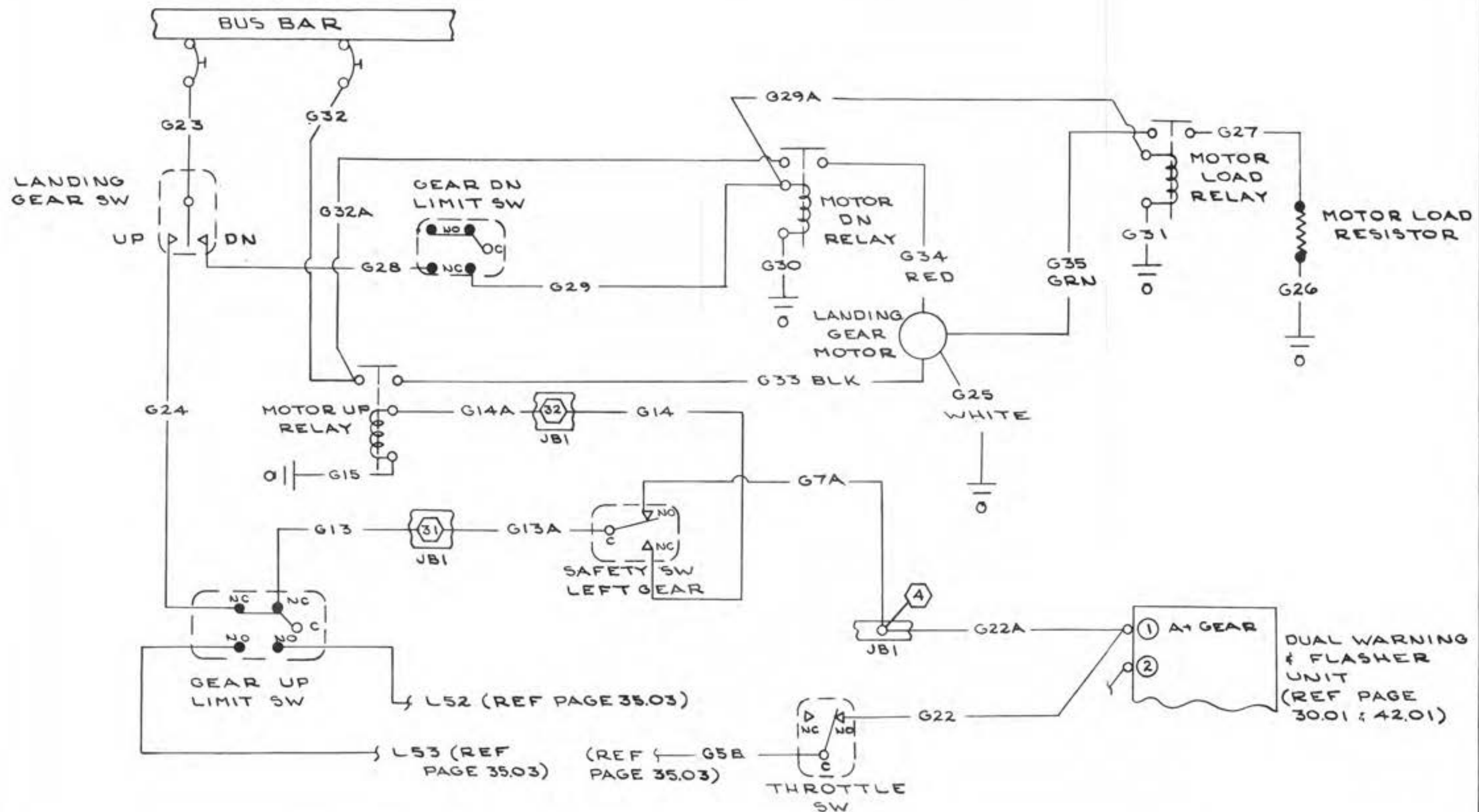


## EFF. SERIALS 310L0001 TO 310N0001



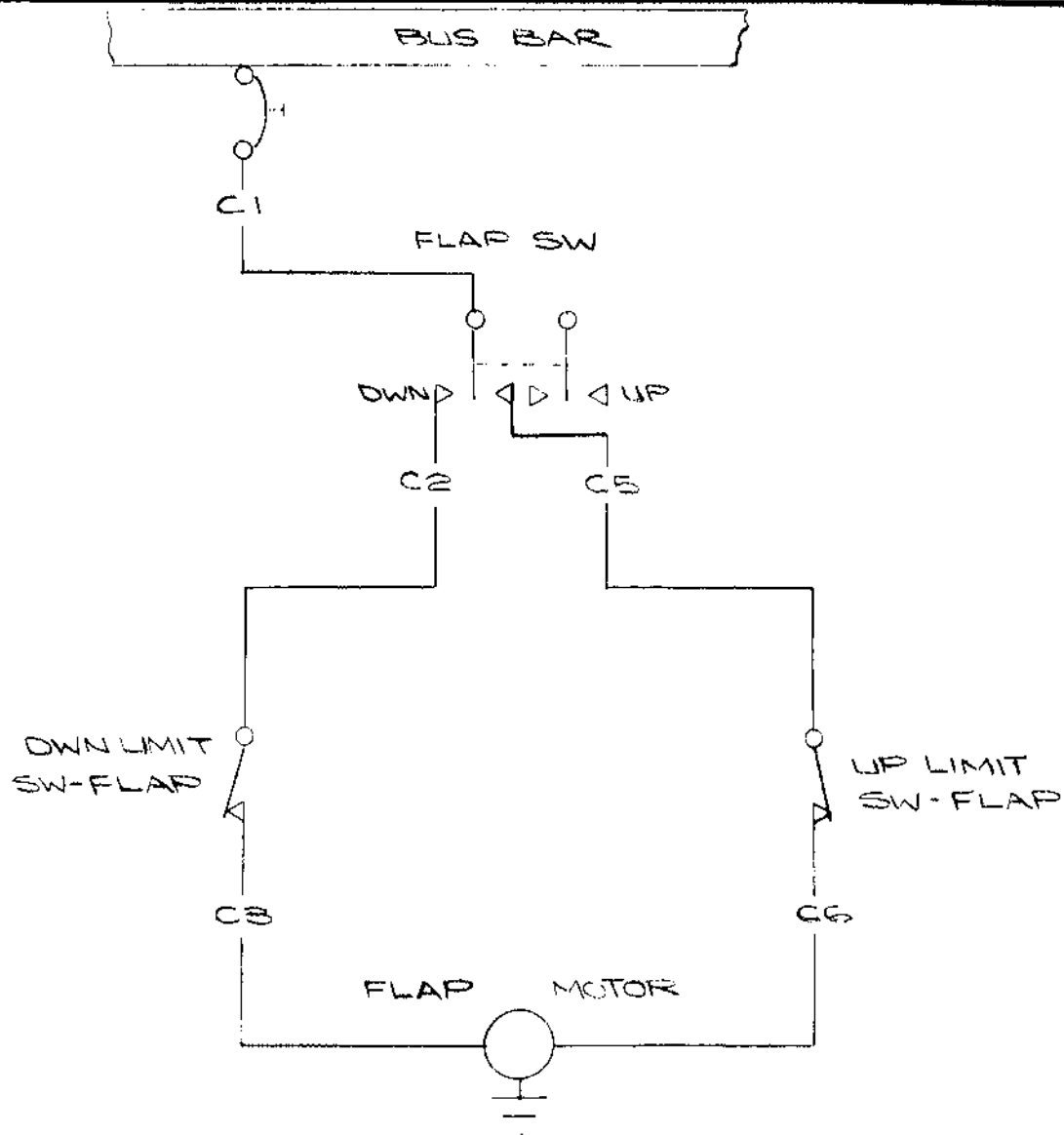
LANDING GEAR ACTUATOR

EFF. SERIALS 310N0001 & ON



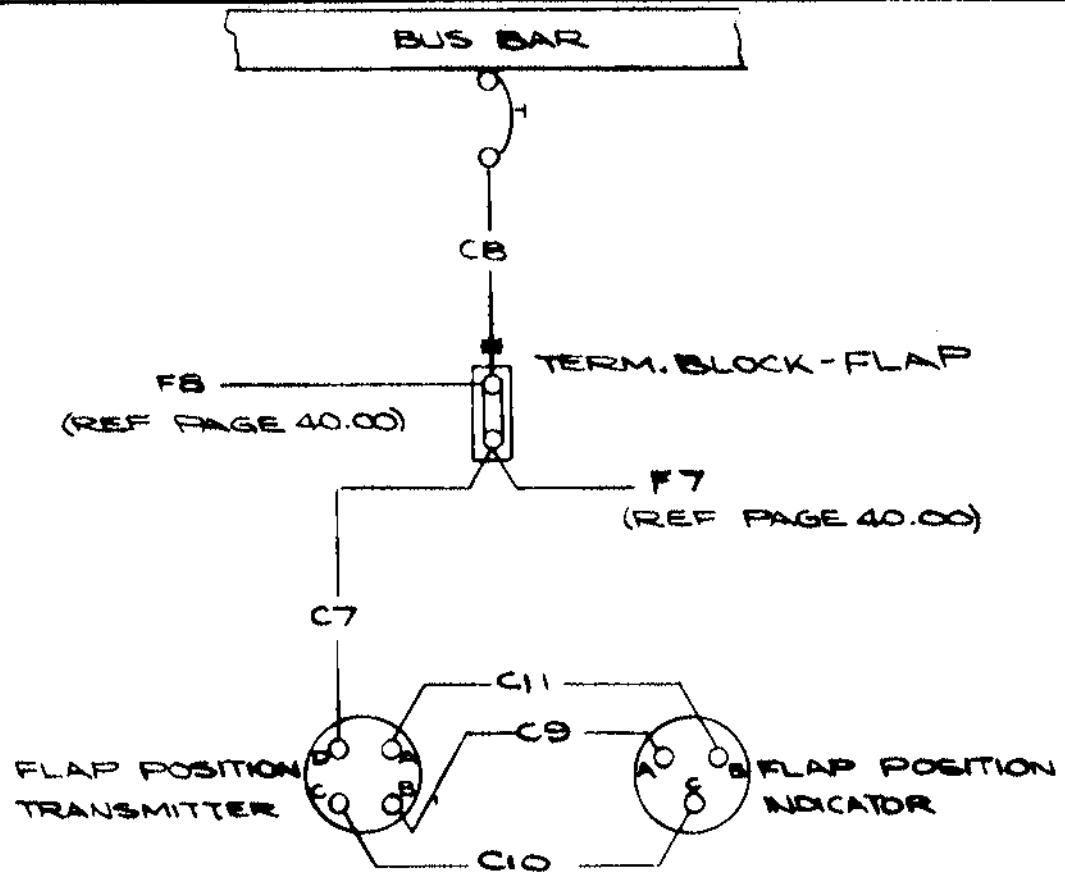
FLAP ACTUATION

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# FLAP POSITION INDICATION SYSTEM

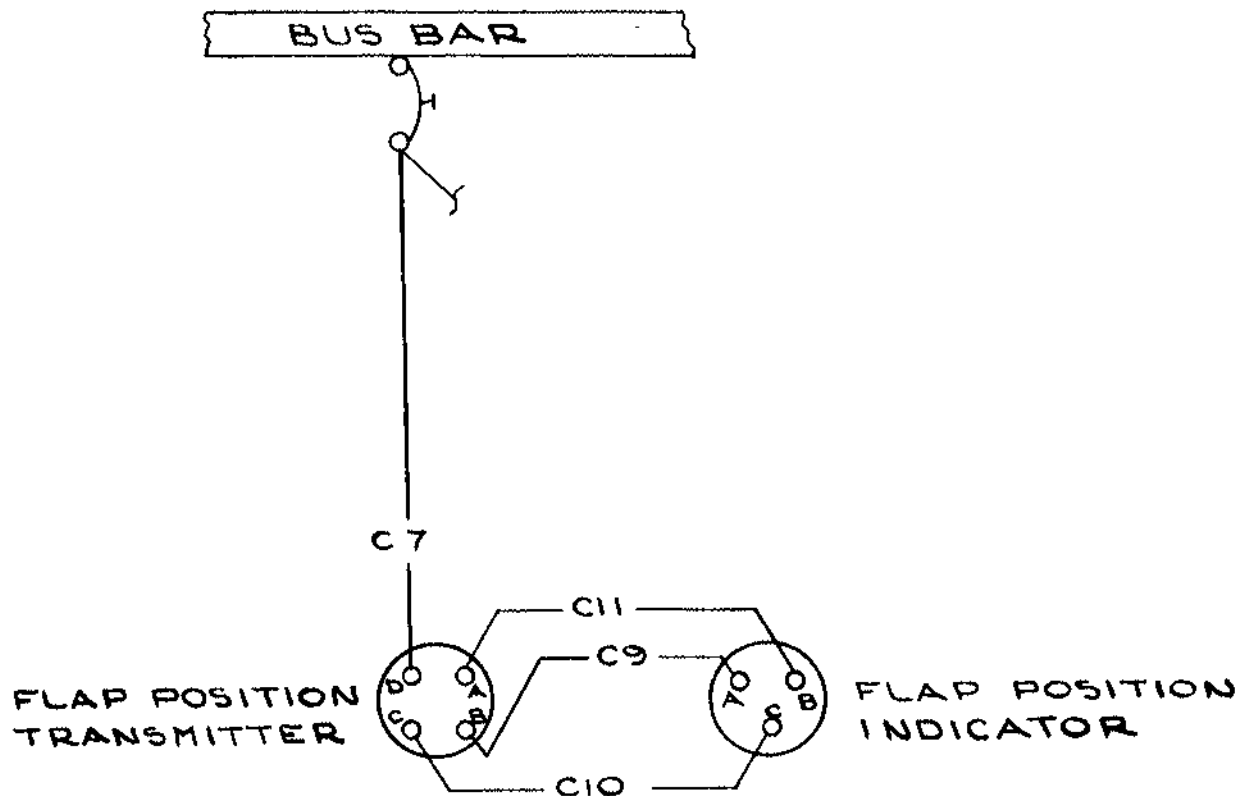
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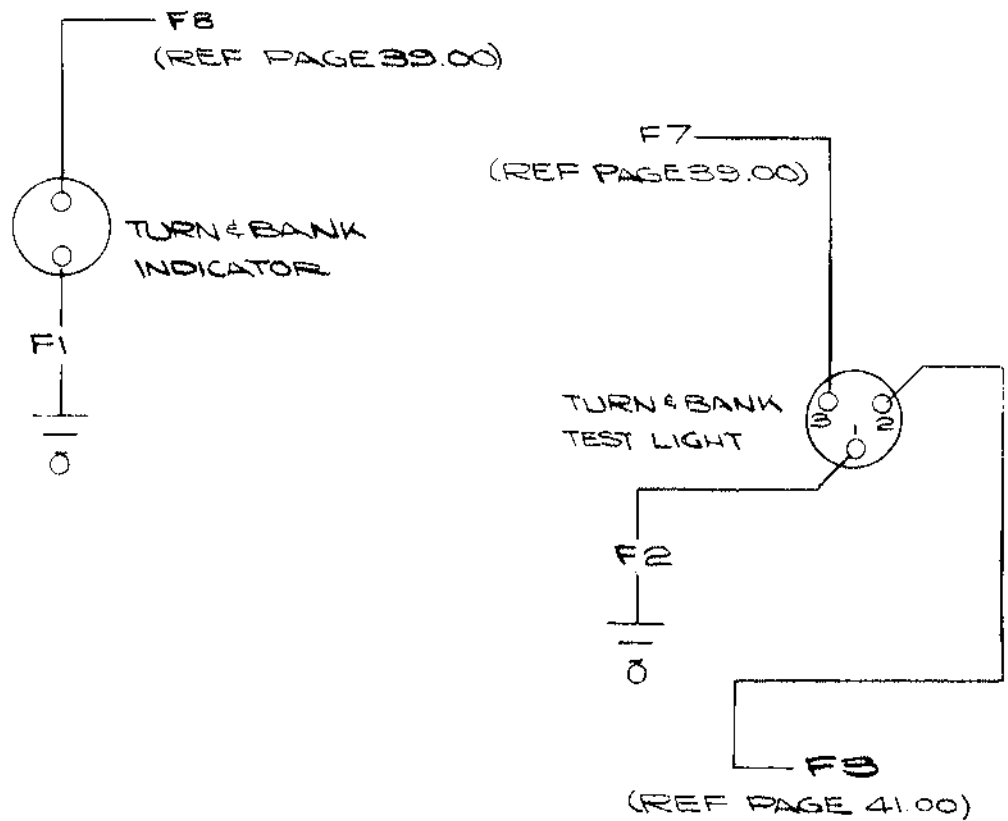
FLAP POSITION INDICATION SYSTEM

EFF. SERIALS 310N0001 & ON



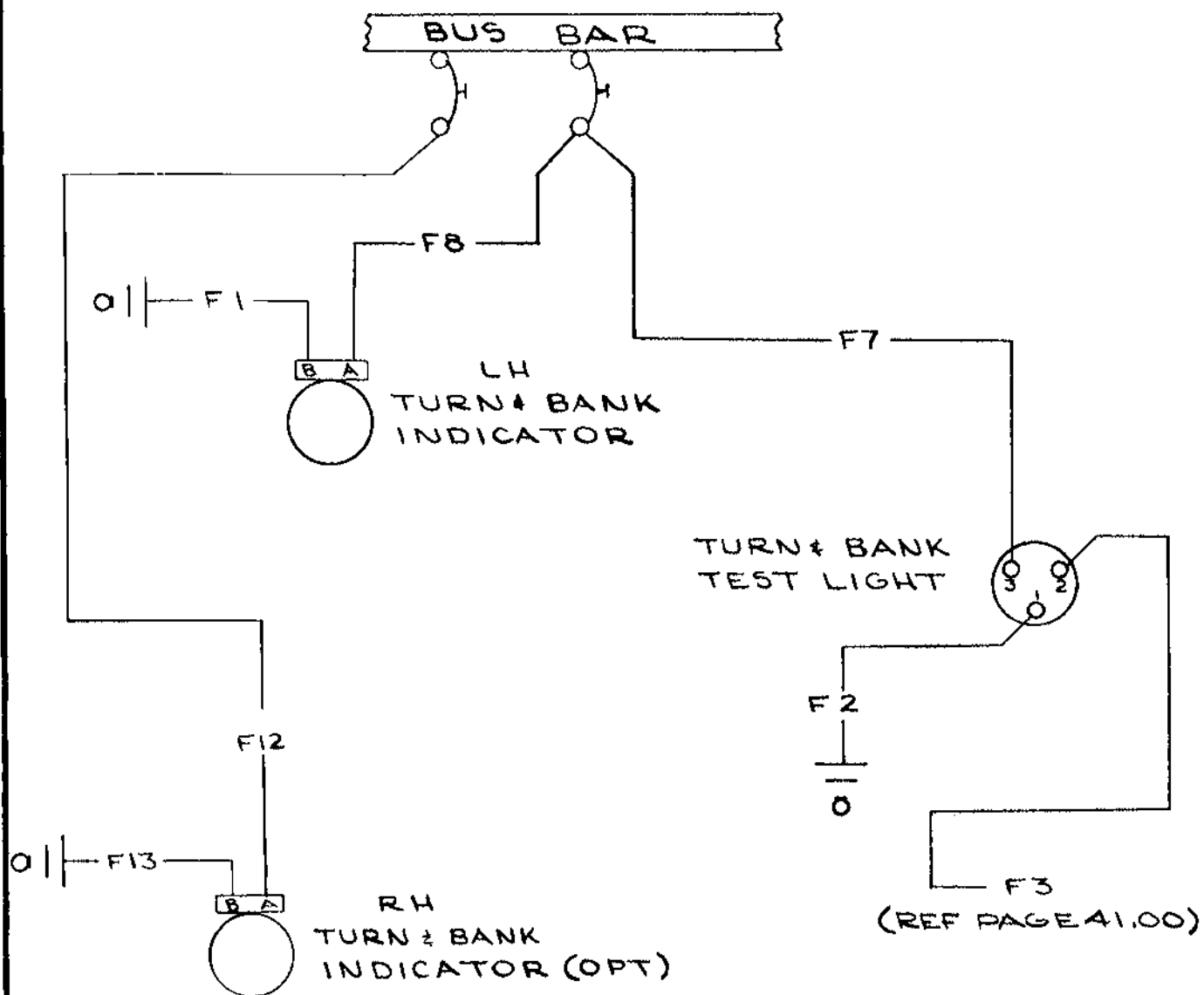
TURN & BANK INDICATOR & TEST LIGHT

PAGE EFFECTIVE



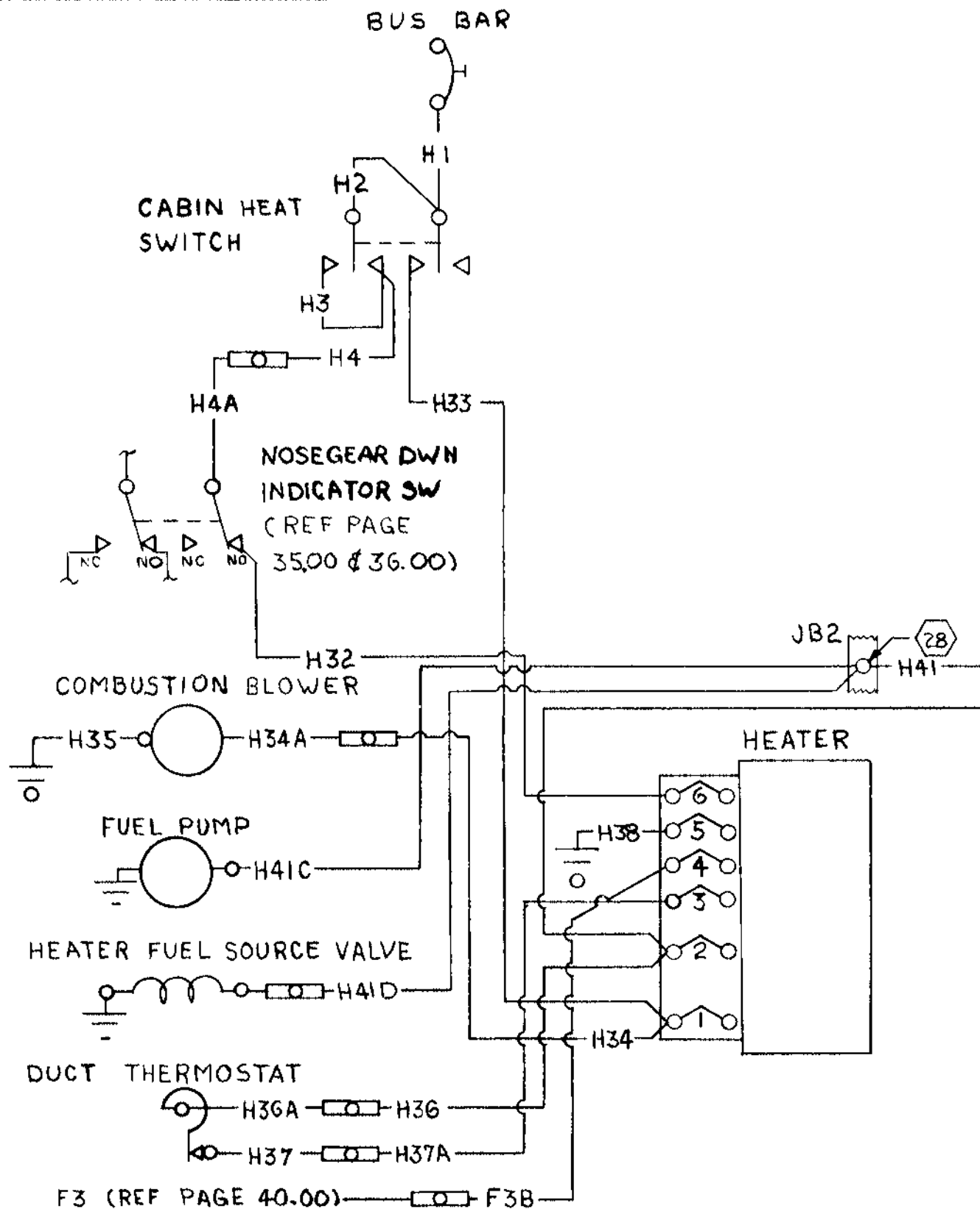
TURN & BANK INDICATOR & TEST LIGHT

EFF. SERIALS 310N0001 & ON



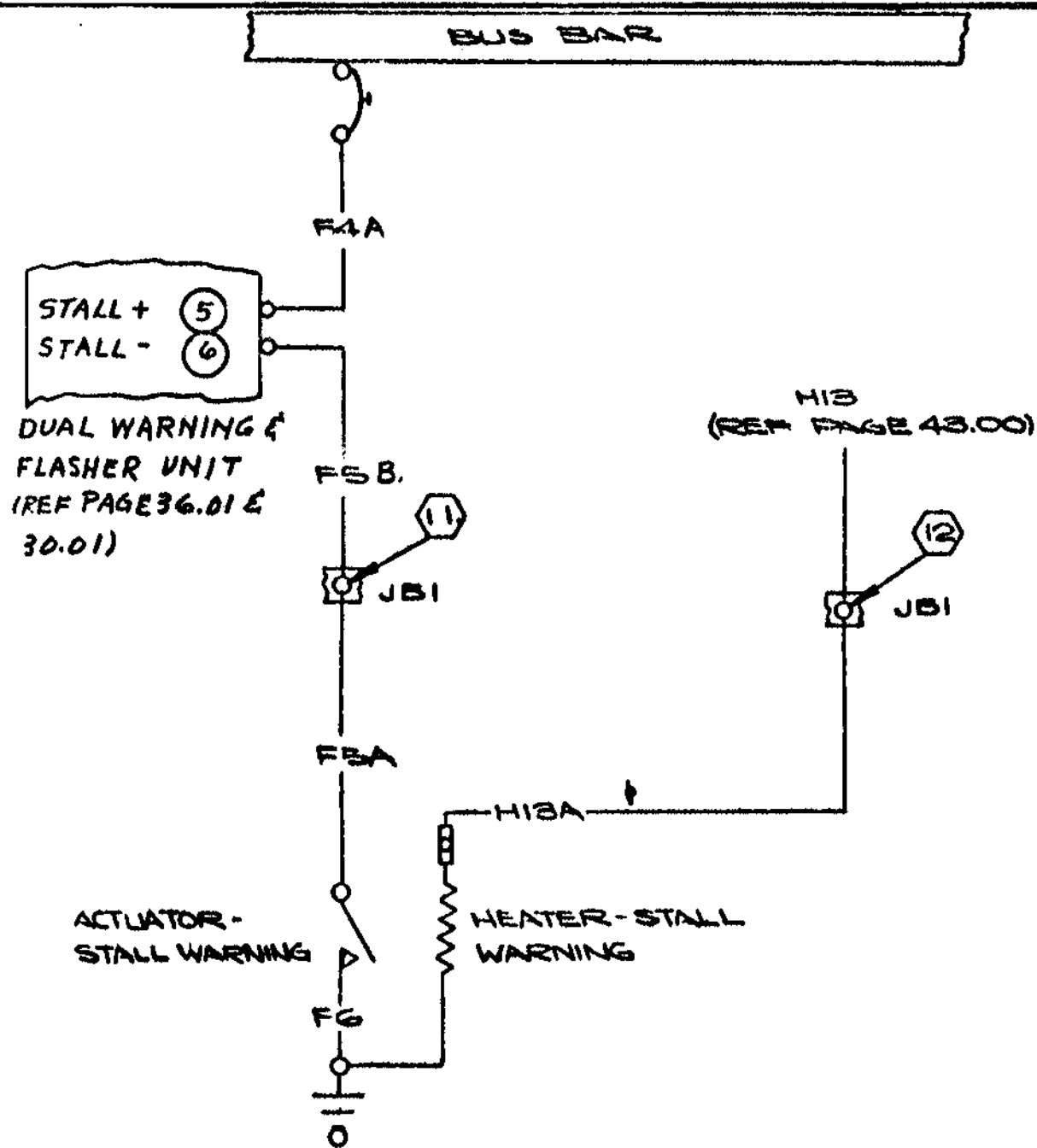
CABIN HEAT SYSTEM

EFF. SERIALS



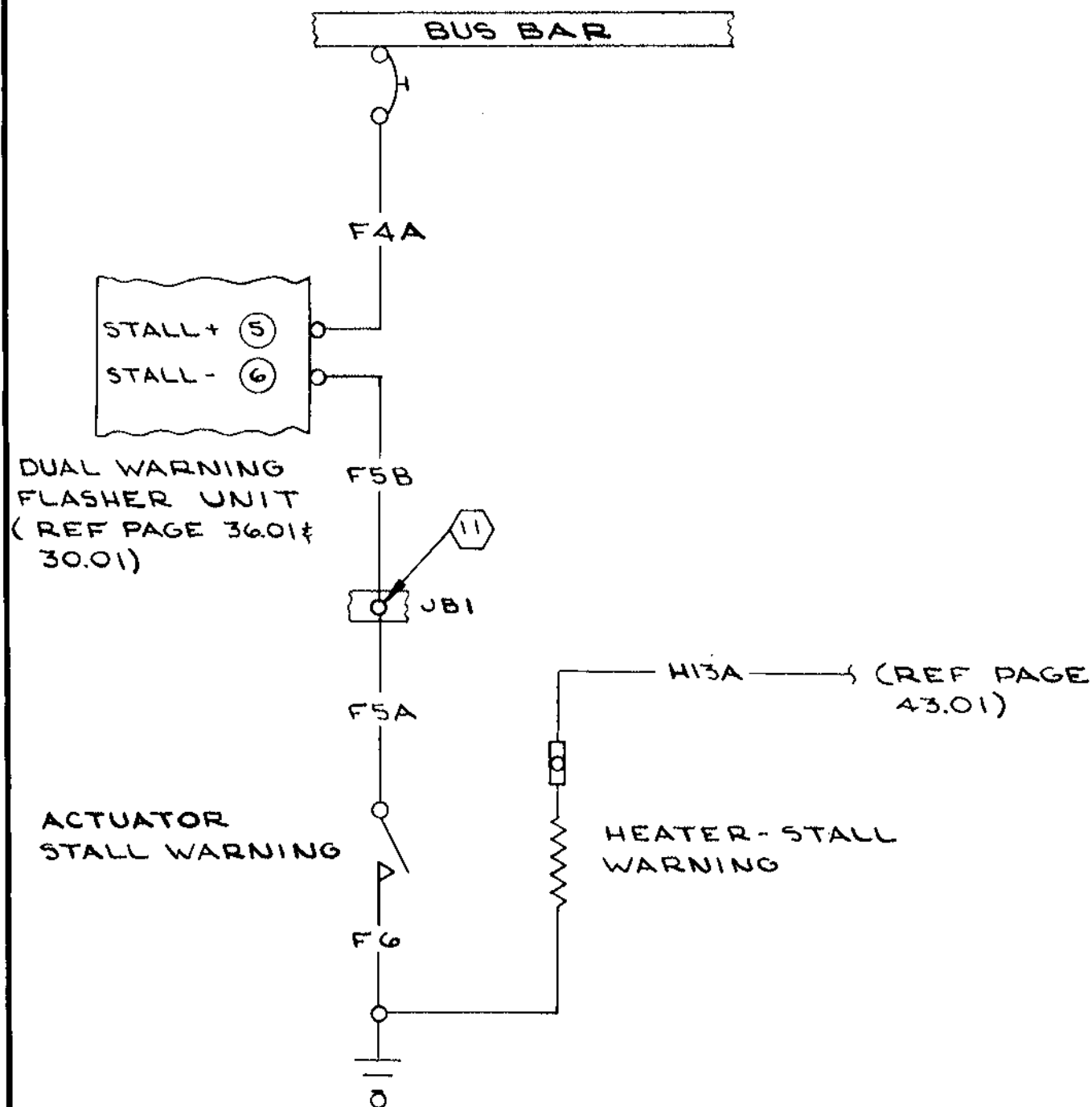
STALL WARNING SYSTEM

EFF. SERIALS 310L0001 TO 310N0001



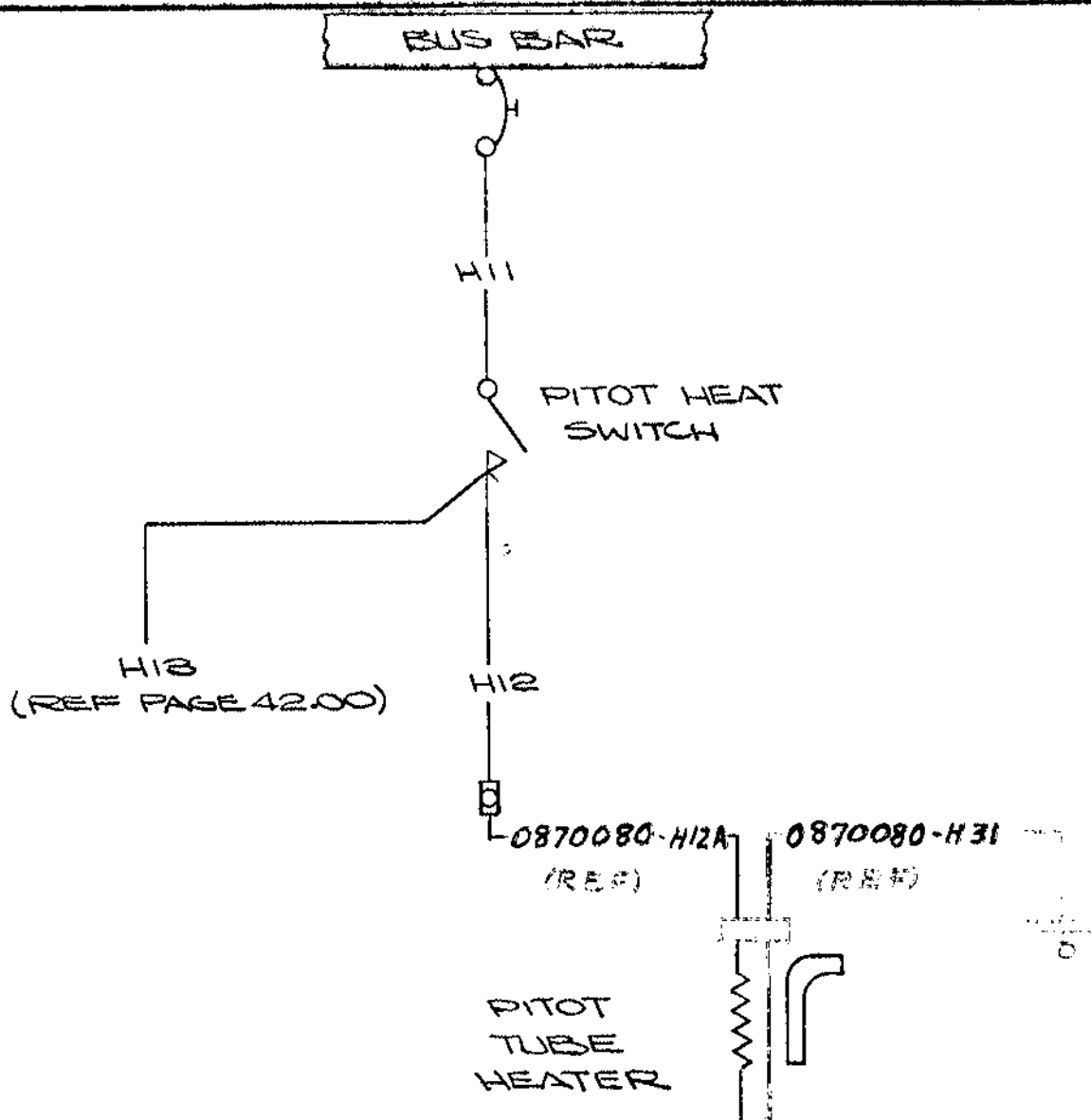
STALL WARNING SYSTEM

EFF. SERIALS 310N0001 & ON



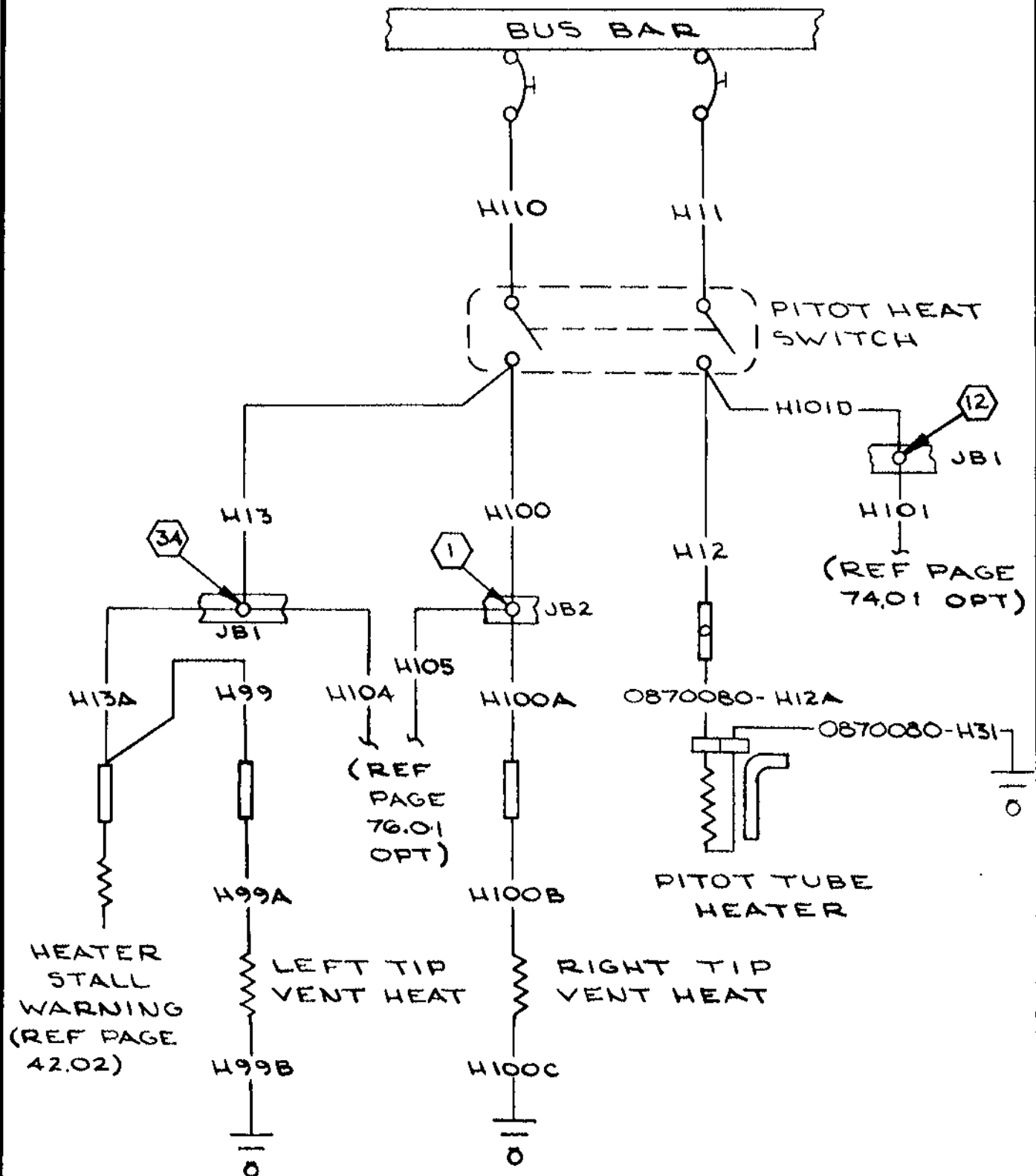
PITOT HEAT SYSTEM

EFF. SERIALS 310L0001 TO 310N0001



PITOT HEAT SYSTEM

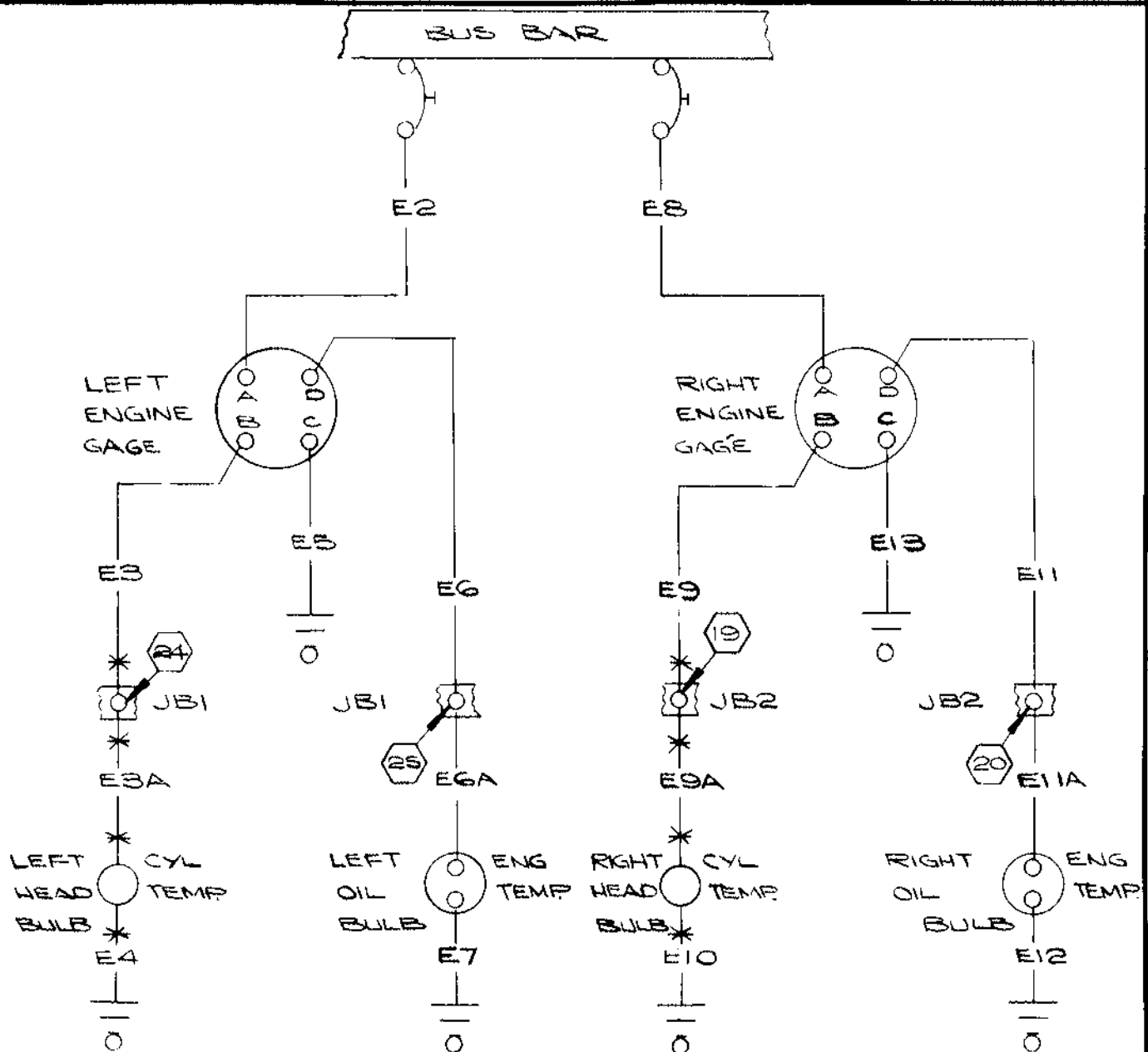
EFF. SERIALS 310N0001 & ON





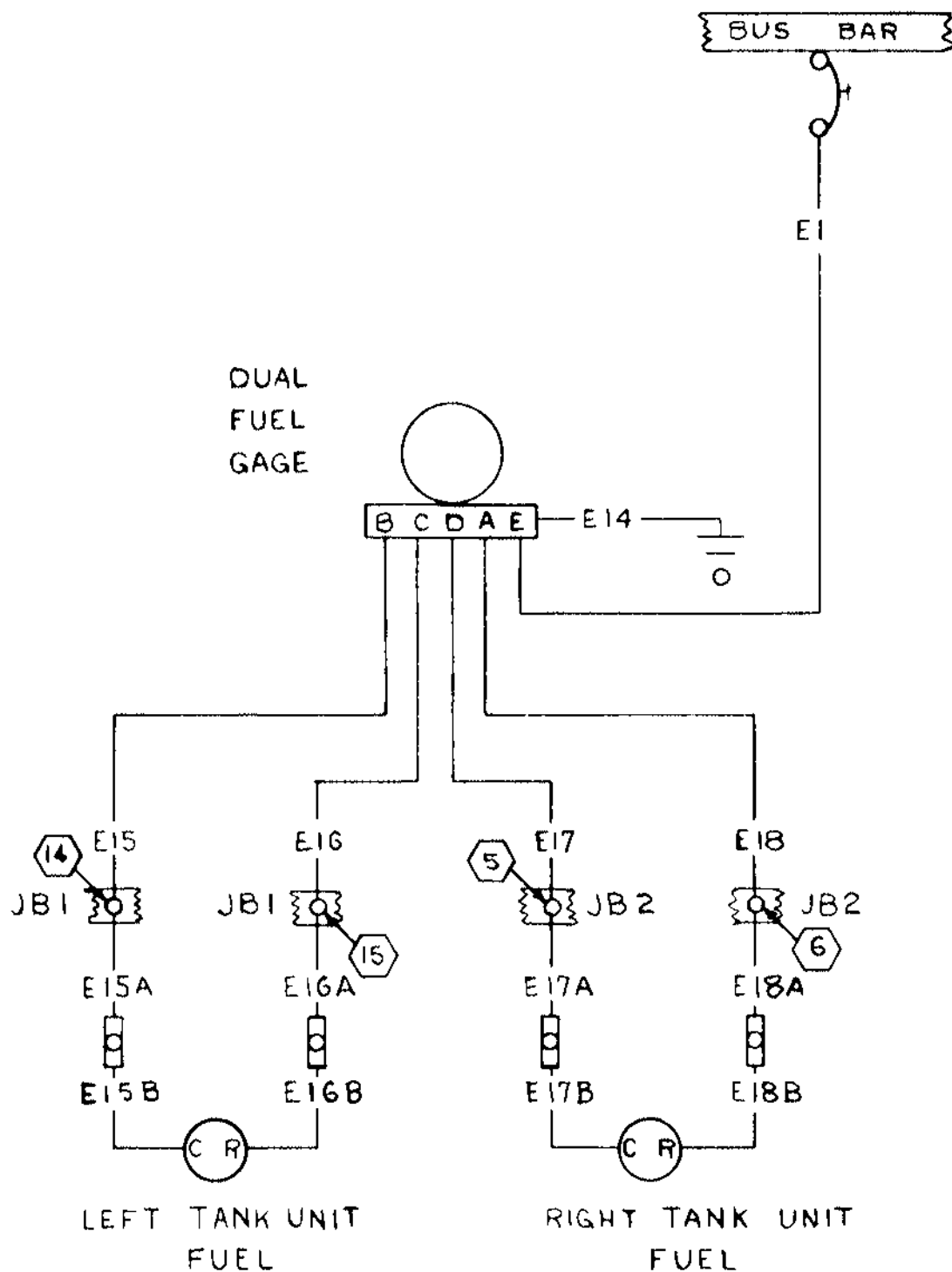
LEFT & RIGHT ENGINE GUAGE SYSTEM

PAGE EFFECTIVE



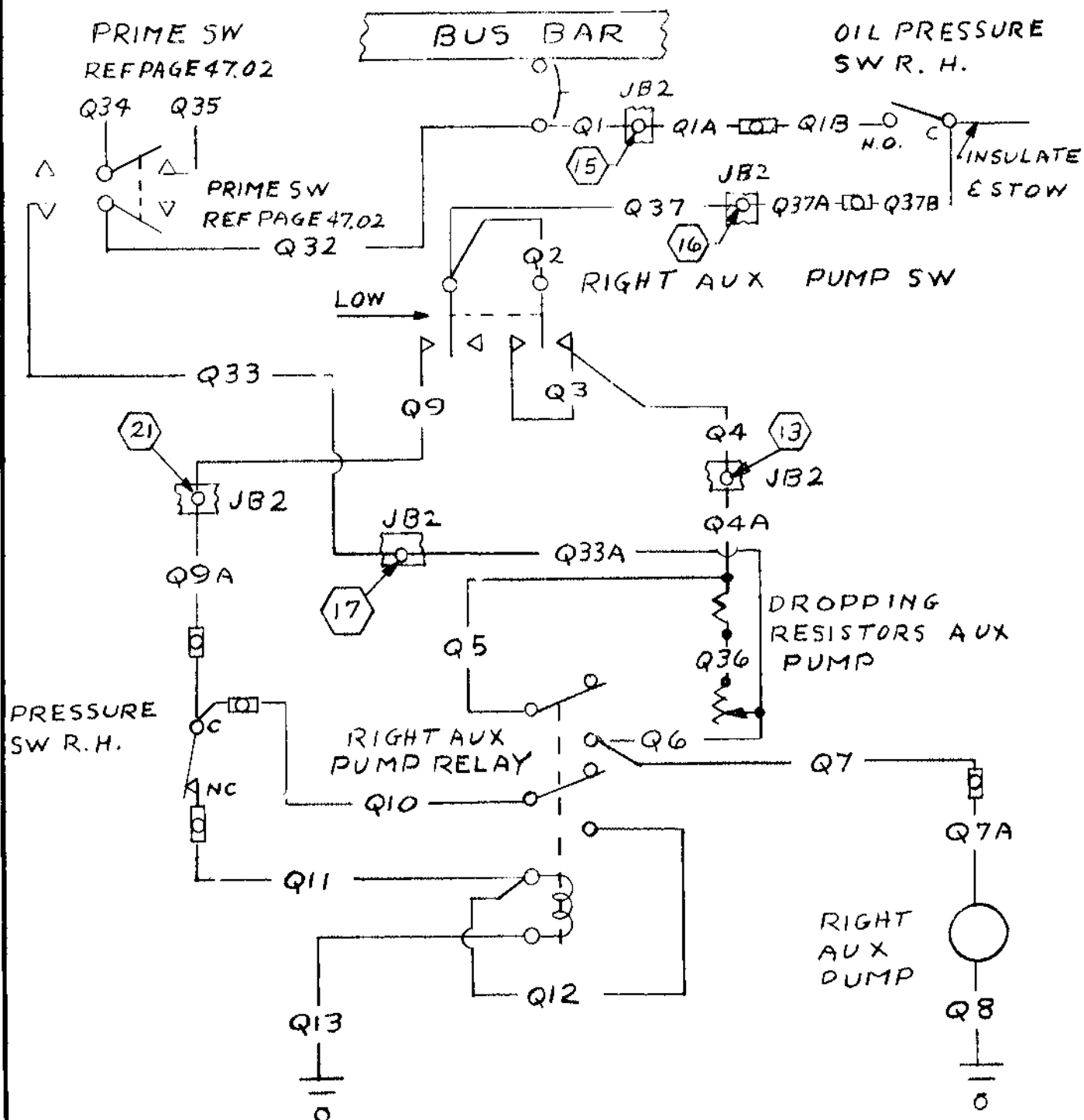
DUAL FUEL GAGE SYSTEM

EFF. SERIALS



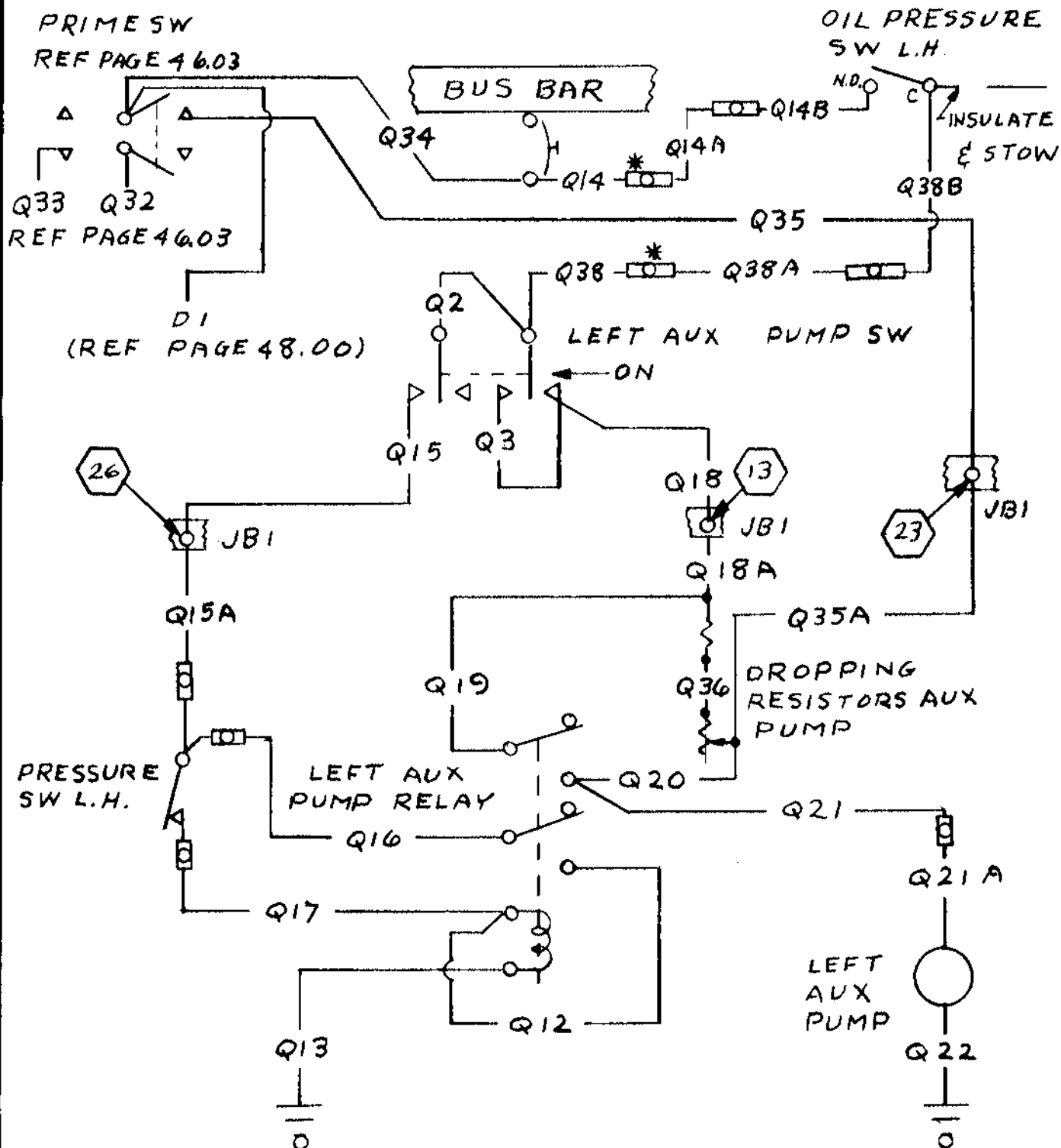
RIGHT AUX PUMP SYSTEM

PAGE EFFECTIVE



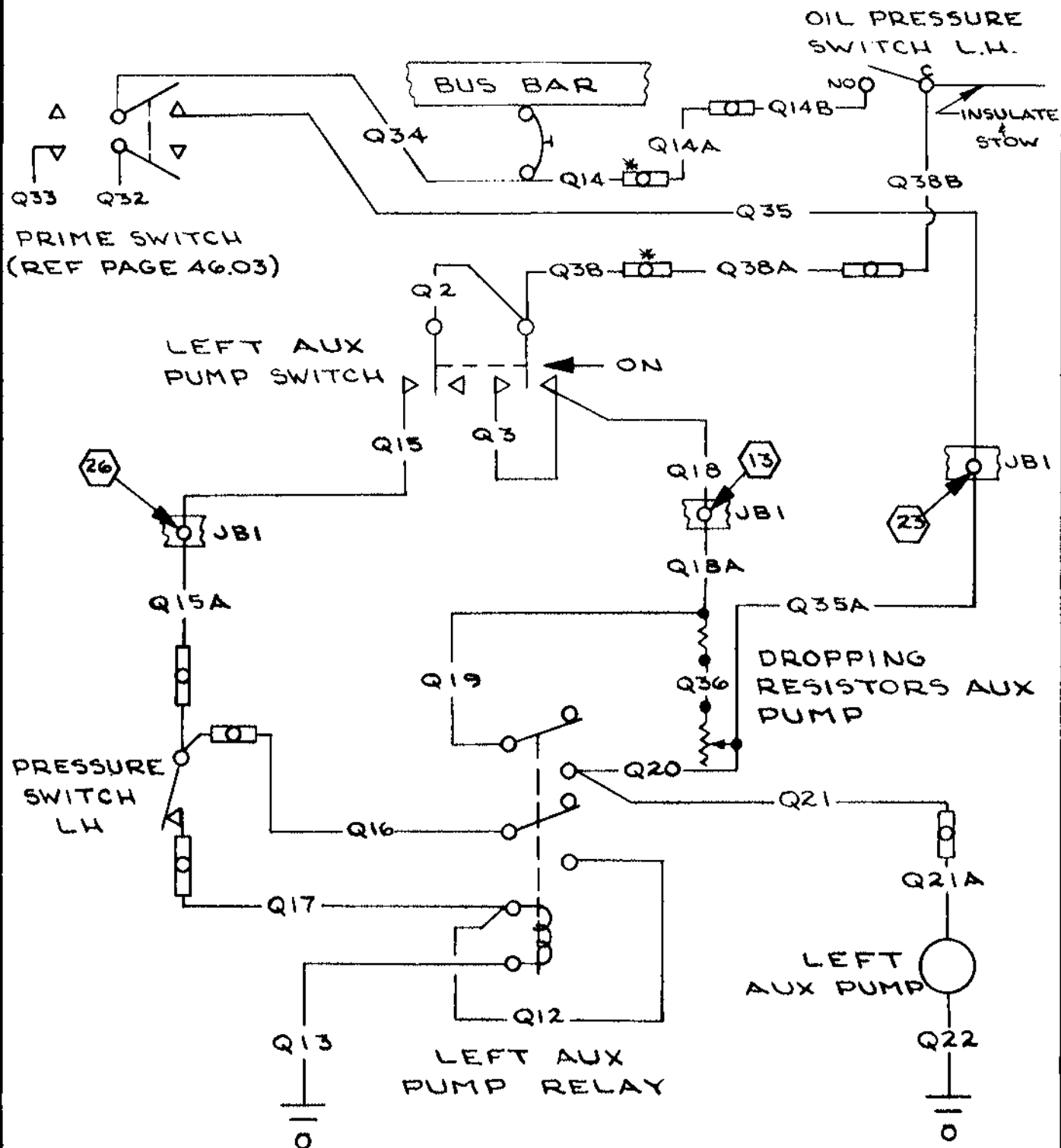
## LEFT AUX PUMP SYSTEM

EFF. SERIALS 310L0001 TO 310N0001



LEFT AUX PUMP SYSTEM

EFF. SERIALS 310N0001 & ON



\* DISCONNECTS IN LEFT JUNCTION BOX

CESSNA AIRCRAFT CO.  
WICHITA KANSAS

310  
MODEL

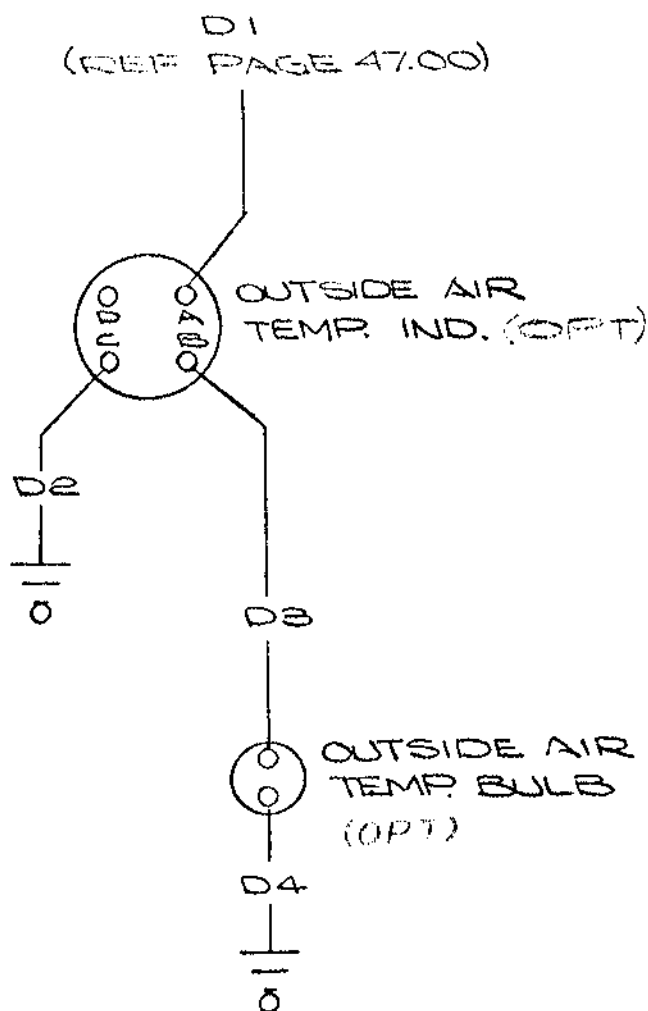
A  
REV.

0870090  
DRAWING NO.

48.00  
PAGE

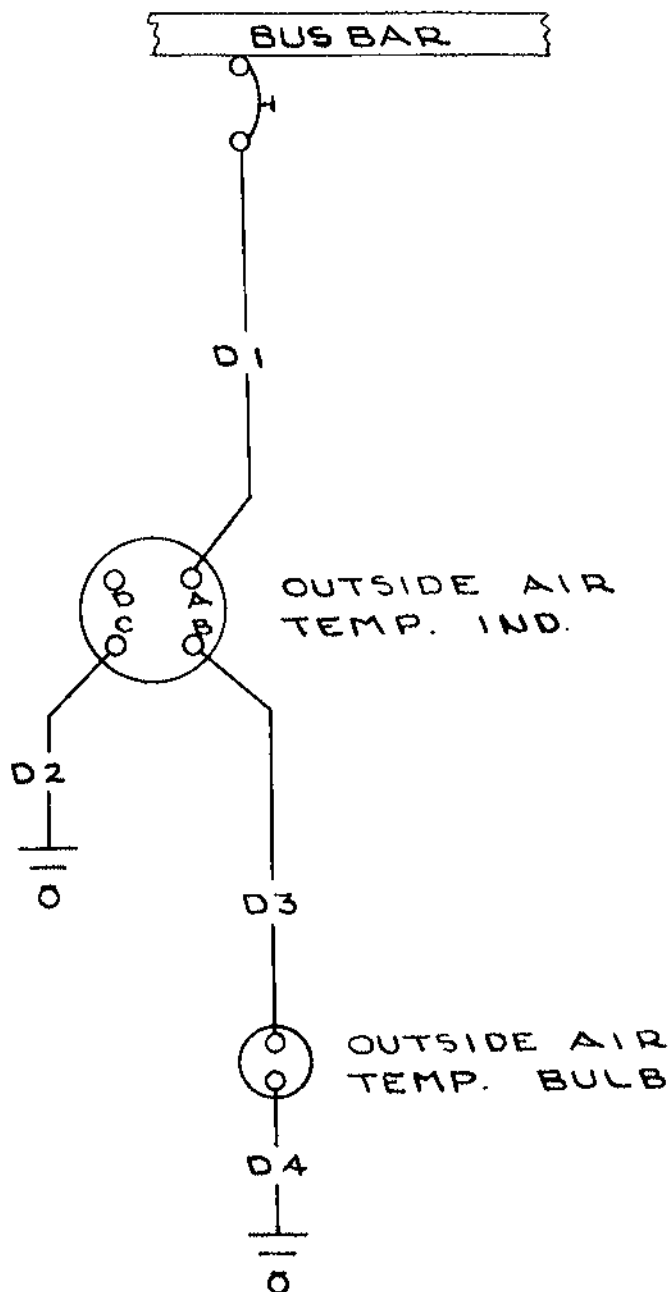
OUTSIDE AIR TEMPERATURE SYSTEM

EFF. SERIALS 310L0001 TO 310N0001



OUTSIDE AIR TEMPERATURE SYSTEM

EFF. SERIALS 310N0001 & ON



P45 (REF PAGE 69.00)

CESSNA AIRCRAFT CO.  
WICHITA, KANSAS

310  
MODEL

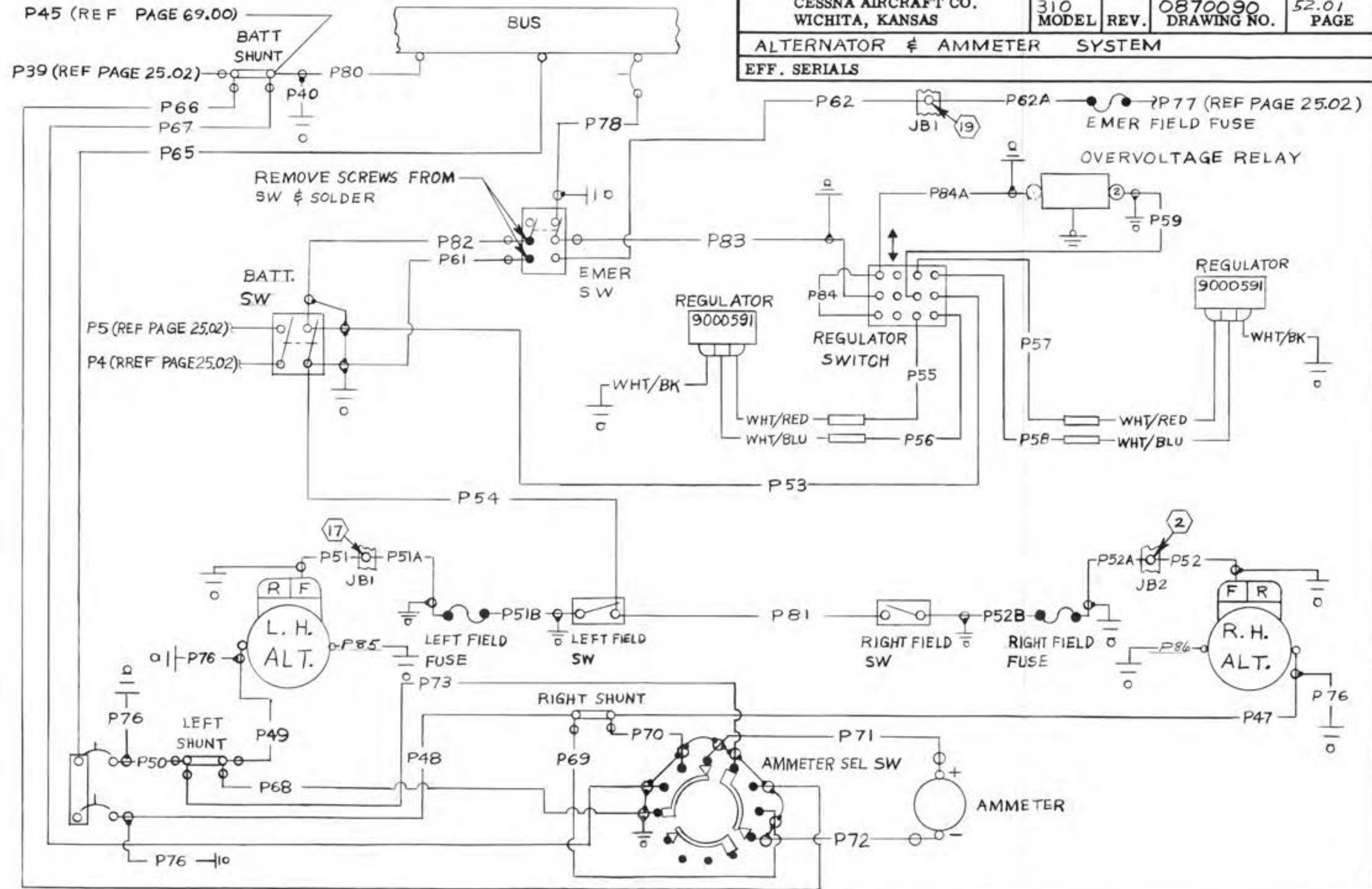
REV.

0870090  
DRAWING NO.

52.01  
PAGE

# ALTERNATOR & AMMETER SYSTEM

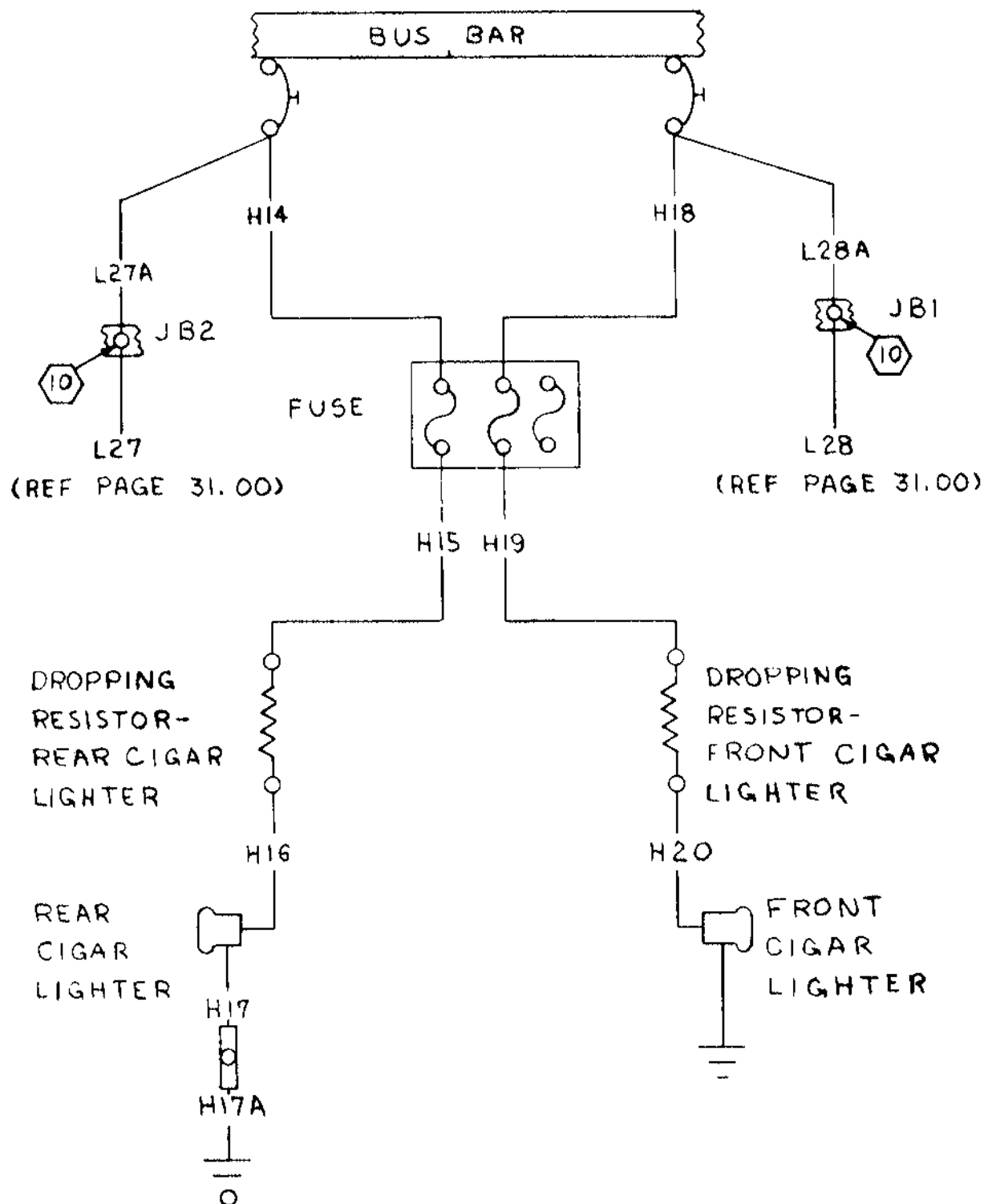
EFF. SERIALS





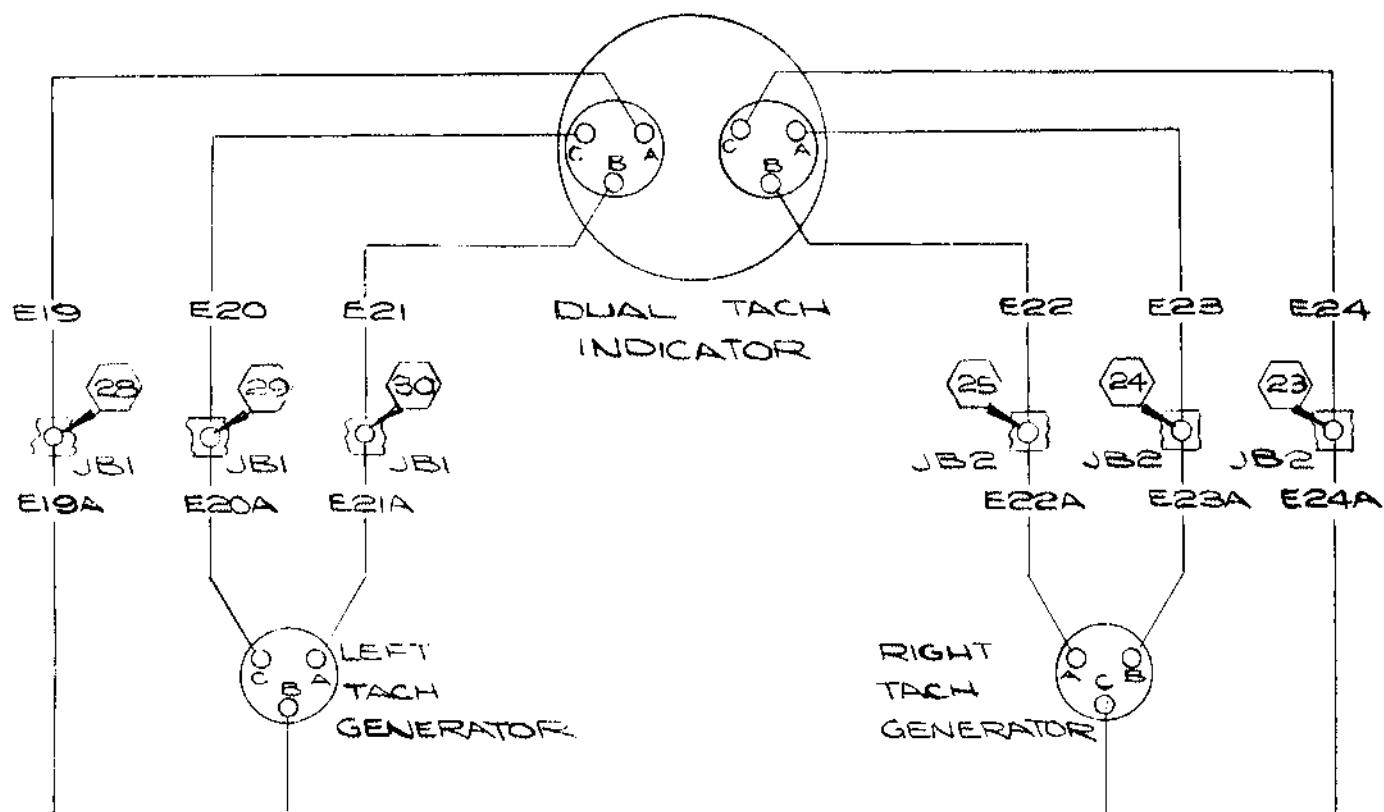
CIGAR LIGHTERS - FRONT & REAR

EFF. SERIALS



DUAL TACHOMETER SYSTEM

PAGE EFFECTIVE



CESSNA AIRCRAFT CO.  
WICHITA, KANSAS

310  
MODEL

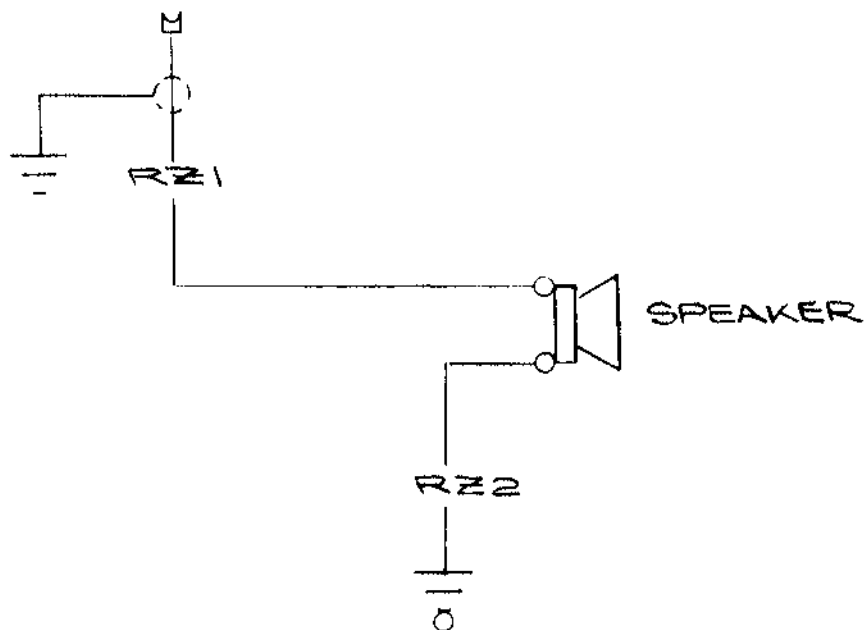
REV

0870090  
DRAWING NO.

55.00  
PAGE

SPEAKER CIRCUIT

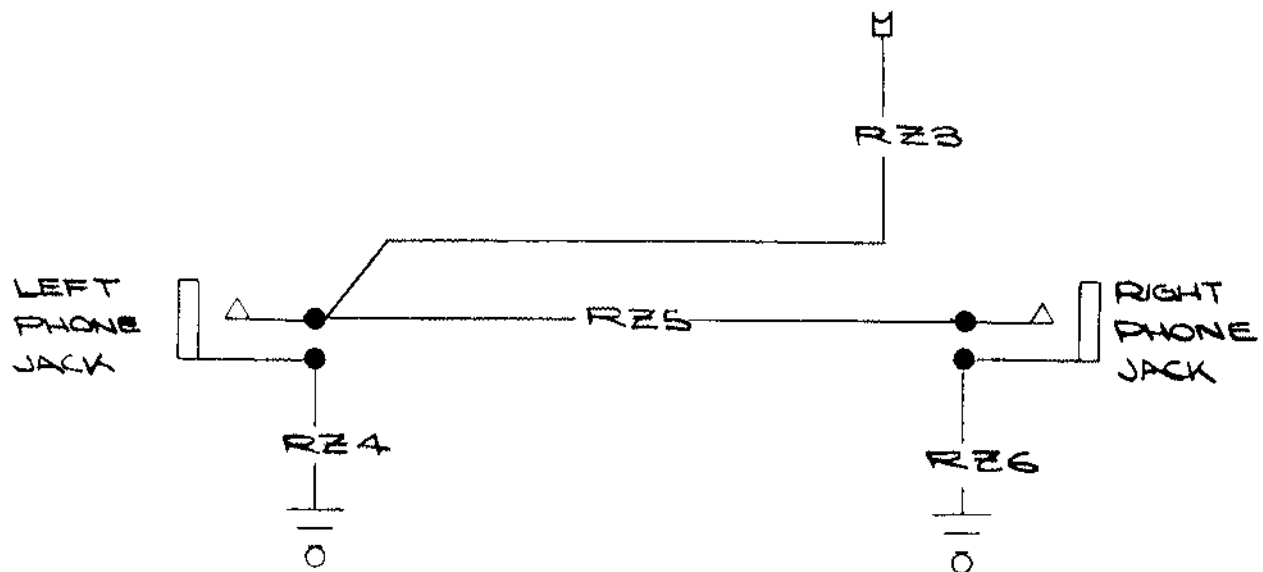
PAGE EFFECTIVE



|                                        |              |     |                        |               |
|----------------------------------------|--------------|-----|------------------------|---------------|
| CESSNA AIRCRAFT CO.<br>WICHITA, KANSAS | 310<br>MODEL | REV | 0870090<br>DRAWING NO. | 56.00<br>PAGE |
|----------------------------------------|--------------|-----|------------------------|---------------|

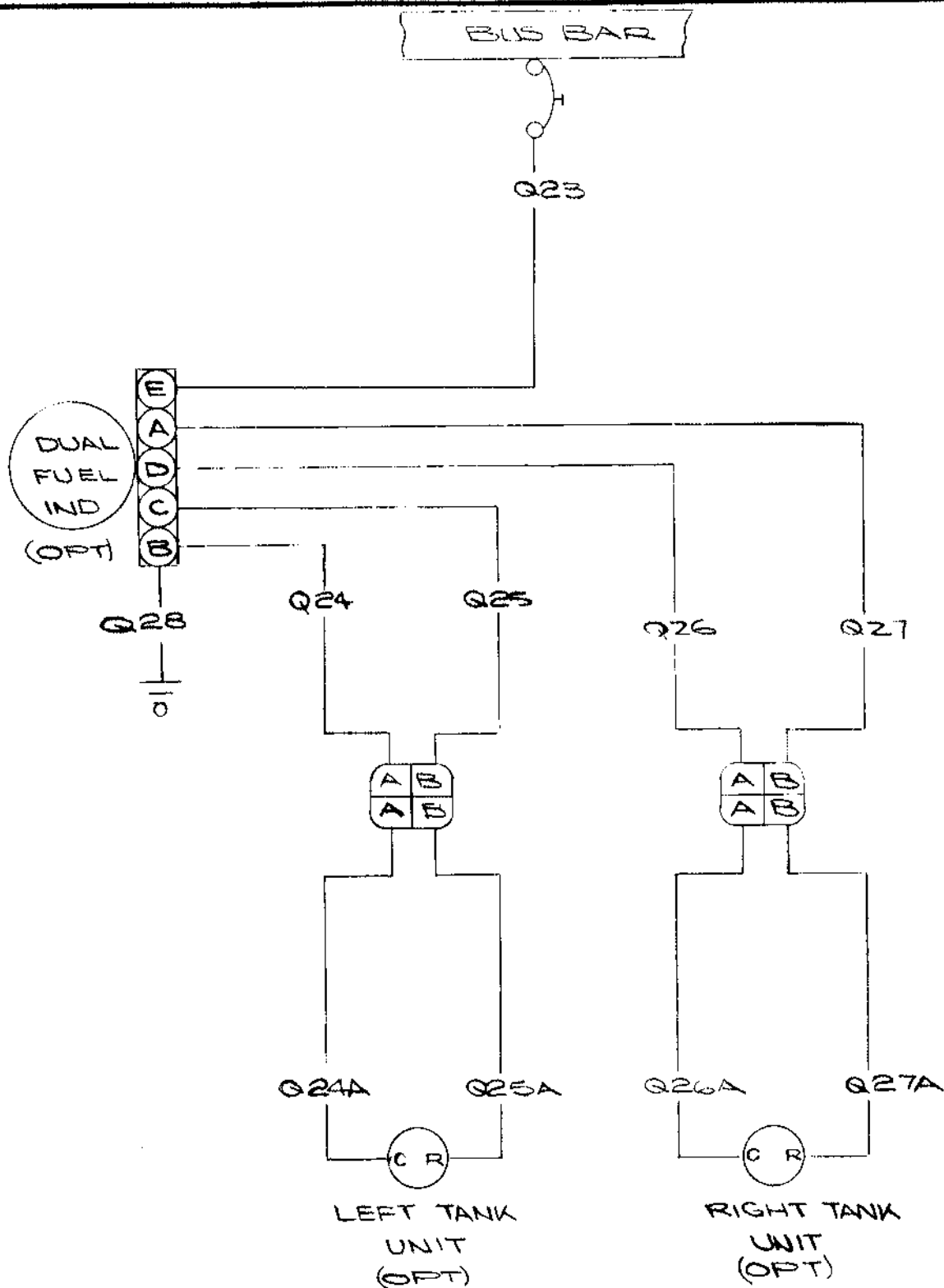
PHONE JACK CIRCUIT

PAGE EFFECTIVE



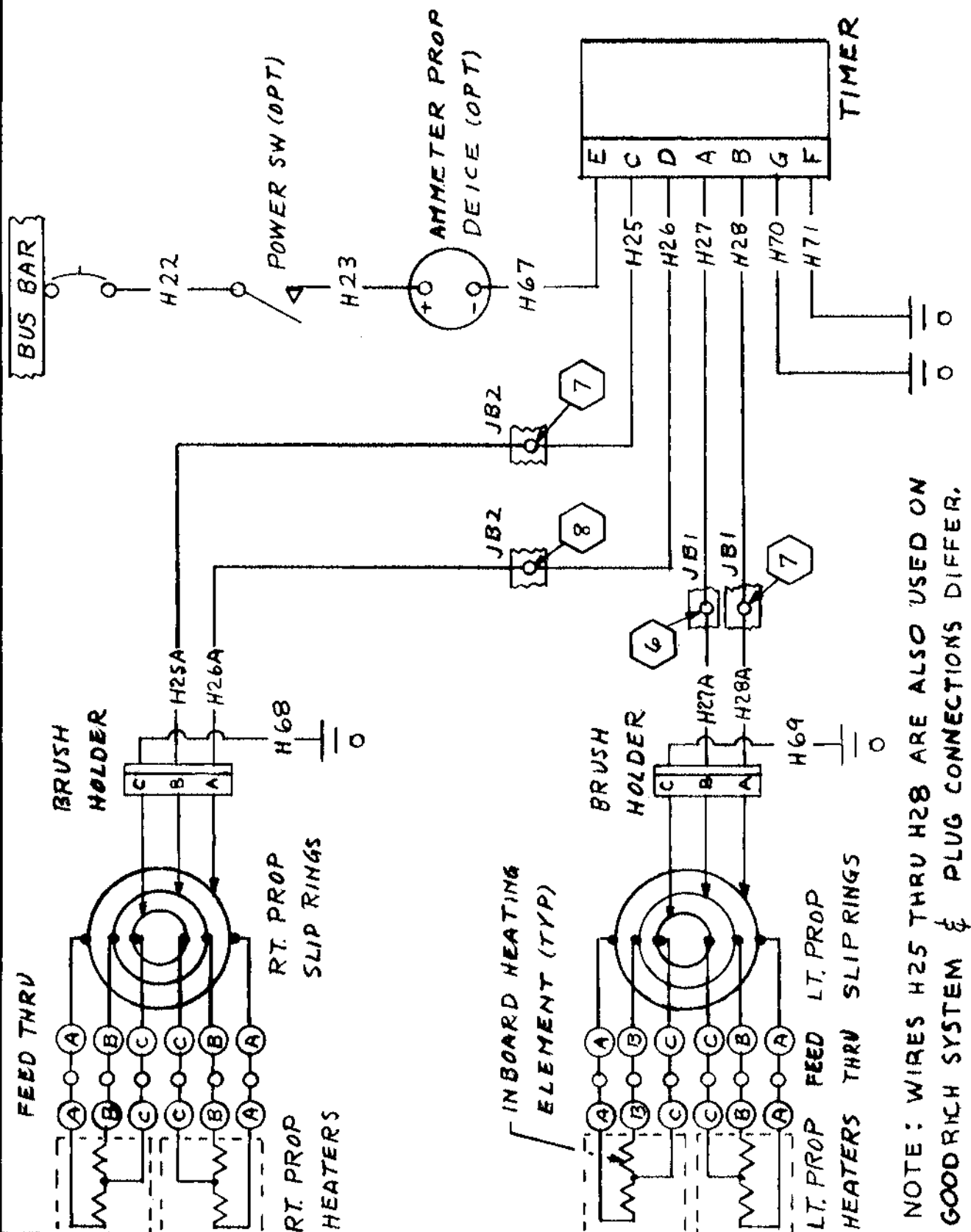
AUXILIARY FUEL INDICATION SYSTEM (OPT)

PAGE EFFECTIVE



PROP DEICE SYSTEM - GOODYEAR (OPT)

EFF. SERIALS 310L0001 & ON



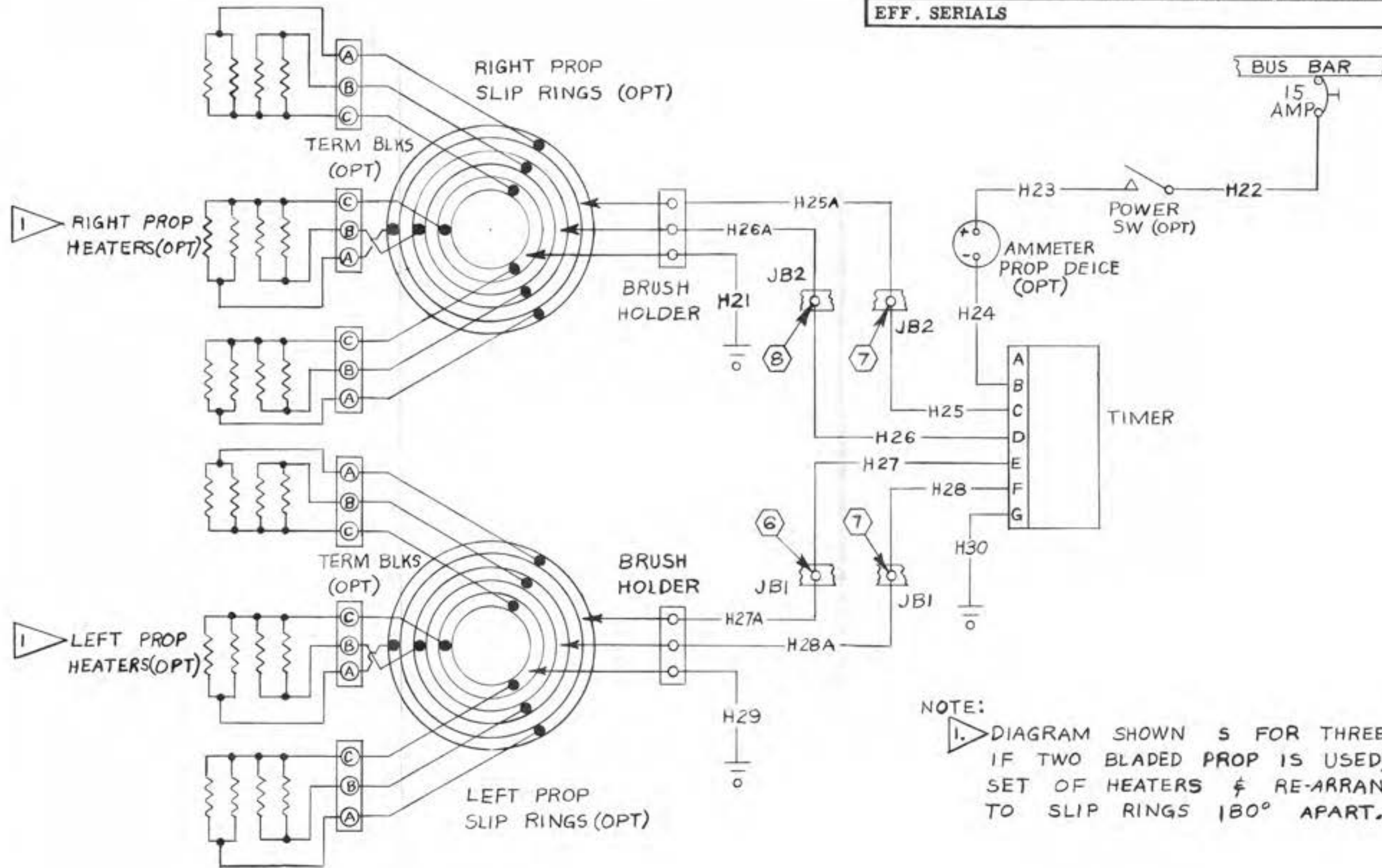
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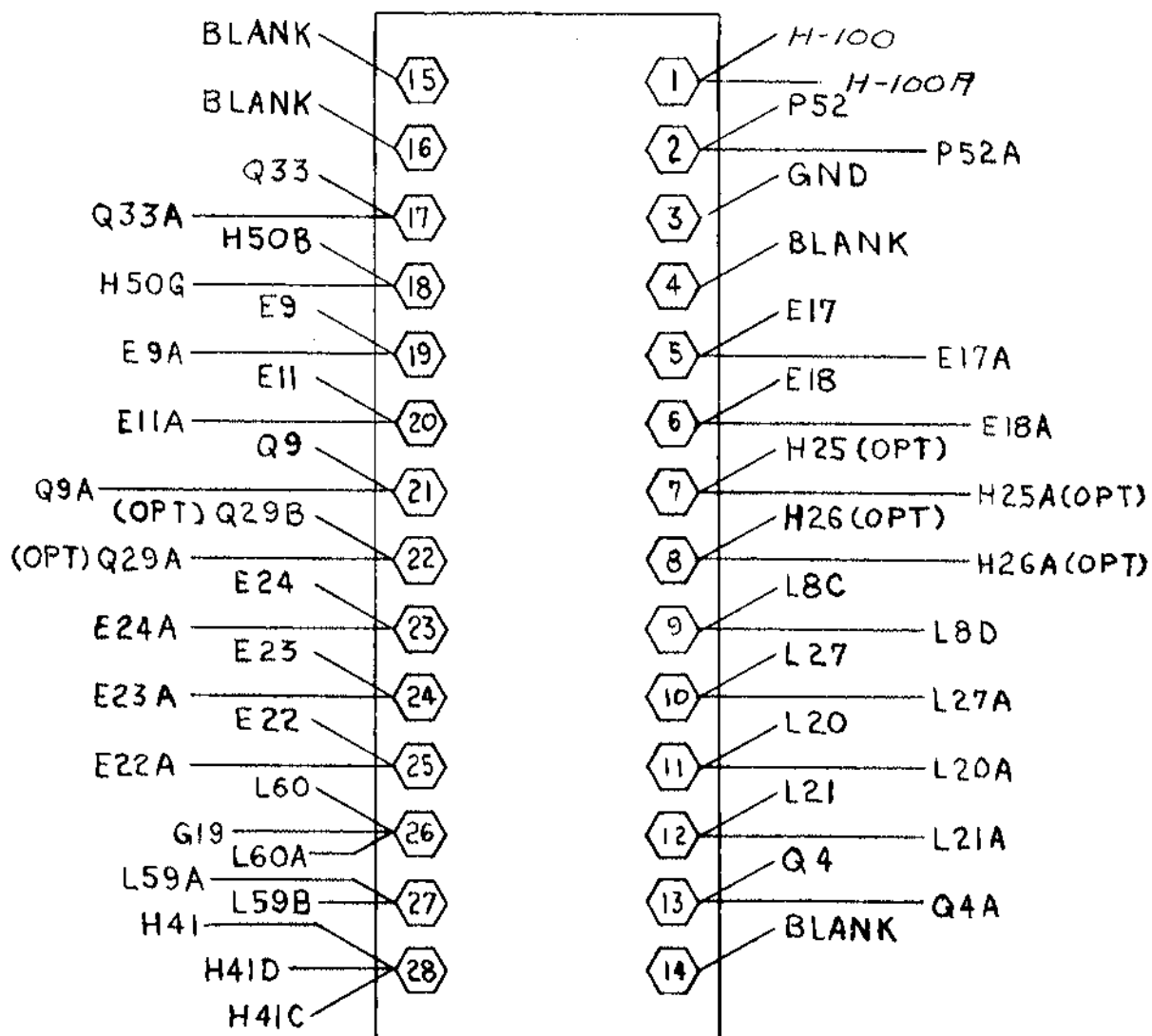
PROP DEICE SYSTEM (OPT) GOODRICH

EFF. SERIALS



RIGHT JUNCTION BOX CONNECTIONS

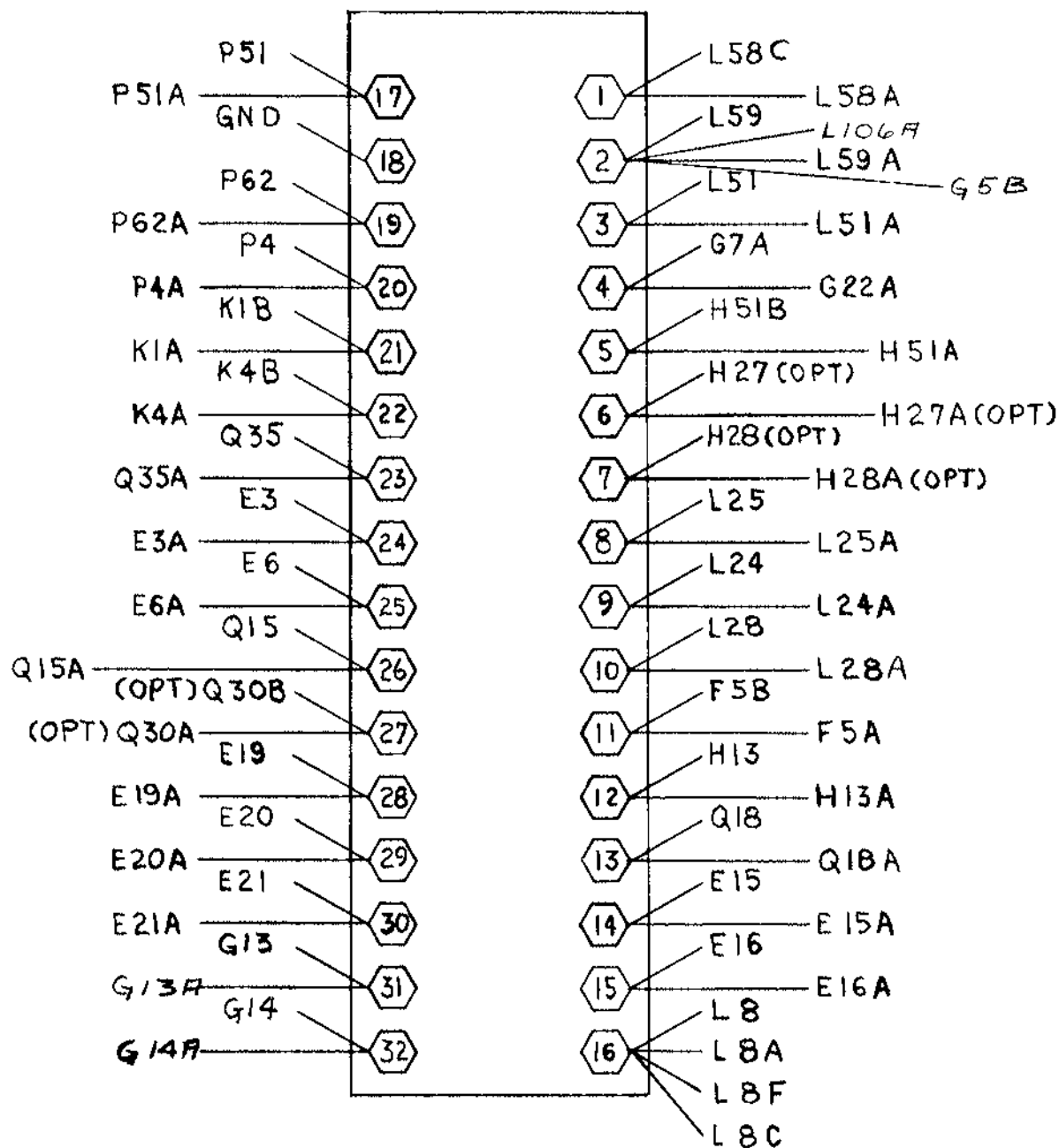
EFF. SERIALS



RIGHT JUNCTION  
BOX  
JB2

LEFT JUNCTION BOX CONNECTIONS

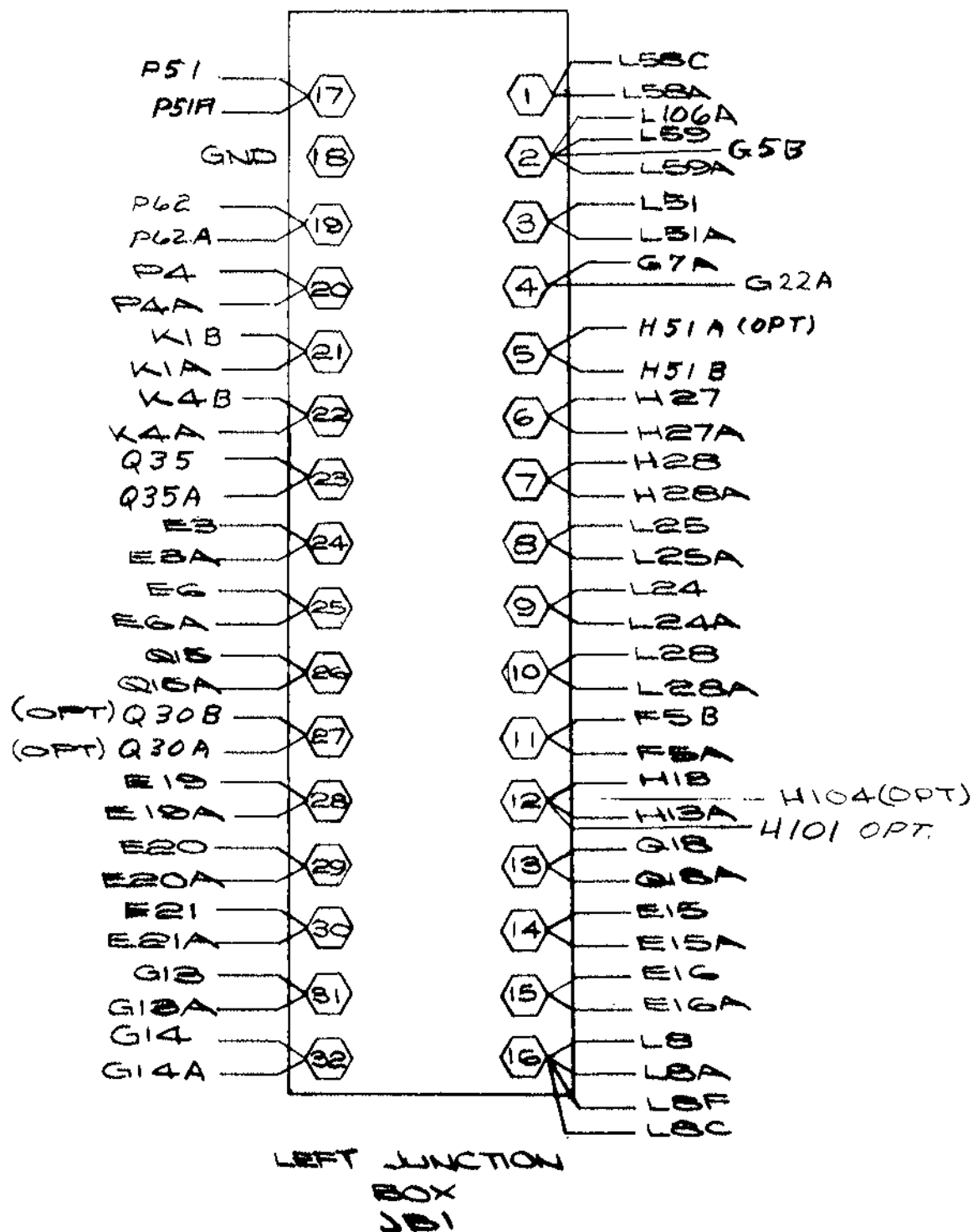
EFF. SERIALS



LEFT JUNCTION  
BOX  
JBI

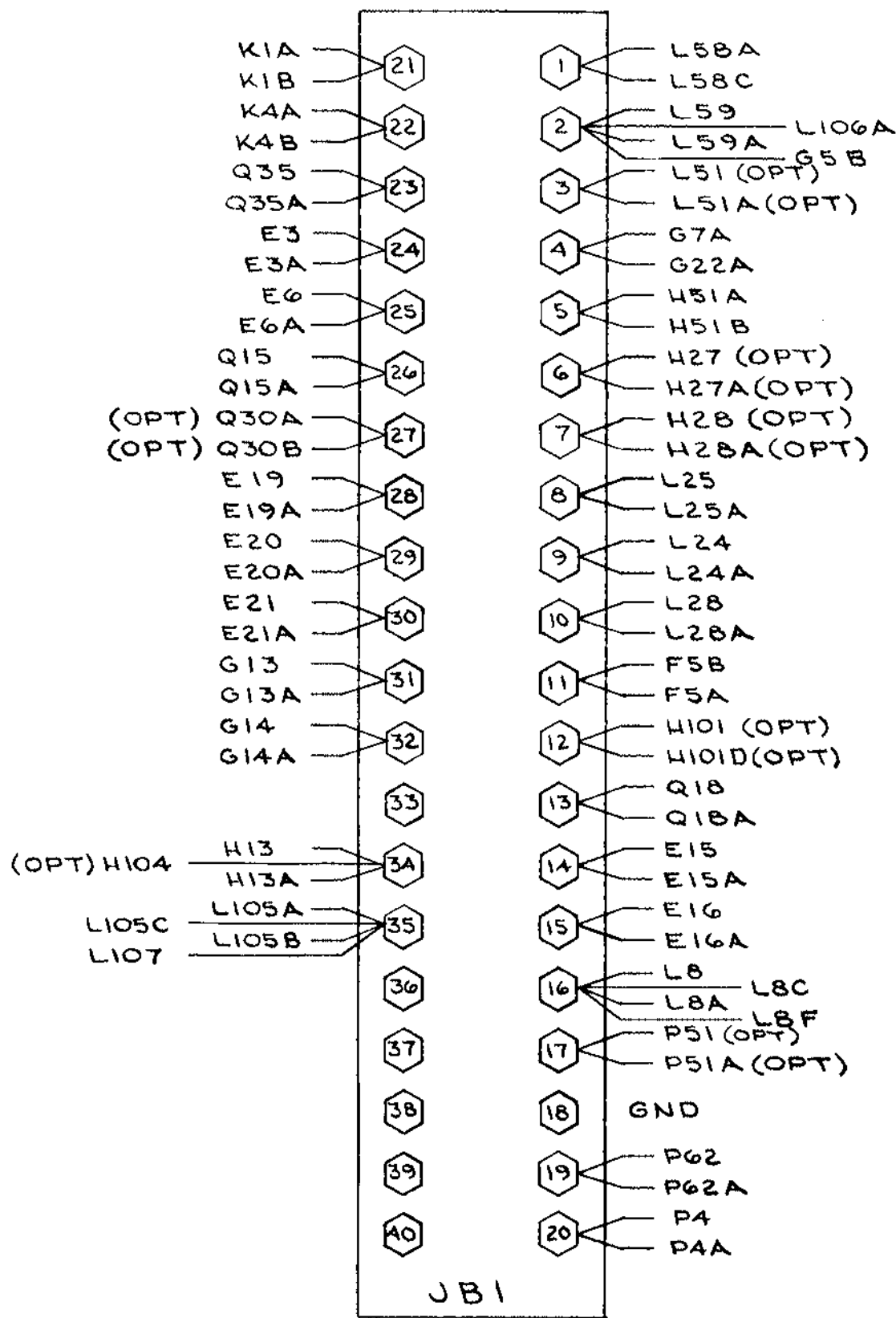
## LEFT JUNCTION BOX CONNECTIONS

EFF. SERIALS 310L0050 TO 310N0001



## LEFT JUNCTION BOX CONNECTIONS

EFF. SERIALS 310N0001 &amp; ON

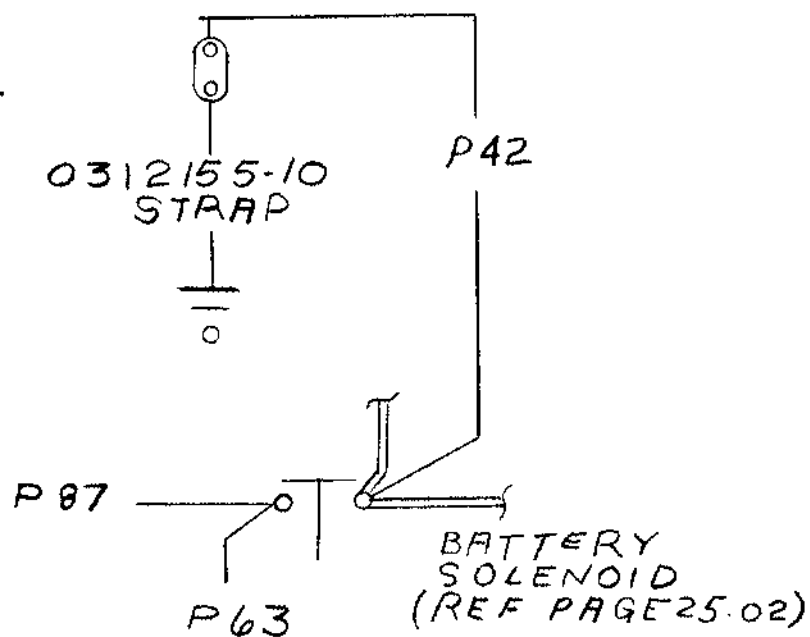


LEFT JUNCTION BOX

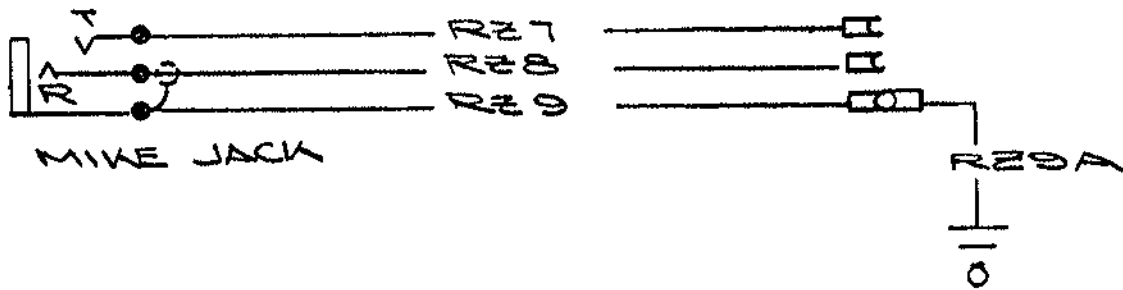
EXTERNAL POWER RECEPTACLE (OPT)

EFF. SERIALS

EXTERNAL  
POWER  
RECEPTACLE  
(OPT)



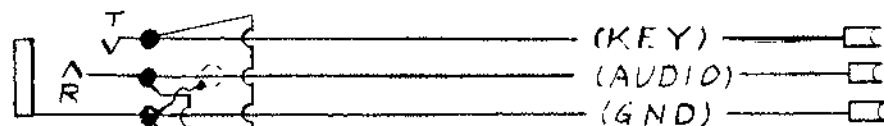
|                                       |              |      |                        |               |
|---------------------------------------|--------------|------|------------------------|---------------|
| CESSNA AIRCRAFT CO.<br>WICHITA KANSAS | 310<br>MODEL | REV. | 0870090<br>DRAWING NO. | 62.00<br>PAGE |
| MIKE JACK CIRCUIT                     |              |      |                        |               |
| EFF. SERIALS 310N0001 & ON            |              |      |                        |               |



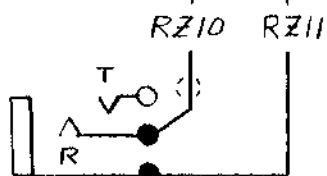
MIKE JACK CIRCUIT (OPT)

EFF. SERIALS

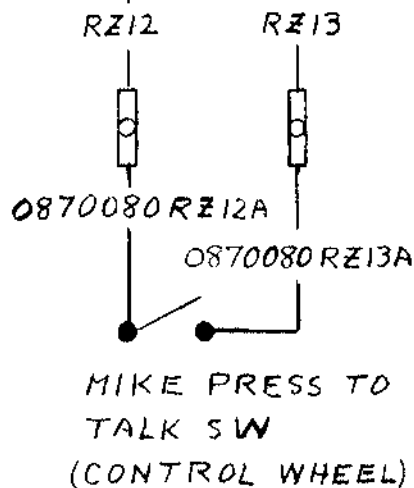
MIKE JACK-STD  
(SEAT BKT)



DE 400 DIODES  
(SECURE TO WIRE BUNDLE)



\* MIKE JACK (OPT)  
(CONSOLE)  
(INSULATED  
FROM GND)

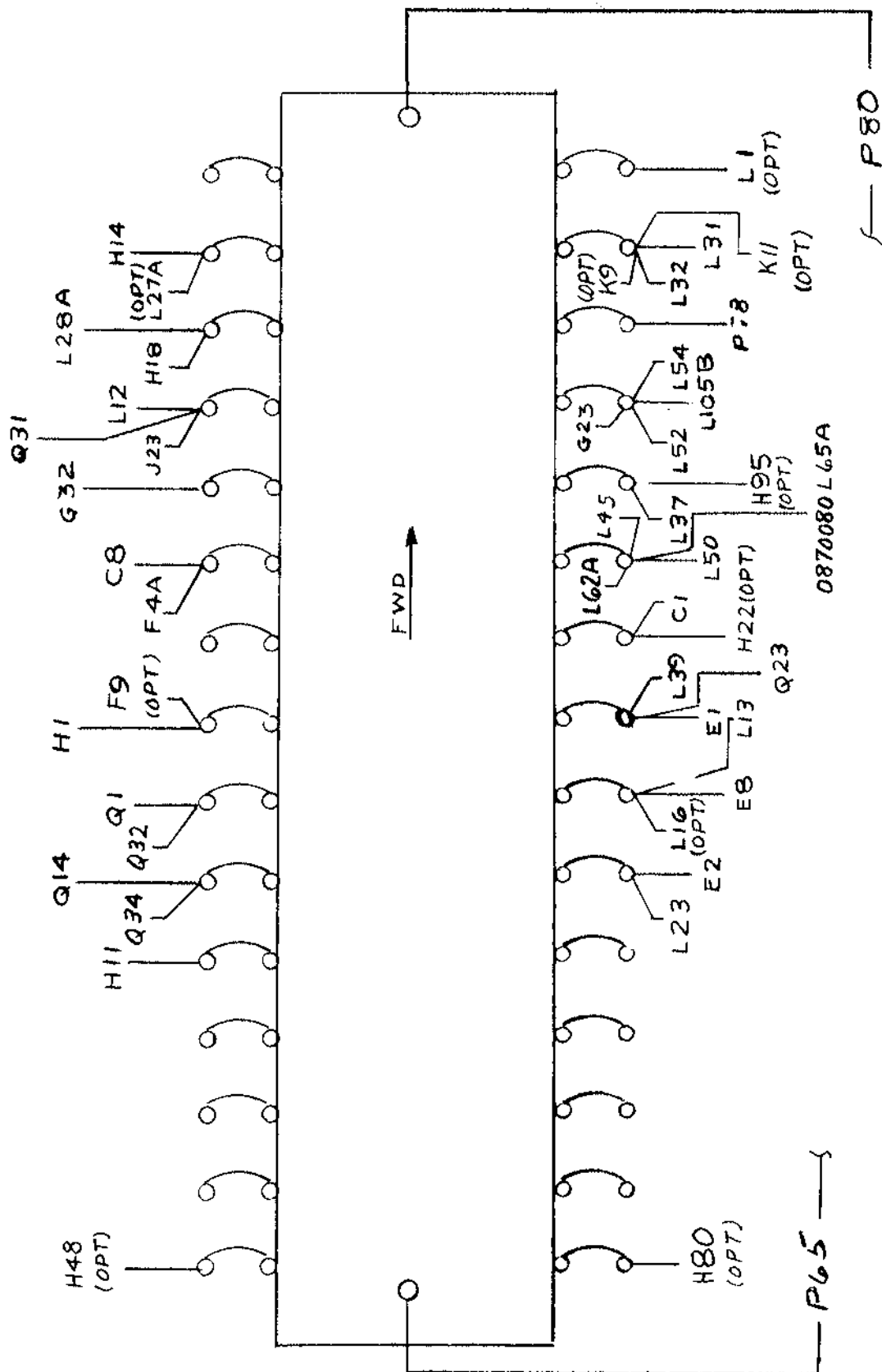


\* ADD TO STD MIKE JACK SYSTEM



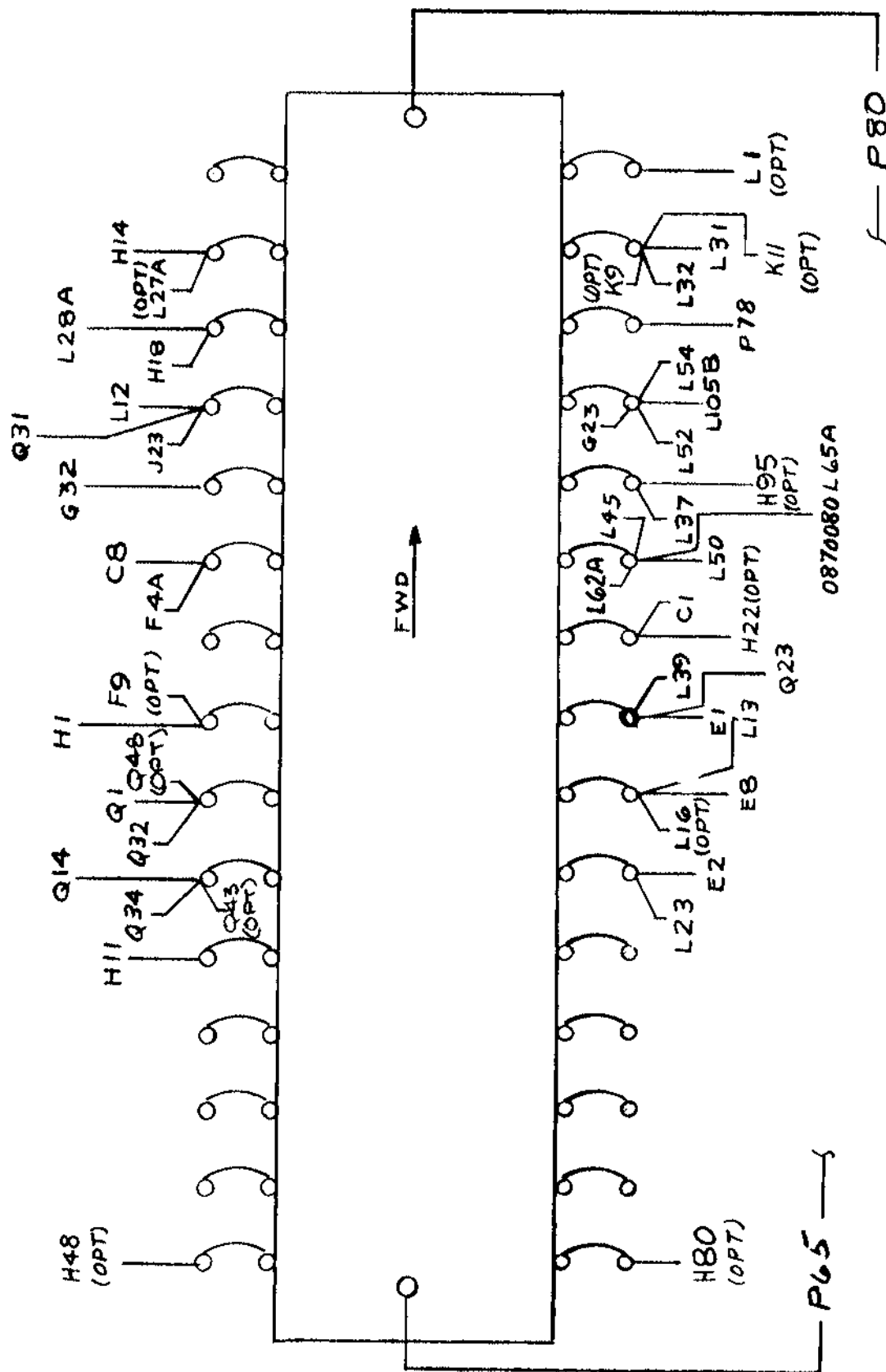
CIRCUIT BREAKER CONNECTIONS

EFF. SERIALS



CIRCUIT BREAKER CONNECTIONS

EFF. SERIALS 310L0050 TO 310N0001

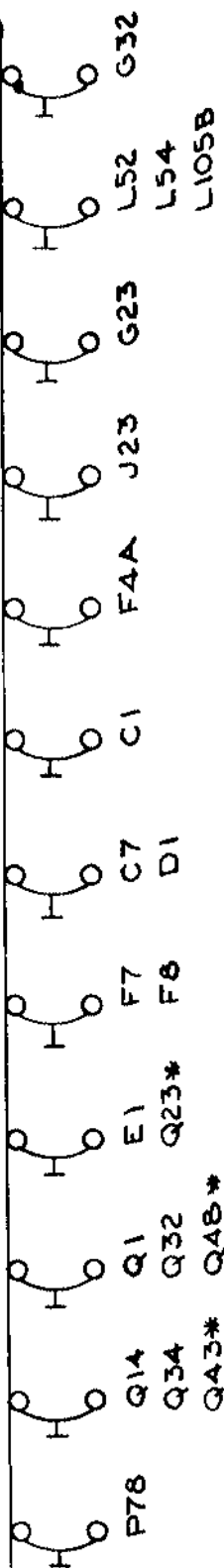


CIRCUIT BREAKER CONNECTIONS

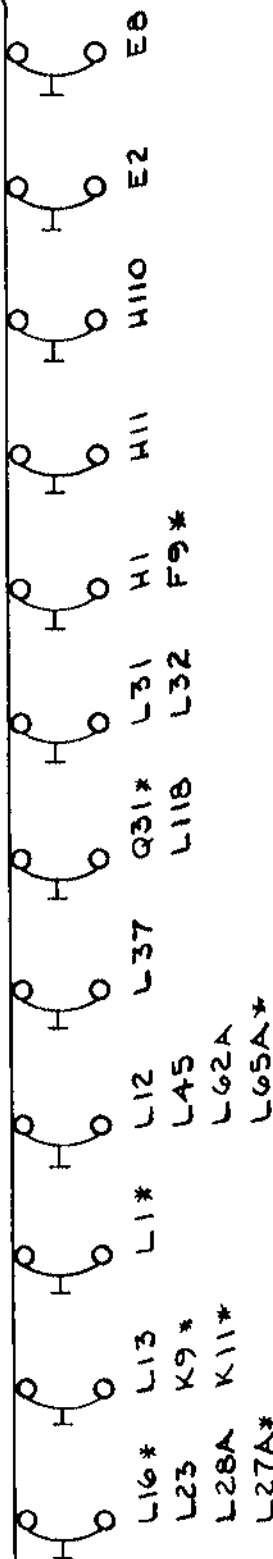
EFF. SERIALS 310N0001 & ON

→ FWD

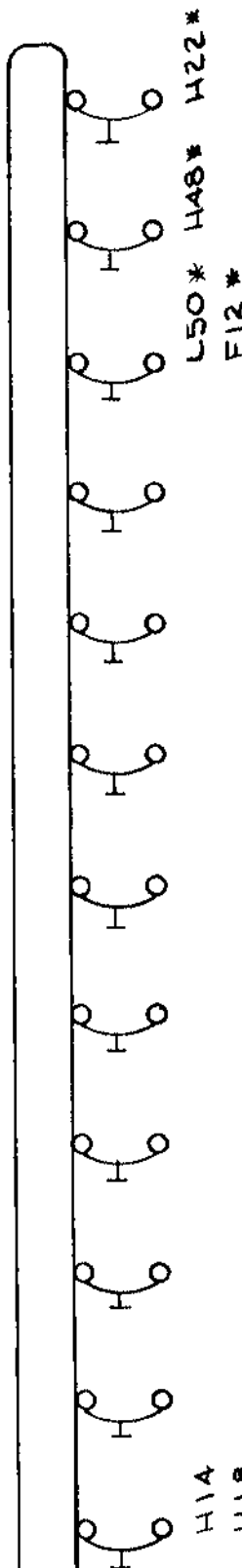
ROW #1



ROW #2



ROW #A



FOR ALTERNATE HOOK UP  
ROW #4 SEE PAGE 63.07

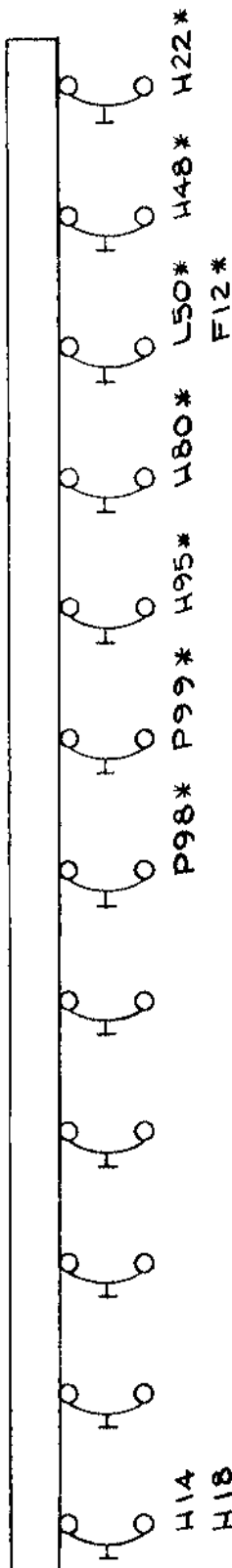
\* OPT EQUIP.

ALTERNATE CONNECTIONS FOR ROW #4 CKT BKR'S

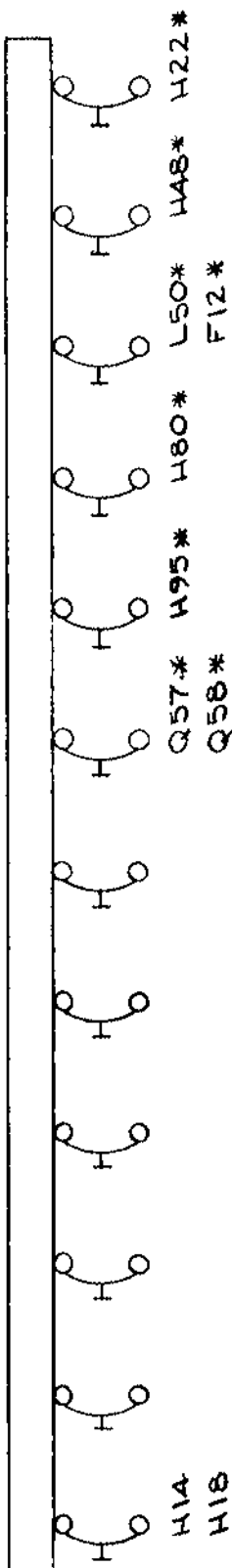
EFF. SERIALS 310N0001 & ON



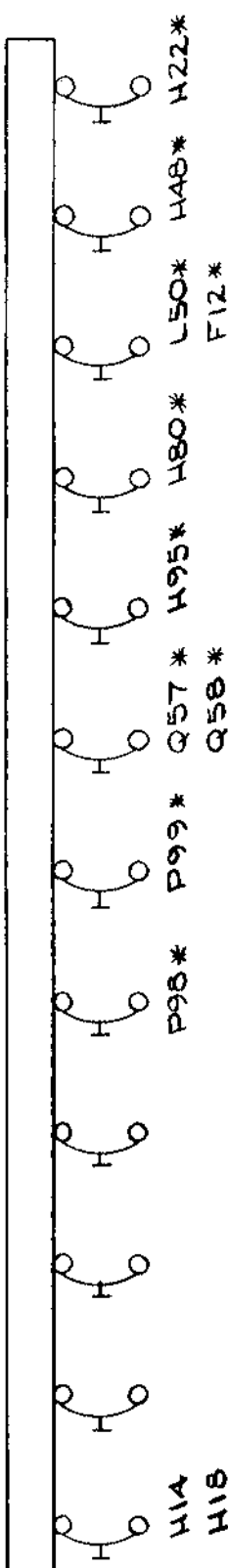
ROW #A



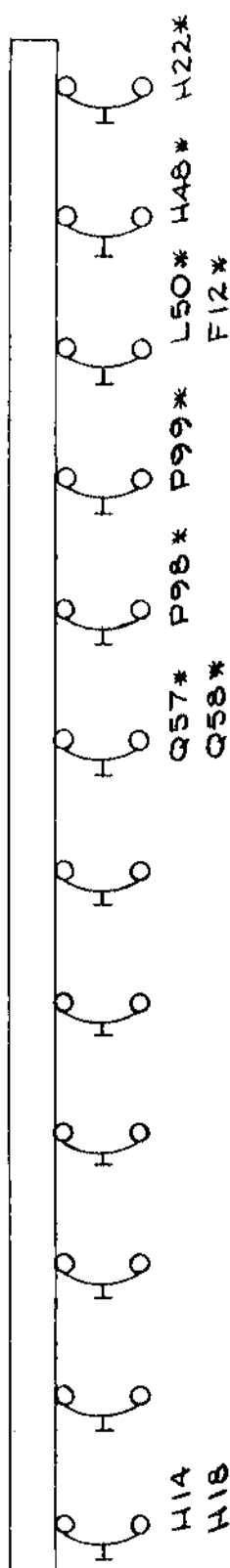
ROW #A



ROW #A



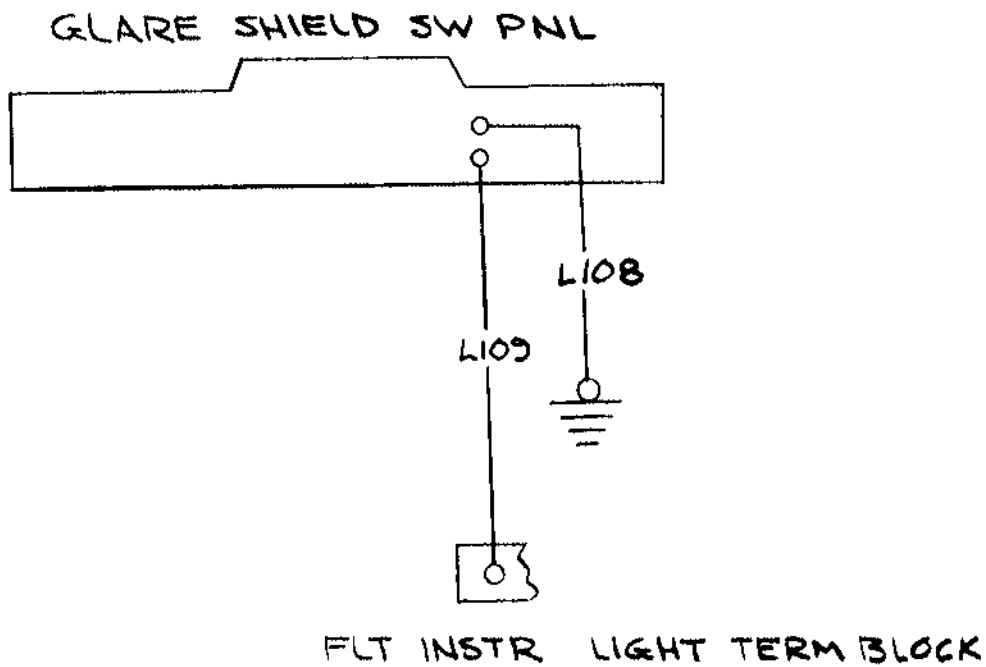
ROW #A



\* OPT EQUIP.

HOOD LIGHT CIRCUIT

EFF. SERIALS 310L0001 TO 310N0001



ELECTROLUMINESCENT LAMP CKT, (OPT) C/B PANEL EL

EFF. SERIALS 310N0001 & ON

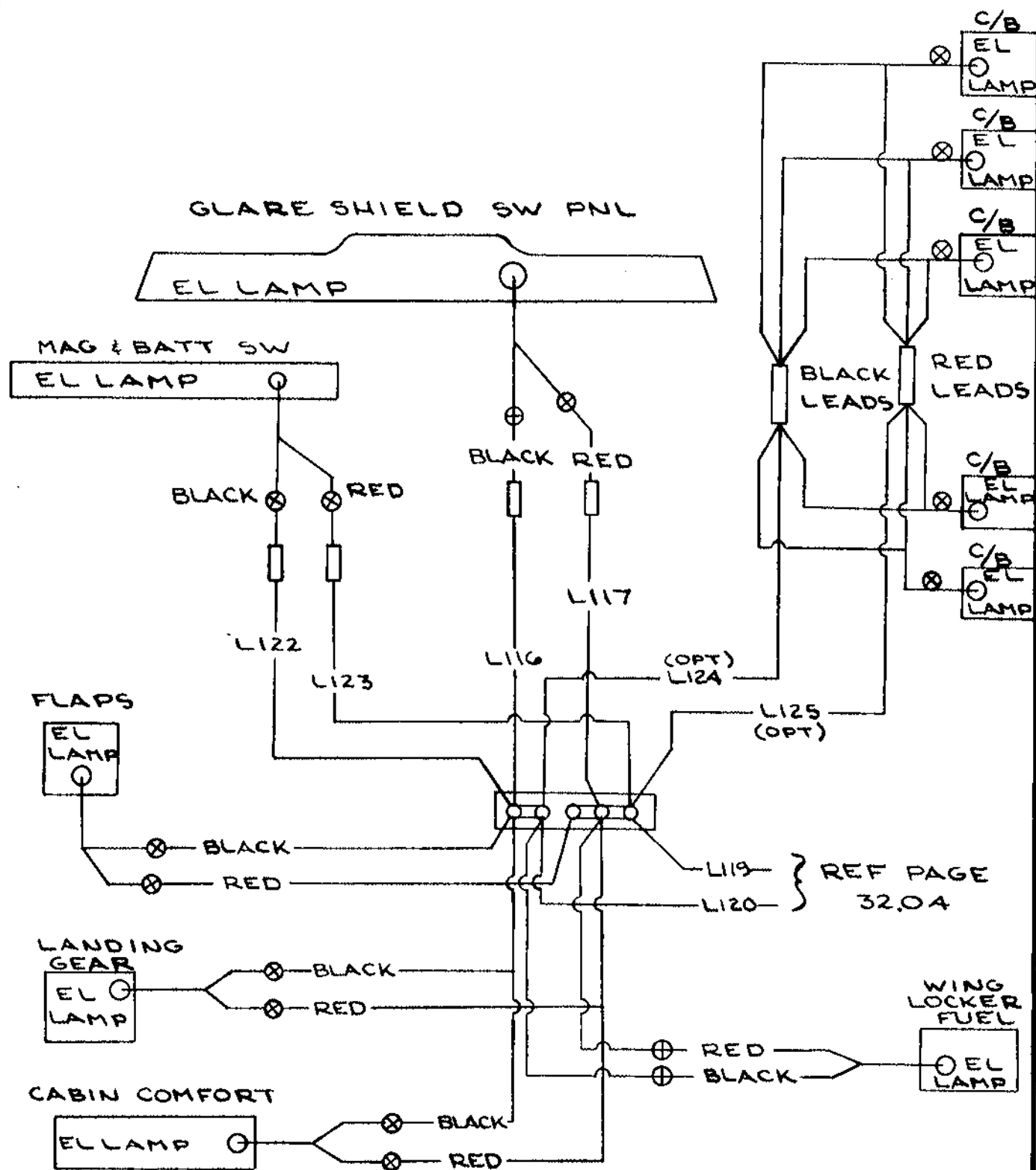
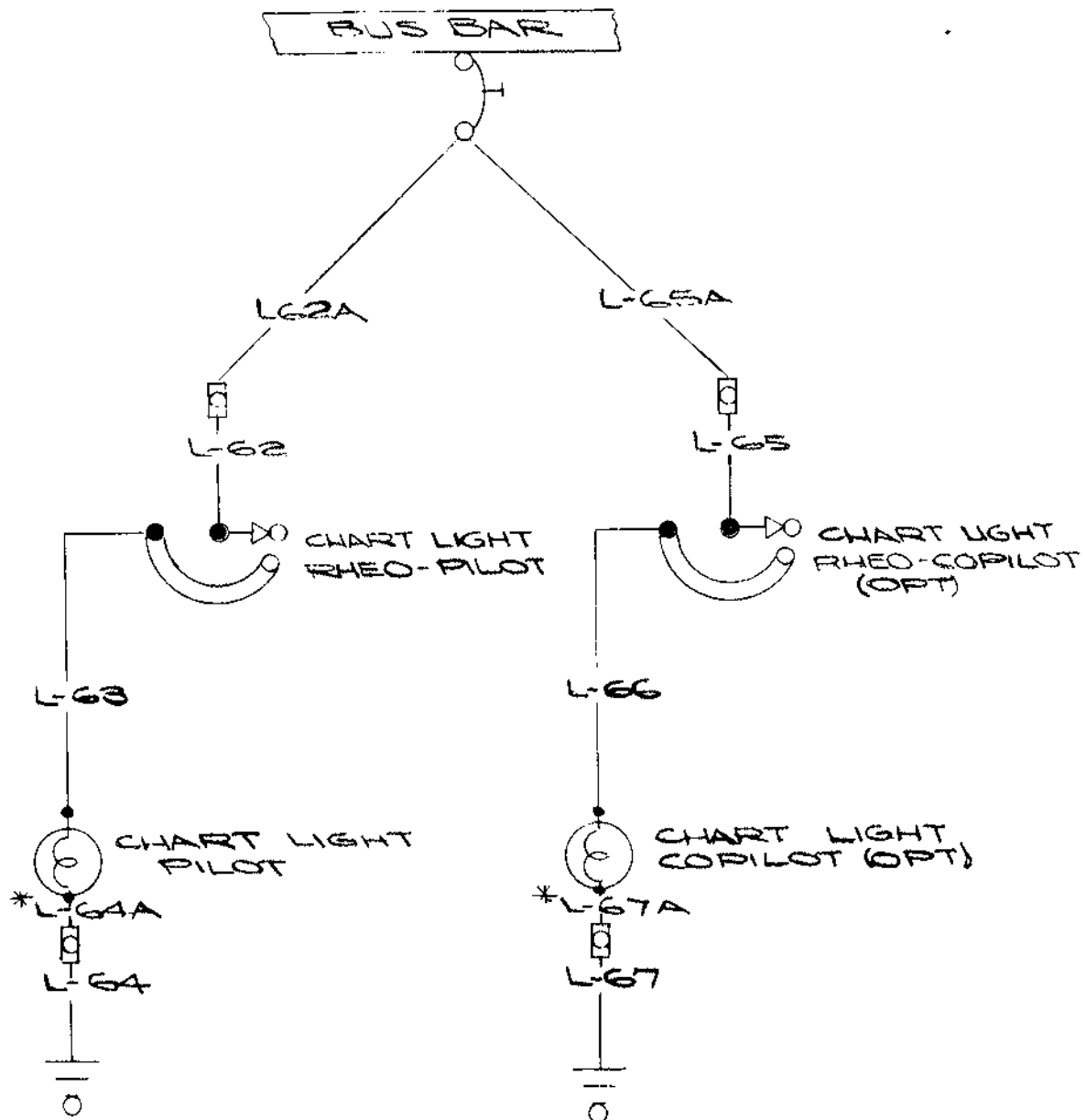


CHART LIGHTS - CONTROL WHEEL

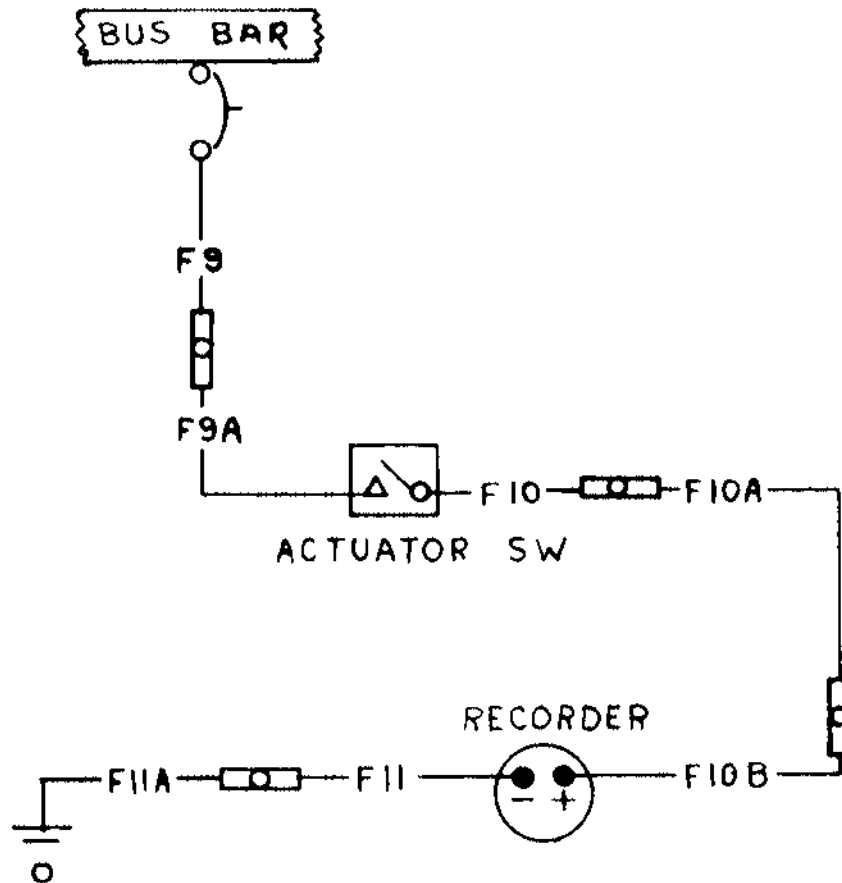
PAGE EFFECTIVE



\* GRND WIRE TO BE SOLDERED  
TO LIGHT SOCKET

FLIGHT HOUR RECORDER (OPTIONAL)

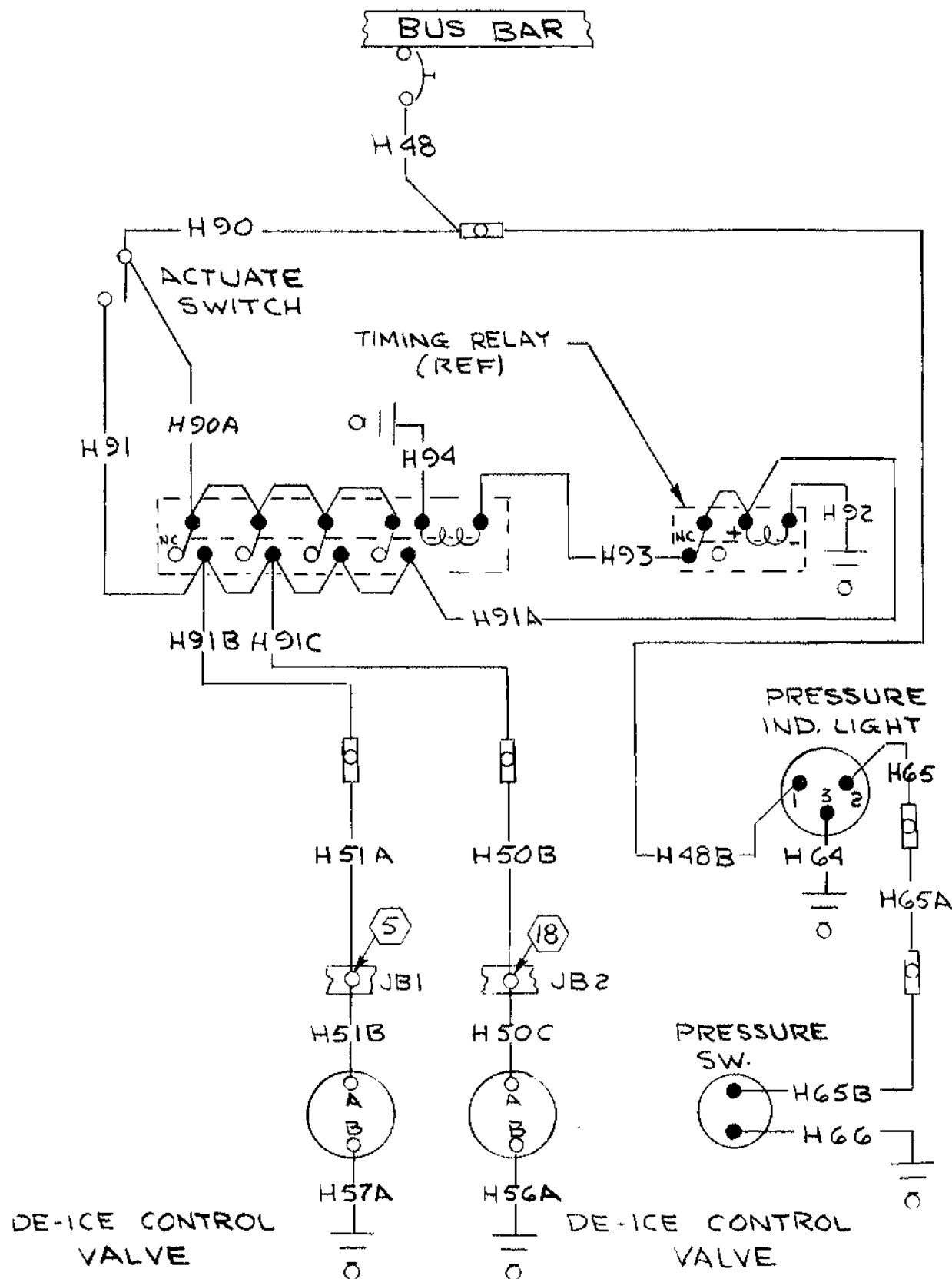
EFF. SERIALS





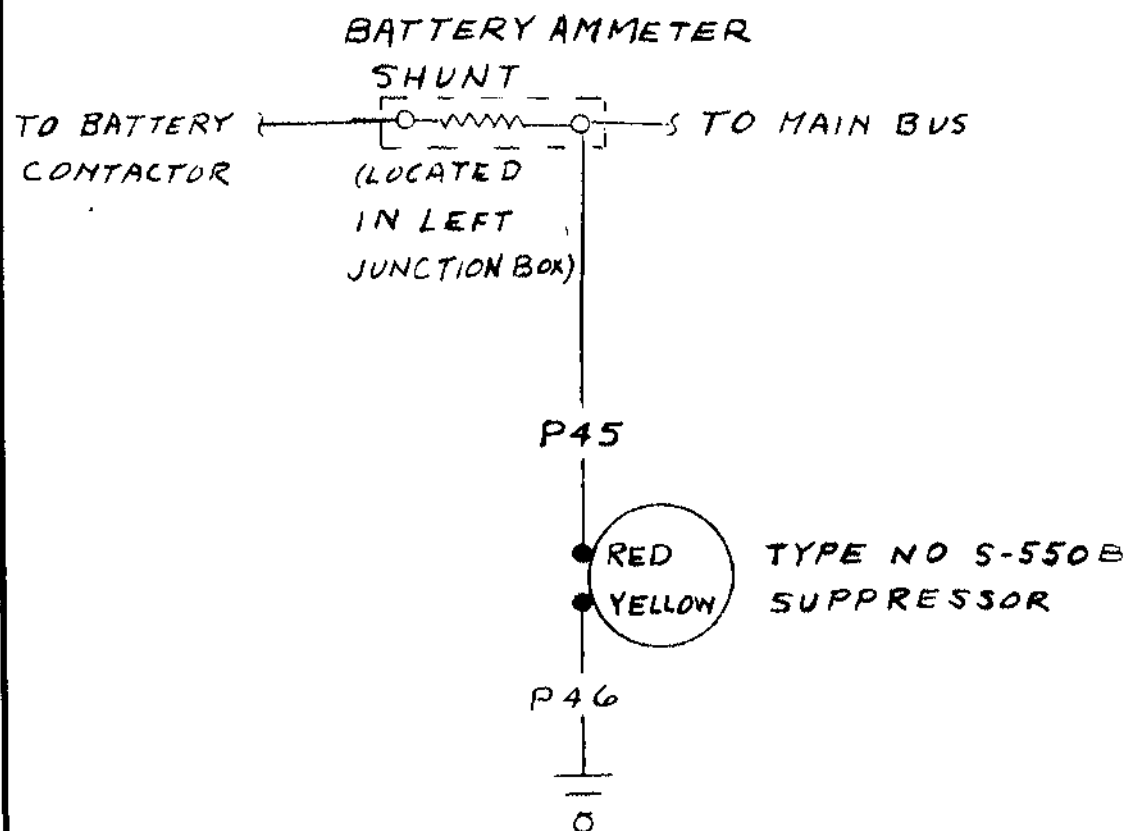
WING DE-ICE SYSTEM (OPT)

EFF. SERIALS

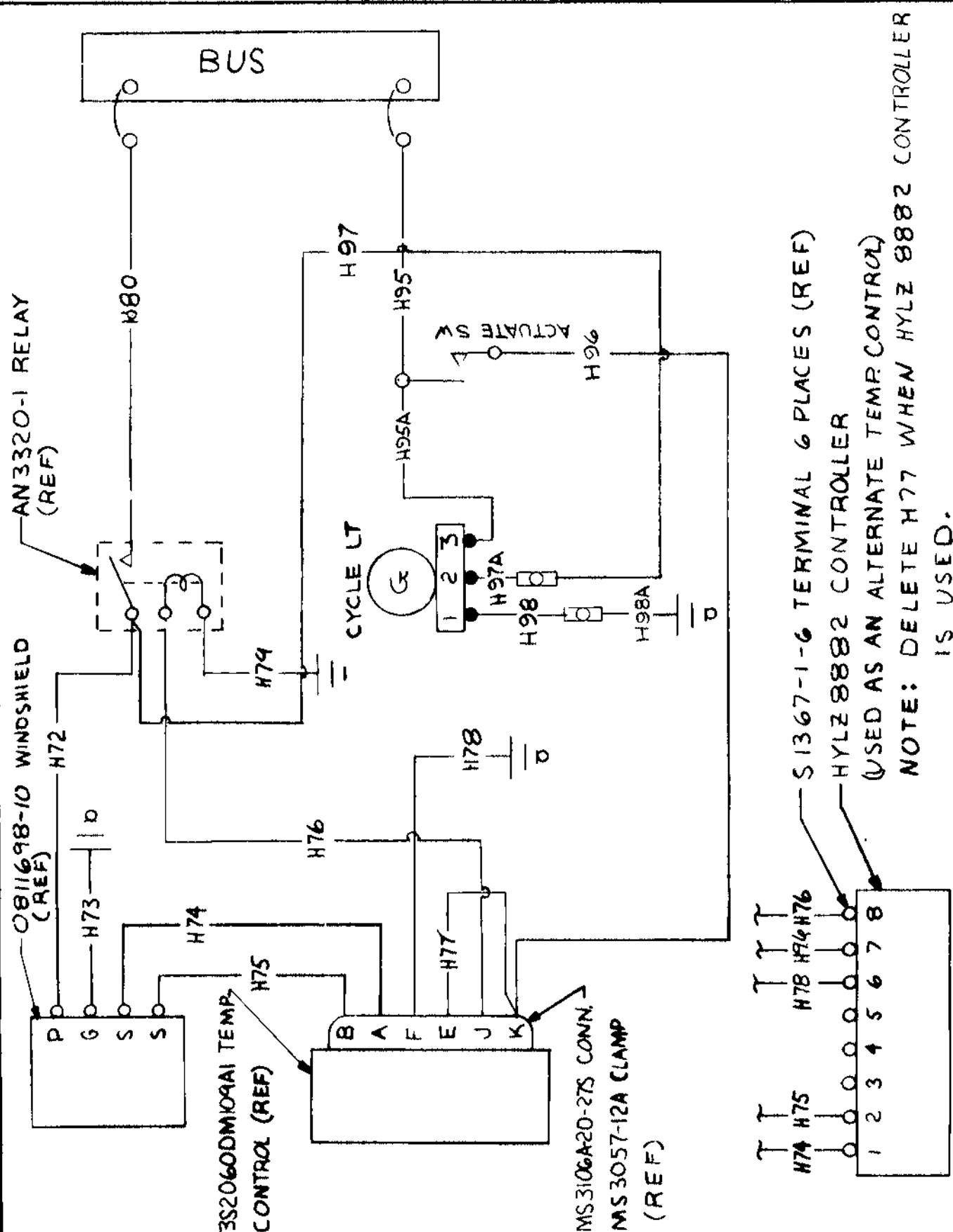


ELECTRICAL SUPPRESSOR

EFF. SERIALS

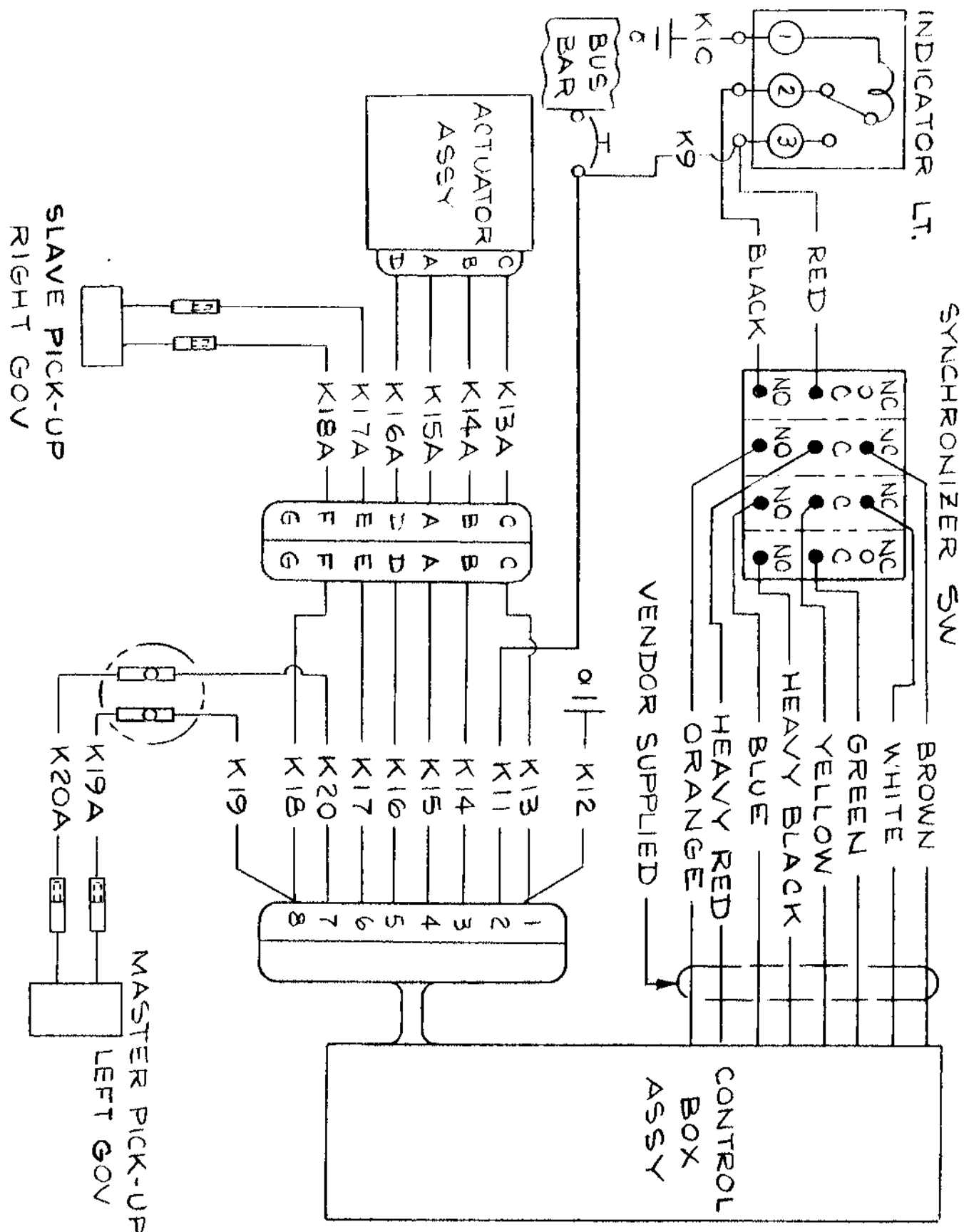


### EFF. SERIALS



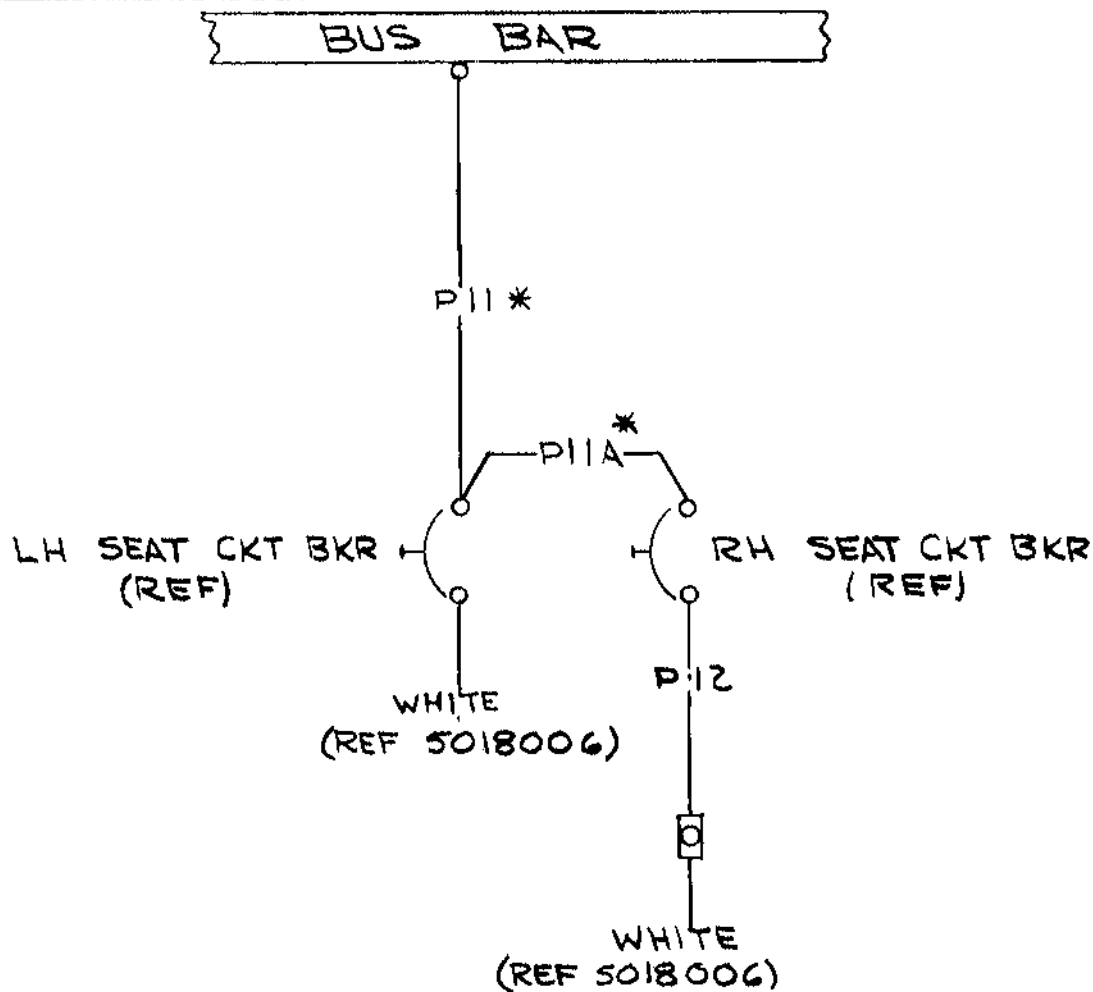
PROP SYNCHRONIZER - WOODWARD

EFF. SERIALS



ELECTRIC SEAT - OPTIONAL

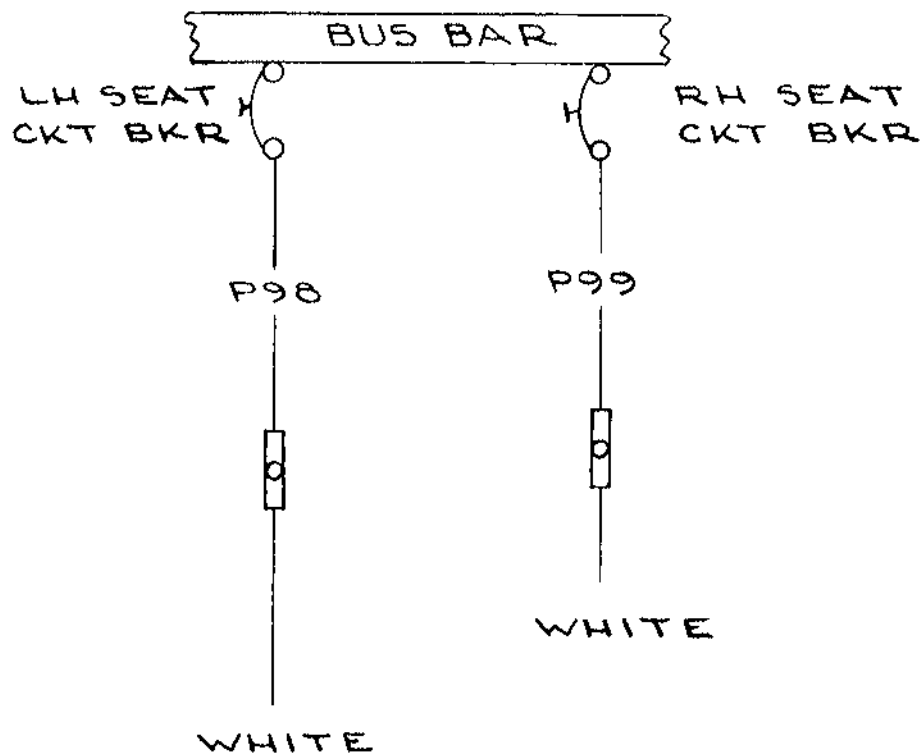
EFF. SERIALS 310L0001 TO 310N0001



\* IF ONLY THE RH SEAT IS INSTALLED  
OMIT WIRE P11A & CONNECT P11 TO  
RH SEAT CKT BKR.

ELECTRIC SEAT - OPTIONAL

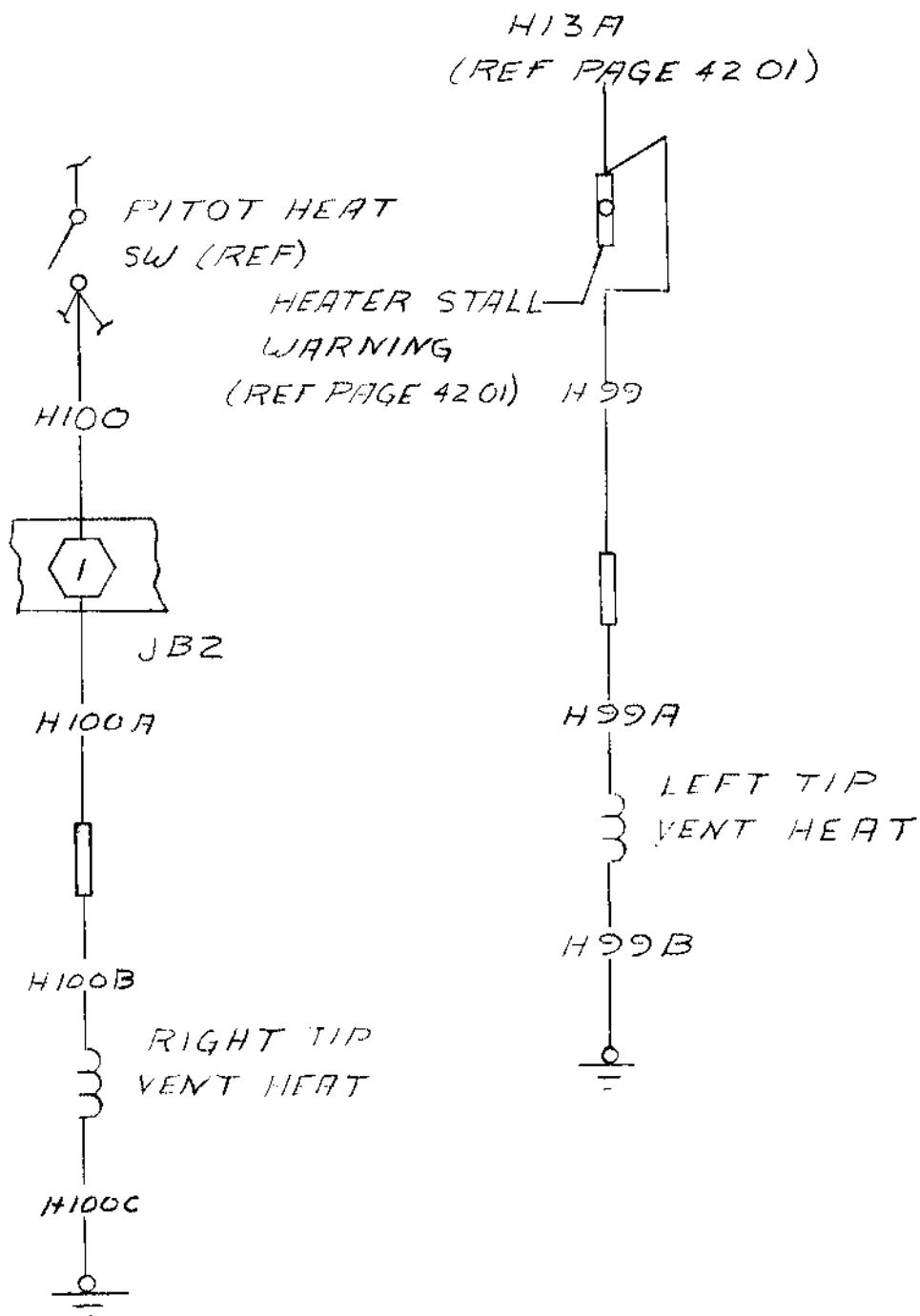
EFF. SERIALS 310N0001 & ON



(SEAT WIRING REF 5018006)

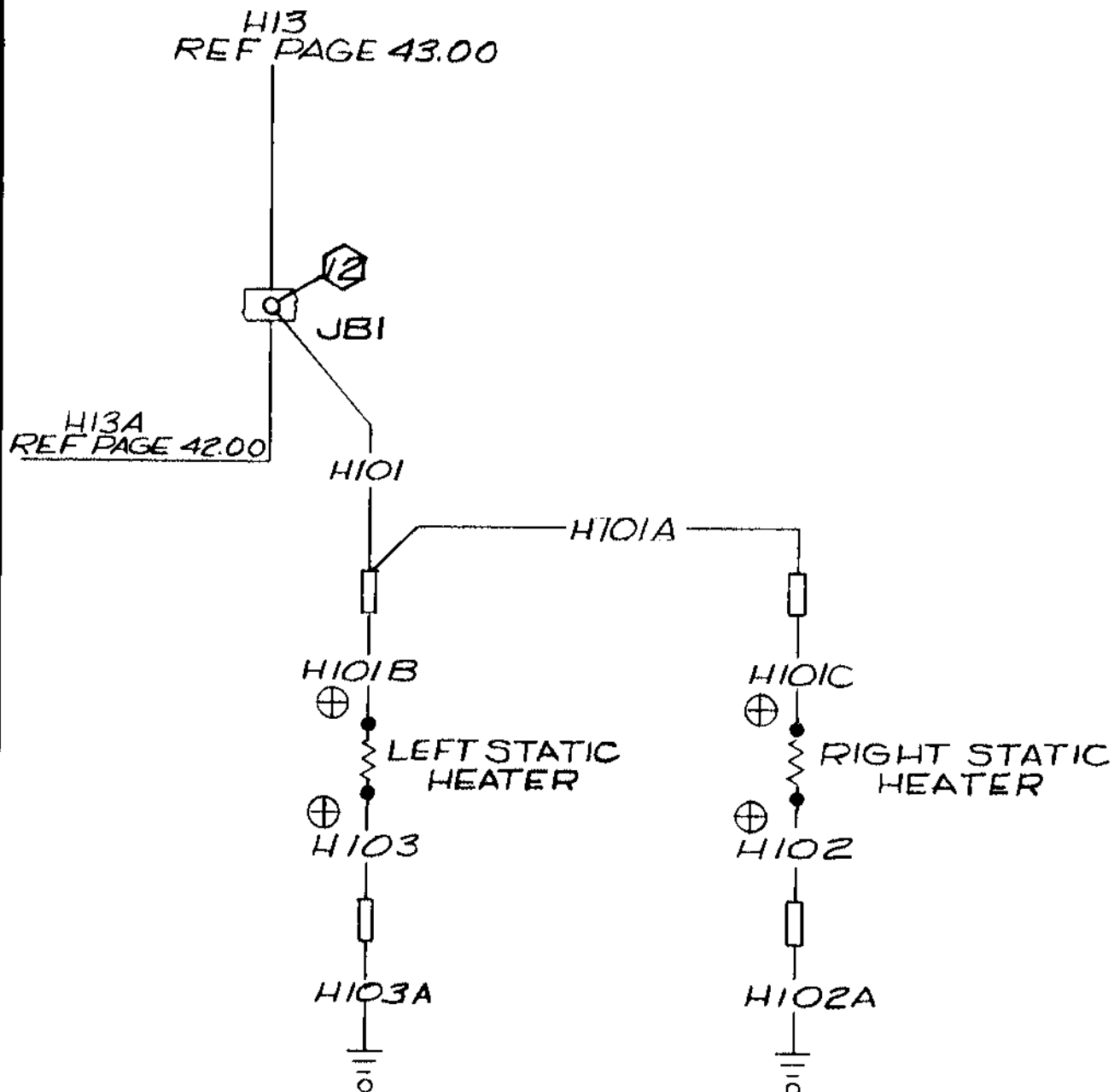
TIP TANK VENT HEAT

EFF. SERIALS



STATIC SOURCE HEAT OPT

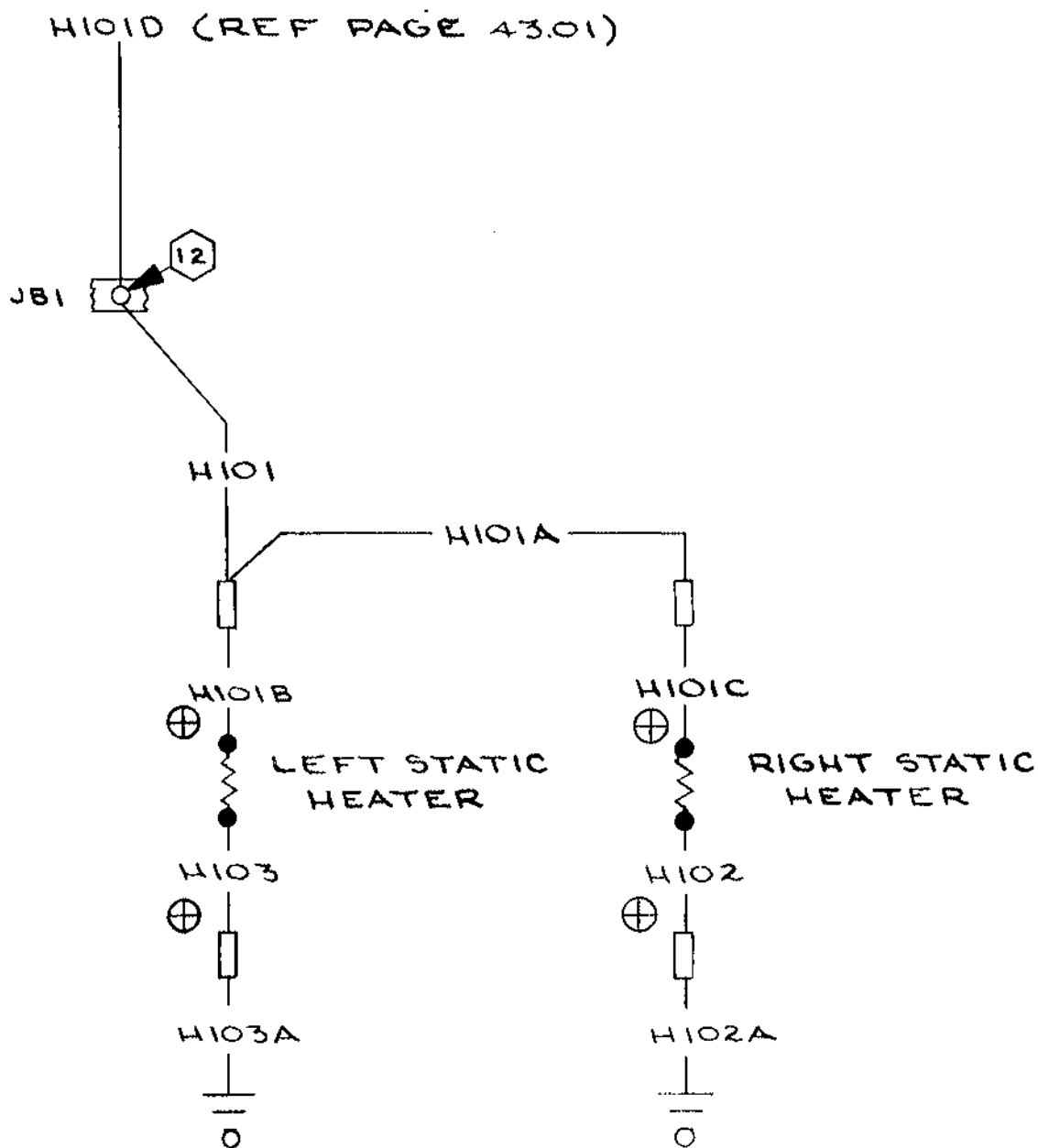
EFF. SERIALS 310L0001 TO 310N0001





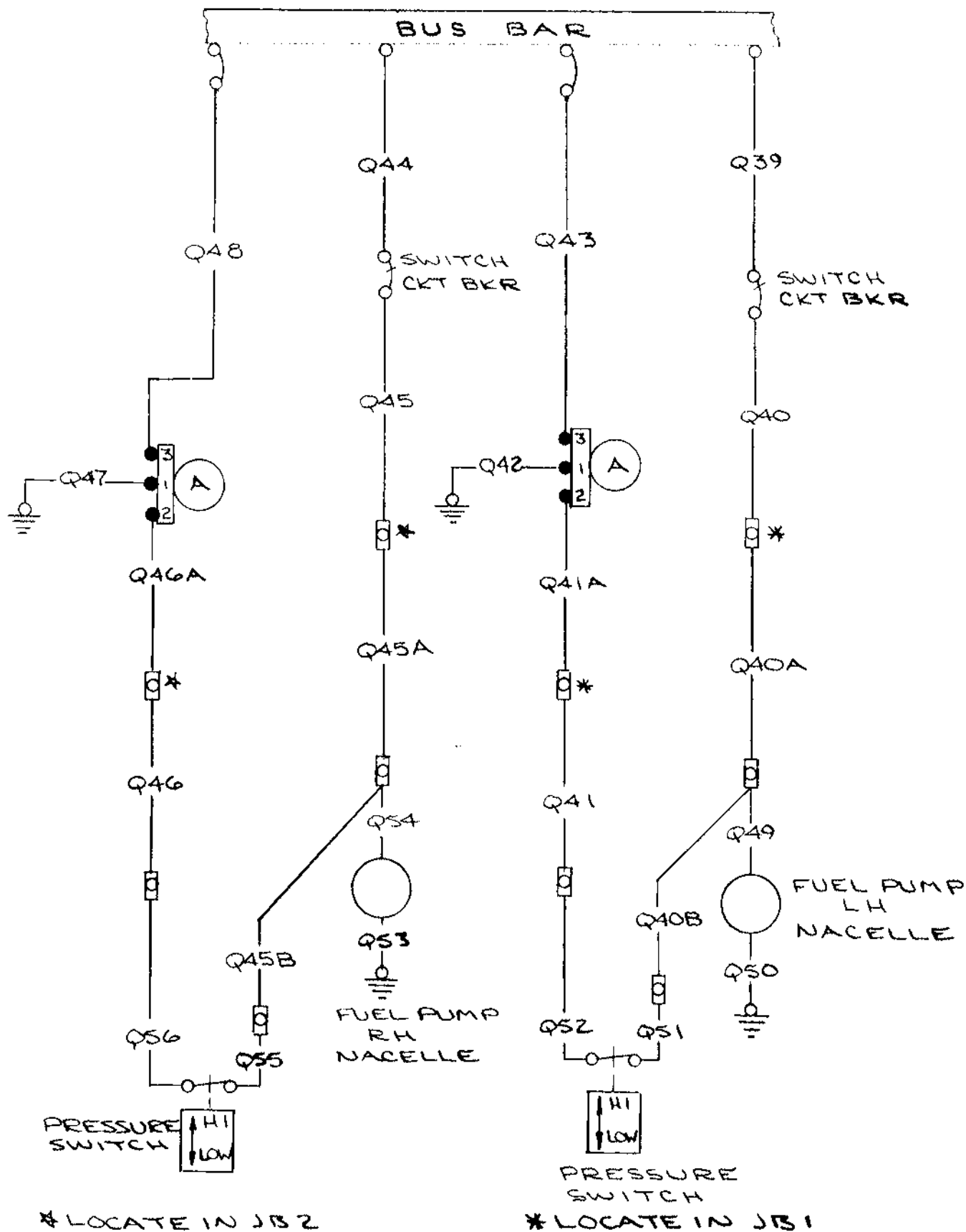
STATIC SOURCE HEAT (OPT)

EFF. SERIALS 310N0001 & ON



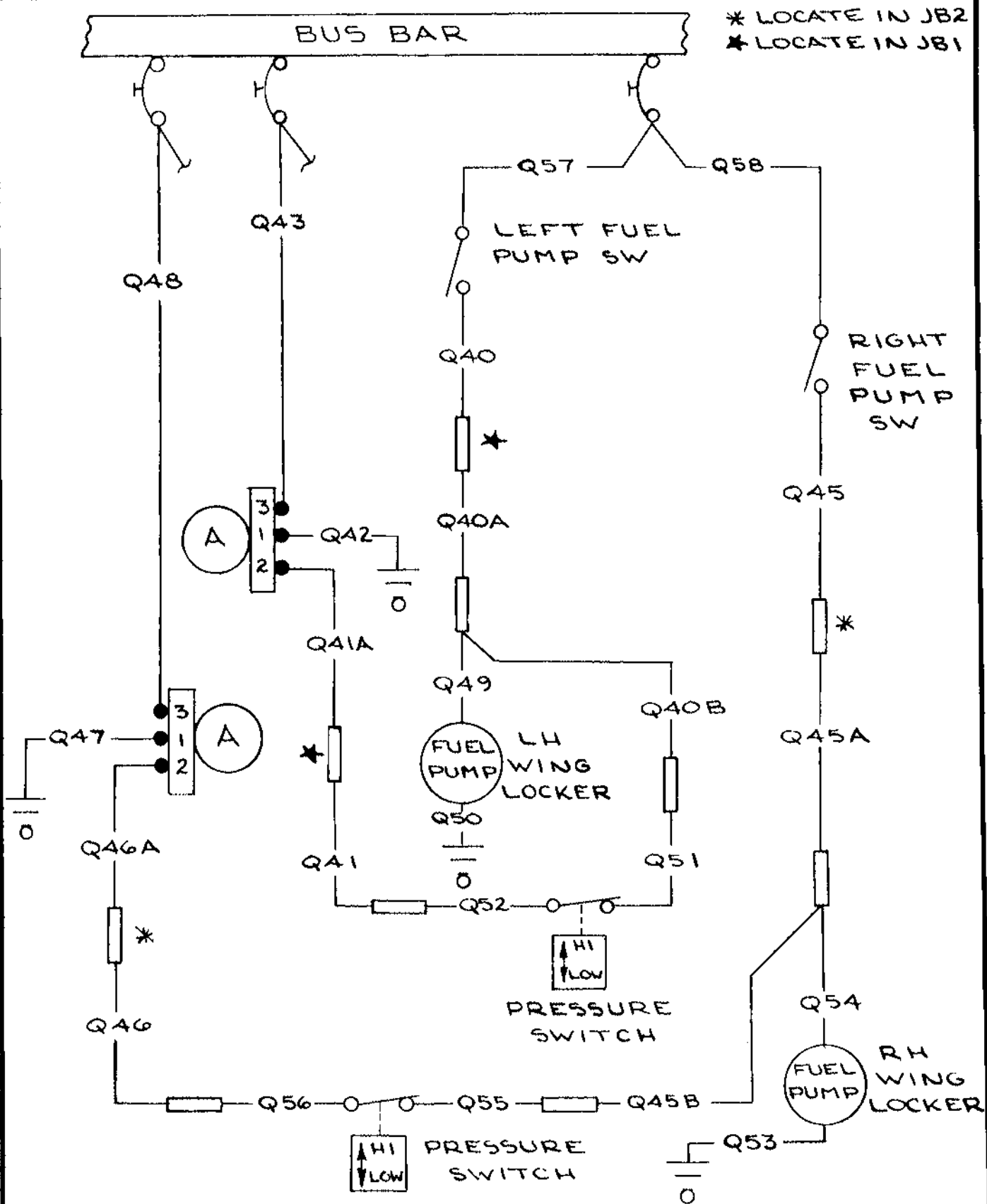
AUX. FUEL TRANSFER PUMP (OPT)

EFF. SERIALS 310L0050 to 310N0001



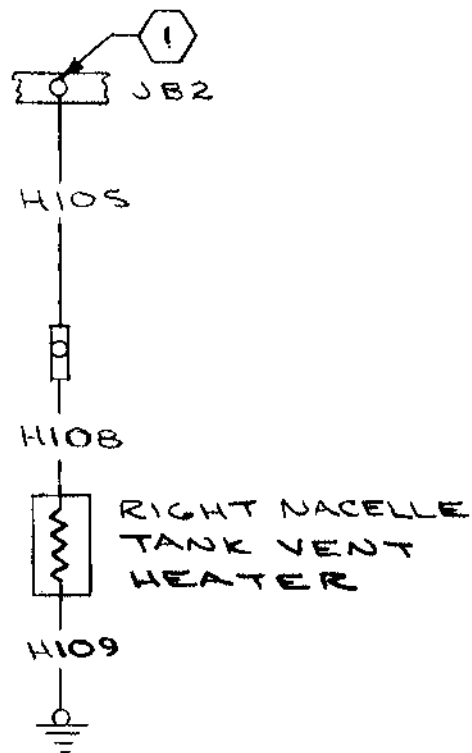
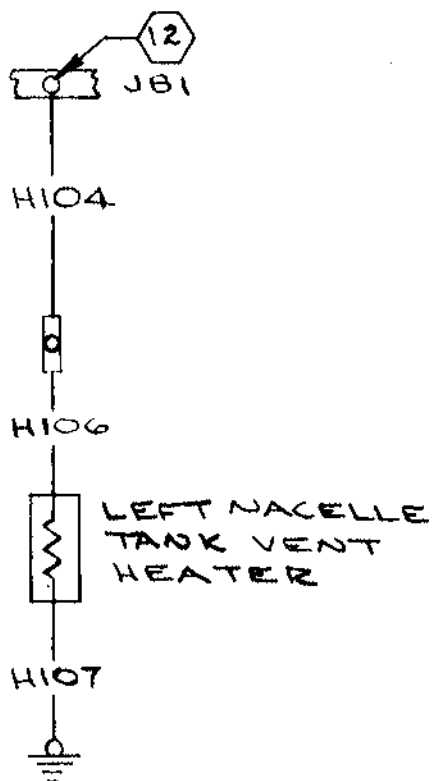
AUX. FUEL TRANSFER PUMP (OPT)

EFF. SERIALS 310N0001 & ON



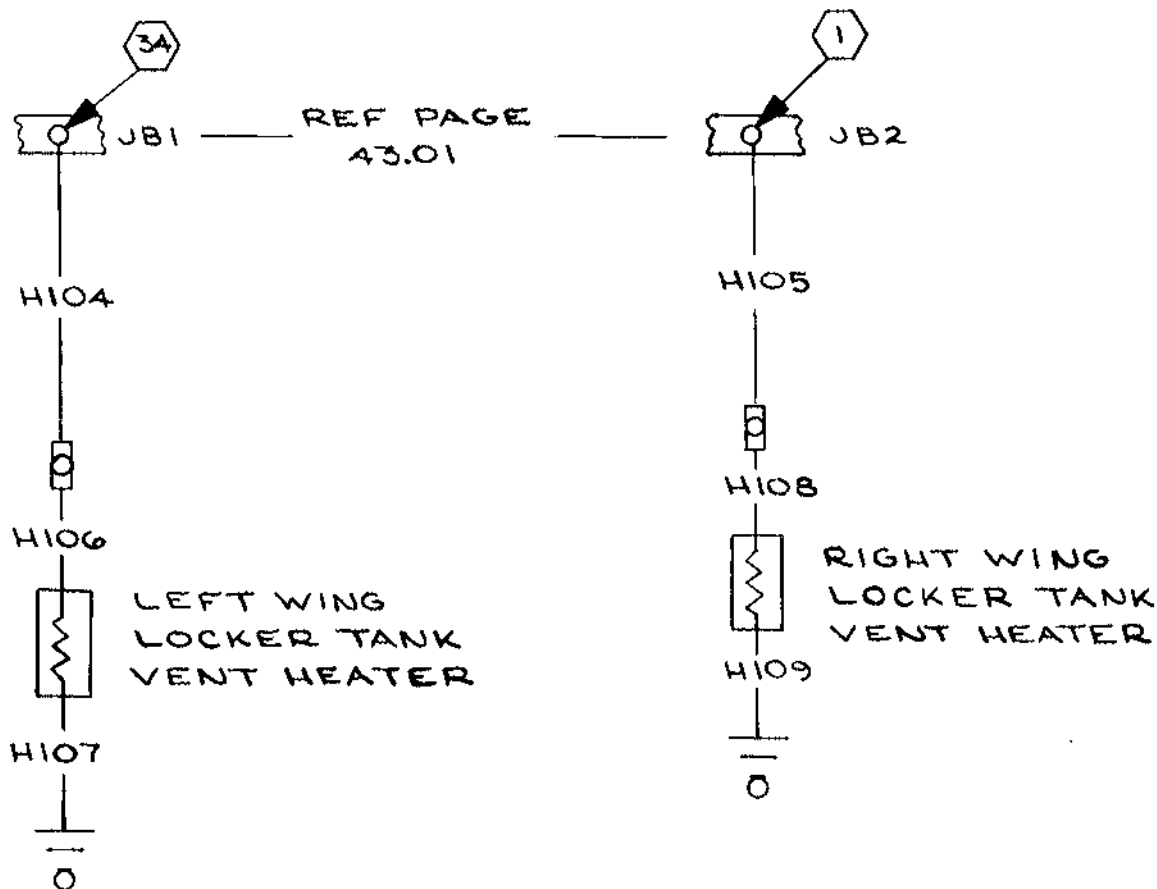
AUX. FUEL TRANSFER VENT HEATER (OPT)

EFF. SERIALS 310L0050 TO 310N0001



AUX. FUEL TRANSFER VENT HEATER (OPT)

EFF. SERIALS 310N0001 & ON



## SECTION 15

**ELECTRONICS SYSTEMS**

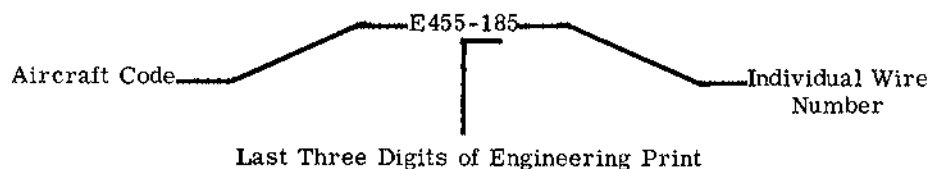
## Table of Contents

|                                                   | Page   |                                             | Page   |
|---------------------------------------------------|--------|---------------------------------------------|--------|
| General Description . . . . .                     | 15-1   | Cessna Nav/Omni 400 (100 Channel) . . . . . | 15-32J |
| Wiring Code . . . . .                             | 15-1   | Cessna ADF 400 Fixed Loop. . . . .          | 15-33  |
| Radio Noise Elimination . . . . .                 | 15-2   | Cessna Marker Beacon 300 . . . . .          | 15-34  |
| Alternator Noise . . . . .                        | 15-2   | Cessna Nav/Com 300R . . . . .               | 15-35  |
| Ignition Noise . . . . .                          | 15-2   | Audio Amplifier Systems . . . . .           | 15-36  |
| Flap and Landing Gear Motor Noise . . . . .       | 15-2   | Cessna Transceiver 300 . . . . .            | 15-37  |
| Auxiliary Fuel Pump Noise . . . . .               | 15-2   | Cessna Nav/Omni 300 . . . . .               | 15-38  |
| Lighting Circuit Noise . . . . .                  | 15-2   | Cessna ADF 300 . . . . .                    | 15-39  |
| Wiring Diagrams                                   |        | Cessna Nav-O-Matic 400 Autopilot . . . . .  | 15-40  |
| Cessna Transceiver 800 . . . . .                  | 15-3   | Cessna Nav-O-Matic 800 Autopilot            |        |
| Cessna Transmitter 800 . . . . .                  | 15-4   | Basic Wiring Circuit . . . . .              | 15-42  |
| Cessna Nav/Omni 800 (190 Channel) . . . . .       | 15-5   | Cessna Nav-O-Matic 800 Autopilot            |        |
| Cessna Nav/Omni 800 (560 Channel) . . . . .       | 15-7   | with 800 Series Radio . . . . .             | 15-43  |
| Cessna Glide Slope 800 . . . . .                  | 15-9   | Cessna Nav-O-Matic 800 Autopilot            |        |
| Cessna ADF 800 . . . . .                          | 15-10  | with 500 Series Radio . . . . .             | 15-44  |
| Cessna ADF 800 Fixed Loop . . . . .               | 15-11  | Cessna Course Director 500 . . . . .        | 15-45  |
| Cessna Course Director 800 . . . . .              | 15-12  | 12310-1144 Ground Adapter . . . . .         | 15-46  |
| Cessna DME 800 . . . . .                          | 15-15  | DG104B-1 Ground Adapter . . . . .           | 15-47  |
| Cessna Marker Beacon 800 . . . . .                | 15-18  | AIM Slaved Directional Gyro . . . . .       | 15-48  |
| Cessna Transponder 800 . . . . .                  | 15-19  | T-10-R Transceiver . . . . .                | 15-49  |
| Cessna Transceiver 500 . . . . .                  | 15-21  | T-22-RA Transceiver . . . . .               | 15-50  |
| Cessna Nav/Com 500 . . . . .                      | 15-22  | PN 101 Nav System Coupled with              |        |
| Cessna ADF 500 . . . . .                          | 15-24  | C-14 Gyro and 800 RMI . . . . .             | 15-50A |
| Cessna ADF 500 Fixed Loop . . . . .               | 15-25  | Radio Cooling Blower (500 Series            |        |
| Cessna Nav/Omni 500 . . . . .                     | 15-26  | Radio) . . . . .                            | 15-51  |
| Audio System Interconnects . . . . .              | 15-28  | Radio Cooling Blower (300 Series            |        |
| Cessna 500 Series Antenna Interconnects . . . . . | 15-32A | Radio) . . . . .                            | 15-52  |
| Cessna 400 Series Antenna Interconnects . . . . . | 15-32C | Audio Code Filter . . . . .                 | 15-52A |
| Cessna 300 Series Antenna Interconnects . . . . . | 15-32D | AVQ-45 Weather Radar . . . . .              | 15-53  |
| Cessna Nav/Com 400 . . . . .                      | 15-32E | Electronic Continuous Load Chart . . . . .  | 15-54  |
| Cessna Glide Slope 400 . . . . .                  | 15-32F | Table of Electronic Equipment               |        |
| Cessna Transponder 400 . . . . .                  | 15-32G | Loading . . . . .                           | 15-55  |
| Cessna Transceiver 400 . . . . .                  | 15-32H |                                             |        |

**GENERAL DESCRIPTION.**

This section contains wiring diagrams which clearly show the complete wiring on each item of electronic

equipment listed in the wiring diagram index. The last portion of the section contains tables showing the electronic loading of various components on the shelves and rack in the aircraft.

**Wiring Code.**

Each wire used in the electronics system is identified by code. This coding provides a convenient way of identifying wires when installing new wiring or servicing existing wires. The wire code is shown on each diagram. Some cabling is supplied by vendors of the electronics equipment and do not carry Cessna identification. The diagrams covering such wiring may refer to the instruction manuals of such equipment where a more complete wiring diagram may be found. The wiring code used by Cessna on the 310 is shown above.

### Radio Noise Elimination

Radio noise is a problem of great importance to the aircraft industry. A noisy radio system may actually imperil the safety of the aircraft occupants. The performance of radio navigation equipment can be completely erroneous if radio noise is excessive. For this reason, radio installations should be made only by persons who are qualified. Radio noise is not generated in a properly operating radio set, but is merely presented to the listener in an audible form exactly the same way that a radio station is received. Many forms of noise can exist in any particular aircraft and, ironically, sometimes certain aircraft can be amazingly quiet. This condition is unusual and even though the aircraft is quiet without noise suppression, it cannot be released without proper suppression. A quiet aircraft without suppression may degenerate into a noisy aircraft with changes in age, temperature, and humidity. Common radio noise is generated by ordinary electrical devices in the aircraft such as flap or gear motors, navigation light flashers and ignition or alternator systems. By properly installing capacitive and inductive devices in these circuits, the noise can usually be reduced to a tolerable level. A more difficult type of noise to suppress, is that generated by friction between two components or by rectification. Another difficult problem is noise that is carried to sensitive areas by grounding loops. The following paragraphs contain solutions that have been effective for the factory. It is important to remember that each aircraft may present a slightly different problem and, therefore, a "fix" on one aircraft will not necessarily be effective in all cases.

### Alternator Noise.

While the alternators are relatively free from radio noise, there is the possibility the alternators will produce an audible noise in the radio and electronic systems. Inside the alternator a three phase AC voltage is applied to a full wave rectifier assembly, thus converting the AC voltage to DC. During the rectification, an AC ripple appears on top of the DC voltage, thus the bus voltage is actually fluctuating. While the battery acts as a capacitance, it is also necessary to have additional filtering. This is accomplished by the use of a capacitor from the output terminal to ground at the alternator. The use of solid state regulators reduces the possibility of regulator noise to a minimum and will not require filtering.

### Ignition Noise.

The sound of ignition noise is easily identified because of its timing. The 310 has a shielded magneto ignition system. Each secondary lead from the magneto to the plug is a shielded wire. Double shielded wiring is used in the primary circuit with a special suppressor in series with the switch lead. The suppressor is constructed coaxially with a shielded lead coming out of the end which is connected to the magneto cigarette cartridge. The double shielded wire is connected to the terminal end of the filter (the shield is grounded). The double shielded wire enters the cabin area through connectors in the wing root rib to prevent noise transfer to the junction box wiring. The double shielding is continued to the inside of the cabin to the magneto switch. The magneto switches are enclosed in a shielded case to which the double shield of the wire is grounded. If ignition noise is prevalent in the radio system, the entire magneto system should be checked for tight connections, especially in the root rib connectors and at the switch and suppressor. All ground connections in the circuit are critical and any oil or dirt accumulation should be cleaned from the connection and the metal should be brightened to provide the best possible ground. Ignition harness should be replaced if the shielding becomes questionable.

### Flap and Landing Gear Motor Noise.

During a landing approach, an unfiltered motor in the flap or gear circuits can produce a startling volume of noise which is very distracting. There is also the possibility of the noise blanketing a message from the tower during the approach. It is possible that sufficient noise could be created through these circuits to blanket an ILS signal, creating a hazardous situation. For these reasons, the circuits have a filter section built into the motor. The filter should be very effective if the unit is properly grounded. If noise becomes excessive with good grounding, a motor overhaul or replacement may be necessary.

### Auxiliary Fuel Pump Noise.

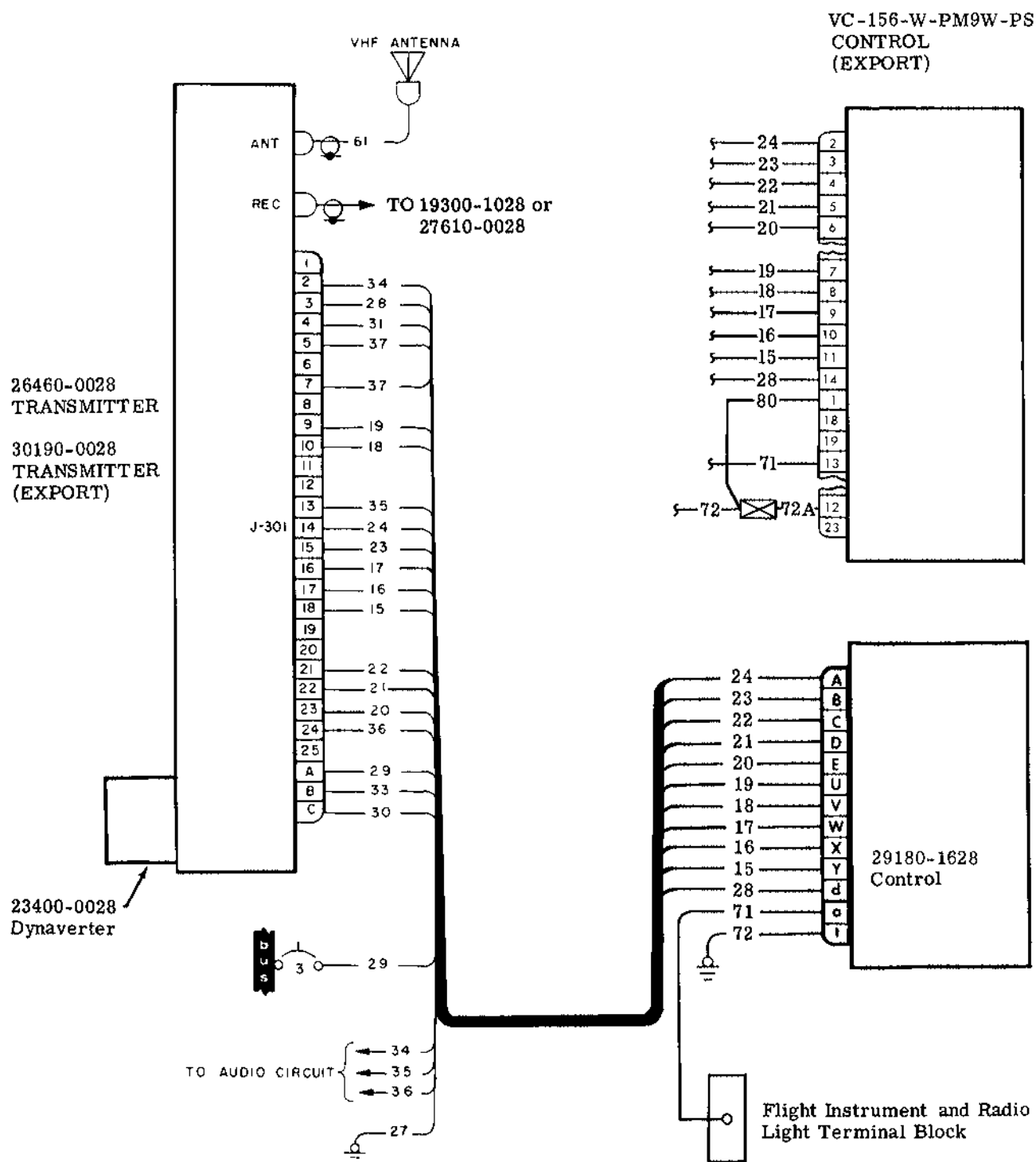
Coaxial type capacitors produce effective results, when installed on the base of the fuel boost pumps. Because of the location of the fuel pump and capacitors, the connections must be kept tight to avoid any possible arcing. When proper filtering and grounding do not produce the desired filtering results, a new pump should be tried.

### Lighting Circuit Noise.

All lighting components on the 310 have internal filters and usually do not require external capacity. The light wiring, however, because of its route to the extremities of the aircraft can, in unusual cases, conduct noise to vital areas. The light wires and electrical wiring bundles should be routed away from the antenna and loop antenna cables to prevent picking up noise in the radio systems. Shielding should be properly grounded.







NOTE: WIRE NUMBERS PREFIXED BY E680

Figure 15-2. Cessna Transmitter 800

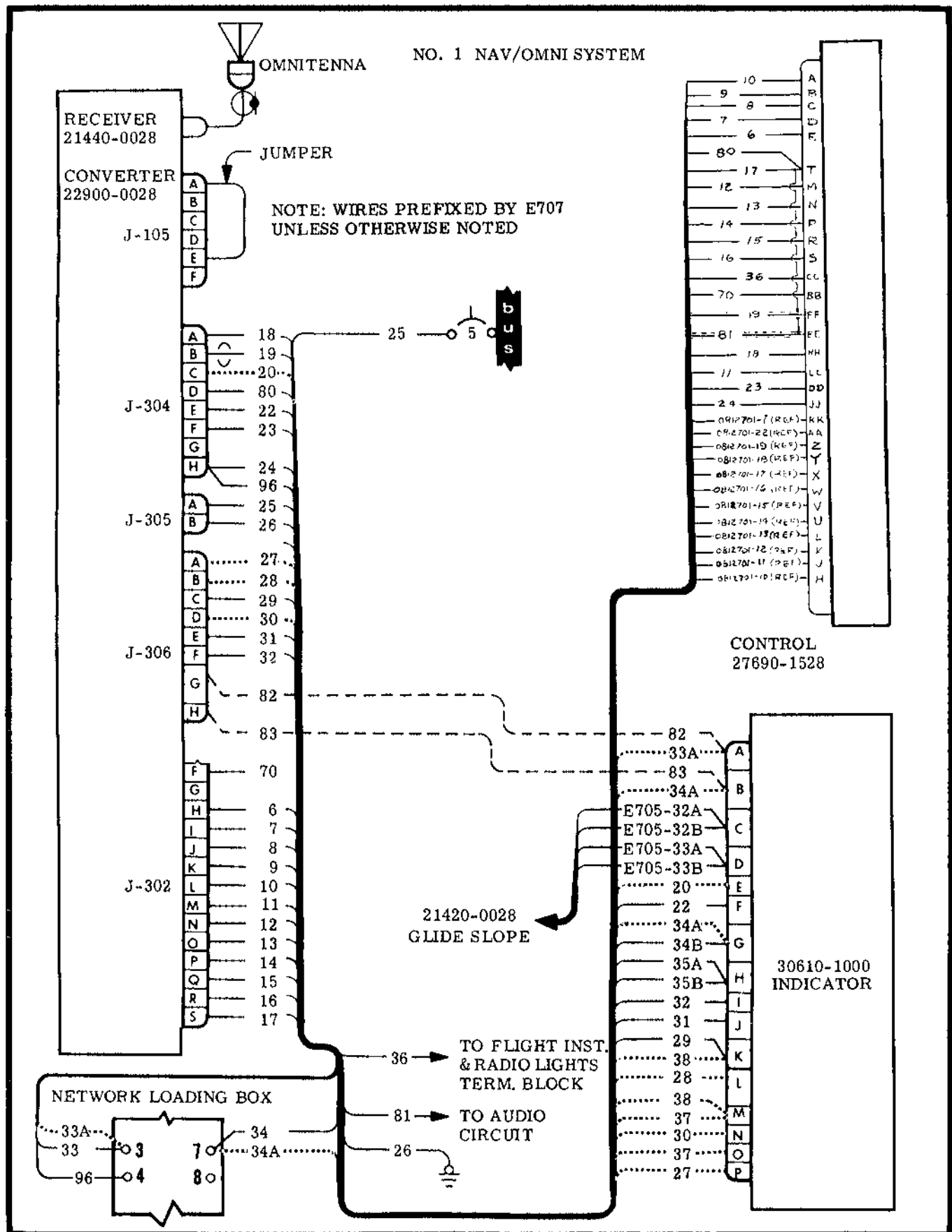


Figure 15-3. Cessna Nav/Omni 800 (190 Channel) (Sheet 1 of 2)

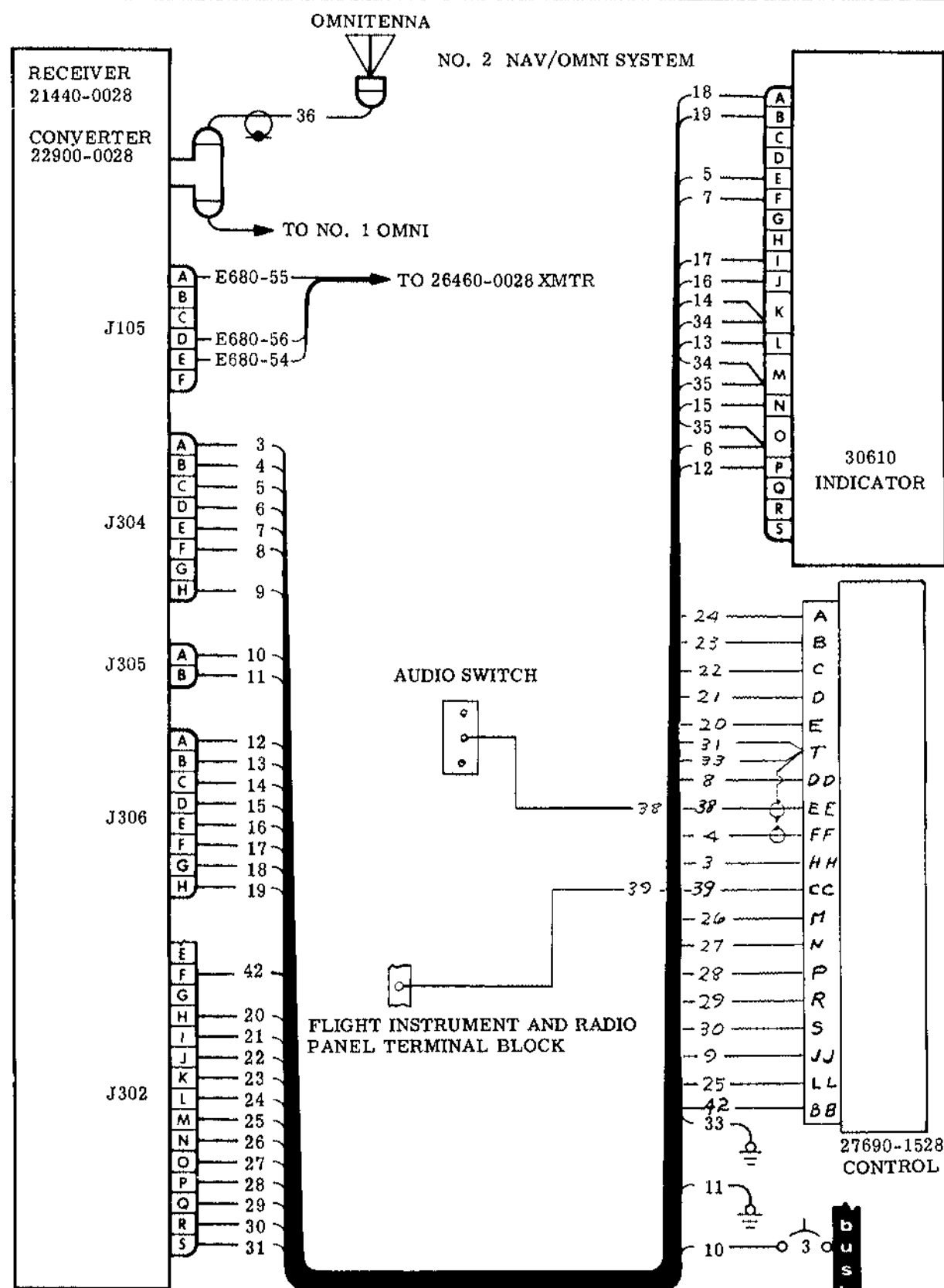
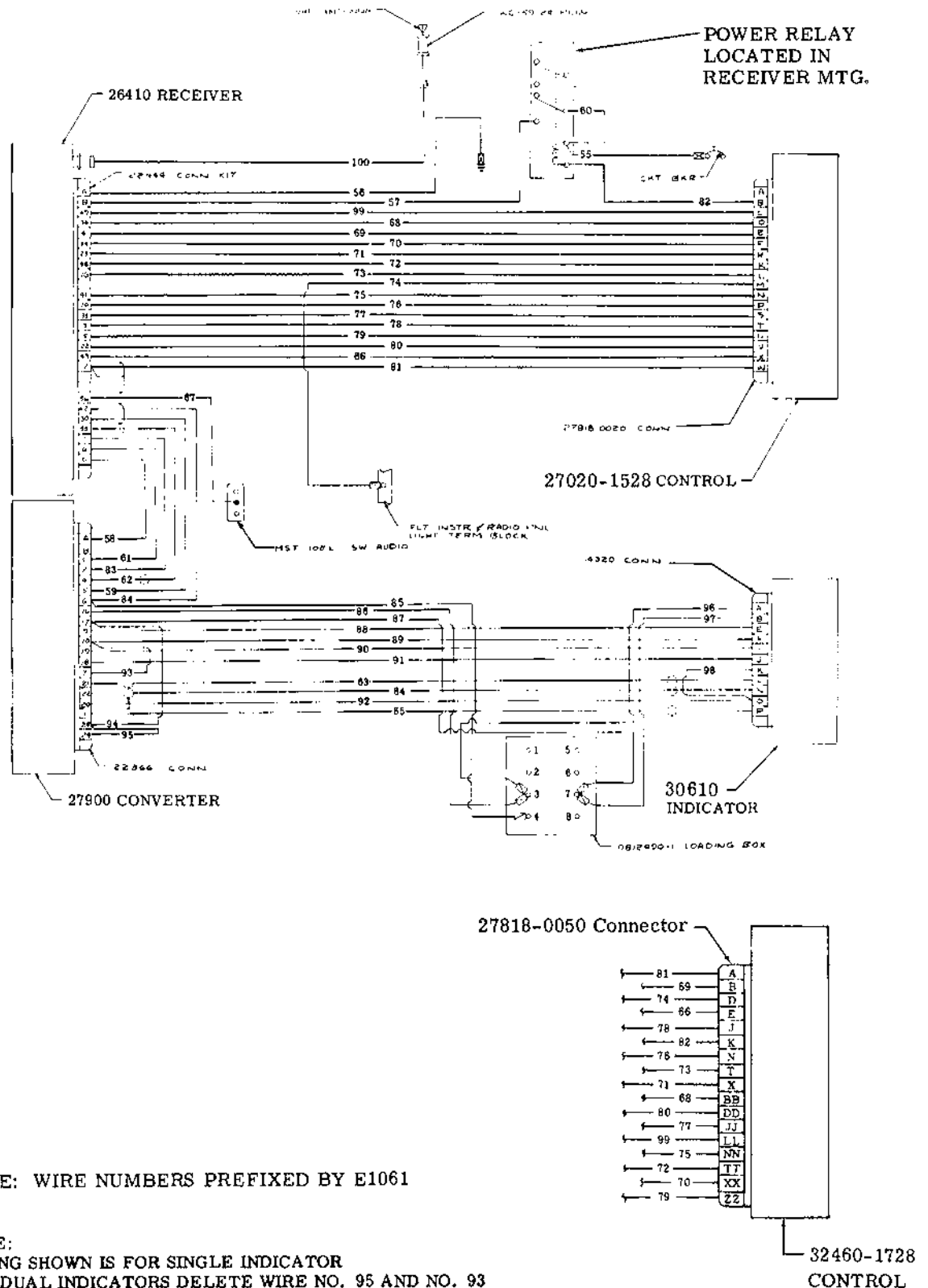
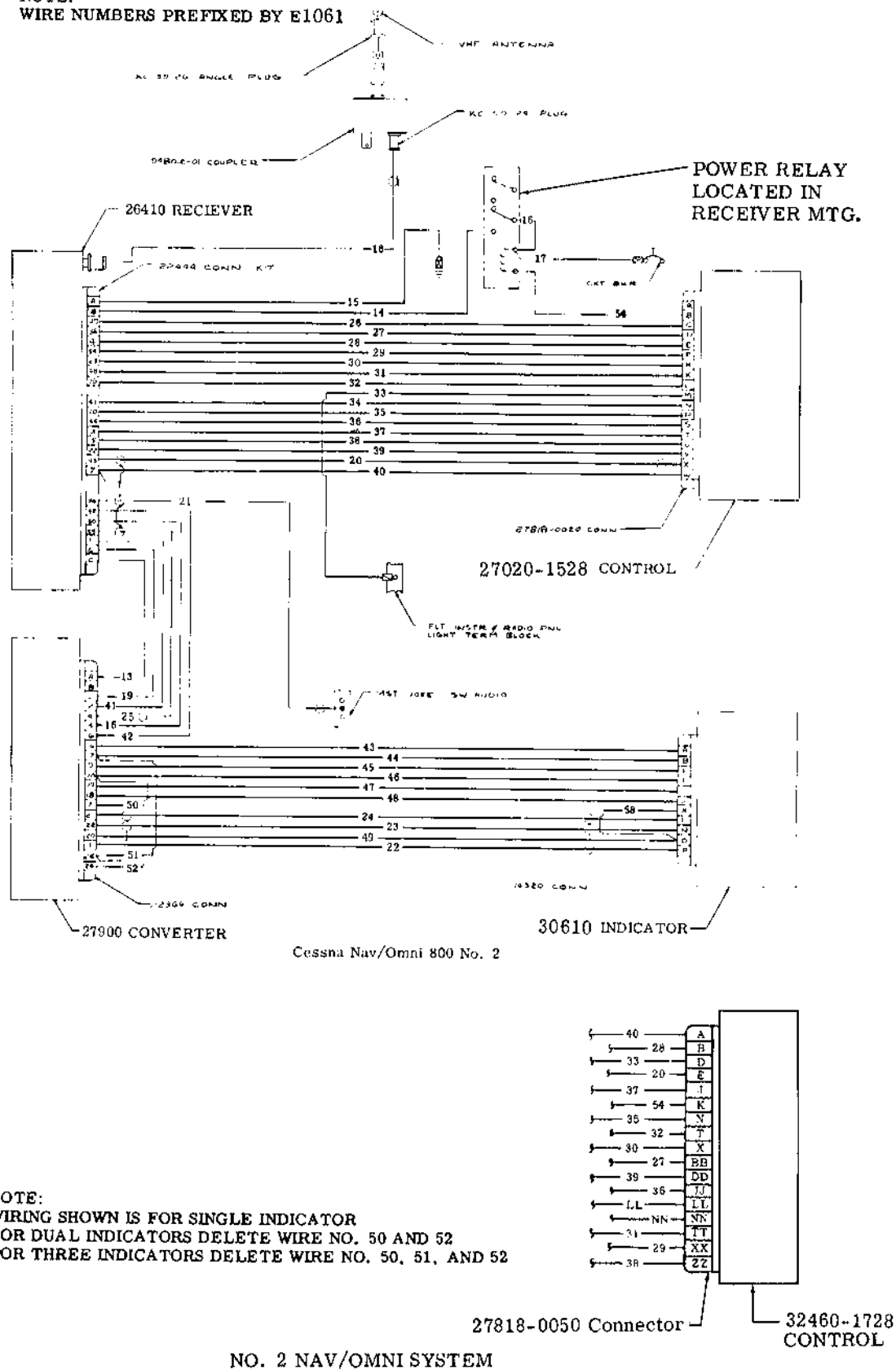


Figure 15-3. Cessna Nav/Omni 800 (190 Channel) (Sheet 2 of 2)



NO. 1 NAV/OMNI SYSTEM

NOTE:  
WIRE NUMBERS PREFIXED BY E1061



NOTE:  
WIRING SHOWN IS FOR SINGLE INDICATOR  
FOR DUAL INDICATORS DELETE WIRE NO. 50 AND 52  
FOR THREE INDICATORS DELETE WIRE NO. 50, 51, AND 52

Figure 15-4. Cessna Nav/Omni 800 (560 Channel) (Sheet 2 of 2)

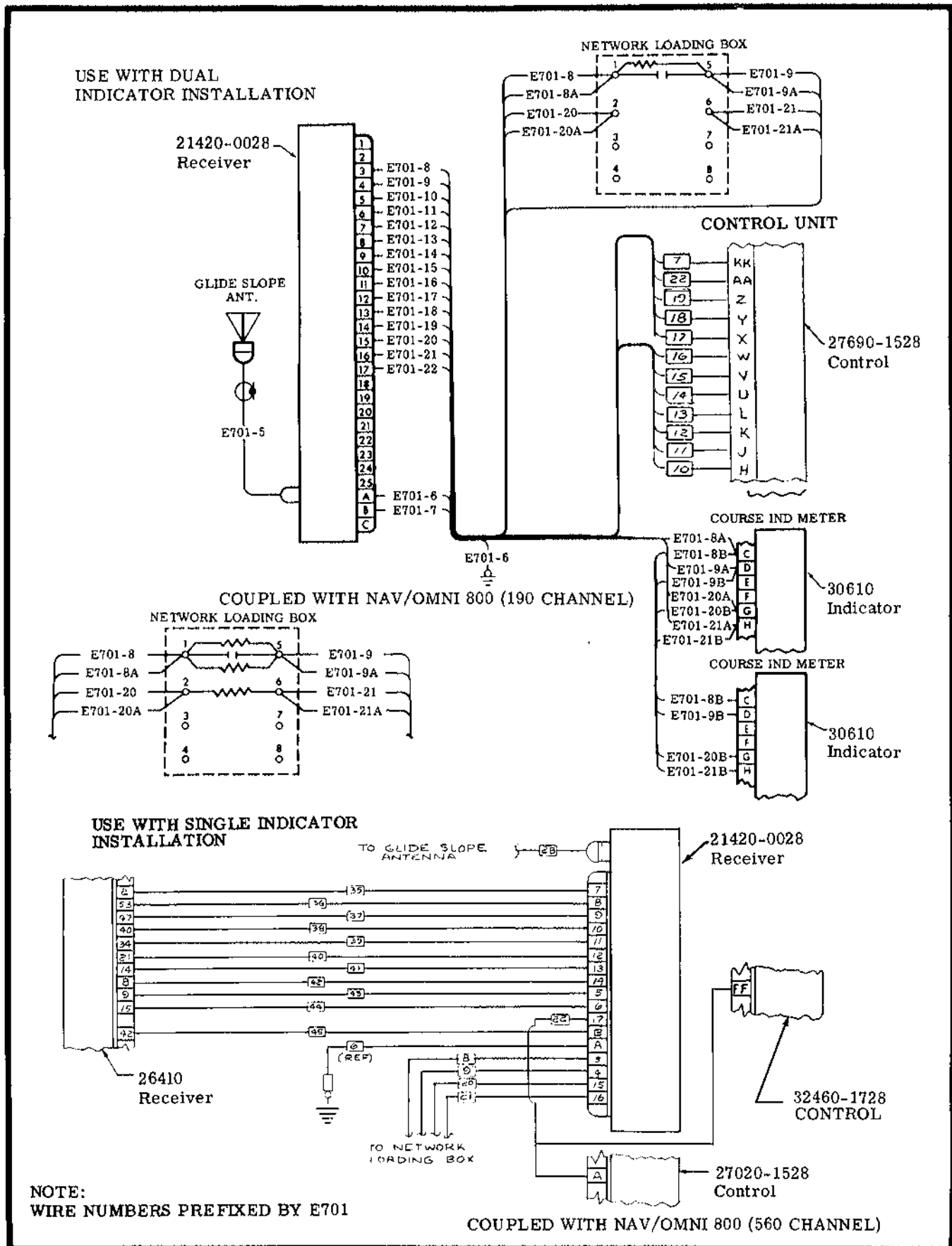


Figure 15-5. Cessna Glide Slope 800

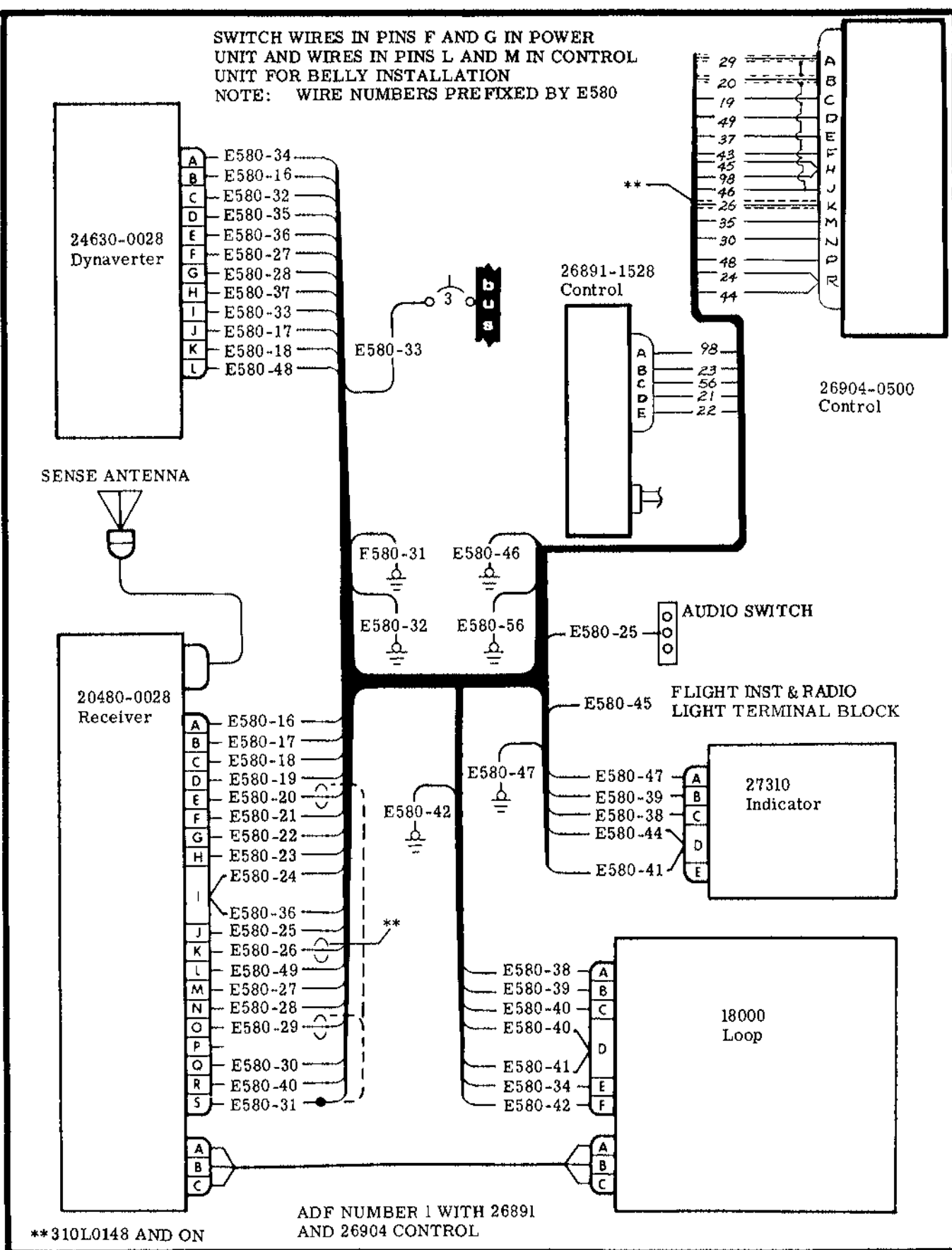


Figure 15-6. Cessna ADF 800 Rotatable Loop (Sheet 1 of 2)

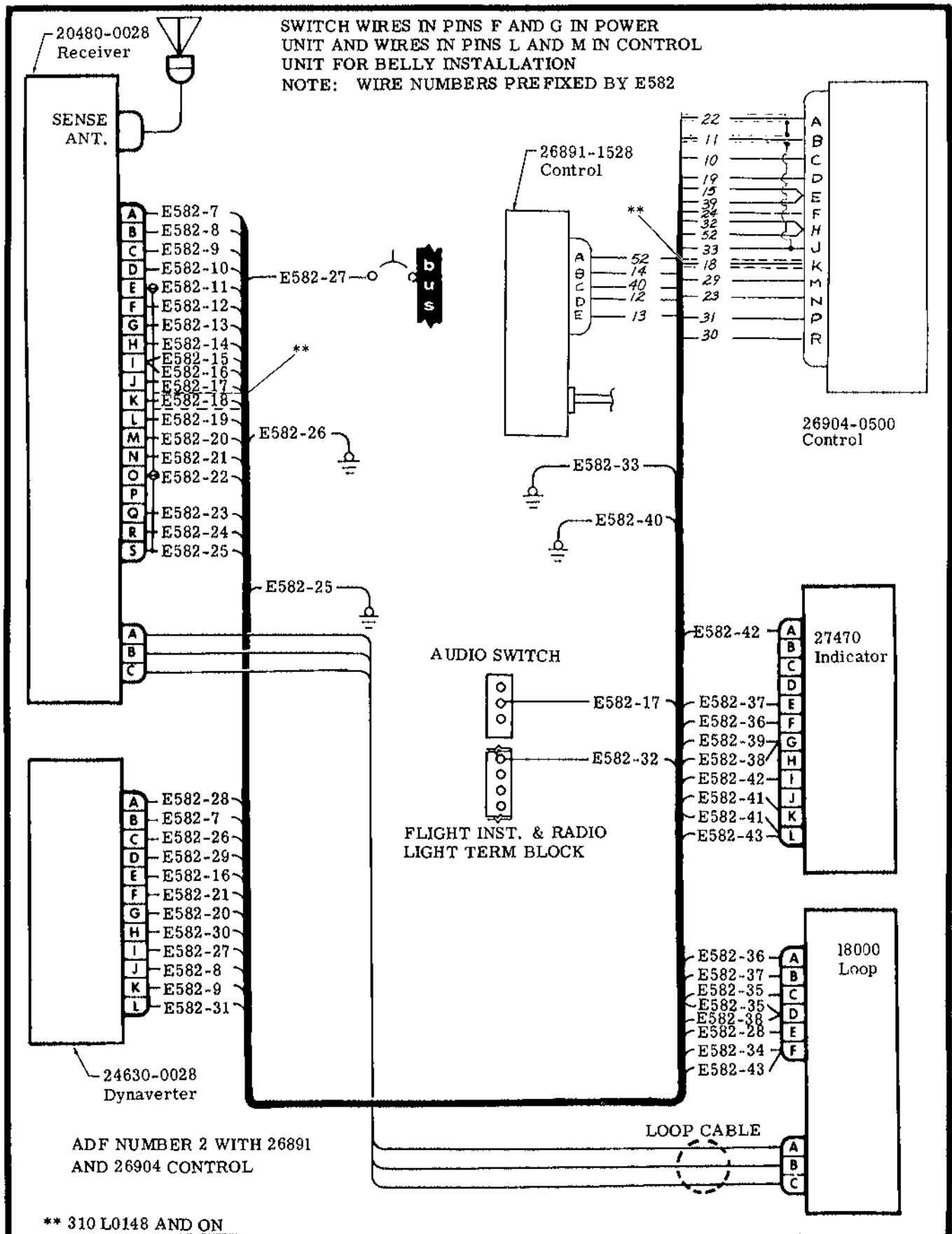


Figure 15-6. Cessna ADF 800 Rotatable Loop (Sheet 2 of 2)



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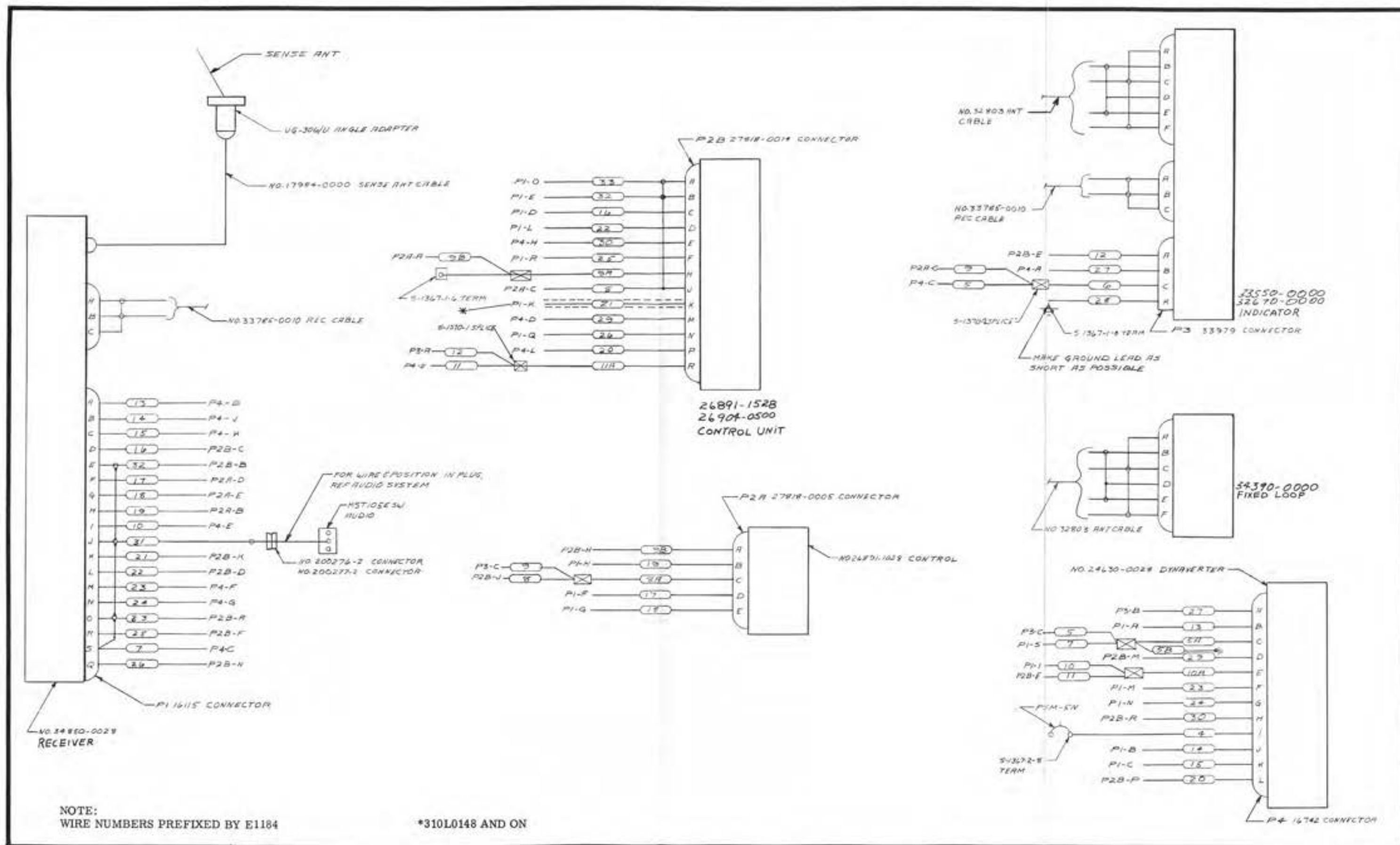
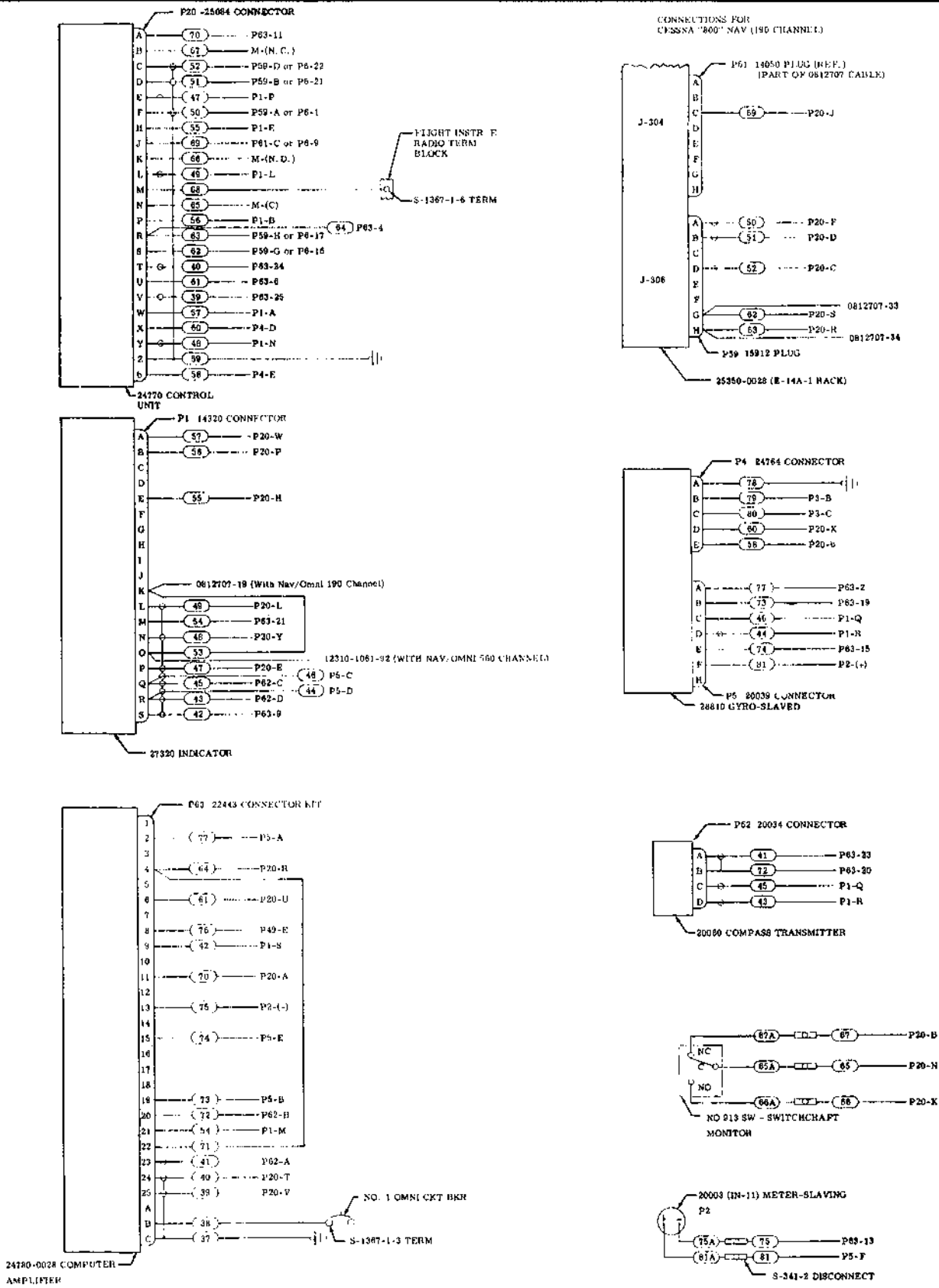


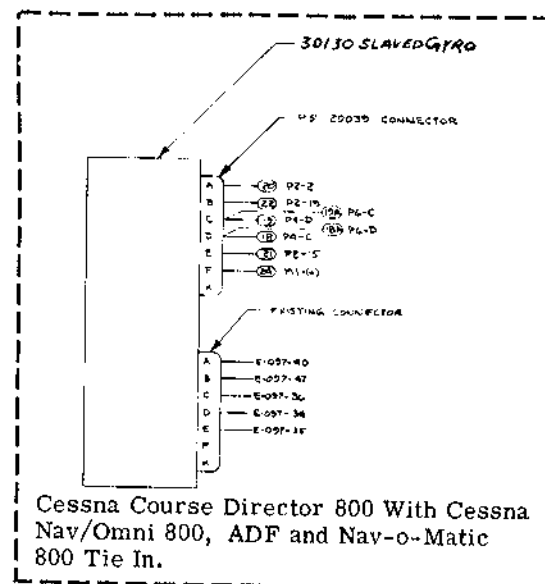
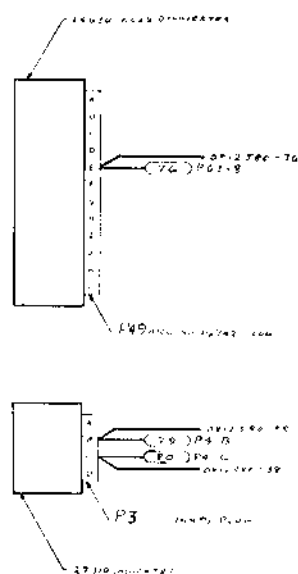
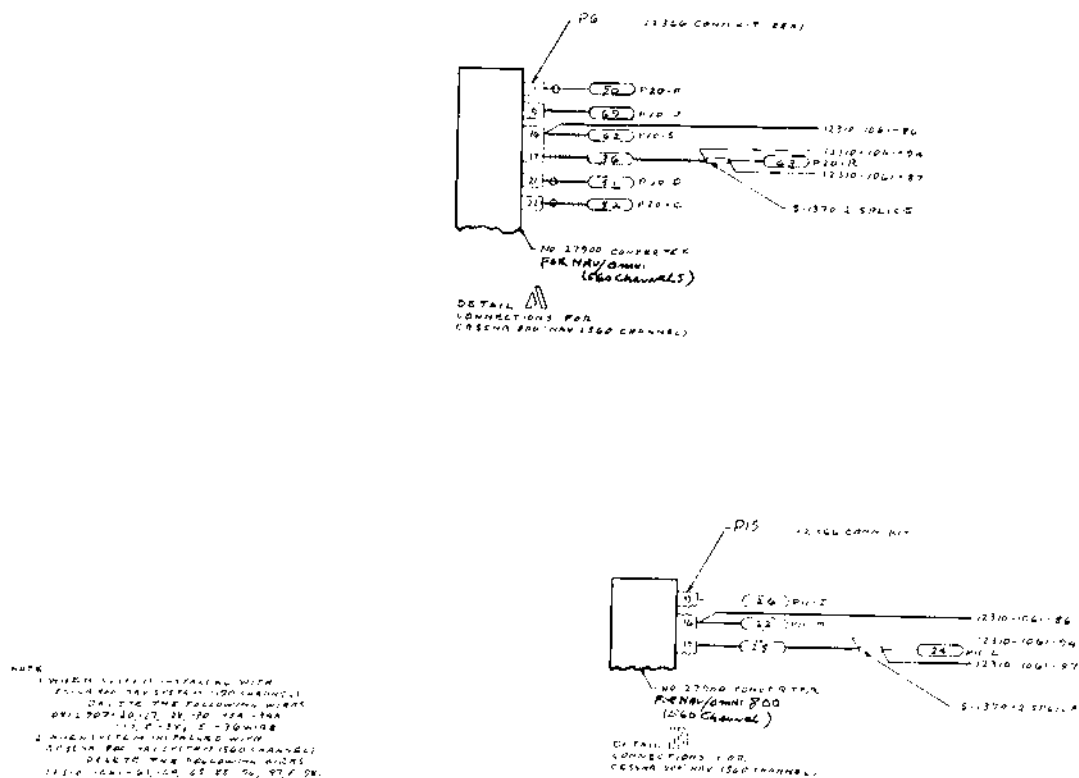
Figure 15-6A. Cessna ADF 800 (Fixed Loop)



Cessna Course Director 800 With Cessna Nav/Omni 800 and ADF Tie In.

NOTE: WIRE NUMBERS PREFIXED BY E1165.

Figure 15-7. Cessna Course Director 800 (Sheet 1 of 3)



NOTE: WIRE NUMBERS PREFIXED BY E1165

Cessna Course Director 800 With Cessna  
Nav/Omni 800 And ADF Tie In.

Figure 15-7. Cessna Course Director 800 (Sheet 2 of 3)

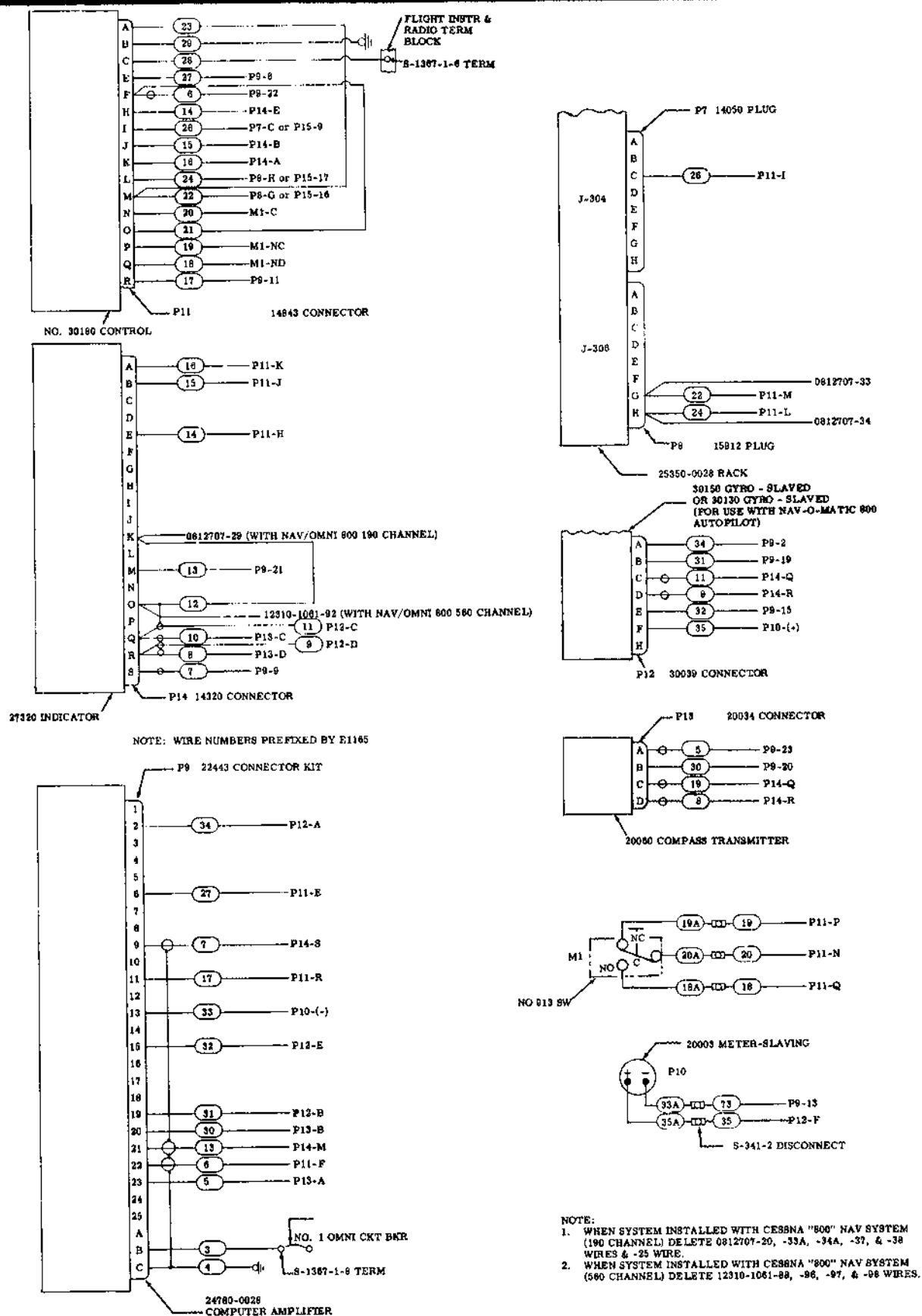


Figure 15-7. Cessna Course Director 800 (Sheet 3 of 3)

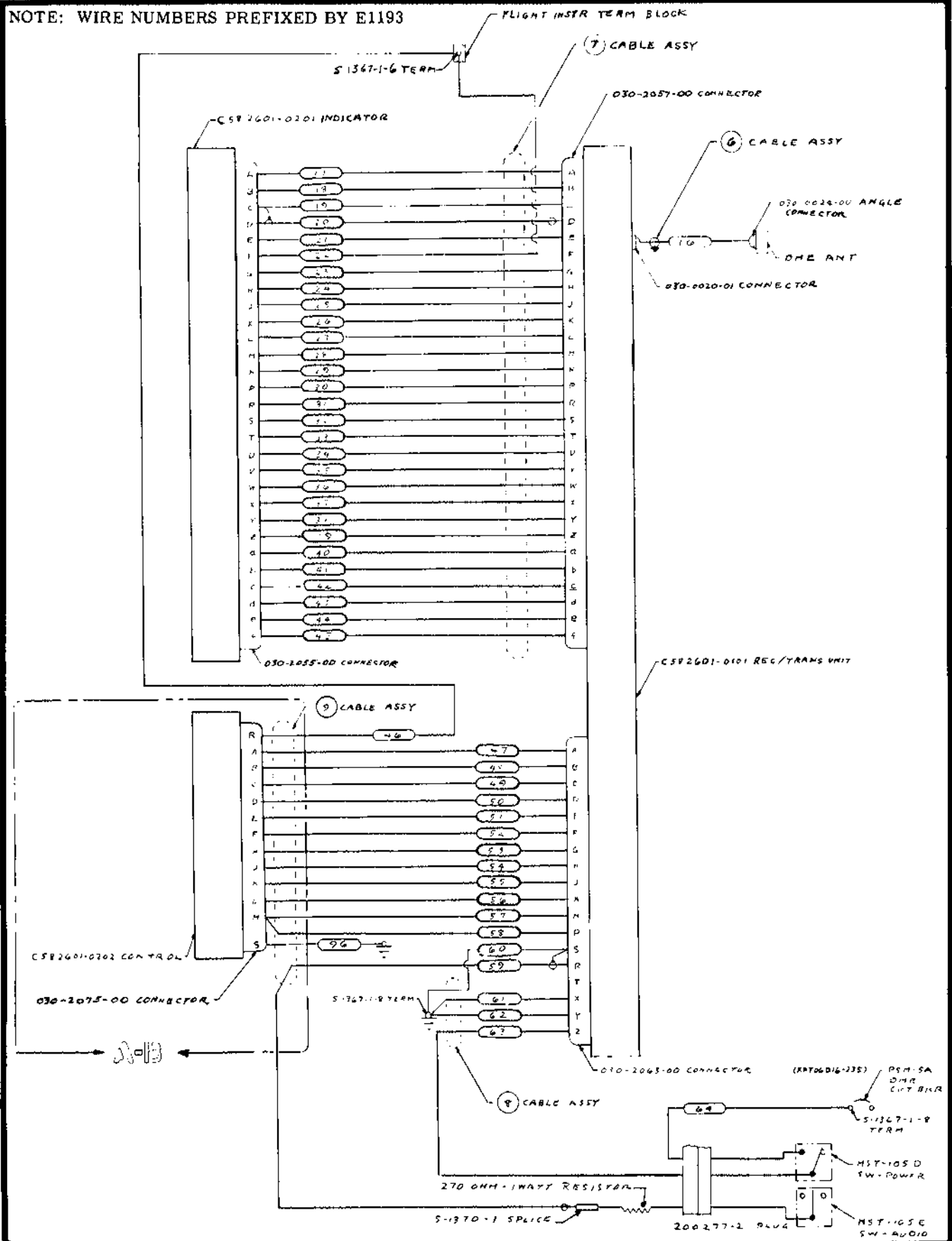


Figure 15-8. Cessna DME 800 (Sheet 1 of 3)

## DETAIL A

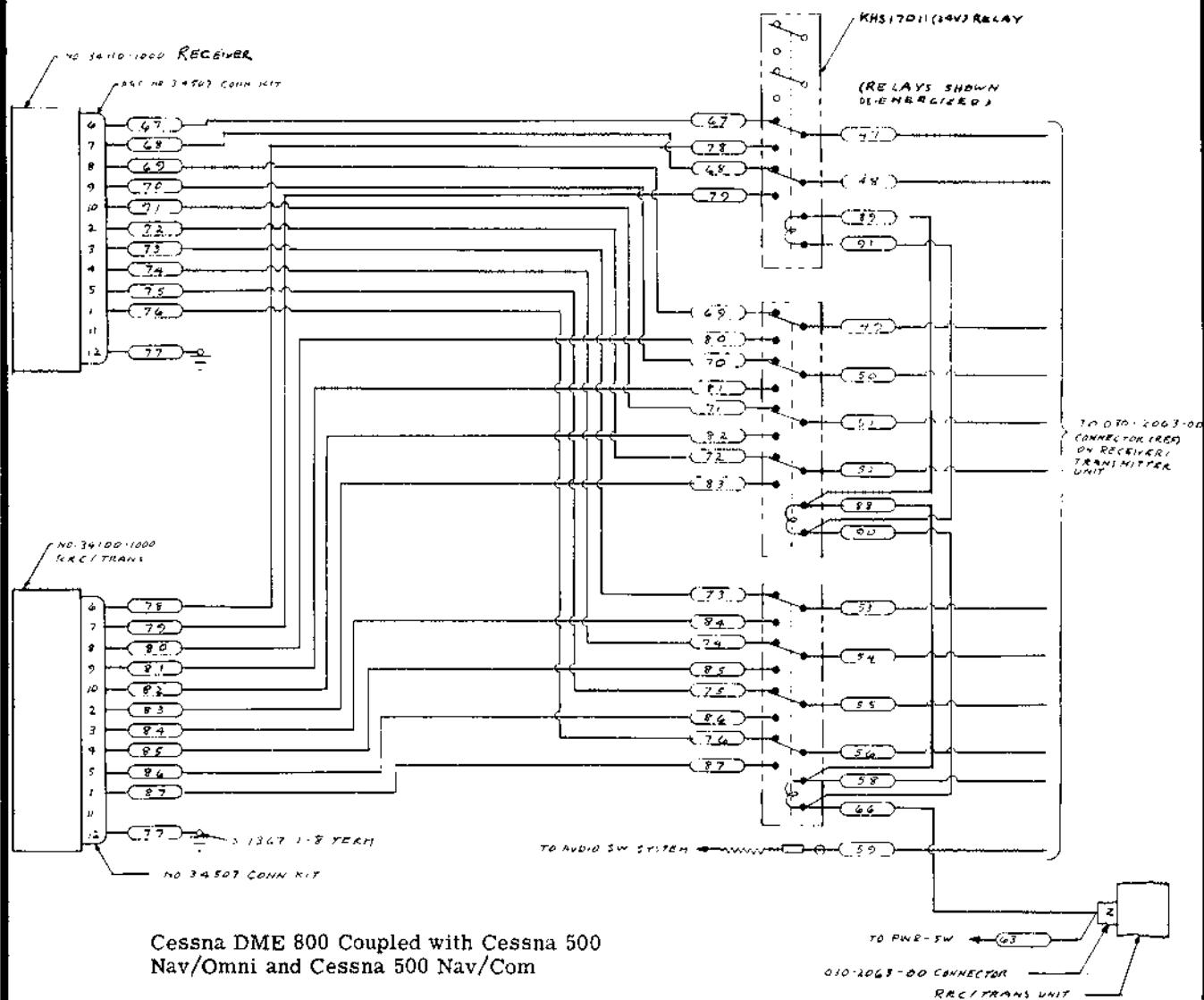
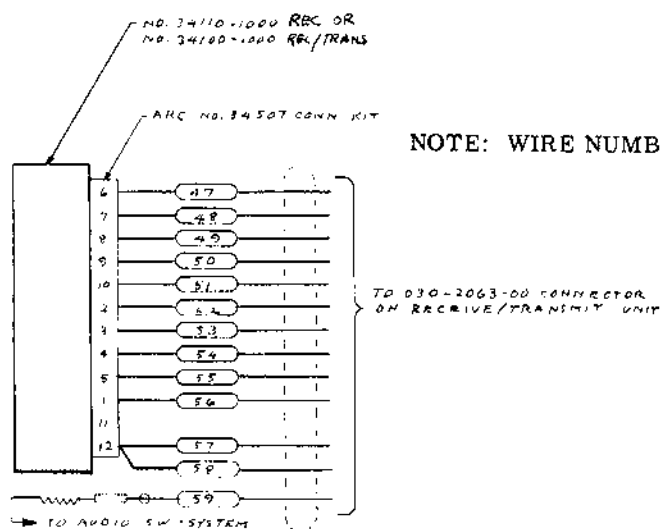
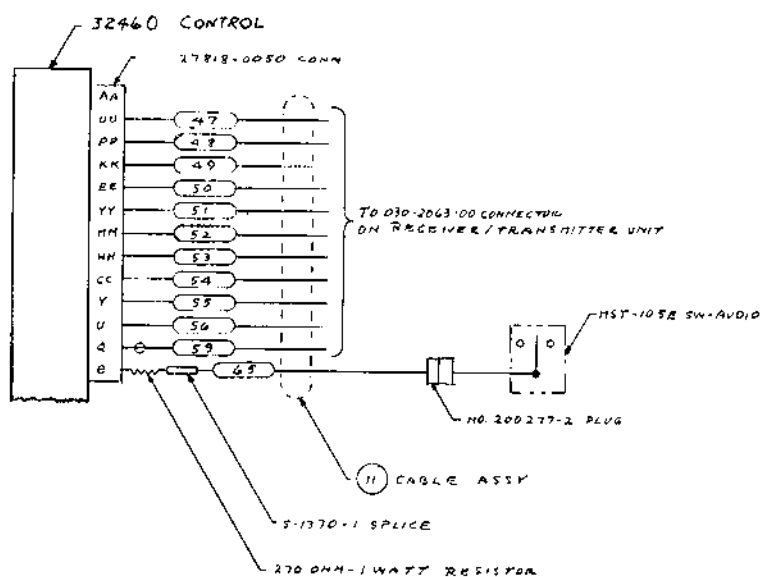


Figure 15-8. Cessna DME 800 (Sheet 2 of 3)

## DETAIL B



NOTE: WIRE NUMBERS PREFIXED BY E1193

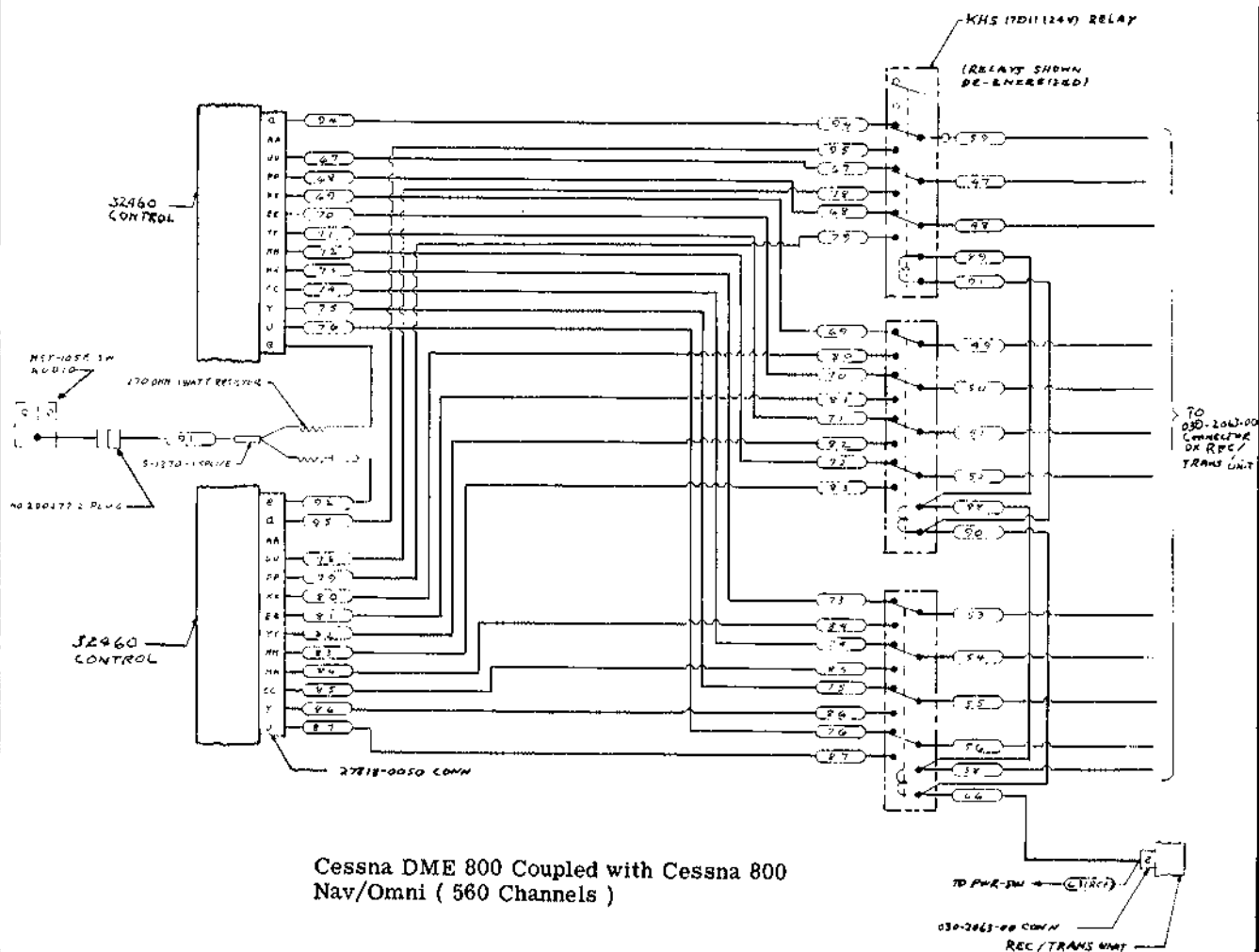
Cessna DME 800 Coupled with Cessna 800  
Nav/Omni ( 560 Channels )

Figure 15-8. Cessna DME 800 (Sheet 3 of 3)



NOTE: WIRE NUMBERS PREFIXED BY E1111

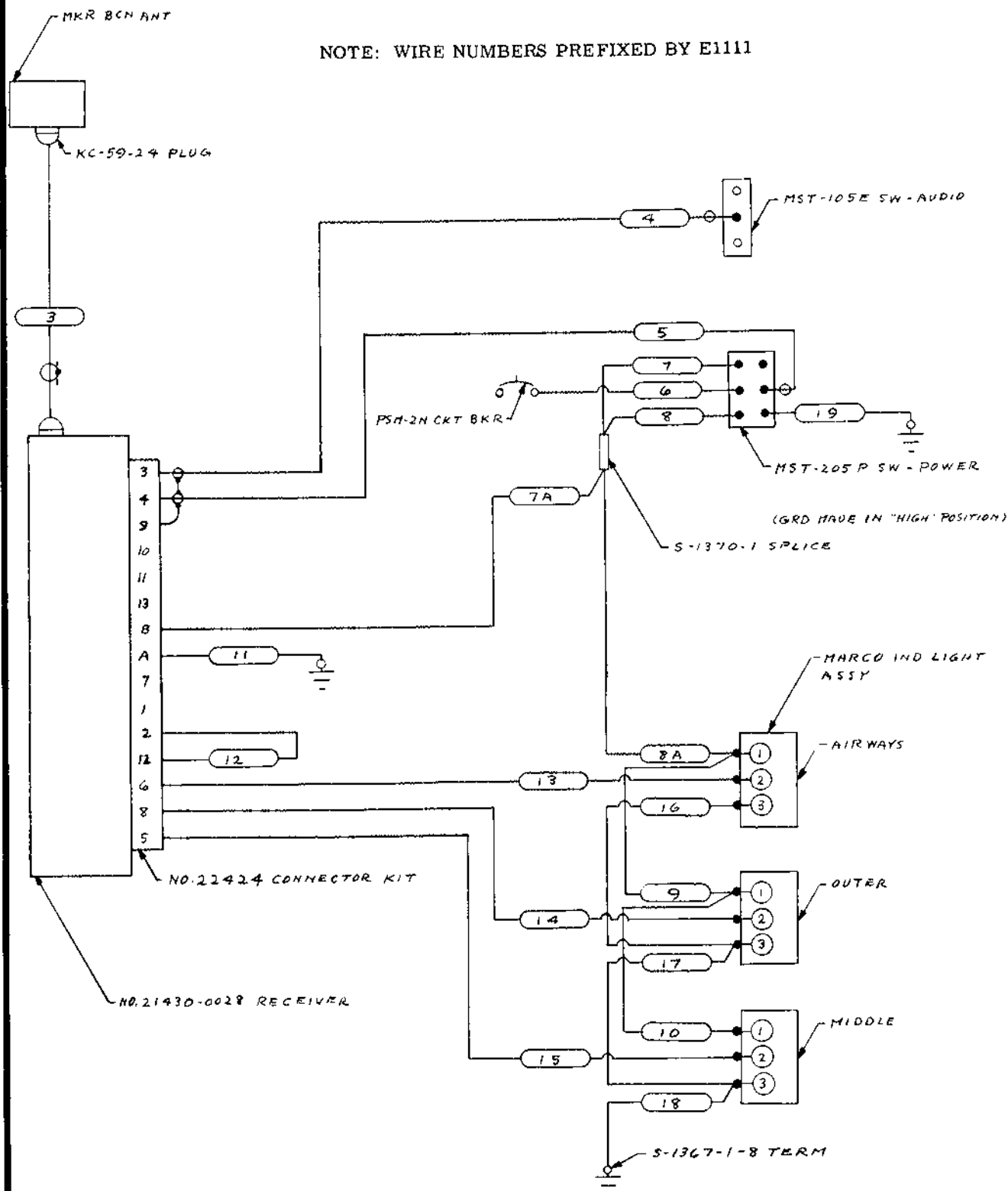
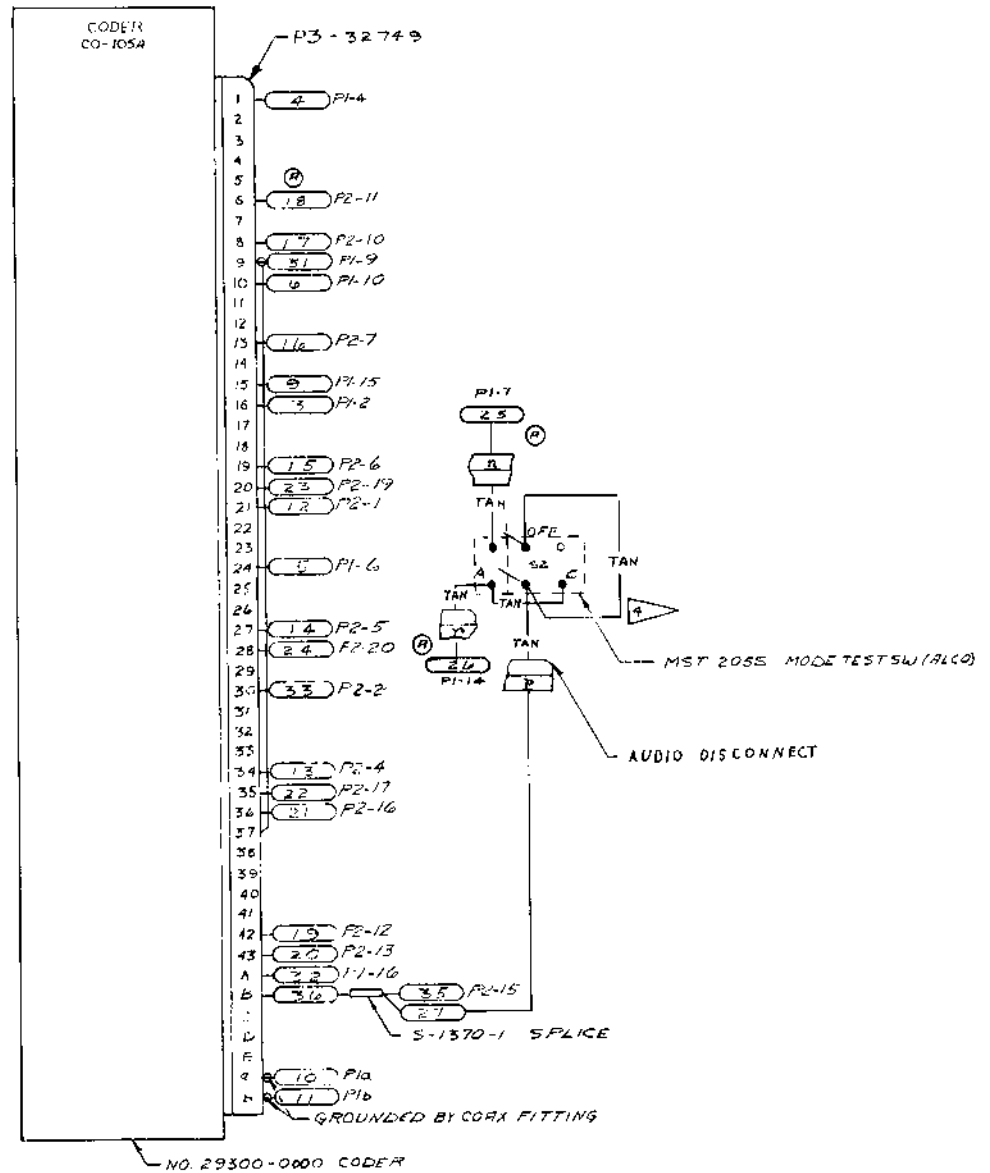


Figure 15-9. Cessna Marker Beacon 800

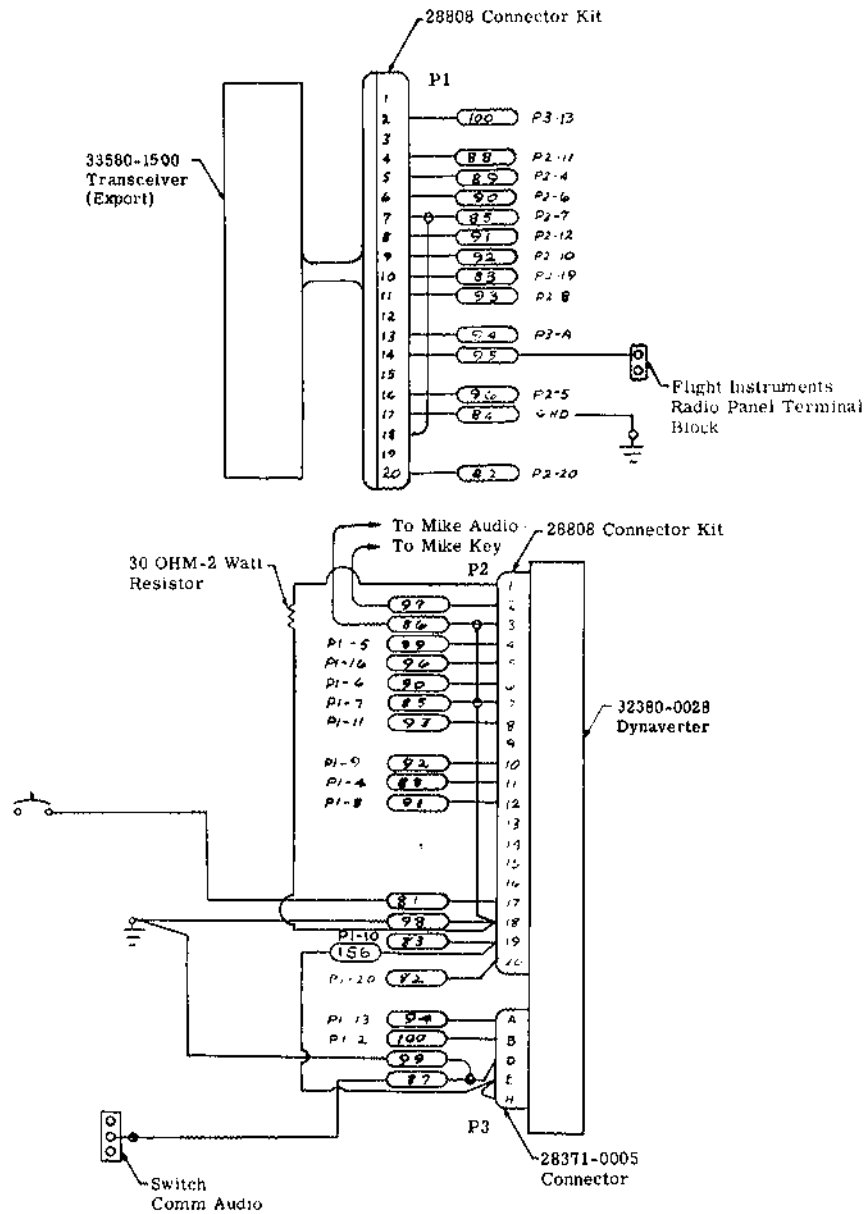


NOTE: WIRE NUMBERS PREFIXED BY E1206

Figure 15-10. Cessna Transponder 800 (Sheet 1 of 2)

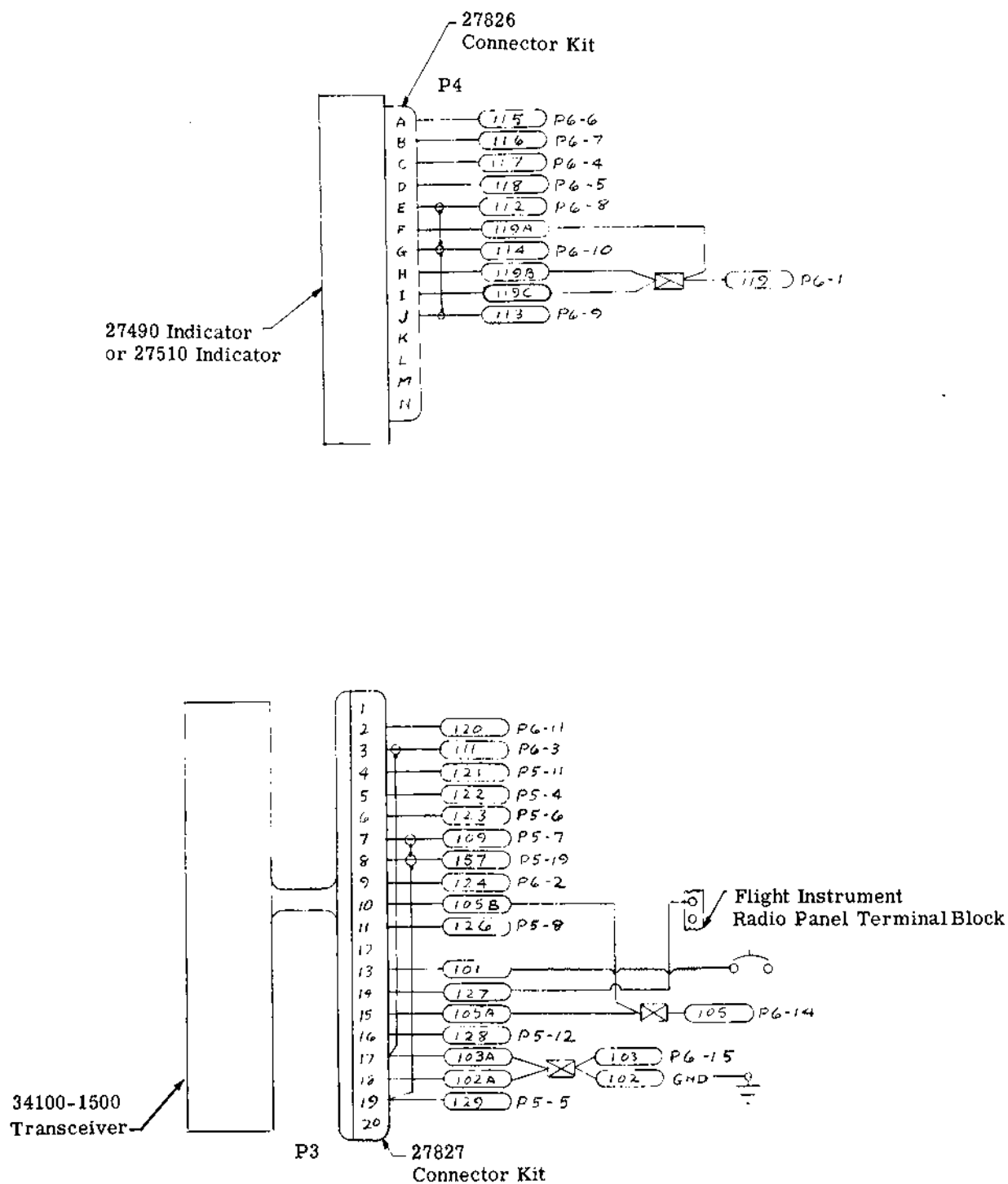


Figure 15-10. Cessna Transponder 800 (Sheet 2 of 2)



NOTE: WIRE NUMBERS PREFIXED BY E1043.

Figure 15-11. Cessna Transceiver 500



## NOTE

WIRE NUMBERS ARE PREFIXED BY E1043

Figure 15-12. Cessna Nav/Com 500 (Sheet 1 of 2)

NOTE: WIRE NUMBERS PREFIXED BY E1043.

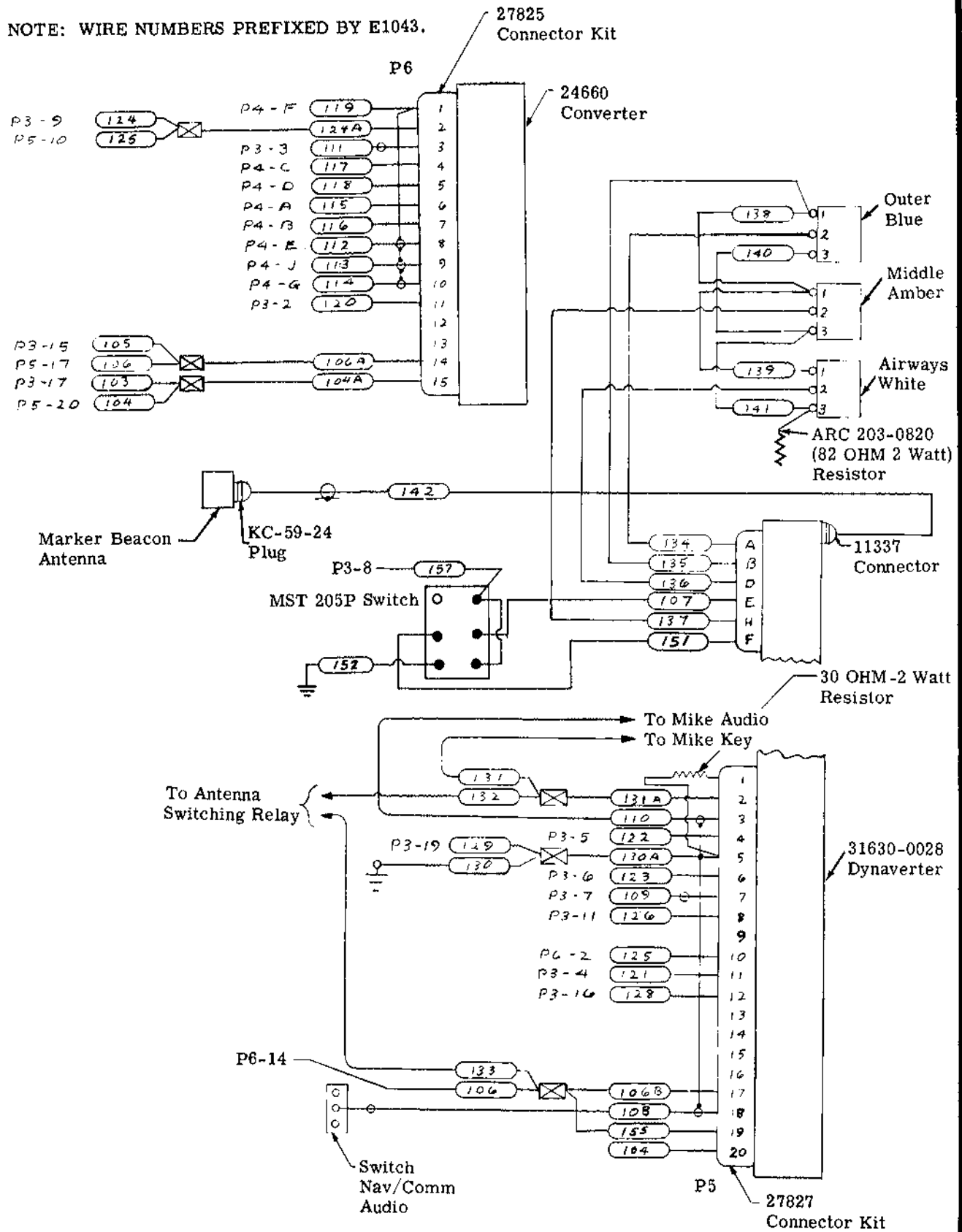
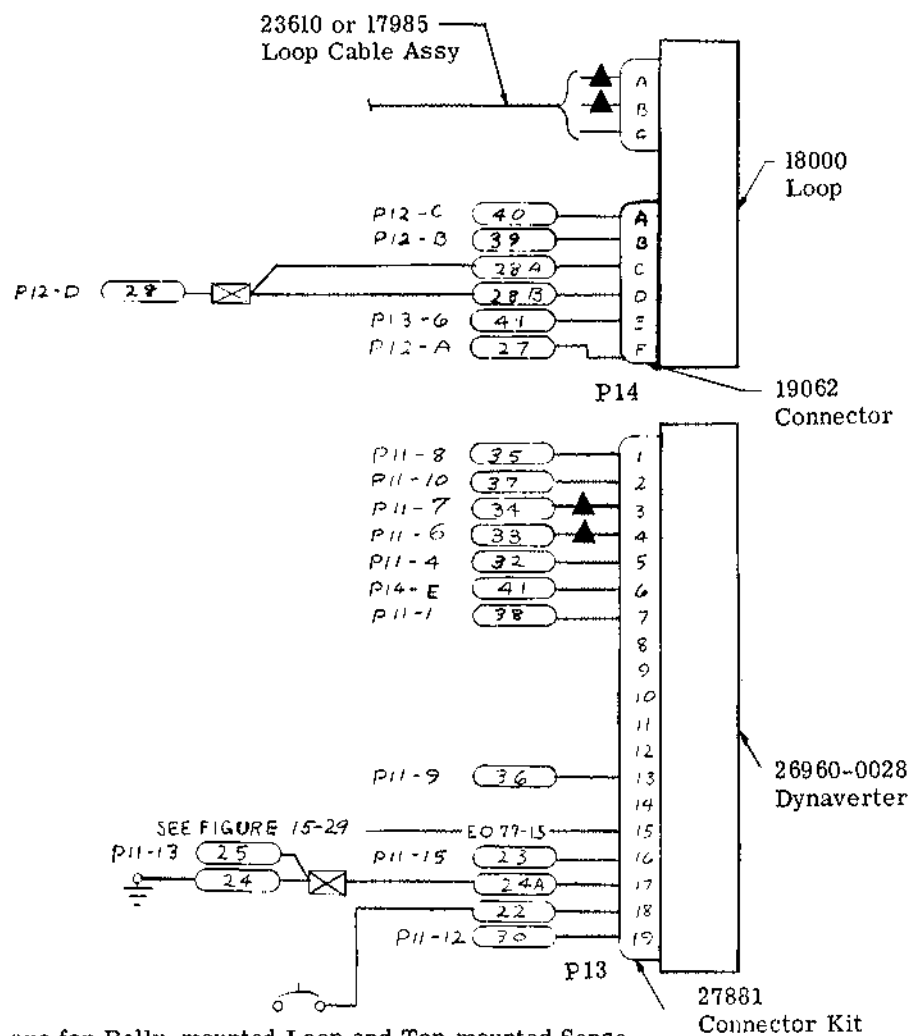
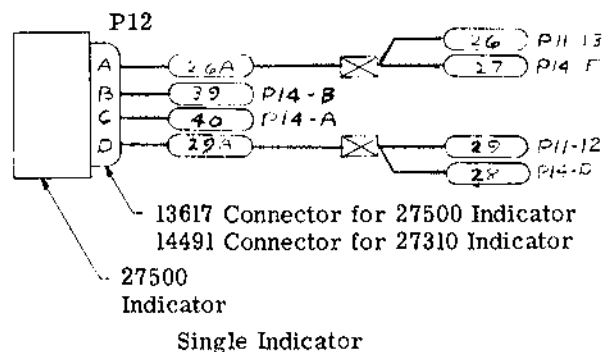


Figure 15-12. Cessna Nav/Com 500 (Sheet 2 of 2)

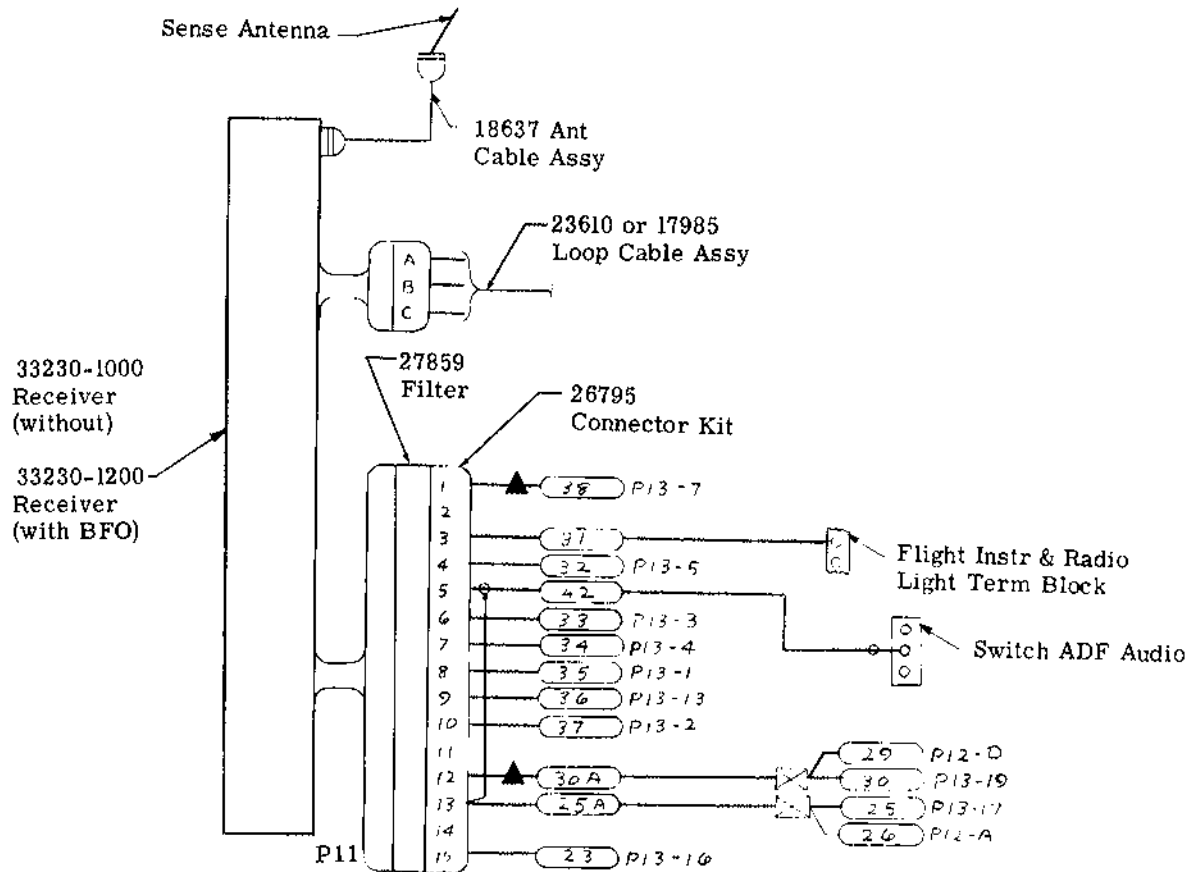


▲ Connections shown are for Belly mounted Loop and Top mounted Sense Antenna. For Belly mounted Sense Antenna reverse connections at point 3 and 4 on Dynavertter and point A and B on Loop.

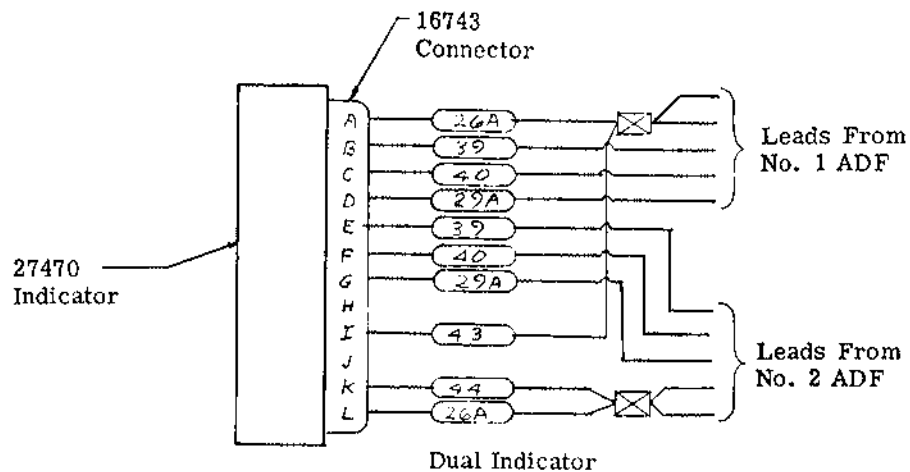


NOTE: WIRE NUMBERS PREFIXED BY E1043.

Figure 15-13. Cessna ADF 500 Rotatable Loop (Sheet 1 of 2)



▲ Connections shown are for Belly Mounted Loop and Top mounted Sense Antenna. For Belly Mounted Loop Antenna reverse connections at points 1 and 12 on the Receiver.



NOTE: WIRE NUMBERS PREFIXED BY E1043

Figure 15-13. Cessna ADF 500 Rotatable Loop (Sheet 2 of 2)



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NOTE: WIRE NUMBERS PREFIXED BY E1175

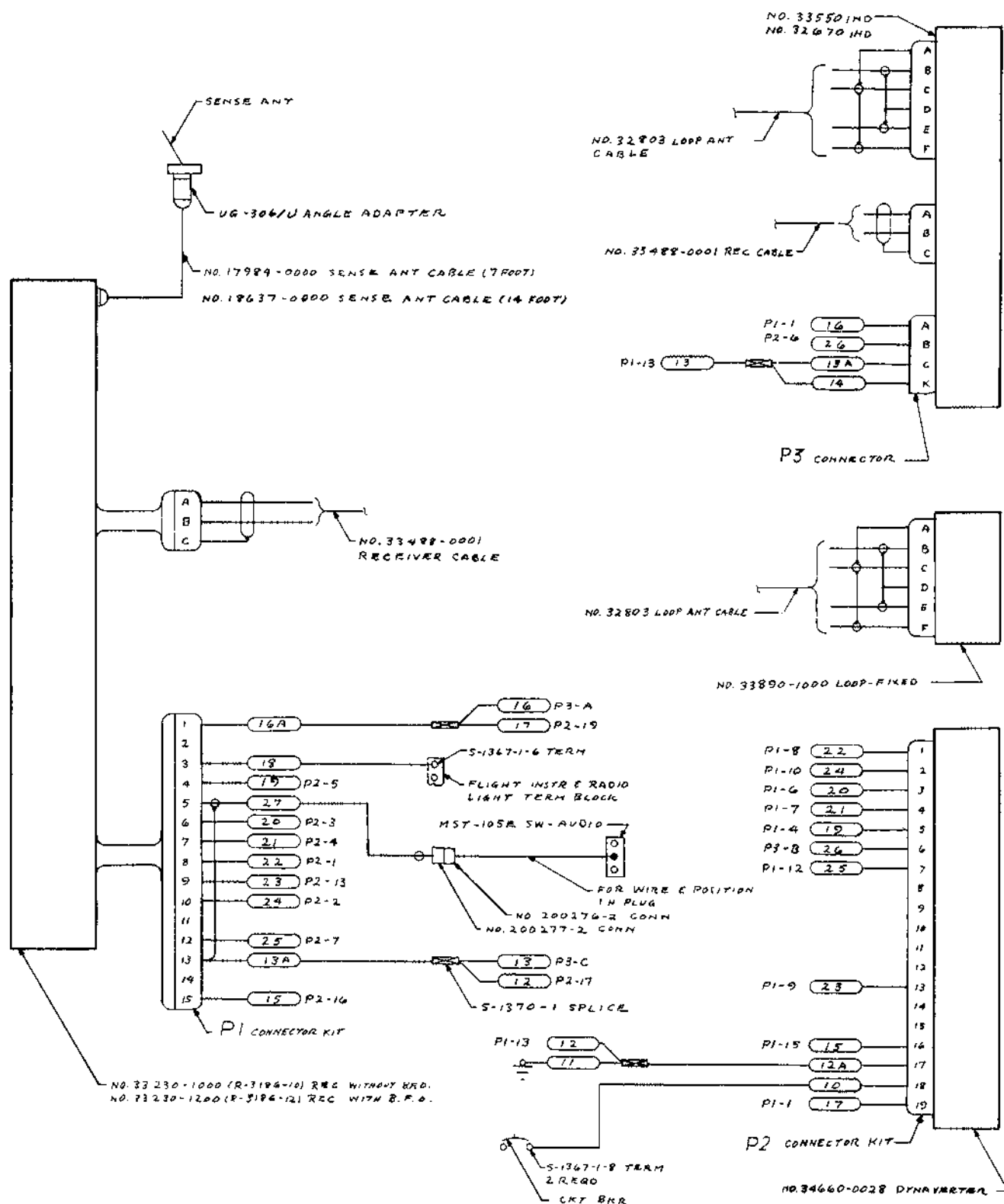
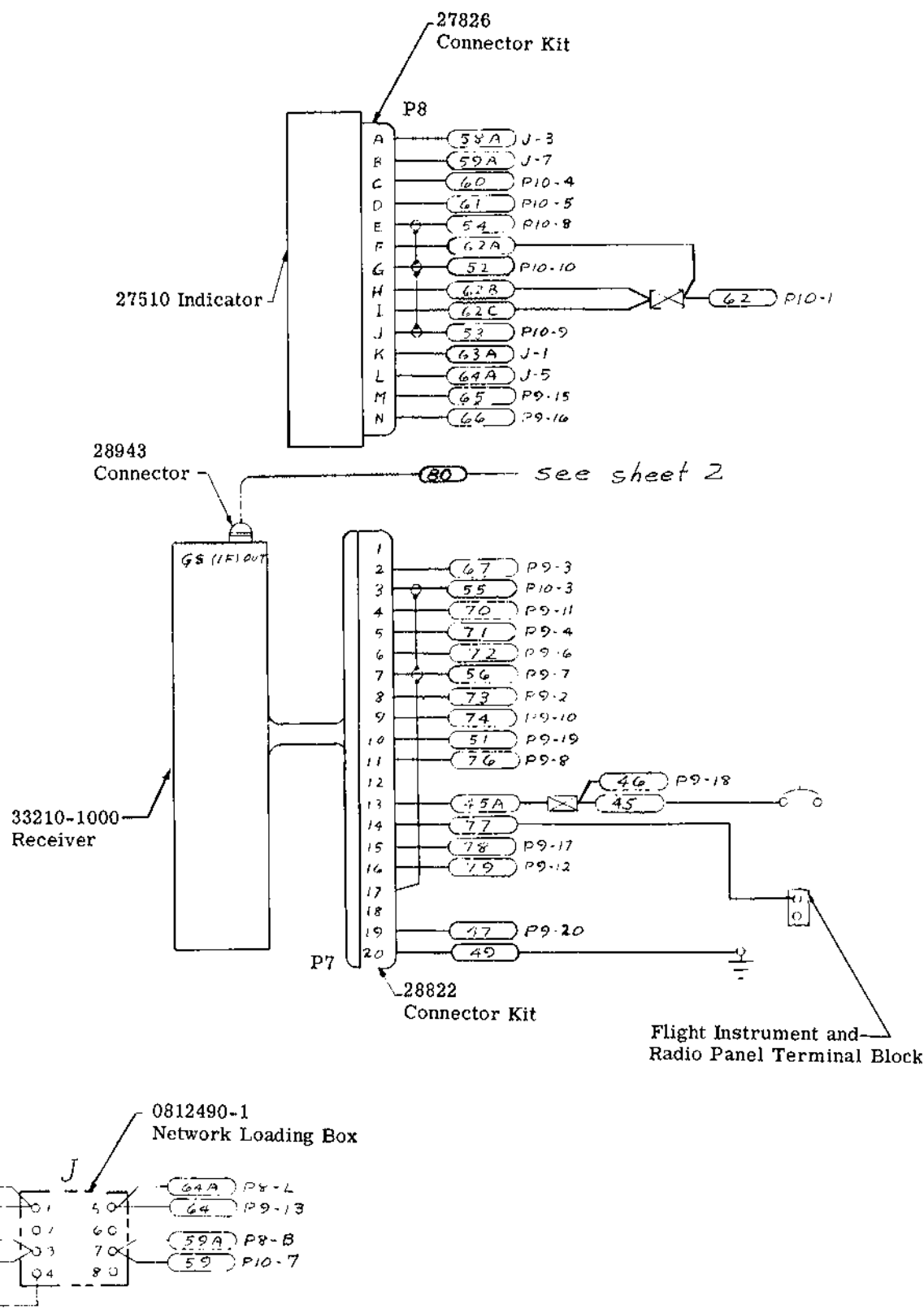
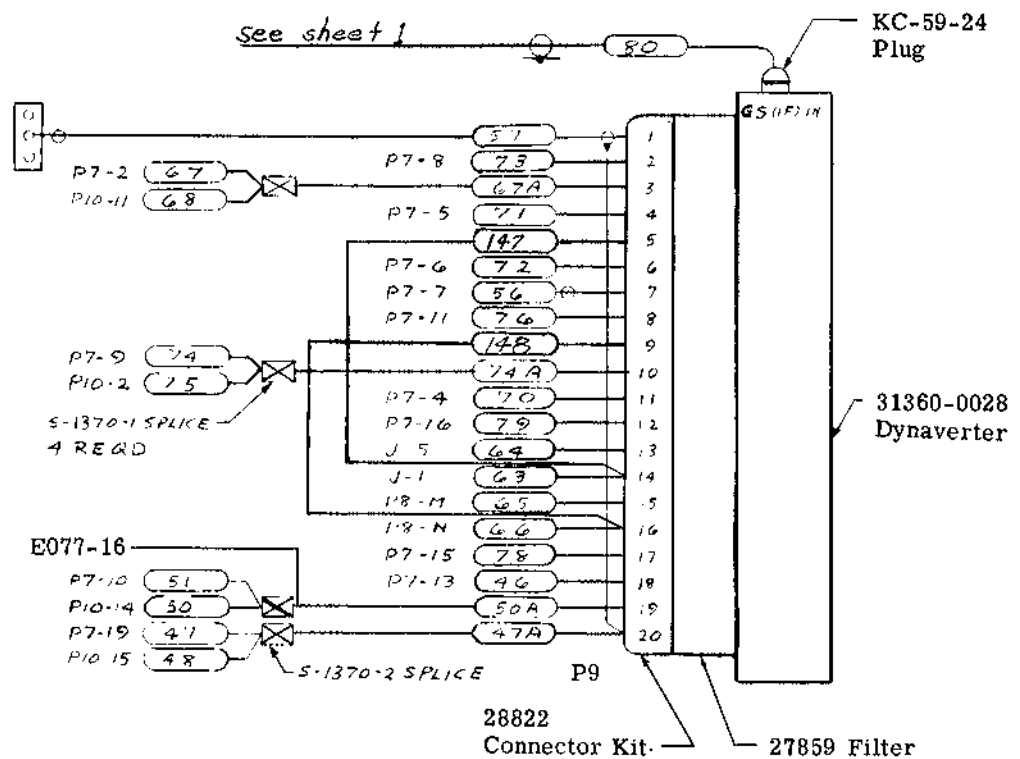
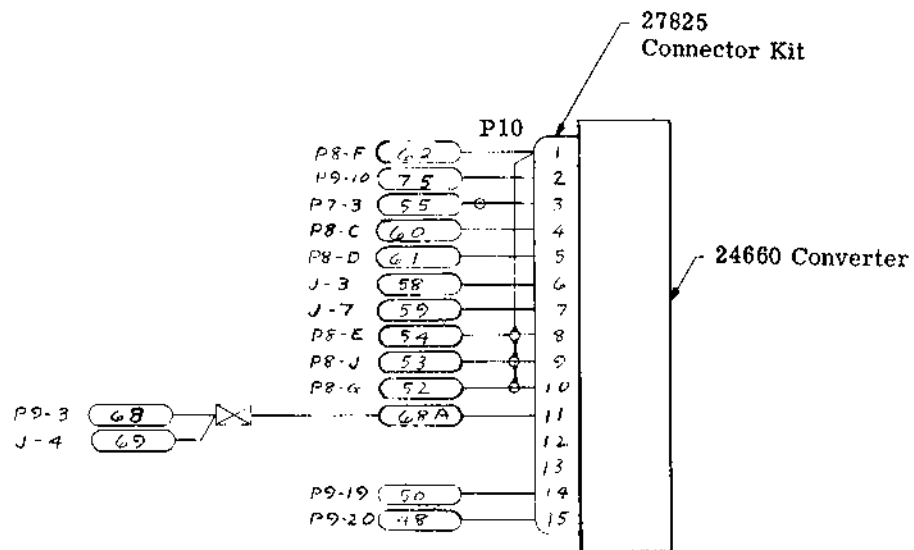


Figure 15-13A. Cessna 500 ADF Fixed Loop



NOTE: WIRE NUMBERS PREFIXED BY E1043.

Figure 15-14. Cessna Nav/Omni 500 (Sheet 1 of 2)



### NOTE

WIRE NUMBERS ARE PREFIXED BY E1043.

Figure 15-14. Cessna Nav/Omni 500 (Sheet 2 of 2)

(2 TRANSMITTERS)

WIRE NUMBERS PREFIXED BY E1232

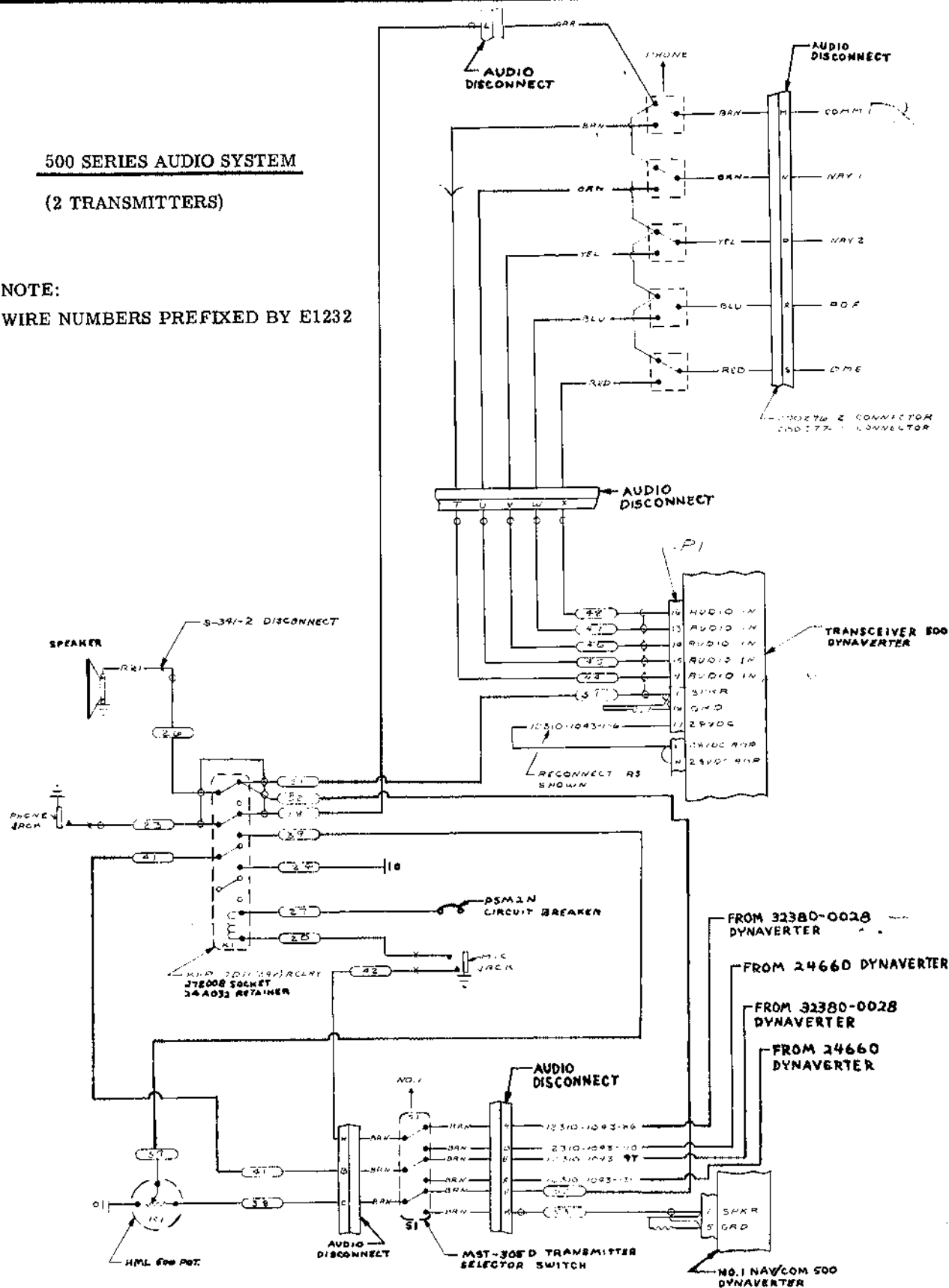


Figure 15-15. Audio Interconnect System (Sheet 1 of 5)

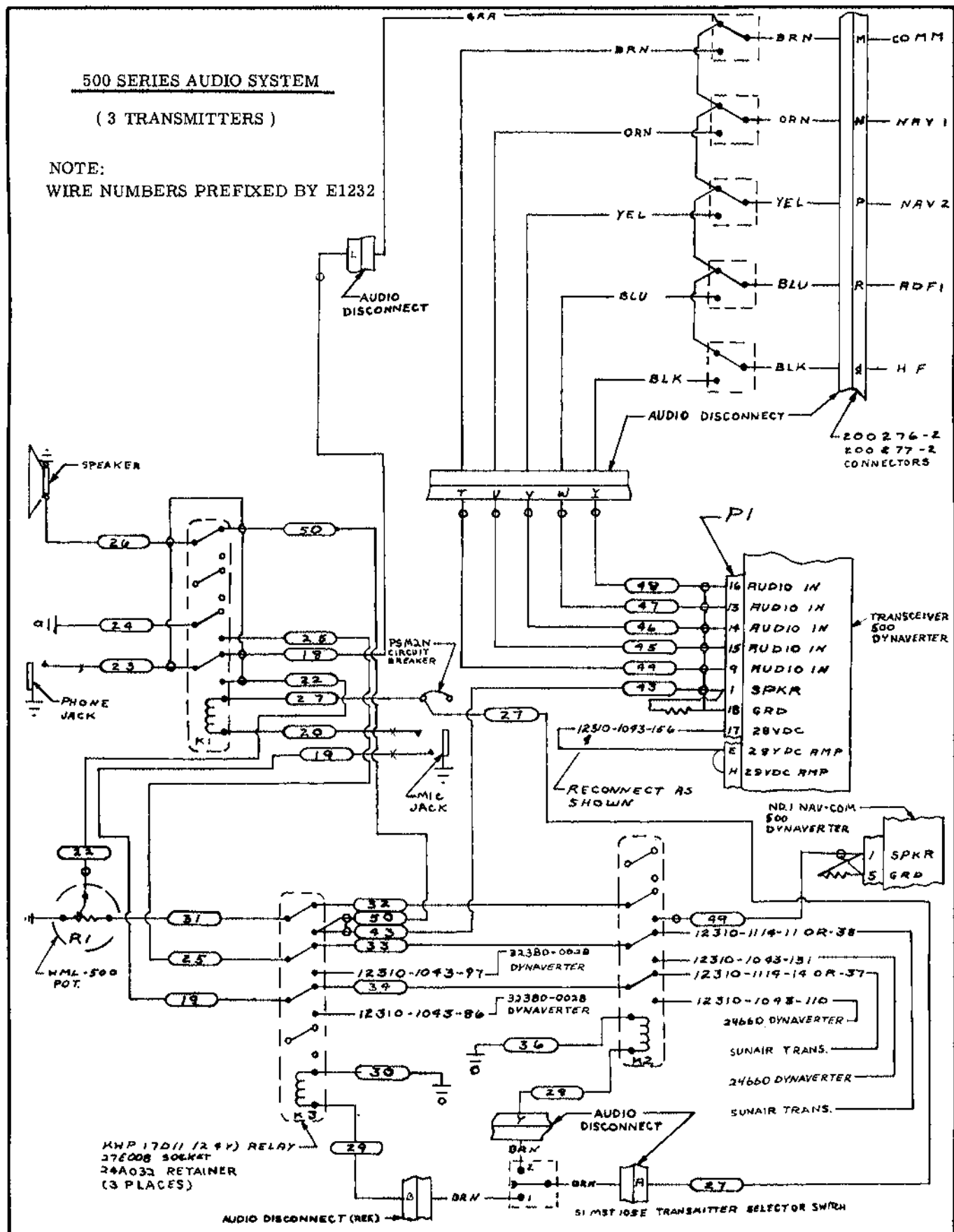


Figure 15-15. Audio Interconnect System (Sheet 2 of 5)







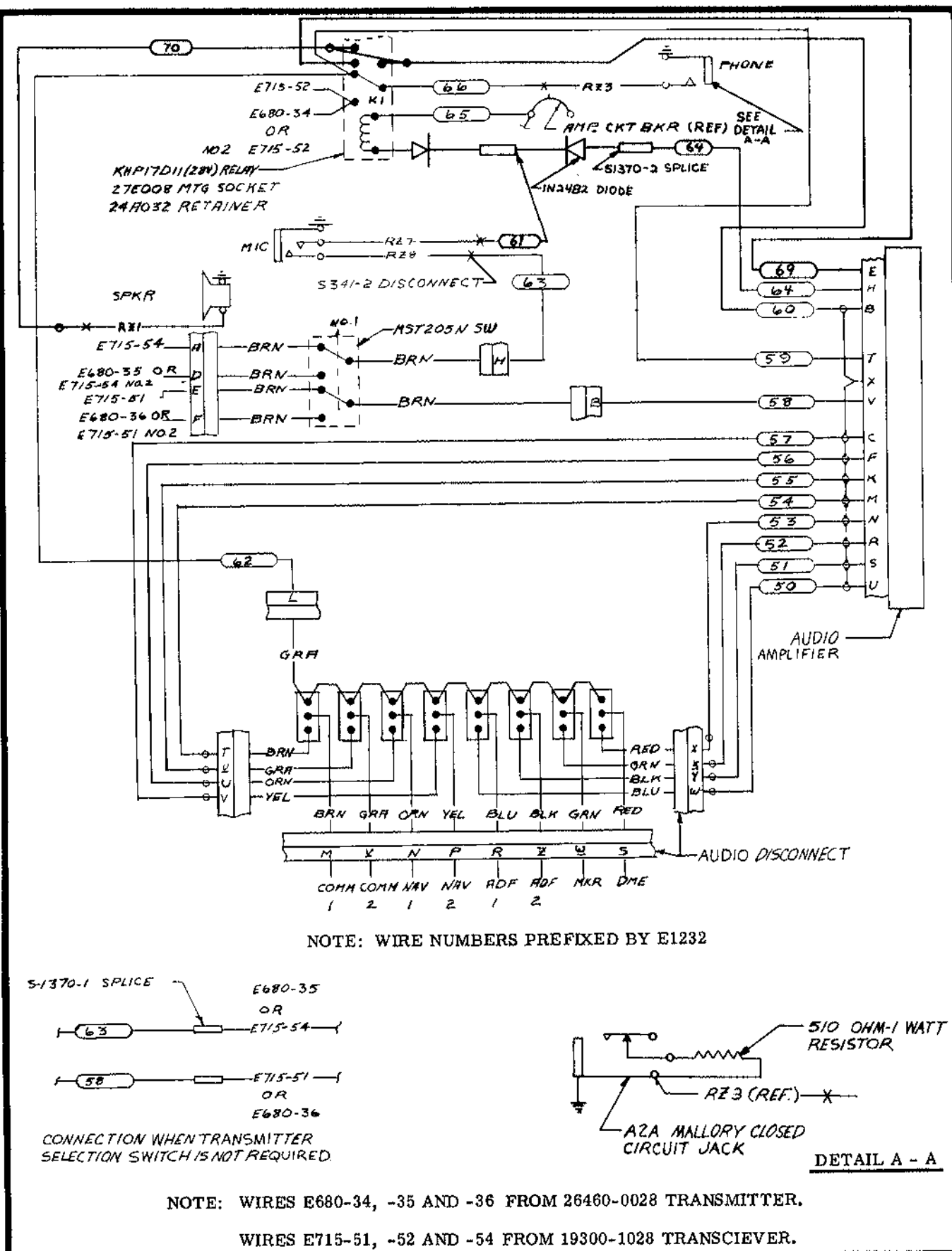
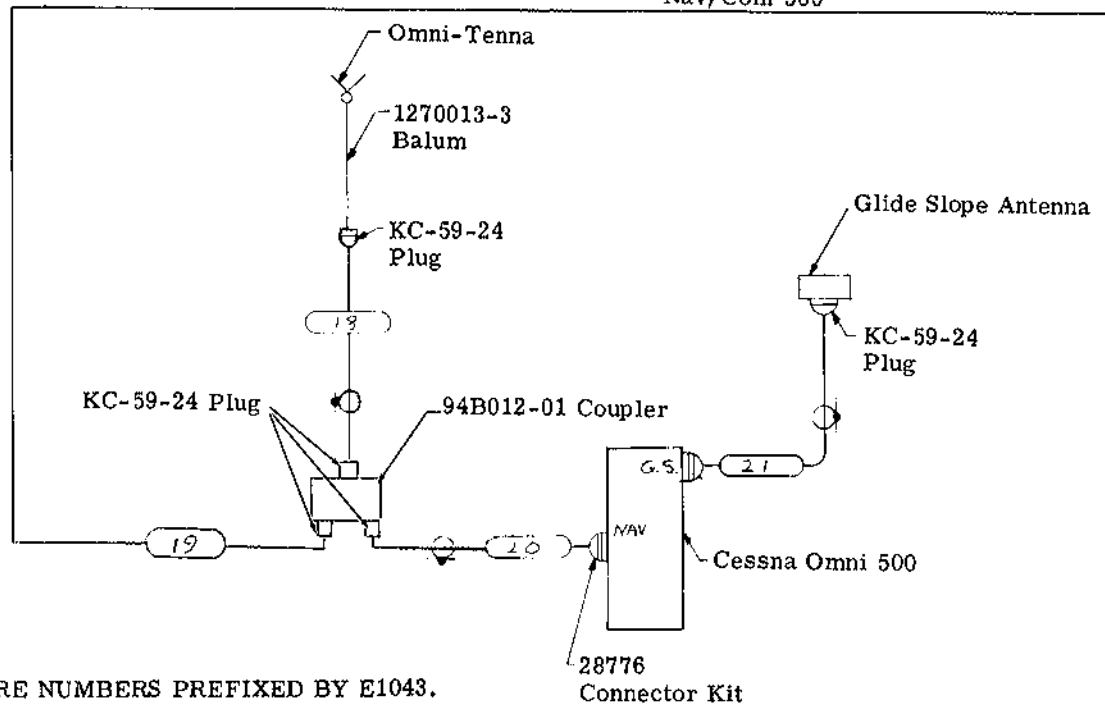
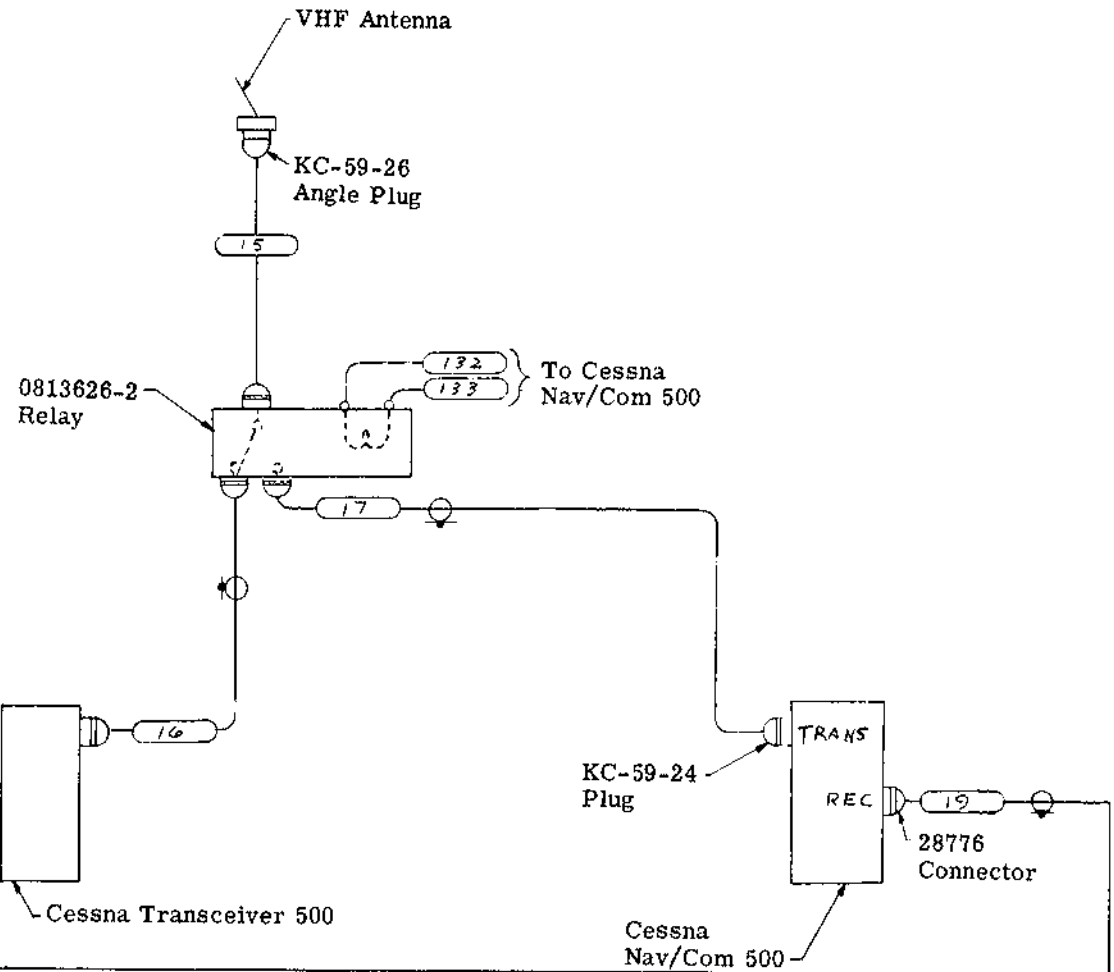


Figure 15-15. Audio Interconnect System (Sheet 5 of 5)



NOTE: WIRE NUMBERS PREFIXED BY E1043.

Figure 15-16. Cessna 500 Series Antenna Interconnects (Sheet 1 of 2)

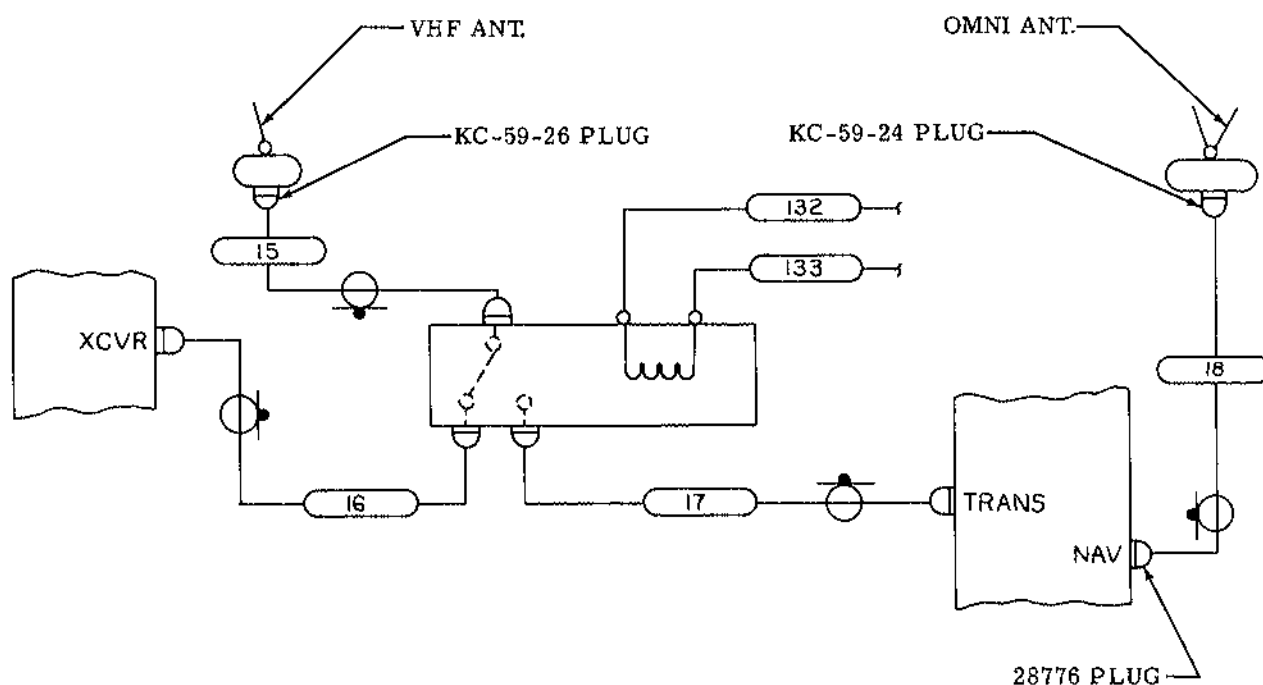
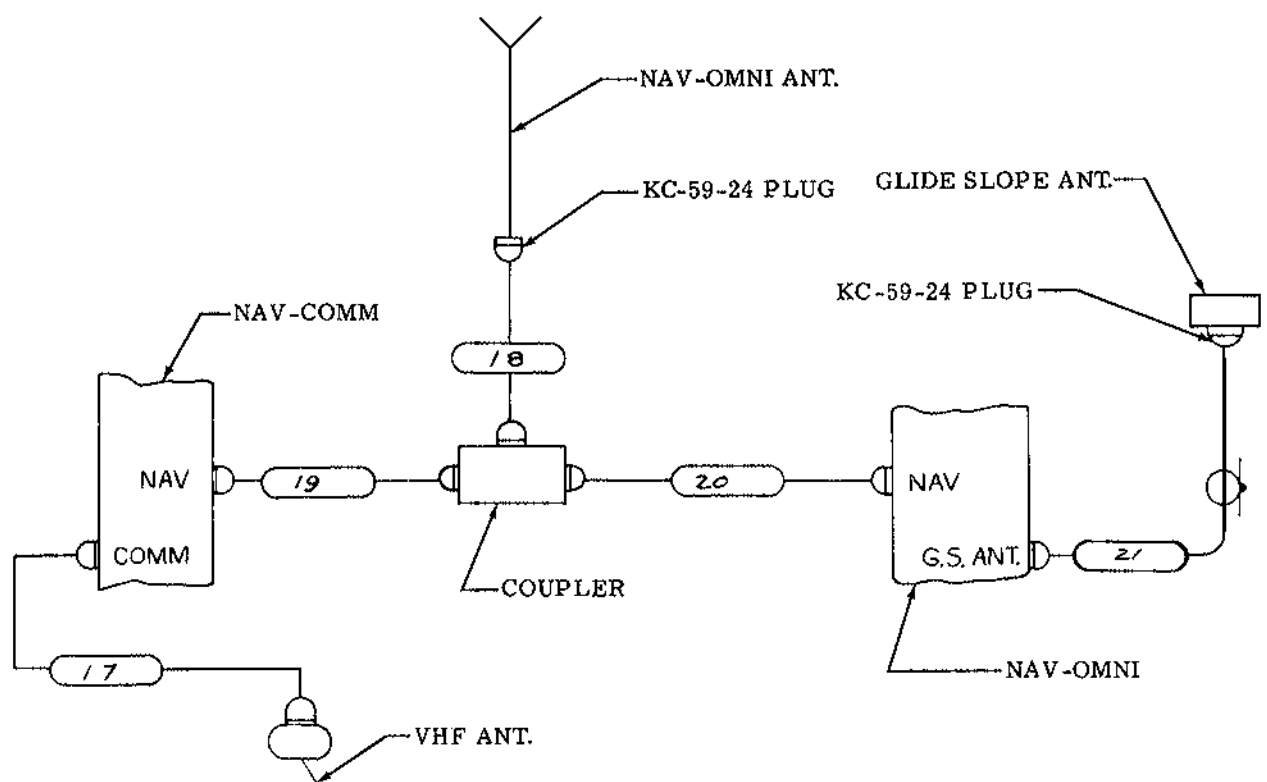


Figure 15-16. Cessna 500 Series Antenna Interconnect (Sheet 2 of 2)

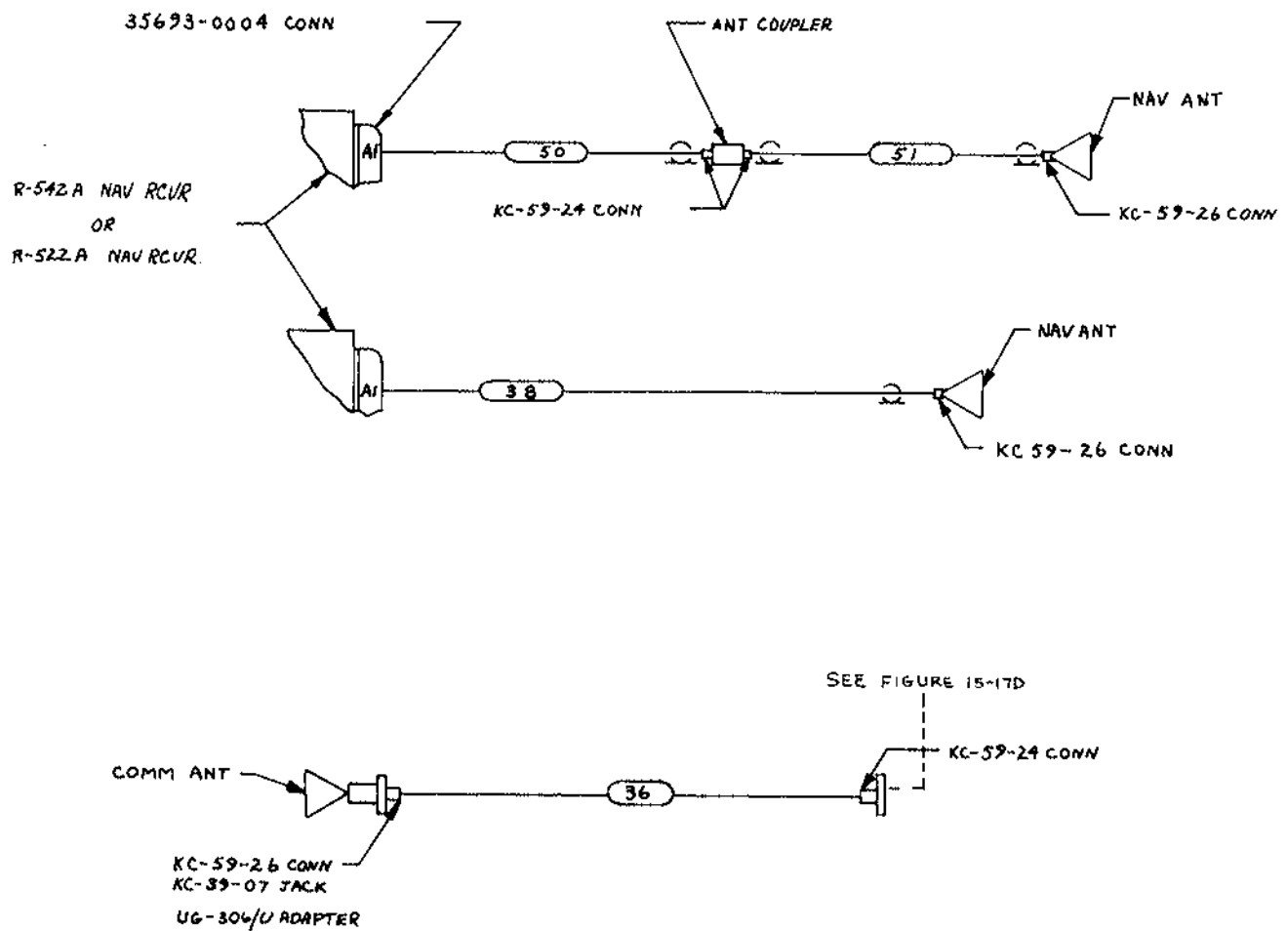


Figure 15-16A. Cessna 400 Series Antenna Interconnects

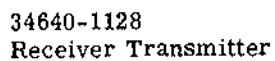


**Figure 15-17. Cessna 300 Series Antenna Interconnect**

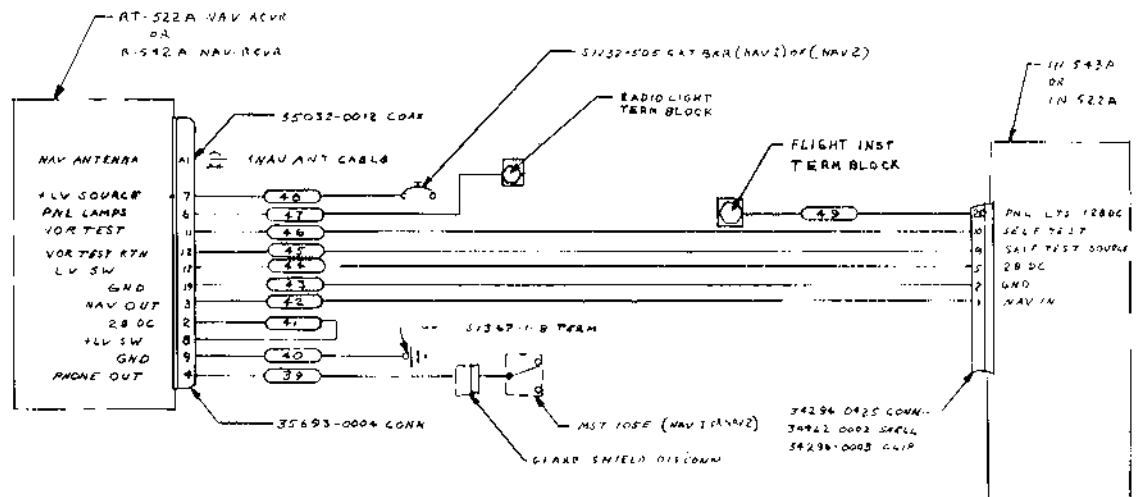
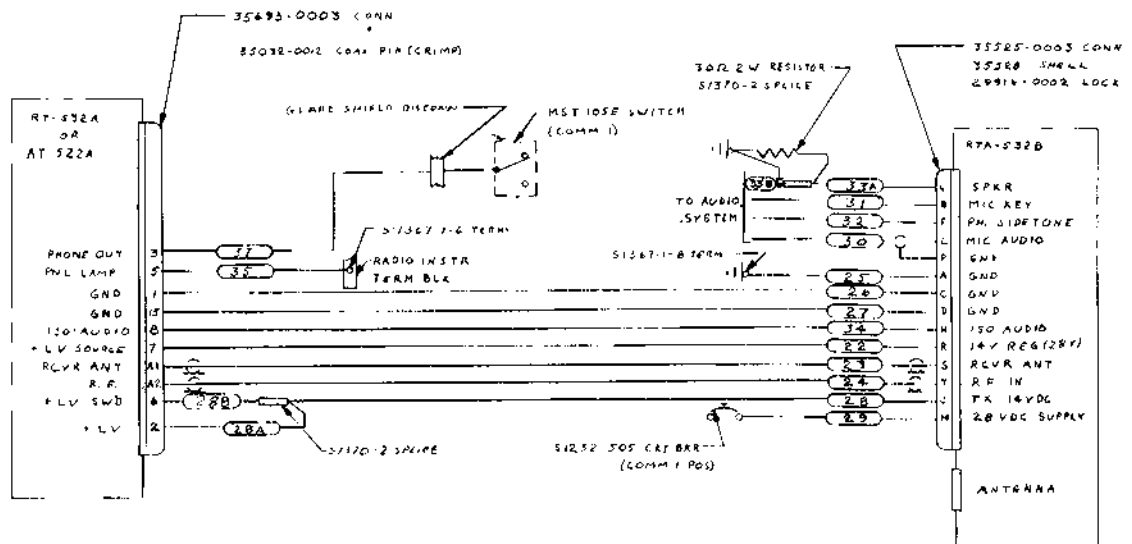


Figure 15-17A. Cessna Nav/ Com 400

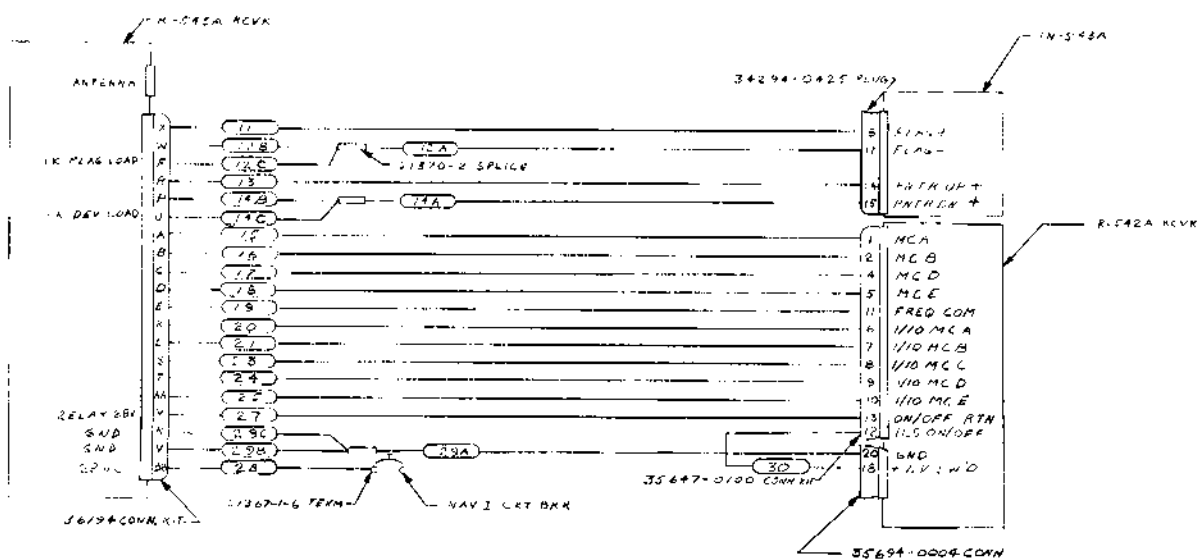
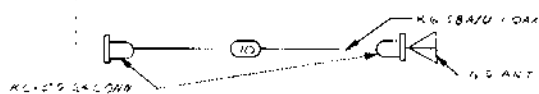
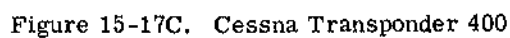


Figure 15-17B. Cessna Glideslope 400





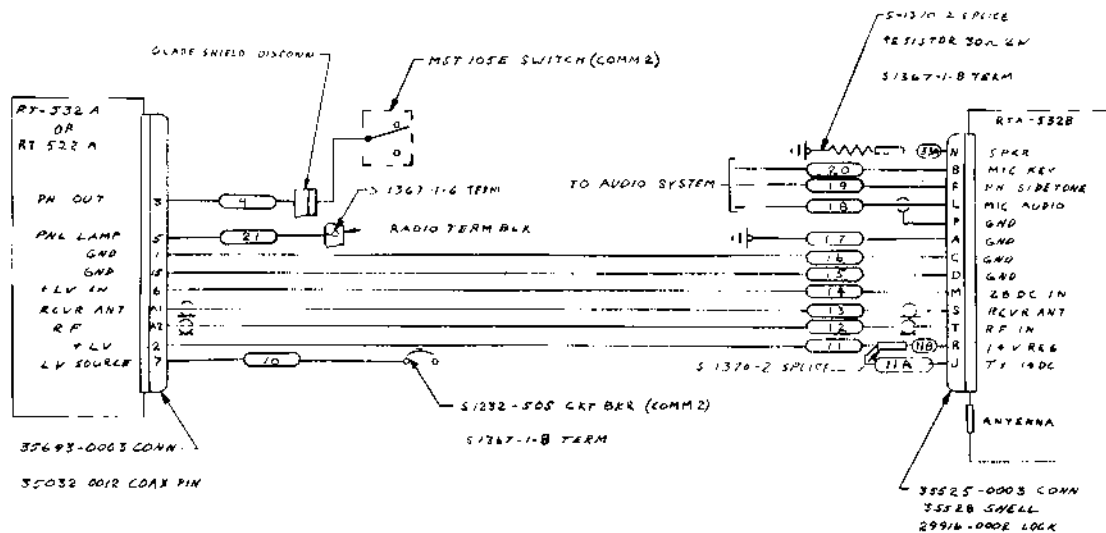
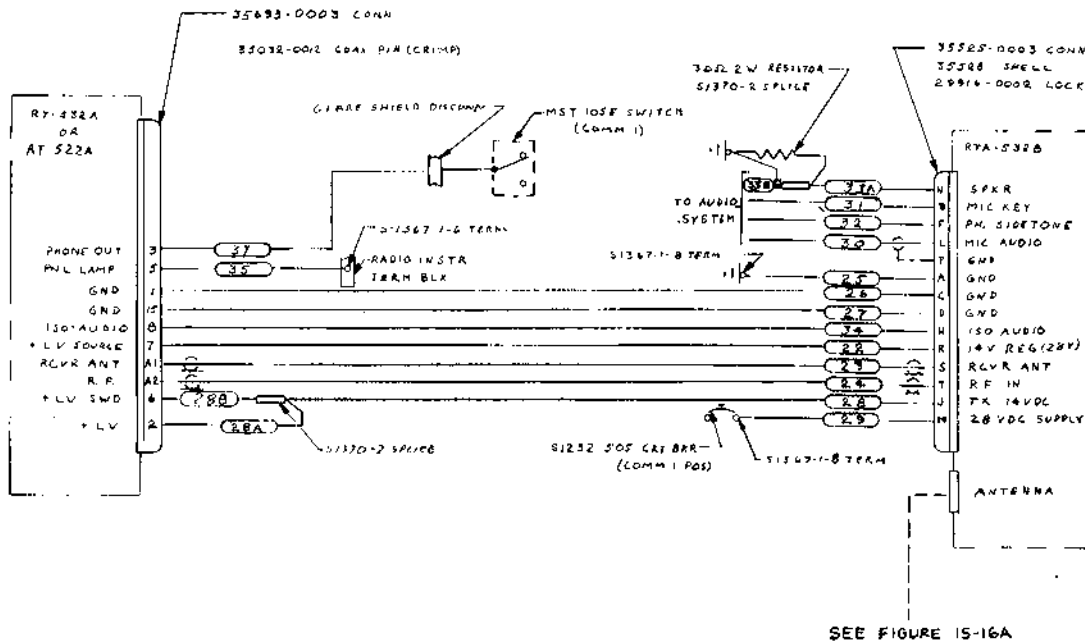


Figure 15-17D. Cessna Transceiver 400

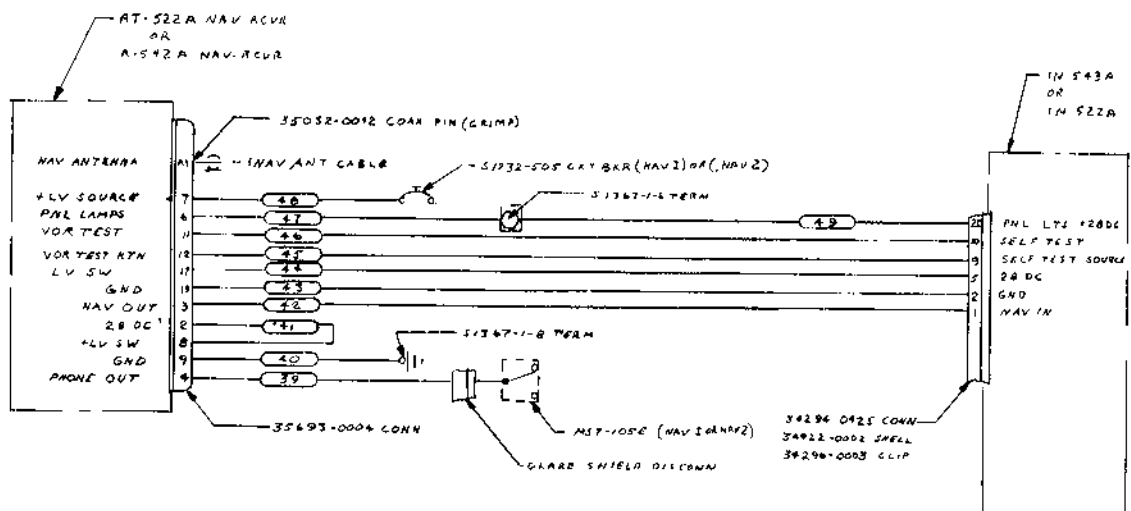
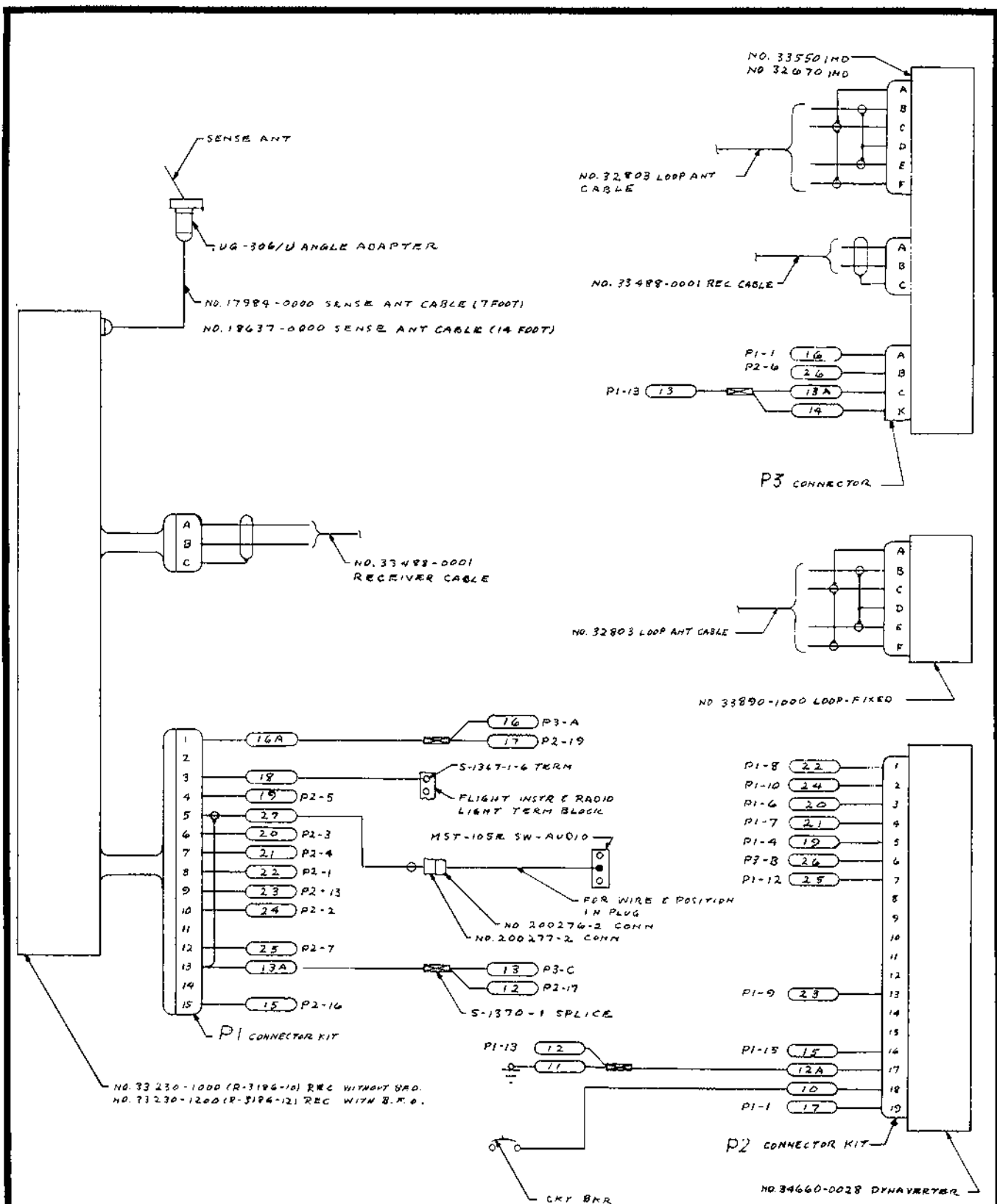


Figure 15-17E. Cessna Nav/Omni 400 (100 Channel)

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NOTE: WIRE NUMBERS PREFIXED BY E1175

Figure 15-17F. Cessna ADF 400 Fixed Loop

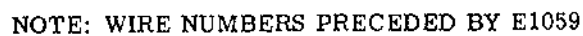


Figure 15-18. Cessna Marker Beacon 300

37600-1128\*  
36150-1128\*  
36150-1528\*

343640-1128  
Receiver Transceiver

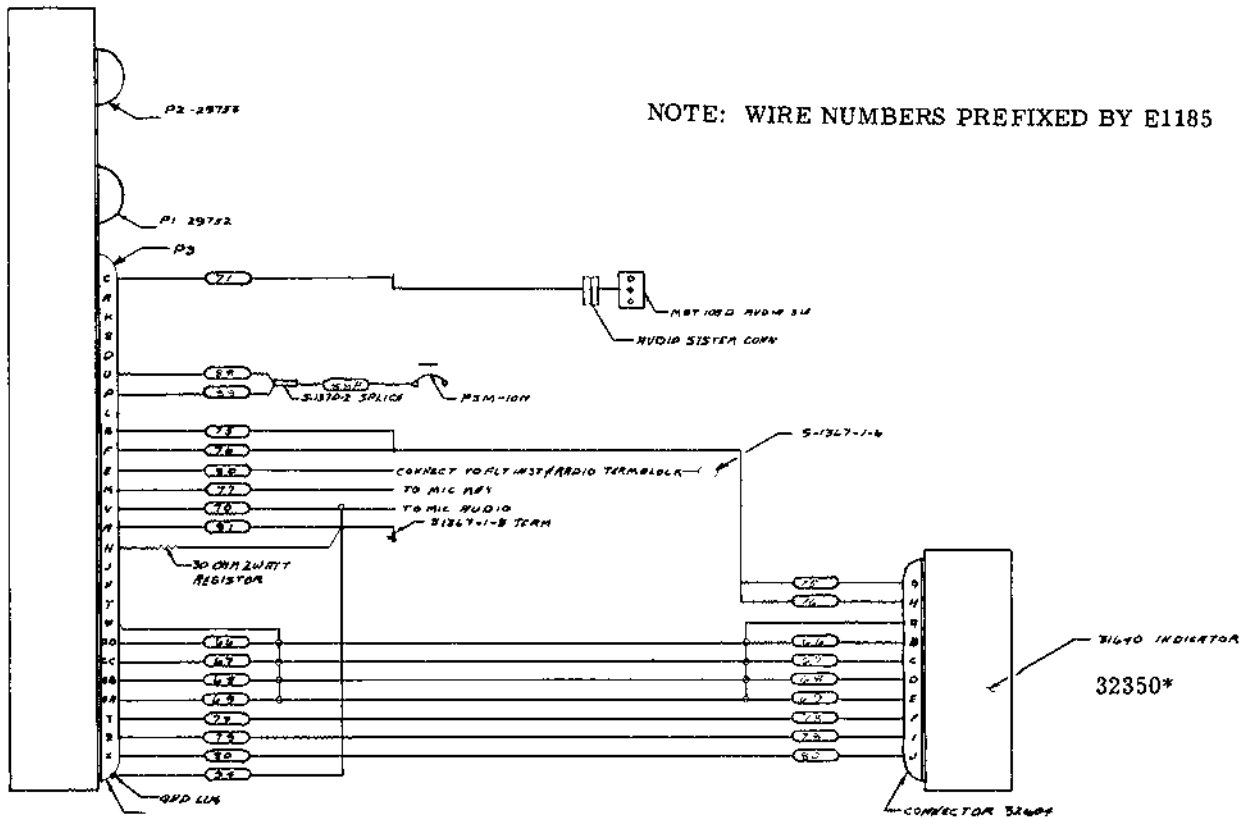


Figure 15-19. Cessna Nav/Com 300R

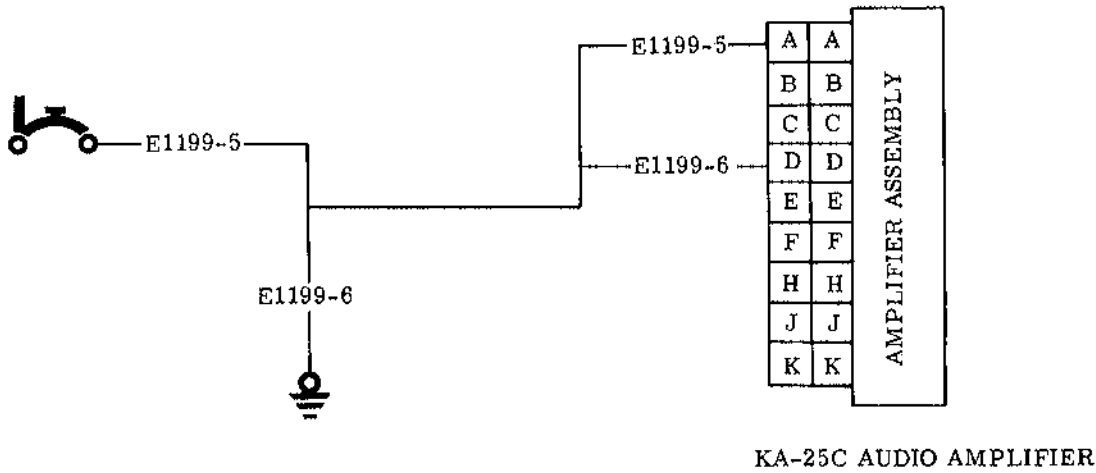
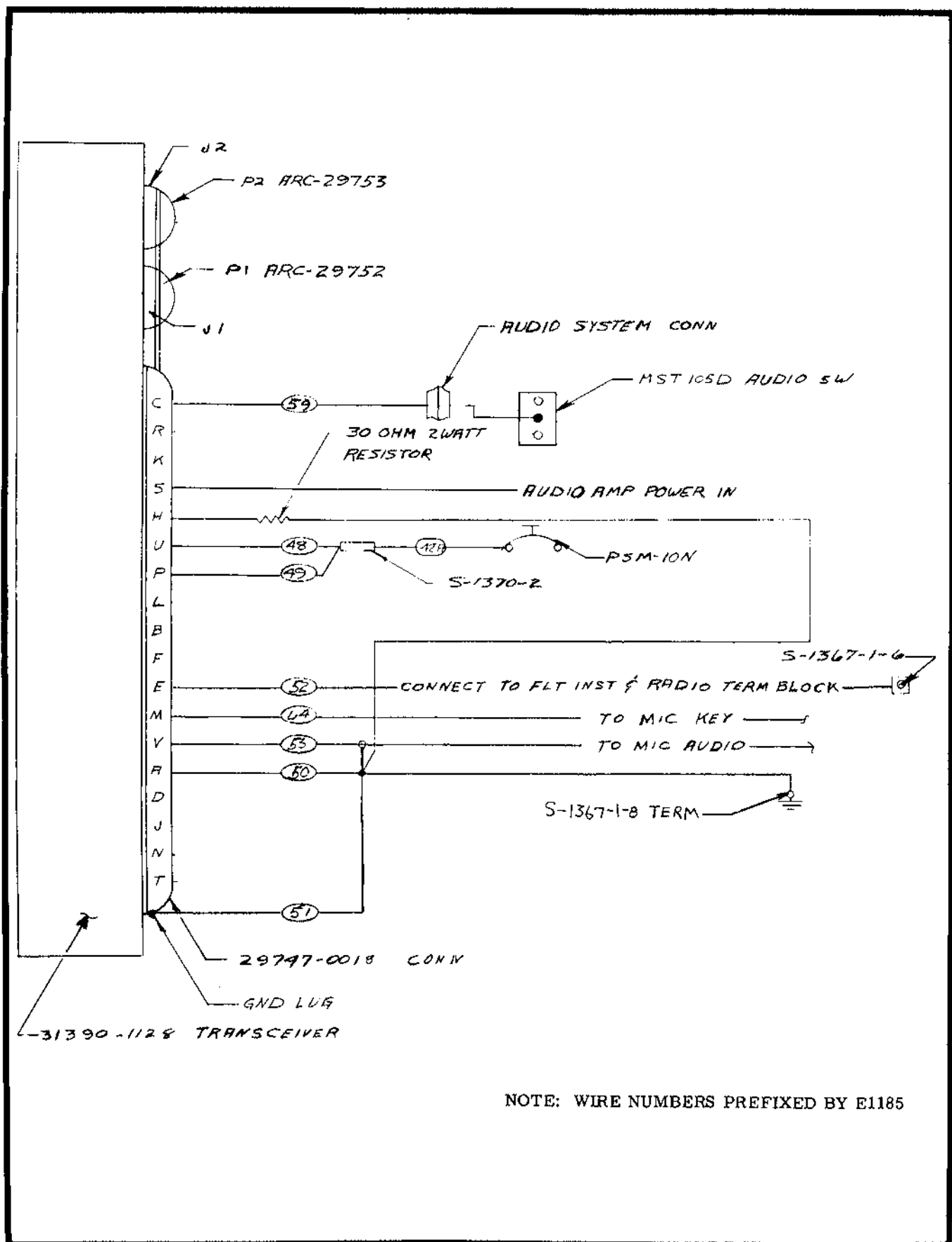


Figure 15-20. Audio Amplifier System



NOTE: WIRE NUMBERS PREFIXED BY E1185

Figure 15-21. Cessna Transceiver 300



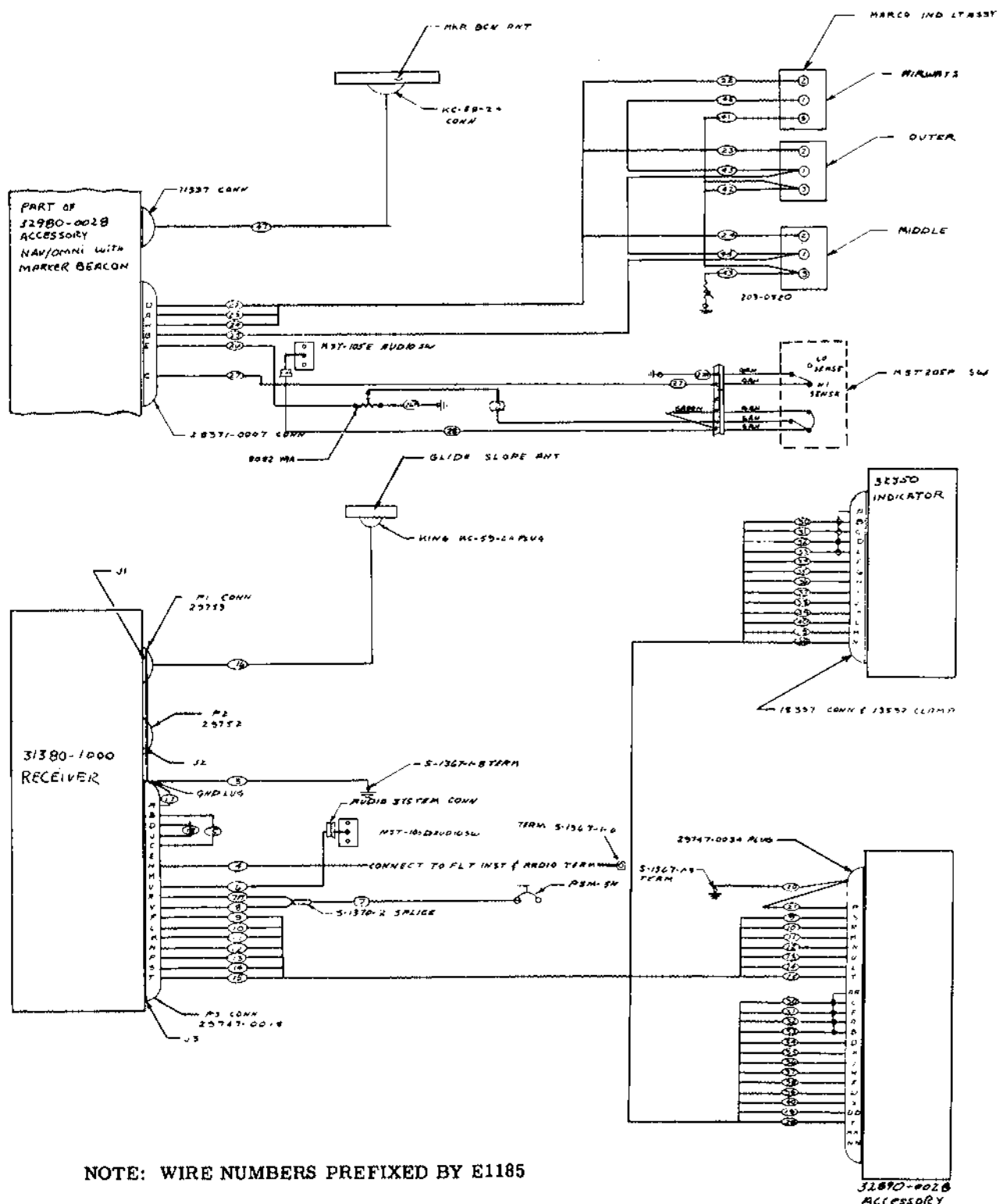
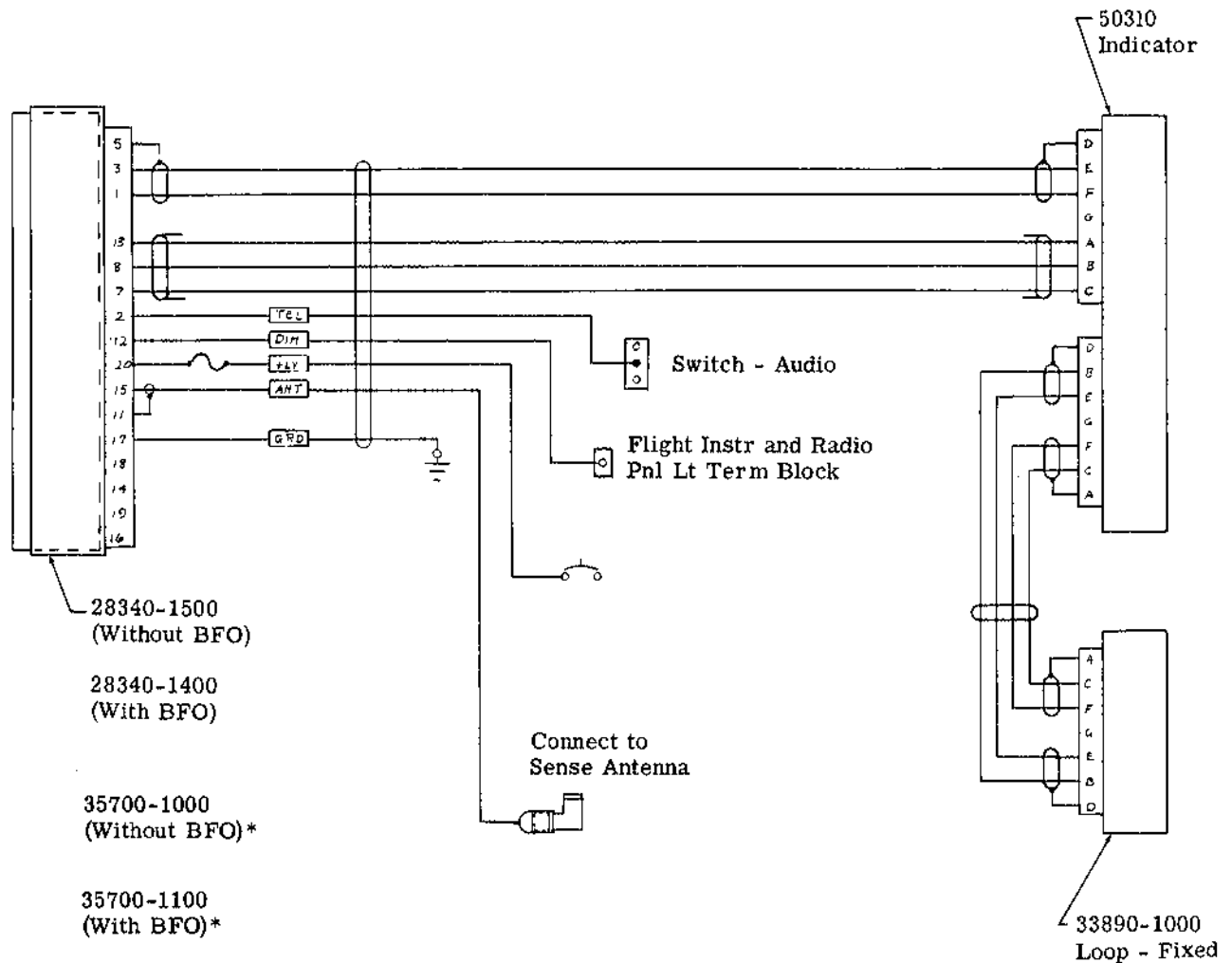


Figure 15-22. Cessna Nav/Omni 300



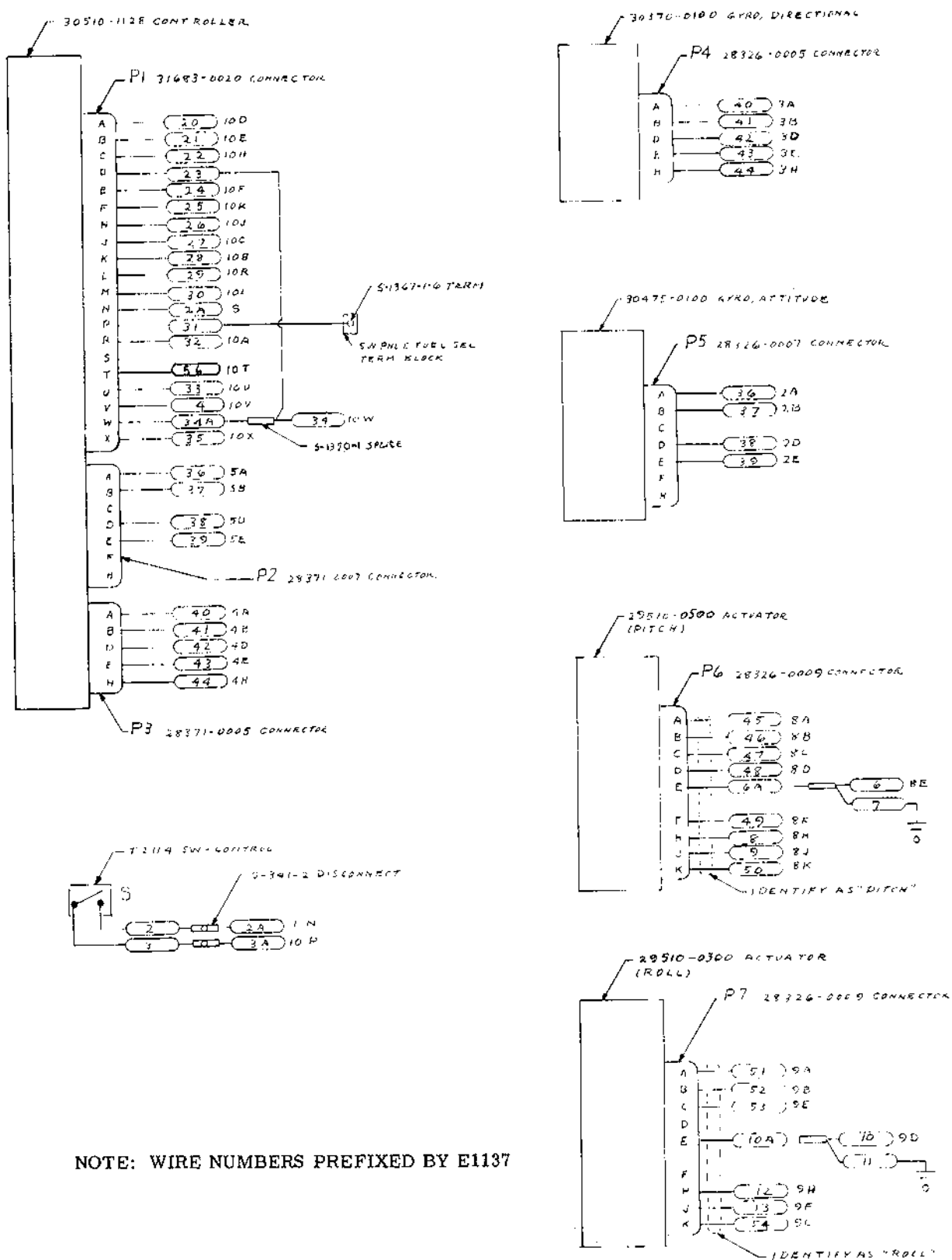
INDICATOR IS INTERNALLY WIRED FOR A BELLY-MOUNTED LOOP ANTENNA & TOP-MOUNTED SENSE ANTENNA. IF OTHER LOCATIONS ARE USED, REMOVE INDICATOR DUST COVER & REWIRE TERMINAL BOARD AS FOLLOWS:

| WIRE<br>COLOR | TERMINAL NUMBER |       |            |       |
|---------------|-----------------|-------|------------|-------|
|               | TOP LOOP        |       | BELLY LOOP |       |
|               | TOP             | BELLY | TOP        | BELLY |
|               | SENSE           | SENSE | SENSE      | SENSE |
| RED           | 6               | 5     | 5          | 6     |
| BLACK         | 5               | 6     | 6          | 5     |
| GREEN         | 1               | 1     | 2          | 2     |
| WHITE         | 2               | 2     | 1          | 1     |

\*310N0001 and ON

NOTE: WIRE NUMBERS PREFIXED BY E1109.

Figure 15-23. Cessna ADF 300



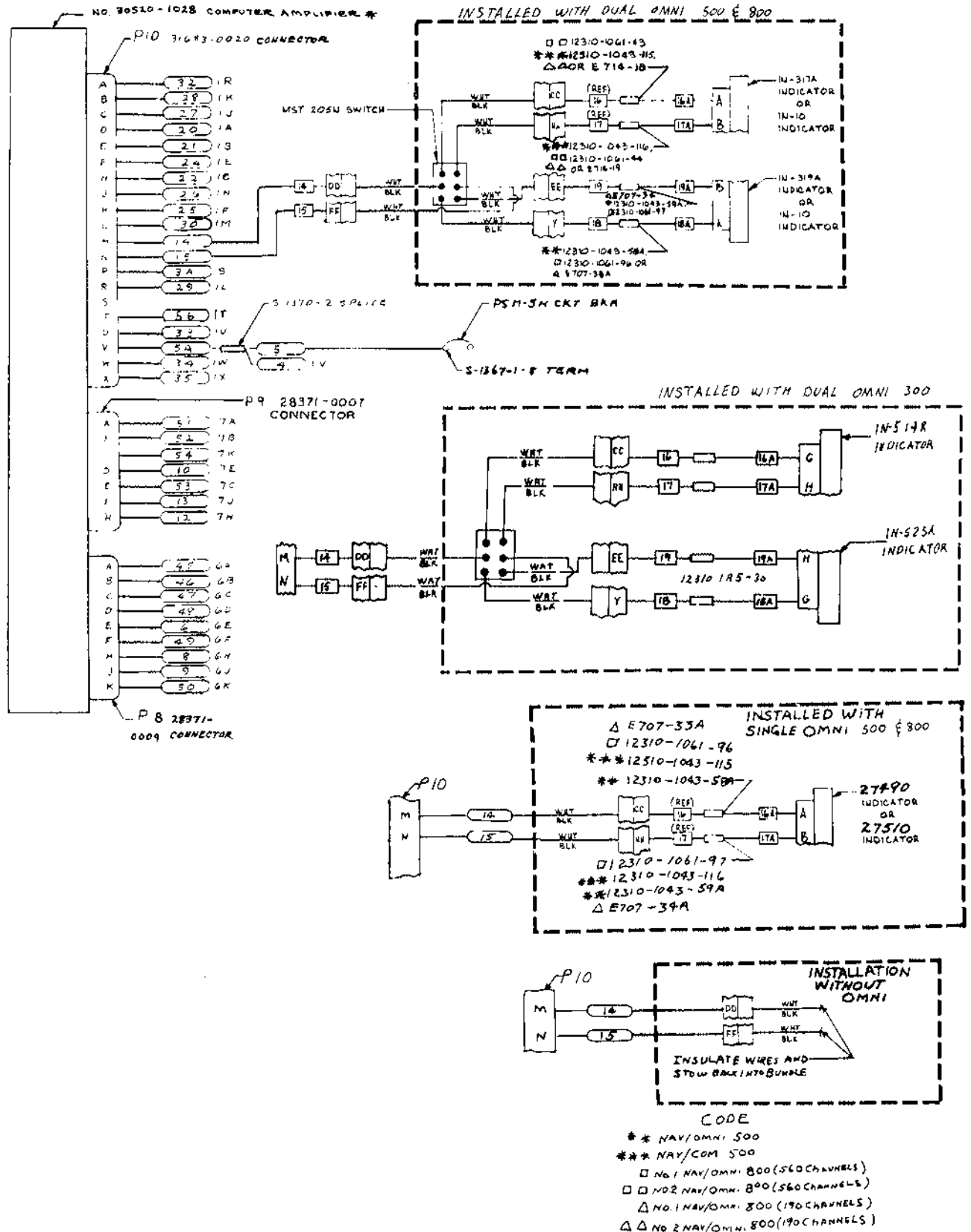


Figure 15-24. Cessna Nav-O-Matic 400 Autopilot (Sheet 2 of 2)

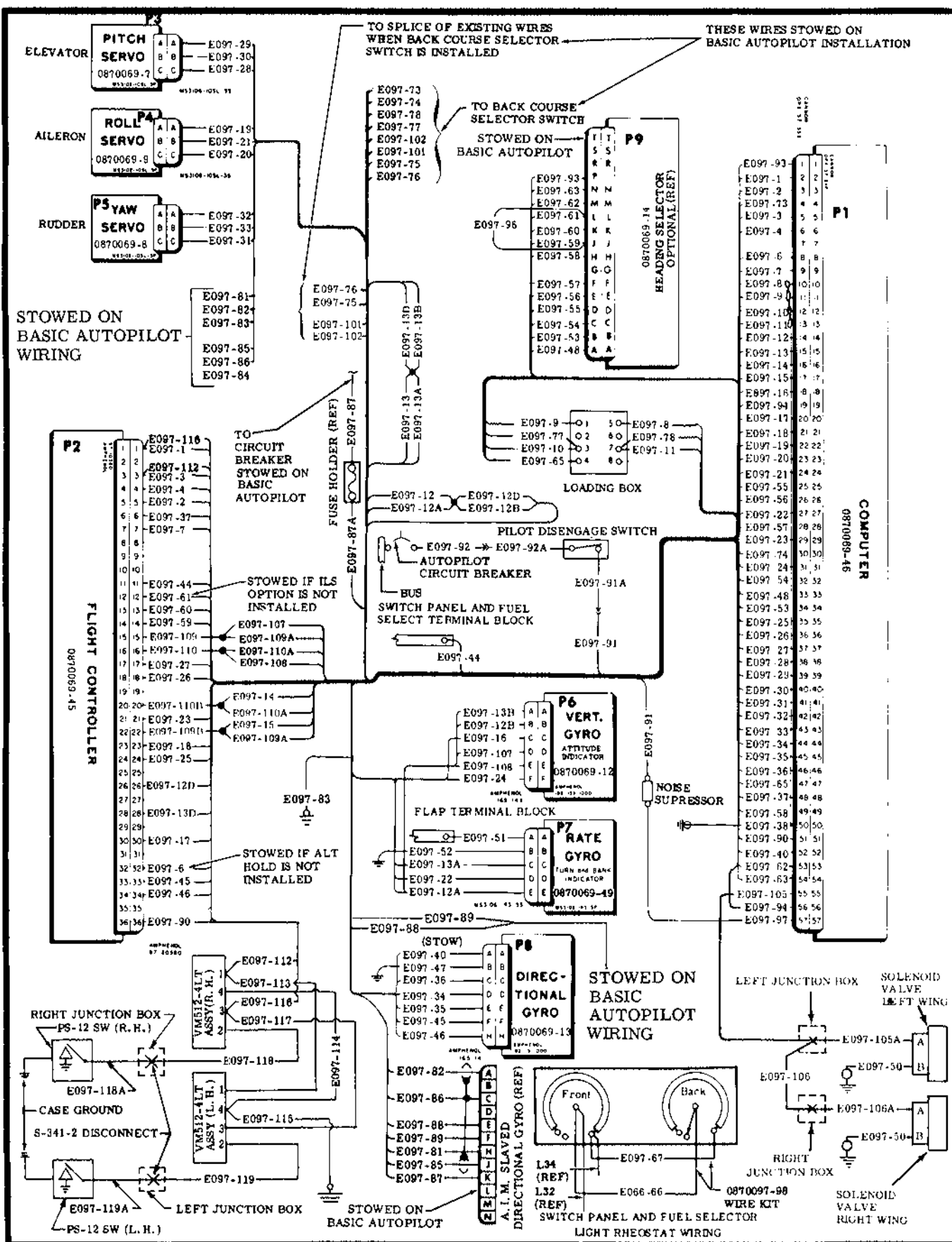
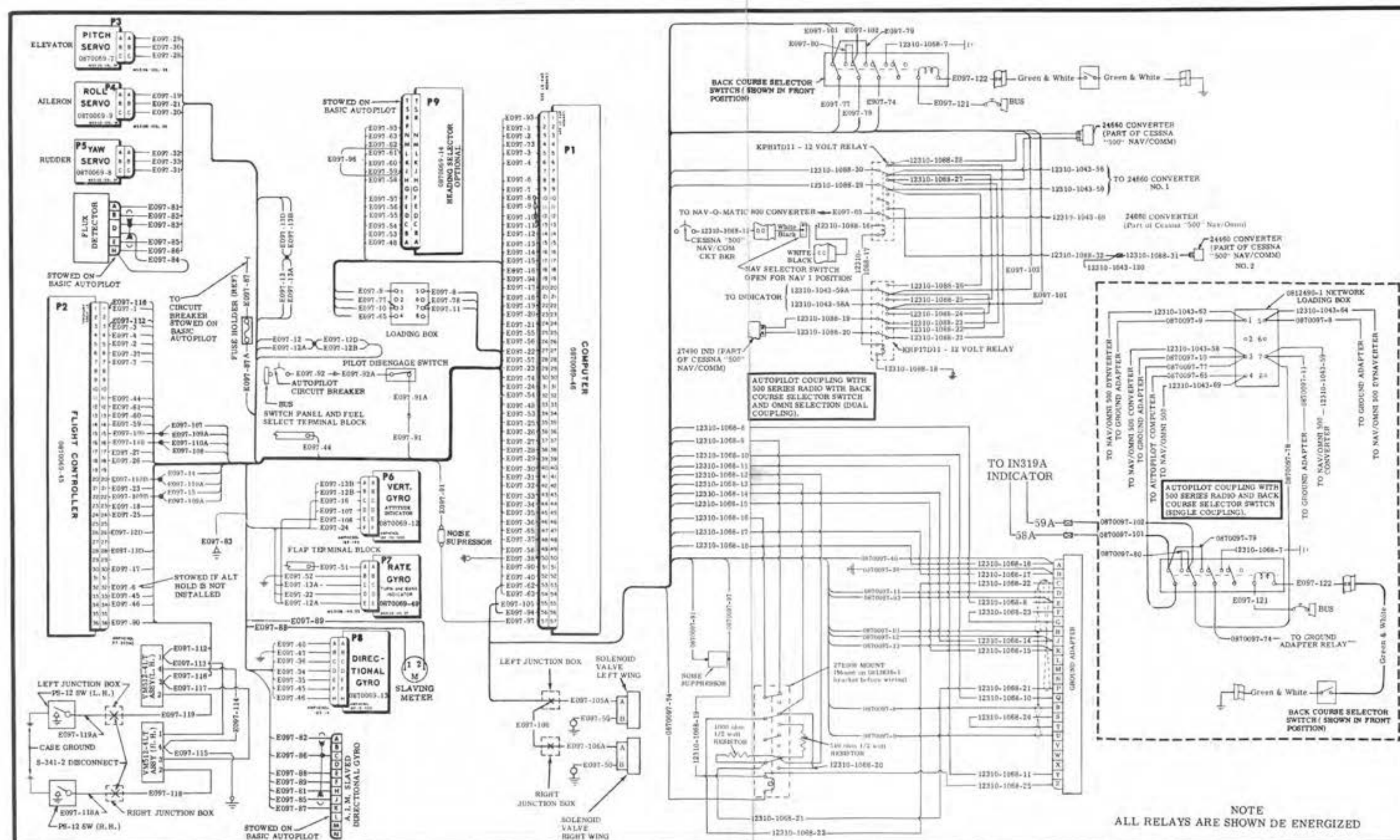


Figure 15-25. Nav-O-Matic 800 Basic Wiring Circuit (Sheet 1 of 3)





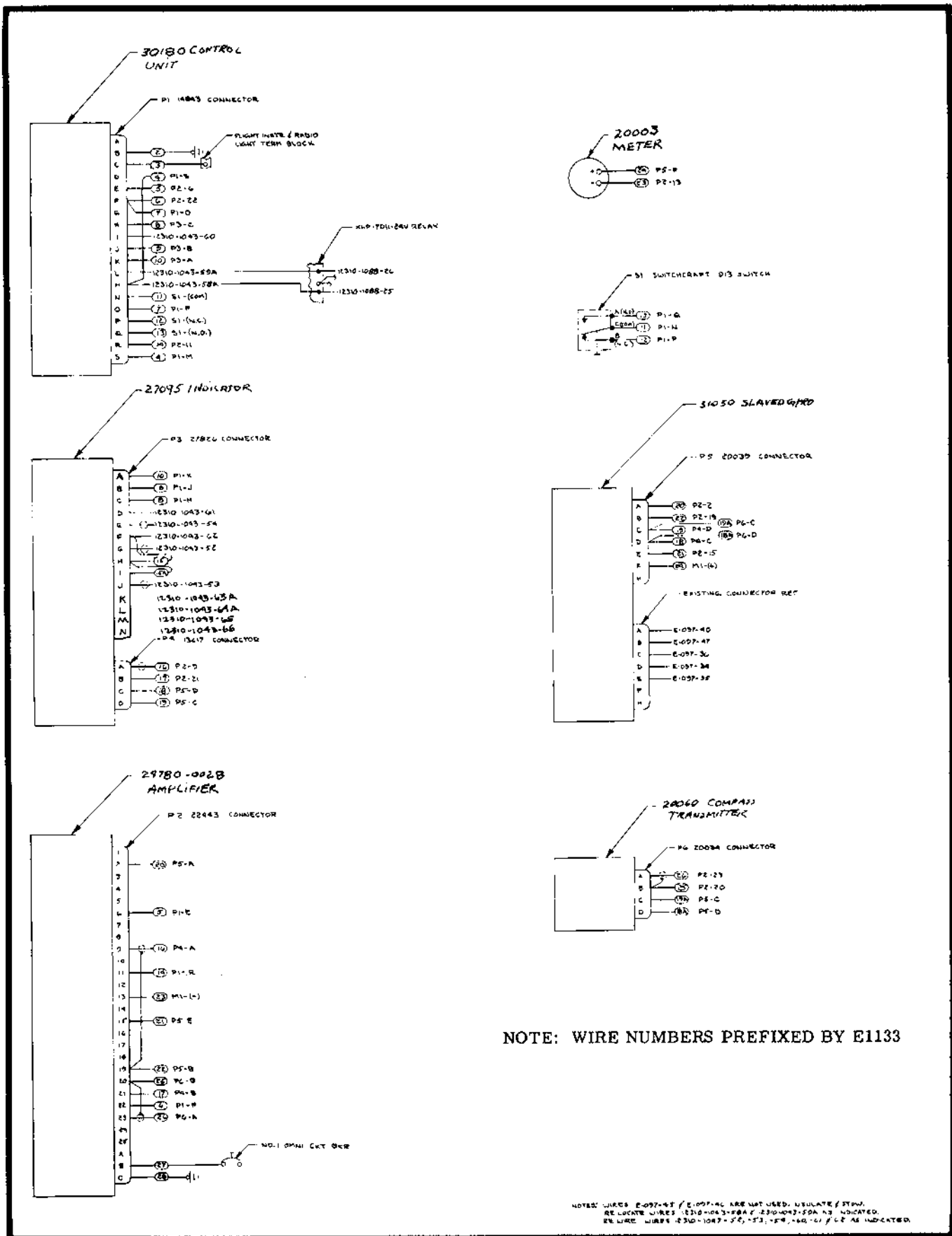


Figure 15-25A. Cessna Course Director 500



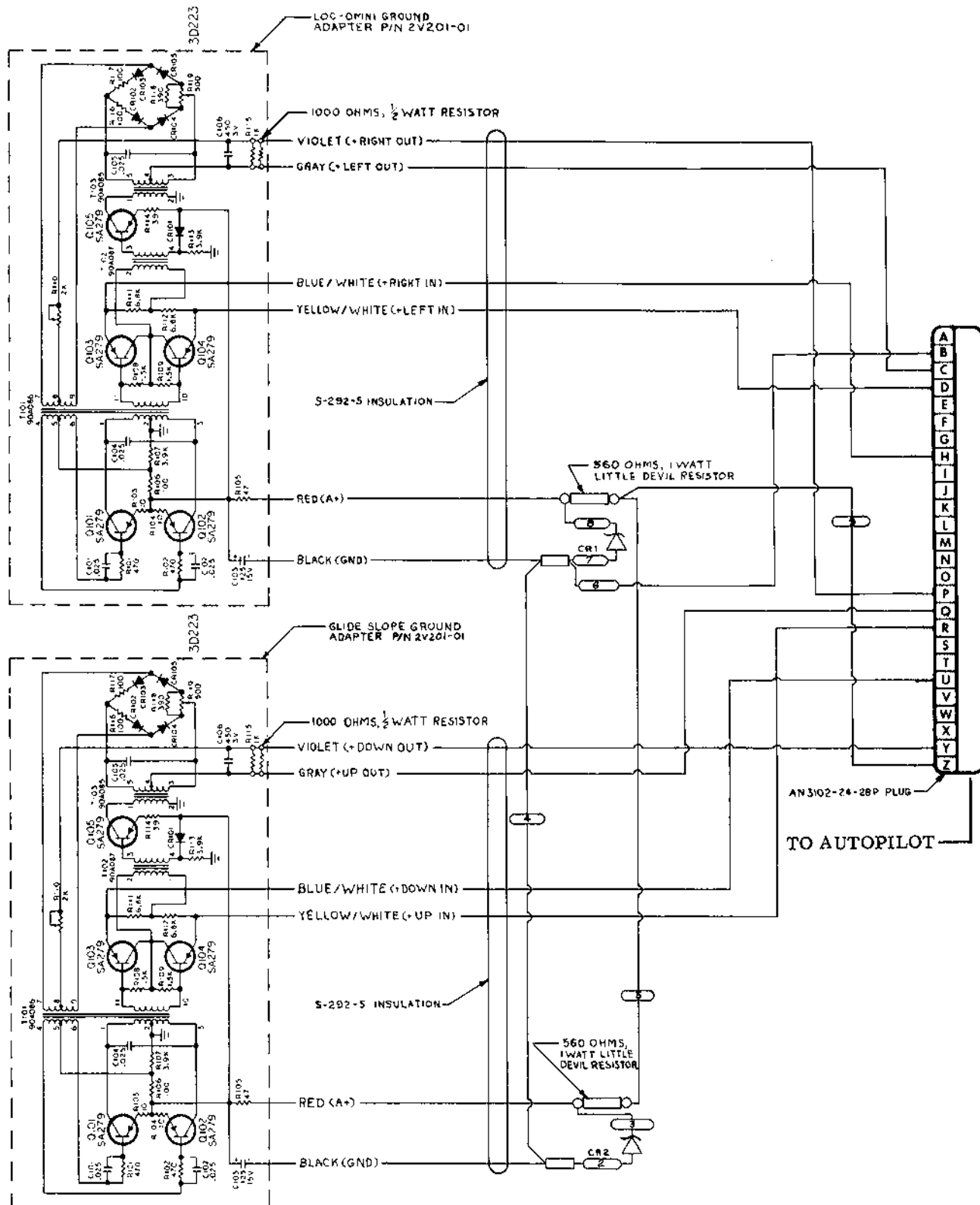


Figure 15-26. 12310-1144 Ground Adapter

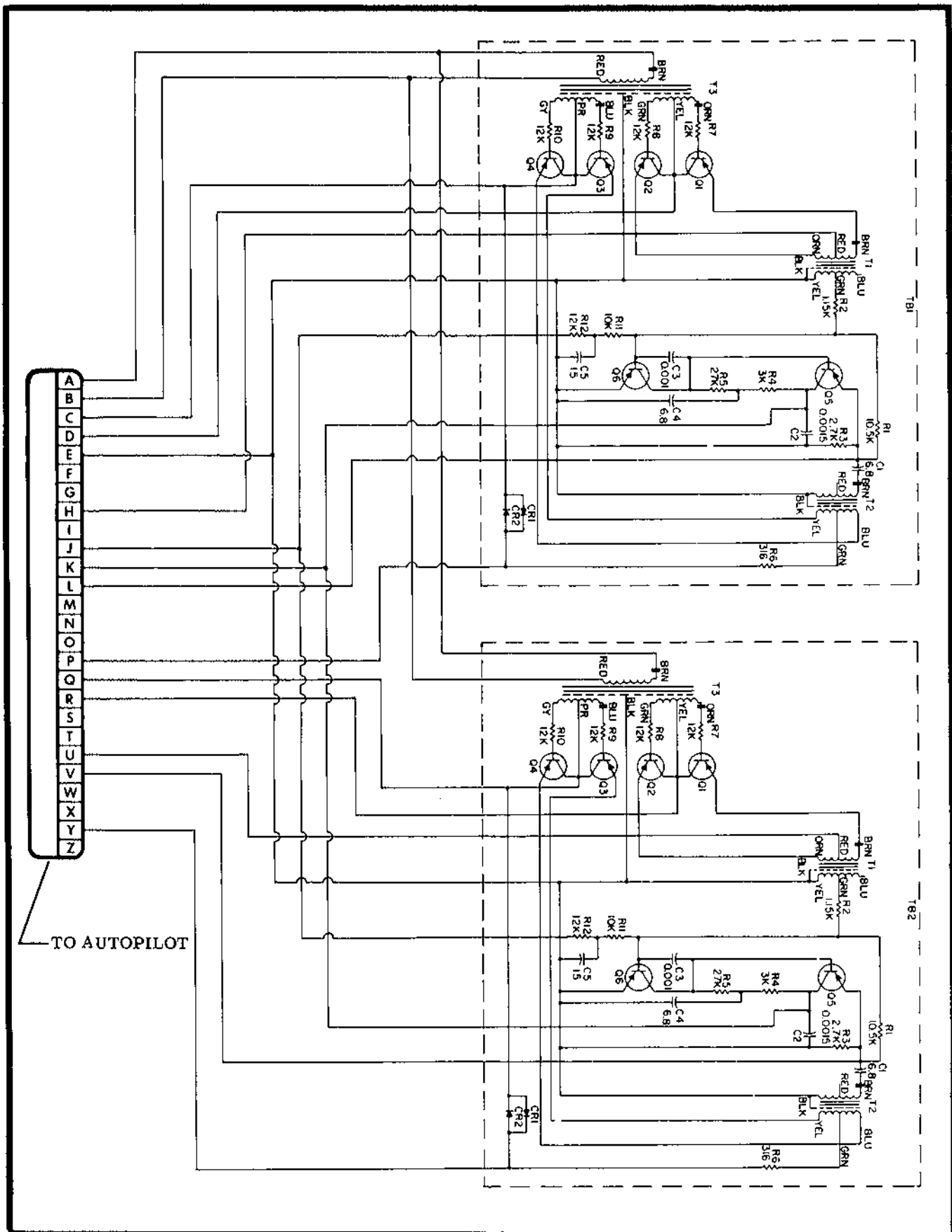


Figure 15-27. DG104B-1 Ground Adapter

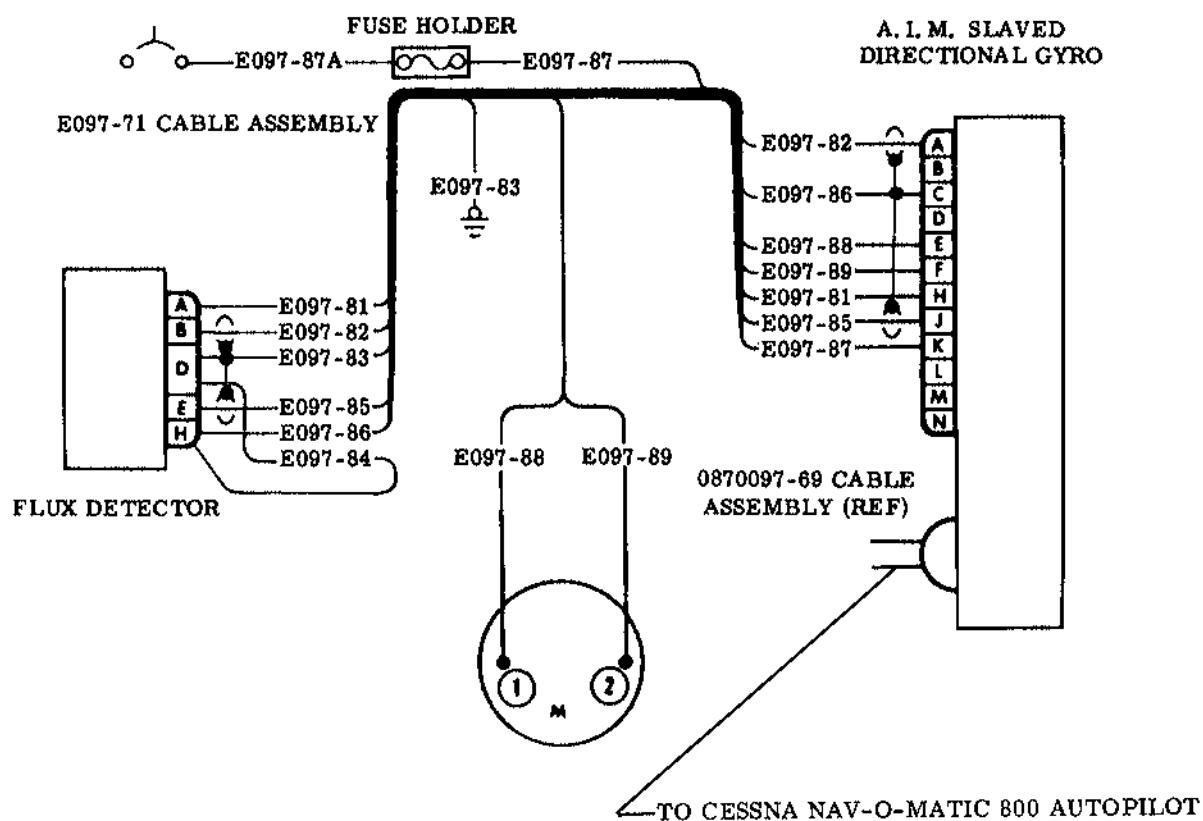
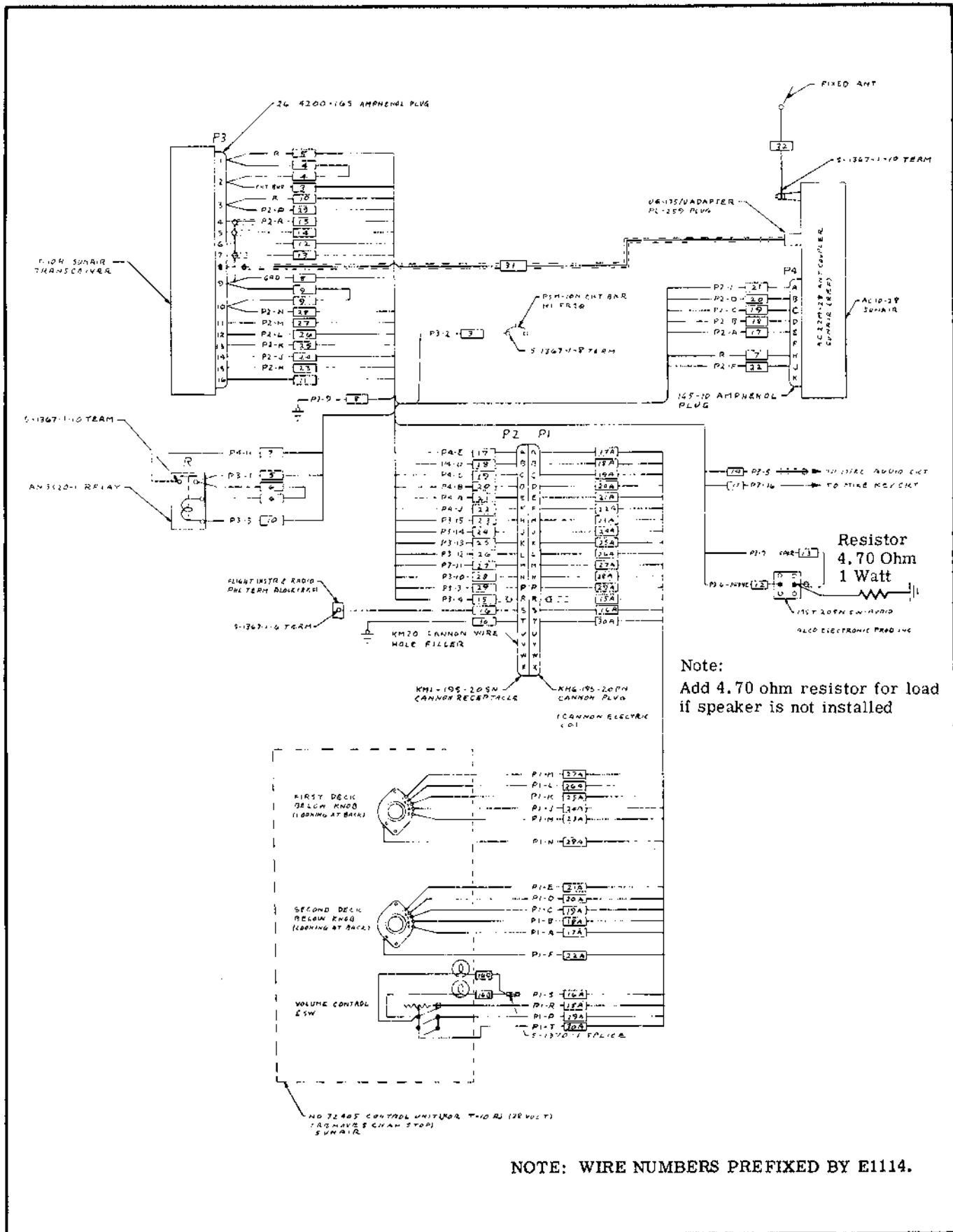


Figure 15-28. AIM Slaved Directional Gyro System



NOTE: WIRE NUMBERS PREFIXED BY E 1148.

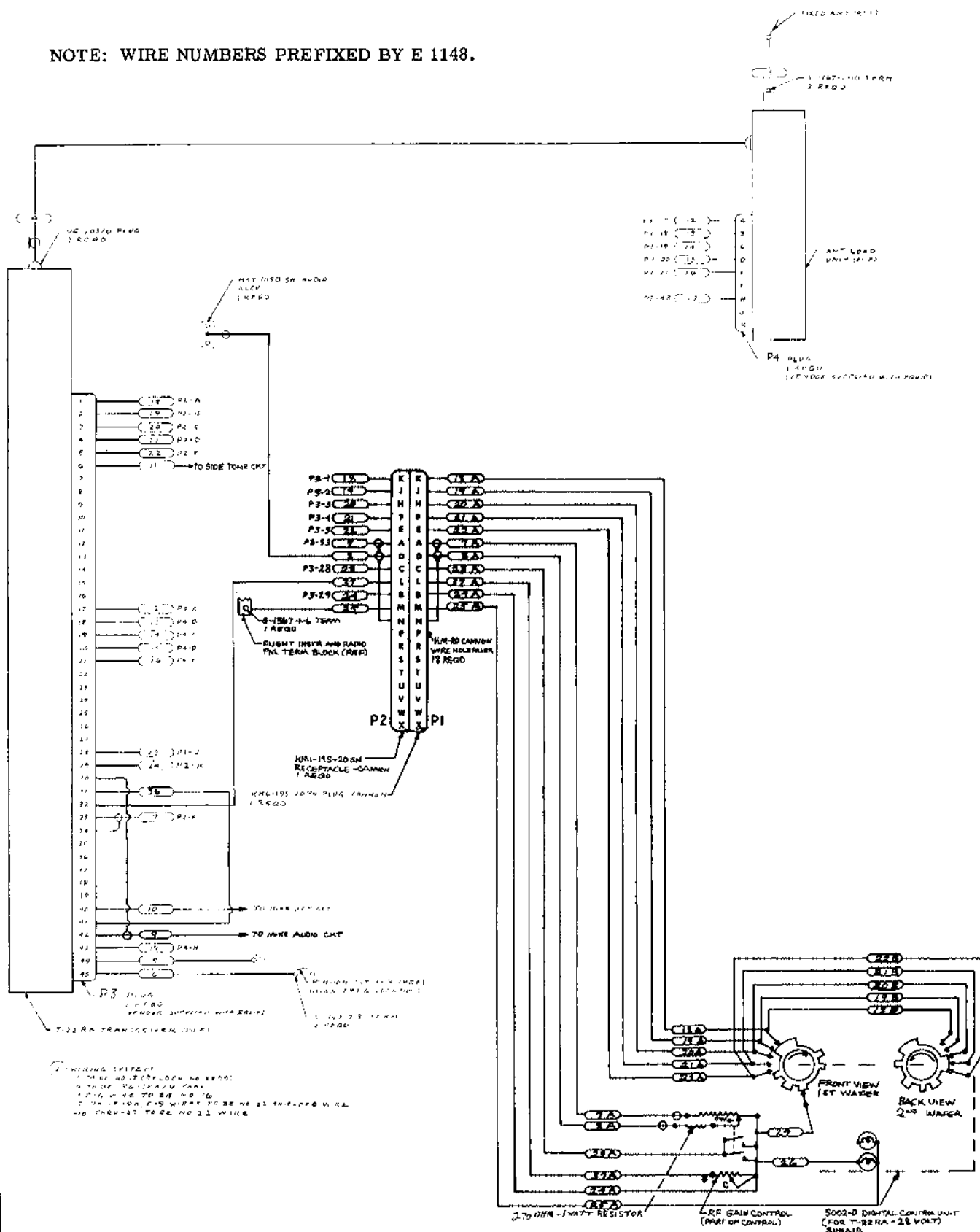


Figure 15-30. T-22-RA Transceiver

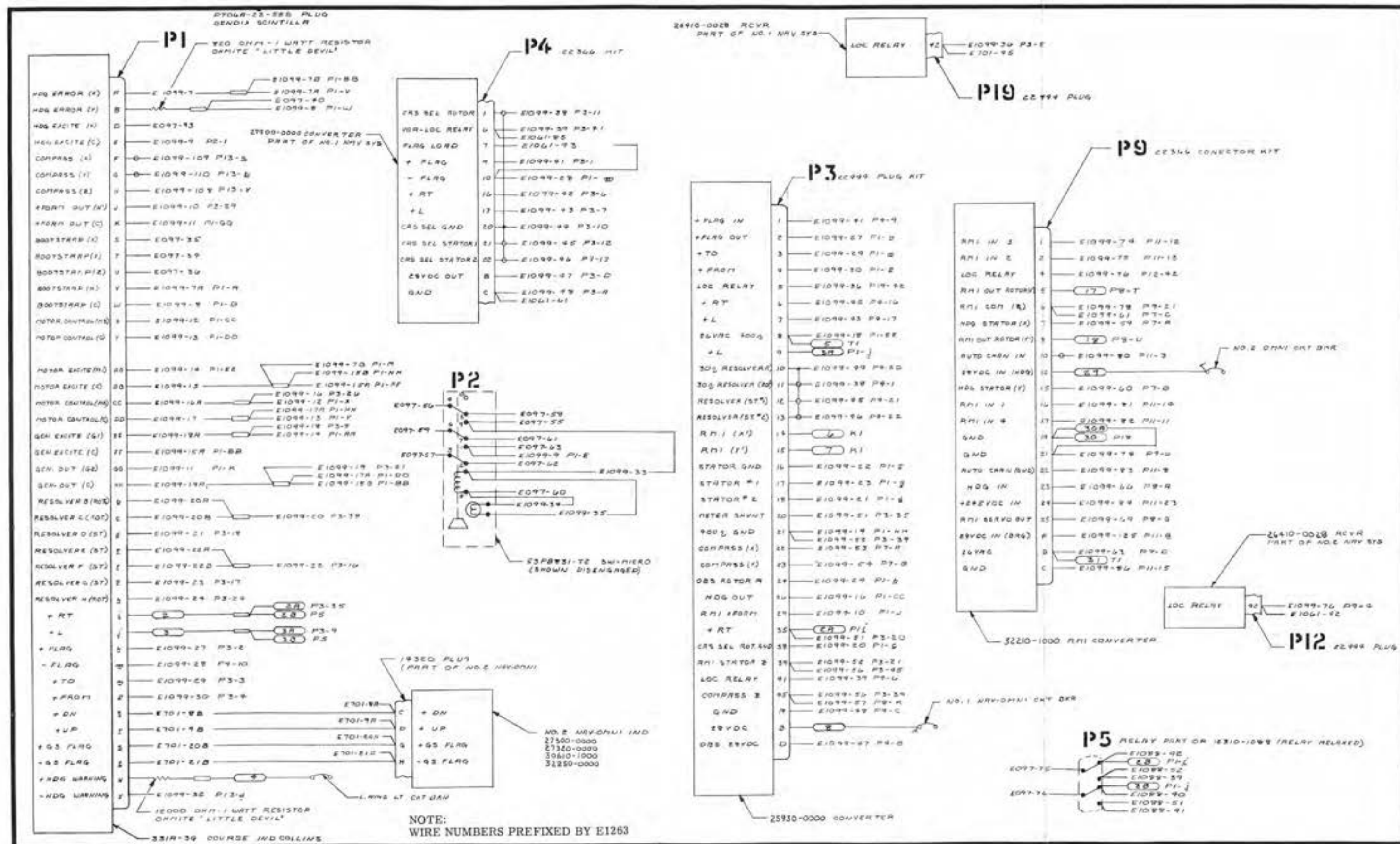
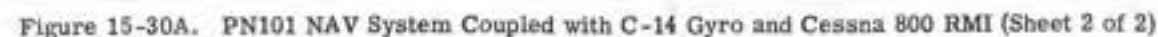
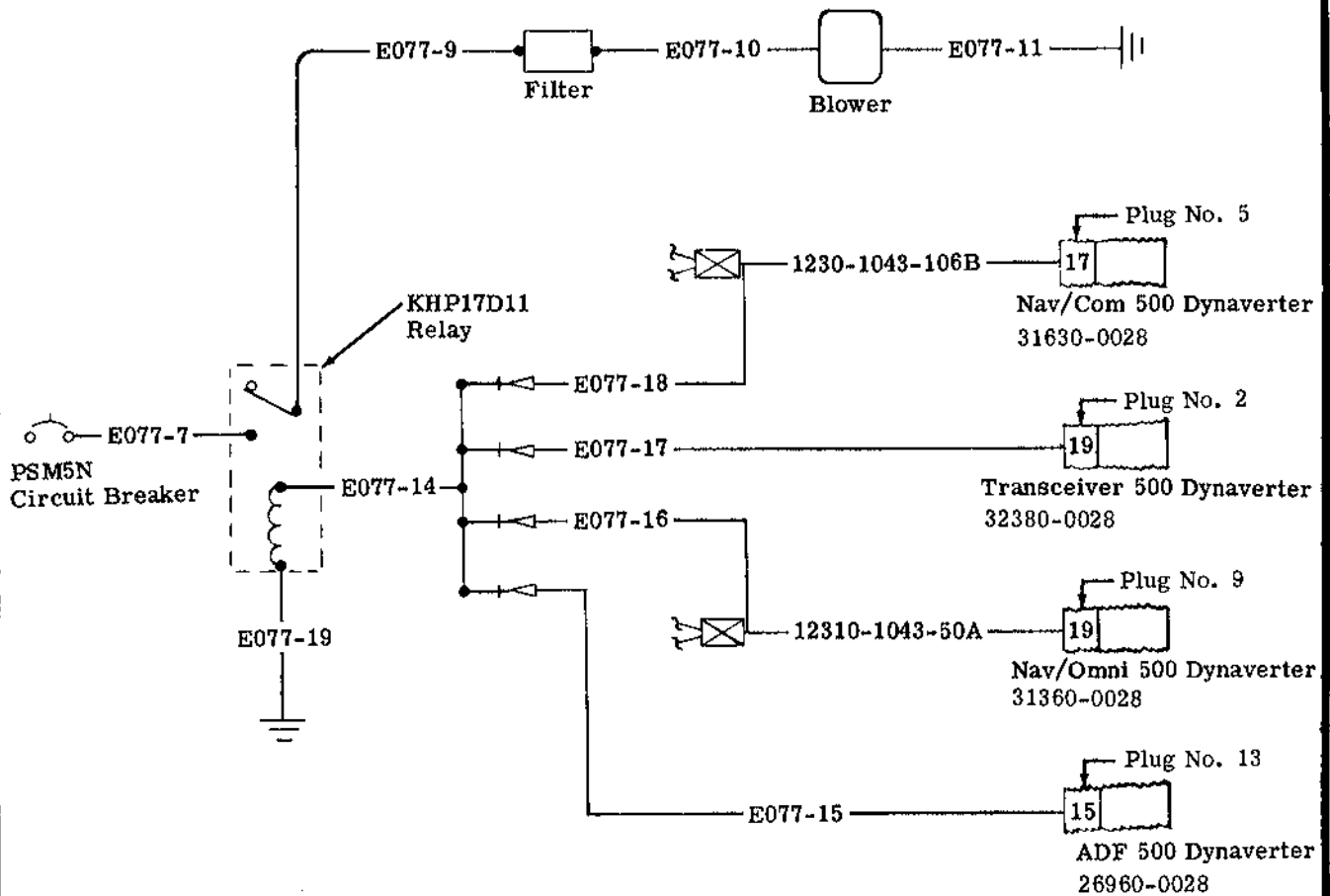


Figure 15-30A. PN101 NAV System Coupled with C-14 Gyro and Cessna 800 RMI (Sheet 1 of 2)

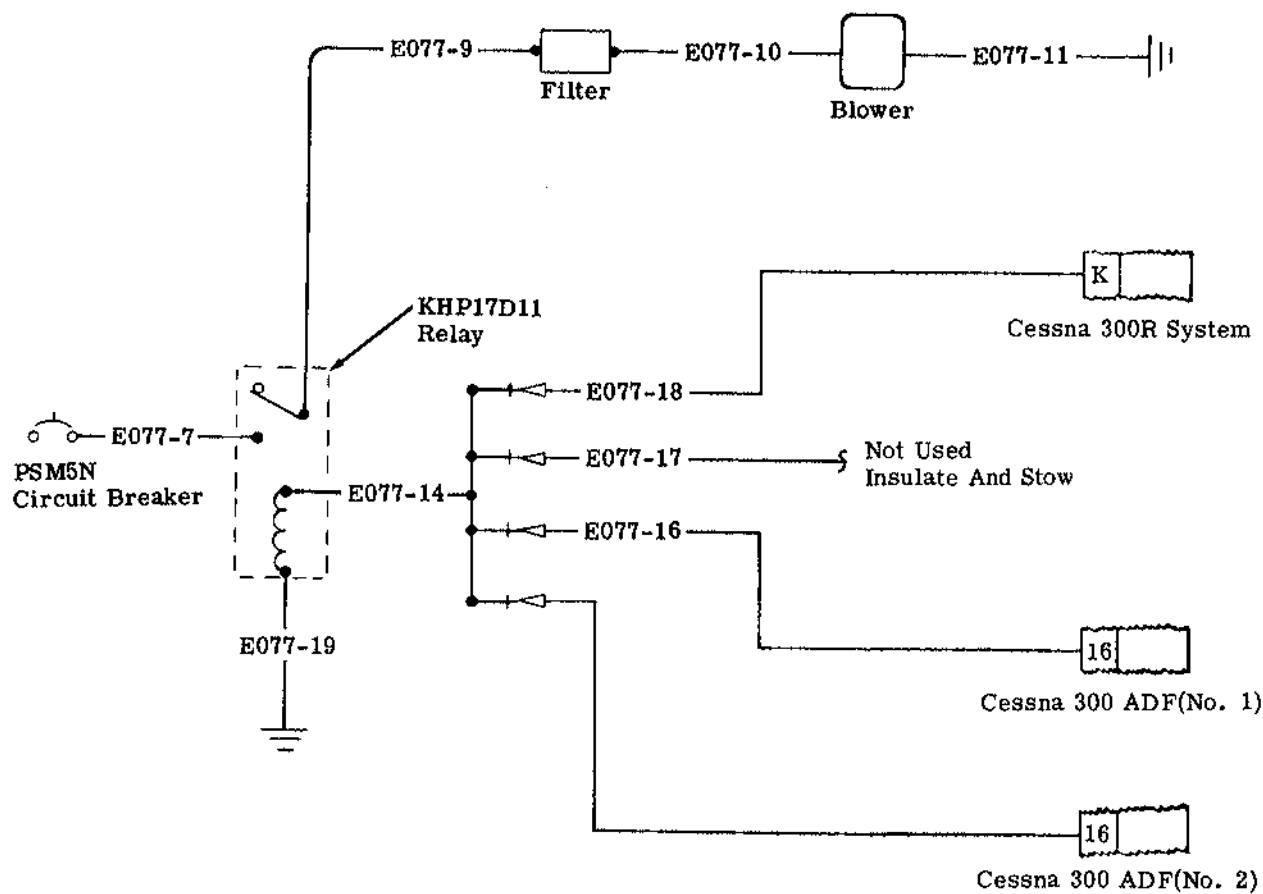




NOTE: WIRE NUMBERS PREFIXED BY E1077.

Figure 15-31. Radio Cooling Blower (500 Series Radio)





NOTE: WIRE NUMBERS PREFIXED BY E1077.

Figure 15-32. Radio Cooling Blower (300 Series Radio)

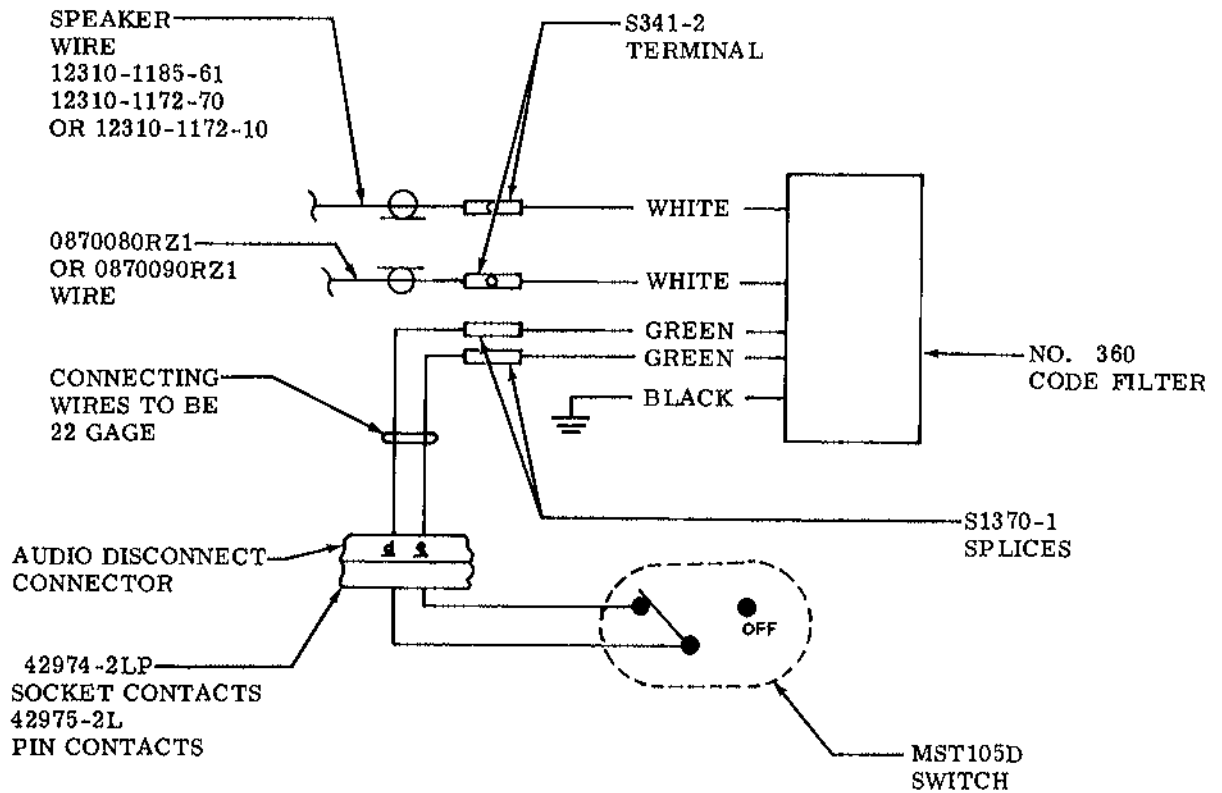
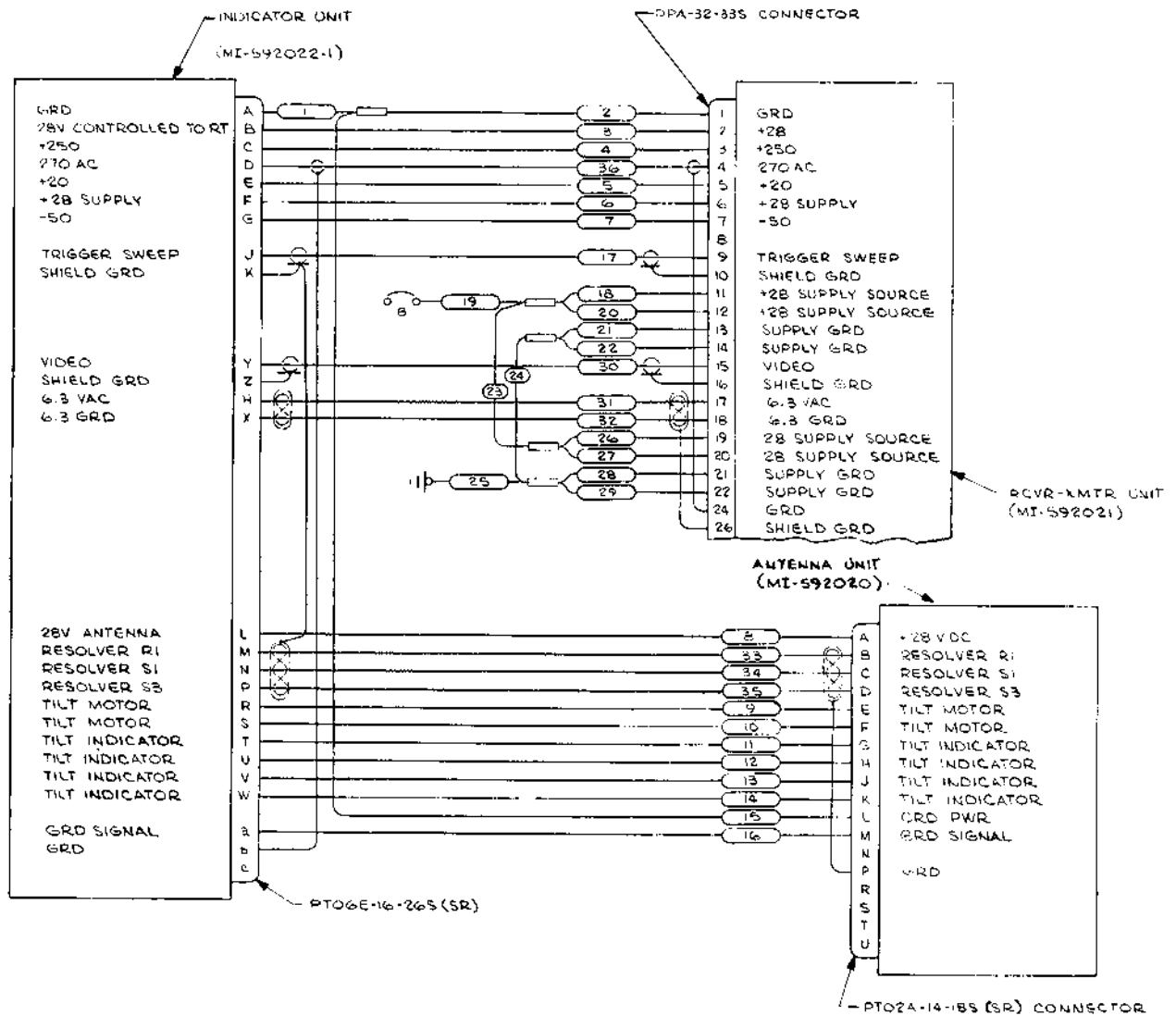


Figure 15-32A. Audio Code Filter

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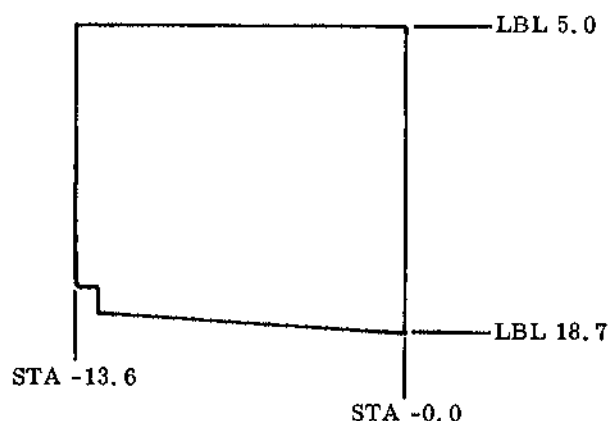
NOTE: WIRE NUMBERS PREFIXED BY E1257

Figure 15-33. AVQ-45 Weather Radar

|                                                   | Amp. Reqd. |
|---------------------------------------------------|------------|
| Cessna ADF 300 . . . . .                          | 1.1        |
| Cessna Nav/Com 300R . . . . .                     | 3.0        |
| Cessna Marker Beacon 300 . . . . .                | 0.015      |
| Cessna Transceiver 300 . . . . .                  | 2.1        |
| Cessna Nav/Omni 300 . . . . .                     | 3.0        |
| Cessna Nav/Com 400 . . . . .                      | 1.5        |
| Cessna Glide Slope 400 . . . . .                  | 0.45       |
| Cessna Transponder 400 . . . . .                  | 1.5        |
| Cessna Transceiver 400 . . . . .                  | 1.0        |
| Cessna Nav/Omni 400 . . . . .                     | 0.5        |
| Cessna Nav/Omni 500 . . . . .                     | 2.5        |
| Cessna ADF 500 . . . . .                          | 2.1        |
| Cessna Nav/Com 500 . . . . .                      | 2.6        |
| Cessna Transceiver 500 . . . . .                  | 3.25       |
| Cessna Course Director 500 . . . . .              | 0.5        |
| Cessna Nav/Omni 800 (560 Channel) . . . . .       | 1.96       |
| Cessna Nav/Omni 800 (190 Channel) . . . . .       | 2.5        |
| Cessna Transceiver 800 . . . . .                  | 4.5        |
| Cessna Transmitter 800 . . . . .                  | 0.9        |
| Cessna ADF 800 . . . . .                          | 2.8        |
| Cessna Nav-O-Matic 800 Autopilot . . . . .        | 4.0        |
| T-10-R Transceiver . . . . .                      | 2.0        |
| T-22-RA Transceiver . . . . .                     | 3.0        |
| KA-25C Audio Amplifier . . . . .                  | 0.5        |
| Radio Cooling Blower (500 Series Radio) . . . . . | 0.74       |
| Cessna Transponder 800 . . . . .                  | 0.25       |
| DV-20B Dynaverter . . . . .                       | 2.7        |
| Cessna Course Director 800 . . . . .              | 0.5        |
| Cessna Glide Slope 800 . . . . .                  | 1.7        |
| Cessna Marker Beacon 800 . . . . .                | 0.4        |
| Cessna Nav-O-Matic 400 Autopilot . . . . .        | 1.2        |
| AIM Slaved Directional Gyro . . . . .             | 0.08       |
| Cessna DME 800 . . . . .                          | 2.75       |
| Cessna RMI 800 . . . . .                          | 3.0        |

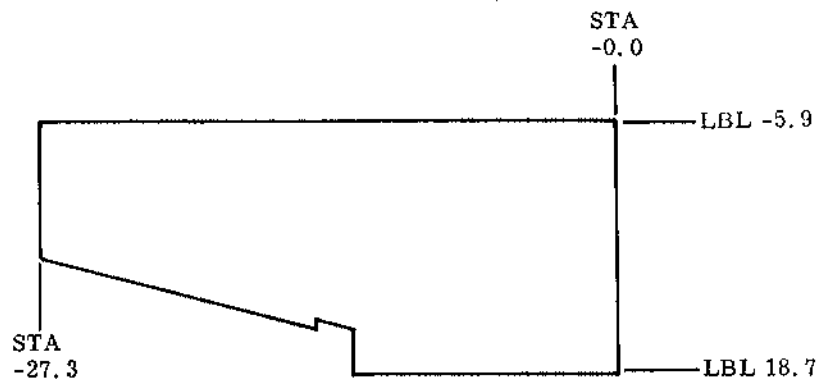
Figure 15-35. Electronics Continuous Load Chart

FOR SHELF ASSEMBLY  
PART NO. 0813300-59



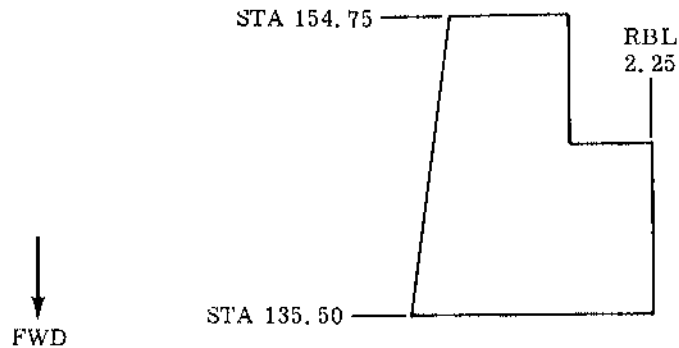
| EQUIPMENT                                                                                                                      | COMPONENT WEIGHT                              | REMARKS                                                                              |
|--------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|--------------------------------------------------------------------------------------|
| Cessna Nav/Omni 800 (190 Channel)<br>Receiver (21440-0028)<br>Converter (22900-0028)                                           | 6.70 lbs.<br>6.10 lbs.                        |                                                                                      |
| Cessna Nav/Omni 800 (560 Channel)<br>Receiver (264101-0028)<br>Converter (27900)<br>Receiver (26410)<br>Converter (27900-0028) | 7.0 lbs.<br>4.5 lbs.<br>14.0 lbs.<br>9.0 lbs. | Single Installation<br>Single Installation<br>Dual Installation<br>Dual Installation |
| Cessna Nav/Com 500<br>Dynaverter (28490-0028)<br>Converter (24660)                                                             | 4.3 lbs.<br>3.7 lbs.                          | W/Mount                                                                              |
| Cessna Nav/Omni 300<br>Accessory Unit (3389-0028)                                                                              | 5.5 lbs.                                      |                                                                                      |
| Cessna Nav/Omni 500<br>Converter (24660)<br>Dynaverter (31630-0028)                                                            | 3.7 lbs.<br>3.7 lbs.                          | W/Mount<br>W/Mount                                                                   |
| Cessna Nav/Com 400<br>Accessory Unit (36600)                                                                                   | 12.2 lbs.                                     |                                                                                      |
| Cessna Nav/Omni 400<br>Accessory Unit (36600)                                                                                  | 7.3 lbs.                                      |                                                                                      |
| Cessna Glide Slope 400<br>Receiver (34340-0000)                                                                                | 4.9 lbs.                                      |                                                                                      |

SHELF ASSEMBLY  
PART NO. 0813300-103



| EQUIPMENT                                                                 | COMPONENT WEIGHT     | REMARKS            |
|---------------------------------------------------------------------------|----------------------|--------------------|
| Cessna ADF 800<br>Receiver (34850-0028)<br>Dynaverter (24630-0028)        | 7.4 lbs.<br>4.1 lbs. | W/Mount<br>W/Mount |
| Cessna DME 800<br>Receiver/Transmitter (C582601-0101)                     | 11.4 lbs.            |                    |
| Cessna ADF 500<br>Dynaverter (34660-0028)                                 | 3.3 lbs.             | W/Mount            |
| T-22-RA Transceiver                                                       | 15.0 lbs.            | W/Mount            |
| Marker Beacon 800<br>Receiver (21430-0028)                                | 3.7 lbs.             |                    |
| Transponder 800<br>Receiver/Transmitter (3490-0028)<br>Coder (29300-0000) | 7.1 lbs.<br>3.5 lbs. |                    |

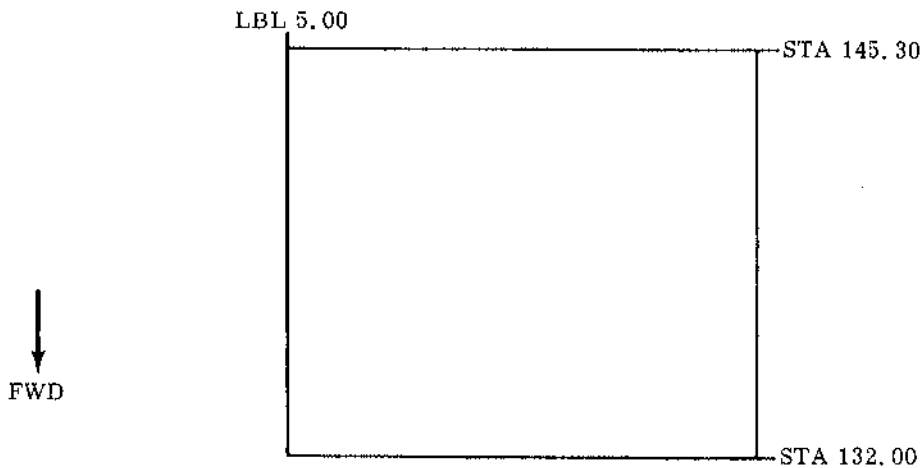
FOR SHELF INSTALLATION  
PART NO. 0870140-3



| EQUIPMENT                                                 | COMPONENT WEIGHT | REMARKS            |
|-----------------------------------------------------------|------------------|--------------------|
| Cessna Nav-O-Matic 800 Autopilot Computer (0870069-1)     | 9.9 lbs.         | A. Pilot, W. Mount |
| Cessna Transceiver 800 Receiver, Transmitter (19300-1028) | 12.2 lbs.        |                    |
| Dynaverter (22560-0028)                                   | 3.8 lbs.         |                    |
| Cessna Transmitter 800 Transmitter (26460-0028)           | 7.1 lbs.         |                    |
| Cessna Glide Slope 800 Receiver (21420-0028)              | 6.0 lbs.         |                    |
| Marker Beacon 800 Receiver (21430-0028)                   | 3.7 lbs.         |                    |
| T-22-RA Transceiver                                       | 15.0 lbs.        | W. Mount           |

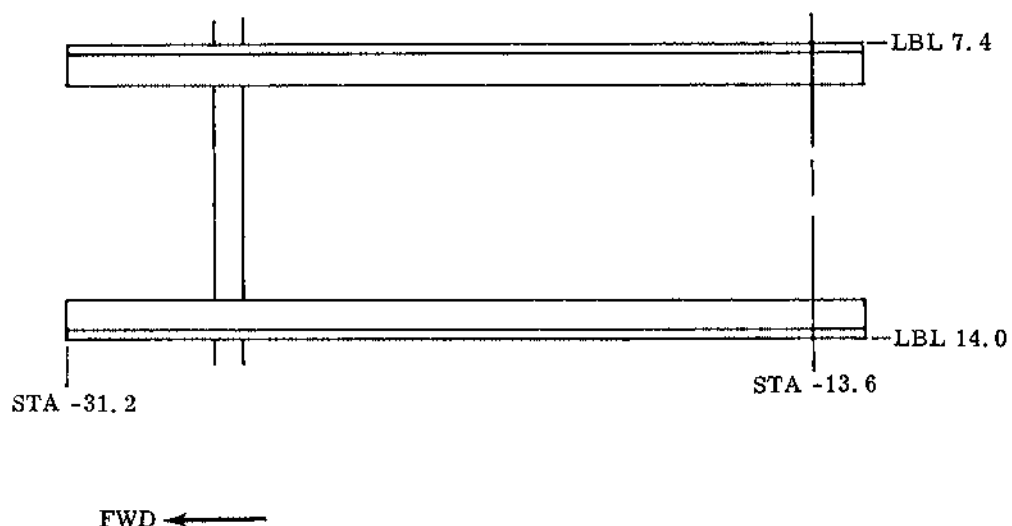


FOR SHELF INSTALLATION  
PART NO. 0870140-1



| EQUIPMENT                                                                             | COMPONENT WEIGHT       | REMARKS |
|---------------------------------------------------------------------------------------|------------------------|---------|
| Cessna Transponder 800<br>Coder (29300-0000)                                          | 3.5 lbs.               |         |
| Cessna Nav. Omni 800 (190 Channel)<br>Receiver (21440-0028)<br>Converter (22900-0028) | 6.70 lbs.<br>6.10 lbs. |         |
| Cessna DME 800<br>Receiver Transmitter (C582601-0101)                                 | 11.4 lbs.              |         |

FOR SHELF ASSEMBLY  
PART NO. 0813316-2

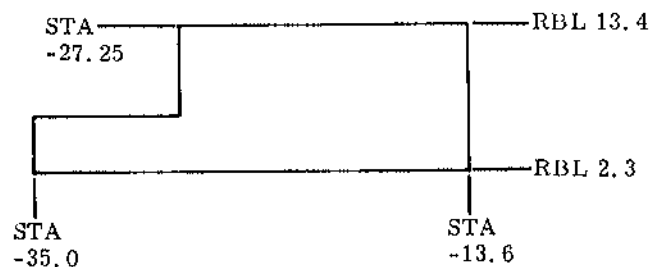


| EQUIPMENT                                                                         | COMPONENT WEIGHT     | REMARKS |
|-----------------------------------------------------------------------------------|----------------------|---------|
| Cessna Glide Slope 800<br>Receiver (21420-0028)                                   | 6.0 lbs.             |         |
| Cessna Marker Beacon 800<br>Receiver (21430-0028)                                 | 3.7 lbs.             |         |
| Cessna Transponder 800<br>Receiver/Transmitter (34900-0028)<br>Coder (29300-0000) | 7.1 lbs.<br>3.5 lbs. |         |
| Course Director 800<br>Computer Amplifier (24780-0028)                            | 4.4 lbs.             |         |
| Cessna Transmitter 800<br>Transmitter 800 (26460-0028)<br>Dynaverter (23400-0028) | 7.1 lbs.<br>1.0 lbs. |         |
| Course Director 500<br>Computer Amplifier (24780-0028)                            | 4.4 lbs.             |         |
| T-10-R Transceiver                                                                | 13.0 lbs.            | W/Mount |
| Cessna Transponder 400<br>Receiver-Transmitter (34950-0028)                       | 1.5 lbs.             |         |

TABLE OF ELECTRONIC EQUIPMENT LOADING (Sheet 5 of 6)

Changed November 1967

FOR SHELF ASSEMBLY  
PART NO. 0813201-8



| EQUIPMENT                                                                              | COMPONENT WEIGHT      | REMARKS               |
|----------------------------------------------------------------------------------------|-----------------------|-----------------------|
| Cessna Transceiver 800<br>Receiver/Transmitter (19300-1028)<br>Dynaverter (22560-0028) | 12.2 lbs.<br>3.8 lbs. |                       |
| Cessna Marker Beacon 300<br>Receiver (31240-0028)                                      | 1.0 lbs.              | Mounted on Lower Side |
| Cessna Transceiver 500<br>Dynaverter (32380-0028)                                      | 4.3 lbs.              | W/ Mount              |
| Cessna Nav/Omni 500<br>Converter (24660)<br>Dynaverter (31360-0028)                    | 3.7 lbs.<br>3.7 lbs.  | W/ Mount<br>W/ Mount  |
| Cessna Transceiver 300<br>Receiver/Transmitter (31390-1128)                            | 7.2 lbs.              |                       |
| Cessna Nav/Omni 300<br>Accessory Unit (3389-0028)                                      | 5.5 lbs.              |                       |
| AVQ-45 Weather Radar<br>Receiver/Transmitter                                           | 15.0 lbs.             | W/ Mount              |

## SECTION 16

## STRUCTURAL REPAIR

## Table of Contents

|                                                             | Page |                                                                                   | Page  |
|-------------------------------------------------------------|------|-----------------------------------------------------------------------------------|-------|
| GENERAL . . . . .                                           | 16-1 | Horizontal Stabilizer . . . . .                                                   | 16-4  |
| Type of Construction . . . . .                              | 16-1 | Negligible Damage . . . . .                                                       | 16-4  |
| Ground Handling . . . . .                                   | 16-2 | Repairable Damage . . . . .                                                       | 16-4  |
| Investigation of Damage . . . . .                           | 16-2 | Damage Necessitating Replacement of Parts . . . . .                               | 16-4  |
| Definition of Damage . . . . .                              | 16-2 | Elevators . . . . .                                                               | 16-4  |
| Preparing Damaged Area for Repairs . . . . .                | 16-2 | Negligible Damage . . . . .                                                       | 16-4  |
| Control Surface Rebalancing Data . . . . .                  | 16-2 | Repairable Damage . . . . .                                                       | 16-4  |
| WING . . . . .                                              | 16-2 | Damage Necessitating Replacement of Parts . . . . .                               | 16-4  |
| Access Openings . . . . .                                   | 16-2 | FUSELAGE . . . . .                                                                | 16-4  |
| Wing and Horizontal Stabilizer Angle of Incidence . . . . . | 16-2 | Negligible Damage . . . . .                                                       | 16-4  |
| Wing Skin . . . . .                                         | 16-2 | Repairable Damage . . . . .                                                       | 16-4  |
| Negligible Damage . . . . .                                 | 16-2 | Damage Necessitating Replacement of Parts . . . . .                               | 16-5  |
| Repairable Damage . . . . .                                 | 16-3 | Bulkheads . . . . .                                                               | 16-5  |
| Damage Necessitating Replacement of Parts . . . . .         | 16-3 | Cracked Bulkhead Webs or Flanges Severely Bent, Kinked or Torn Channels . . . . . | 16-5  |
| Wing Ribs . . . . .                                         | 16-3 | LANDING GEAR . . . . .                                                            | 16-5  |
| Negligible Damage . . . . .                                 | 16-3 | Repairs of Landing Gear . . . . .                                                 | 16-5  |
| Repairable Damage . . . . .                                 | 16-3 | ENGINE MOUNT . . . . .                                                            | 16-5  |
| Damage Necessitating Replacement of Parts . . . . .         | 16-3 | ENGINE COWLING . . . . .                                                          | 16-5  |
| Wing Spars . . . . .                                        | 16-3 | Repair Procedures for Bonded Honeycomb Engine Cowls . . . . .                     | 16-5  |
| Flaps and Ailerons . . . . .                                | 16-3 | FIBERGLASS PARTS . . . . .                                                        | 16-11 |
| Negligible Damage . . . . .                                 | 16-3 | Repairable Damage . . . . .                                                       | 16-11 |
| Repairable Damage . . . . .                                 | 16-3 | Damage Necessitating Replacement of Parts . . . . .                               | 16-11 |
| Damage Necessitating Replacement of Parts . . . . .         | 16-3 | POLYCARBONATE AND ACRYLIC PLASTIC BONDING . . . . .                               | 16-11 |
| TAIL GROUP . . . . .                                        | 16-3 | REPAIR OF PLASTIC WINDOW SURFACES . . . . .                                       | 16-11 |
| Vertical Fin and Dorsal Group . . . . .                     | 16-3 | RADOME REPAIR PROCEDURES . . . . .                                                | 16-13 |
| Negligible Damage . . . . .                                 | 16-4 | CHECKING WING TWIST AND LOCATION OF THRUST LINE . . . . .                         | 16-15 |
| Repairable Damage . . . . .                                 | 16-4 | ALIGNMENT AND SYMMETRY CHECK . . . . .                                            | 16-49 |
| Damage Necessitating Replacement of Parts . . . . .         | 16-4 |                                                                                   |       |
| Rudder . . . . .                                            | 16-4 |                                                                                   |       |
| Negligible Damage . . . . .                                 | 16-4 |                                                                                   |       |
| Repairable Damage . . . . .                                 | 16-4 |                                                                                   |       |
| Damage Necessitating Replacement of Parts . . . . .         | 16-4 |                                                                                   |       |

## GENERAL.

## Type of Construction.

The 310 is an all-metal aircraft of semimonocoque type construction with the skin carrying a portion of all structural loads. The fuselage is comprised of a forward cabin section and a tailcone. It is constructed of formed bulkhead rings, stringers, and

stiffeners all of which are riveted to the external skin. The wing, horizontal stabilizer and vertical fin are built up around two main spars, with ribs, formers and riveted skin forming the basic structure. Torsional stiffness of this structure is afforded by the skin closure of areas between the spars forming enclosed "boxes." Each movable surface consists of a hinge support spar with ribs, formers and riveted outer covering skin.

**Ground Handling.**

Leveling, jacking and other ground handling details are covered in Section 2.

**Investigation of Damage.**

After a thorough cleaning of the damaged area, all structural parts should be carefully examined to determine the extent of damage. Frequently the force causing the initial damage is transmitted from one member to the next, causing strains and distortions. Abnormal stresses incurred by shock or impact forces on a rib, bulkhead or similar structure may be transmitted to the extremity of the structural member, resulting in secondary damage such as sheared or stretched rivets, elongated bolt holes, canned skin plate or bulkheads. Points of attachment should be examined particularly for distortion and security of fastenings in the primary and secondary damaged areas.

**Definition of Damage.**

Structural Damage to the aircraft is divided into the following classifications:

- a. Negligible Damage shall be considered damage that will not affect the airworthiness of the aircraft and can be permitted to exist as is or can be corrected with a simple repair such as removing dents, burnishing scratches and stop drilling cracks in non-structural parts.
- b. Damage Repairable by Patching will be considered damage that may be repaired by covering or reinforcing a portion of the aircraft.
- c. Damage Repairable by Insertion will be considered damage requiring replacement of a section with the correct repair material.
- d. Damage Necessitating Replacement of Parts will be considered as damage not repairable by patching or insertion, but that may be repaired by installing a new or reconditioned part. If a part or area of an assembly is damaged to the extent that it requires replacement, and a replacement cannot be made because of tooling or jig requirements, the entire assembly must be replaced.

**Preparing Damaged Area for Repairs.**

To prepare an area for repair, examine and classify the damage. Make a thorough check before beginning repairs. In some cases a damaged part may be classified as needing replacement when after removal, closer inspection indicates the part may be repaired. Take more time for the damage estimate and save man-hours on repairs. To prepare a damaged area for patch or inserting repairs:

- a. Remove all ragged edges, dents, tears, cracks, punctures and similar damages.
- b. Leave edges, after removal of damaged area, parallel to any square or rectangular edges of the unit.
- c. Round all square corners.
- d. Smooth out abrasions and dents.

- e. Apply two coats of zinc-chromate primer to all internal surfaces and edges lapping over another.

**NOTE**

Damage adjacent to a previous repair requires removal of the old repair and inclusion of the entire area in the new repair.

**Control Surface Rebalancing Data.**

The control surfaces of the aircraft have been 100% statically balanced. After each repair or painting of the control surfaces they must be rebalanced. Correct balance is restored by the addition or removal of lead ballast weights in the counterbalance sections of the surfaces.

**WING.**

The wings are all-metal, full cantilever, semimonocoque type construction, utilizing two main spars. Each wing consists of a wing panel, aileron, flaps, engine nacelle, wing tip fuel tank, and main landing gear. The landing gear is attached to and retracts into the wing.

**Access Openings.**

Access openings with removable cover plates are located in the underside of the wing between the root rib and the tip section. These openings afford access to the aileron bellcranks, flap bellcranks, electrical wiring, pulleys, cables and inspection of internal structure. When work is done on the trailing edge wing structure in the flap area, partial access can be provided by lowering the flaps. Outboard of this area, the trailing edge wing structure can be made available for repair by removing the aileron.

**Wing and Horizontal Stabilizer Angle of Incidence.**

Angle of incidence is defined as the angle between the wing or stabilizer chord line and aircraft waterline (aircraft level longitudinally). Stabilizers do not have twist. Wings have a constant rate of twist from the wing root rib to the tip rib. All twist is between these two ribs. The amount of twist between these points is the difference between the angle of incidence at the root rib and the angle of incidence at the tip. Refer to Section 3 to check wing twist.

**Wing Skin.**

All wing, aileron, and flap skin thickness and temper are listed in figure 16-10.

**Negligible Damage.**

Any smooth dents in the wing skin that are free from cracks, abrasions and sharp corners, which are not

stress wrinkles and do not interfere with any internal structure or mechanism may be considered as negligible damage. In areas of low stress intensity, cracks, deep scratches, or deep sharp dents, which after trimming or stop drilling can be enclosed by a two-inch circle, can be considered as negligible if the damaged area is at least one diameter of the enclosing circle away from all existing rivet lines. Stop drilling is considered a temporary repair.

#### Repairable Damage.

Skin damage ahead of the front spar and also where the optimum in appearance is desired should be repaired by the insertion method. Typical insertion repairs are illustrated in figure 16-16. Skin damage aft of the front spar which exceeds the negligible damage limit but is not extensive enough to necessitate replacement of a skin panel can be repaired by patching. Typical wing repairs are illustrated in the back of the Section.

#### Damage Necessitating Replacement of Parts.

In case the skin is extensively damaged, repairs should be made by replacing an entire sheet panel from one structural member to the next. The repair seams should be made to lie along stiffening members, or bulkheads, and each seam should be made exactly the same in regard to rivet size, spacing and rivet pattern as the manufactured seam at the edges of the original sheet. If the two manufactured seams are different, the stronger one should be copied.

#### Wing Ribs.

All ribs except those exposed to the wheel well contain flanged lightening holes. Flanged upper and lower edges of all ribs serve as cap-strips in addition to providing rigidity to the rib. The skin riveted directly to each rib flange provides the cellular strength for each successive rib bay. The nose, center and trailing edge rib segments are riveted together through the front and rear spars to form the basic airfoil sections. Spanwise alclad stringers stiffen the skin between ribs.

#### Negligible Damage.

Refer to negligible damage paragraph under wing skin.

#### Repairable Damage.

Repairs for wing rib webs and flanges are shown in figures 16-25 and 16-26. Before repairing is attempted, all cracks or deep scratches must be stop-drilled with a 3/32-inch drill, and all sharp corners and ragged edges must be trimmed and deburred.

#### Damage Necessitating Replacement of Parts.

Parts such as stiffeners, small ribs, clips and brackets should be replaced if their damage exceeds that specified as negligible. These parts, due to their size, are usually impractical to repair. In many instances, the time required to replace the damaged part may be considerably less than the time required to repair it. This should be considered carefully prior to making any repair whether it be only a small part or a complete component.

#### Wing Spars.

Repair of spar damage affecting the alignment of the wing spar should not be attempted in the field. Permissible spar repairs are illustrated in the back of this Section.

#### Flaps and Ailerons.

#### Negligible Damage.

Minor skin dents and nicks are considered negligible and can be worked out by burnishing.

#### Repairable Damage.

Skin damage exceeding that considered negligible damage can be repaired by patching. Typical skin repairs are illustrated in the back of the section.

#### Damage Necessitating Replacement of Parts.

Warped and cracked skin, ribs, hinge brackets and torque tubes are replaceable items. Any damage that covers more than half of the unit will require replacement of the entire unit.

#### TAIL GROUP.

The all-metal tail group is of full cantilever design, consisting of the conventional arrangement of vertical fin and rudder, horizontal stabilizer and elevators. The right elevator and the rudder both contain flight adjustable trim tabs, actuated by a system of cables and pulleys controlled from the pilot's tab control wheels.

#### Vertical Fin and Dorsal Group.

The vertical fin and dorsal area are constructed jointly to form a single unit. Basically the unit consists of formed sheet metal spars and ribs to which the outer skin is attached. The front spar is reinforced at its root end and drilled to facilitate the installation of two attachment bolts. Stiffness to the entire fin and dorsal assembly is provided by the attachment of the skins and the forward leading edge skin.

**Negligible Damage.**

Refer to negligible damage paragraph under wing skin.

**Repairable Damage.**

Repair of the skins, ribs and spars can be accomplished as illustrated in the back of the section. Access to the internal fin structure is best gained by removing the skin attaching rivets on one side of the rear spar and springing back the skin.

**Damage Necessitating Replacement of Parts.**

Extrusion, hinge brackets and small ribs should be replaced rather than repaired. In general, where parts are available, the easiest and most satisfactory repairs can be accomplished by replacing the damaged parts.

**Rudder.****Negligible Damage.**

Minor skin dents and nicks are considered negligible and will be worked out by burnishing.

**Repairable Damage.**

Skin damage, exceeding that considered negligible damage, can be repaired by patching. Typical skin repairs are illustrated in the back of the section.

**Damage Necessitating Replacement of Parts.**

Warped and cracked skin, ribs, hinge brackets and torque tubes are replaceable items. Any damage that covers more than half of the rudder will require replacement of the rudder.

**Horizontal Stabilizer.****Negligible Damage.**

Refer to negligible damage paragraph under wing skin.

**Repairable Damage.**

Skin damage, exceeding that considered negligible damage, can be repaired by patching. Typical skin repairs are illustrated in the back of the section. Repairs to spars should consist of channels formed of the same material and bend radius as the spar and extending at least three inches each side of the damaged area. Access to the internal stabilizer structure may be gained by removing a portion of the rivets along the rear spar and ribs and springing back the skin. By using the proper bucking bars

through holes in the spar web, the skins may be closed with a minimum of blind rivets.

**Damage Necessitating Replacement of Parts.**

Extrusions, hinge brackets, stabilizer tab, spar and ribs should be replaced rather than repaired. In general, where parts are available, the easiest and most satisfactory repairs can be accomplished by replacing the damaged parts.

**Elevators.****Negligible Damage.**

For a description of negligible damage, refer to negligible damage paragraph under wing skin. The exception to negligible damage on the elevator surfaces is the front spar, a crack appearing in the web at the hinge fittings or in the tip rib which supports the overhanging balance weight is not considered negligible. Cracks in the over-hanging tip rib, in the area at the front spar intersection with the web of the rib, also cannot be considered negligible.

**Repairable Damage.**

Skin damage, exceeding that considered negligible damage, can be repaired by patching. Typical skin repairs are illustrated in the back of the Section.

**Damage Necessitating Replacement of Parts.**

Warped and cracked skin, ribs, hinge brackets and torque tubes are replaceable items. Any damage that covers more than half of the elevator will require replacement of the elevators.

**FUSELAGE.**

The fuselage is of semimonocoque construction consisting of formed bulkhead, longitudinal stringers, reinforcing channels and skin platings. The fuselage forward section consists of all the fuselage structure from the nose to station 109.375. Formed bulkheads, channels and extrusions constitute the frame members of the cabin area.

**Negligible Damage.**

Refer to negligible damage paragraph under wing skin.

**Repairable Damage.**

Mild wrinkles occurring in the upper or lower skin panels in the bay forward of the horizontal stabilizer and which extend through the corners (shoulder areas) may be repaired by the addition of a stringer. A wrinkle, which is hand removable, should be rein-

forced by a 1/2 x 1/2 x .050-inch 2024-T42 extruded angle. The angle should be inserted fore and aft across the center of the wrinkle and should extend to within 1/16 to 1/8-inch of the fuselage bulkheads comprising the ends of the bay. If wrinkles cannot be removed by hand, the damaged area should be repaired.

#### Damage Necessitating Replacement of Parts.

All forgings and castings of any material and structural parts made of steel must be replaced if damaged. Structural members of a complicated nature that have been distorted or wrenched should be replaced. Major skin damage should be repaired by replacing the entire damaged sheet.

#### NOTE

When replacing entire skin panels, duplication of the forward edge of the original sheet is required. In effect, this flange is a structural member, carrying specific loads across the open areas.

#### Bulkheads.

Bulkheads are composed of formed "U" channel sections. The principle material of construction is 2024-O clad aluminum alloy, which after forming is heat treated to a 2024-T42 condition. All bulkheads in the fuselage are of the formed sheet metal or the reinforced formed sheet metal type.

#### Cracked Bulkhead Webs or Flanges.

Acceptable methods of repairing various types of cracks occurring in service are shown in the back of the section. Small holes (3/32-inch) should be drilled at the extreme ends of the cracks to prevent further spreading. Reinforcement should be added to carry the stresses across the damaged portion and stiffen the joints. The condition causing such cracks to develop at a particular point may be stress concentration at that point, in conjunction with repetition of stress (such as produced by vibration of the structure). The stress concentration may be due to defects such as nicks, scratches, tool marks and initial stresses or cracks from forming or heat treating operations.

#### NOTE

An increase in sheet thickness alone is usually beneficial but does not necessarily remedy the conditions leading to cracking. Patch type repairs are generally employed and are usually satisfactory in restoring the original material strength characteristics.

#### Severely Bent, Kinked or Torn Channels.

If practical, severely bent, kinked or torn portions of bulkheads should be removed and a replacement

section installed and joined at the original splice joint. If this is not justified, cutting away the damaged portion and inserting a trimmed portion of the original section, adequately reinforced by splice plates or doublers, will prove satisfactory. This is known as an insertion type repair.

#### LANDING GEAR.

The main gears are carried by the wings and are housed within the wing wheel wells when retracted. The nose gear retracts into the fuselage nose wheel well. Doors covering the wells are regarded as parts of the landing gear assemblies but the wells are structural features of the wings and fuselage.

#### Repairs of Landing Gear.

The landing gear assemblies are composed of parts that are not regarded as repairable. Minor repairs are permissible on the doors but when they are reinstalled there must be no distortion that will prevent perfect operation.

#### ENGINE MOUNT.

Replacement of mount is the only recommended procedure.

#### ENGINE COWLING.

Repair Procedures for Bonded Honeycomb Engine Cowls. (See figure 16-33.)

a. The 310 engine cowl is fabricated using a sandwich type honeycomb construction. Sometime during the life of the aircraft damage may occur to the skin and/or honeycomb which will require repairs. In the event damage does occur, the following repair procedures have been developed with the objective of equaling, as nearly as possible, the strength of the original part with a minimum loss of aerodynamic characteristics, electrical properties and minimize increase in overall weight.

b. Damage to sandwich honeycomb construction are divided into classes according to severity and possible effect upon the airframe structure. Damage classifications are as follows:

- Class 1. Dents, scars, scratches, cracks, etc., in the facings not accomplished by a puncture or a fracture.
- Class 2. Punctures or fractures on one facing only, possibly accompanied by damage to the honeycomb core but without damage to the opposite facing.
- Class 3. Holes or damage extending completely through the sandwich, affecting both facings and the core.



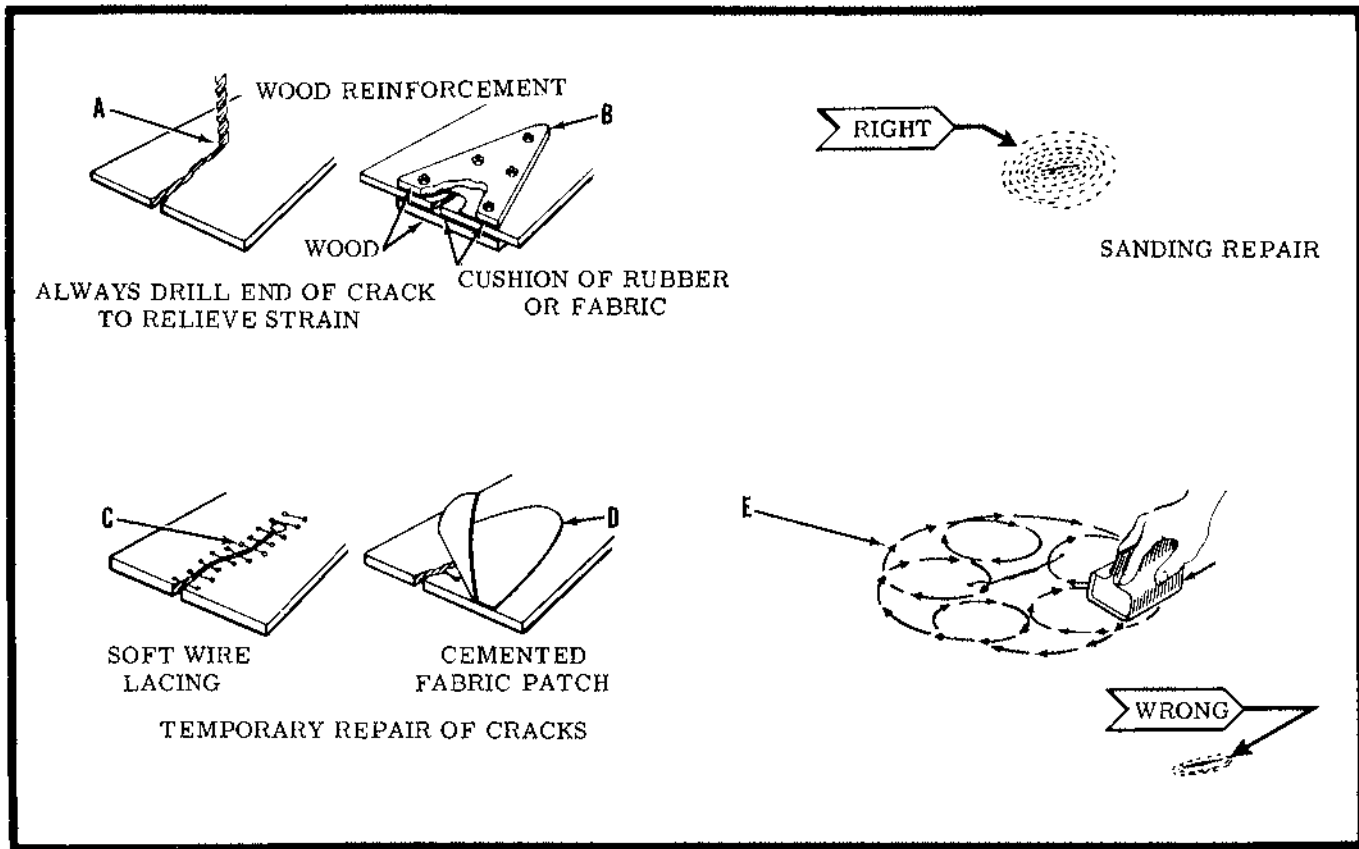


Figure 16-1. Plastic Repairs

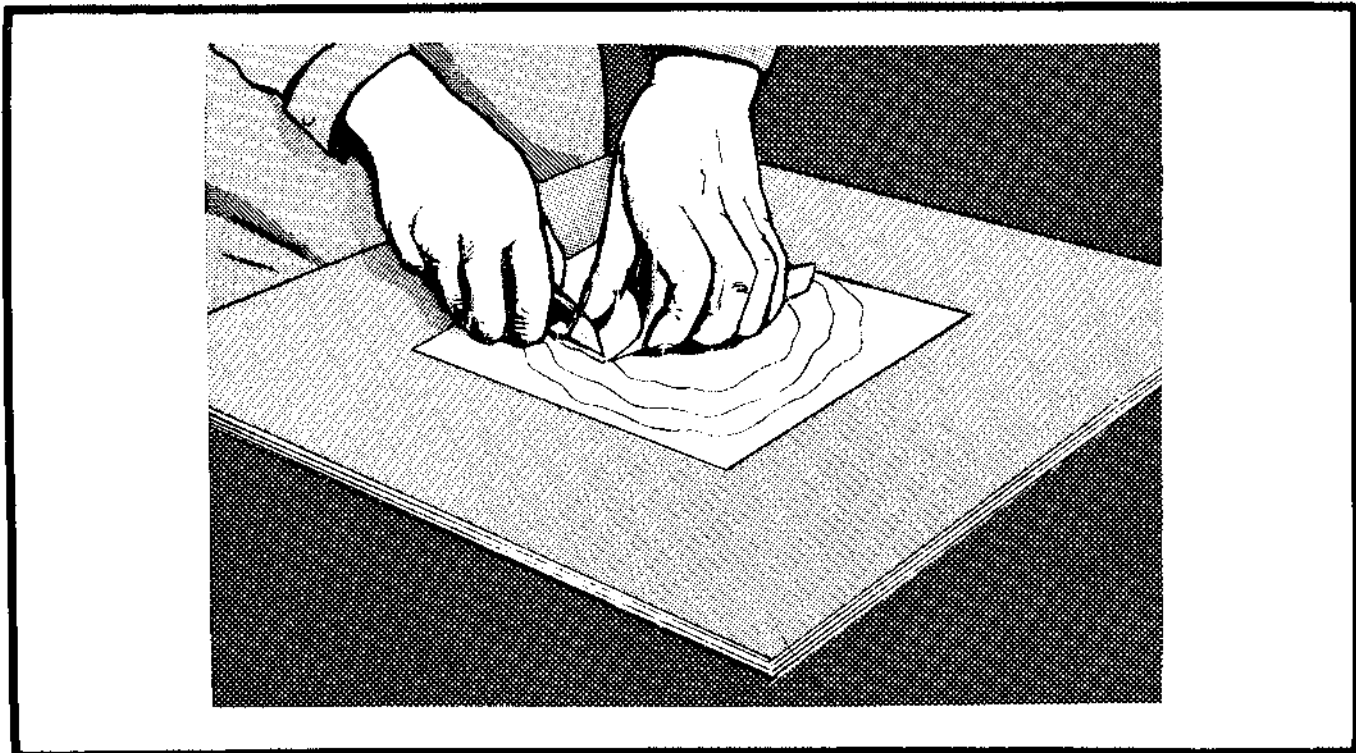


Figure 16-2. Removing Damaged Face Plies - Step Joint Method

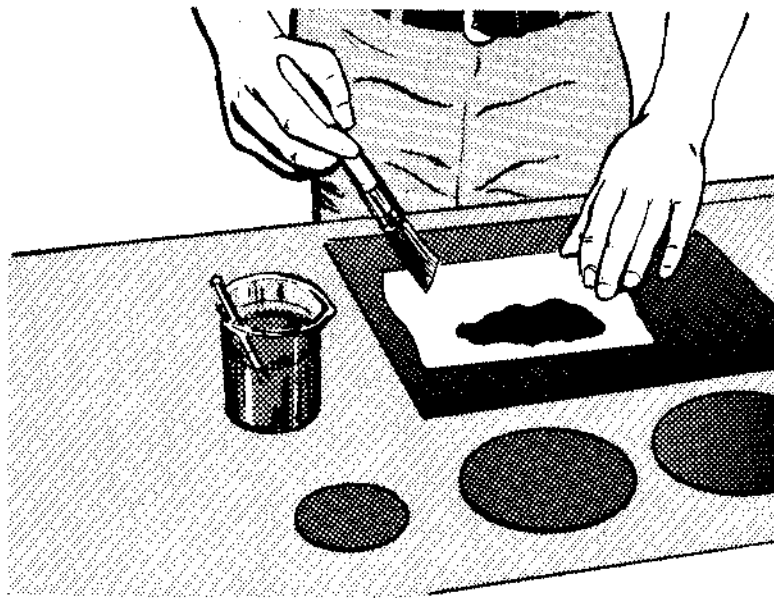


Figure 16-3. Suggested Method of Resin Impregnating Replacement Plies

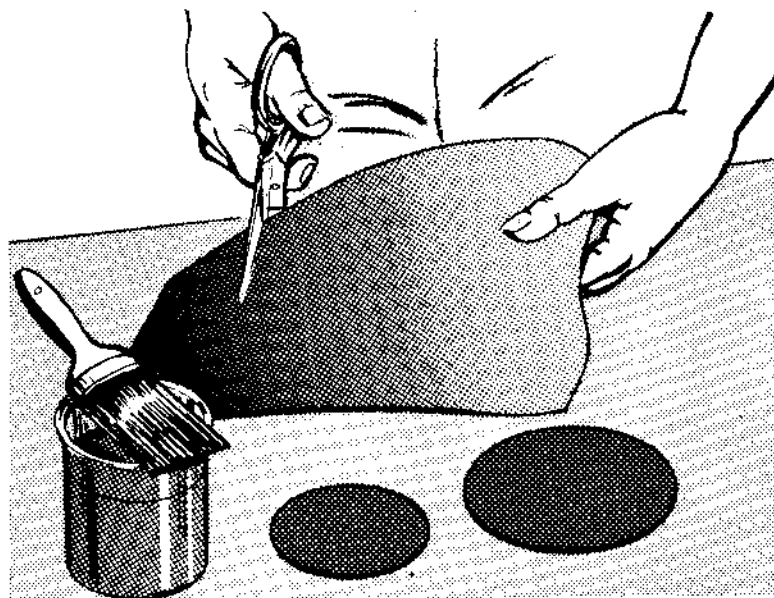


Figure 16-4. Cutting Replacement Plies from Impregnated Glass Cloth Sandwiched Between Sheet of Cellophane

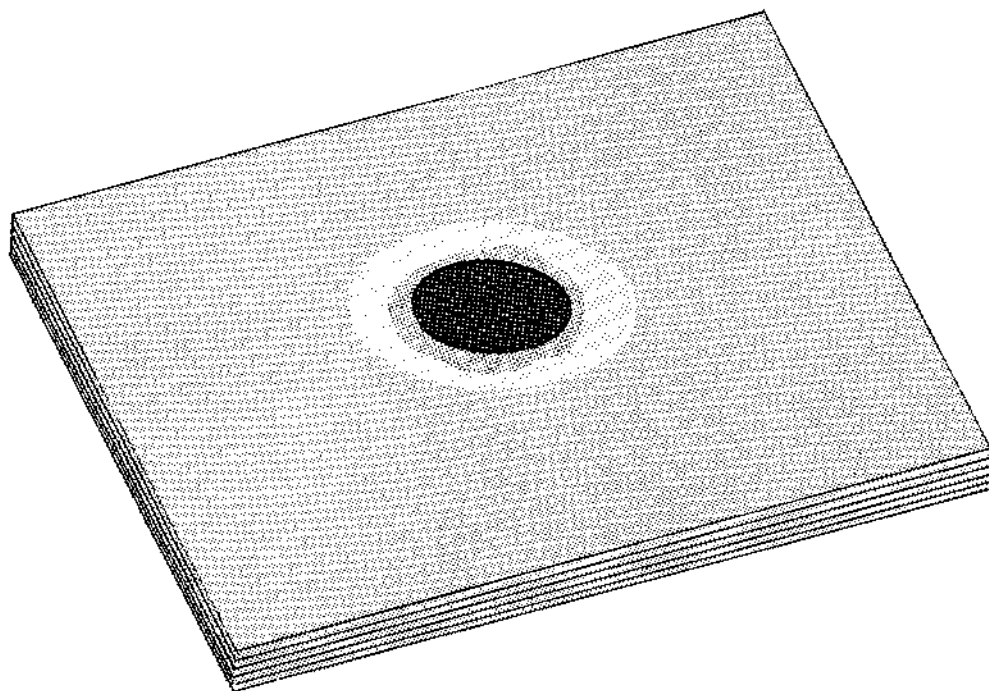


Figure 16-5. Damaged Face Plies Removed - Scarf Method

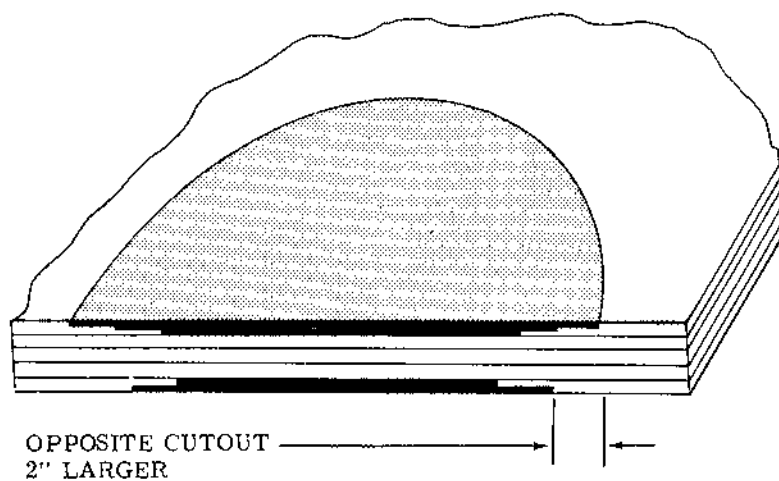


Figure 16-6. Completed Double Face Patch Repair

Class 4. Adhesive voids between skin and honeycomb core.

### WARNING

Solvents used must be stored in, transported in, and used from safety containers. Adequate ventilation must be provided in storage and usage areas. The solvents specified are flammable and caution to prevent fires must be taken. No smoking, sparks or open flames shall be permitted in the immediate area where the solvents are being used. Storage and usage areas shall be free from excessive heat, sparks, and open flames when possible and practical, rubber gloves shall be worn when performing solvent operations.

c. Repair of Class 1 damage shall be as follows:

1. Class 1 damage resulting in a hole not exceeding 1-1/2 inches diameter, dents, scratches or scars of .030 inch deep shall be repaired as follows:

- (a) Remove paint to bare metal using either 400 or 600 grit wet sandpaper.
- (b) Mask area adjacent to sanded area.
- (c) Mix thoroughly equal portions, by volume, of Epon 828 and Versamid 125. Add aluminum powder until a thick non-flowing paste is obtained.

### NOTE

Prepare only that quantity of material that will be used in 30 minutes.

- (d) Fill damaged area with mix and smooth with a putty knife or spatula.
- (e) Allow the mix to cure at room temperature until hard (approximately 4 hours).
- (f) Wet sand the repaired area with 400 grit wet sandpaper until smooth.
- (g) Clean the repaired area with a clean cloth moistened with Isopropyl Alcohol, Naphtha or Toluene. Allow to air dry.
- (h) Brush a minimum of two coats of Zinc Chromate primer over the repaired area, allowing each coat to dry.
- (i) Refer to Section 2, and paint in accordance with applicable finish specifications.

2. Class 1 damage resulting in cracks shall be repaired as follows:

- (a) Stop drill crack at both ends with 3/16 inch diameter holes.
- (b) Prepare a circular external patch, which will extend one inch beyond damage area from .012 or .015 aluminum.
- (c) Remove all paint and primer around damage area by sanding with 400 to 600 grit wet sandpaper.

### NOTE

Sanded area must be approximately 1/2 inch wider than aluminum patch.

- (d) Lightly sand entire damage area with 400 grit sandpaper until a satin finish is ob-

- tained. Mask off around damage area.
- (e) Wipe damage area with a clean cloth moistened with Isopropyl Alcohol, Naphtha or Toluene. Wipe dry with a clean cloth.
- (f) Mix thoroughly 100 parts (by weight) Epon VIII Adhesive with 6 parts (by weight) of curing agent "A".

### NOTE

Prepare only that quantity of material that will be used in two hours.

- (g) Work some of the prepared adhesive in the crack and drilled holes. Apply a thin film over sanded surface.
  - (h) Prepare a one-ply No. 191 glass cloth or similar scrim cloth 1/8 inch wider than aluminum patch.
  - (i) Apply a thin film of the adhesive on the aluminum patch and, then place cloth between patch and damaged assembly and apply sufficient pressure to assure positive contact.
  - (j) Using mylar or cellophane over aluminum patch, place a clamping device on patch to insure complete contact of all bonding surfaces.
  - (k) Remove excess adhesive with a clean cloth dampened with Naphtha or Toluene.
  - (l) Cure at 150° to 200° F using heat lamps or oven.
  - (m) Remove clamps, pressure pads, etc., and sand away remaining excessive adhesive.
  - (n) Brush a minimum of two coats of Zinc Chromate primer over the repaired area, allowing each coat to dry.
  - (o) Refer to Section 2, and paint in accordance with applicable finish specifications.
- d. Repair of Class 2 damage shall be as follows:
1. Class 2 damage to upper cowl resulting in damages that extend completely through the aluminum outer skin and into the aluminum honeycomb core but without damage to the inner skin:
- (a) Carefully trim out skin to a circular or oval shape with a hole saw or fly cutter removing honeycomb core completely to the opposite skin.

### CAUTION

Extreme care should be taken not to damage the inner skin.

- (b) Remove completely all the damaged honeycomb core.
- (c) Prepare either an aluminum honeycomb core or balsa wood replacement plug as follows:
  - (1) If balsa wood is used, fabricate plug so that the grain will be perpendicular to the skins.
  - (2) Lightly sand balsa plug with 400 grit sandpaper and wipe off dust with a clean cloth.

### NOTE

Do not touch the bare surface with bare hands

after sanding. If the balsa wood is cut too short, the distance between shall be shimmed up until positive contact is made with all surfaces.

- (3) Wrap balsa plug in clean waxed paper until ready for use.
- (4) When aluminum honeycomb plug is used, the core shall be the approximate density of the original core.
- (5) Cut aluminum honeycomb plug so that the top edge will be even with the adjacent skins and completely fills the damaged area.
- (d) Remove all paint and primer (approximately 1-1/2 inches larger in diameter than cutout) from around damage area with either 400 or 600 grit wet sandpaper.
- (e) Mask around sanded area and cutout area.
- (f) Mix thoroughly 100 parts (by weight) Epon VIII adhesive with 6 parts (by weight) of curing agent "A".

#### NOTE

Prepare only that quantity of material that will be used in two hours.

- (g) If balsa plug is being used, spread the adhesive lightly over all surfaces. If aluminum plug is being used, brush or trowel adhesive on the internal side of the existing skin and where the plug will make contact with core.
- (h) Position balsa wood or aluminum plug into place.
- (i) Prepare a circular external patch, which will be one inch larger than plug hole, from .012 or .015 aluminum.
- (j) Prepare a one-ply circular No. 191 glass cloth or similar scrim cloth 1/8 inch larger than plug hole.
- (k) Apply a thin film of adhesive over sanded surface and place the No. 191 glass cloth or similar cloth over the plug.
- (l) Clean the bond surface of aluminum patch and coat with adhesive.
- (m) Assemble patch over glass cloth and plug and apply sufficient pressure to assure positive contact.

#### NOTE

Care should be taken to insure that plug and glass cloth remain in place.

- (n) Using mylar or cellophane over aluminum patch, place a clamping device on patch to insure complete contact of all bonding surfaces.
- (o) Remove excessive adhesive with a clean cloth moistened with Naphtha or Toluene.
- (p) Cure at 150° to 200° F using heat lamps or oven.
- (q) Remove clamps, pressure pads, etc., and sand away excessive adhesive.
- (r) Brush a minimum of two coats of Zinc

Chromate primer over the repaired area, allowing each coat to dry.

- (s) Refer to Section 2, and paint in accordance with applicable finish specifications.

2. Class 2 damage to upper cowl resulting in damage which extends completely through the fiberglass inner skin and into aluminum honeycomb core but without damage to the outer aluminum skin.

- (a) Carefully trim out skin to a circular or oval shape with a hole saw or fly cutter removing aluminum honeycomb core completely to opposite skin.
- (b) Prepare a balsa wood or aluminum honeycomb plug as stated in step 1. (c) above.
- (c) Sand undamaged fiberglass skin lightly approximately 2 inches out from around the hole.

#### CAUTION

Do not sand through fiberglass skin.

- (d) Prepare two No. 181 glass fabric patches, 1/8 inch larger than hole diameter.
- (e) Mix thoroughly 100 parts (by weight) Epon 828 and 10 parts (by weight) Diethlenetriamine (DTA).
- (f) Coat plugs with Epon 828 and DTA mix as described in step 1. (g).
- (g) Impregnate the two No. 181 glass patches with mixture to the content of approximately 50% and assemble patches over plug.

#### NOTE

Smooth out all wrinkles.

- (h) Prepare one No. 181 glass fabric patch large enough to cover sanded area and impregnate with mixture.
- (i) Assemble third patch over the two previous layers and remove all wrinkles as before.
- (j) Using mylar or cellophane, cover patches and apply a clamping device.
- (k) Cure assembly at 150° to 200° F for approximately 90 minutes.
- (l) Remove clamps, pressure pads, etc., and sand smooth to original contour.

3. Class 2 damage to side cowl which extends completely through aluminum skin and the aluminum honeycomb core shall be repaired as follows:

- (a) Repair damage as described under step 1. (d), except use Bloomingdale's HT-424 or Narmco's Metlbond 302 adhesives.
- (b) The cure time for adhesives described in step (a) above, will be a minimum of 5 hours.

4. Class 2 damage to side cowl which extends completely through fiberglass skin and aluminum honeycomb core shall be repaired as follows:

- (a) Repair damage as described under step 2. (d), except, use either Bloomingdale's HT-424 or Narmco's Metlbond 302 adhesives. The skins shall be fabricated from either Cordo's Pyroreg AC, U.S. Polymeric's Poly Preg 502, or Narmco's 506 (color black).
- (c) The reinforcement shall be 181-150 Valan.

- (d) Cure time for adhesives described in step (a) above, will be a minimum of 5 hours.
- e. Repair of Class 3 damage is as follows:
  - 1. Class 3 damage to upper and side cowls resulting in damage to both aluminum and fiberglass skins having a minimum damage size of 1.0 inch or maximum damage size of 4 inches.
    - (a) Prepare surfaces, plugs and patches as described in step (d).
    - (b) Fabricate a temporary mold or block to hold the plug in place while aluminum outer skin is being repaired.
    - (c) Repair outer aluminum skin in accordance with step (d).
    - (d) Remove temporary mold or block and repair fiberglass skin in accordance with step (d), and flare in patch with existing skin contour.
- f. Repair of Class 4 damage is as follows:
  - 1. Class 4 repairs are those repairs needed to fill voids between aluminum core and skin surfaces.
    - (a) Drill sufficient 1/8 inch holes in the fiberglass inner skin adjacent to voids.
    - (b) Remove all burrs around drilled holes.
    - (c) Mix thoroughly 100 parts (by weight) Epon 828 with 10 parts (by weight) curing agent "D".

## NOTE

Prepare only that quantity that can be used in one hour.

- (d) Using a syringe or pressure gun, inject resin mix into the aluminum honeycomb cells until they become filled.
- (e) Wipe off excess resin with a cloth that has been dampened with MIBK or MEK and cover the holes with masking tape.
- (f) Position the structure so that both skins will be in positive contact with resin.
- (g) Cure adhesive for 2 hours at 150° to 200° F.
- (h) Remove masking tape and sand away excess resin.

## FIBERGLASS PARTS.

The engine cowlings nose caps, tail stinger, tail surface tips, fairings, heater ducts, and other parts of the aircraft are made of fiberglass.

## Repairable Damage.

Damaged fiberglass parts may be repaired by the methods shown in figure 16-7. Cut and trim the area just beyond the noticeable damage. If the parts are painted, remove paint and sand clear an area at least two inches beyond the edge of the cutout. Prepare the necessary size and number of patches of glass cloth. Mix a sufficient amount of resin in accordance with the manufacturer's instructions.

## WARNING

Always follow the manufacturer's mixing instructions carefully as the mixing of peroxide

and cobalt together will result in a spontaneous fire.

Be sure that your hands are free from oil, grease, and dirt. Apply an even coat of resin on the sanded area. Impregnate all the glass cloth patches by laying them on a clear paper and working the resin through the fabric with a small brush. Place the larger patch over the cutout area, working out all air bubbles and wrinkles. If the cutout is large enough to cause the patch to sag, place a suitable support behind the repair area. Coat the support with automobile wax or wax paper to prevent the resin from adhering to the support. Apply a second patch over the first patch, etc., working out all wrinkles and air bubbles. After all the patches have been applied, brush the area with an even coat of resin and allow to cure. Smooth the patch area with fine sandpaper until the desired finish is obtained. Repaint the finished area with matching paint.

## Damage Necessitating Replacement of Parts.

When the fiberglass parts are torn or cracked over a large area or show signs of strain through the appearance of small cracks or show signs of loss of rigidity through the use of too much pressure on the surface, then the parts shall be removed and replaced.

## Polycarbonate and Acrylic Plastic Bonding.

a. When it becomes necessary to bond Polycarbonate and acrylic - such as the magnetic compass base plate to the windshield - 5% solution of methylene chloride is recommended as a bonding agent. This solution can be prepared as follows:

100 parts (by weight) Methylene Chloride  
5 parts (by weight) Polycarbonate powder  
(such as Lexan 105 powder).

## NOTE

Due to the short pot life of this solution, no more material than that which can be used in 30 minutes should be mixed.

b. Following coating of the parts to be bonded, positive contact of the mating surfaces must be made within 10 to 15 seconds. A locally manufactured tool capable of exerting 50 to 60 psi should be used to hold the bonded parts for a minimum of 4 hours.

c. Curing the bond should be accomplished by allowing the bonded parts to remain at room temperature for at least 24 hours before any stress is applied.

## Repair of Plastic Window Surfaces. (See figure 16-1.)

a. Damaged window panels and windshield of this aircraft are ordinarily removed and replaced if the damage is extensive. However, certain repairs as prescribed in the following paragraphs can be made successfully without removing the damaged part from

NOTE: SEE FIBERGLASS PARTS PARAGRAPH  
BEFORE ATTEMPTING A FIBERGLASS  
REPAIR.

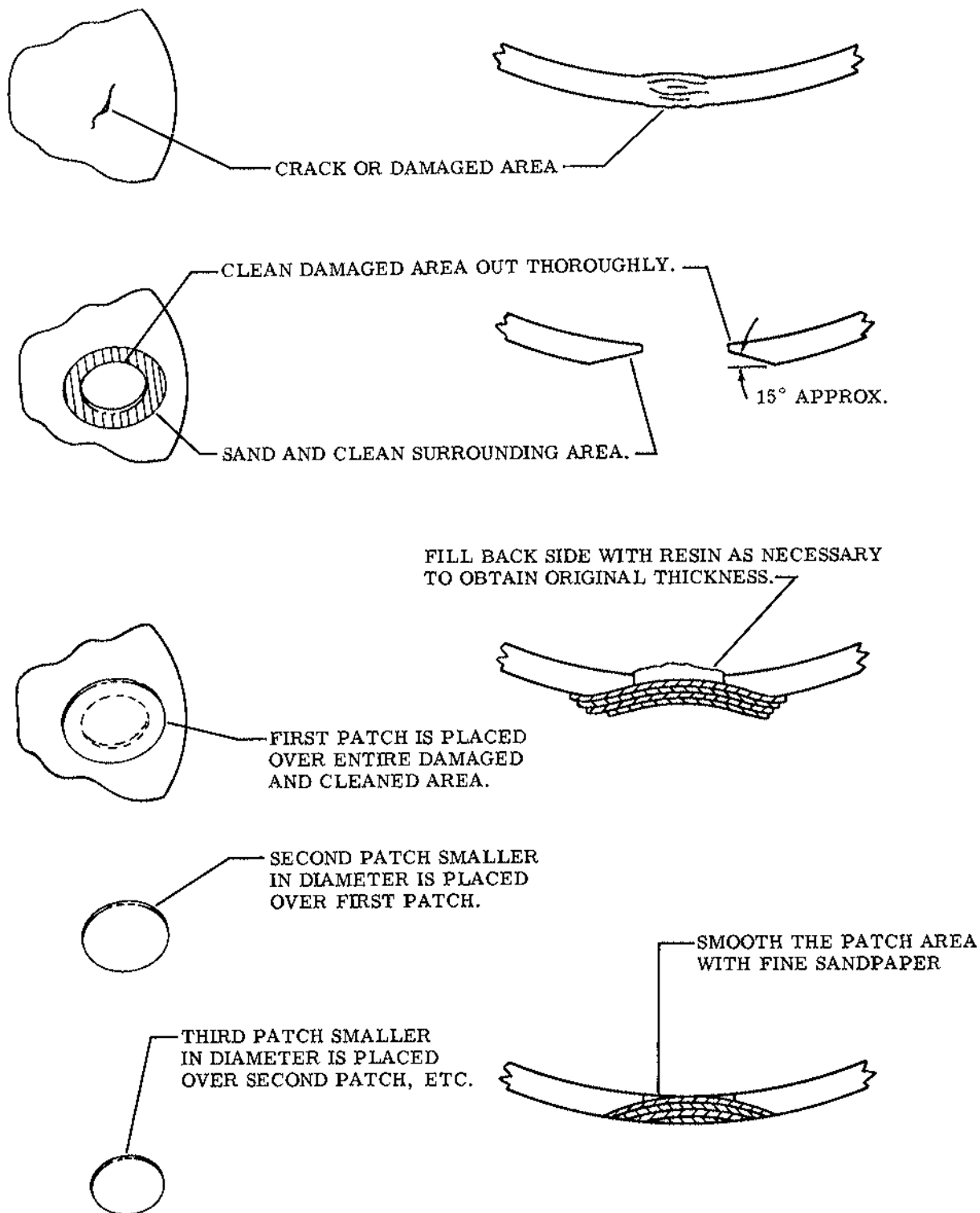


Figure 16-7. Fiberglass Repair

the aircraft. Three types of temporary repairs for cracked plastic are possible. No repairs of any kind are recommended on highly-stressed or compound curves where the repair would be likely to affect the pilot's or copilot's field of vision. Curved areas are more difficult to repair than flat areas and any repaired area is both structurally and optically inferior to the original surface.

b. When a crack appears in a panel, drill a hole at the end of the crack to prevent further spreading. The hole should be approximately 1/8 inch in diameter, depending on the length of the crack and thickness of the material.

c. Temporary repairs on flat surfaces can be effected by placing a thin strip of wood over each side of the surface and then inserting small bolts through the wood and plastic. A cushion of sheet rubber or aircraft fabric should be placed between the wood and plastic on both sides.

d. A temporary repair can be made on a curved surface by placing fabric patches over the affected areas. Secure the patches with aircraft dope, Specification No. MIL-D-5549, or lacquer, Specification No. MIL-L-7178. Lacquer thinner, Specification No. MIL-T-6094 can also be used to secure the patch temporarily.

e. A temporary repair can be made by drilling small holes along sides of the crack 1/4 to 1/8 inch apart and lacing the edges together with a soft wire. Small stranded antenna wire makes a good temporary lacing material. This type of repair is used as a temporary measure only, and as soon as facilities are available, the panel should be replaced.

f. Scratches on transparent plastic surfaces can be removed by hand-sanding operations followed by buffing and polishing, provided subsequent instructions are followed carefully. Wrap a piece of No. 320 (or finer) sandpaper or abrasive cloth around a rubber pad or wood block. Rub the surface around the scratch with a circular motion, keeping the abrasive constantly wet with clean water to prevent scratching the surface further. Use minimum pressure and cover an area large enough to prevent the formation of the "bull's-eye" or other optical distortions.

#### CAUTION

Do not use a coarse grade of abrasive; No. 320 is the maximum coarseness permitted.

g. Continue the sanding operation, using progressively finer grade abrasives.

h. When the scratches have been removed, wash the area thoroughly with clean water to remove all the gritty particles. The entire sanded area will be clouded with minute scratches which must be removed to restore transparency.

i. Apply fresh tallow and buffing compound to a motor-driven buffing wheel. Hold the wheel against the plastic surface, moving it constantly over the damaged area until the cloudy appearance disappears. A 2000-foot-per-minute surface speed is recommended to prevent heating, distortion, or burns.

#### NOTE

Polishing can be accomplished by hand, but

it will require a considerably longer period of time to attain the same result as produced by the buffing wheel.

j. When buffing is finished, wash the area thoroughly and dry it with a soft flannel cloth. Allow the surface to cool and inspect the area to determine if full transparency has been restored. Then apply a thin coat of hard wax and polish the surface lightly with a clean flannel cloth.

#### NOTE

Rubbing a plastic surface with a dry cloth will build up an electrostatic charge which attracts dirt particles and may eventually cause scratching of the surface. After the wax has hardened dissipate this charge by rubbing the surface with a slightly damp chamois. This will also remove the dust particles which have collected while the wax was hardening.

#### Radome Repair Procedures.

a. Remove radome in accordance with Section 3. Repair procedures are developed with the objective of equaling as nearly as possible the electrical and strength properties of the original part with a minimum increase in weight. This can only be accomplished by repairing damaged parts with approved materials and working techniques. For convenience in presentation and for clarity in designating repair procedures to be used, damages to solid laminate radomes in this procedure shall be divided into classes according to severity, as follows:

1. Class I Repair. Surface scratches, scars or erosion not penetrating through the first ply of fabric.
2. Class II Repair. Punctures, delaminations, contaminates or fractures extending through the first ply down into the laminate but without damage to the opposite facing.
3. Class III Repair. Damage extending completely through the laminate affecting both facings.
4. Class IV Repair. Defect which does not exceed an area .5 inch square and surface has not been broken and does not occur more than twice in any 1 foot square area.
5. Class V Repair. Delamination in edge bond extending up to 1/8 inch out from drilled holes; delaminations not extending more than 1/2 inch from trimmed edges and approximately 1 inch in size.

#### b. Repair Techniques.

1. Class I Repair. Surface scratches, scars or erosion not penetrating through the first ply shall be repaired as follows:

- (a) Clean damaged area thoroughly and carefully using a clean cloth saturated with methyl-ethyl-ketone or another approved cleaning agent.
- (b) Lightly sand the damaged area, using No. 280 grit sandpaper, clean the sanded surface thoroughly, using methyl-ethyl-ketone, Specification TT-M-261. Moisture and solvents should be completely removed to prevent their inhibiting the cure of



the resin.

(c) Apply one or two coats (depending on severity of the abrasion) of the following resin mix to the abraded surface.

#### Composition

|                                                |                             |
|------------------------------------------------|-----------------------------|
| Resin Selectron 5003<br>(Alternate: Hetron 92) | 100 parts by weight         |
| Lupersol DDM                                   | 0.5 to 1.5 parts by weight  |
| Luperco ATC Paste                              | .95 to 1.05 parts by weight |
| Nuodex Cobalt                                  | 4 to 8 drops/lb. resin      |

#### Mixing Procedure

Dissolve ATC Paste in the resin and thoroughly mix. Add Nuodex Cobalt and mix. Add DDM and thoroughly mix.

#### Bench Life

Approximately 30 minutes at room temperature.

(d) Over this coated surface, apply a sheet of colored cellophane or polyvinyl alcohol film extending two or three inches beyond the surface. The cellophane or PVA prevents exposure to the air and will provide a smooth surface against which the resin may cure.

(e) Tape cellophane or PVA in place and work out air bubbles and excessive resin with the hand or a rubber squeegee. Cure the resin as follows:

- (1) Gel resin any surface temperature from 80° F up to a maximum of 150° F.
- (2) After gelation the repaired area is cured at a surface temperature of 120 to 150° F for 30 minutes. The surface temperature is then raised to 200-230° F and maintained for 30 minutes. Heat may be obtained by heat lamps, glow rods, etc.

(f) After the resin has cured or set, remove the cellophane or PVA from the cured resin and remove any excessive resin by sanding lightly.

2. Class II Repair. Punctures, delaminations, contaminants or fractures extending through the first ply down into the laminate but without damage to the opposite facing.

#### Method I (Stepped Joint Method).

(a) The preferred method of removing damaged plies in accomplishing a Class II Repair is by the stepped joint method. For small damages the scarf method of repair may be used.

(b) Ascertain the extent of the damaged area by visual inspection, using a strong light source, prior to beginning repair. With aid of a straight edge or compass, outline the damaged area by scribing a rectangle with rounded corners or circle that will necessitate removal of a minimum of sound material. Extend the sides of the circle a distance in inches equal to the number of plies to

be removed less one inch. (Five inches if six plies are to be removed, four inches if five plies are to be removed, etc.) Overlap should be at least one inch per ply of glass cloth.

(c) With the aid of a straight edge, use a sharp knife or other specially prepared cutter and cut along the lines scribed in the outermost ply. Use extreme care not to cut or score the underlying ply. A suggested method is to cut through the overlaying ply in a series of cuts rather than attempt to cut through the ply in one cut.

(d) Remove the cut outermost ply by inserting the knife blade under the corner and prying loose carefully. When this outermost ply is removed, scribe on the next exposed ply a similar outline except reducing the dimensions one inch in all directions. (Overlaps shall be one inch each ply.) Repeat this procedure until all the damaged plies have been removed.

(e) Lightly sand exposed plies and clean surfaces using methyl-ethyl-ketone, Specification TT-M-261, and allow to dry thoroughly preparatory to completing repair buildup.

#### **WARNING**

The sanding operation on glass cloth reinforced laminates gives off a fine dust that may cause skin irritation. Breathing of an excessive amount of this dust may be injurious, therefore, precaution as to skin and respiratory protection will be observed.

(f) Cut patches from the same type of fabric as was used in the original part. Cut the fabric patches to the size of each hole. Impregnate the cloth patches with the resin mix specified under Repair Method I, paragraph (c). Sandwich each patch ply between two sheets of PVA or cellophane larger than the patch by at least two inches on all sides. (See Figures 16-3, and 16-4.) The impregnated glass cloth shall contain 45-50 percent of catalyzed resin after cellophane has been removed. (Weight of resin equal to weight of dry glass cloth comprises 50 percent resin content.) Brush a coat of resin on the surface of the scarified plies.

(g) Fit the smallest patch in place taking care to avoid entrapping air under the patch. Smooth out all wrinkles and trim to fit. Add successive plies in a like manner the warp direction of each patch ply approximately the same as that of the original ply.

(h) Surround the patch with a bleeder and cover the entire area with polyvinyl alcohol film and secure in an air tight seal with either double-backed tape or extruded sealing tape or both. Evacuate the area under the PVA film. Sweep out entrapped air and excess resin with the motion of a rubber squeegee or a similar device. The motion of the squeegee shall be slow enough so that the air bubbles will be swept clear of the laminate by the wave, or motion of the excess resin. The air bubbles may be observed through the transparent PVA sheeting and the wiping process will continue until all air bubbles are swept past the edge of the laminate. The working or wiping of the lami-

nate will be stopped when the plies of fabric are firmly packed together. Further wiping will create air or vapor voids observable as a whitening and a loss of transparency. Should the PVA sheet be punctured during the void-free working or wiping process, the hole may be repaired with transparent tape and the air which has penetrated the bag shall be worked from the laminate. Vacuum pressure shall be maintained during the complete curing process.

(i) Cure repaired area as described under Repair Method I, paragraph (c). After the resin has cured, remove the PVA from the cured resin and remove any excessive resin by sanding lightly.

#### Method II (Scarf Joint Method).

(a) The scarf joint method may be used when the repair of a damaged area will require removal of an area less than three-inches in diameter.

(b) The scarf method consists of sanding out the damaged plies to a circular or oval disc shape. (See Figure 16-5.) The damaged plies will be scarfed back carefully to a distance of at least 50 times the total face ply thickness by using polisher-sander Stock No. 5130-537-3394, or by hand-sanding using No. 180 grit sandpaper. The scarfing operation will be performed very accurately to provide a uniform taper and usually requires some practice before acceptable scarfs are obtained.

(c) The glass cloth laminations for the facing repairs are prepared with the largest piece being cut to the exact shape of the outside of the scarfed area. The smallest piece is cut so that it overlaps the scarfed area by its proportionate amount, depending on the number of plies in the repair and the intermediate pieces are cut so as to have equal taper.

(d) Process the prepared area in accordance with paragraphs (f), (g), (h) and (i) under Class II Repairs, Method I.

3. Class III Repair. Damage extending completely through the laminate affecting both facings.

(a) Damages completely through the laminate shall be repaired by removing and replacing the damaged material as previously outlined under Class II Repair. Never remove inner and outer radome face ply at the same time. One facing will be completed before repair is made on the opposite facing. On solid laminate radomes, 1/2 of the damaged face plies will be removed from one side and the buildup repair completed, then repeat removal and new ply buildup procedures on opposite side.

(b) To accomplish Class III Repairs, it is necessary that the opposite side of the laminate be provided with a temporary mold or block to hold the laminate in place during the first face ply buildup.

(c) The damaged facing shall be removed and replaced as previously outlined for removing and replacing damaged plies for Class II Repair. Repeat repair procedures on the opposite facing except the cut out ply area will be larger by approxi-

mately two inches than the first ply cut out area on the opposite face repair. This will prevent the joints of the inner and outer repair area from being in the same position. (See Figure 16-6.)

4. Class IV Repair. Defects which do not exceed an area .5 inch square and the surface has not been broken and does not occur more than twice in any 1 foot square area.

(a) If surface is broken, sand smooth.

(b) Drill 2 to 3 No. 50 holes into the damaged skin spaced throughout the damaged area. Inject resin mix under Class I Repair, paragraph (c), with a hypodermic syringe and needle to insure contact with all surfaces and to obtain a maximum possible "wetting up" of the fractured skin.

(c) Cure as described under Class I Repair, paragraph (e).

5. Class V Repair. Delamination in edge band extending up to 1/8 inch out from drilled holes; delaminations not extending more than 1/2 inch inward from trimmed edges and approximately 1 inch in size.

(a) Work as much resin mix as possible under Class I Repair, paragraph (c), into the discrepant area. Resin may be injected into the delaminated area along the panel edges with a hypodermic syringe and needle through holes drilled with a No. 50 drill bit. Extruded Sealing Tape placed around the needle and against the panel will force the resin throughout the delaminated area.

(b) Apply pressure, if necessary, with C-clamps or vacuum blanket. Cure per paragraph (3), under Class I Repairs.

#### CHECKING WING TWIST AND LOCATION OF THRUST LINE. (See Figure 3-7A.)

a. Remove wing in accordance with wing removal procedures and place wing on suitable supports beneath the root and tip ribs.

#### NOTE

The wing tip tank must be removed during check.

b. Locate wing datum plane as follows:

1. Locate a line at the root rib (wing station 28.40) which is 4.52 inches up from the lower surface of the front spar, and 4.00 inches up from the lower surface of the rear spar.

2. Locate a line at the tip rib (wing station 199.92) which is 1.44 inches up from the lower surface of the front spar, and 181 inches up from the lower surface of the rear spar.

3. These two lines locate the wing datum plane, and the three degrees of twist will be present if the lines are parallel.

c. Refer to Figure 3-18 (Details C, D and E), locate engine thrust line.

d. Install wing and wing tip tank in accordance with installation procedures.

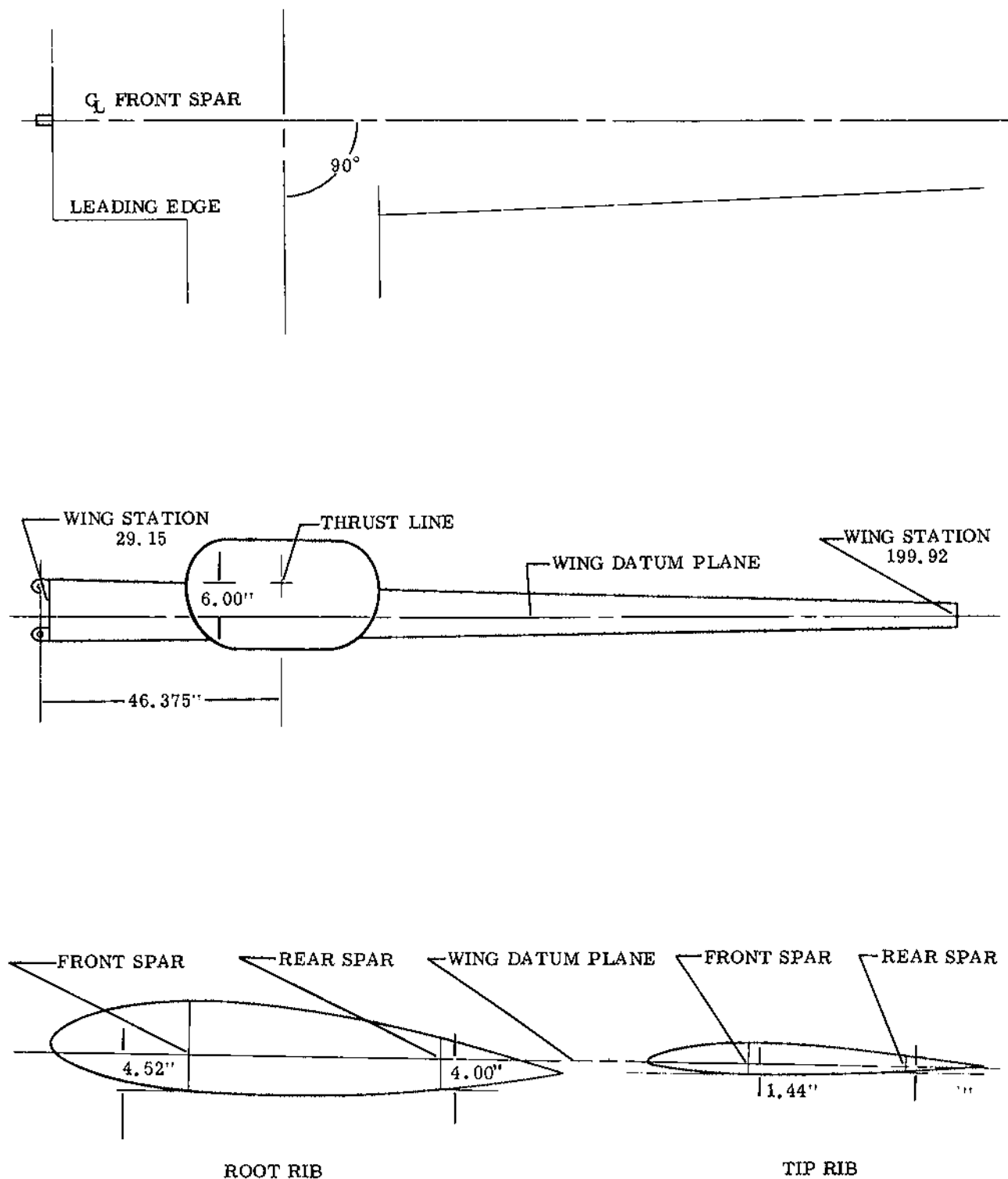


Figure 16-7A. Wing Twist and Thrust Line Data

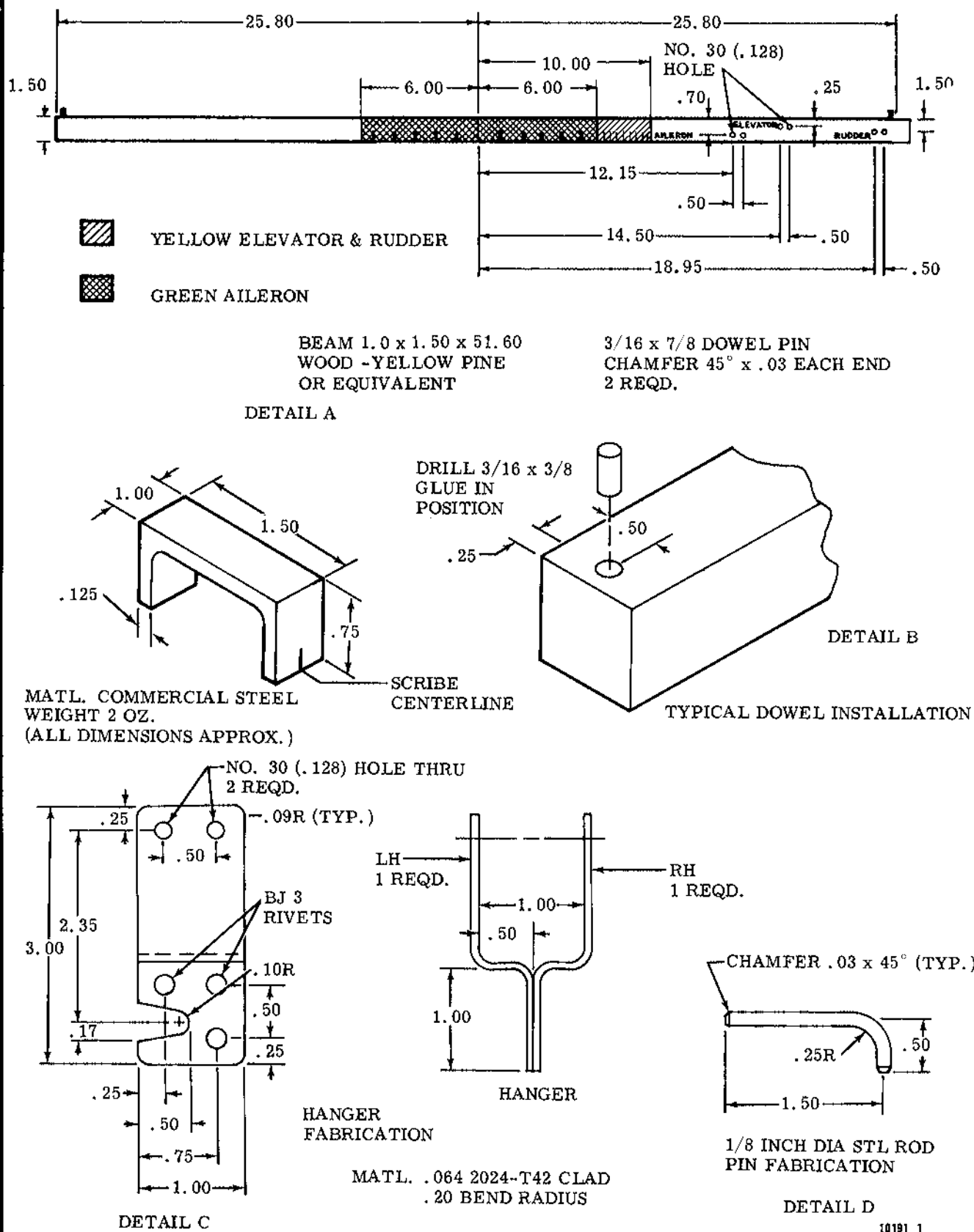
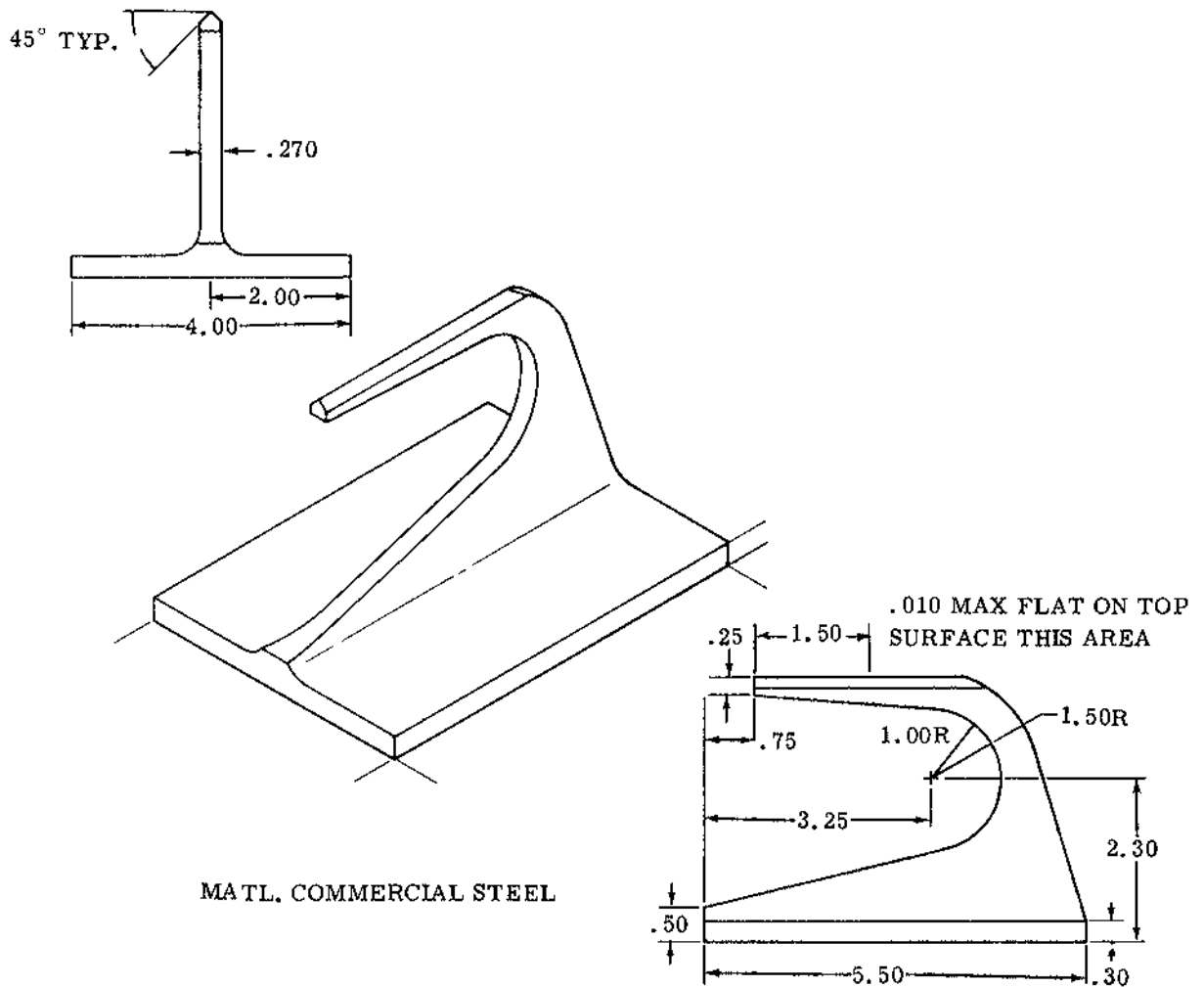


Figure 16-8. Balancing Fixture Fabrication. (Sheet 1 of 2)

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## FABRICATION OF BALANCE FIXTURE.

## Beam.

- Fabricate beam from wood (yellow pine) or equivalent, one by one and one-half inch stock.
- Locate center of beam. (Should be 25.80 inches from end.)
- Locate and drill 3/16 (.1875) x 3/8 (.375) holes .25 in from each end of beam.
- (See Detail B.) Fabricate dowel and install in beam using glue for security.
- Measuring from the center point of beam or 25.80 inch Station, locate and drill No. 30 (.128) diameter holes for aileron, elevator and rudder hanger locations.
- Mark off and paint the beam as indicated for aileron, rudder and elevator positions.

## Hanger.

- Fabricate right and left hanger halves per Detail C.

- Assemble the hanger using three MS20470AD3-5 rivets.

## Pin.

- Fabricate pin from 1/8 sti. rod per Detail D.

## Balance Weight.

- Fabricate balance weight per Detail A.

## NOTE

If necessary, grind or file balance weight to obtain two (2) ounce weight. Scribe center-line after fabrication.

## Mandrel.

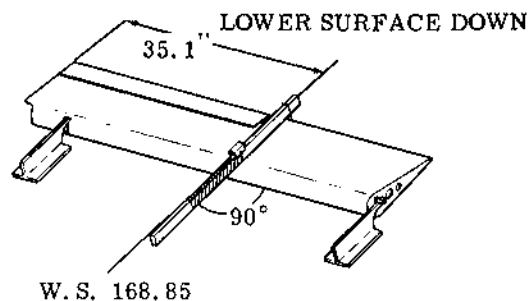
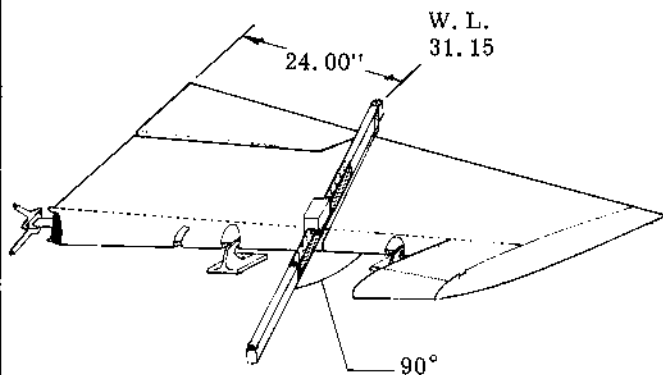
- Fabricate mandrel in accordance with Detail E.

## NOTE

Mandrel may be fabricated from any suitable material.

Figure 16-8. Balancing Fixture Fabrication. (Sheet 2 of 2)

## LEFT HAND SIDE SURFACE DOWN

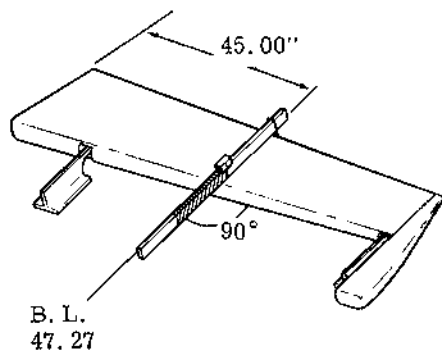


## RUDDER:

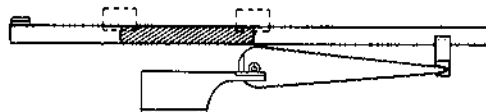
Place balanced fixture (refer to balancing procedures)  
on first rib line above the trim tab on the rudder

## AILERON:

Place balanced fixture (refer to balancing procedures)  
on first rib line outboard of trim tab on the aileron



LOWER SURFACE DOWN



TYPICAL BALANCED CONTROL

## ELEVATOR:

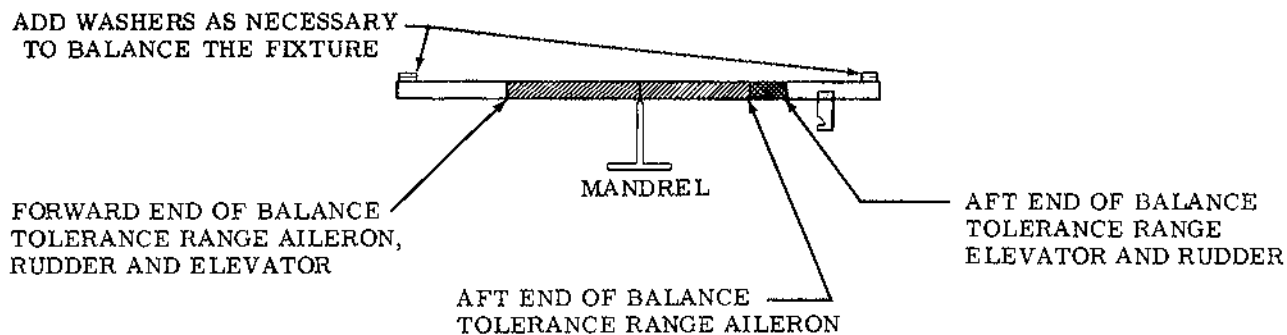
Place balanced fixture (refer to balancing procedures)  
on first rib line outboard of trim tab on the elevator

| SURFACE  | BALANCE TOLERANCE    |
|----------|----------------------|
| AILERON  | +.75 TO -.75 in-lb.  |
| ELEVATOR | +.75 TO -1.25 in-lb. |
| RUDDER   | +.75 TO -1.25 in-lb. |

## NOTE:

The above balance tolerances are provided in the event the regular balance fixture is not used. The minus tolerance is forward of hinge line and plus tolerance is aft of hinge line.

Figure 16-9. Static Balancing Aileron, Rudder and Elevator (Sheet 1 of 4)



### BALANCING PROCEDURES.

It is recommended that control surface balancing be accomplished in a draft-free room/area using the balancing equipment fabricated from instructions contained in figure 16-9.

#### NOTE

Be certain control surface weights are installed, surfaces are clean, all foreign matter inside control surfaces removed, and control surface painted with hinge bolts installed. Surfaces which have trim tabs incorporated must have the tab secured in a streamlined position. Push-pull rods, with attaching hardware on the trim tab, must be installed before starting balancing procedures.

### BALANCING FIXTURE.

- Install hanger assembly in the appropriate position for the surface being balanced.
- Place mandrel on a table or other suitable flat surface and center balancing beam on mandrel at the centerline of bar.
- Add washers to dowel pins until a balanced condition is obtained.

#### NOTE

When balancing fixture is in balance, it must assume a position parallel to the work surface.

### RUDDER BALANCING PROCEDURE.

- Remove rudder from aircraft in accordance with Section 7.
- Insert hinge bolts in place and position rudder on mandrels with bolts resting on the knife edge.

#### NOTE

Make sure rudder control surface has freedom of movement and does not drag on mandrels and bonding wires do not interfere with movement of control.

- Secure the rudder trim tab in a streamlined position and install associated hardware.
- Locate the position for balancing fixture on the rudder and place balancing beam in position.

#### NOTE

If balancing beam position falls on a rivet line, it will be necessary to move the beam to one side to provide a flat surface for the balancing beam. The balancing beam must be perpendicular to the hinge centerline and the trailing edge of the rudder control surface must be firmly seated in the cutout of the hanger.

- If the rudder assumes position parallel with base of mandrel and the two-ounce weight is within the Green and Yellow range, the rudder is statically balanced.

- If rudder assumes a position of trailing edge up, when balance weight is on aft end of range, rudder is overbalanced and needs weight removed.

#### NOTE

Remove overbalance by using a 1/2 inch drill to remove some of the weight.

- If rudder control surface assumes position of trailing edge down, when balance weight is on forward end of range, rudder surface is underbalanced and needs more balance weight added.

- The approximate amount of weight needed for underbalance may be determined by placing small amounts of loose weight in the balance weight area.
- Additional balance weight may be added by pound-

Figure 16-9. Static Balancing Aileron, Rudder and Elevator (Sheet 2 of 4)



ing lead into existing holes of weight and staking. If holes are not available to insert added weight, it will be necessary to add 2 nutplates on each side of lightening hole and add a lead bar weight secured by two bolts.

#### NOTE

The rudder tip and mounting screws must be installed each time the rudder is checked for balance.

- j. Install rudder in accordance with Section 7.

#### AILERON BALANCING PROCEDURE.

- a. Remove aileron from aircraft in accordance with Section 5. (The outboard hinge is a pin.)
- b. Balance the fixture for aileron control surface.
- c. Insert hinge bolt in place and position aileron on the mandrels with bolt and pin resting on the knife edge.

#### CAUTION

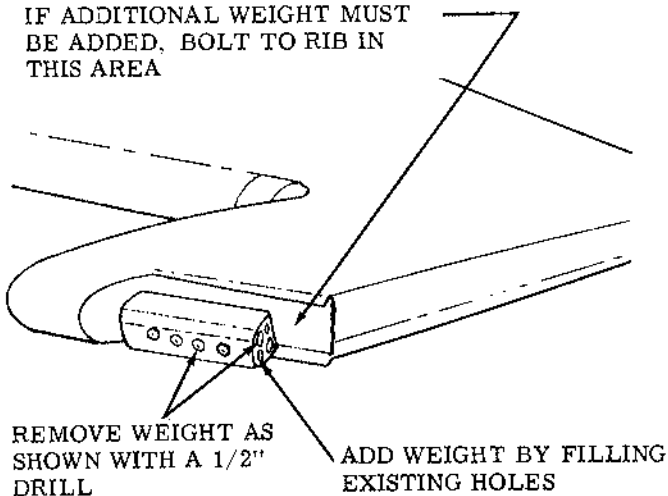
Be sure bolt is inserted in correct hinge location (upper hole).

#### NOTE

Make sure aileron control surface has freedom of movement, does not drag on mandrels and the bonding straps are free.

- d. Secure the trim tab on the left hand aileron in a streamlined position and install associated hardware.
- e. Locate the position for balancing fixture on the aileron and place balancing beam into position.

IF ADDITIONAL WEIGHT MUST BE ADDED, BOLT TO RIB IN THIS AREA



RUDDER BALANCE WEIGHT

#### NOTE

If balancing beam position falls on a rivet line, it will be necessary to move the beam to one side to provide a flat surface for the balancing beam. The balancing beam must be perpendicular to the hinge centerline and trailing edge of the aileron control surface must be firmly seated in the cutout of the hanger.

- f. If the aileron assumes a position parallel with base of mandrel and the two-ounce weight is within Green range, the aileron is statically balanced.
- g. If aileron assumes a position of trailing edge up, when balance weight is on aft end of range, the aileron is overbalanced and needs weight removed.

#### NOTE

Remove overbalance by removing weight as necessary.

- h. If the aileron assumes position of trailing edge down, when balance weight is on forward end of range, aileron is underbalanced and needs more balance weight added.
- i. The approximate amount of weight needed for underbalance may be determined by placing small amounts of loose weight in the balance weight area.
- j. Addition of balance weight may be added by inserting lead into existing holes of the weight. If holes are not available additional weight may be added by removing existing screws and installing longer screws to attach added weight.

#### NOTE

The aileron balance weight must be removed from the aileron in order to remove excess weight.

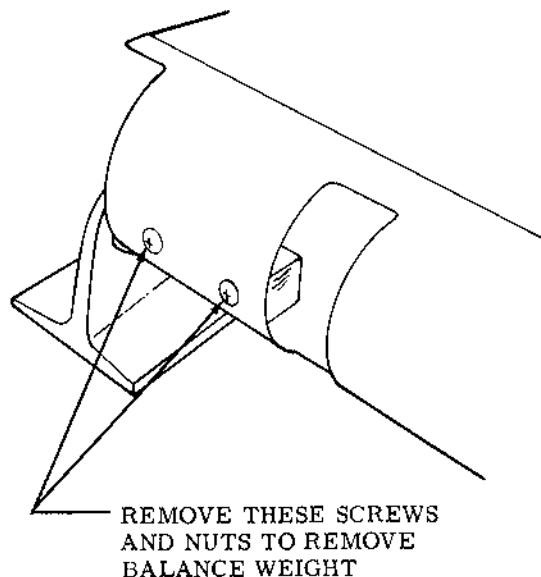


Figure 16-9. Static Balancing Aileron, Rudder and Elevator (Sheet 3 of 4)

**CAUTION**

Make certain bolts securing weight in place are tight before installing aileron on aircraft.

- k. Install aileron in accordance with Section 5.

**ELEVATOR BALANCING PROCEDURE.**

- a. Remove elevator in accordance with Section 6.
- b. Balance the fixture for elevator control surface.
- c. Insert hinge bolts in place and position elevator on the mandrels with bolts resting on the knife edge.

**NOTE**

Make sure elevator control surface has freedom of movement, does not drag on mandrels and bonding straps are free.

- d. Secure the elevator trim tab on left hand elevator in a streamlined position and install associated hardware.
- e. Locate the position for balancing fixture on the elevator and place balancing beam into position.

**NOTE**

If balancing beam position falls on a rivet line it will be necessary to move the beam to one side to provide a flat surface for the balancing beam. The balancing beam must be perpendicular to the hinge centerline and trailing edge of the aileron control surface must be firmly seated in the cutout of the hanger.

- f. If the elevator assumes a position parallel with base of mandrel, and the two-ounce weight is within the Green and Yellow range, the elevator is statically balanced.

- g. If the elevator assumes a position of trailing edge up, when balance weight is on aft end of range, elevator is overbalanced and needs weight removed.

**NOTE**

Remove overbalance by using a 1/2 inch drill to remove some of the weight.

- h. If the elevator assumes position of trailing edge down, when balance weight is on forward end of range, elevator is underbalanced and needs more balance weight added.

- i. The approximate amount of weight needed for underbalance may be determined by placing small amounts of loose weight in the balance weight area.

- j. Additional balance weight may be added by inserting lead in existing holes of the weight. If holes are not available, additional weight may be added by bolting a lead bar in the center of existing weight.

**NOTE**

Each time the elevator is checked for weight and balance, the elevator tip must be installed and elevator tip screws must be in the proper location (short screws toward aft end of elevator).

- k. Install elevator in accordance with Section 6.

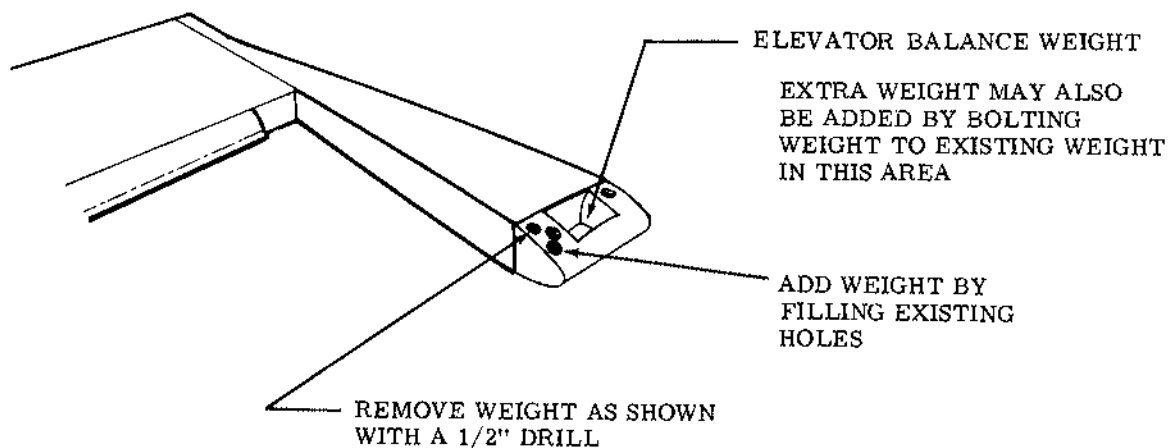


Figure 16-9. Static Balancing Aileron, Rudder and Elevator (Sheet 4 of 4)

- |                              |                               |
|------------------------------|-------------------------------|
| 1. FIBERGLASS                | 7. .040 INCH 2024 T42 ALCLAD  |
| 2. .016 INCH 2024 T3 ALCLAD  | 8. .020 INCH 2024 T3 ALCLAD   |
| 3. .025 INCH 2024 T3 ALCLAD  | 9. .040 INCH 2024 T3 ALCLAD   |
| 4. .025 INCH 2024 T42 ALCLAD | 10. HONEYCOMB                 |
| 5. .032 INCH 2024 T3 ALCLAD  | 11. .020 INCH 2024 T42 ALCLAD |
| 6. .032 INCH 2024 T42 ALCLAD |                               |

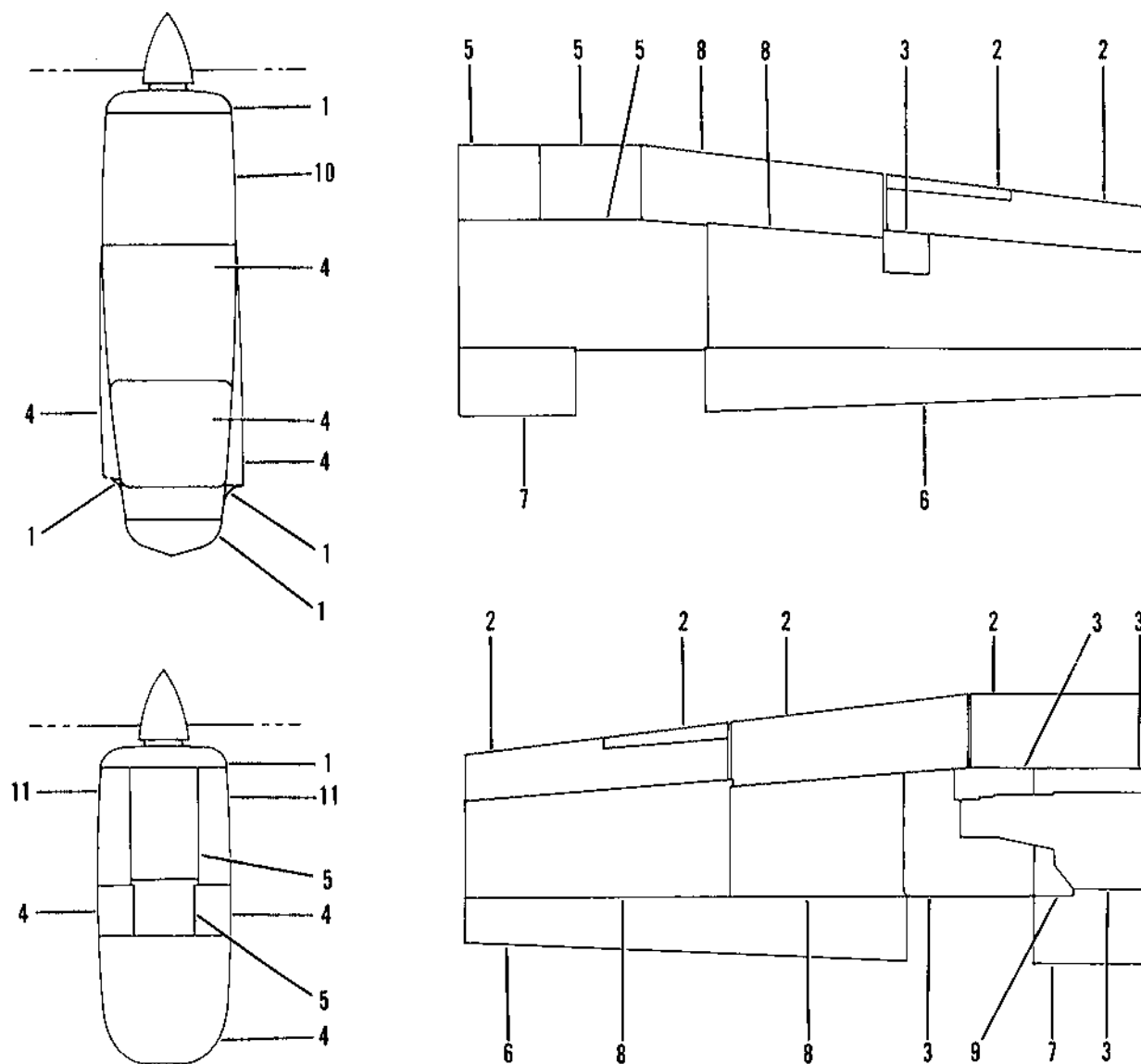


Figure 16-10. Wing Skin

- |                              |                               |
|------------------------------|-------------------------------|
| 1. .016 INCH 2024 T3 ALCLAD  | 6. .040 INCH 2024 T3 ALCLAD   |
| 2. .025 INCH 2024 T42 ALCLAD | 7. FIBERGLASS                 |
| 3. .032 INCH 2024 T3 ALCLAD  | 8. .050 INCH 2024 T42 ALCLAD  |
| 4. .032 INCH 2024 T4 ALCLAD  | 9. .063 INCH 2024 T42 ALCLAD  |
| 5. .032 INCH 2024 T42 ALCLAD | 10. .080 INCH 2024 T42 ALCLAD |

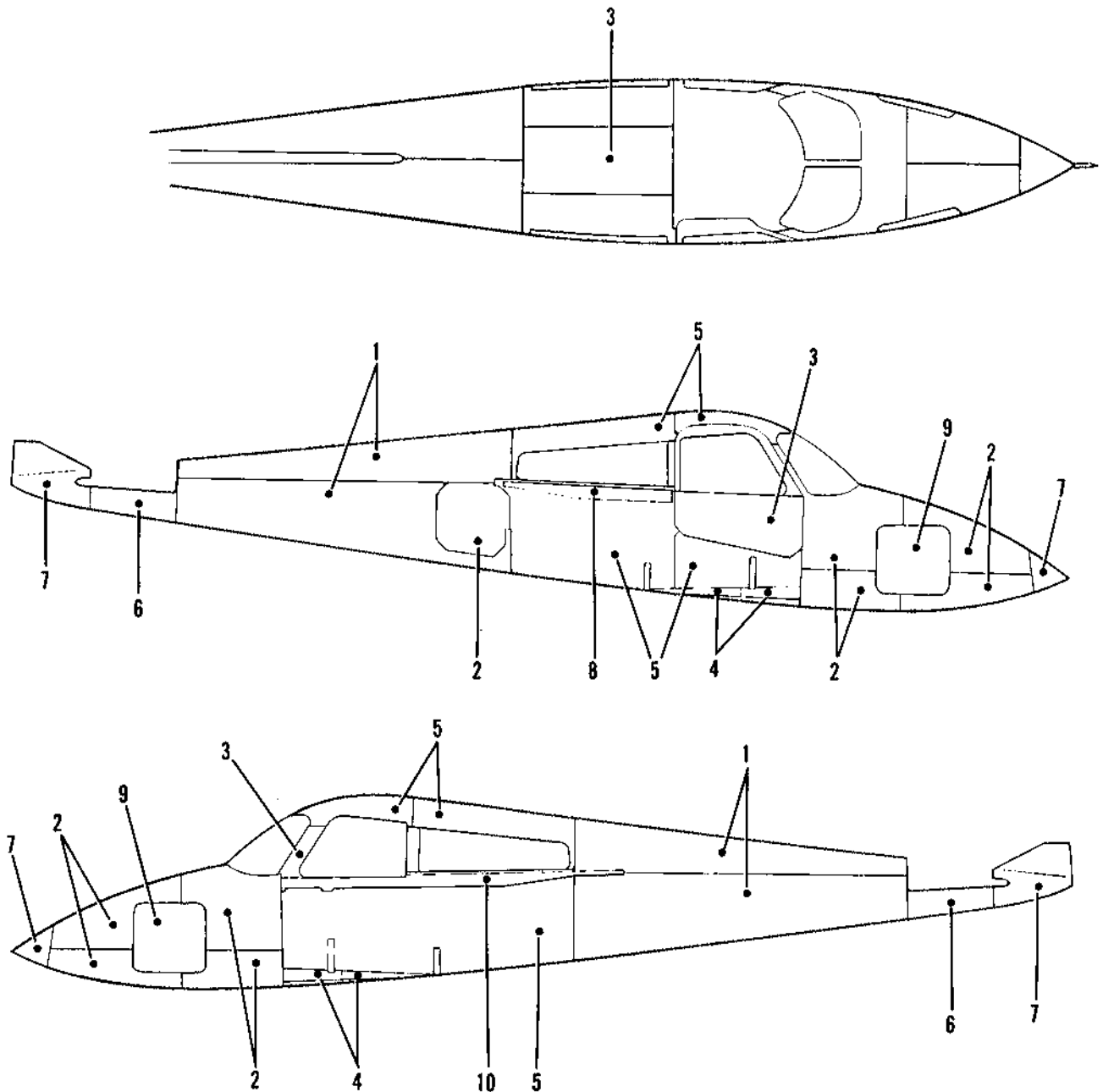
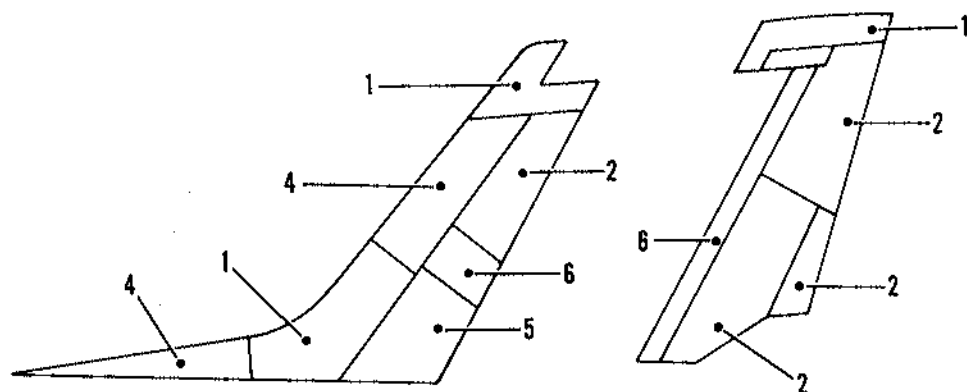
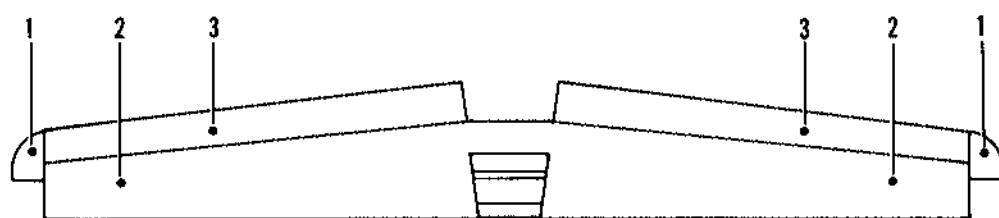


Figure 16-11. Fuselage Skin

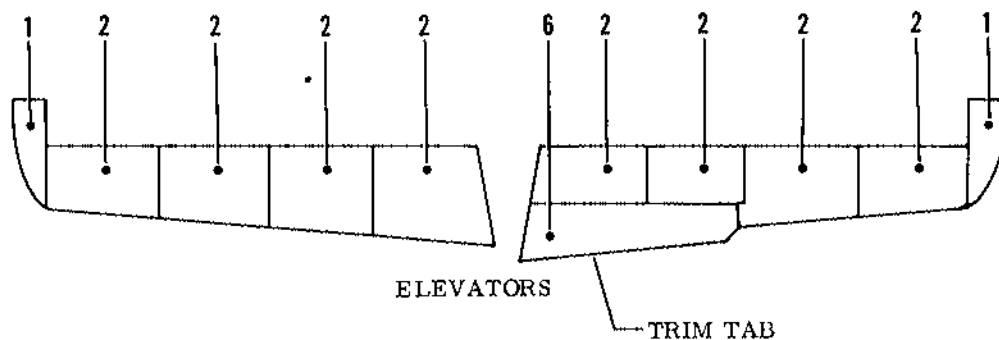
1. FIBERGLASS
2. .016 INCH 2024 T3 ALCLAD
3. .025 INCH 2024 T3 ALCLAD
4. .025 INCH 2024 T42 ALCLAD
5. .032 INCH 2024 T3 ALCLAD
6. .020 INCH 2024 T3 ALCLAD



VERTICAL FIN AND RUDDER



HORIZONTAL STABILIZER



ELEVATORS

TRIM TAB

Figure 16-12. Empennage Skin

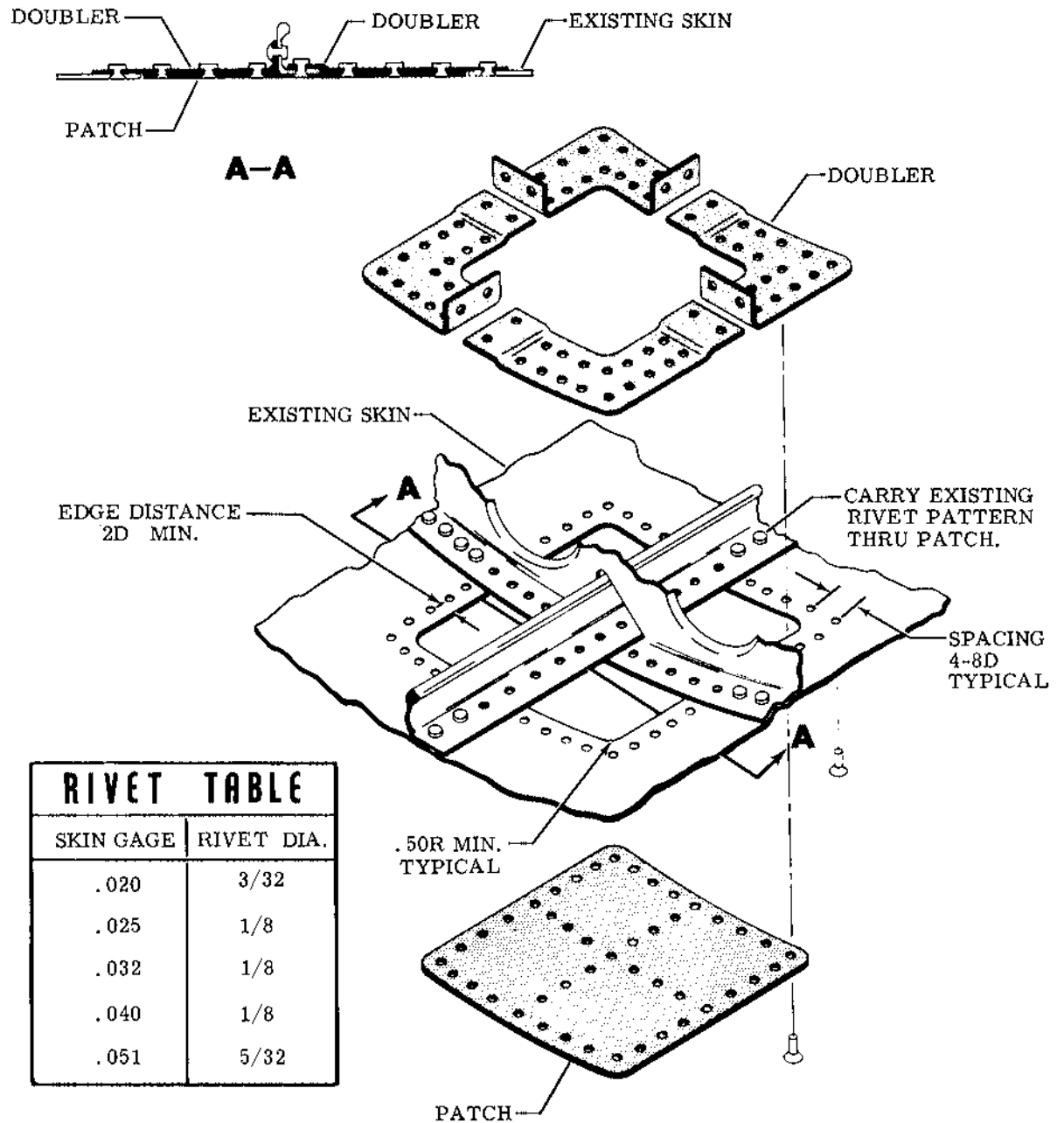


Figure 16-13. Typical Over-Structure Skin Repair (Sheet 1 of 2)

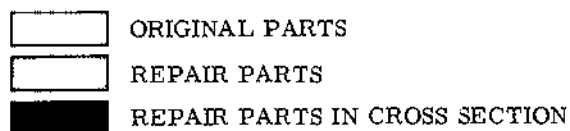
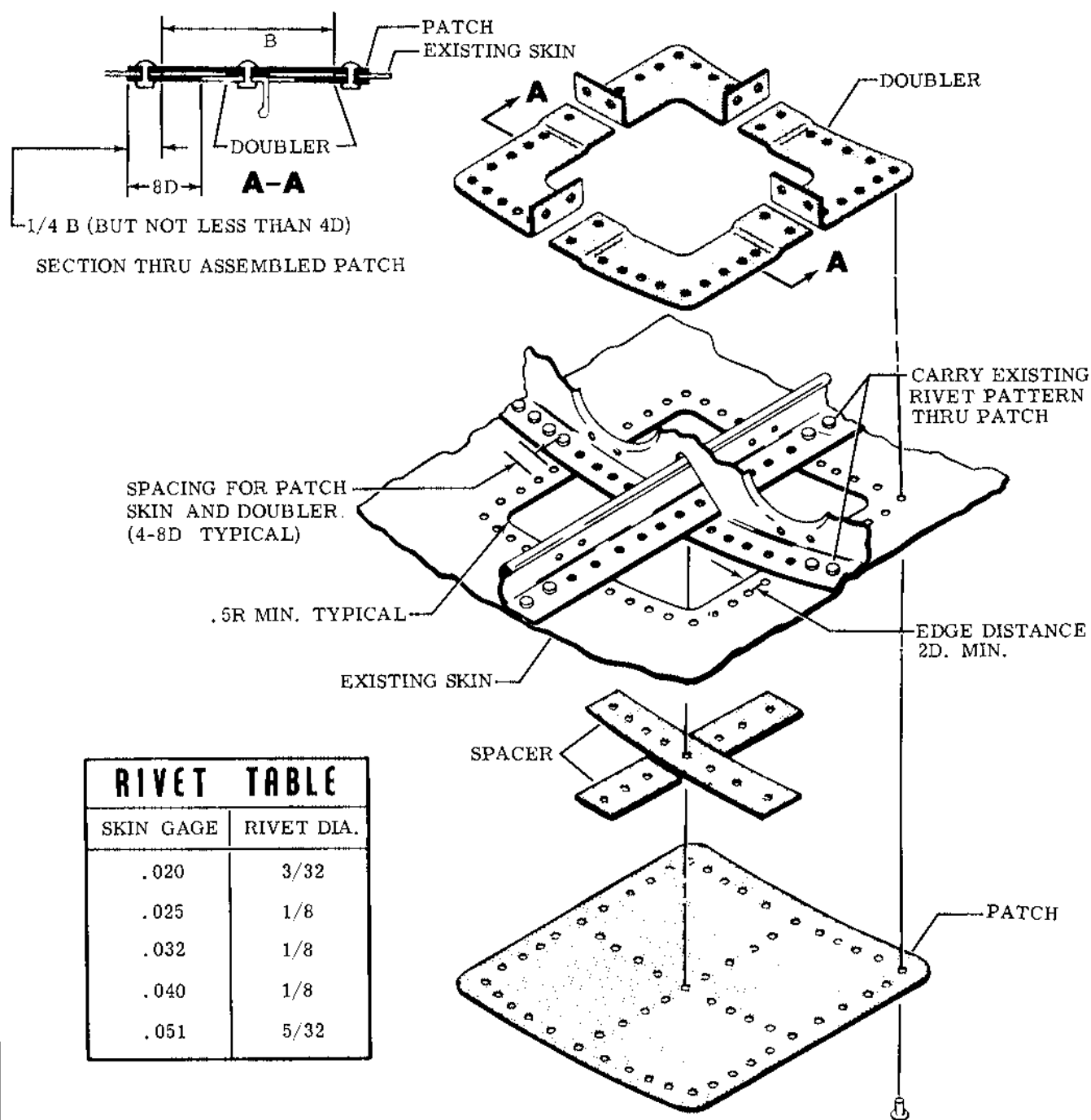
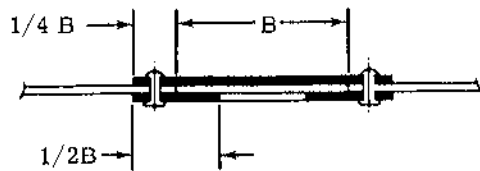
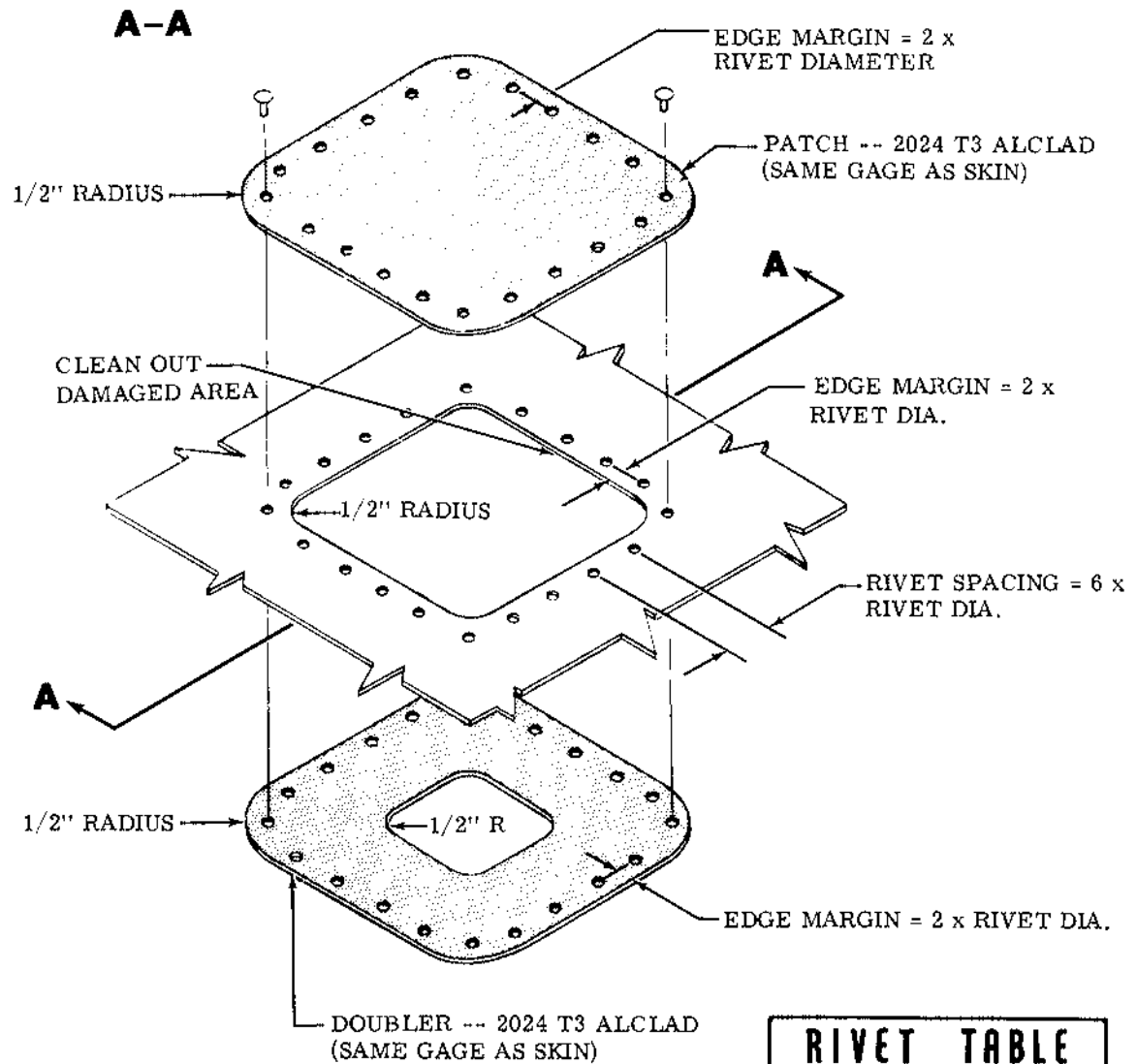


Figure 16-13. Typical Over-Structure Skin Repair (Sheet 2 of 2)



SECTION THRU ASSEMBLED PATCH



- ORIGINAL PARTS
- REPAIR PARTS
- REPAIR PARTS IN CROSS SECTION

| RIVET TABLE |            |
|-------------|------------|
| SKIN GAGE   | RIVET DIA. |
| .020        | 3/32       |
| .025        | 1/8        |
| .032        | 1/8        |
| .040        | 1/8        |
| .051        | 5/32       |

Figure 16-14. Typical Clear-of-Structure Skin Repair



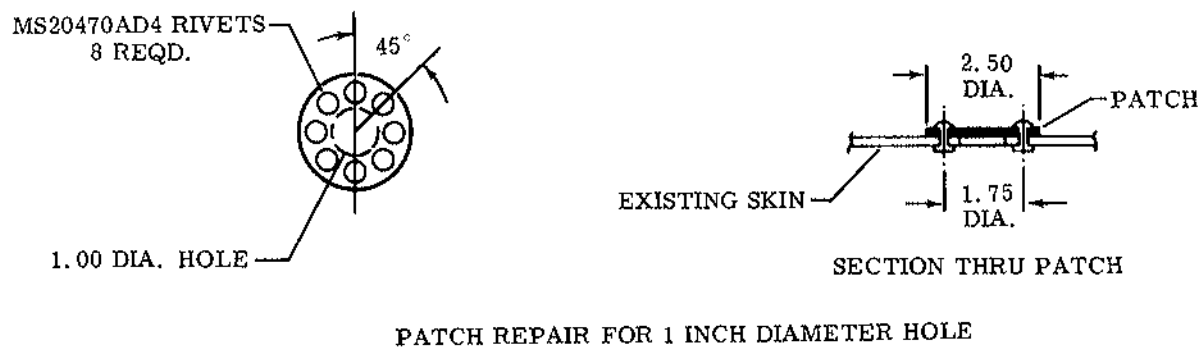
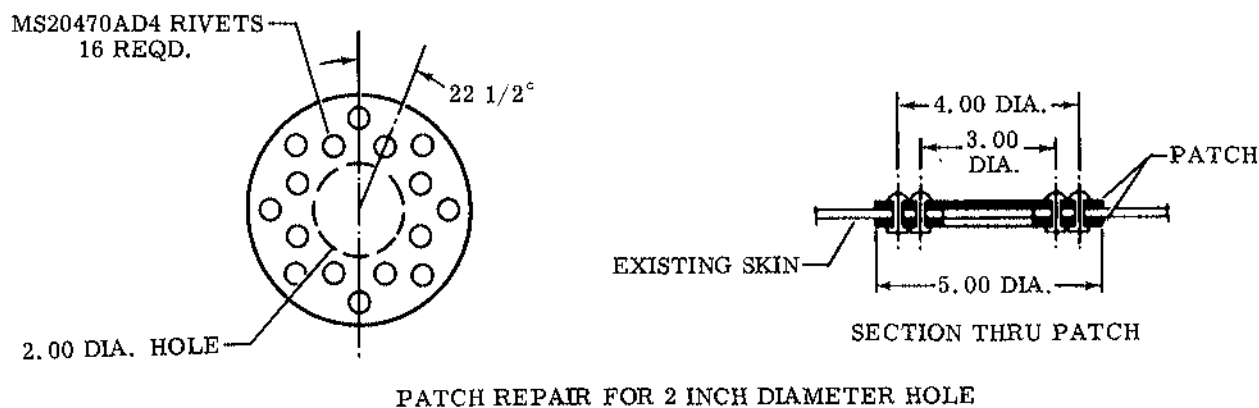
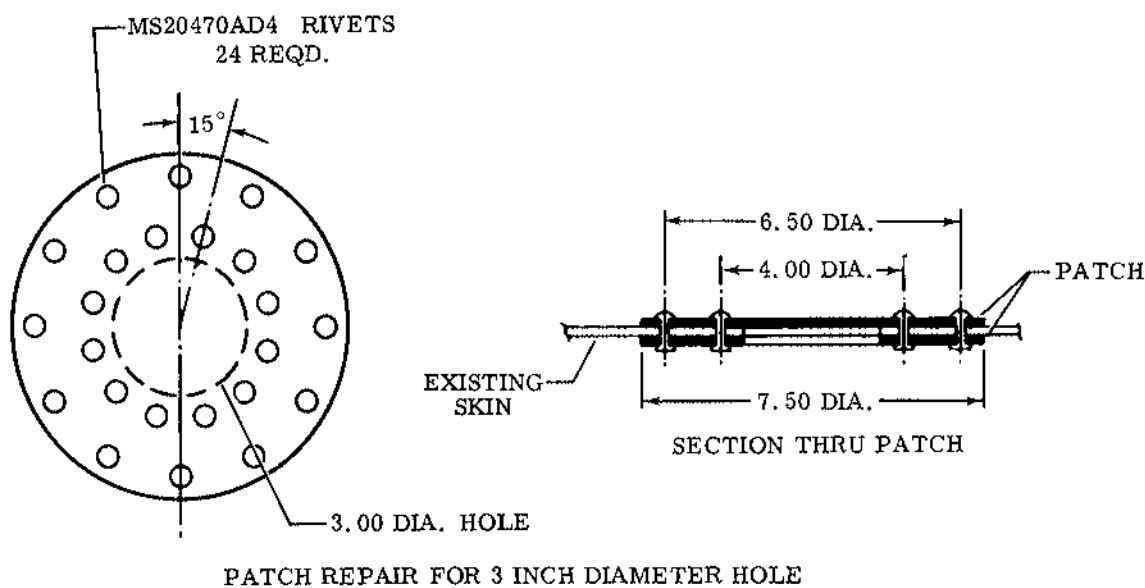
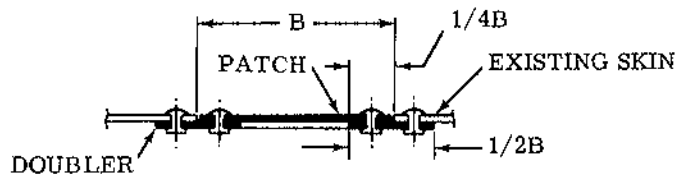


Figure 16-15. Typical Patch Repair of Circular Holes



SECTION THRU ASSEMBLED PATCH

**A-A**

| RIVET TABLE |            |
|-------------|------------|
| SKIN GAGE   | RIVET DIA. |
| .020        | 3/32       |
| .025        | 1/8        |
| .032        | 1/8        |
| .040        | 1/8        |
| .051        | 5/32       |

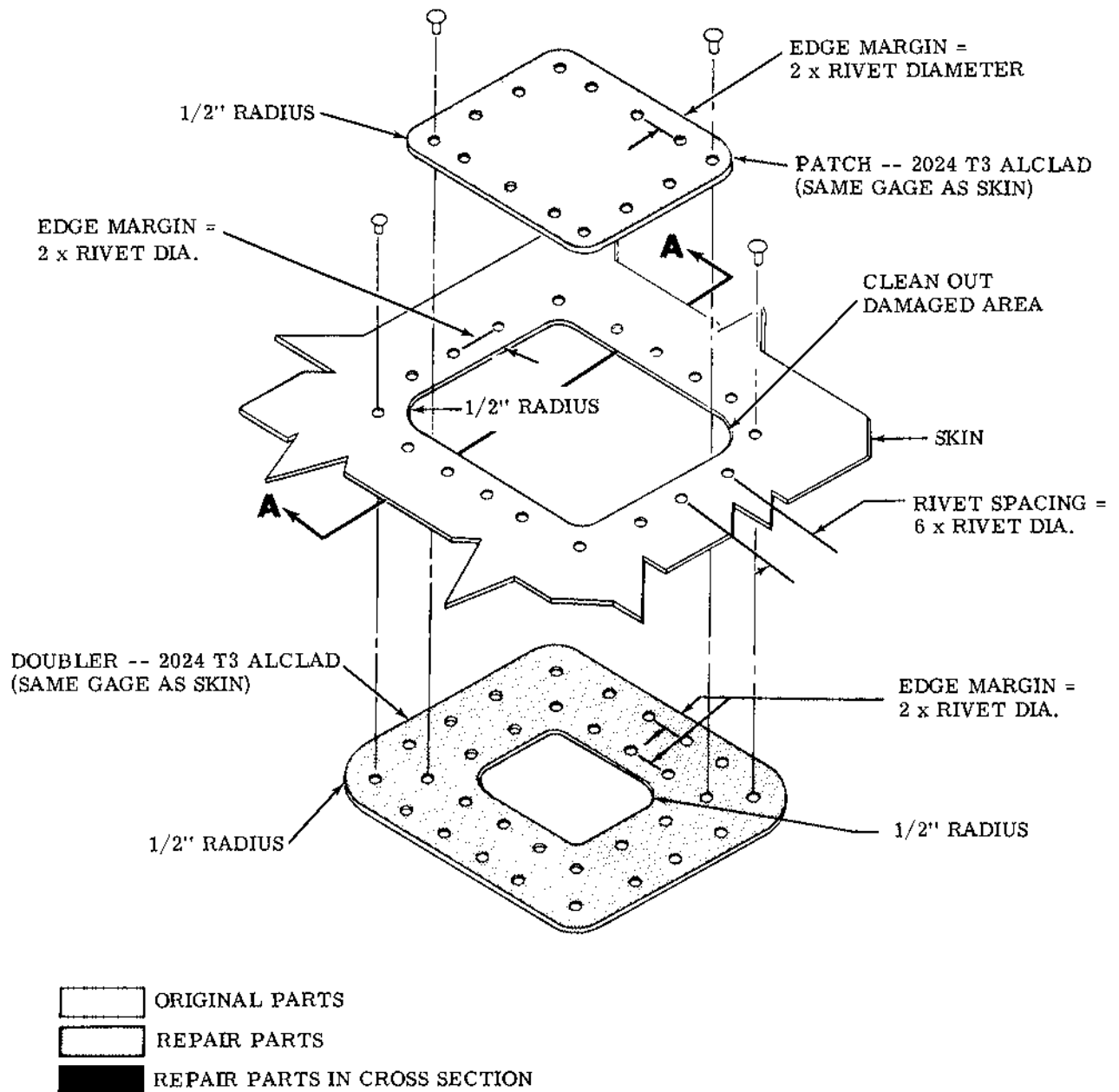


Figure 16-16. Typical Insert Patch

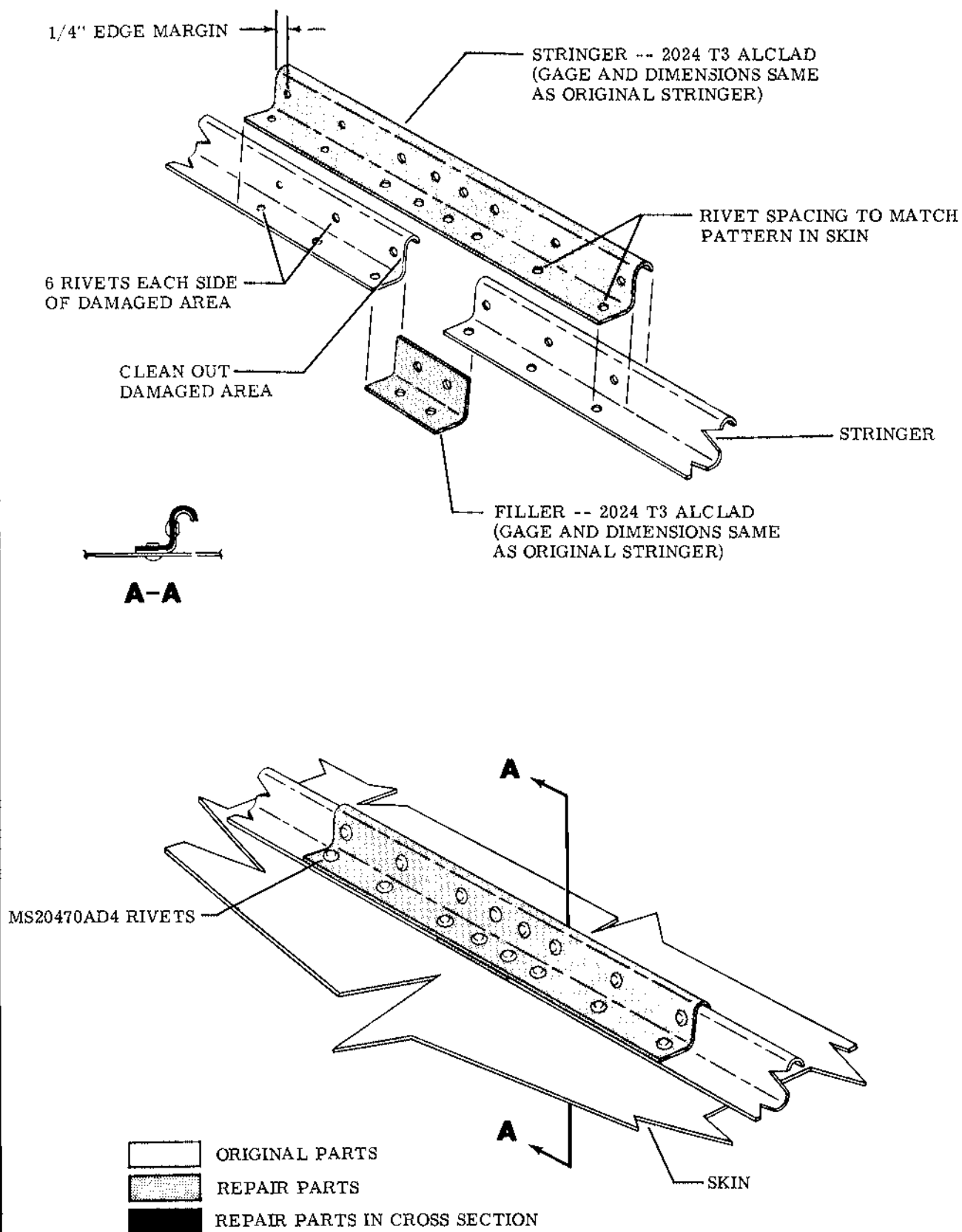


Figure 16-17. Typical Fuselage Stringer Repair (Sheet 1 of 2)

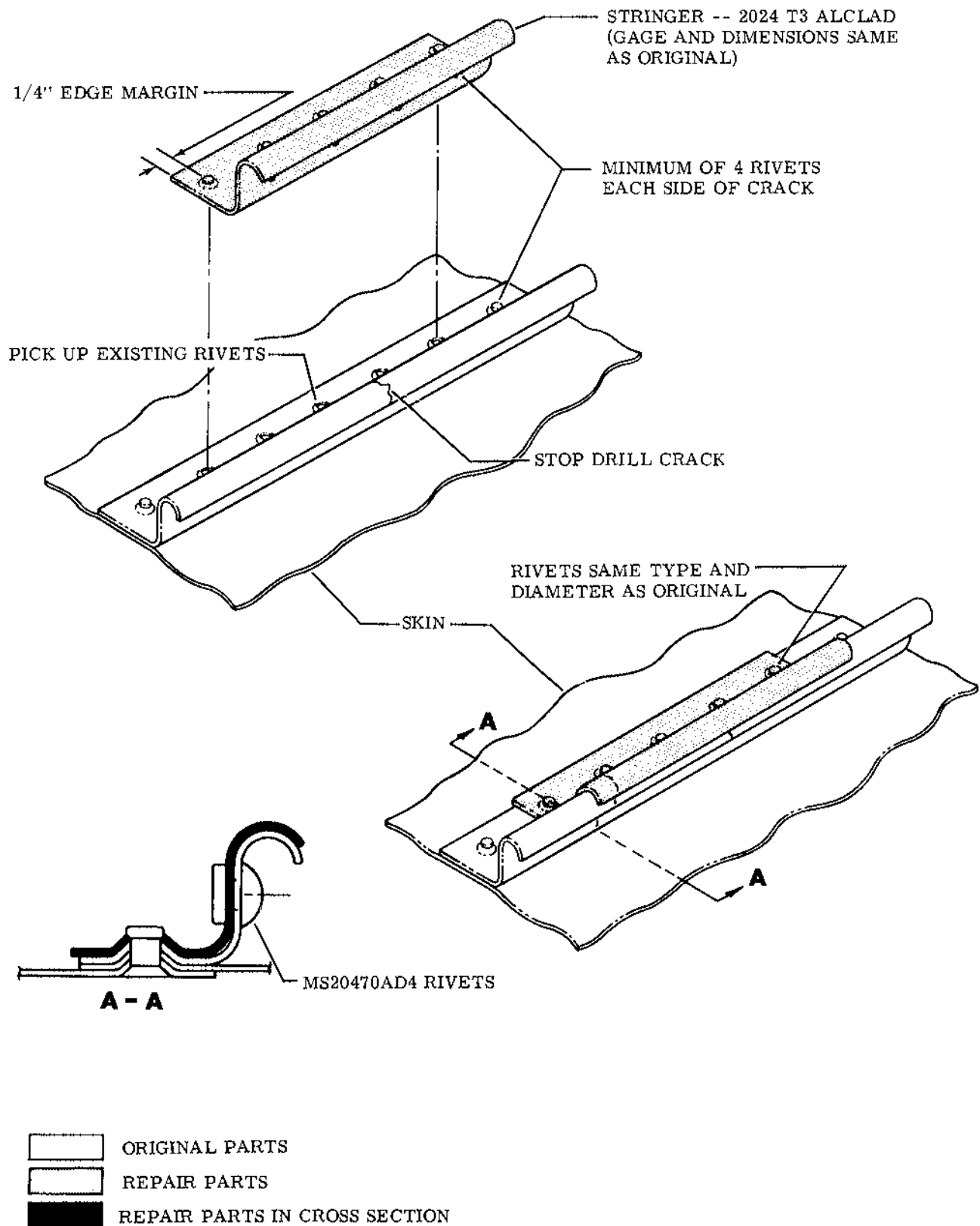


Figure 16-17. Typical Fuselage Stringer Repair (Sheet 2 of 2)

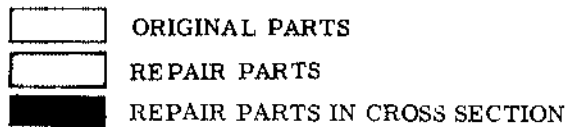
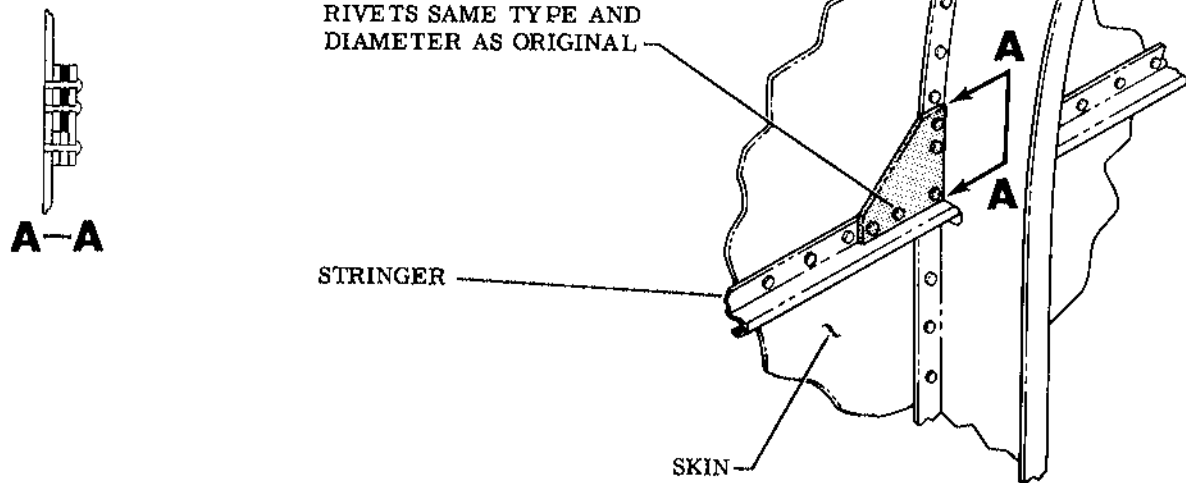
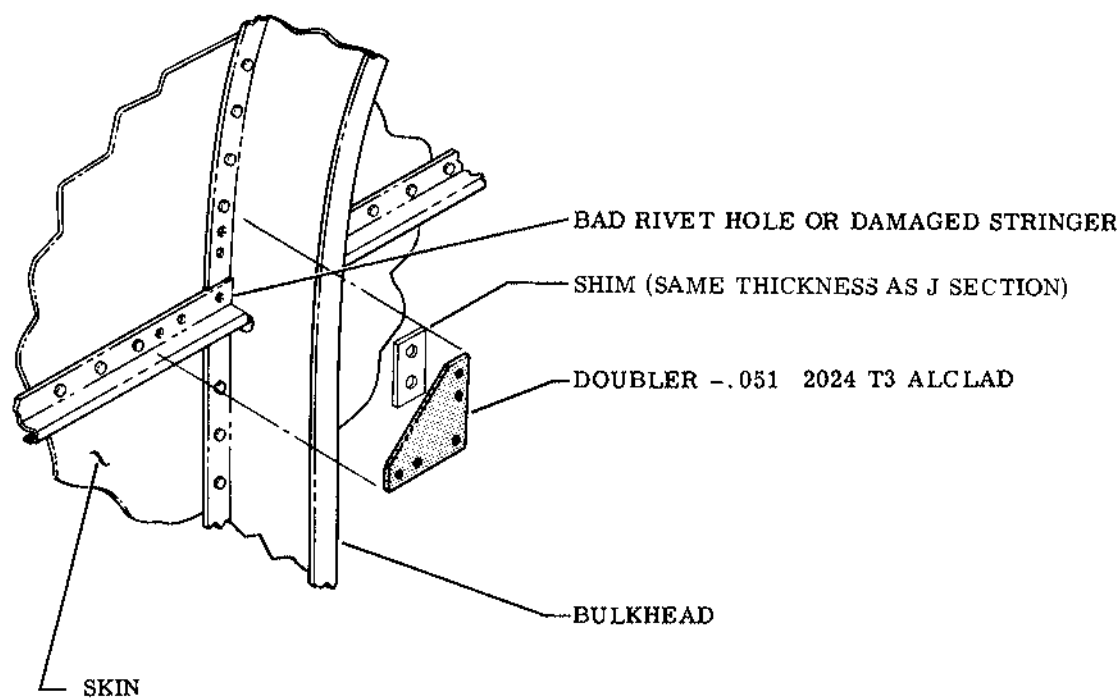


Figure 16-18. Typical Stringer to Bulkhead Repair

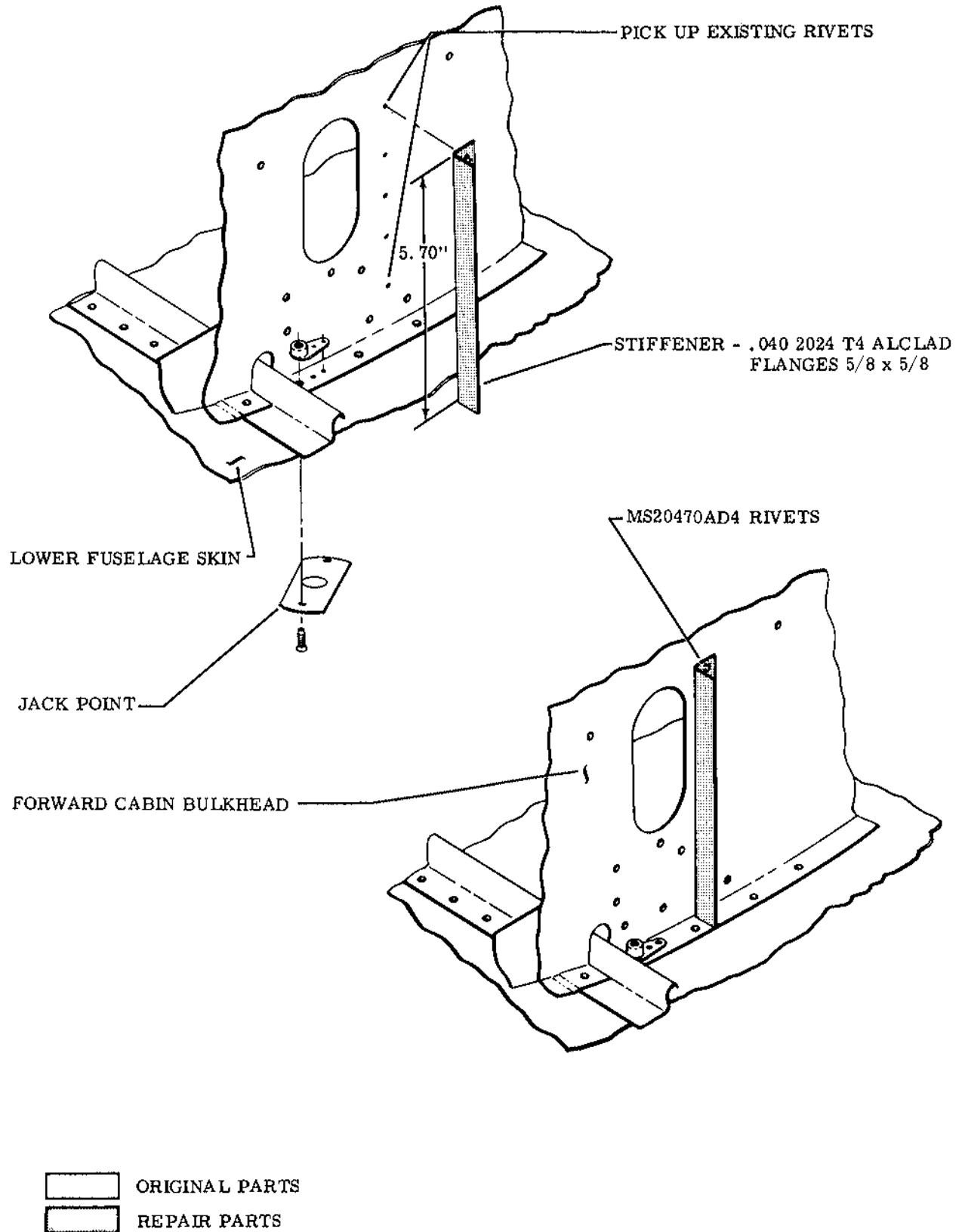


Figure 16-19. Typical Jacking Point Reinforcement (Sheet 1 of 2)

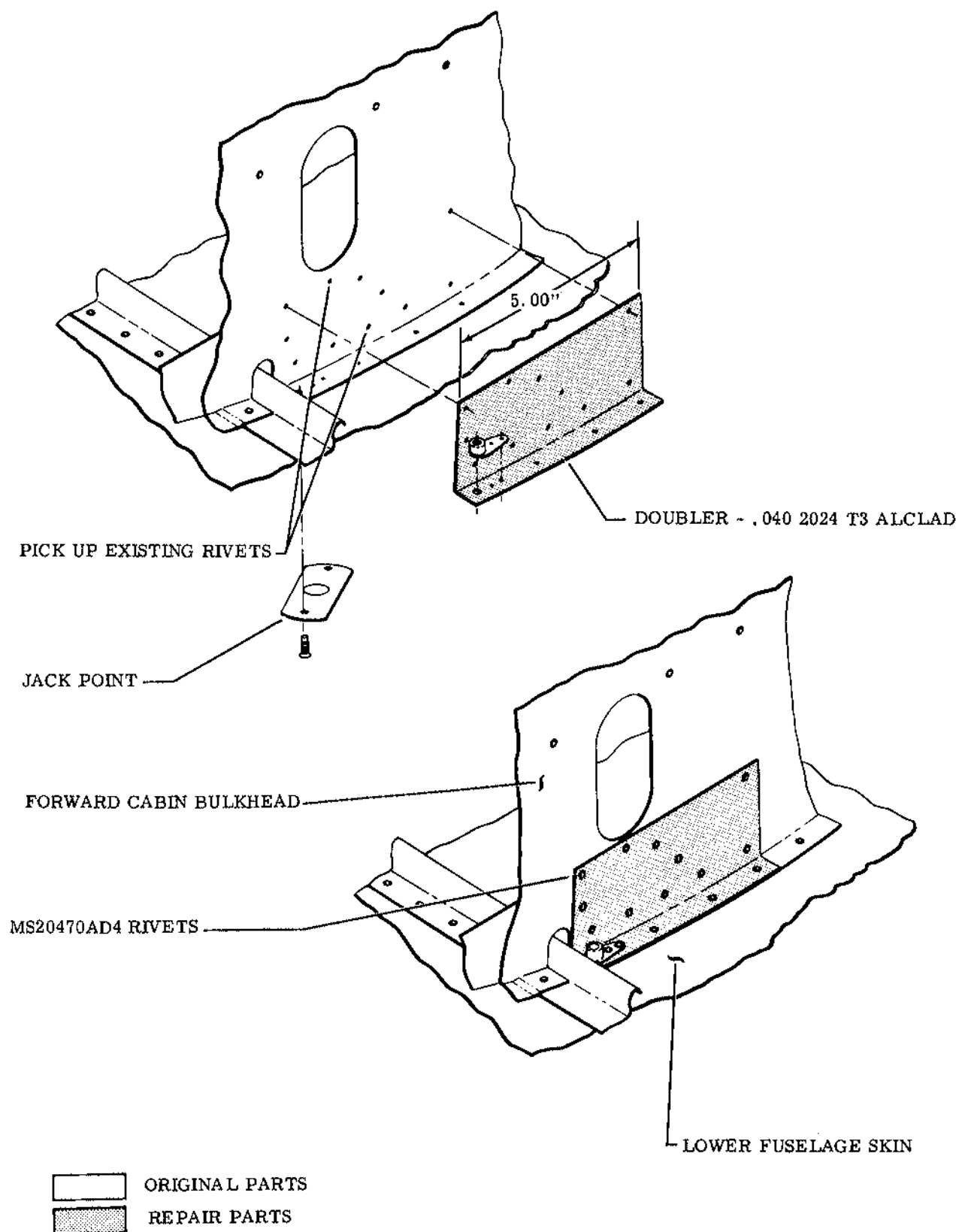


Figure 16-19. Typical Jacking Point Reinforcement (Sheet 2 of 2)

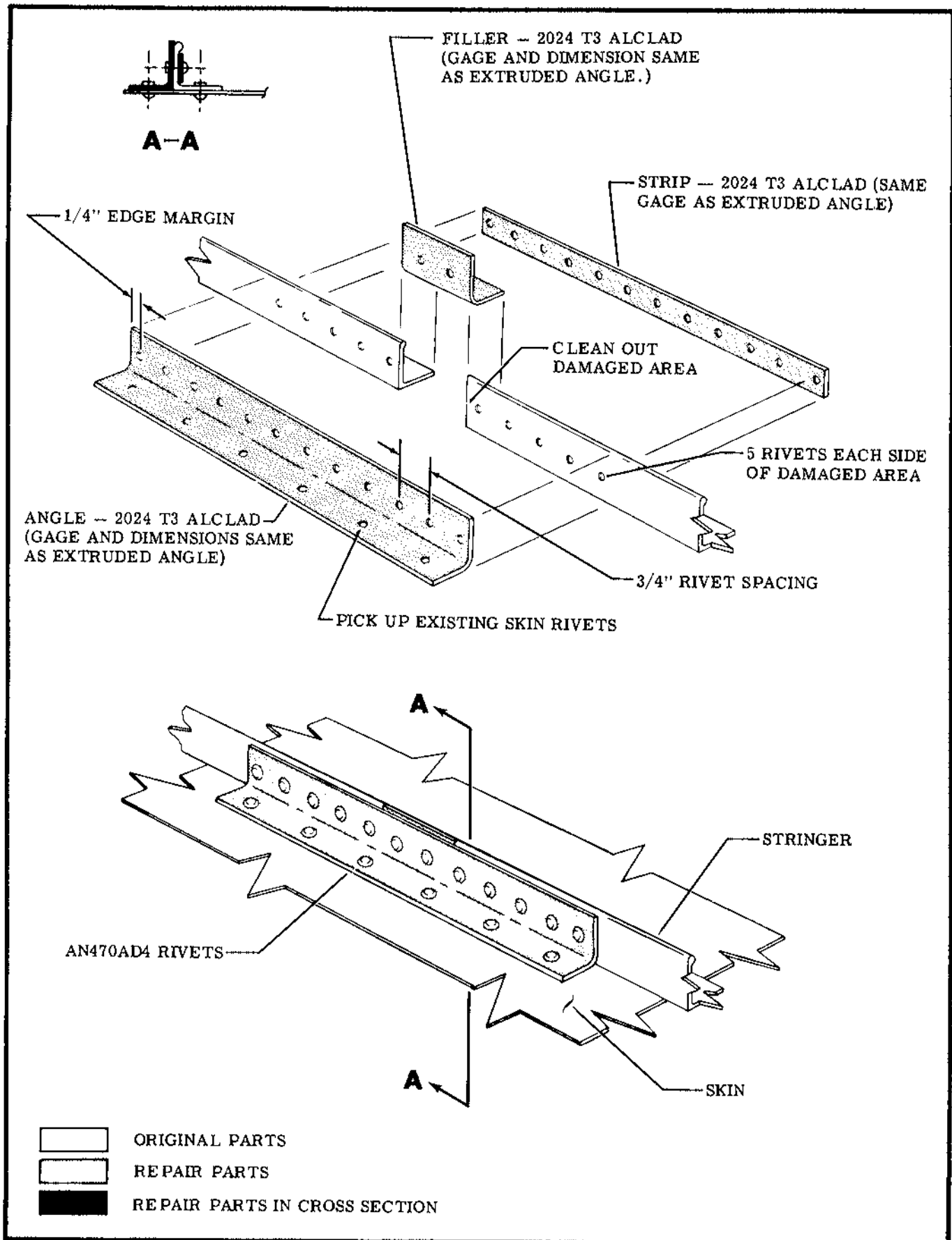


Figure 16-20. Typical Stringer Repair



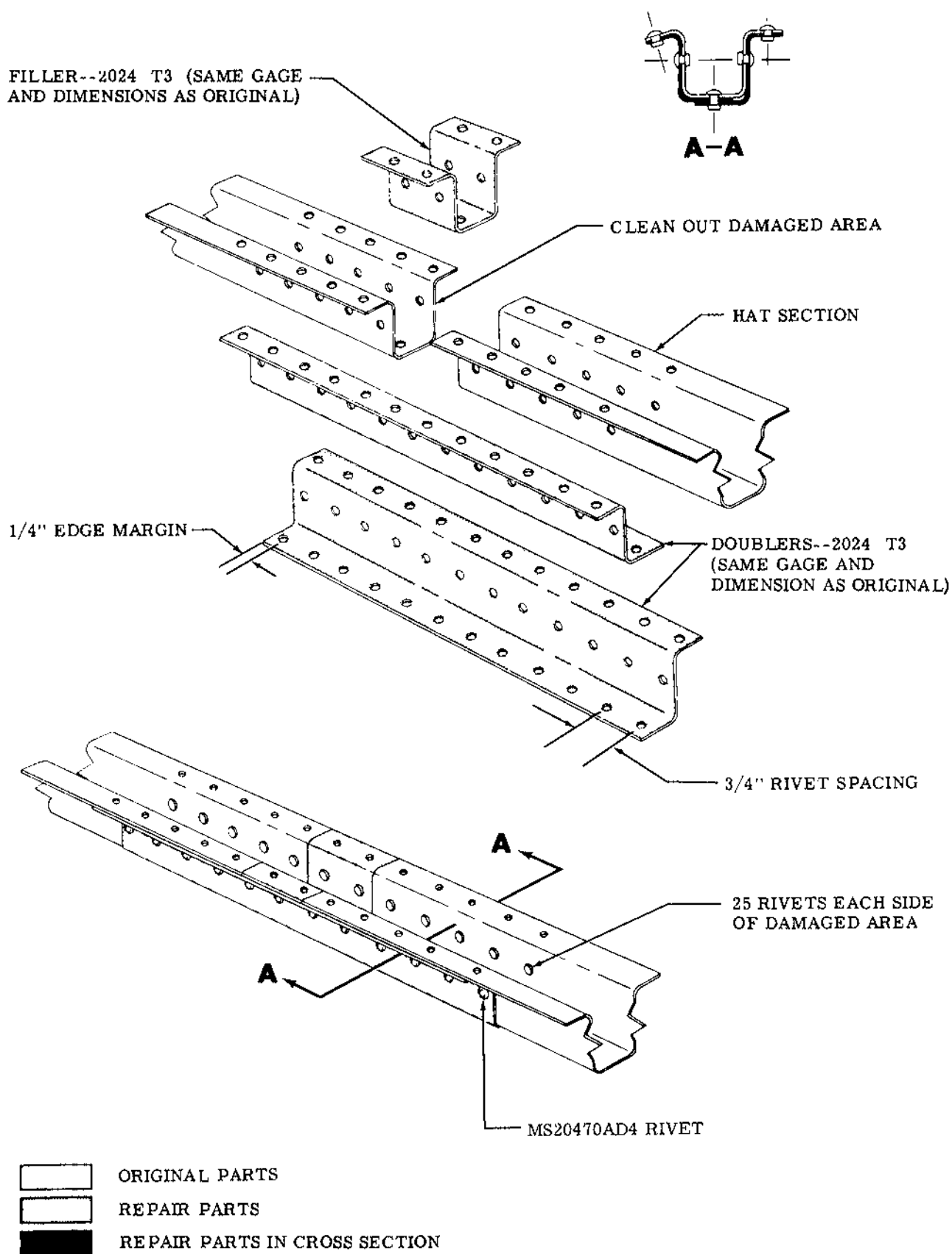


Figure 16-21. Typical Hat Section Repair

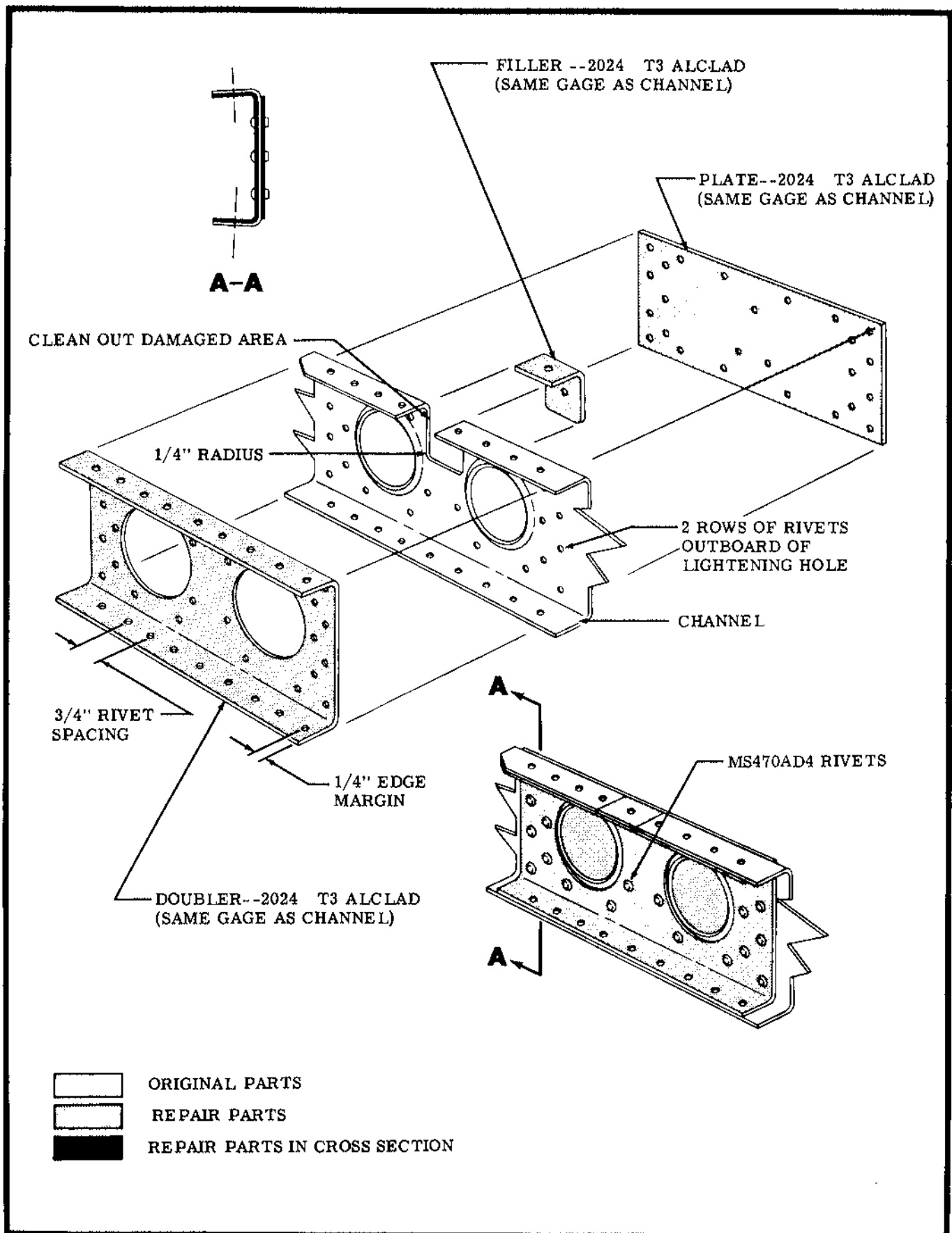


Figure 16-22. Typical Channel Flange Repair

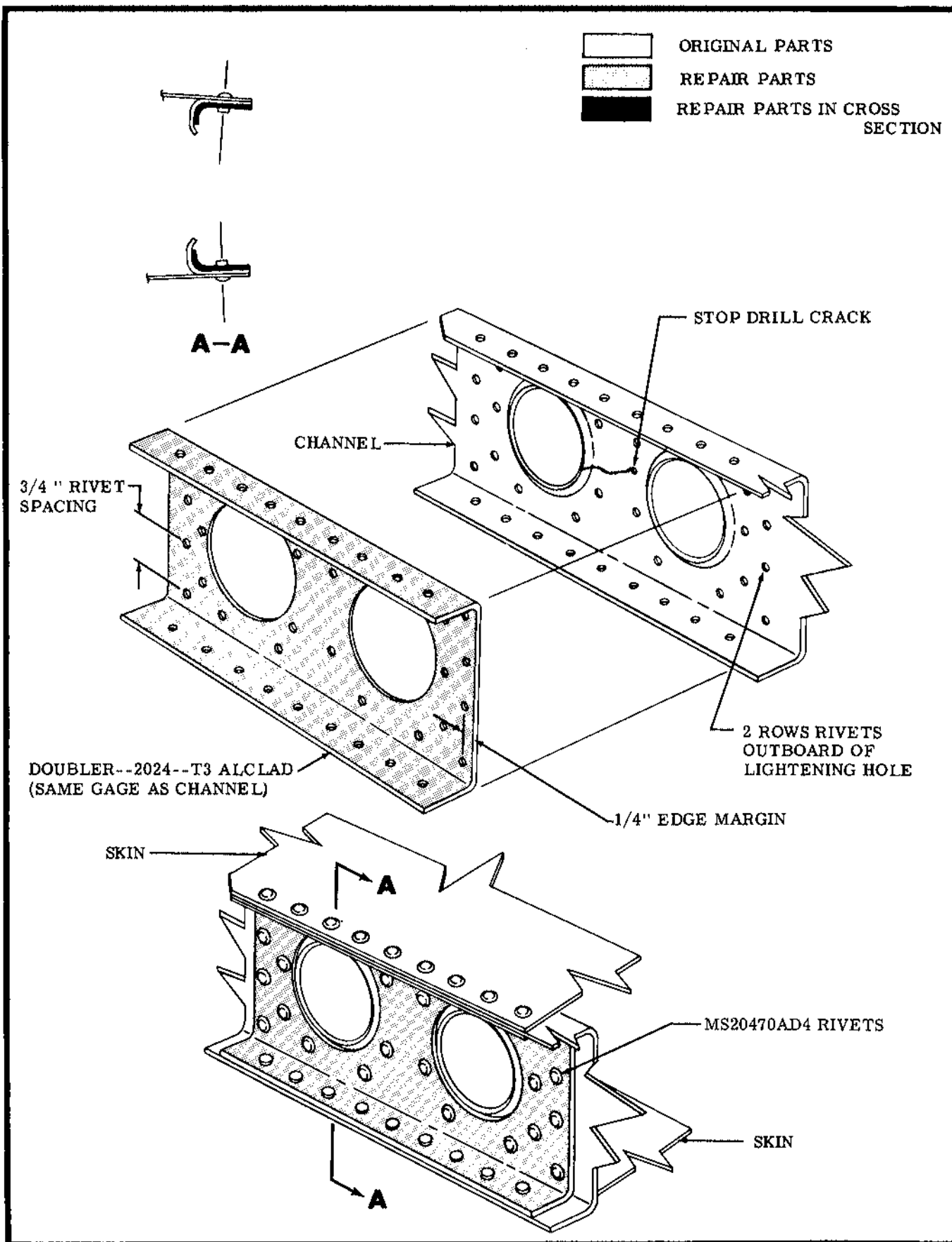


Figure 16-23. Typical Channel Repair

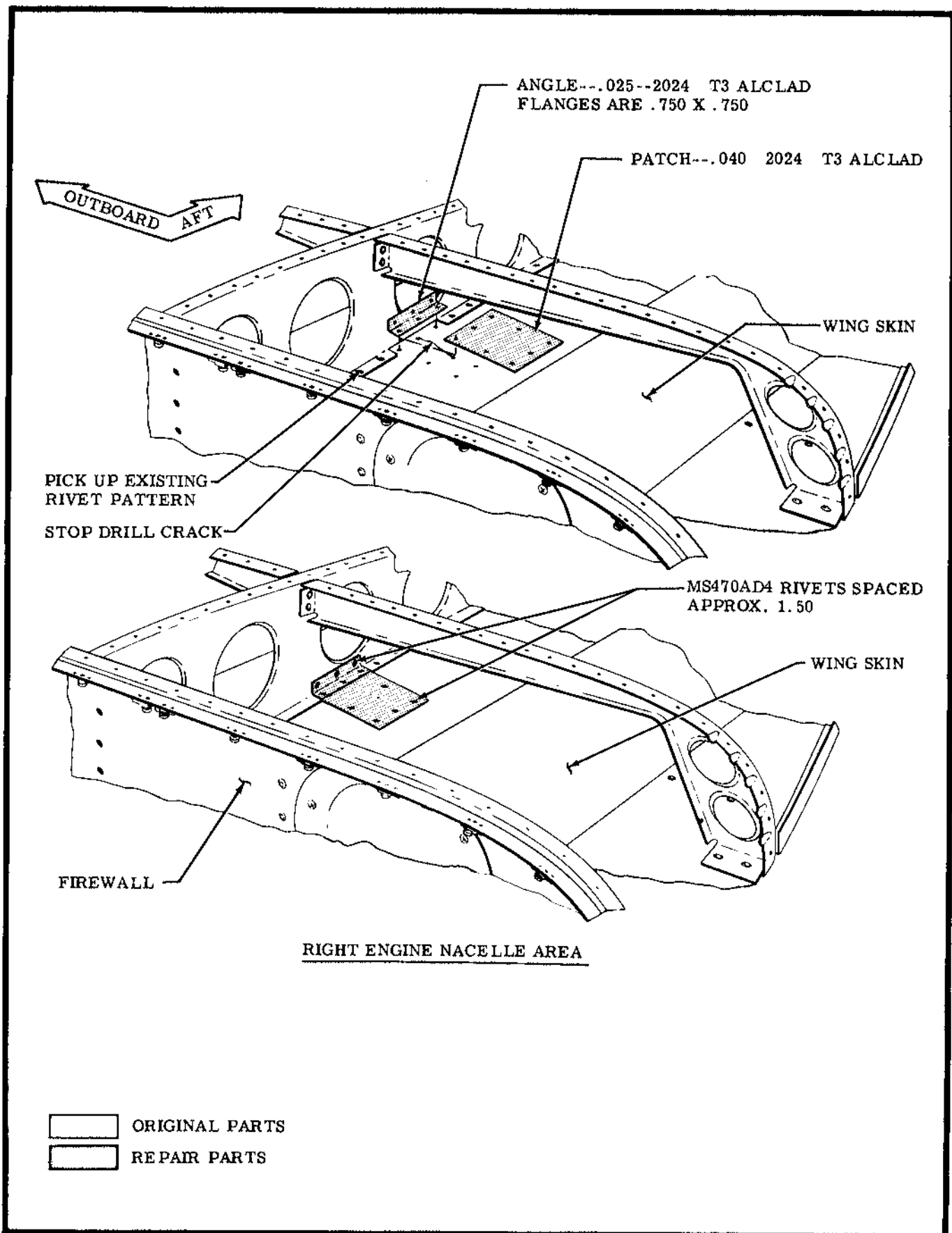
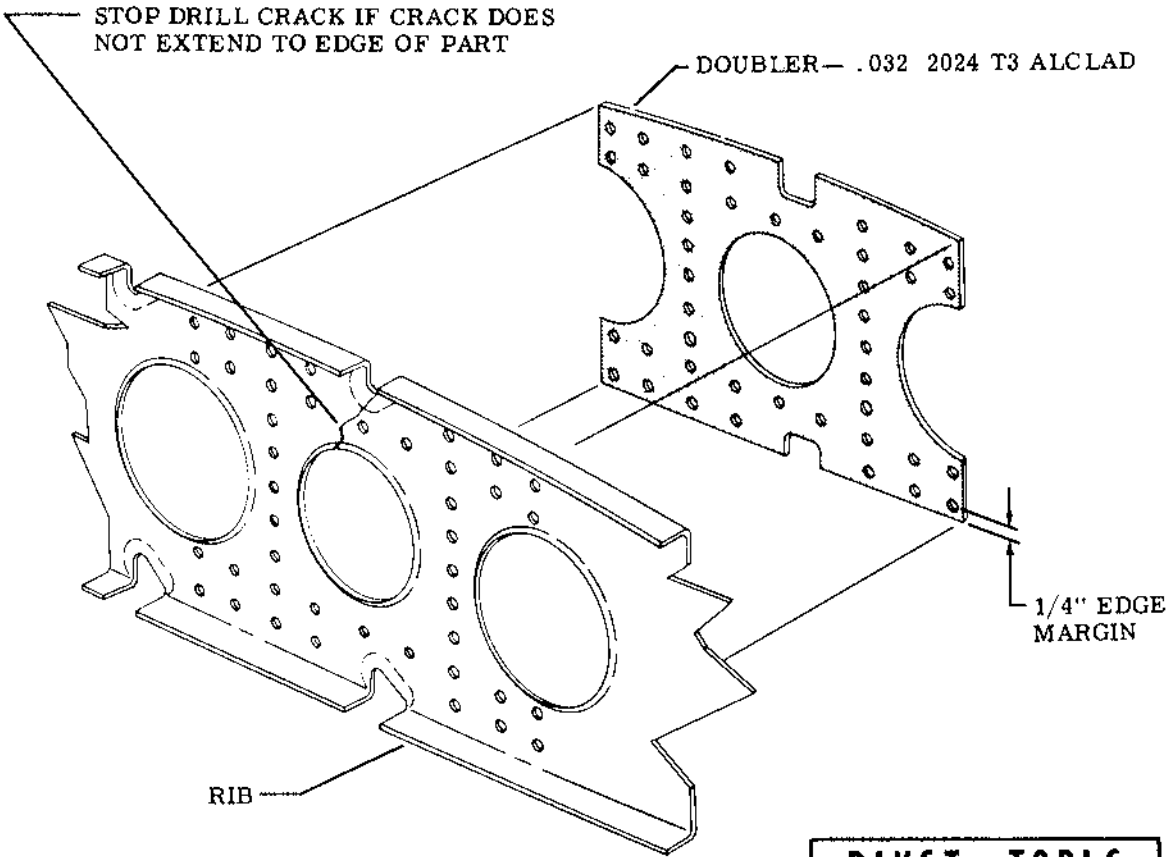
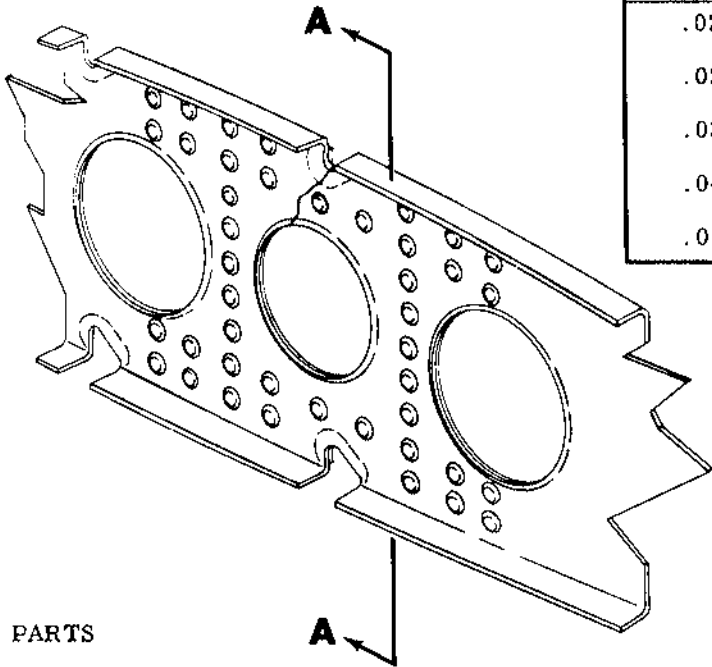


Figure 16-24. Typical Wing Skin Repair - Nacelle Area



| RIVET TABLE |            |
|-------------|------------|
| SKIN GAGE   | RIVET DIA. |
| .020        | 3/32       |
| .025        | 1/8        |
| .032        | 1/8        |
| .040        | 1/8        |
| .051        | 5/32       |



- ORIGINAL PARTS
- REPAIR PARTS
- REPAIR PARTS IN CROSS SECTION

Figure 16-25. Typical Rib Web Repair

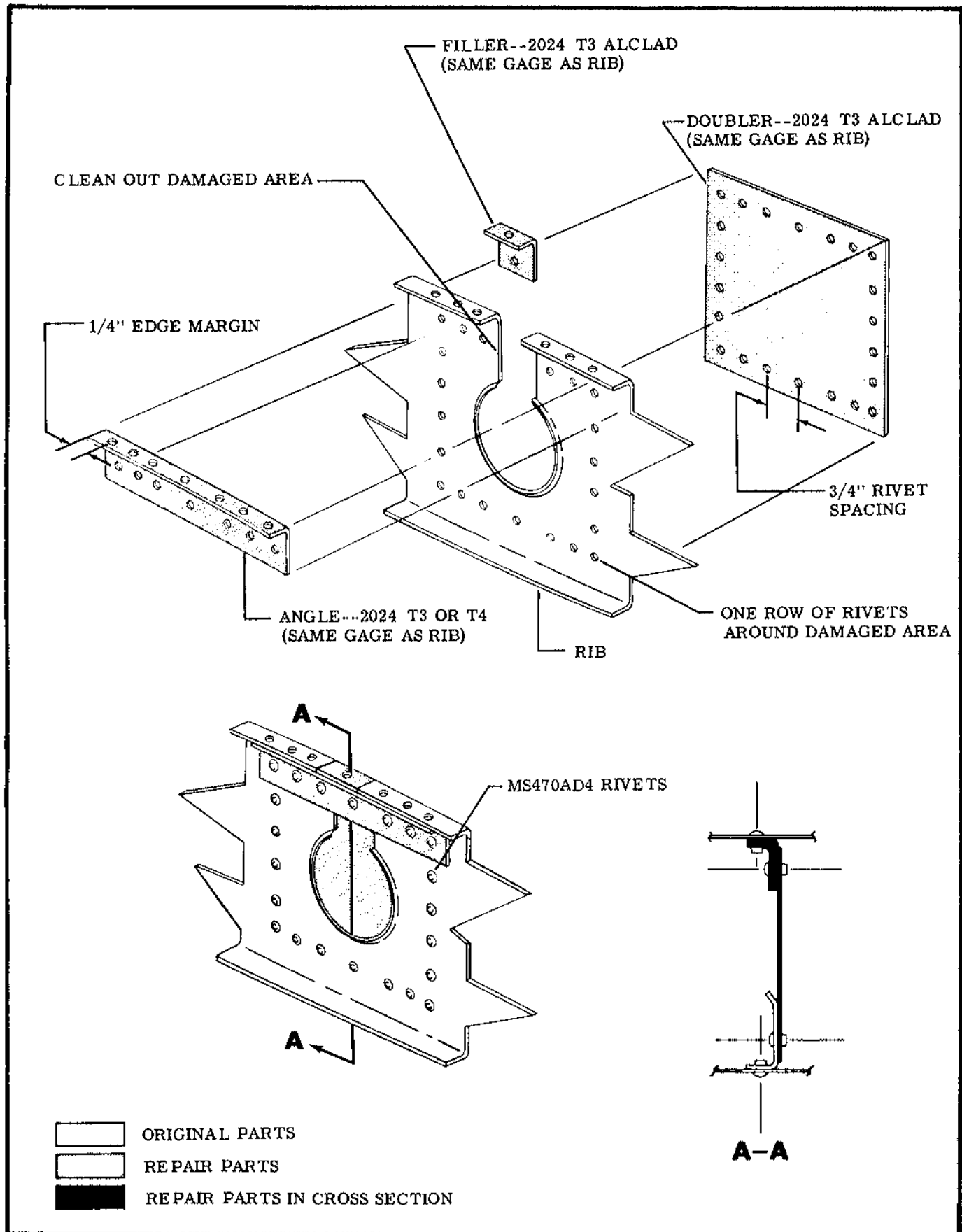


Figure 16-26. Typical Rib Flange Repair

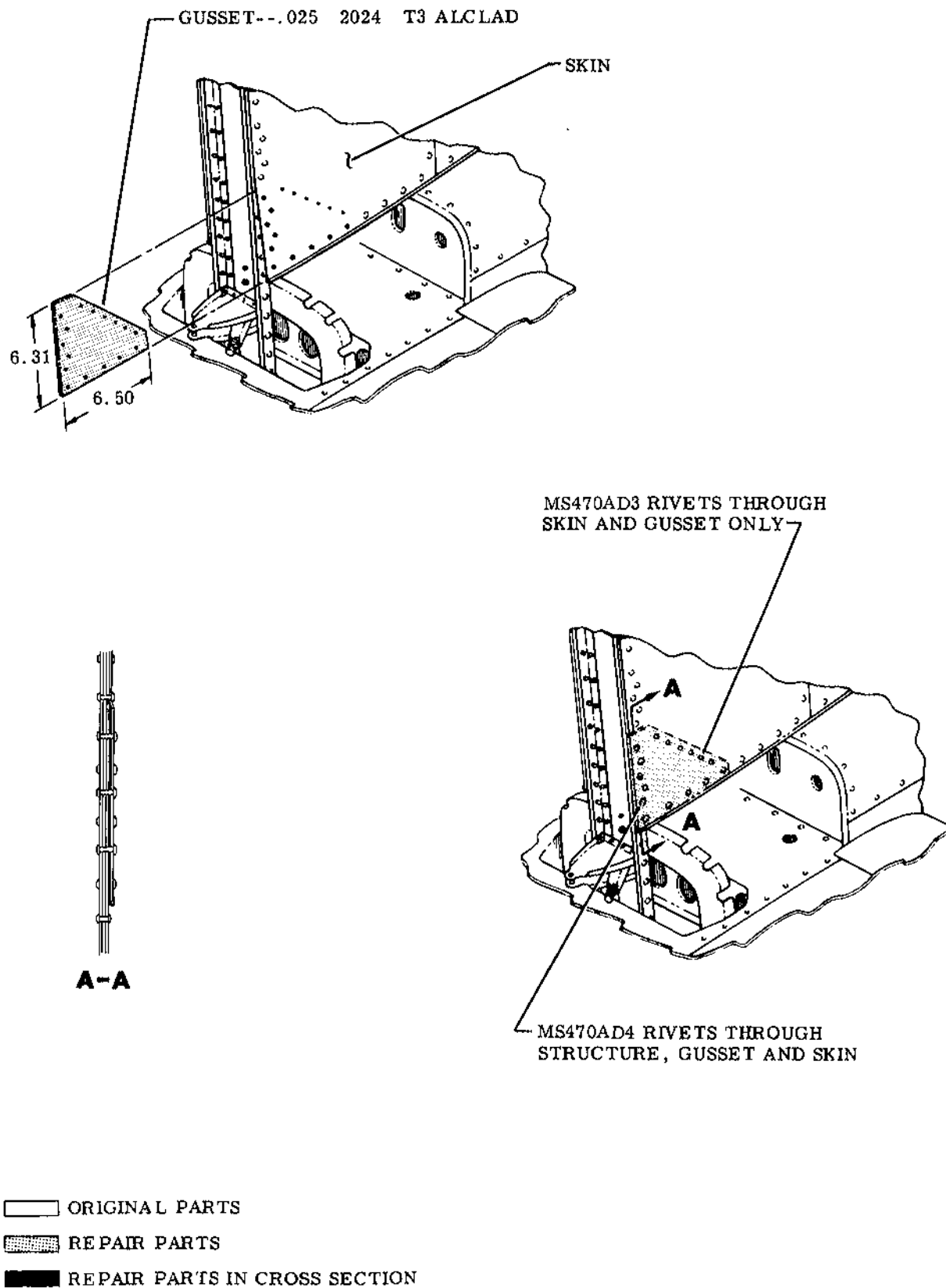


Figure 16-27. Typical Vertical Fin Repair

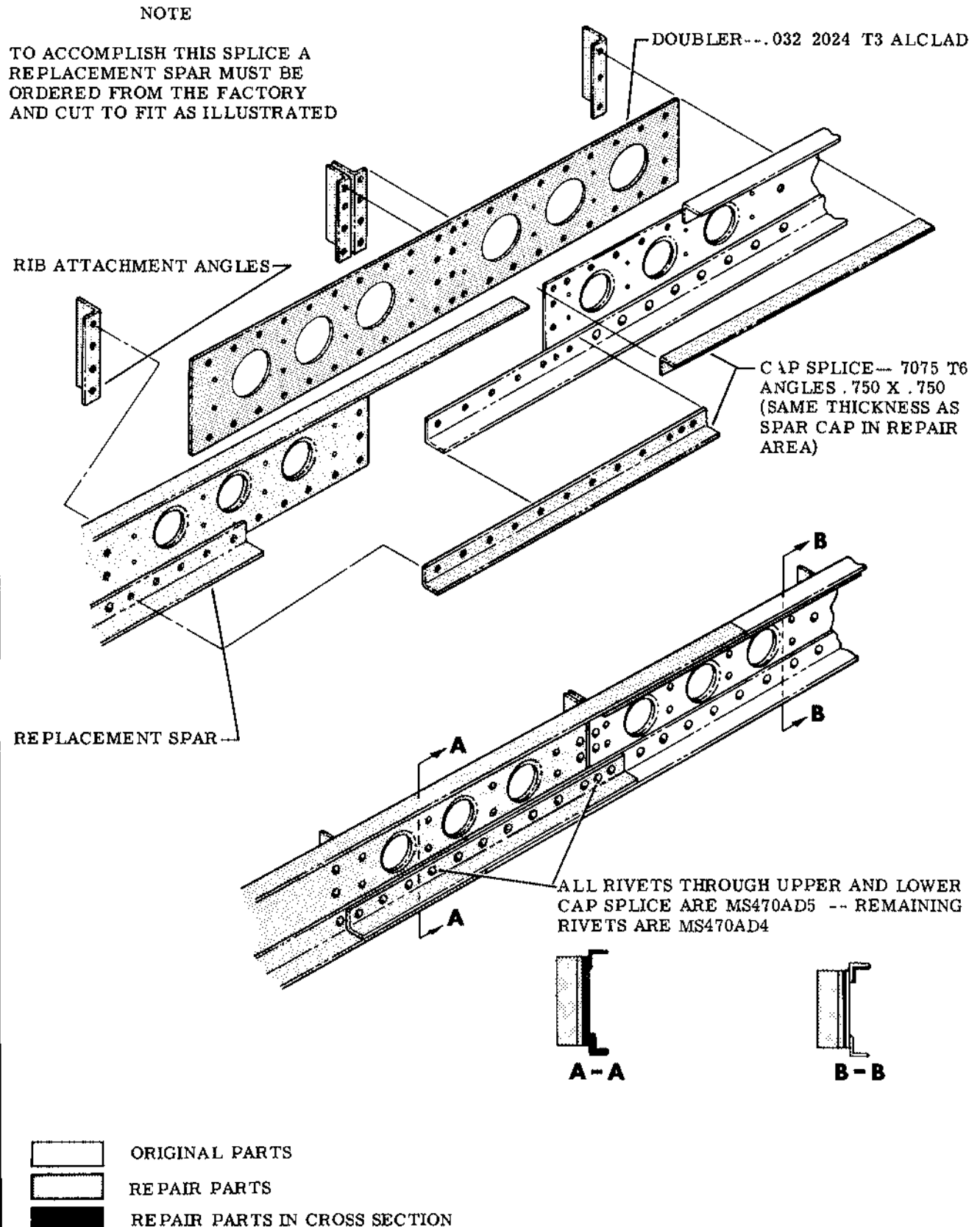


Figure 16-28. Typical Rear Spar Repair (Station 111, 12 and outboard)



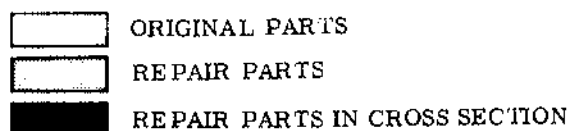
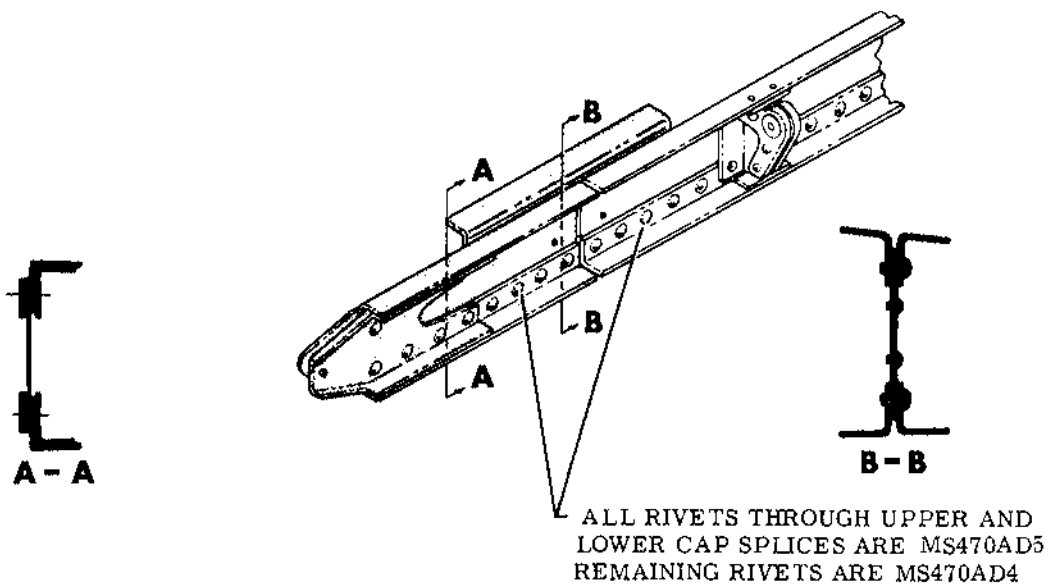
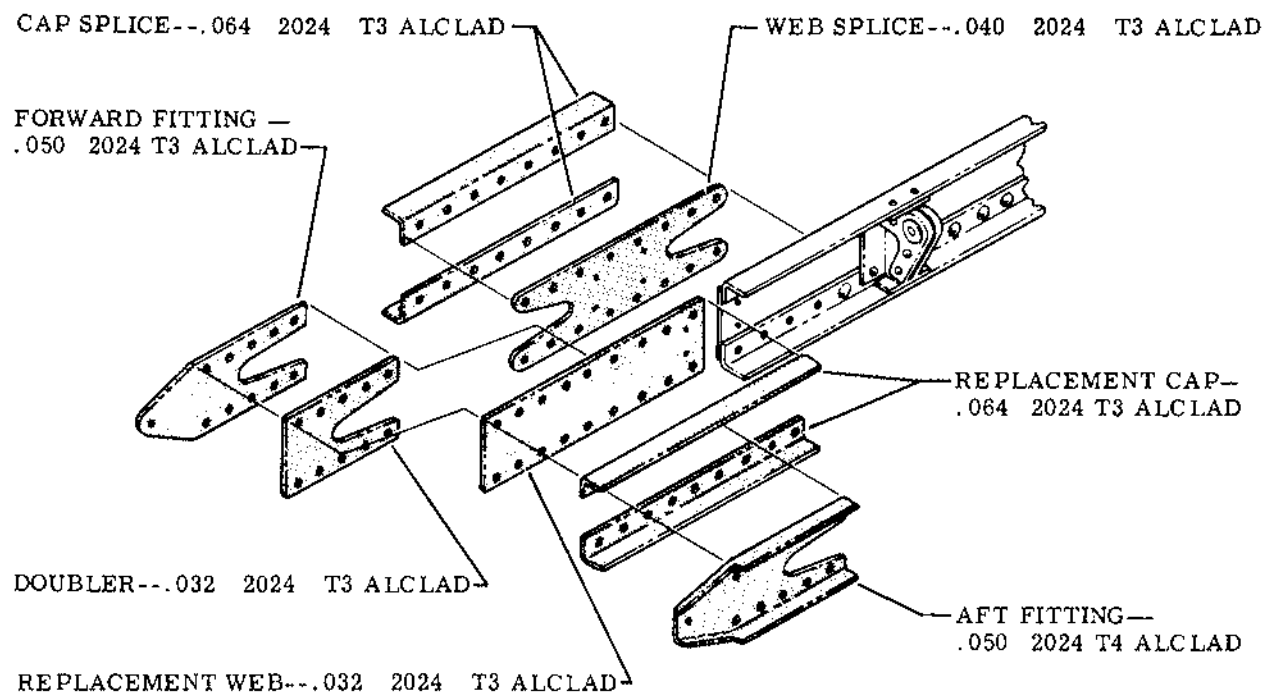


Figure 16-29. Typical Rear Spar Repair (Station 189, 20 and outboard)

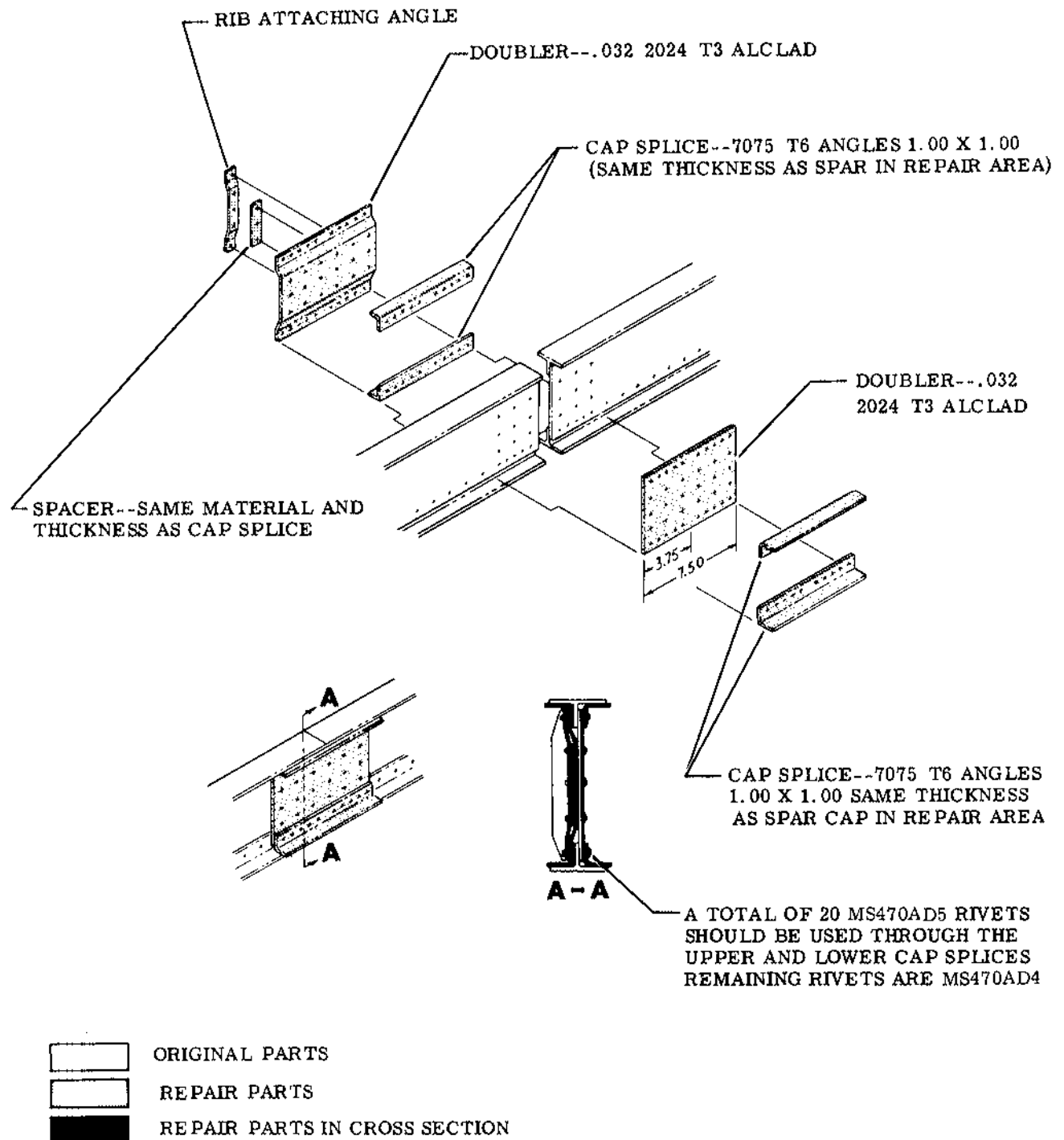


Figure 16-30. Typical Front Spar Repair (Station 168.75 and outboard)

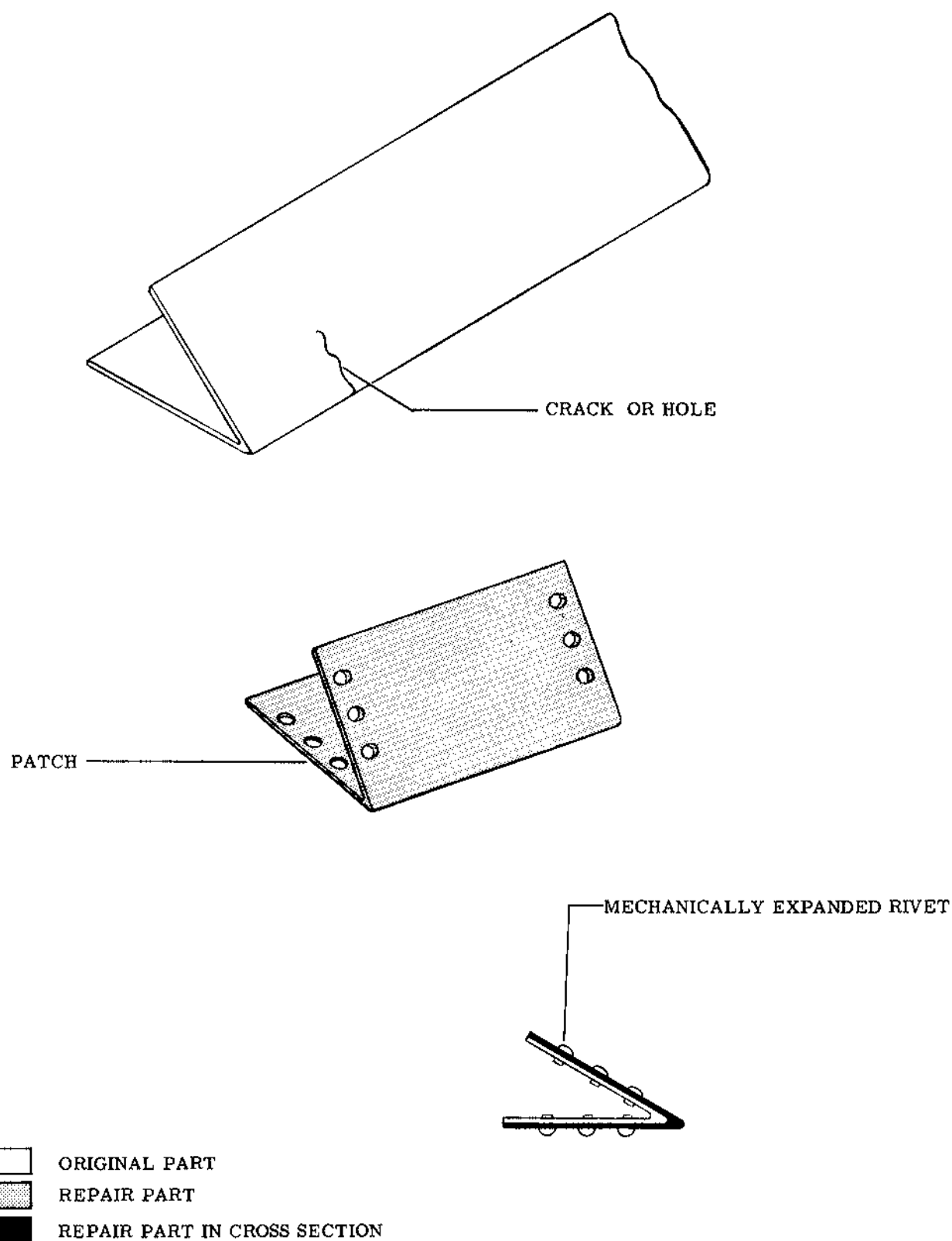
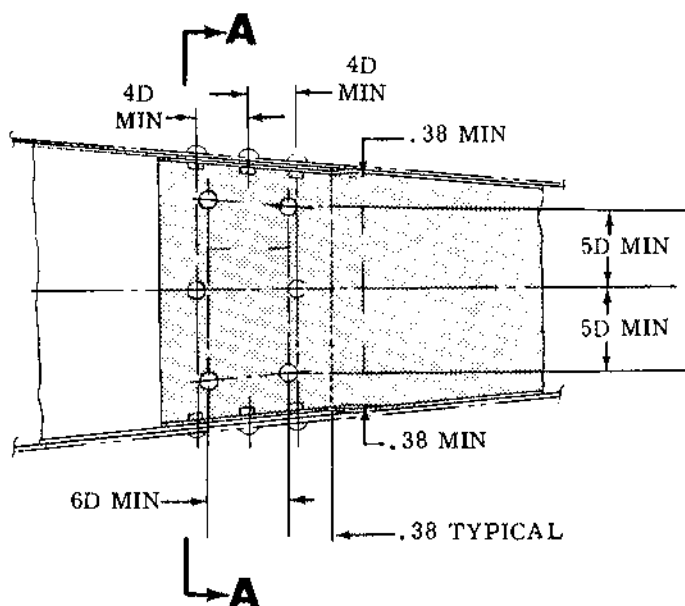
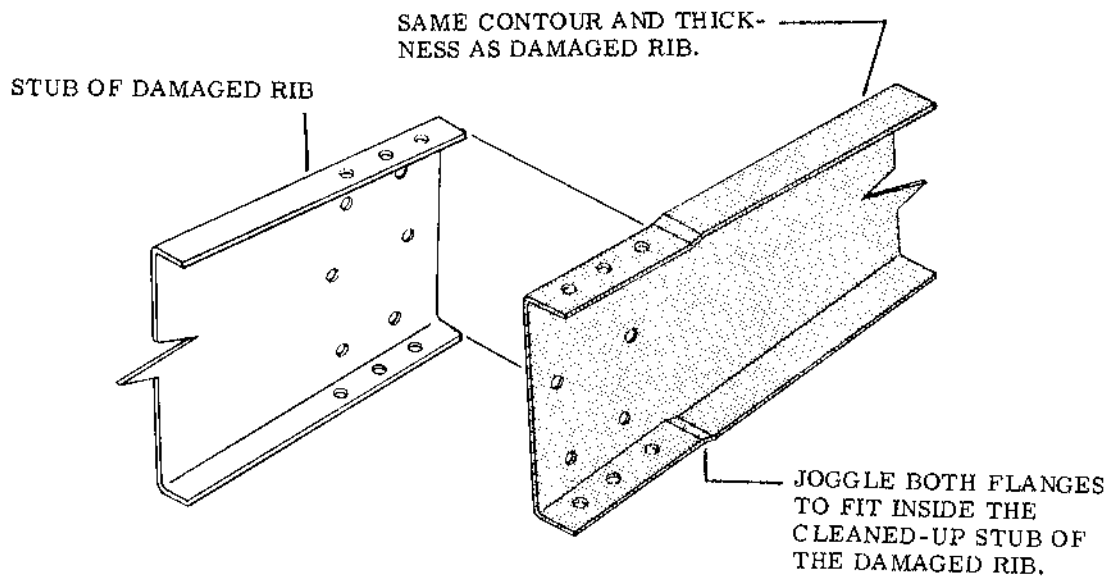


Figure 16-31. Typical Repair of Trailing Edge of a Control Surface



NUMBER OF ROWS OF RIVETS IN WEB DEPENDS ON AREA AVAILABLE. SEE MINIMUM SPACING. MAXIMUM SPACING IS ONE INCH. RIVETS IN FLANGES MUST BE AS SHOWN.

FOR RIB THICKNESS OF .032 OR LESS USE AD-3 RIVETS AND FOR THICKER MATERIAL USE AD-4.

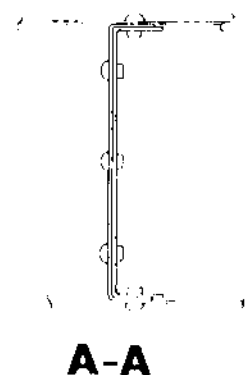
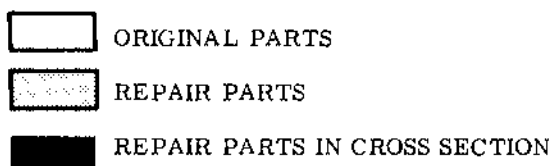
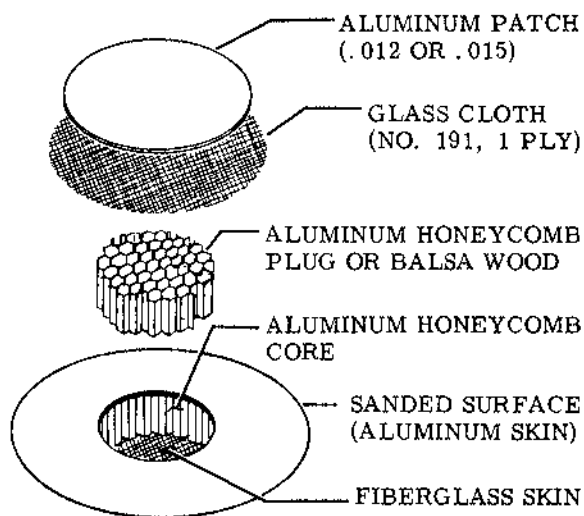
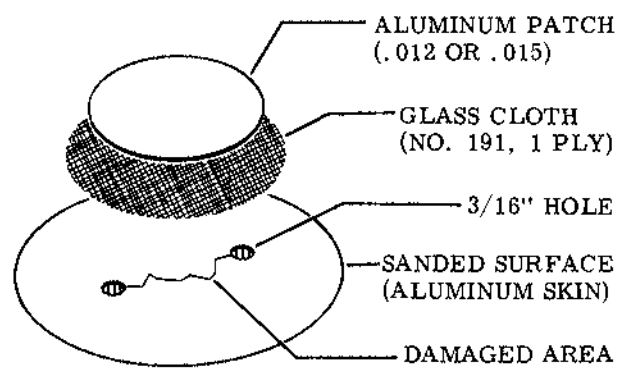


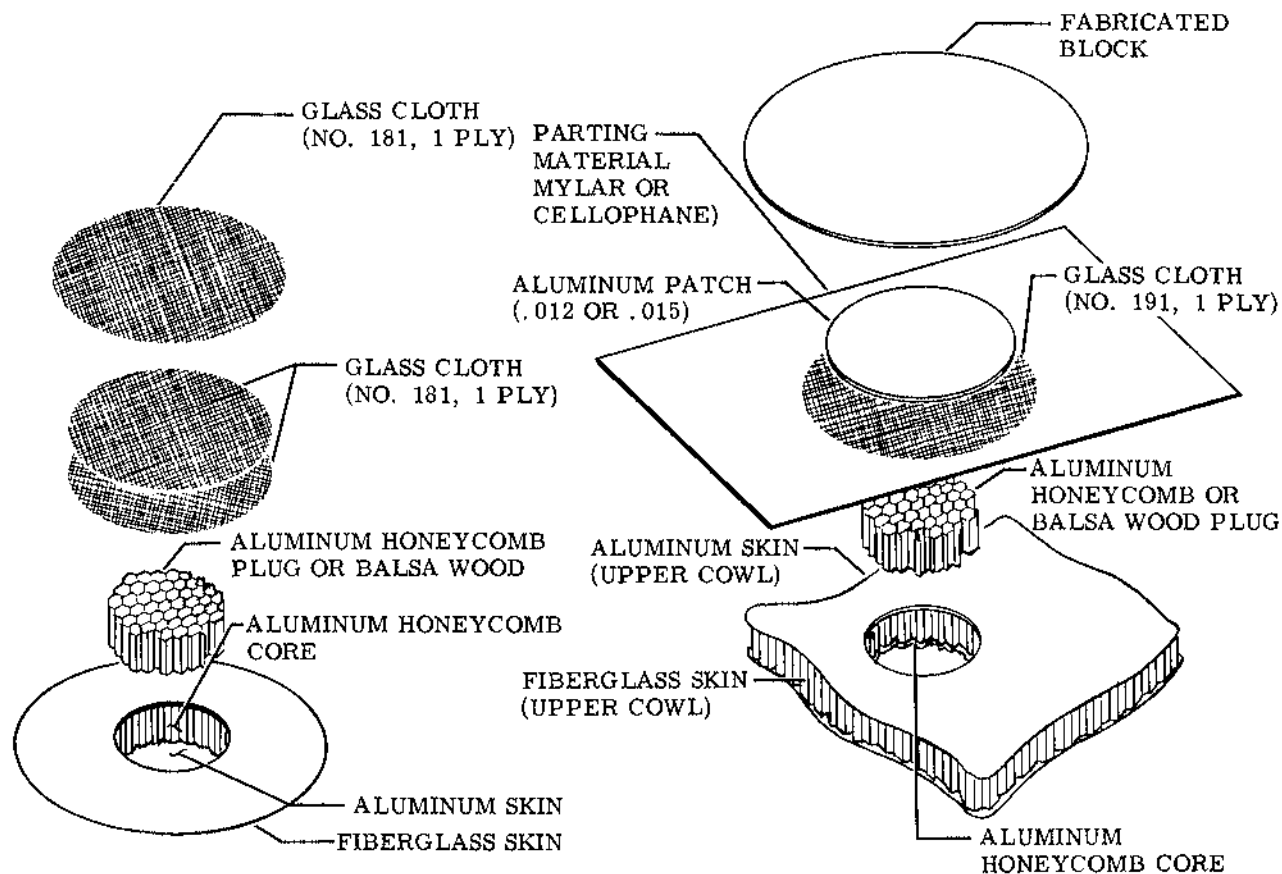
Figure 16-32. Typical Repair of Control Surface Rib



CLASS 2: DAMAGE THROUGH ALUMINUM OUTER SKIN AND ALUMINUM HONEYCOMB CORE (UPPER COWL)



CLASS 1: DAMAGE RESULTING IN CRACK (UPPER COWL)



CLASS 2: DAMAGE THROUGH FIBERGLASS INNER SKIN AND ALUMINUM HONEYCOMB CORE (UPPER COWL)

CLASS 3: DAMAGE THROUGH ALUMINUM HONEYCOMB CORE, ALUMINUM AND FIBERGLASS SKINS

Figure 16-33. Repair of Upper and Side Engine Cowling

ALIGNMENT AND SYMMETRY CHECK. (See figure 16-34.)

Before making an alignment and symmetry check the aircraft should be defueled and leveled in accordance

with Section 2. Figure 16-34 provides the measurements and shows the relative elevation points to be measured during the alignment symmetry check. Measurements are made with a steel tape projected between alignment points.

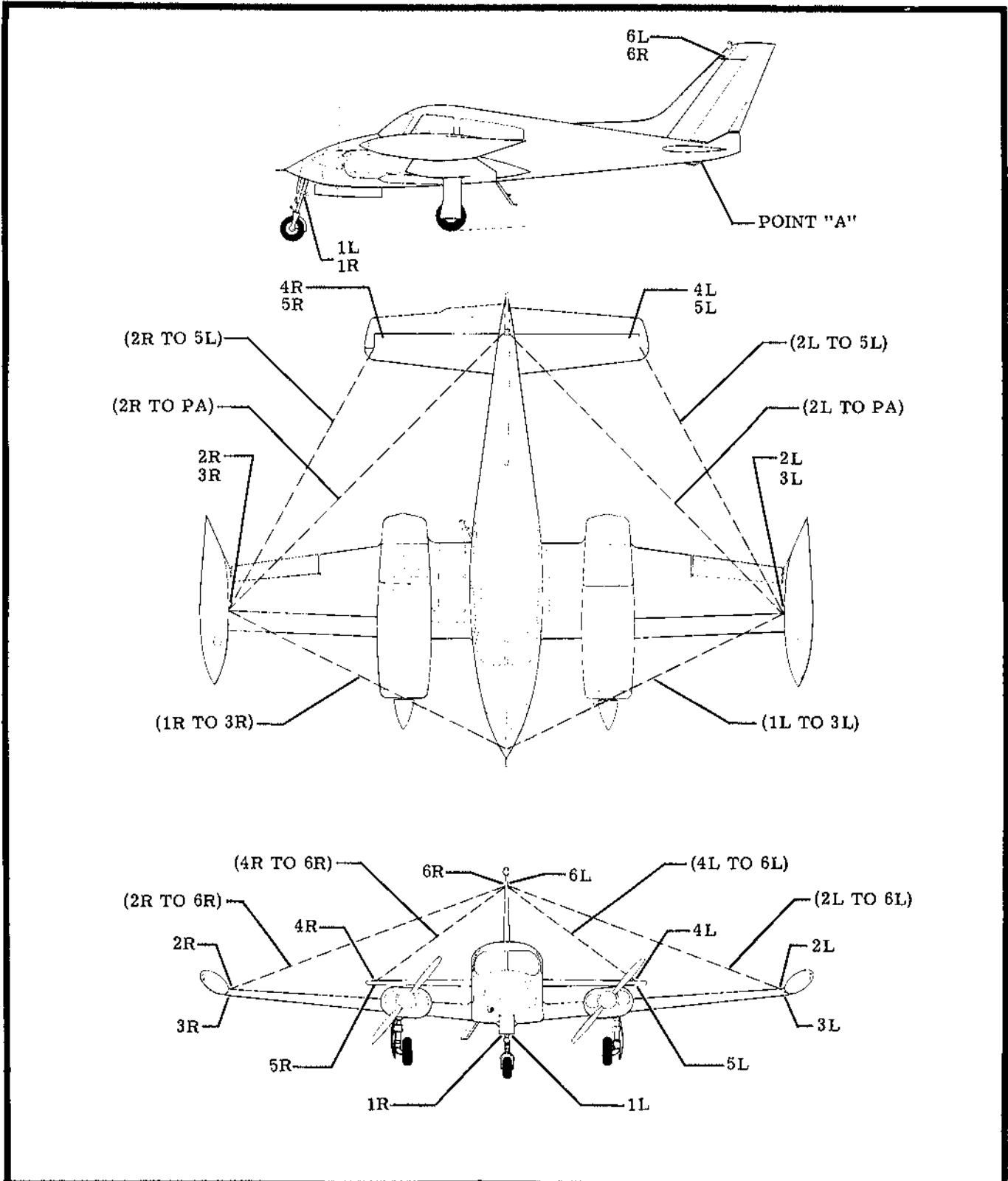
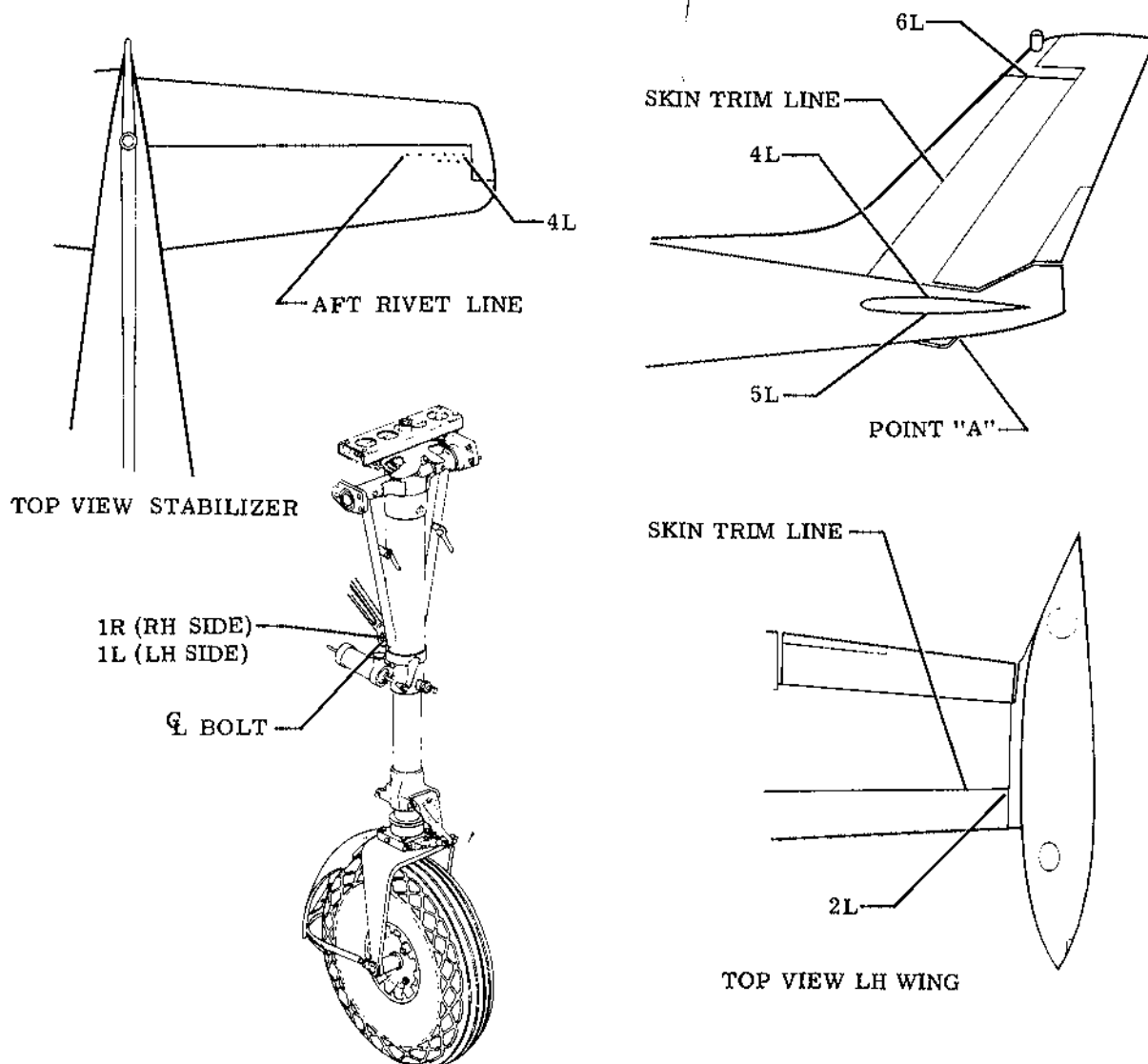


Figure 16-34. Alignment and Symmetry Check (Sheet 1 of 2)



#### Details of Check Points:

- A. Center line aft tail skid bolt.
1. Center line of bolt at gear strut and drag brace attachment. Center line head of bolt RH side and shank of bolt LH side.
2. Skin trim line and inboard edge of tip fairing at front spar.
3. Same as 2 except bottom of wing.
4. Center line aft rivet line of rear stabilizer at outboard edge of stabilizer.
5. Same as 4 except bottom of stabilizer.
6. Skin trim line at forward fin spar and lower edge of tip cap.

#### ALIGNMENT AND SYMMETRY CHECK

| POINTS               | DISTANCE               |
|----------------------|------------------------|
| 1L TO 3L<br>1R TO 3R | 18' 2.50" $\pm$ 1.25"  |
| 2L TO 5L<br>2R TO 5R | 18' 6.70" $\pm$ 2.00"  |
| 2L TO PA<br>2R TO PA | 23' 3.40" $\pm$ 1.50"  |
| 4L TO 6L<br>4R TO 6R | 9' 6.70" $\pm$ 1.00"   |
| 2L TO 6L<br>2R TO 6R | 24' 11.00" $\pm$ 2.00" |

Figure 16-34. Alignment and Symmetry Check (Sheet 2 of 2)