OVERHAUL MANUAL FOR CONTINENTAL MOTORS CORPORATION AIRCRAFT ENGINE MODEL

IO-520-A

IO-520-B

IO-520-C

WARRANTY

CONTINENTAL MOTORS CORPORATION warrants each new aircraft engine or aircraft engine part to be free from defects in material and workmanship, when properly installed and used under normal conditions, for one hundred eighty (180) days, or in no case to exceed two hundred (200) hours of operation after the shipment of each engine or part from the plant. This warranty is limited to replacing or repairing at its shops any part or parts which have been returned to the Aircraft Engine Division with transportation charges prepaid, and which, in its opinion, are defective. This warranty is expressly in lieu of all other warranties or representations, expressed or implied, and all other liabilities on the part of Continental Motors Corporation.

This warranty does not cover any labor charges for replacement of parts, adjustments, repair or any other work done on Continental Aircraft engines or parts.

This warranty shall not apply to any engine or part which shall have been repaired or altered outside of a Continental factory in any way so as, in its judgment, to affect its operation, or which has been subject to misuse, neglect or accident, or operated beyond factory recommended limits; such as, but not limited to, R. P. M. temperatures or manifold pressure.

This warranty shall not apply to any engine which shall have been operated with any other than fuel, oil or lubricants conforming to specifications released by the Aircraft Engine Division of Continental Motors Corporation.

The Aircraft Engine Division of Continental Motors Corporation will warrant each new accessory furnished by it to be free from defects in material and workmanship for ninety (90) days or fifty (50) hours of operation after original installation in an aircraft. Since many of these accessories are procurable from other sources, this clause applies only to accessories purchased with engine or as spare parts from Continental Motors Corporation.

The Aircraft Engine Division of Continental Motors Corporation reserves the right to change engine or parts specifications or prices without incurring any responsibility with regard to engines or parts previously sold or replaced.

This warranty is effective on all engines or parts shipped from the factory after October 1, 1961 and on all engines beginning with installations in 1962 model airplanes.

CONTINENTAL MOTORS CORPORATION
AIRCRAFT ENGINE DIVISION
MUSKEGON, MICHIGAN

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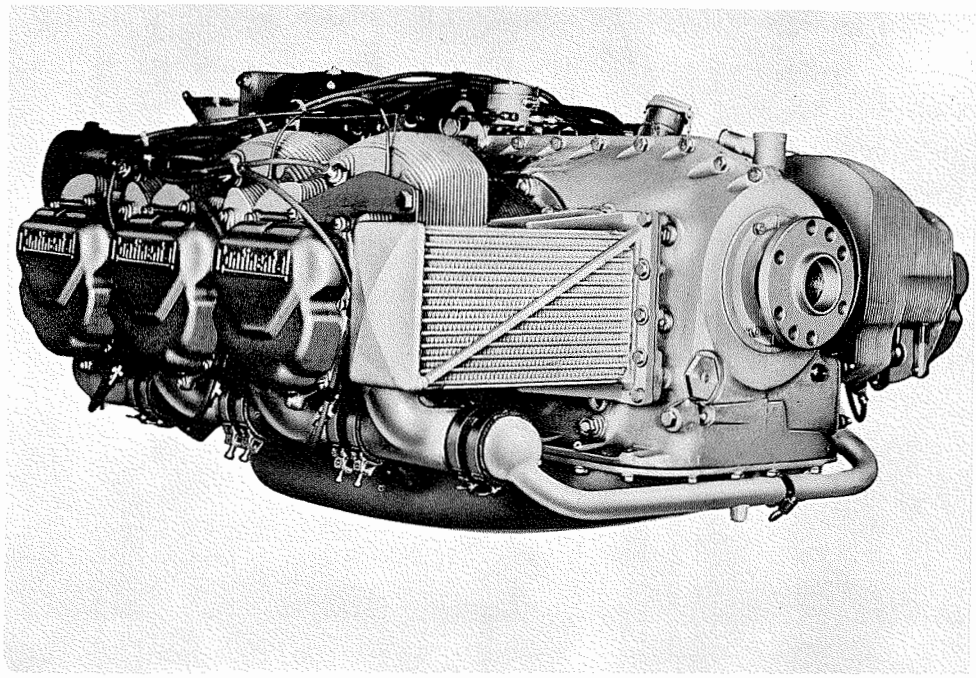


Figure 1-1. Three-Quarter Right Front View of the IO-520-A.

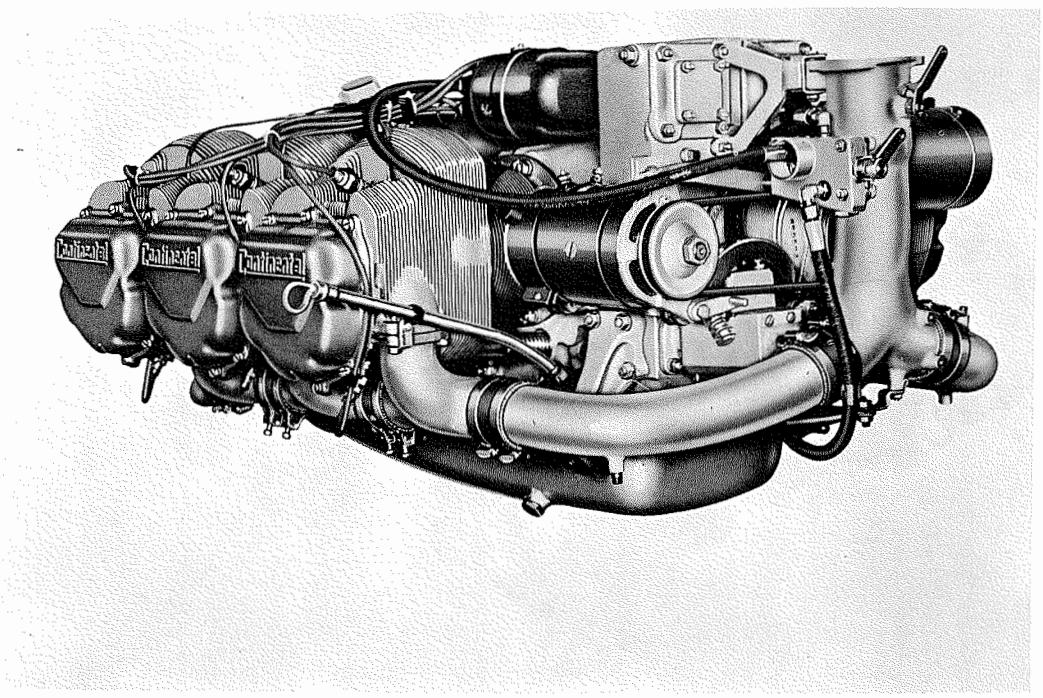


Figure 1-2. Three-Quarter Left Rear View of the IO-520-A.

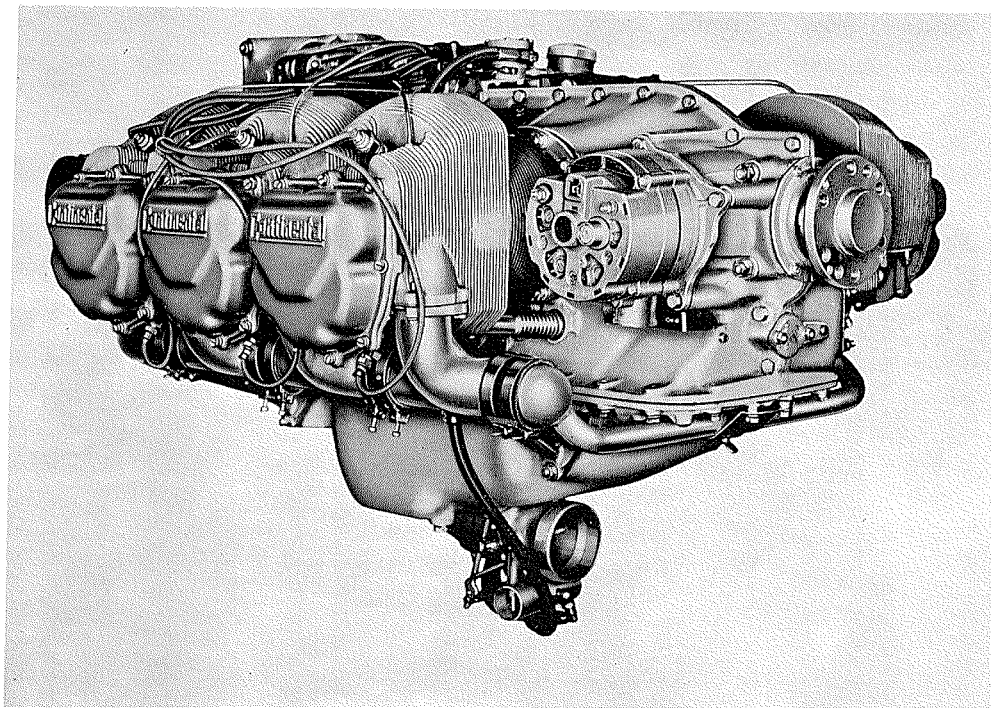


Figure 1-3. Three-Quarter Right Front View of the IO-520-B.

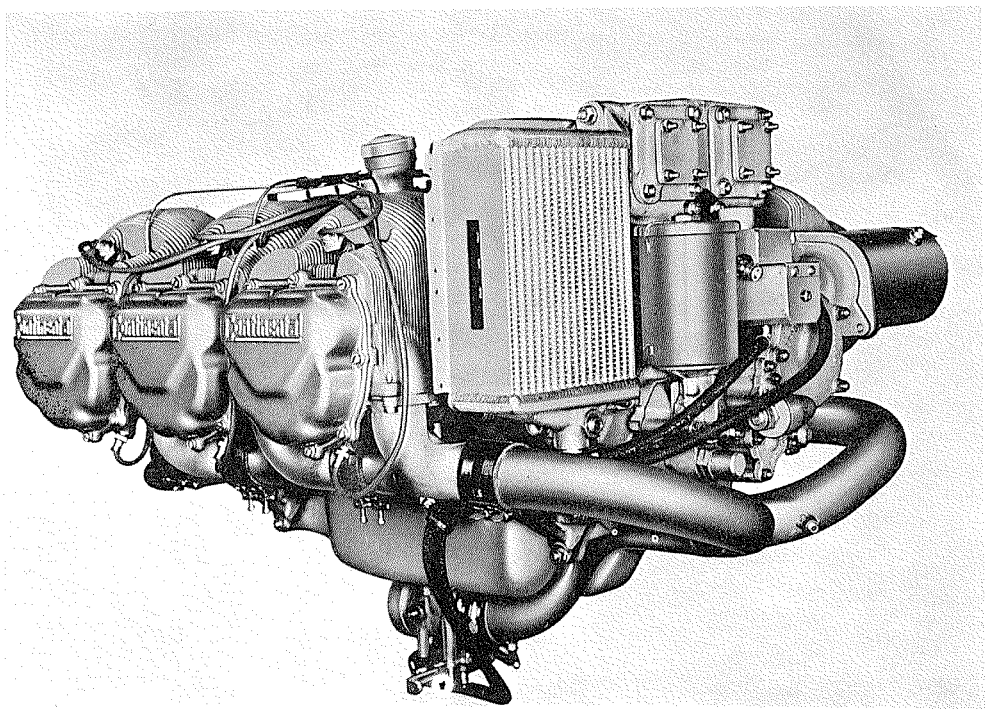


Figure 1-4. Three-Quarter Left Rear View of the IO-520-B.

SECTION I

INTRODUCTION

1-1. SCOPE. This publication comprises Overhaul Instructions for Models IO-520-A, IO-520-B and IO-520-C aircraft engines.

1-2. RELATED PUBLICATIONS. Detail part numbers and service assemblies for these engine models are contained in Parts Catalog IO-52-4. Operating instructions are contained in Operator's Handbook IO-52-2.

a. Service instructions for Slick Magneto Model #662 may be obtained from Slick Electro Inc., Rockford, Illinois.

b. Service instructions for Bendix-Scintilla Magneto Model S6RN-201 & S6RN-205 may be obtained from Scintilla Magneto Division, Bendix Aviation Corporation, Sidney, New York.

c. Service instructions for Delco-Remy Starter Model(s) 1108249 or 1108234, Generator Model 1101912 or Alternator Models 1100667 or X3831 may be obtained from Delco-Remy Division, General Motors Corporation, Anderson, Indiana.

1-3. SERVICE BULLETINS. Important changes and product improvements are covered by factory service bulletins available for study at all Approved Distributors. These Bulletins are also available to owners, operators or maintenance personnel on an annual subscription basis.

1-4. SERVICE REPORTS AND INQUIRIES. It is the policy of Continental Motors Corporation to handle all reports of service difficulty and requests for information through Approved Distributors. Request for further copies of this or any other Continental Motors Aircraft Engine Service Publication should be made through these agencies. There is an Approved Distributor at every major airport.

1-5. DEFINITION OF TERMS. Front, rear, left and right, as used in this manual, refer to the engine as viewed by the mechanic in a normal position, facing the accessory end.

1-6. CYLINDER ARRANGEMENT. Cylinders are numbered starting from the rear, with odd numbers on the right and even numbers on the left.

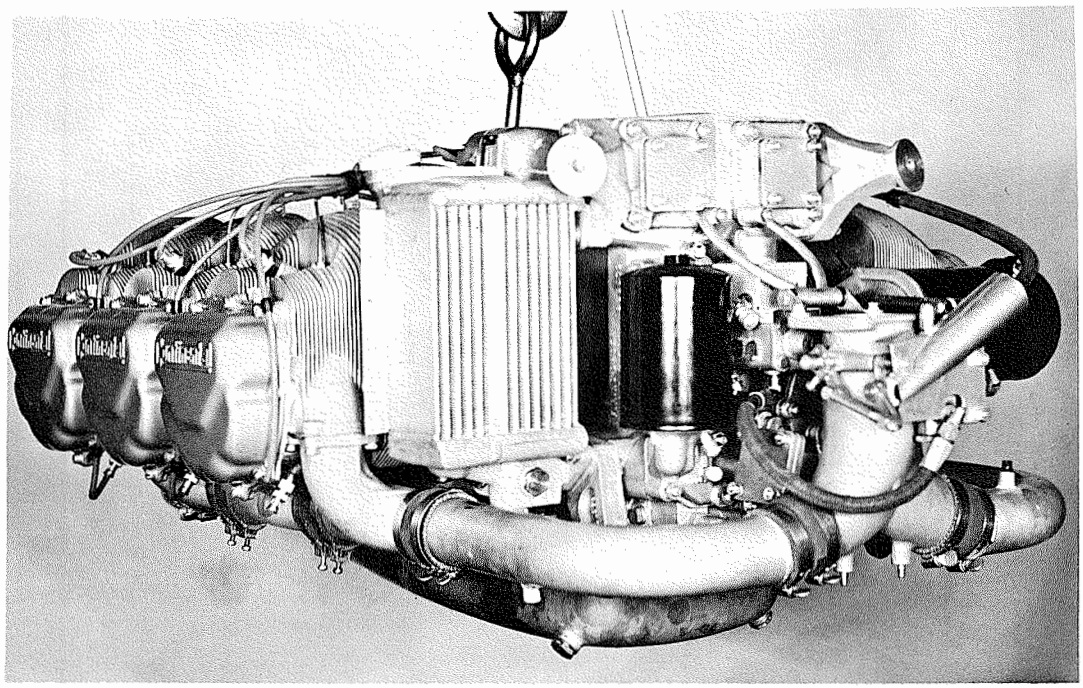


Figure 1-5. Three-Quarter Left Rear View of the IO-520-C.

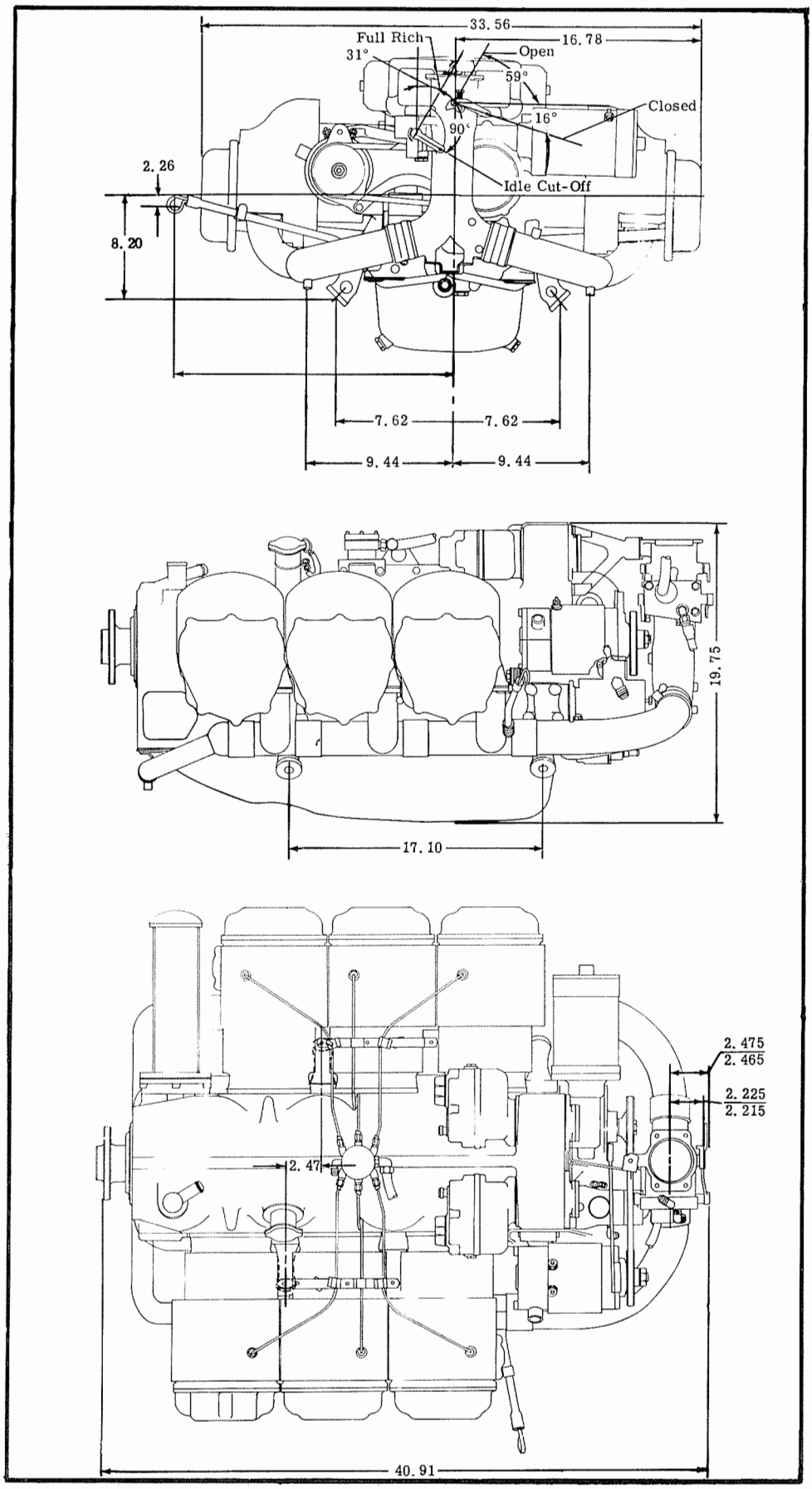


Figure 1-6. Installation Drawing for the IO-520-A

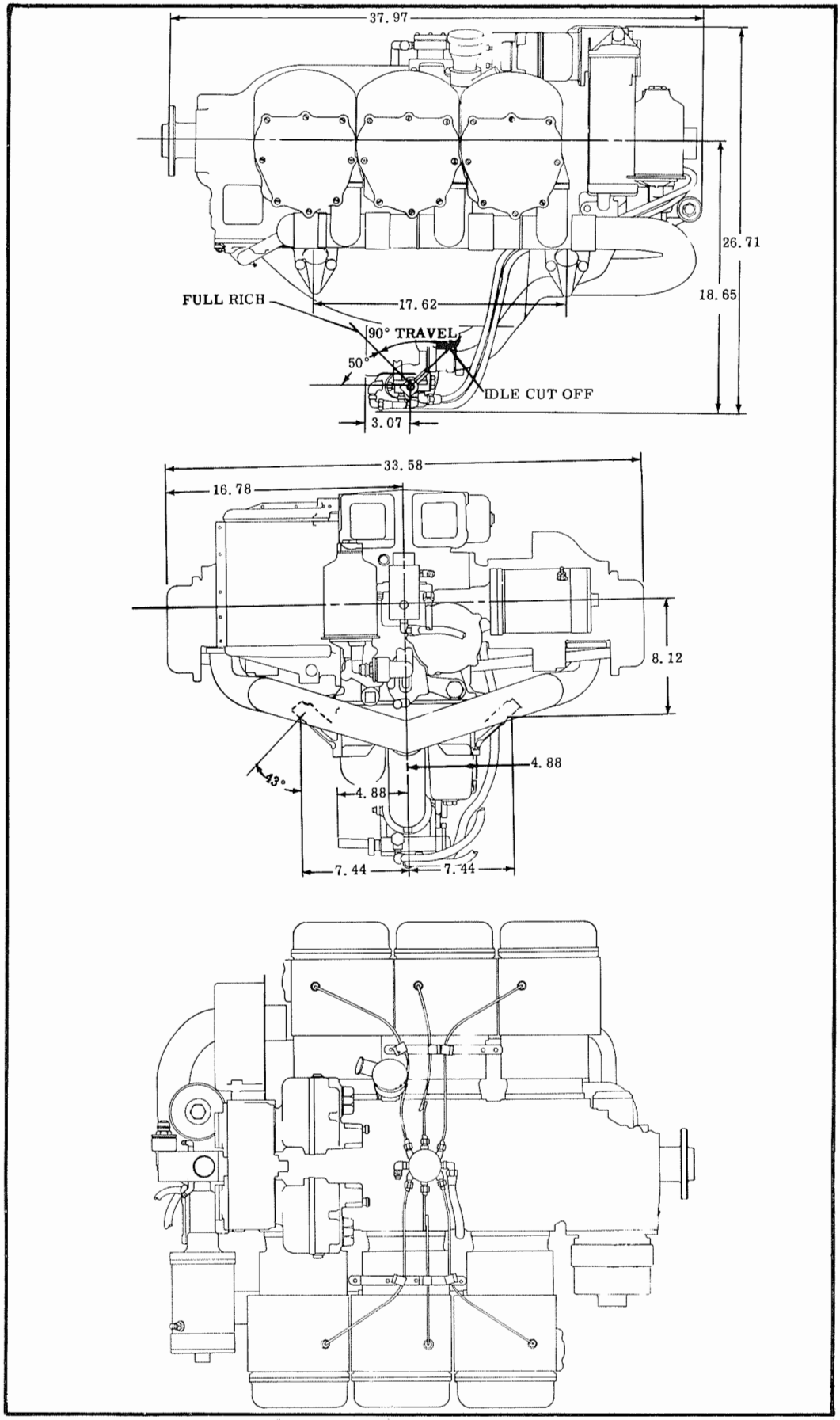


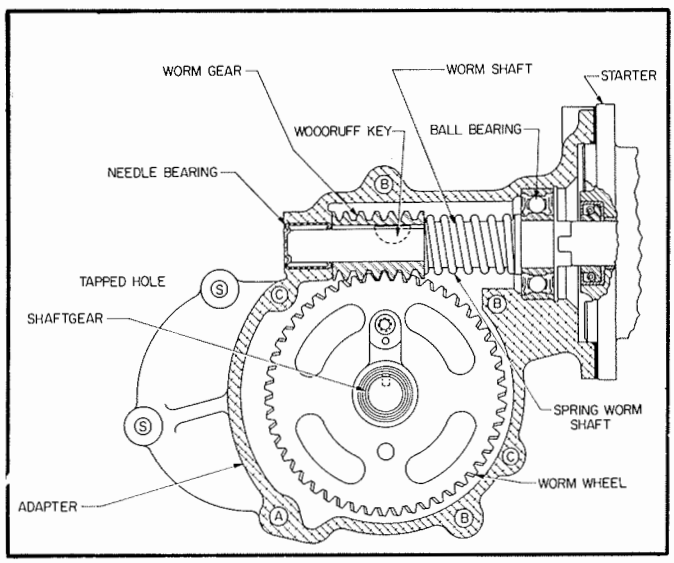
Figure 1-7. Installation Drawing for the IO-520-B

SECTION II

GENERAL DESCRIPTION

2-1. SIGNIFICANT DIFFERENCES. Specific detail parts differences between the IO-520-A, B and C will be noted in the Parts Catalog. The significant difference in configuration are the location of the generator on the accessory end of the IO-520-A while the IO-520-B & C both employ an alternator located near the front on the 1-3-5 side. The oil sump on the IO-520-B is an aluminum casting as compared to a stamped aluminum sheet metal sump on the IO-520-A & C. Along with the cast sump, the IO-520-C employs mounting legs attached to the sump and the air throttle body below the engine as compared with the mounting legs on the crankcase and the air throttle body upright at the accessory end of the IO-520-A & C.

2-2. GENERAL. The arrangement and appearance of engine components are indicated in figures 1-1 through 1-5. Additional information will be found in installation drawings. It will be observed that minimum length has been achieved by mounting the starter on right angle and by mounting the magnetos in the forward side of the accessory gear compartment formed by the crankcase castings at the rear. The magneto location also serves to shorten the high tension cables as much as possible.



A. Adapter cover and adapter-to-crankcase bolt
B. Adapter-to-crankcase bolts
C. Adapter cover-to-adapter bolts
S. Crankcase-to-adapter studs

Figure 2-1. Cross-Section of Starter Drive

2-3. CRANKCASE. Two aluminum alloy castings are joined along the vertical center plane to form the complete crankcase. The individual castings (with studs and inserts) will be referred to as the "left crankcase" and "right crankcase" throughout this publication.

a. Bosses molded in the crankcase castings are line bored in the assembled castings to form bearings for the camshaft and seats for precision, steel-backed, lead alloy lined crankshaft main bearing inserts. Guides are bored through lateral bosses for the tappets and for the governor drive shaft. A needle bearing is pressed into the right crankcase, to the right of the rear main bearing, to support the front end of the starter shaftgear.

b. Cylinder mounting pads on the left crankcase are farther forward than the corresponding pads on the right crankcase to permit each connecting rod to work on a separate crankpin. Each pad has six studs and two through bolts for attaching cylinder base flanges. The governor mount pad is located on the side of the left crankcase at the lower front corner. On the IO-520-B & C an alternator pad is located on the right crankcase at the front.

c. The crankcase interior is ventilated by a breather consisting of a tube and baffles assembly with a side extension for hose attachment. The breather assembly is pressed into the upper left crankcase.

2-4. CRANKSHAFT. The six throw, steel alloy forging is machined all over except for some portions of the crankcheeks. The main bearing journals and crankpins are nitrided after grinding. A flange is formed at the front for attaching a propeller. An oil transfer collar, encompassing the crankshaft between the front and rear halves of the main thrust bearing, transfers the governor controlled oil from the crankcase passage to the crankshaft interior. Side blades projecting from the crankcheeks 1 and 2, 3 and 4 are machined for the installation of one 4th, one 5th and two 6th order counterweights. Oscillation of the counterweights on their pins dampen crankshaft torsional vibration.

a. The crankshaft gear is heated prior to installation to obtain a shrink fit. The gear is driven by a dowel of uniform diameter which is positively retained by a washer under the head of one of the six 5/16 in. gear retaining bolts. A cluster gear on the IO-520-B & C provides for direct drive of the fuel pump.

b. On the IO-520-B & C, an accessory drive gear is heated and shrunk onto a flange just behind the oil transfer collar at the front of the crankshaft, and retained by four bolts.

c. A rubber oil seal, which is stretched over the crankshaft flange is seated between crankcase castings in front shaft exit, and is sealed to the crankshaft by a helical spring inside the seal's cavity. A split felt dust shield is installed in front of the oil seal to prevent abrasive material working under the oil seal lip and scoring the crankshaft. The oil seal and felt are held in place by two "c" shaped aluminum retainers attached to the front of the crankcase.

2-5. CONNECTING RODS. The "I" beam-type connecting rods have split bronze piston pin bushings and two identical precision inserts (of the same type as the main bearings) at the crankpin end. Weight variation of rods in any one engine is limited to 1/4 ounce.

2-6. CAMSHAFT. A steel alloy forging is machined on four journals, nine cam lobes and the gear mount flange at the rear end. The lobes and journals are hardened and ground. A groove around the front journal passes engine oil from the right crankcase cross passage to the left case passage. The camshaft gear is attached by four unequally spaced bolts to locate its timing mark in relation to the cam lobes. On the IO-520-A, a cluster gear is bolted with the camshaft gear and drives the fuel pump gear.

2-7. PISTONS. Pistons are aluminum alloy forgings. The skirts are solid and have cylindrical relief cuts at the bottom to clear the crankshaft counterweights. Pistons have three grooves above the pin hole and one groove below. Compression rings are installed in the top, second and the groove below the pin hole. A center grooved and slotted oil ring is installed in the third groove, which has six oil drain holes to the interior. Piston pins are full floating, ground steel tubes with permanetly forged-in aluminum end plugs.

2-8. TAPPETS. The barrel type hydraulic tappets may be removed and replaced without complete disassembly of the engine as described in Section IV. The construction and operation of the tappets are described in paragraph 2-15 and figure 2-6.

2-9. CYLINDERS. The externally finned aluminum alloy head castings are heated and valve seat inserts installed before the head is screwed and shrunk onto an externally finned steel alloy barrel to make the permanent head and barrel assembly. Bronze valve guides are pressed into the cold cylinder assembly and reamed to slightly different diameters. Special 18 mm "Heli-Coil" thread inserts are installed in upper and lower spark plug holes. Smaller "Heli-Coils" are installed in exhaust manifold attaching stud holes. Both intake and exhaust ports are on the bottom of the head when the cylinder is installed. Exhaust valve faces are Stellite No. 6 and stem tips are hardened. Valve stems are solid. Outer retainers of the two concentric springs surrounding each valve are locked to the stems by tapered, semi-circular keys which engage grooves around the stems. Rotocaps are installed on exhaust valves only. The rotating action of this type retainer helps to prevent burning and eroding of the valve and valve seat. Inner spring retainers are pressed steel. Valve rocker covers are aluminum alloy castings. Rocker shafts are ground steel tubes with a hole drilled in one end at a 90 degree angle to the longitudinal axis. The two inside rocker shaft bosses are drilled and tapped for the 5/16 inch rocker shaft retaining screws. Valve rockers are steel forgings with hardened sockets and rocker faces and pressed in bronze bearings. They are drilled for lubrication. Pushrods are constructed of steel tubes and pressed-in, hardened, forged steel ball ends, which are center drilled for oil passages. The pushrod housings are beaded steel tubes. The bead at the cylinder end retains a washer and packing ring. The bead at the crankcase end retains a heavy spring, washer, packing ring and second washer.

2-10. FUNCTIONAL SYSTEMS.

2-11. GEAR TRAIN IO-520-A (See Figure 2-2). When starting engine torque is transmitted from the starter (17) through adapter components (19 through 25) to crankshaft gear (1). As wormwheel (22) is turned, spring mounted on its hub is tightened to grip knurled drum of shaftgear (25). This design eliminates wear and stress encountered in direct drive starter systems. After engine is started, spring returns to its normal position, thus disengaging starter. The shaftgear (25) is now used to transmit torque from the crankshaft gear to the generator drive pulley (16, figure 4-11).

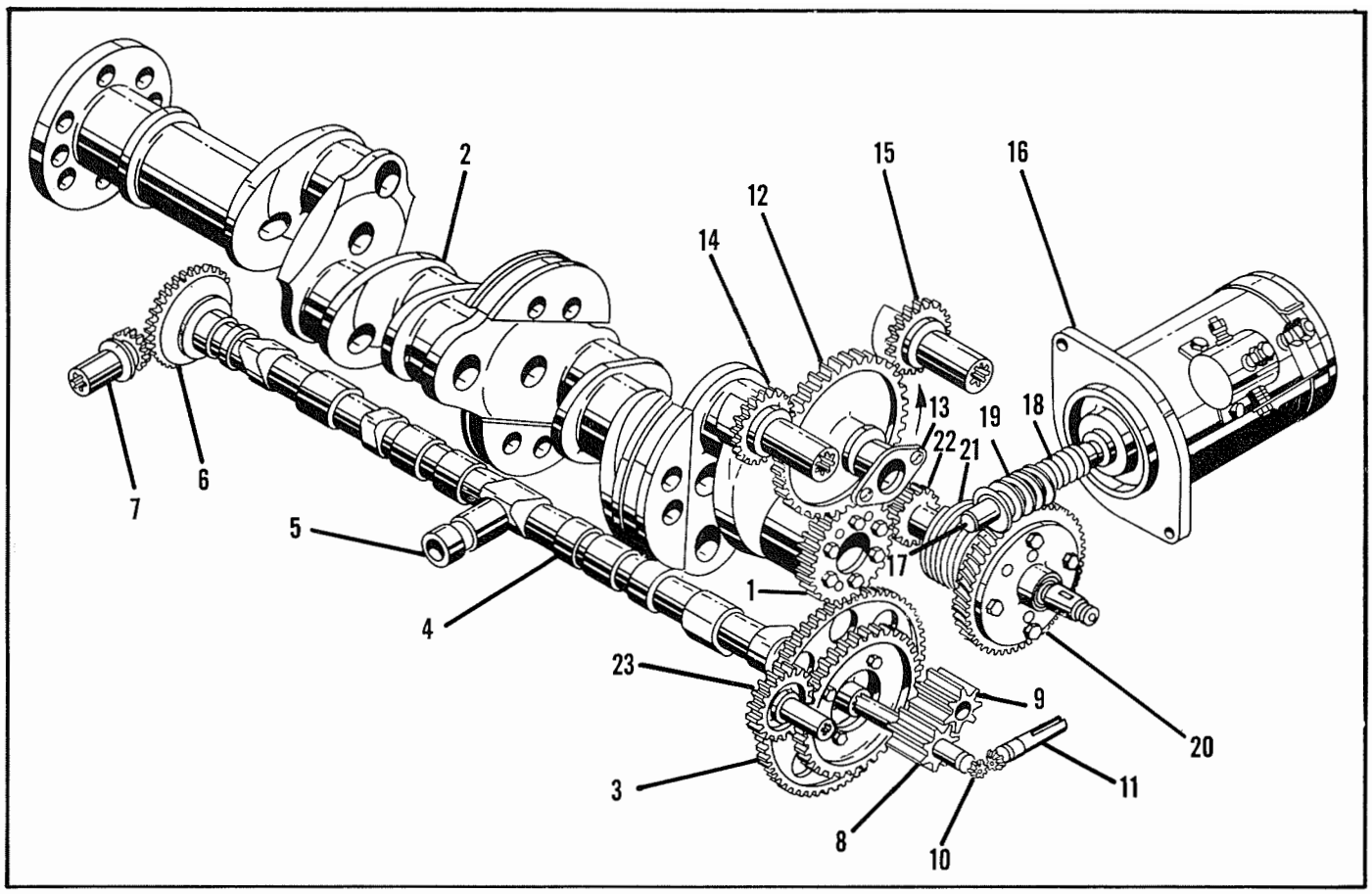
a. Torque from the crankshaft (2) is transmitted by the crankshaft gear (1) directly to the idler gear (13) and camshaft gear (3).

b. The idler gear, rotating in a counterclockwise direction, drives magneto drive gears (15 and 16). Optional accessories mounted on crankcase upper rear are driven by internal splines of magneto drive gears.

c. The fuel pump drive gear for the IO-520-A is driven by the camshaft cluster gear. The splined end of the oil pump and tachometer drive gear (8) mates with internal splines of the camshaft gear and transmits torque to the oil pump driven gear (9) and the tachometer drive gear (10). The governor drive bevel gear (6) on the front of the camshaft drives the governor driven bevel gear (7).

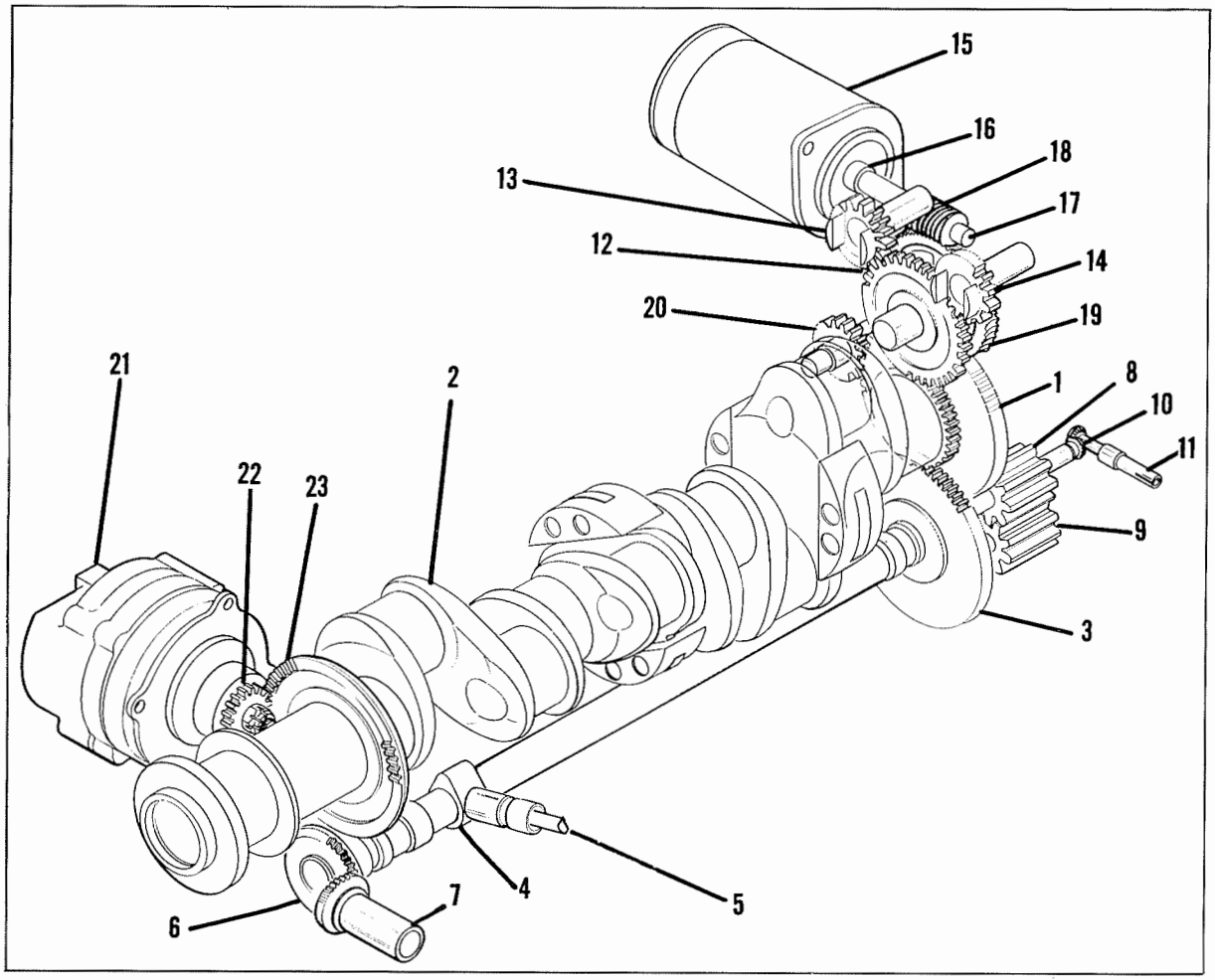
2-12. GEAR TRAIN IO-520-B & C. (See Figure 2-3).

a. When starting engine, torque is transmitted from the starter (15) through adapter components (16 through 20) to crankshaft gear (1). As wormwheel (19) is turned, spring mounted on its hub is tightened to grip knurled drum of shaftgear (.20). After engine is started, spring returns to its normal position, thus disengaging starter. Torque is transmitted to the alternator by a face gear (23) mounted on the crankshaft.



1.	Crankshaft gear	1:1
2.	Crankshaft	1
3.	Camshaft cluster gear	1:0.5
4.	Camshaft	1:0.5
5.	Hydraulic tappet	-
6.	Governor drive bevel gear	1:0.5
7.	Governor driven bevel gear	1:1
8.	Oil pump and tachometer drive shaftgear	1:0.5
9.	Oil pump driven gear	1:0.5
10.	Tachometer drive bevel gear	1:0.5
11.	Tachometer shaftgear	1:0.5
12.	Idler gear assembly	1:0.652
13.	Idler gear support pin	-
14.	Left magneto drive gear	1:1.5
15.	Right magneto drive gear	1:1.5
16.	Starter, 12 volt	32:1
17.	Worm drive shaft	32:1
18.	Worm shaft spring	-
19.	Starter worm gear	32:1
20.	Starter worm wheel	2:1
21.	Clutch spring	2:1
22.	Starter shaftgear	1:2
23.	Fuel pump drive gear	1:1

Figure 2-2. Gear Train Diagram, IO-520-A



1.	Crankshaft gear	1:1
2.	Crankshaft	1
3.	Camshaft gear	1:0.5
4.	Camshaft	1:0.5
5.	Hydraulic tappet	-
6.	Governor drive bevel gear	1:0.5
7.	Governor driven bevel gear	1:1
8.	Oil pump and tachometer drive shaftgear	1:0.5
9.	Oil pump driven gear	1:0.5
10.	Tachometer drive bevel gear	1:0.5
11.	Tachometer drive bevel gearshaft	1:0.5
12.	Idler gear assembly	1:0.652
13.	Right magneto drive gear	1:1.5
14.	Left magneto drive gear	1:1.5
15.	Starter	48:1
16.	Starter coupling	-
17.	Worm drive shaft	48:1
18.	Starter worm gear	48:1
19.	Starter worm wheel	2:1
20.	Starter shaftgear	1:3
21.	Alternator	3:1
22.	Alternator driven gear	3:1
23.	Alternator drive gear	1:1

Figure 2-3. Gear Train Diagram, IO-520-B & C

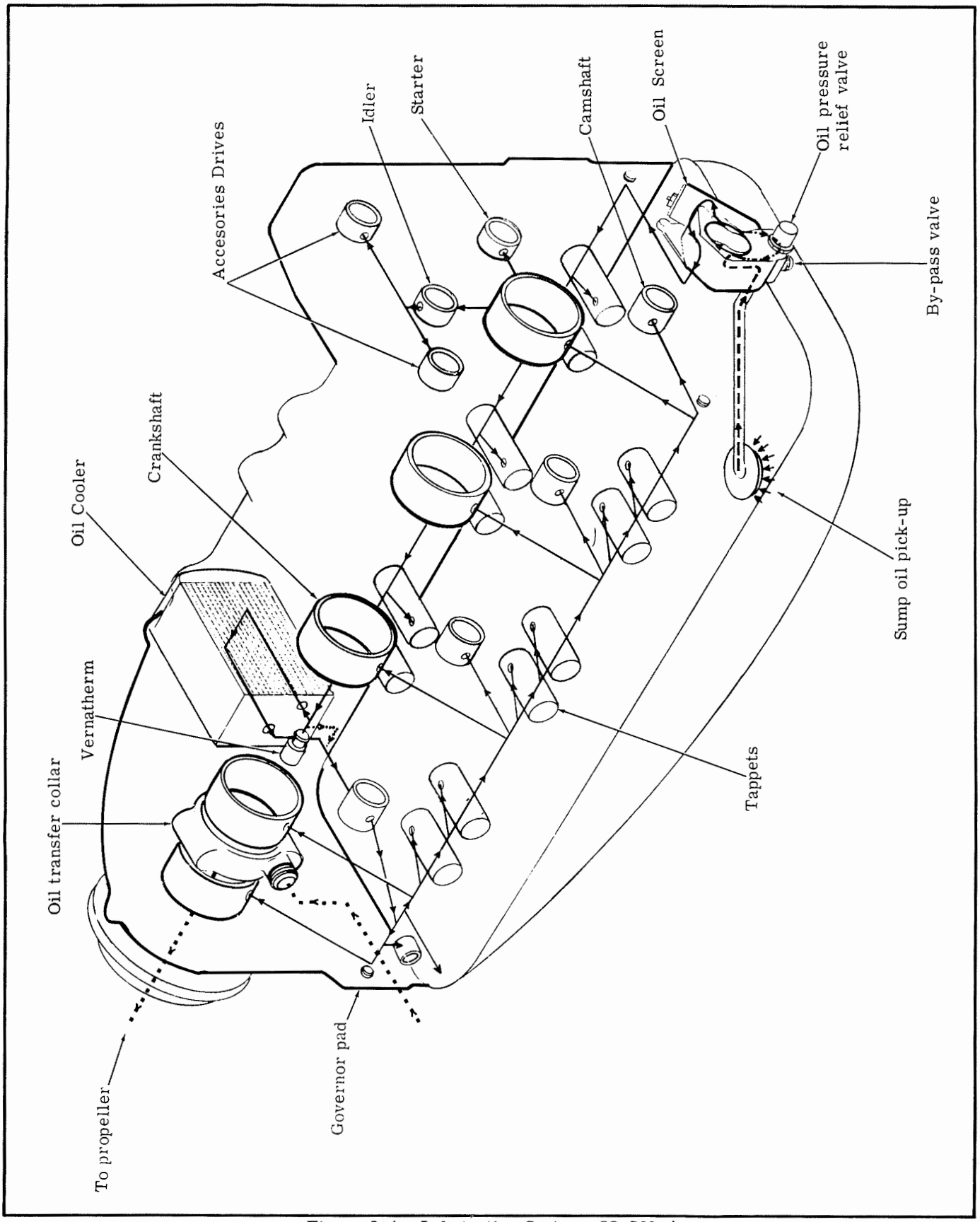


Figure 2-4. Lubrication System, IO-520-A

b. Torque from the crankshaft (2) is transmitted by the crankshaft gear (1) directly to the idler gear (12) and the camshaft gear (3).

c. The idler gear, rotating in a counterclockwise direction, drives the magneto drive gears (13, 14). Optional accessories mounted on the crankcase upper rear are driven by internal splines of magneto drive gears.

d. The fuel pump coupling is driven directly from the crankshaft gear (1). The splined end of the oil pump and tachometer drive gear (8) mates with the internal splines of the camshaft gear and transmits torque to the oil pump driven gear (9) and the tachometer drive gear (11). The governor drive bevel gear (6) is keyed to the camshaft (4) and meshes with and drives the governor driven bevel gear (7).

2-13. LUBRICATION SYSTEM FOR IO-520-A.

a. The engine driven, gear type oil pump draws oil from the sump through the oil suction tube and crankcase oil passage. From the gear chamber oil is directed to the oil filter chamber and to the tachometer drive gear. A filter by-pass valve is incorporated in the pump housing in the event that the filter becomes clogged.

b. After leaving the pump oil is directed through passages to the right crankcase oil gallery. Right side lifters, guides and valve mechanisms are lubricated by passages leading off this gallery. A Vernatherm valve is located at the front end of the right oil gallery to regulate oil temperature within specific limits. When oil reaches a temperature high enough to require cooling, Vernatherm expands and blocks passage, directing oil to the oil cooler. From the Vernatherm cavity oil is directed to the camshaft passage. A groove around the front of the camshaft directs oil to the front camshaft bearing and left crankcase oil gallery.

c. Lubricating oil is directed to the governor drive bearing and the propeller governor through passages off the left main gallery. Oil is channeled through a discharge port to the crankshaft oil transfer collar, which directs it to the crankshaft interior.

d. Passageways from the left crankcase gallery direct oil to the front, intermediate and rear main bearings.

e. Four drilled passages radiating from the rear main bearing conduct lubricating oil to the adapter ports of the fuel pump drive, right and left magneto and accessory drives and to starter shaft gear bearing. An intersecting passage directs oil to the idler gear support.

f. Oil is returned to the sump through a system of oil transfer tubes and drain holes.

2-14. LUBRICATION SYSTEM FOR IO-520-B & C.

a. Oil is drawn from the sump through the suction tube to the intake side of the engine driven, gear type, oil pump from the outlet side of the pump, oil is directed to the full flow, replaceable element oil filter. A by-pass valve is incorporated in the filter in the event that the element becomes clogged. Lubrication reaches the tachometer drive gears through oil passages drilled in the oil pump cover. An oil pressure relief valve is incorporated in the oil pump housing.

b. From the filter discharge port, oil is directed through a crankcase passage to the oil cooler. In addition to facilities for temperature and oil pressure connections, the oil cooler incorporates a Vernatherm valve. Oil passing through the Vernatherm cavity is directed either through the oil cooler or directly to the crankcase passage to the rear of the camshaft, depending on the oil temperature. In this manner, engine oil temperature is maintained at 175° F.

c. Oil entering the engine is directed to the hollow camshaft, which serves as the engine main oil gallery. Grooves and drilled holes in the camshaft are located so as to afford proper lubrication through a system of orifices to the main bearings, lifters, idler gear bushing, accessory drive gear bushings and the starter drive gear bearing.

d. Oil leaving the camshaft interior at the front of the crankcase is directed to the left main crankcase gallery. From there it is dorected to the main thrust bearing and the governor drive gear.

e. From the governor drive gear lubricating oil is directed to the crankshaft oil transfer collar, which in turn directs oil to the interior of the crankshaft.

f. Oil transfer tubes and drain holes are provided to return oil to the sump.

2-15. VALVE MECHANISM. Oil fed to hydraulic valve lifters, under pressure from the hollow camshaft is divided between the overhead system, the lifter guide surfaces and the reservoirs inside the lifters. The oil which reaches the pushrod ends is forced through the pushrods to the drilled rockers and the groove between their bushings. Each intake valve rocker directs a portion of its oil through a squirt nozzle towards the exhaust valve stem. The oil spray from the rockers lubricates the valve stems and springs. Oil is returned to the crankcase through the pushrod housings which are sealed to cylinder heads and crankcase by rubber packings. Drain holes in valve lifter guides direct the returning oil to the sump.

2-16. The barrel type hydraulic lifter (See figure 2-6) consists of a steel body (1), an expanding spring (2), and a check valve assembly (3, 4 and 5), a plunger (6), a socket (7) for pushrod end, and a retaining ring (8).

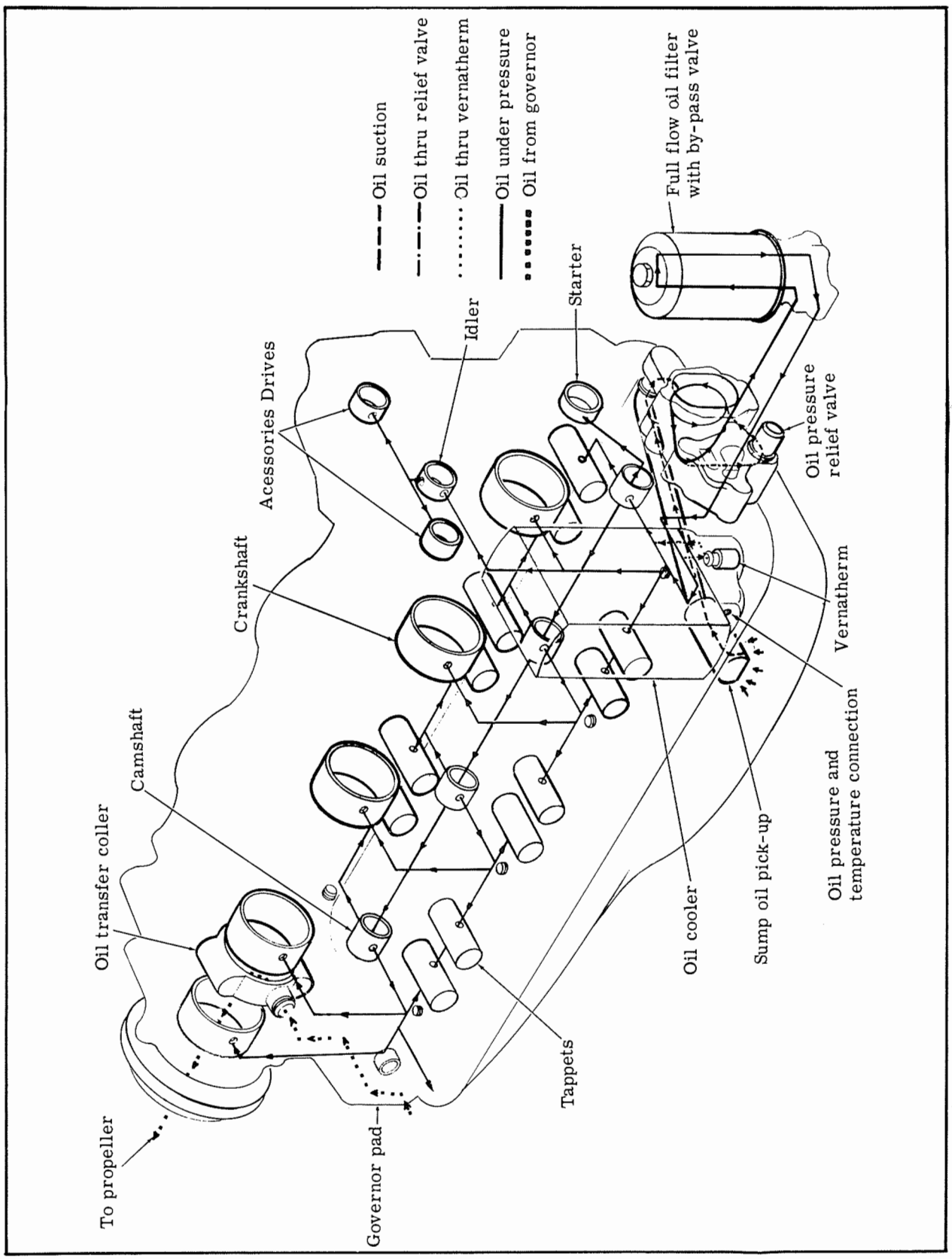
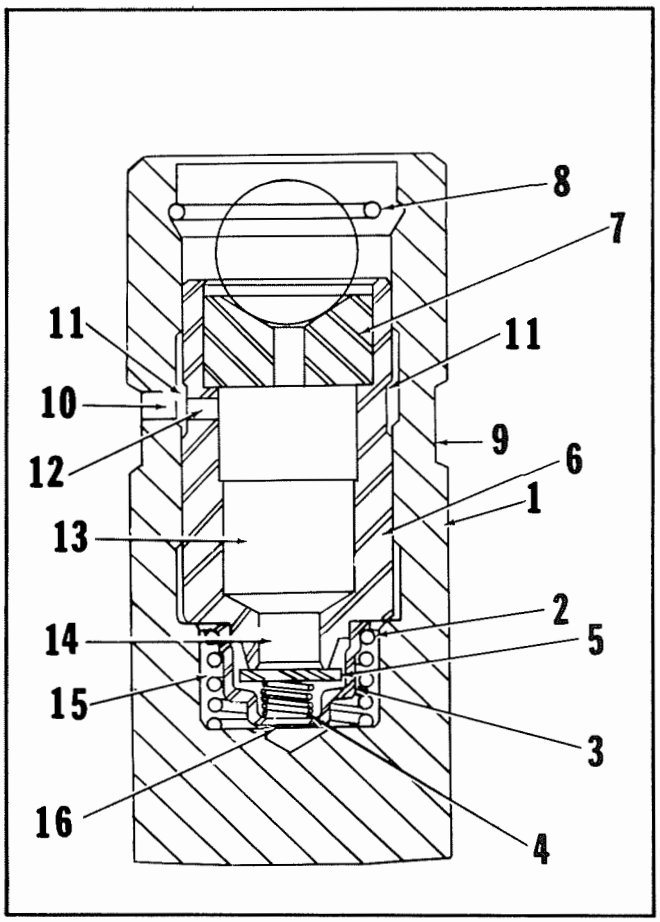


Figure 2-5. Lubrication System IO-520-B & C.



1. Body
2. Spring, plunger
3. Housing, check valve
4. Spring, check valve
5. Plate, check valve
6. Plunger
7. Socket
8. Ring, retaining
9. Oil groove, exterior
10. Oil inlet, body
11. Oil groove, interior
12. Oil inlet, plunger
13. Oil reservoir, plunger
14. Hole, oil discharge
15. Oil reservoir, body
16. Hole, oil outlet

Figure 2-6. Cut-away View of Hydraulic Valve Lifter

A groove (9), around outside of body, picks up oul from crankcase supply hole only when lifter is near outer end of its stroke so engine pressure will not "pump up" plunger and hold the valve off its seat. From the exterior groove oil is directed to interior body groove (11) through hole (10) and from the interior groove through the hole (12) to the reservoir (13). Oil is withheld from reservoir (15) by check valve plate (5) which is supported by spring (4) of housing (3). The check valve is opened by outward motion of the plunger under pressure of the expanding spring whenever a clearance occurs in the valve train. Thus the body reservoir is kept full of oil which transmits lifting force from body of plunger. The plunger and socket are fitted to the body selectively to permit a calibrated leakage so the lifter will readjust its effective length after each cycle, while cylinder valve is closed, to return "lash" in valve train to zero.

2-17. INDUCTION SYSTEM MODEL IO-520-A and IO-520-C. The air induction system used on the IO-520-A and IO-520-C engine consists of intake tubes, a balance tube, connecting hoses, clamp assemblies, a combination air throttle and fuel metering control. The air throttle assembly is located at the rear of engine. It is supported by two brackets, one attached at each corner of the oil sump and a bracket assembly that is attached to the crankcase cover at the accessory drive pads. The throttle assembly is connected by elbows to the rear cylinder intake tubes by connector hoses and clamps. These are connected to the center intake tubes and in turn the center to the front intake tubes in the same manner. Each intake tube is attached to a cylinder by a welded flange and four bolts and is sealed by a gasket. The front cylinder intake tubes are connected by a balance tube assembly. The balance tube incorporates a boss for connection of a manifold pressure line. The balance tube is supported by a bracket assembly attached to the front of the oil sump.

2-18. INDUCTION SYSTEM MODEL IO-520-B. This system is similar to that described in paragraph 2-17, except the air throttle assembly is located below and center of the oil sump facing the front of engine. An inverted manifold assembly connects and supports the throttle assembly at its rear. Two bolts secure throttle assembly to the oil sump. The manifold assembly incorporates a boss for connection of a pressure line, which is located at the rear of assembly. Due to possible fuel leakage from this system, when engine is not in operation, a manifold drain valve is provided at the lowest point of the manifold assembly next to throttle assembly.

SECTION III

SPECIAL TOOLS AND EQUIPMENT

3-1. It is advisable to have an engine transportation stand on which the engine can be inverted so certain parts can be removed or installed easily. A typical engine transportation stand is shown in Figure 3-1.

3-2. Figure 3-2 shows special tools used for removing and installing pushrod springs.

3-3. The tool in Figure 3-3 is used for installing the needle bearing in the starter adapter. This tool can be manufactured locally in accordance with the dimensions specified in Figure 3.

3-4. For replacing a new outer sleeve on the ignition harness use a Thomas & Betts Crimping Tool #WT-217.

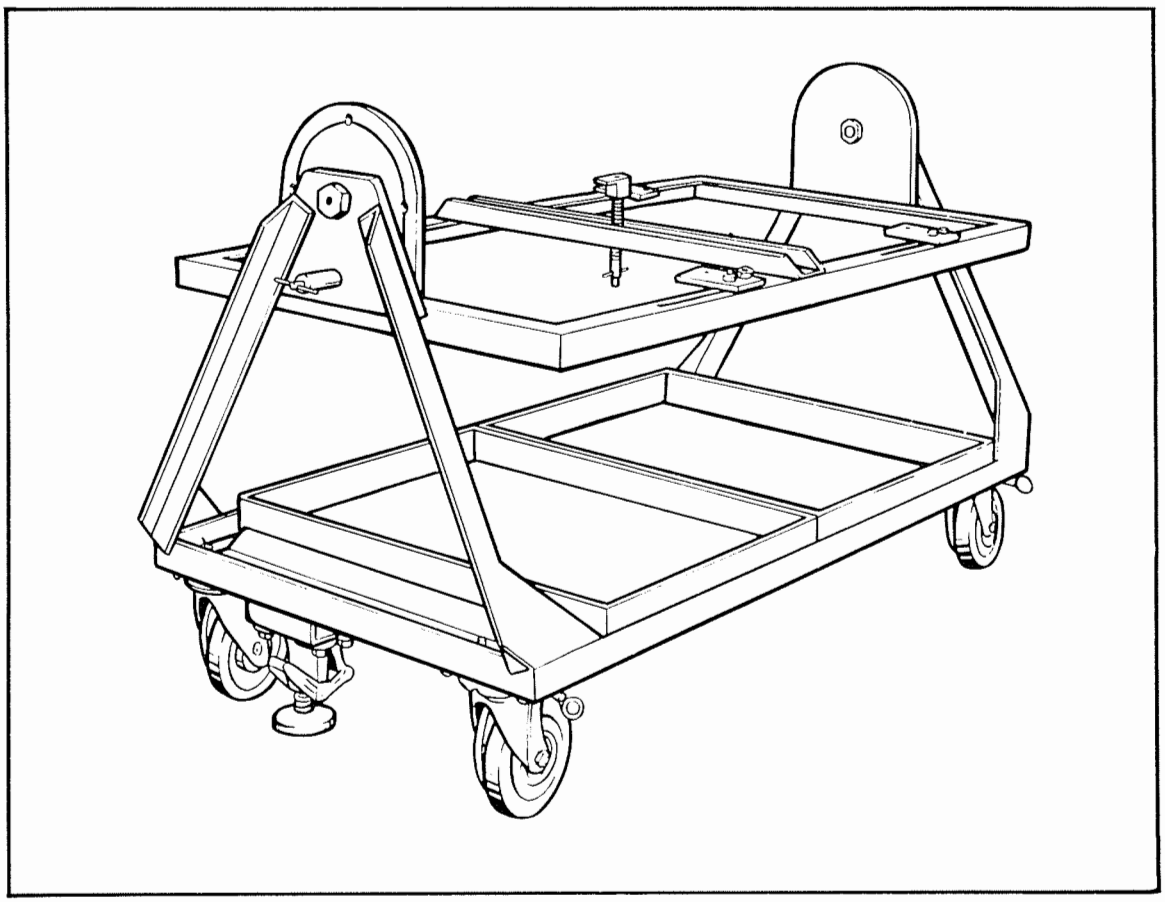
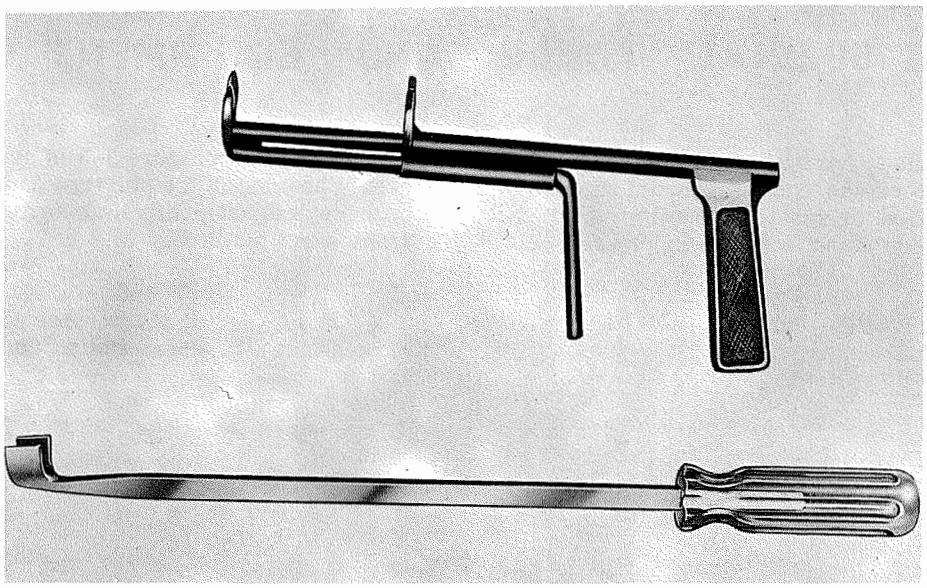


Figure 3-1. Engine Transportation Stand



1. Installing spring compressor
2. Removing spring compressor

Figure 3-2. Pushrod Housing Removal and Replacement Tools

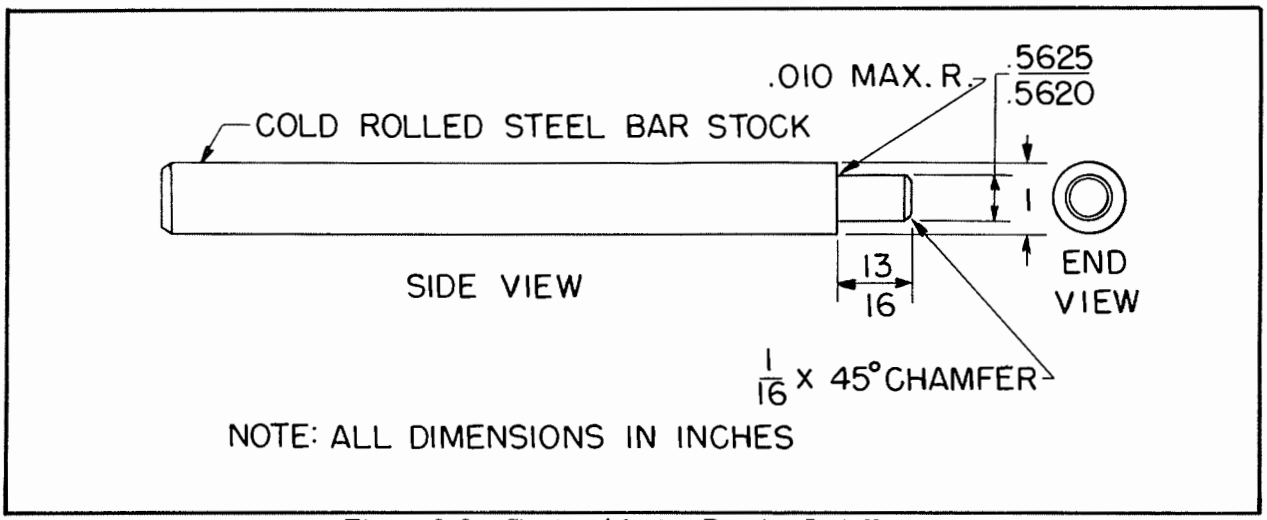


Figure 3-3. Starter Adapter Bearing Installer

SECTION IV

DISASSEMBLY

4-1. GENERAL.

4-2. AIRCRAFT PARTS AND ACCESSORIES.

4-3. Instructions in this section are based on the assumption that all parts attached by the aircraft manufacturer, except optional pumps, have been removed.

4-4. Accessories supplied by the engine manufacturer may be serviced according to instructions supplied by the applicable accessory manufacturer.

4-5. EXTENT OF DISASSEMBLY. Line drawings reproduced in this section are identical to those used in the parts catalog, except for order of index numbers assigned to components. Index numbers herein indicate the order of disassembly. In many instances the location of components and attaching parts in the illustration will be sufficient to enable personnel to accomplish disassembly operations. In such instances such disassembly is to be accomplished, even though there are no printed instructions to that effect, excepting those parts which need to be removed only for replacement. Such parts include studs, bushings, and other tight fit inserts. The identity of these will be obvious.

4-6. PARTS TO BE DISCARDED. Discard all palnuts, shakeproof washers, lockwires, tab washers, rubber seal rings, oil seals, gaskets, cotter pins, hose connectors and magneto coupling (rubber) bushings in such manner that they will not be used again inadvertently. Care should be taken in removing gaskets from aluminum parts by scraping. Such removal should be delayed until the part is to be cleaned.

4-7. DISASSEMBLY STAND. For greatest ease of disassembly, this engine should be mounted on an engine stand with a tilting bed. See the installation drawings for necessary dimensions for mounting engine on stand.

4-8. PRELIMINARY CLEANING. Spray, or apply with a brush, a solvent used for general cleaning of engine parts. Remove caked dirt on bolt heads and nuts especially. At the same time the oil sump drain plugs should be removed to drain any remaining oil.

CAUTION

Do not use a caustic or even mild alkaline cleaning solution for external precleaning, as these solutions will also remove the "alodized" finish of certain aluminum parts.

4-9. DISMANTLING.

4-10. IGNITION SYSTEM.

a. Disconnect cables from spark plugs.

b. Detach ignition cable retaining clamps from fuel discharge brackets.

c. Detach clip from cable bracket on top of crankcase. Disengage band clamps.

d. Detach high tension cable outlet plates from magnetos and withdraw them to free cable assemblies.

e. Remove two attaching nuts, lockwashers and holding washers from each magneto. Withdraw magnetos forward from the crankcase.

4-11. FUEL INJECTION SYSTEM IO-520-A. (See Figure 4-1).

a. Disconnect six fuel, discharge tubes (2) from manifold valve (59) and nozzles (3). Compress spring legs of each clamp (1), in turn, and remove clamp. Disconnect hose assembly (10) from manifold. Remove nozzles (3) and store in a clean container.

NOTE

Further disassembly of the nozzle should not be attempted unless flow-test equipment is available.

b. Disconnect hose assemblies (8 and 9) from fuel pump (44). Disconnect hose assemblies at fuel control (25) and remove hose assemblies. Remove shroud attaching parts (11, 12, 13) and remove shroud (14).

c. Remove spring (18), two sets of cotter pins (15) and washers (16 and 17) and remove link rod assembly. Remove screws (23) and tab washers (24) and separate fuel control from throttle control.

d. Remove attaching parts (41, 42, 43) and remove fuel pump (44) and shroud assembly (49) as a unit. Disconnect spring (45), screw (46) and nut (47) and remove shroud from fuel pump. Remove gasket (50), fuel pump drive coupling (51) and fuel pump drive gear assembly (52).

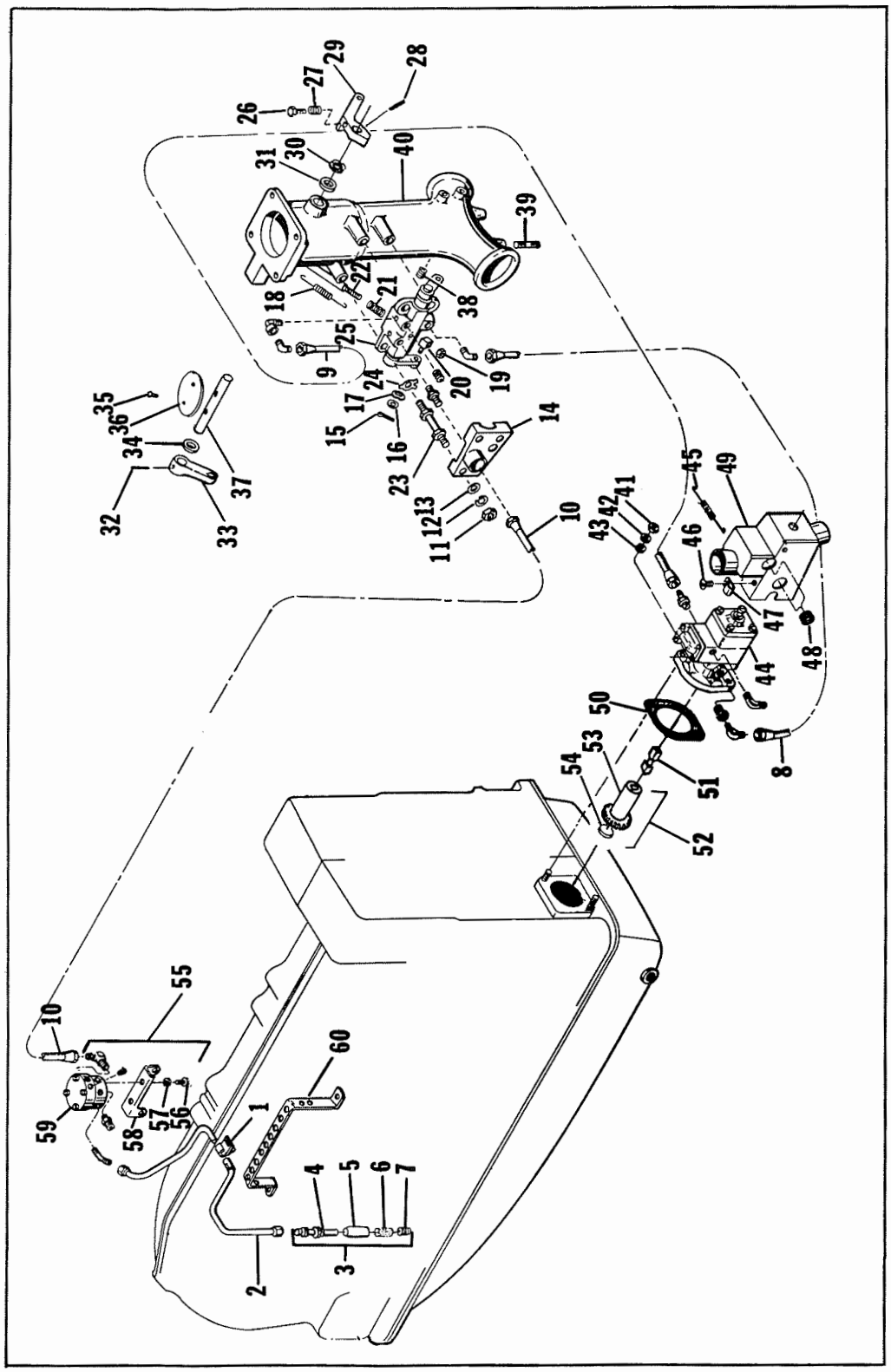


Figure 4-1. Fuel Injection System IO-520-A

1. Clamp, Fuel Discharge Tube
2. Tube Assembly
3. Nozzle Assembly
4. Nozzle
5. Shield, Dust
6. Screen
7. Jet
8. Hose Assembly
9. Hose Assembly
10. Hose Assembly
11. Nut, Plain, Hex
12. Washer, Lock
13. Washer, Plain
14. Shroud Assembly
15. Pin, Cotter
16. Washer, Plain
17. Washer, Wave
18. Spring, Throttle
19. Nut, Elastic Stop
20. Rod End, Special
21. Spring, Compression
22. Rod and Link Assembly
23. Screw, Special
24. Washer, Tab
25. Control Assy, Complete
26. Screw, Idle Adjusting
27. Spring, Idle Adjusting
28. Pin, Tubular
29. Lever, Throttle Shaft
30. Washer, Wave
31. Washer, Plain
32. Pin, Tubular
33. Lever
34. Washer, Plain
35. Screw
36. Plate, Air Throttle
37. Shaft
38. Plug, Pipe
39. Stud
40. Body Assembly, Air
41. Nut, Plain, Hex
42. Washer, Lock
43. Washer, Plain
44. Fuel Pump Assembly
45. Spring
46. Screw
47. Nut, Tinnerman
48. Grommet
49. Shroud Assembly
50. Gasket
51. Coupling Drive
52. Gear Assy, Fuel Pump
53. Gear
54. Plug
55. Valve Assy, Fuel Manifold
56. Screw
57. Washer, Lock
58. Bracket
59. Fuel Manifold Valve
60. Bracket, Discharge Tubes

Legend for Figure 4-1.

e. Remove two sets of manifold valve-to-crankcase attaching parts and remove manifold and bracket as a unit. Remove attaching parts (56, 57) to separate bracket (58).

NOTE

Further disassembly of the fuel injection system components is not advised unless proper test equipment is available.

For further information see Continental Fuel Injection System Manual FIS-3.

4-12. FUEL INJECTION SYSTEM IO-520-B. (See Figure 4-2).

a. Disconnect six fuel discharge tubes (2) from manifold valve (53) and nozzles (3). Compress spring legs of each clamp (1) in turn, and remove tubes and clamps. Disconnect hose (8) at fuel manifold valve. Remove nozzles (3) and store in a clean container.

NOTE

Further disassembly of the nozzles should not be attempted unless flow test equipment is available.

b. Invert engine and disconnect hose assemblies (8 and 9) from the fuel control (32) and hose assemblies (9) from the fuel pump (49). Remove three sets of attaching parts (13, 14, 15 and 16) from clamps (10, 11, 12) and remove hose assemblies (8 and 9).

c. Loosen air throttle body to intake manifold hose clamp and remove attaching parts (17 and 18) and withdraw air throttle and fuel control as a unit.

d. To separate fuel control (32) from air throttle body (45) remove two sets of cotter pins (19), plain washers (20), and wave washers (21) and remove link rod assembly (22 through 25). Remove nut (26), washers (27, 28), screw (29) and tab washer (30). Metering unit shroud (31) will also come free at this time.

e. Further disassembly of the air throttle body, if necessary, may be accomplished in the order of index numbers assigned.

f. Remove fuel pump attaching parts (46, 47 and 48) and withdraw fuel pump (49) and shroud (50). Remove coupling (51) and gasket (52).

g. Remove two sets of crankcase-to-crankcase nuts, washers and bolts and lift off fuel manifold valve and bracket (53) separate bracket from manifold valve by removing screws (54) and washers (55).

NOTE

Further disassembly of fuel injection system components is not advised unless proper test equipment is available.

For further information see Continental Fuel Injection System Manual FIS-3.

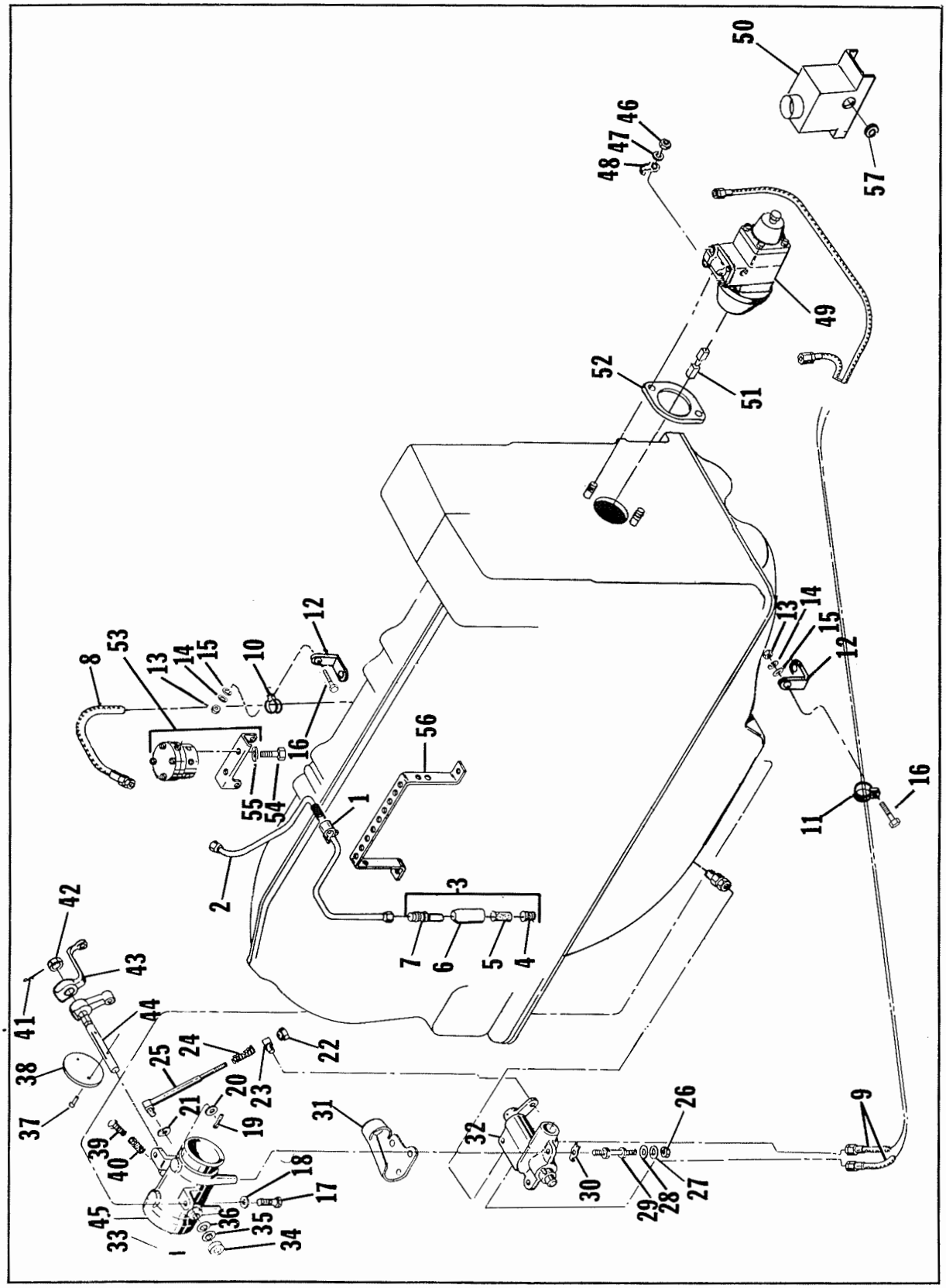


Figure 4-2. Fuel Injection System IO-520-B

1. Clamp
2. Tube Assembly
3. Nozzle Assembly
4. Jet
5. Screen
6. Shield, Dust
7. Nozzle
8. Hose Assembly
9. Hose Assembly
10. Clamp
11. Clamp
12. Bracket
13. Nut, Plain, hex
14. Washer, Lock
15. Washer, Plain
16. Bolt
17. Bolt
18. Washer, Plain
19. Pin, Cotter
20. Washer, Plain
21. Washer, Wave
22. Nut, Elastic Stop
23. Rod End, Special
24. Spring, Compression
25. Rod and Link Assembly
26. Nut, Plain, Hex
27. Washer, Lock
28. Washer, Plain
29. Screw
30. Washer, Tab
31. Shroud, Metering Shaft
32. Control Assembly
33. Pin, Tubular
34. Collar
35. Washer, Wave
36. Washer, Plain
37. Screw
38. Plate, Air Throttle
39. Screw, Idle Adjusting
40. Spring
41. Pin, Cotter
42. Nut, Plain, Hex
43. Lever, Throttle Control
44. Shaft, Air Throttle
45. Body Assembly, Air
46. Nut, Plain, Hex
47. Washer, Lock
48. Washer, Hold Down
49. Fuel Pump Assembly
50. Shroud Assembly
51. Coupling
52. Gasket
53. Fuel Manifold Valve Assy
54. Screw
55. Washer, Lock
56. Bracket, Discharge Tubes
57. Grommet

Legend for Figure 4-2.

4-13. MAGNETO AND ACCESSORY (See Figure 4-3).

a. Remove two sets of attaching parts (1, 2, 3) and six sets of attaching parts (4, 5, 6) and remove adapter assembly (7) and related parts as a unit.

b. Remove gear assembly (18), magneto drive coupling bushings (21) and retainer (22).

c. Remove attaching parts (8, 9, 10) and lift cover (11) and gasket (12). Remove oil seal (14) from adapter (17).

4-14. INDUCTION SYSTEM (See Figure 4-4).

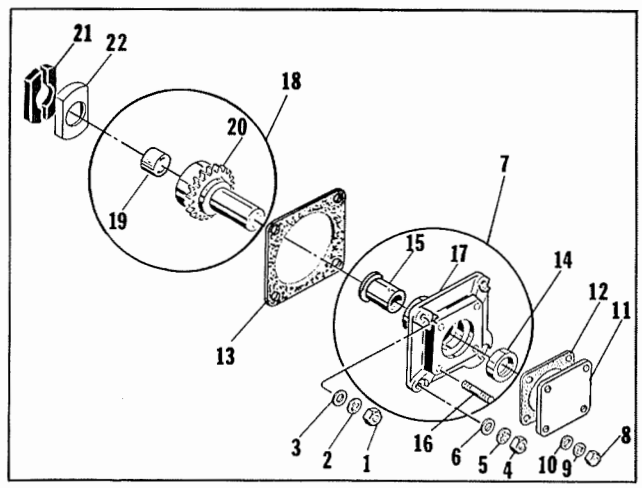
a. Loosen hose clamps (1) or clamp assemblies (2) on hoses (3) or (4) and remove elbows (5, 6) or elbow assembly (7).

b. Remove attaching parts (8, 9) loosen hose clamps (11, 12) and remove balance tube (13) and bracket (10).

c. Loosen hose clamps (14) from hoses (15) and remove attaching parts (16, 17, 18). Remove intake manifold tubes (19, 20) and gasket (21).

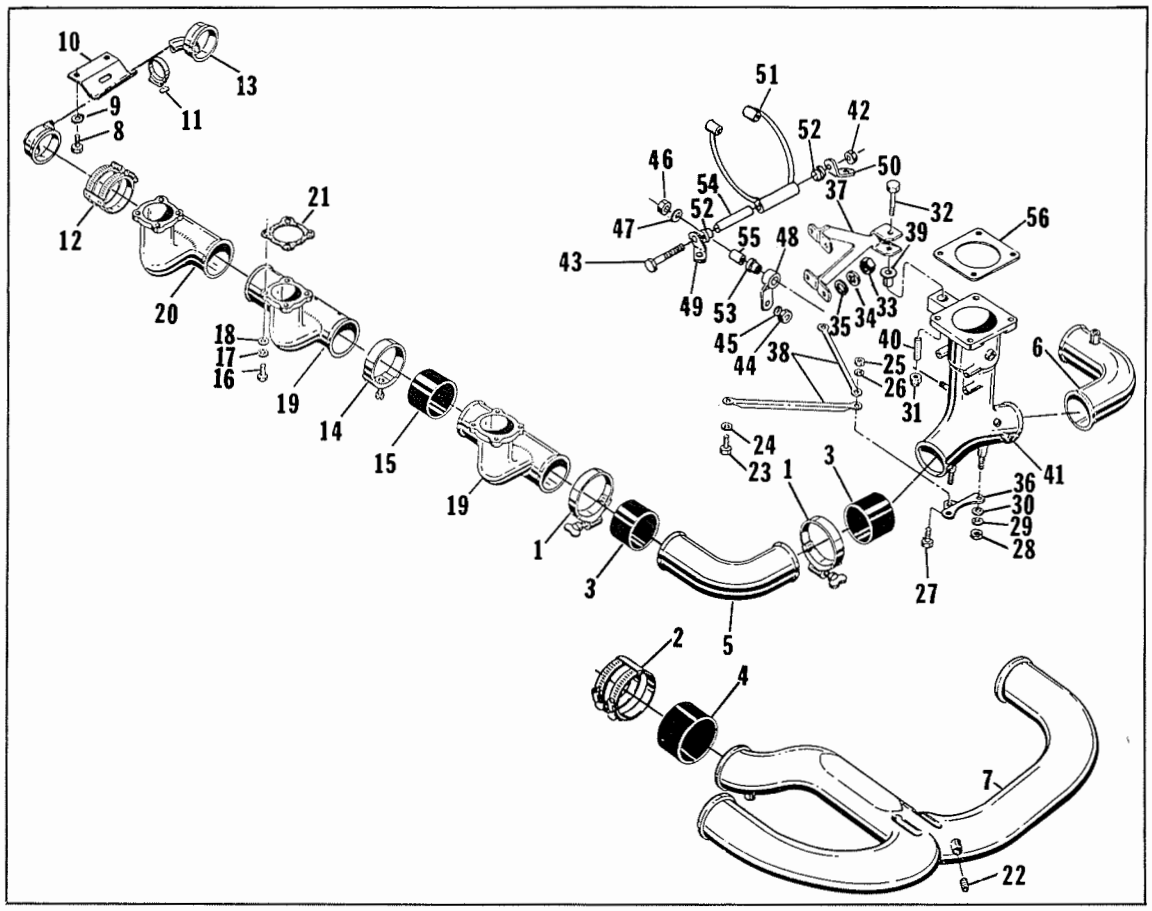
d. IO-520-A BRACKETS. Remove attaching parts (23 through 35) to separate brackets (36, 37, 38), bushing (39), sleeve (40) and housing (41).

e. IO-520-C BRACKETS. Remove attaching parts (42 through 47) to separate brackets (48, 49, 50, 51), bushing (52, 53), sleeves (54, 55) and housing (41).



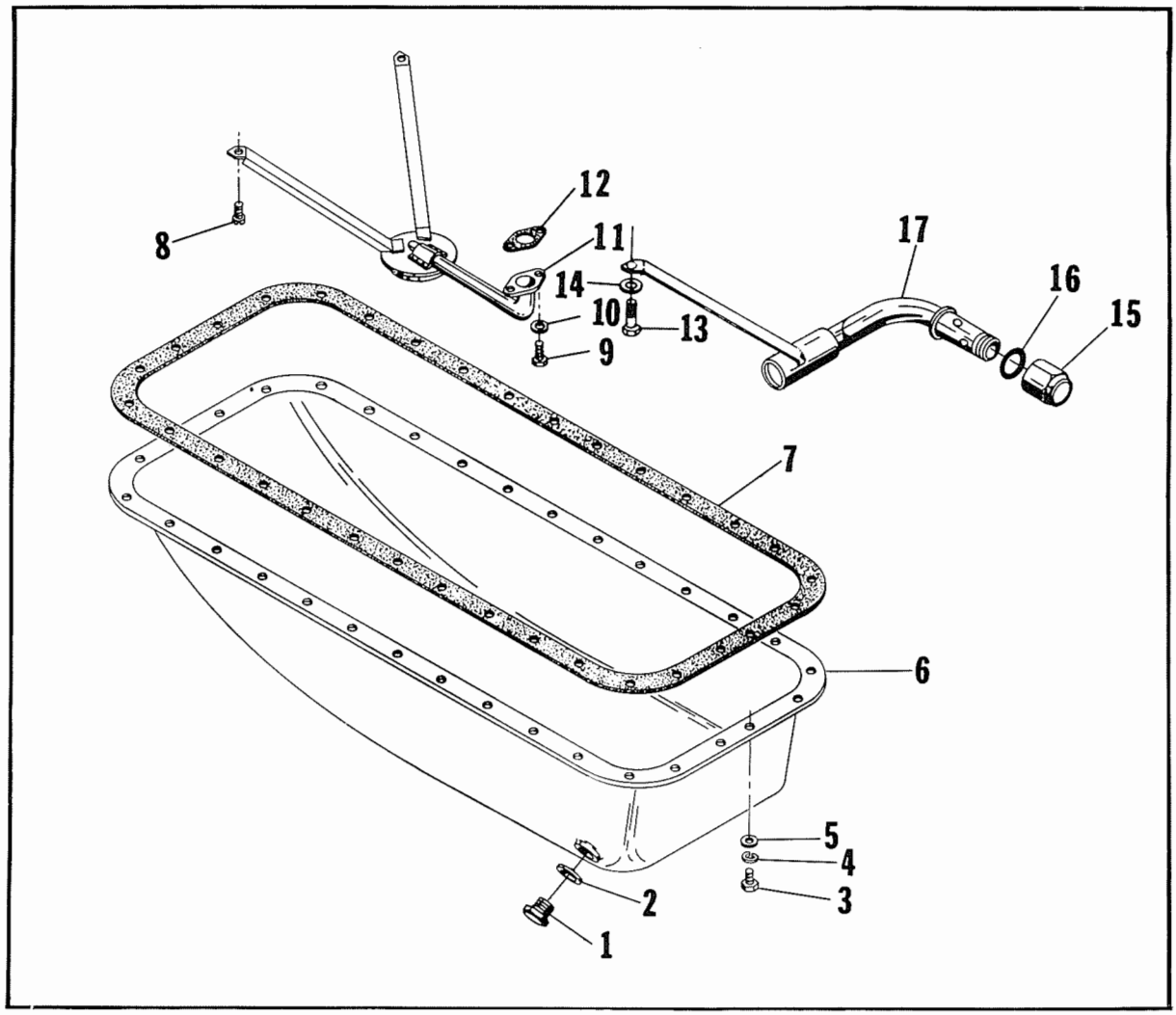
1. Nut, Plain, Hex
2. Washer, Lock
3. Washer, Plain
4. Nut, Plain, Hex
5. Washer, Lock
6. Washer, Plain
7. Adapter Assembly
8. Nut, Plain, Hex
9. Washer, Lock
10. Washer, Plain
11. Cover, Accy Drive
12. Gasket
13. Gasket
14. Seal, Oil
15. Bushing, Adapter
16. Stud
17. Adapter
18. Gear Assembly
19. Sleeve
20. Gear, Drive
21. Bushing
22. Retainer

Figure 4-3. Magneto & Accessory Drives IO-520-A, B & C



1. Clamp, Hose
2. Clamp Assembly
3. Hose, Intake Manifold
4. Hose
5. Tube Assy, Elbow, 2-4-6 Side
6. Tube Assy, Elbow, 1-3-5 Side
7. Manifold Assembly
8. Bolt
9. Washer, Lock
10. Bracket
11. Clamp
12. Clamp
13. Tube Assembly, Balance
14. Clamp, Hose
15. Hose
16. Screw
17. Washer, Lock
18. Washer, Plain
19. Tube Assembly
20. Tube Assembly
21. Gasket
22. Plug, Pipe
23. Screw
24. Washer, Lock
25. Nut, Plain, Hex
26. Washer, Lock
27. Screw
28. Nut, Plain, Hex
29. Washer, Lock
30. Washer, Plain
31. Nut, Self Locking
32. Bolt
33. Nut, Plain, Hex
34. Washer, Lock
35. Washer, Plain
36. Bracket
37. Bracket
38. Bracket
39. Bushing
40. Sleeve
41. Throttle Assembly, Air
42. Nut, Self Locking
43. Bolt
44. Nut, Plain, Hex
45. Washer, Lock
46. Nut, Plain, Hex
47. Washer, Lock
48. Bracket Assembly
49. Bracket
50. Bracket
51. Bracket Assembly
52. Bushing
53. Bushing
54. Sleeve
55. Sleeve
56. Gasket

Figure 4-4. Induction System IO-520-A, B & C



1. Plug, Oil Drain
2. Gasket, Annular
3. Screw
4. Washer, Lock
5. Washer, Plain
6. Sump Assembly, Oil
7. Gasket, Oil Sump
8. Screw
9. Screw
10. Washer, Plain
11. Tube Assembly
12. Gasket
13. Screw
14. Washer, Plain
15. Nut, Acorn
16. Gasket, Annular
17. Tube Assembly

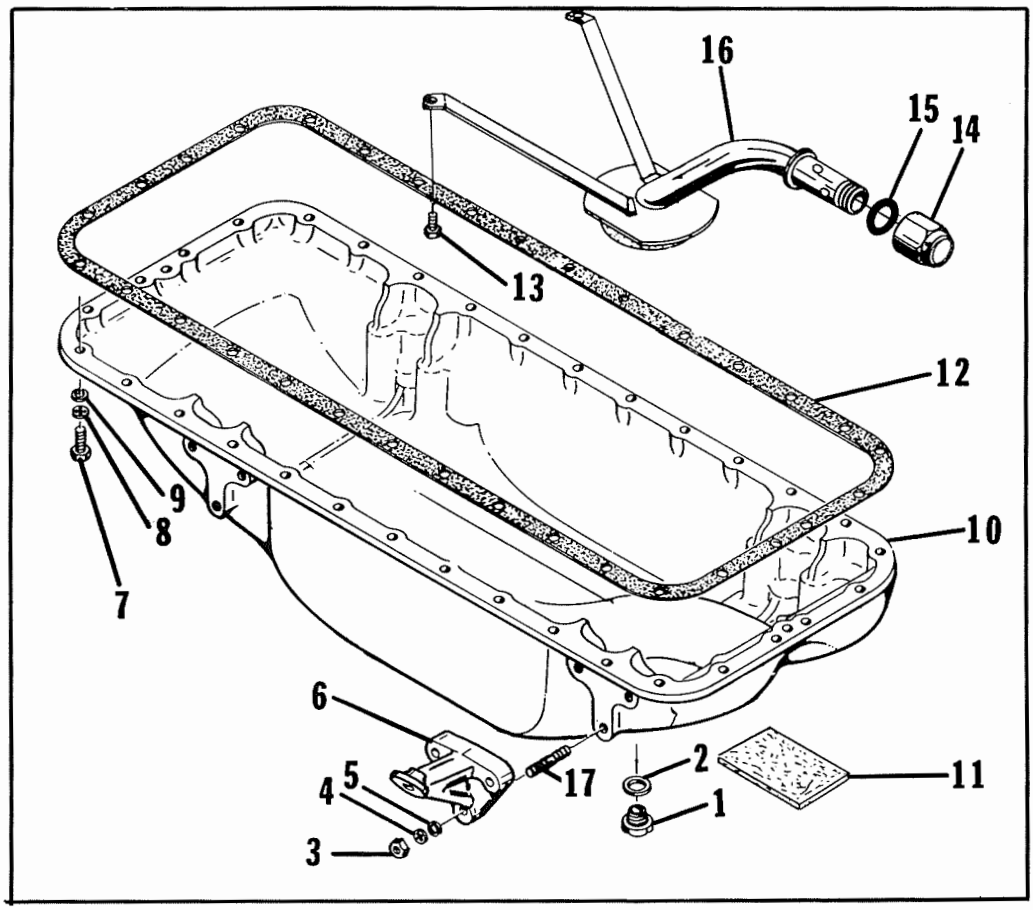
Figure 4-5. Oil Sump IO-520-A & C

4-15. OIL SUMP IO-520-A & C (See Figure 4-5).

a. Drain plug (1) and gasket (2) should have been removed when engine was mounted on stand. Remove attaching parts (3, 4, 5) and lift sump from engine.

b. Remove screws (8, 9) and washers (10) and lift off suction tube assembly (11).

c. Remove screw (13), washer (14), acorn nut (15) and gasket (16) and withdraw oil suction tube (17).



1. Plug, Oil Drain
2. Gasket
3. Nut, Plain, Hex
4. Washer, Lock
5. Washer, Plain
6. Bracket, Engine Mount
7. Screw
8. Washer, Lock
9. Washer, Plain
10. Sump, Oil
11. Felt
12. Gasket, Oil Sump
13. Screw
14. Nut, Acorn
15. Gasket, Annular
16. Tube Assembly
17. Stud

Figure 4-6. Oil Sump IO-520-B

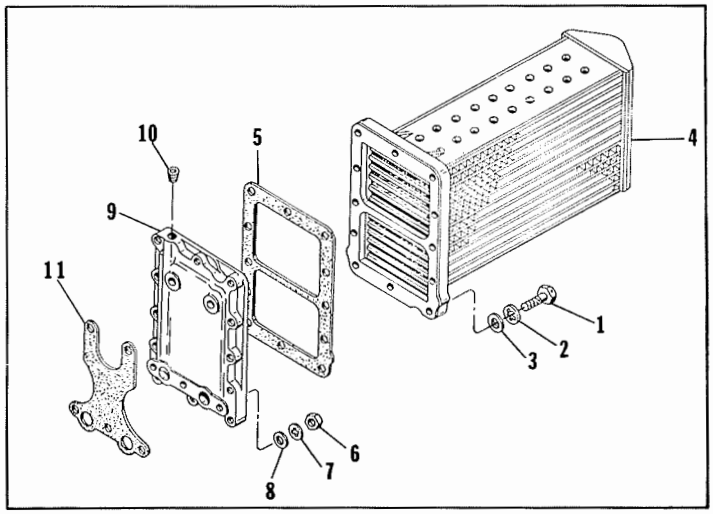
4-16. OIL SUMP IO-520-B (See Figure 4-6).

a. Drain plug (1) and gasket (2) should have been removed when engine was mounted on stand.

b. Remove attaching parts (3, 4, 5) and lift off mounting legs (6).

c. Remove attaching parts (7, 8, 9) and lift off sump (10).

d. Remove screw (13), acorn nut (14), gasket (15) and withdraw oil suction tube (16).



1. Screw
2. Washer, Lock
3. Washer, Plain
4. Cooler Assembly
5. Gasket
6. Nut, Plain, Hex
7. Washer, Lock
8. Washer, Plain
9. Plate
10. Plug, Pipe
11. Gasket

Figure 4-7. Oil Cooler IO-520-A

4-17. OIL COOLER IO-520-A (See Figure 4-7).

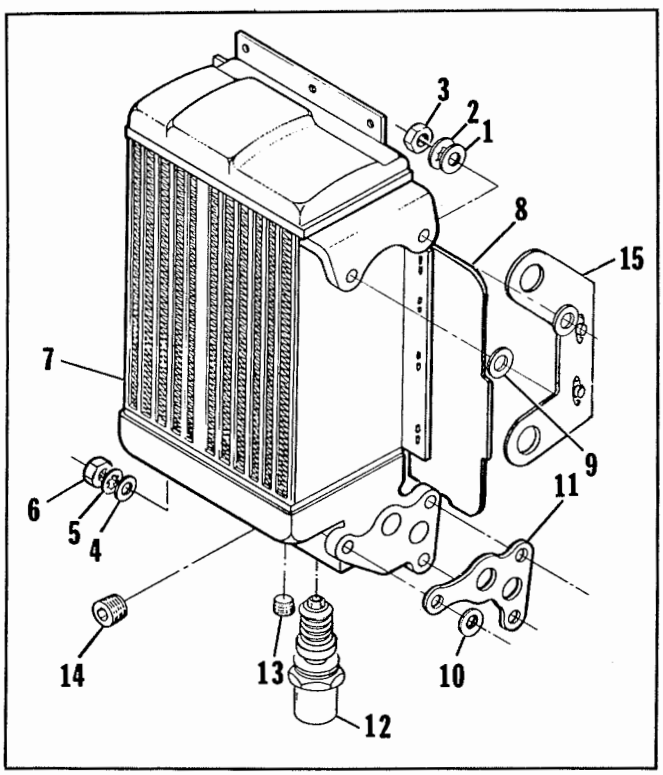
a. Remove attaching parts (1, 2, 3) and separate cooler (4) from adapter.

b. Remove attaching parts (6, 7, 8) and pull adapter (9) from crankcase.

4-18. OIL COOLER IO-520-B & C (See Figure 4-8).

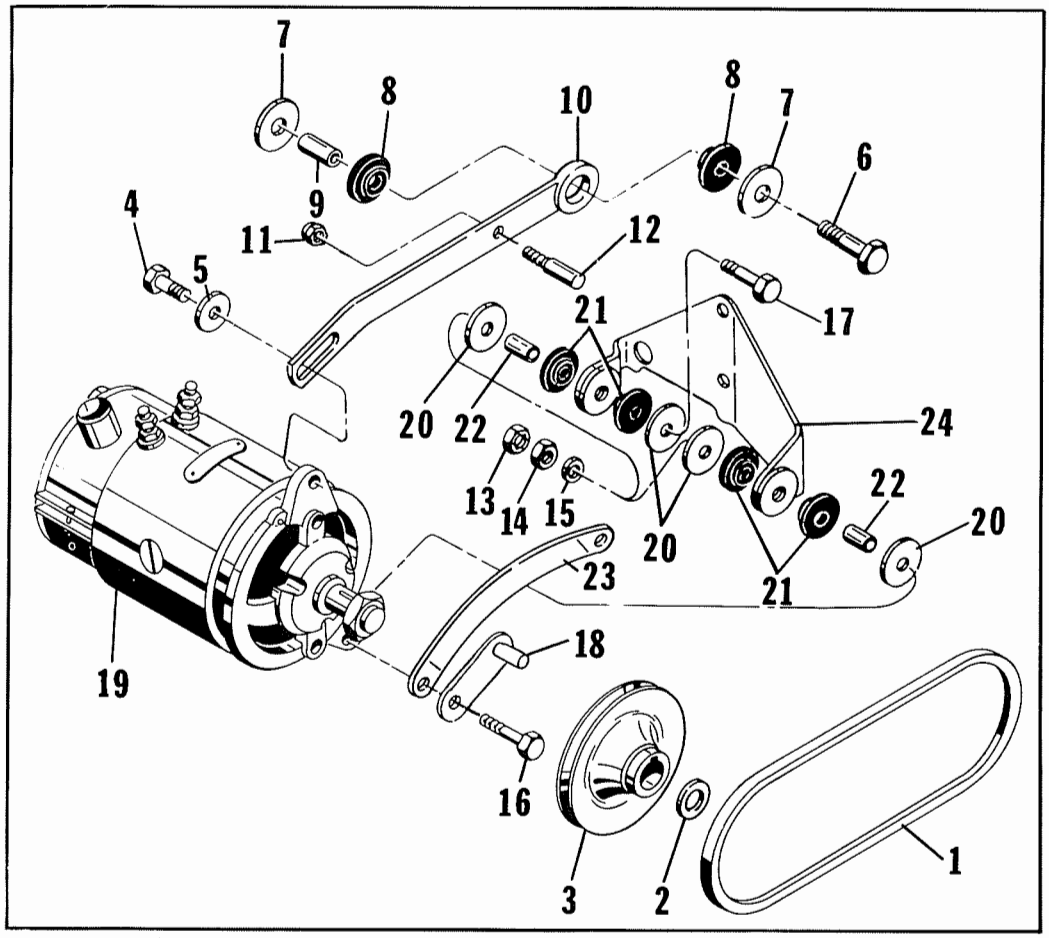
a. Remove four sets of attaching parts (1, 2, 3) and one set of attaching parts (4, 5, 6) and remove oil cooler.

b. Remove baffle (15) and vernatherm valve (12).



1. Washer, Plain
2. Washer, Lock
3. Nut, Plain, Hex
4. Washer, Plain
5. Washer, Lock
6. Nut, Plain, Hex
7. Oil Cooler
8. Baffle
9. Gasket
10. "O" Ring
11. Gasket
12. Valve Assembly
13. Plug
14. Plug
15. Support Assembly, Baffle

Figure 4-8. Oil Cooler IO-520-B & C



1. Belt, Generator Driven
2. Spacer, Generator Driven
3. Sheave, Generator Driven
4. Screw
5. Washer, Plain
6. Screw
7. Washer, Special
8. Bushing, Rubber
9. Bushing, Spacer
10. Bracket
11. Nut, Self Locking
12. Idler, Kiss
13. Palnut
14. Nut, Plain, Hex
15. Washer, Plain
16. Bolt
17. Bolt
18. Bracket Assembly
19. Generator, 12 Volt, 50 Amp
20. Washer, Special
21. Bushing, Rubber
22. Bushing, Spacer
23. Bracket, Support
24. Bracket, Mounting

Figure 4-9. Generator Assembly IO-520-A

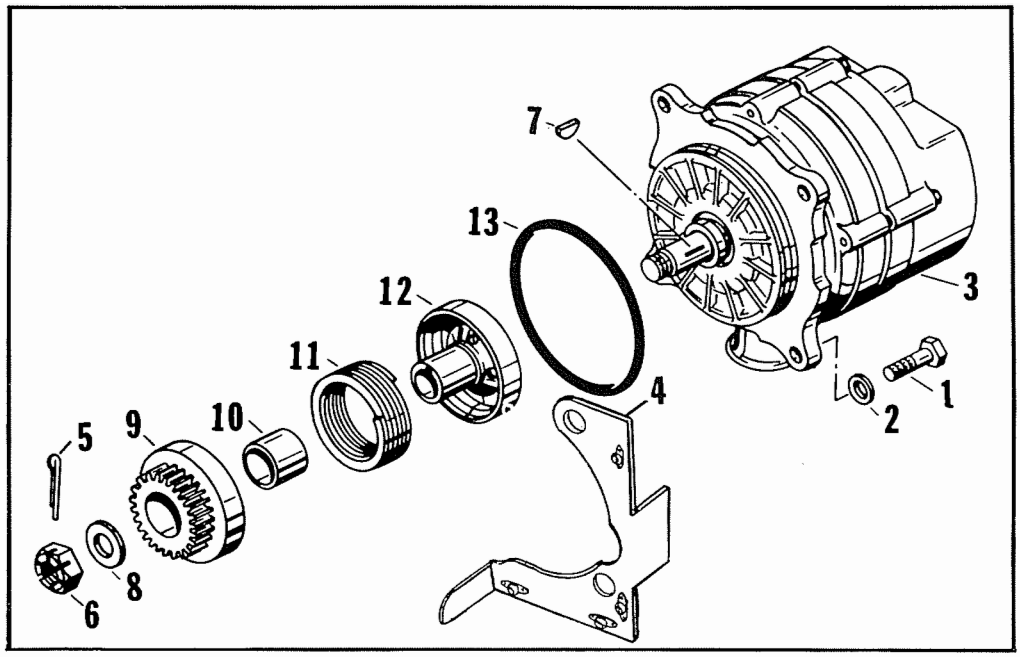
4-19. GENERATOR IO-520-A (See Figure 4-9).

a. Loosen sheave retaining nut on both starter drive adapter and generator and adjusting arm screw. Tilt generator and remove belt (1).

b. Remove generator sheave retaining nut and remove spacer (2) and sheave (3). Tape woodruff key to shaft and replace retaining nut to protect threads.

c. Remove bracket adjusting screw (4) and washer (5). Remove bracket retaining screw (6), washers (7), bushings (8), and sleeve (9) to remove bracket (10).

d. Remove palnut (13), nut (14) and washer (15), and bolts (16, 17). Idler kiss bracket (18) will come off at this time. Generator (19) should pull free. Remove special washers (20), bushings (21), and bushing spacer (22). Remove support bracket (23) and mounting bracket (24) by removing nuts and washers retaining them to the crankcase.



1. Bolt
2. Washer, Plain
3. Alternator
4. Support Assembly, Baffle
5. Pin, Cotter
6. Nut, Slotted, Hex
7. Woodruff Key
8. Washer, Thrust
9. Gear
10. Bushing
11. Spring, Clutch
12. Hub, Alternator
13. "O" Ring

Figure 4-10. Alternator Assembly IO-520-B & C

4-20. ALTERNATOR ASSEMBLY IO-520-B & C (See Figure 4-10).

a. Remove four sets of attaching parts (1, 2) and pull alternator (3) and baffle (4) from crankcase.

b. Remove cotter pin (5), nut (6) and pull hub assembly from alternator shaft. Remove woodruff key (7).

c. Separate thrust washer (8), gear assembly (9, 10), clutch spring (11) and hub (12).

d. Remove "O" ring (13).

4-21. STARTER AND STARTER DRIVE ADAPTER IO-520-A (See Figure 4-11).

a. Remove two sets of attaching parts (1, 2, 3) and pull starter from starter adapter studs. Remove "O" ring (5).

b. Remove attaching parts (6 through 11) and pull starter adapter assembly from crankcase studs. Remove gasket (12).

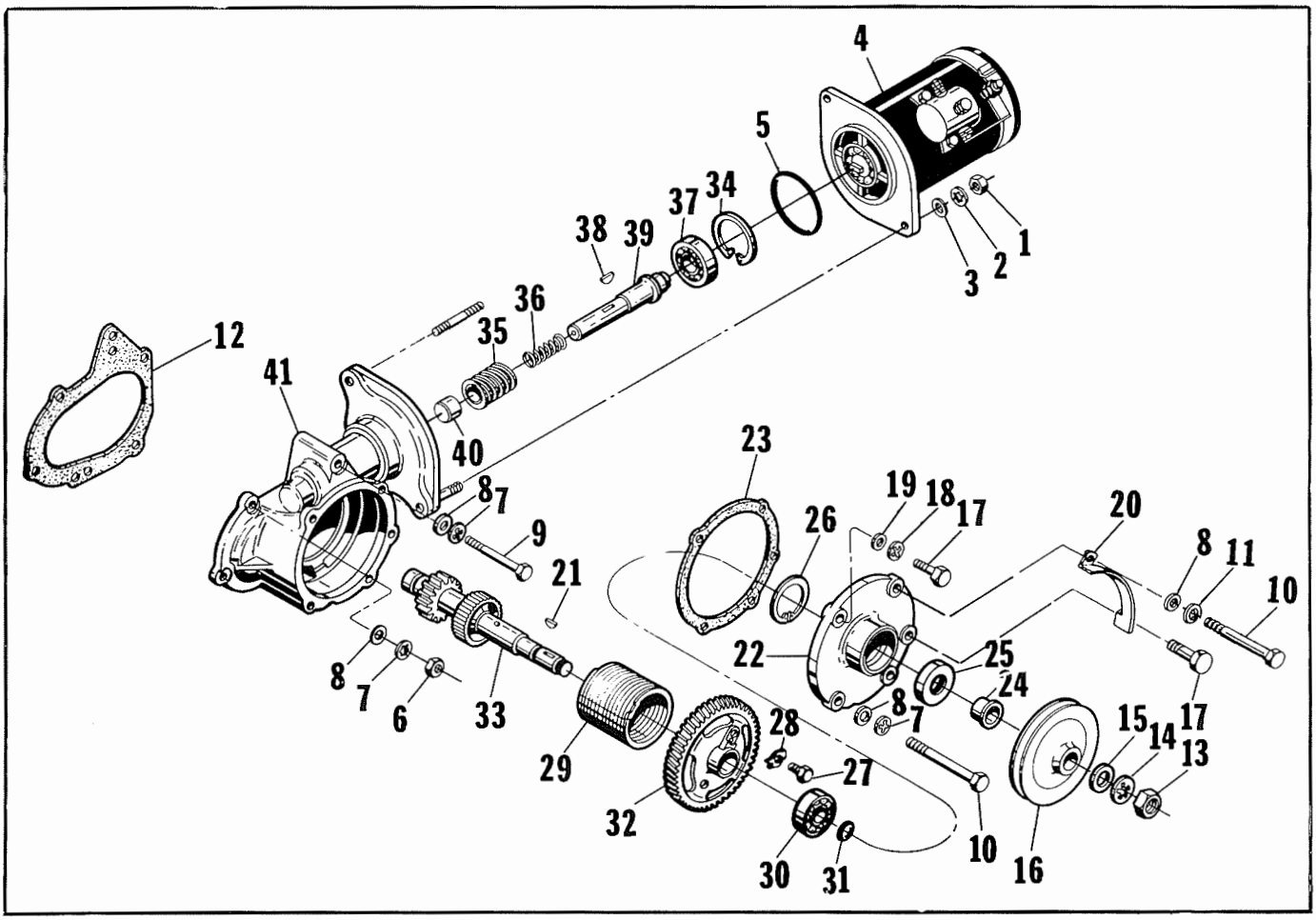
c. Clamp shaft gear (33) in shielded vise jaws and remove nut (13), lockwasher (14) and plain washer (15). Pull sheave (16) from shaft and remove woodruff key (21).

d. Remove attaching parts (17, 18, 19) and pull cover (22) together with sleeve (24) and oil seal (25) from shaft.

e. Use Truarc No. 3 or No. 23 pliers and remove retaining ring (26). Remove sleeve and use arbor press to remove oil seal. Remove gasket (23) from adapter.

f. Support rear side of adapter (41) on blocks and tap front end of clutch spring (29) carefully with a brass drift or pin punch all around.

g. Use a wheel puller or arbor press to press the shaftgear (33) from the wormwheel (32) and bearing (30).



1. Nut
2. Lockwasher
3. Washer, Plain
4. Starter
5. "O" Ring
6. Nut
7. Washer, Lock
8. Washer, Plain
9. Bolt
10. Bolt
11. Washer, Lock
12. Gasket
13. Nut
14. Washer, Lock
15. Washer, Plain
16. Sheave
17. Screw
18. Washer, Lock
19. Washer, Plain
20. Indicator, Timing
21. Woodruff Key
22. Cover
23. Gasket
24. Sleeve
25. Oil Seal
26. Retaining Ring
27. Screw
28. Tab Washer
29. Clutch Spring
30. Bearing, Ball
31. "O" Ring
32. Worm Wheel
33. Shaftgear
34. Ring, Retaining
35. Gear, Starter Worm
36. Spring
37. Bearing, Ball
38. Woodruff Key
39. Shaft, Worm Drive
40. Needle Bearing
41. Adapter

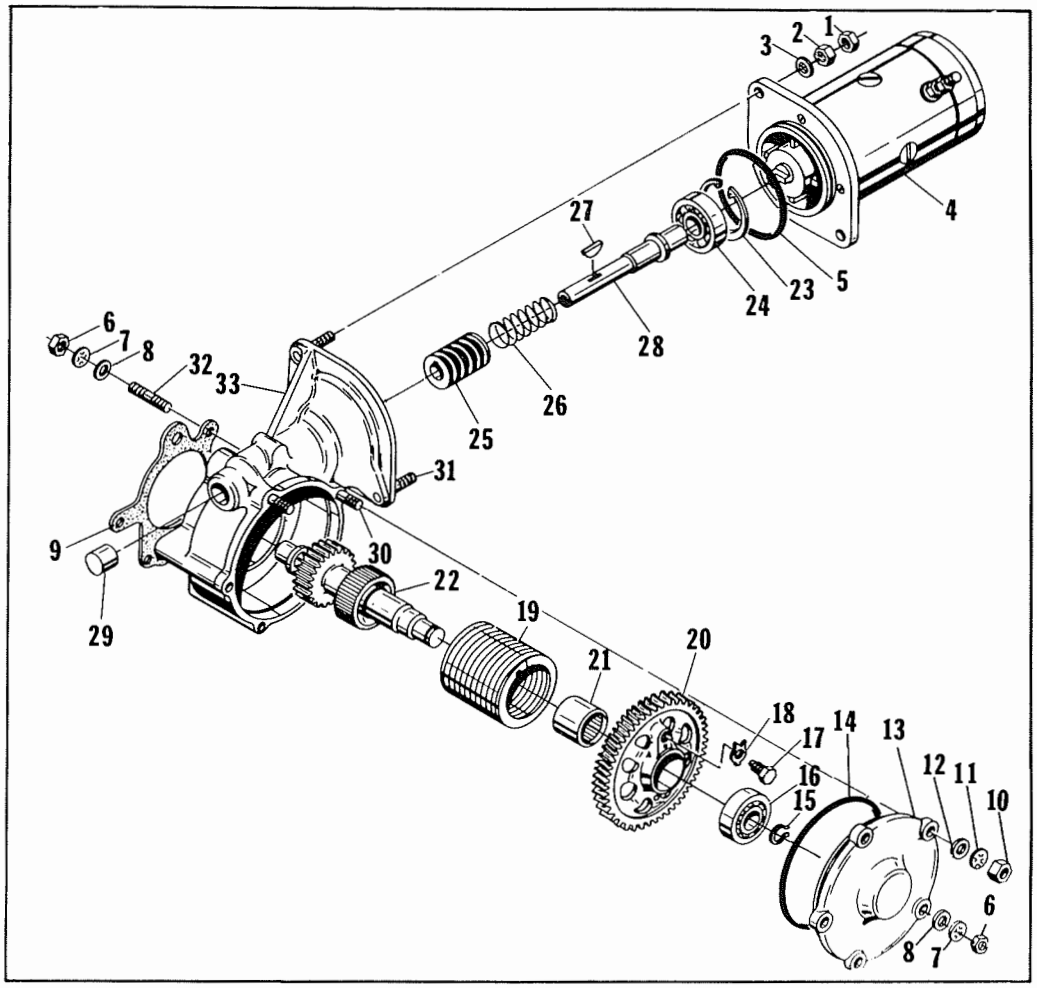
Figure 4-11. Starter Adapter IO-520-A

h. Clamp wormwheel in shielded vise and remove retaining screw (27) and tab washer (28). Rotate the spring until its depressed rear end lies across the upper 1/4 inch hole in the flange. Insert a 3/16 inch wide screwdriver blade, and pry the spring end outward clear of the drum groove. Hold it out while pulling the spring away.

i. Clamp adapter in shielded vise and remove retaining ring (34) with Truarc No. 5 or No. 25 pliers. Remove bearing (37) and worm and shaft assembly.

j. Separate worm gear (35), spring (36), woodruff key (38) and shaft (39).

k. Use arbor press to remove needle bearing (40) from adapter (41).



1. Palnut
2. Nut, Plain, Hex
3. Washer, Plain
4. Motor, 24 Volt, Starter
5. "O" Ring
6. Nut, Plain, Hex
7. Washer, Lock
8. Washer, Plain
9. Gasket
10. Nut, Plain, Hex
11. Washer, Lock
12. Washer, Plain
13. Cover, Starter Adapter
14. "O" Ring
15. Ring, Retaining
16. Bearing, Ball
17. Screw
18. Washer, Tab
19. Spring, Clutch
20. Gear, Starter Worm
21. Bearing, Needle
22. Shaftgear Assembly, Starter
23. Ring, Retaining
24. Bearing, Ball
25. Gear, Starter Worm
26. Spring
27. Woodruff Key
28. Shaft, Worm Drive
29. Bearing, Needle
30. Stud
31. Stud
32. Stud
33. Adapter & Sleeve Assy

Figure 4-12. Starter Adapter IO-520-B & C

4-22. STARTER AND STARTER DRIVE ADAPTER IO-520-B & C (See Figure 4-12).

a. Remove attaching parts (1, 2, 3) and pull starter (4) from adapter studs. Remove "O" ring (5).

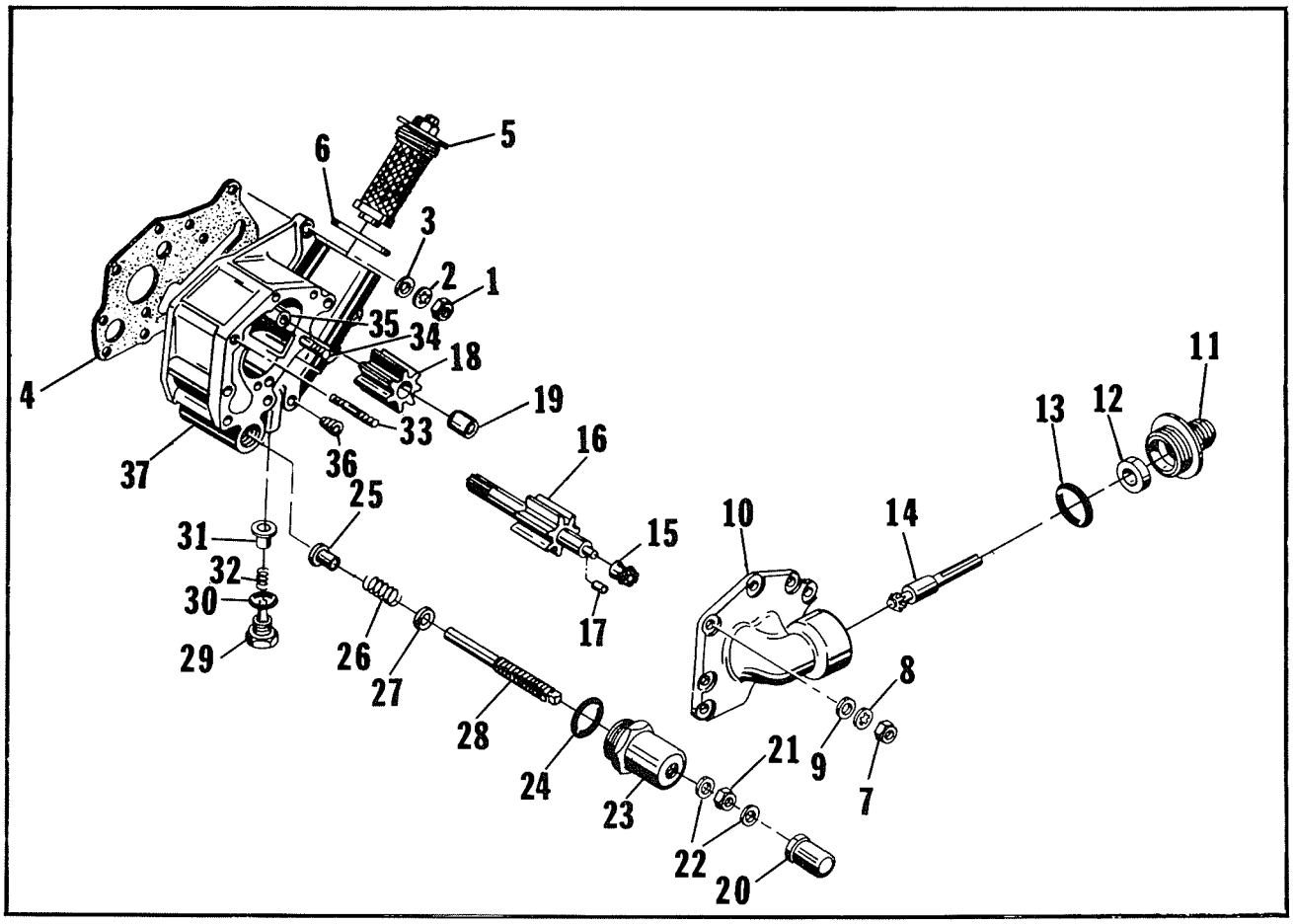
b. Remove four sets of attaching parts (6, 7, 8) and pull starter adapter assembly from crankcase. Remove gasket (9).

c. Remove three sets of attaching parts (10, 11, 12) and detach cover (13) and "O" ring (14) from starter adapter.

d. Support adapter on wood blocks and tap clutch spring carefully around front end with a brass drift to remove clutch spring assembly.

e. Remove retaining ring (15). Use arbor press to remove shaft gear (22) from bearing (16) and worm gear (20).

f. Clamp worm gear in shielded vise and remove clutch spring retaining screw (17) and tab washer (18). Turn clutch spring (19) until its depressed rear end lies across the 1/4 inch worm gear hub. Use a 3/16 inch screwdriver blade to pry spring outward clear of



1. Nut
2. Washer, Lock
3. Washer, Plain
4. Gasket
5. Filter Assembly, Oil
6. Gasket
7. Nut
8. Washer, Lock
9. Washer, Plain
10. Cover, Right Angle Tach Drive
11. Housing, Tach Drive
12. Seal, Oil
13. Gasket
14. Shaftgear, Tach Drive
15. Gear, Bevel, Tach Drive
16. Shaftgear, Tach Drive & Oil Pump
17. Pin, Dowel
18. Gear, Oil Pump Driven
19. Bushing
20. Cap
21. Nut, Adjusting
22. Washer, Copper
23. Housing, Relief Valve
24. Gasket
25. Plunger
26. Spring
27. Washer
28. Screw, Adjusting
29. Pin and Plug Assy
30. Gasket
31. Valve
32. Spring
33. Stud
34. Stud
35. Shaft
36. Plug, Pipe
37. Housing

Figure 4-13. Oil Pump IO-520-A

drum groove. Hold spring end out while pulling spring from drum.

f. Clamp adapter in shielded vise jaws. Remove retaining ring (23) using Truarc No. 5 or No. 25 pliers. Remove bearing (24) and worm shaft assembly.

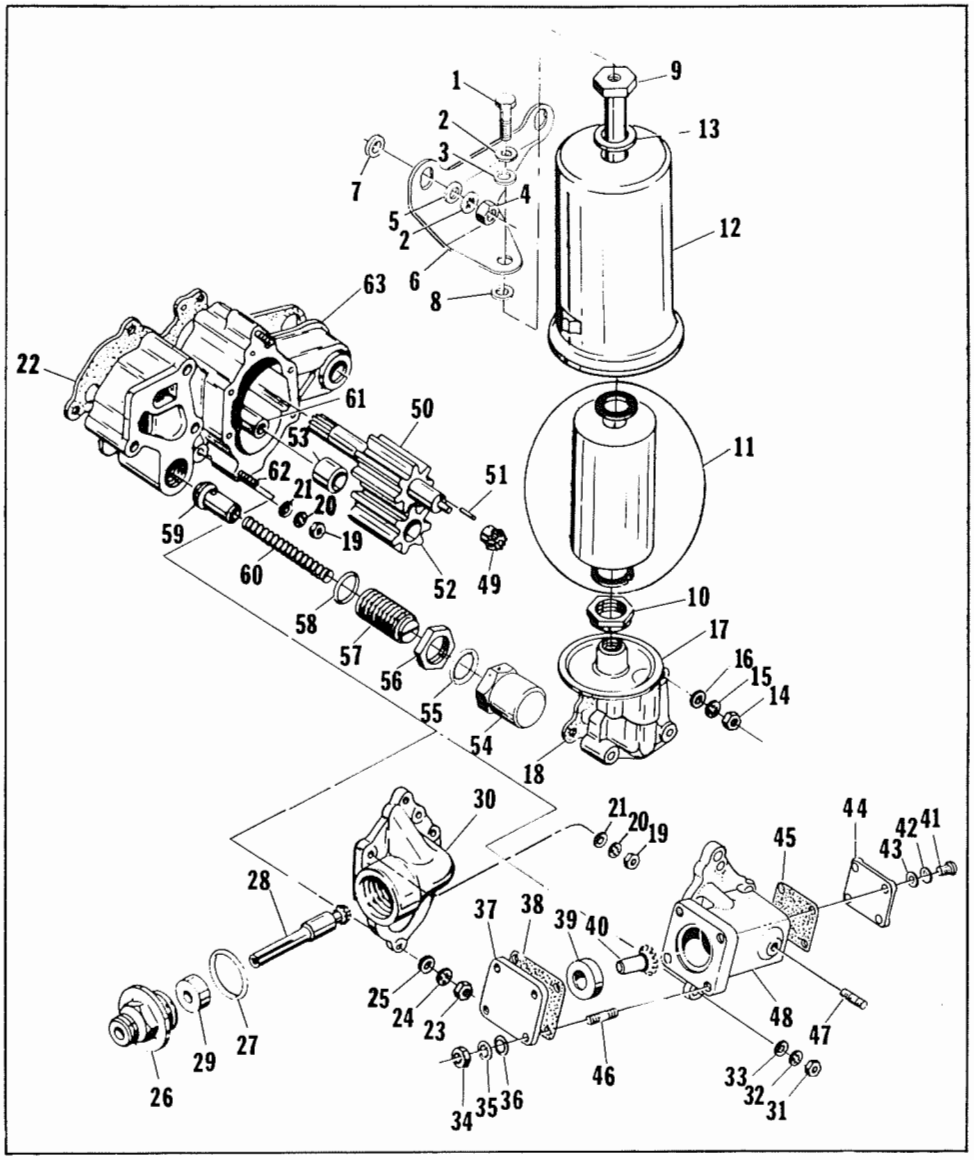
h. Separate worm gear (25), spring (26), woodruff key (27), and shaft (28).

i. Use arbor press to remove needle bearing (29) from adapter (33).

4-23. OIL PUMP ASSEMBLY IO-520-A (See Figure 4-13).

a. Loosen oil filter (5) and tachometer drive housing (11) to facilitate later removal. (Tachometer drive housing has a left hand thread.) Remove ten sets of attaching parts (1, 2, 3) and pull pump assembly to the rear. Remove gasket (4).

b. Remove oil filter (5) and gasket (6).



1. Bolt
2. Washer, Lock
3. Washer, Plain
4. Nut
5. Washer, Plain
6. Bracket
7. Spacer
8. Spacer
9. Stud
10. Nut, Nylon, Lock
11. Element, Oil Filter
12. Housing
13. Gasket
14. Nut
15. Washer, Lock
16. Washer, Plain
17. Adapter
18. Gasket
19. Nut
20. Washer, Loc
21. Washer, Plain
22. Gasket
23. Nut
24. Washer, Lock
25. Washer, Plain
26. Housing, Tach Drive
27. Gasket
28. Shaftgear, Tach Drive
29. Seal, Oil
30. Cover, Right Angle Tach Drive
31. Nut
32. Washer, Lock
33. Washer, Plain
34. Nut
35. Washer, Lock
36. Washer, Plain
37. Cover, Tach Gear Box
38. Gasket
39. Seal, Oil
40. Shaftgear Assembly
41. Screw
42. Washer, Lock
43. Washer, Plain
44. Shipping Cover
45. Gasket
46. Stud
47. Stud
48. Cover, R. Angle Tach Drive
49. Gear, Bevel
50. Shaftgear
51. Pin, Dowel
52. Gear, Oil Pump Driven
53. Bushing
54. Cap
55. Gasket
56. Nut, Adjusting
57. Screw, Adjusting
58. Gasket
59. Plunger
60. Spring
61. Shaft, Oil Pump
62. Stud
63. Housing, Oil Pump

Figure 4-14. Oil Pump IO-520-B & C

c. Remove attaching parts (7, 8, 9) and separate cover (10) from pump housing (37). Remove tachometer drive housing (11). Press oil seal (12) from housing. Remove gasket (13) and tachometer drive shaft (14).

d. Remove oil pump drive gear assembly and separate tachometer drive gear (15) oil pump drive gear (16) and pin (17). Remove oil pump driven gear and bushing assembly (18, 19).

e. Remove oil pressure relief valve (20 through 28). Remove by-pass assembly (29 through 32).

4-24. OIL PUMP ASSEMBLY IO-520-B & C (See Figure 4-14).

a. Remove attaching parts (1 through 5), bracket (6), two spacers (7) and spacer (8).

b. Remove filter assembly (9 through 13).

c. Remove three sets of attaching parts (14, 15, 16) and separate oil filter adapter (17) from oil pump housing. Remove gasket (18).

d. Remove six sets of attaching parts (19, 20, 21) and pull oil pump assembly from crankcase studs. Remove gasket (22).

e. COVER, RIGHT ANGLE TACH DRIVE IO-520-B. Remove attaching parts (19, 20, 21) and separate cover (30) from oil pump. Remove tachometer drive housing (26). (Tachometer drive housing has a left hand thread.) Remove gasket (27), shaftgear (28) and press oil seal (29) from housing.

f. COVER ASSY, RIGHT ANGLE TACH DRIVE IO-520-C. Remove attaching parts (31, 32, 33) and pull right angle tachometer drive cover assembly from oil pump. Remove attaching parts (34, 35, 36) tachometer gear box cover (37) and gasket (38). Pull oil seal (39) and gear (40) from cover (48). Remove attaching parts (41, 42, 43) and separate cover (44) and gasket (45) from cover (48).

g. Remove oil pump and tachometer drive shaftgear assembly and separate tachometer drive gear (49), oil pump drive gear (50) and pin (51).

h. Remove oil pump driven gear assembly (52, 53).

j. Remove oil pressure relief valve (54 through 60) from oil pump housing (63).

4-25. CYLINDERS AND PISTONS (See Figure 4-15).

a. Rotate engine stand so engine is in inverted position. Remove attaching parts (1, 2, 3), cover (4) and gasket (5).

b. Position crankshaft so valve lifters of cylinder to be removed are on heels of cam lobes and both valves are fully closed. Remove screw (6), washer (7), shafts (8), rocker assemblies (9, 10, 11) and thrust washers (12). Withdraw pushrods (13). Repeat these steps on remaining cylinders.

c. Push the pushrod housing (14) against the spring (15) until the cylinder flange end is clear. Lift cylinder end of housing and withdraw from crankcase. Remove spring (15), washers (16) and packing (17).

d. Remove one set of attaching parts (18, 19) and three sets (20, 21) from each cylinder flange. Rotate engine stand so engine is in upright position. Make certain piston in cylinder to be removed is top dead center. Remove nut locks (18, 19) and nuts (19, 21). Cradle cylinder in arm and withdraw it straight outward. Catch piston with other hand as it clears the cylinder to prevent damage to piston or crankcase.

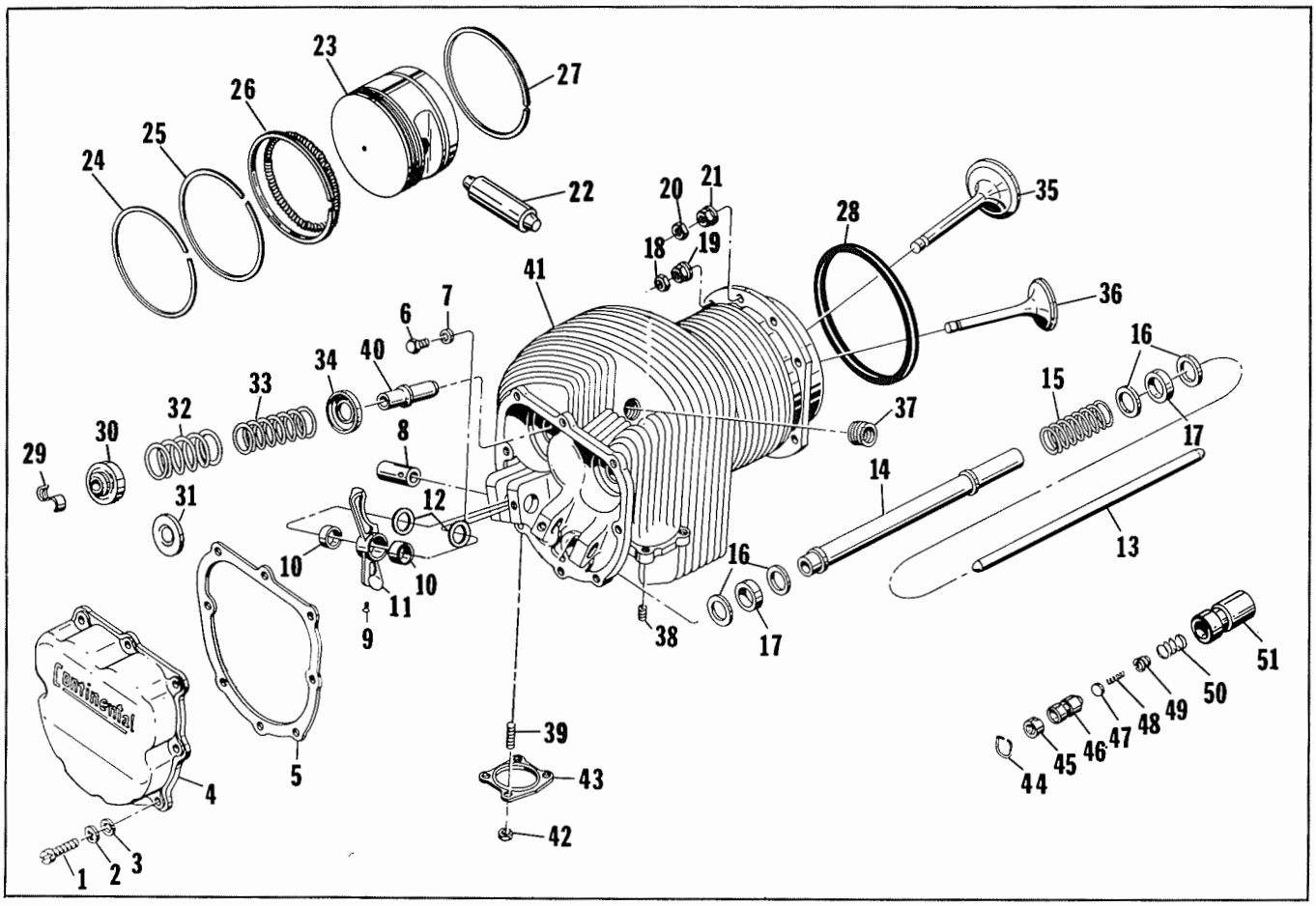
e. Remove piston pin (22) and piston (23) with rings (24, 25, 26, 27) as an assembly.

f. Remove packing (28). Use of a cylindrical wood block anchored to a work bench, with provisions for clamping the cylinder in place, is recommended to facilitate removal of valve springs and to prevent dropping of valves.

g. Compress valve springs and remove keys (29). Be careful not to cock retainers (30, 31) and score valve stems. Remove rotocap (30) or outer retainer (31), outer spring (32), inner spring (33) and inner retainer (34). Hold valve stems while lifting cylinder from its support, and lay cylinder on its side. Stone down any nicks before removing valve stems (35, 36).

h. Remove rings (24, 25, 26 and 27) from piston (23). Be careful not to score ring lands with ring ends.

i. Remove hydraulic valve lifters (44 through 51). Stand valve lifter on its flat end. Use a small screwdriver and carefully pry snap ring (44) from body groove. Hold down socket (45) with a pushrod until ring has been removed. Invert filter and catch socket as it drops out. Insert a finger into plunger (46) and withdraw plunger (46), spring (50) and check valve assembly (47, 48, 49). If plunger is stuck in body (51), hold plunger down fully and scrape out carbon deposit. If this obstruction cannot be removed, or if plunger is seized by score marks, the entire assembly must be replaced. Remove spring by turning as if to unwind it while pulling outward. Be careful not to stretch spring out of shape. Remove checkvalve housing from plunger with a small screwdriver by prying against plunger shoulder. Do not flip off housing. After housing is loosened lift off, and remove plate (47) and spring (48).



1. Screw, Fil Hd.
2. Washer, Lock
3. Washer, Plain
4. Cover, Valve Rocker
5. Gasket
6. Screw
7. Washer, Plain
8. Shaft, Valve Rocker
9. Screw, Drive
10. Bushing
11. Rocker, Exhaust Valve
12. Washer, Thrust
13. Push Rod Assembly
14. Housing
15. Spring
16. Washer
17. Packing
18. Palnut
19. Nut, Flanged
20. Palnut
21. Nut, Flanged
22. Pin and Plug Assembly
23. Piston
24. Ring, Compression
25. Ring, Compression
26. Ring, Scraper
27. Ring, Compression
28. Packing
29. Key, Retainer
30. Roto Cap Assembly
31. Retainer, Intake
32. Spring, Valve, Outer
33. Spring, Valve, Inner
34. Retainer, Inner
35. Valve, Intake
36. Valve, Exhaust
37. Insert
38. Insert
39. Stud
40. Guide, Valve
41. Head and Barrel Assy
42. Nut, Brass
43. Gasket, Exhaust, Flange
44. Ring, Retaining
45. Socket, Hydraulic, Lifter
46. Plunger
47. Plate, Check Valve
48. Spring
49. Housing
50. Spring, Plunger
51. Body, Valve Lifter

Figure 4-15. Cylinder IO-520-A, B & C

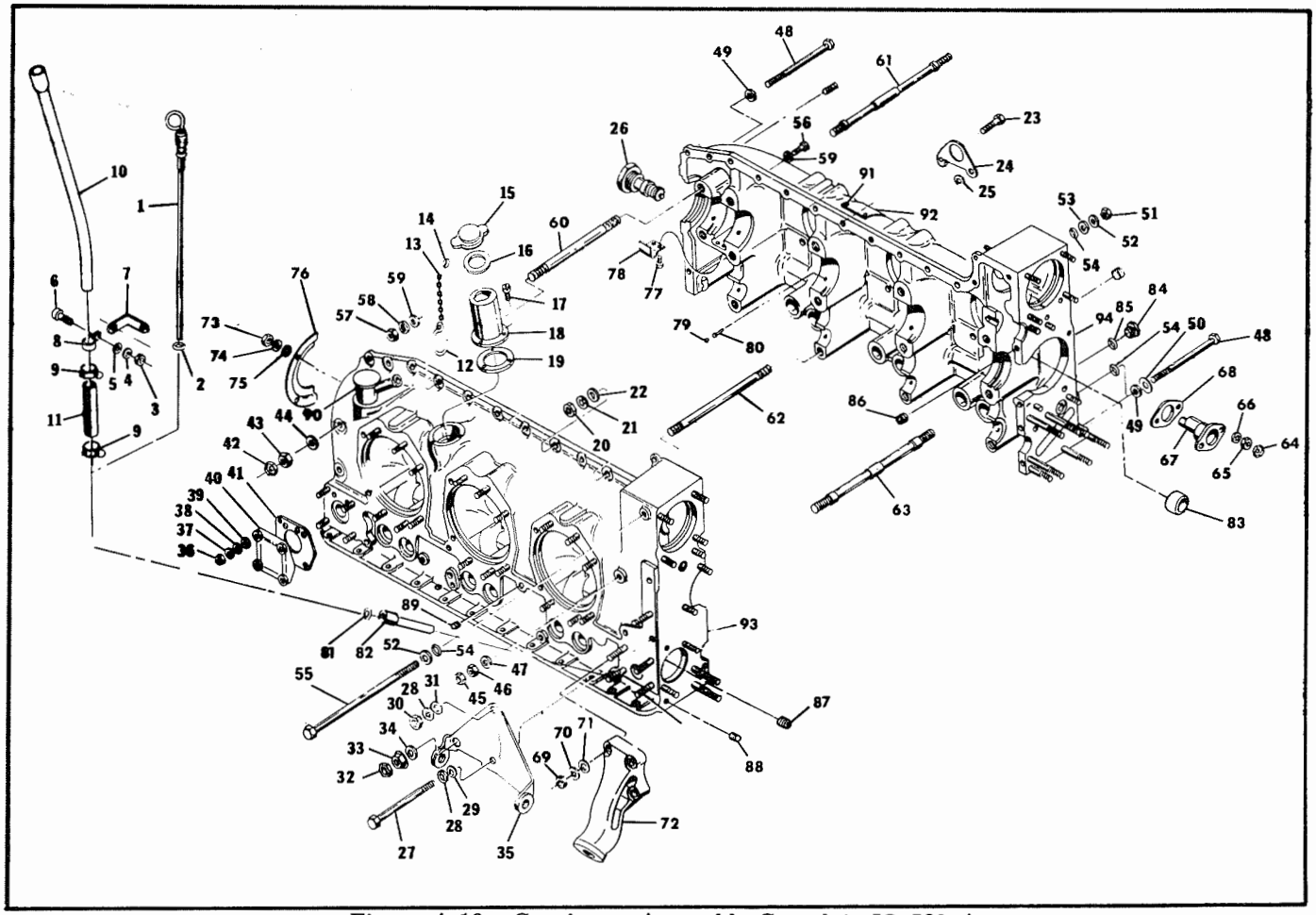


Figure 4-16. Crankcase Assembly Complete IO-520-A

4-26. CRANKCASE IO-520-A (See Figure 4-16).

a. Oil gauge rod and guide and brackets. (items 1 through 11) are shipped loose with the engine, and were probably returned in the same manner. If not, remove in the order of index numbers assigned.

b. Unhook filler cap retaining ring (12) and remove oil cap retainer assembly (12 through 16). Remove three screws (17) and lift off oil filler neck (18) and gasket (19).

c. Remove attaching parts (20, 21, 22, 23) and remove lifting eye (24) and spacer (25).

d. Cut lockwire and remove Vernatherm valve (26).

e. Remove bolt (27), nut (30), lockwashers (28), plain washer (29), plain washer (31), palnut (32), flanged nut (33) and washer (34) to remove generator mount bracket (35).

f. Remove nut (36), lockwasher (37), plain washer (38), spacer (39) and lift off governor pad cover (40) and gasket (41).

g. Remove parts indexed (42 through 55).

h. Rotate engine disassembly stand bed so that left crankcase (93) will be downward and support it as illustrated in figure 8-1.

i. Remove retaining crankcase-to-crankcase flange bolts (56), nuts (57), lockwashers (58) and plain washers (59).

NOTE

Do not attempt to remove bolt and washer adjacent to right magneto upper stud. These two parts are installed before the stud and cannot be removed before removal of that stud without damage to crankcase hole. Take care to avoid damage to bolt threads during subsequent overhaul operations.

j. With a non-marring hammer, tap upper ends of through bolts (60, 61, 62, 63) and pull them downward and out of the crankcase.

k. Remove idler gear support pin attaching parts (64, 65, 66) and hold idler gear while support pin (67) is withdrawn. Lower gear to rest in left crankcase. Remove gasket (68).

1. Rod Assembly, Oil Gauge
2. "O" Ring
3. Nut, No. 10-32
4. Washer, Lock
5. Washer, Plain
6. Screw
7. Bracket
8. Clamp
9. Clamp, Hose, Worm Type
10. Housing
11. Hose
12. Ring, Retainer
13. Chain
14. Ring, Retainer
15. Cap, Oil Filler
16. Gasket
17. Screw
18. Neck Assembly, Oil Filler
19. Gasket
20. Nut, Plain, Hex
21. Washer, Lock
22. Washer, Plain
23. Bolt
24. Eye, Engine Lifting
25. Spacer
26. Valve Assembly
27. Bolt
28. Washer, Lock
29. Washer, Plain
30. Nut, Plain, Hex
31. Washer, Plain
32. Palnut
33. Nut, Flanged
34. Washer, Plain
35. Bracket, Generator
36. Nut, Plain, Hex
37. Washer, Lock
38. Washer, Plain
39. Washer
40. Cover, Gov. Pad
41. Gasket
42. Palnut
43. Nut, Flanged
44. Spacer
45. Palnut
46. Nut, Plain
47. Washer, Plain
48. Bolt
49. Washer, Plain
50. Washer, Plain
51. Nut, Plain, Hex
52. Washer, Lock
53. Washer, Plain
54. "O" Ring
55. Bolt
56. Bolt
57. Nut, Plain, Hex
58. Washer, Lock
59. Washer, Plain
60. Bolt, Thru
61. Bolt, Thru
62. Bolt, Thru
63. Bolt, Thru
64. Palnut
65. Nut, Plain, Hex
66. Washer, Lock
67. Pin, Idler Gear Support
68. Gasket
69. Nut, Plain, Hex
70. Washer, Lock
71. Washer, Plain
72. Bracket, Engine Mount
73. Nut, Plain, Hex
74. Washer, Lock
75. Washer, Plain
76. Retainer
77. Screw
78. Clip, Oil Transfer
79. Screen
80. Nozzle, Squirt
81. Ring, Oil
82. Housing
83. Bearing, Needle
84. Plug, Machine Thrd.
85. Gasket, Copper
86. Insert, Thread
87. Plug
88. Plug
89. Plug
90. Breather
91. Screw, Drive
92. Plate, Identification
93. Crankcase, 2-4-6 Side
94. Crankcase, 1-3-5 Side
95. Plug

Legend for Figure 4-16

l. Remove attaching parts (69, 70, 71) and remove mounting brackets (72).

m. Lift off right crankcase subassembly.

n. Lift out camshaft assembly and governor driven gear. (See figure 4-14.)

o. Lift out idler gear assembly, crankshaft assembly with connecting rods, thrust washers and bearings. (See figure 4-19.)

4-27. CRANKCASE IO-520-B & C (See Figure 4-17).

a. Remove oil gauge rod (1). Remove attaching parts (2, 3, 4) and detach oil filler tube (5), gasket (6) and "O" ring (7).

b. Remove nut (8), washers (9, 10), bolt (11), lifting eye (12) and spacer (13).

c. Remove nut (14), washers (15, 16), spacer (17) and lift off governor pad cover (18) and gasket (19).

d. Remove camshaft hole cover attaching parts (20, 21, 22), cover (23) and gasket (24).

e. Remove crankshaft oil seal and felt retainer attaching parts (25, 26, 27) and lift off retainer halves (28).

f. Rotate engine stand bed to place left crankcase downward. Place a length of pipe or wood under the left crankcase to support it during disassembly. Remove right mount brackets (IO-520-C only).

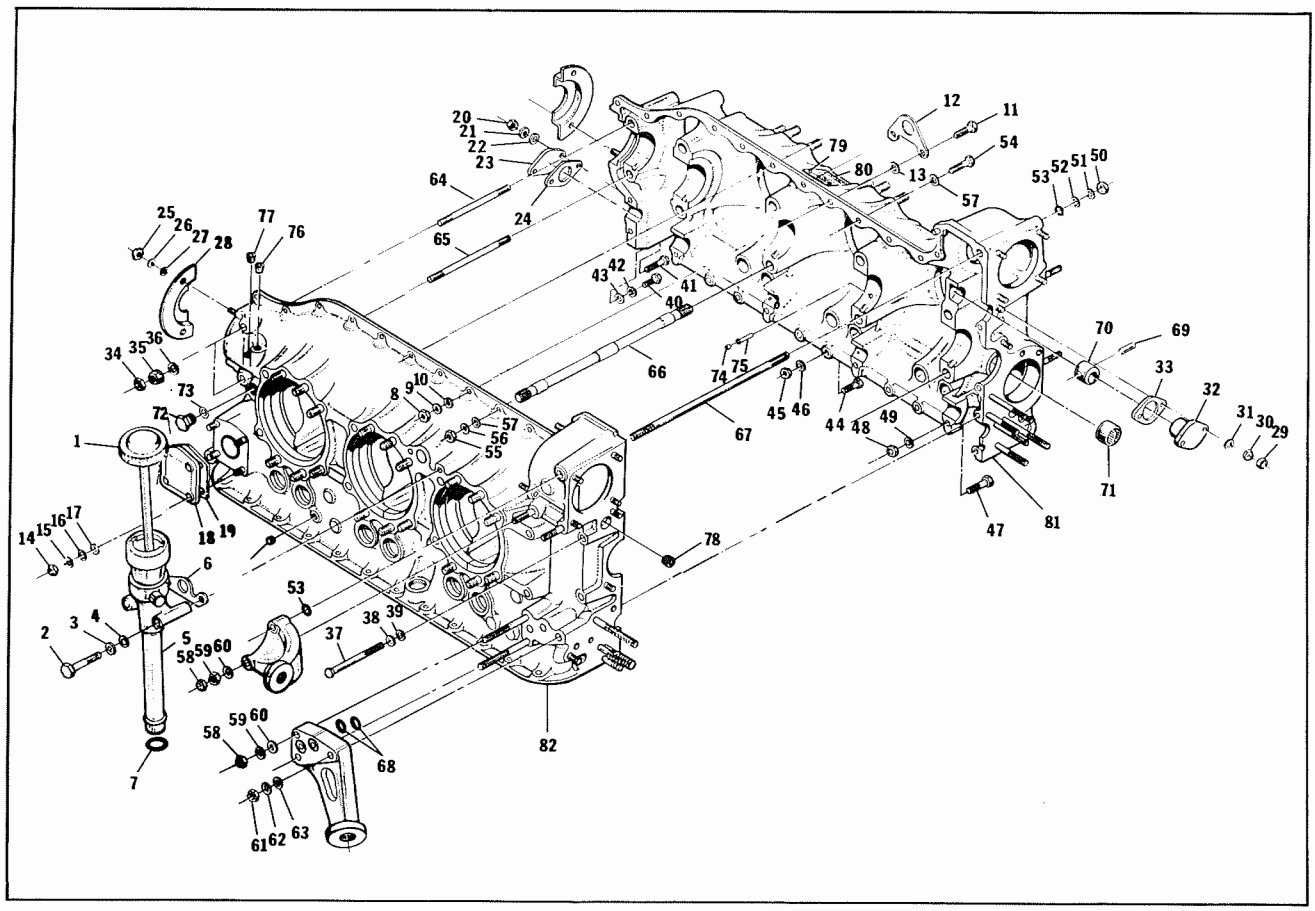
g. Remove two sets of attaching parts (29, 30, 31) idler gear flanged bushing (32) and gasket (33).

h. Remove attaching parts (34 through 63). Tap crankcase through bolts (64 through 67) with a non-marring hammer and remove carefully from crankcase so as not to damage threads. Remove "O" rings (53).

NOTE

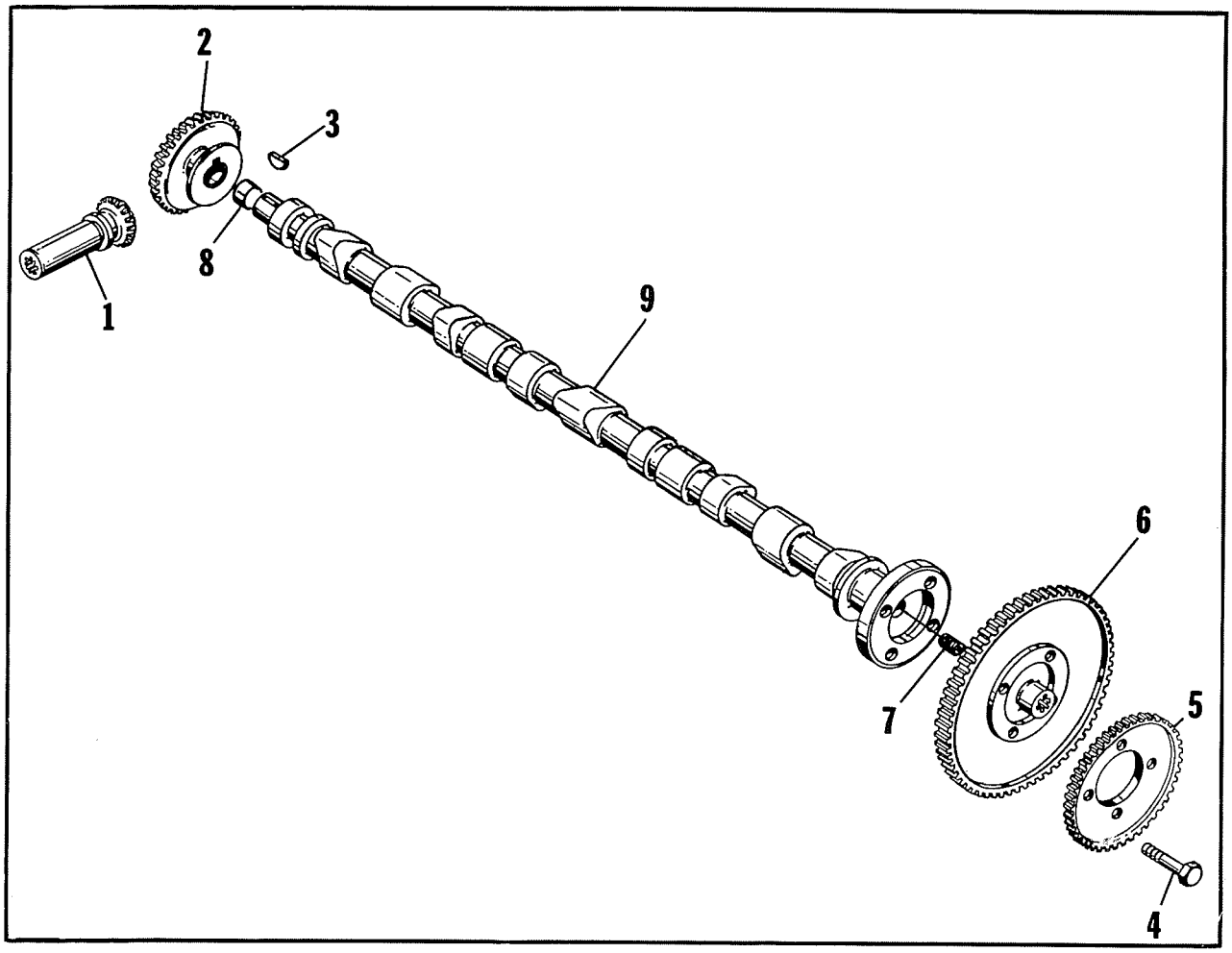
Do not attempt to remove bolt and washer adjacent to right magneto upper stud. These two parts are installed before the stud and cannot be removed before removal of that stud without damage to crankcase hole. Take care to avoid damage to bolt threads during subsequent overhual operations.

i. Lift off right crankcase. Lift out camshaft assembly and governor driven gear (See figure 4-18). Remove idler gear, crankshaft assembly with connecting rods, thrust washers and main bearings (See figure 4-20.)



1. Gauge and Cap Assy, Oil
2. Screw
3. Washer, Lock
4. Washer, Plain
5. Tube, Oil Filler Assy
6. Gasket
7. "O" Ring
8. Nut, Plain, Hex
9. Washer, Lock
10. Washer, Plain
11. Bolt
12. Eye, Engine Lifting
13. Spacer
14. Nut, Plain, Hex
15. Washer, Lock
16. Washer, Plain
17. Spacer, Gov. Pad
18. Cover, Gov. Pad
19. Gasket
20. Nut, Plain, Hex
21. Washer, Lock
22. Washer, Plain
23. Cover, Camshaft Hole
24. Gasket
25. Nut, Plain
26. Washer, Lock
27. Washer, Plain
28. Retainer
29. Palnut
30. Nut, Plain, Hex
31. Washer, Plain
32. Bushing, Flanged
33. Gasket
34. Palnut
35. Nut, Flanged
36. Washer, Plain
37. Bolt
38. Washer, Lock
39. Washer, Plain
40. Bolt
41. Bolt
42. Washer, Lock
43. Washer, Plain
44. Bolt
45. Nut, Marsden, Lock
46. Washer, Plain
47. Bolt
48. Nut, Marsden, Lock
49. Washer, Plain
50. Nut, Plain, Hex
51. Washer, Lock
52. Washer, Plain
53. "O" Ring
54. Bolt
55. Nut, Plain, Hex
56. Washer, Lock
57. Washer, Plain
58. Nut, Plain, Hex
59. Washer, Lock
60. Washer, Plain
61. Nut, Plain, Hex
62. Washer, Lock
63. Washer, Plain
64. Bolt, Thru
65. Bolt, Thru
66. Bolt, Thru
67. Bolt, Thru
68. "O" Ring
69. Dowel
70. Bushing, Idler Gear
71. Bearing, Needle
72. Plug, Machine Thrd.
73. Gasket, Copper
74. Screen
75. Nozzle, Squirt
76. Plug, Pipe
77. Plug, Pipe
78. Plug, Pipe
79. Screw, Drive
80. Plate, Identification
81. Crankcase, 1-3-5 Side
82. Crankcase, 2-4-6 Side

Figure 4-17. Crankcase Assembly Complete IO-520-B & C



1. Gear, Bevel, Driven
2. Gear, Bevel, Drive
3. Woodruff Key
4. Screw
5. Cam Gear
6. Gear, Camshaft
7. Plug, Pipe
8. Plug, Expansion
9. Camshaft

Figure 4-18. Camshaft Assembly IO-520-A, B & C

j. Remove dowel pin (69) and idler gear bushing (70).

4-28. CAMSHAFT ASSEMBLY (See Figure 4-18).

a. Remove governor drive gear (2) and woodruff key (3).

b. Remove four screws (4) and lift off gear (5) (IO-520-A only) and gear (6).

4-29. CRANKSHAFT GROUP IO-520-A (See Figure 4-19).

a. Use wooden support blocks under front and rear main journals of crankshaft during disassembly.

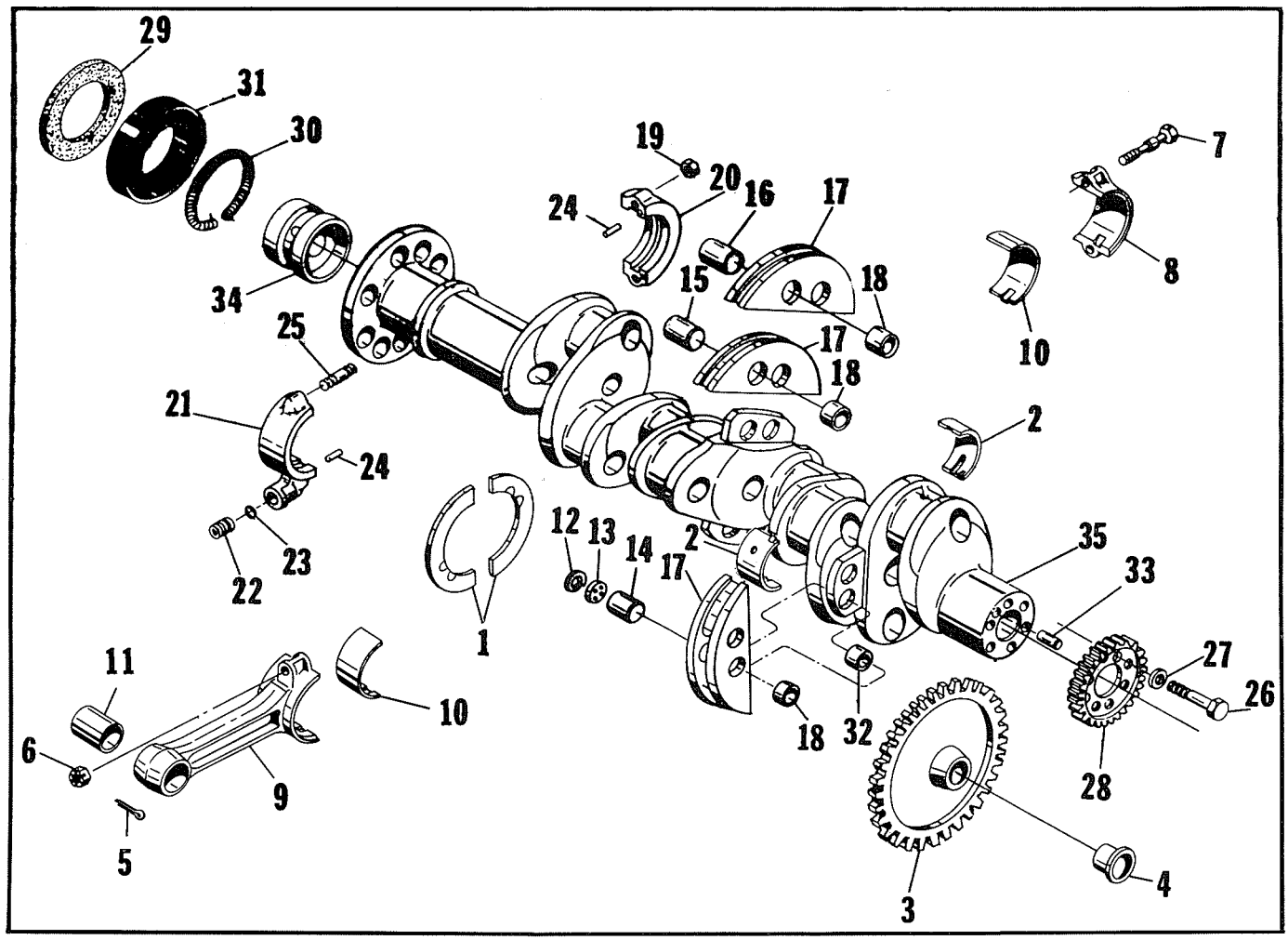
b. Remove cotter pin (5), slotted nut (6), bolt (7) and separate connecting rod caps (8) and rods (9). Remove all bearing inserts (10). Loosely reassemble rods, caps, bolts and nuts with position numbers matched.

c. Remove retaining rings (12), retaining plates (13) and pins (14, 15, 16). Remove counterweights (17).

d. Remove nuts (19) and lift off governor oil transfer collar (20 through 25).

e. Remove six screws (26), one washer (27) and pull gear (28) from crankshaft.

f. Twist and remove oil seal felt (29). Work oil seal spring (30) from its groove. Remove oil seal (31) from crankshaft (35).



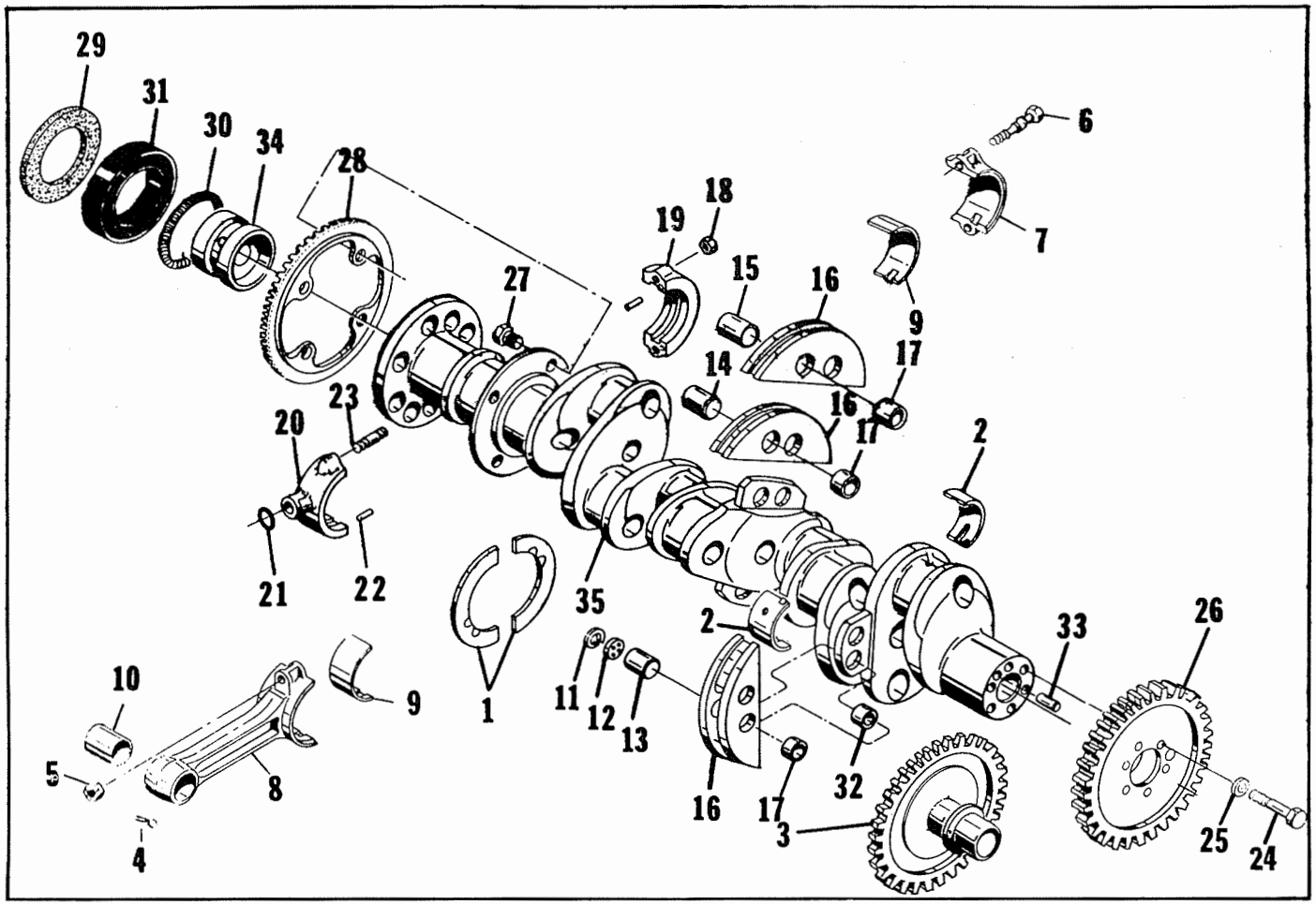
1. Washer, Thrust
2. Bearing, Crankshaft, Main
3. Gear, Idler
4. Bushing, Idler Gear
5. Pin, Cotter
6. Nut, Slotted
7. Bolt
8. Cap
9. Rod, Connecting
10. Bearing
11. Bushing
12. Ring, Retaining
13. Plate, Counterweight
14. Pin, Counterweight
15. Pin, Counterweight
16. Pin, Counterweight
17. Counterweight, Crankshaft
18. Bushing, Counterweight
19. Nut, Marsden
20. Collar, 1-3-5 Side
21. Collar, 2-4-6 Side
22. Sleeve, Oil Transfer
23. "O" Ring
24. Pin, Roll
25. Stud
26. Screw
27. Washer, Plain
28. Gear, Crankshaft
29. Felt, Crankshaft, Oil Seal
30. Spring, Oil Seal
31. Seal, Oil
32. Bushing
33. Dowel
34. Plug, Oil Control
35. Crankshaft Group

Figure 4-19. Crankshaft Group IO-520-A

4-30. CRANKSHAFT IO-520-B & C (See Figure 4-20).

a. Use wooden support blocks under front and rear journals of crankshaft during disassembly.

b. Remove cotter pin (4), slotted nut (5), bolt (6), and separate connecting rod cap (7) and rod (8). Remove bearing inserts (9). Loosely reassemble rod, cap, bolt and nut with their position numbers matched.



1. Washer, Thrust
2. Bearing, Crankshaft, Main
3. Gear, Idler
4. Pin, Cotter
5. Nut, Slotted, Special
6. Bolt
7. Cap
8. Connecting Rod Assembly
9. Bearing
10. Bushing
11. Ring, Retaining
12. Plate, Counterweight
13. Pin, Counterweight, 6th Order
14. Pin, Counterweight, 4th Order
15. Pin, Counterweight, 5th Order
16. Counterweight Assembly
17. Bushing
18. Nut, Marsden
19. Collar, 1-3-5 Side
20. Collar, 2-4-6 Side
21. "O" Ring
22. Dowel
23. Stud
24. Screw
25. Washer, Plain
26. Gear, Cluster
27. Bolt
28. Gear, Face, Alt. Drive
29. Felt, Oil Seal
30. Spring
31. Seal, Oil
32. Bushing
33. Dowel
34. Plug, Oil Control
35. Crankshaft and Tube Assy

Figure 4-20. Crankshaft Group IO-520-B & C

c. Remove retaining ring (11), plate (12) and pins (13, 14, 15). Lift counterweight assemblies (16, 17) from crankshaft (35).

d. Remove nuts (18) and separate governor oil transfer collar (19 through 23) from crankshaft.

e. Remove six screws (24), one washer (25) and gear (26). Remove four bolts (27) and alternator drive gear (28).

f. Twist and remove felt oil seal (29). Work oil seal spring (30) from groove and detach from seal. Twist and remove oil seal (31) from crankshaft.

SECTION V

CLEANING PARTS

5-1. MATERIALS AND PROCESSES.

5-2. Equipment, materials and processes in general use in aircraft engine overhaul shops are satisfactory for cleaning IO-520 engine parts.

5-3. Aluminum alloy parts can be degreased by spraying with any fortified mineral spirit solvent or by brush application of the same liquid. Fortified mineral spirits are more effective when the parts are immersed in them and allowed to remain for a short time to permit solvent action to loosen caked deposits. Carbon deposits and gum (oil varnish) may be removed most easily by immersing these parts in a hot bath of an inhibited, mild alkaline cleaning compound. Immersion time should be only as long as necessary to remove the deposits. Carbon solvent should be employed only when carbon deposits are too hard and thick for removal by other solvents. Give special attention to cleaning studs, tapped holes and drilled holes. Caution must be exercised in cleaning of all aluminum alloy engine parts. Do not use any strong alkaline solutions to clean aluminum alloy castings or wrought aluminum alloy parts, because strong solutions will attack and destruct a bare machined surface. Immedaitely after removing soaking parts from a caustic or inhibited, mild alkaline bath, remove all traces of the alkali by spraying the parts with a jet of wet steam or by brushing vigorously with a mineral spirit solvent. Cleaned parts may be dried by use of a jet of dry compressed air to remove all solvent liquids.

CAUTION

All alkaline residues must be removed from crevices, recesses and holes, as well as from other surfaces, to prevent the formation of a foaming emulsion in the engine lubricating oil after reassembly.

5-4. No polishing compound or abrasive paste or powder should be needed or employed for cleaning engine parts. Scraping, abrasion with wire brushes, sand paper or abrasive cloth and buffing wheels are dangerous methods to use on soft metals such as aluminum. Scratches resulting from such methods allow a concentration of stress at the scratch and may cause fatigue failure.

5-5. Various blasting techniques can be employed to remove hard carbon deposits if suitable equipment is available. The most suitable types of grit for dry blasting are plastic pellets and processed natural materials, such as wheat grains and crushed furit pits or shells. Air pressure should be the lowest that will produce the desired cleaning action. Small holes and finished surfaces which do not require cleaning should be protected from the blast by seals and covers, particularly if the grit is sharp. Sand, shot and metal grit are too abrasive and too heavy for use on soft metals such as aluminum. After any blasting process, blow off all dust with dry compressed air and make sure that no grit has lodged in crevices, recesses and holes.

5-6. SPECIFIC PARTS.

5-7. CYLINDERS. Precautions applicable to both aluminum and steel must be exercised in cleaning and storing these assemblies. Remove oil and loose material with a mild alkaline cleaner by spraying or brushing. If stubborn deposits of carbon remain on cylinder heads, the areas affected may be vapor blasted. All machined surfaces must be protected from abrasive action during the blasting operation.

5-8. PISTONS. Do not use wire brushes or scrapers of any kind. Soft and moderately hard carbon deposits may yield to solvent action. If deposits remain, blast the heads with soft grit or by the vapor grit method, first having installed tight fitting skirt protectors. Ring grooves may be cleaned by pulling through them lengths of binder twine or very narrow strips of crocus cloth. Do not use automotive ring groove scrapers, since the corner radii at the bottoms of the grooves must not be latered, nor any metal removed from the sides. Discoloration and light scoring need not be removed from piston skirts. The use of abrasive cloth on the skirts is not recommended, because the diameters and cam-ground contour must not be altered. Heavily scored or burned pistons should be discarded.

5-9. VALVES. After degreasing valves, inspect them and discard any whose head is warped excessively, or which has insufficient stock to permit refacing within specified limits, or whose stem is burned, scored, eroded or nicked. Carbon deposits may be loosened by solvent action or they may be scraped off while the valve is rotated in a polishing head or lathe collet. Apply crocus cloth moistened in mineral spirit, and polish the stems with dry crocus cloth.

5-10. ROCKER SHAFTS. Degrease these parts by brushing on any mineral spirit solvent. Prior to magnetic inspection, polish the steel bearing surfaces with crocus cloth moistened with kerosene, then with dry crocus cloth.

5-11. PUSHRODS, VALVE ROCKERS AND OTHER SMALL STEEL PARTS. Degrease these parts with mineral spirit solvent, paying special attention to removal of sludge from all oil passages.

5-12. CAMSHAFT AND CRANKSHAFT. All parts may be degreased by brushing or spraying with mineral spirit solvent. Pay particular attention to threads, oil holes and recesses. Before magnetic inspection, the crankpins, main journals, oil seal race of the crankshaft and all journals, cam lobes and gear mount flange of the camshaft must be smoothed with crocus cloth, moistened in a mineral spirit. If possible, this should be accomplished while shaft is rotated in a high speed lathe (about 100 rpm). All gum (varnish) deposits must be removed to permit reliable magnetic indications.

5-13. CRANKCASE. The oil passages should be pressure-flushed with mineral spirit solvent and inspected with the aid of a flashlight. If the castings are immersed in an alkaline bath, it is strongly recommended that such treatment be followed by spraying with a jet of wet steam and this followed by flushing of the oil passages with solvent. After the castings dry, inspect them thoroughly for alkaline residues, and remove any traces of scum.

5-14. GEARS. Gears without bushings may be freed of hard deposits by immersion in a caustic stripping bath, when cold solvents are not effective. Bushings are discolored by such treatment, hence bushed gears should be cleaned by other methods such as spraying and/or brushing with a mineral spirit solvent and brushing with a brass wire brush.

5-15. SHEET METAL PARTS. Clean these parts with a mineral spirit spray or by brushing with the same liquid, or use a cold emulsion type cleaner and flush with water to rinse.

5-16. Immediately after cleaning bare steel parts spray them with or dip them in clean engine oil or, for longer storage, in a corrosion-preventive oil mixture. Wrap ball bearings in waxed paper. Wrap or cover other clean parts to protect them from abrasive dust in the air.

SECTION VI

INSPECTION

6-1. DEFINITIONS OF TERMS.

6-2. The following definitions apply to terms used to describe kinds of damage for which parts should be inspected.

a. ABRASION: Scratching of a surface, either by motion while in contact with another part or by mechanical cleaning or resurfacing with abrasive cloth or lapping compound.

b. BURNING: As applied to valve heads, this term indicates roughening or erosion due to high temperature gases escaping past valve faces. In other instances it indicates drawing of the temper of steel parts to be soft (blue) condition as a result of overheating in absence of lubrication on moving surfaces, such as gear teeth, subject to high loading.

c. BURR: A sharp projection of metal from an edge, usually the result of drilling, boring, counter-sinking, etc., but may also be caused by excessive wear of one or both surfaces adjacent to the burred edge.

d. CORROSION: Deterioration of a surface, usually caused by oxidation of metal.

e. ELONGATION: Stretching or increase in length.

f. FRETTING: Scuffing or deterioration of a metal surface caused by vibration or chattering of/or against another part. A fretted steel surface may appear dull, scuffed or corroded, depending on length of time subject to the action, dissimilarity and link of contacting metal and presence or absence of moisture.

g. GALLING: Excessive friction between two metals resulting in particles of the softer metal being torn away and "welded" to the harder metal.

h. INDENTATION: Dents or depressions in a surface caused by severe blows.

i. OXIDATIONS: Chemical combining of a metal with atmospheric oxygen. Aluminum oxide forms a tough, hard film and protects the surface from further decomposition, however iron oxides do not form continuous cover or protect underlying metal, thus oxidation of steel parts is progressive and destructive.

j. PITTING (OR SPALLING): Small, deep cavities with sharp edges. May be caused in hardened steel surfaces by high impacts or in any smooth steel part by oxidation.

k. RUNOUT: Eccentricity or wobble of a rotating part. Eccentricity of two bored holes or two shaft diameters. A hole or bushing out of square with a flat surface. Usually measured with a dial indicator, and limits stated indicate full deflection of indicator needle in one revolution of part or indicator support.

l. SCORING: Deep grooves in a surface caused by abrasion when fine, hard particles are forced between moving surfaces, as in a bearing and journal, or by galling when a moving part is not supplied with lubricant.

6-3. PROTECTION FROM CORROSION. Bare steel should be covered with oil or a corrosion-preventive oil mixture except during the actual inspection operations. Since inspection involves handling of dry steel parts it is advisable to apply a fingerprint remover solution after such handling, particularly since perspiration and skin oils often have a high acid content. Application of lubricating oil or corrosion-preventive mixture will not necessarily stop corrosion from this cause.

6-4. VISUAL INSPECTION: Parts without critical dimensions and in small parts, as well as running parts and others of major importance, should be inspected visually under good light for surface damage such as nicks, dents, deep scratches, visible cracks, distortion, burned areas, pitting, pick-up of foreign metal and removal of enamel coating. Visual inspection should also determine the need for further cleaning of obscure areas. Inspect all studs for possible bending, looseness or partial removal. Inspect all threaded parts for nicks and other damage to the screw threads. After visual inspection the engine parts should be in three groups: apparently serviceable parts, repairable parts and parts to be discarded.

6-5. MAGNETIC PARTICLE INSPECTION. Inspection by the Magnaflux method should be conducted on all ferrous parts listed in Table IV, and in accordance with the methods and data in the table before dimensional inspection. The Magnaglow method is recommended whenever the necessary equipment is available. This method employs magnetic particles coated with a fluorescent organic material which may be illuminated with "black light", as in the Zyglo process, to amplify weak indications. If a crankshaft is doubtful after circular magnetization and inspection, demagnetize and remagnetize it longitudinally for further inspection.

Before magnetic particle inspection, piston pins and valve rocker shafts must be polished with corcus cloth.

CAUTION

Before magnetic particle inspection of any part, plug small holes leading to obscure cavities with tight-fitting wood plugs or with a hard grease which is soluble in lubricating oil to prevent particles from lodging in places from which they would be difficult to remove and which places are not subject to visual inspection. After magnetic particle inspection, remove all such plugs and clean the part thoroughly in solvent; then dry with compressed air. Check for complete demagnetization. Do not inspect springs by the Magnaflux process.

6-6. FLUORESCENT PARTICLE INSPECTION. This process, commonly known under the trade name of "Zyglo", is recommended for inspecting aluminum alloy parts for invisible cracks. The standard operating technique for the process is applicable.

6-7. DIMENSIONAL INSPECTION.

6-8. INSTRUMENTS. Areas of running parts and bushings subject to wear should be inspected for serviceable fit with mating parts by comparative linear measurements and alignment measurements, using standard pattern precision measuring instruments such as micrometer calipers, telescoping gauges and dial indicators. The use of a dial-type cylinder bore gauge is recommended in preference to other tools not specifically designed for this purpose.

6-9. DIMENSIONAL LIMITS. After comparative measurements of mating parts and determination of running clearance, refer to the Table of Limits, Section VI, and to the Limits and Lubrications Chart to locate the reference number of each fit and the aceptable limits assigned to it. Limits under the column heading "New Parts" are manufacturing limits. All running clearances in this column apply to mating parts, both of which are new, and the low limit applies in all instances; however, such clearances are allowed to increase with wear to, but not beyond, the values in the column headed "Serviceable Limit". All press and shrink fits must be maintained as specified in the "New Parts" columns when the inserted member is replaced. Oversize parts are supplied, in some instances, to permit conformity to this requirement.

6-10. ORIGINAL DIMENSIONS. Although comparative measurements of mating parts will determine the serviceability of the fit, it is not always easy to determine which part has worn the most, and in some instances (e.g., main journals in new bearing inserts), accurate measurements of fit are not possible. While no limits of wear on critical dimensions have been assigned to specific parts in most instances, it is helpful in estimating wear to know the original dimensions. Hence, the following list of manufacturing limits on important dimensions of new parts should be consulted when the servicebility of a specific part is in doubt.

TABLE I
CRITICAL NEW PART DIMENSIONS

Part Name	Feature	New Dimension (Inches)
Cylinder head	Rocker shaft boss bore	0.7495 - 0.7505
	Intake valve guide bore	0.4352 - 0.4362
	Exhaust valve guide bore	0.4370 - 0.4380
Valve rocker shaft	Outside diameter	0.7490 - 0.7495
Valve rocker bushings	Inside diameter	0.7505 - 0.7515
Intake valve	Stem diameter	0.4335 - 0.4340
Exhaust valve	Stem diameter	0.4345 - 0.4350
Piston (Std)	*Diameter at top	5.208 - 5.210
	*Diameter below 1st groove	5.218 - 5.220
	*Diameter at bottom	5.2400 - 5.2410
	Pin bore diameter	1.1246 - 1.1250
	Third ring groove width	0.191 - 0.192
	Fourth ring groove width	0.100 - 1.101
Piston pin assembly	Length (including plugs)	5.205 - 5.215

TABLE I (Cont.)
CRITICAL NEW PART DIMENSIONS

Part Name	Feature	New Dimension (Inches)
Connecting rod	Bushing bore diameter	1.1267 - 1.1269
	Bushing center to crankpin center	6.623 - 6.627
Crankshaft assembly	Damper pin bushing I. D. (16)	0.662 - 0.626
Camshaft	Journal diameter (4)	0.998 - 0.999
Hydraulic valve tappets	Outside diameter	0.9990 - 0.9995
Crankcase	Camshaft bearings dia.	1.000 - 1.001
	Tappet guides dia.	1.000 - 1.001
	Governor driven gear bearing dia.	0.875 - 0.876
Starter worm drive shaft	Small end diameter	0.5615 - 0.5625
Starter shaftgear	Front journal diameter	0.7495 - 0.7500
	Knurled drum diameter	1.931 - 1.932
	Clutch drum support dia. (A)	0.787 - 0.789
	Clutch drum support dia. (B & C)	0.995 - 1.0000
Starter clutch drum	Inside diameter	0.790 - 0.791
Starter clutch spring	Outside diameter	2.374 - 2.376
	Inside diameter	1.938 - 1.940
Starter drive adapter	Sleeve front end I. D.	2.338 - 2.343
Oil pump driver gear	Shaft diameter	0.5600 - 0.5605
Oil pump driven gear	Shaft hole diameter	0.687 - 0.688
Oil pump housing and shaft assembly	Driven gearshaft diameter	0.564 - 0.565
	Driver gearshaft hole diameter	0.5620 - 0.5630
	Gear chamber depth	1.3275 - 1.3290
Magneto drive gears	Shaft diameter	0.812 - 0.813
Magneto and accessory drive adapter	Bushing inside diameter	0.8145 - 0.8155
Idler gear assembly	Bushing inside diameter (A)	0.812 - 0.813
Idler gear front bushing	Bushing inside diameter (B & C)	0.560 - 0.561
Idler gear flanged bushing	Bushing inside diameter (B & C)	0.1501 - 0.502
Idler gear support pin	Gear support diameter (A)	0.8095 - 0.8105
Idler gear	Large diameter (B & C)	0.558 - 0.559
	Small diameter (B & C)	0.449 - 0.500

* Measure piston diameters at right angles to pin bore.

6-11. PROTECTIVE COATING. The manufacturer protects all aluminum alloy castings, sheet metal and tubing from corrosion by treating all surfaces, of the parts, with "Alodine 1200" (American Paint and Chemical Co., Ambler, Penn.).

6-12. APPLICATION OF "ALODINE 1200". In the event the original finish of an aluminum part has deteriorated or been removed, the part may be "Alodized" or as described in "Alodine" manufacturers Technical Service Data Sheet No. AL-1200-D. Wrought or die cast (smooth surface) parts, such as valve rocker covers and intake tubes, are tumble blasted prior to machining, if any, to roughen surface before treatment. Such treatment should not be employed in overhaul work on parts with machined surfaces. "Alodine", unlike enamel or primer, will not flake or peel off to contaminate engine lubricating oil; therefore, corrosion protection can be afforded to all interior aluminum surfaces and parts. If an enamel coating is required for a part previously treated with "Alodine", application of a primer before painting is not necessary. "Alodizing" will be performed after all machining and/or repair operations have been completed. The surface color of an "Alodized" part may vary from light gold to dark brown. When a part is treated with "Alodine 1200" the thickness of the film, or build up, on the mating or bearing surfaces is so small that the effect on dimensional tolerances is negiligible.

6-13. REPAIR OF "ALODIZED" SURFACES. If "Alodized" parts have been remachined, rubbed with abrasives or scratched in handling so as to expose areas of bare aluminum, the surface may be repaired by local application of "Alodine" solution in the following steps:

a. Clean bare area thoroughly with carbon tetrachloride. Do not under any circumstances use an oil base solvent or strong alkaline cleaner.

b. Mix a small quantity of hot water (180° F.) with 1-1/2 to 2 ounces of "Alodine 1200" powder to form a paste, then gradually dilute with hot water until a solution of one gallon is attained. This solution is to be adjusted by addition of nitric acid to a PH value of 1.5 to 1.7.

c. Apply solution with a rubber set paint brush in such a manner that solution flows over bare area. Allow solution to remain on the part from one to five minutes or until color of the new film is approximately same as original.

d. Flush part with clear water and dry with warm air current. Do not air blast or rub with cloth to dry new film area. If color is too light, repeat step "C" until desired color is obtained.

NOTE

If "Alodine" does not adhere to metal, a more severe cleaning method must be used. A solution of 12 to 16 ounces of Oakite No. 61, or equal, per one gallon of water is preferred. Apply and remove the solution with caution because an alkaline cleaner of this type will remove any "Alodine" film previously applied. Remove cleaning solution thoroughly with plenty of hot water and vigorous brushing.

6-14. ENAMEL COATINGS. Ferrous parts when painted with gold enamel will be baked with infra-red equipment for 15 minutes at 275-285° F. following application of each coat. Magnesium parts will be pickled and primed before painting; then baked with infra-red equipment for 15 minutes at 275-285° F. following application of each coat of enamel.

NOTE

If a part which was originally "Alodized" is to be refinished with enamel, it will not be necessary to apply zinc chromate primer except to the surface areas completely stripped of "Alodine".

CAUTION

Before application of primer and enamel to a part, carefully mask all connection joints and mating surfaces. No primer or enamel is permissible on interior surfaces of any parts contacted by engine lubricating oil after assembly.

6-15. SPECIFIC INSPECTIONS.

6-16. CRANKCASE. If any cylinder base nut was loose at disassembly or if any of the cylinder attaching studs are bent, even slightly, or if there is definite evidence that a cylinder was loose at any time, then it is possible that reversal of stress has fatigued the studs and through bolts installed on that cylinder pad, in which case all of them should be replaced. Test for bent studs with a toolmaker's-square. When inspecting for casting cracks pay particular attention to areas on and adjacent to the cylinder mount pads, tappet guides, bottom flange and bearing bosses. Look for nicks on machined surfaces and scoring in shaft bearings and the shaftgear bushing. The castings must be clamped together at all attaching points before dimensional inspection of camshaft bearings.

NOTE

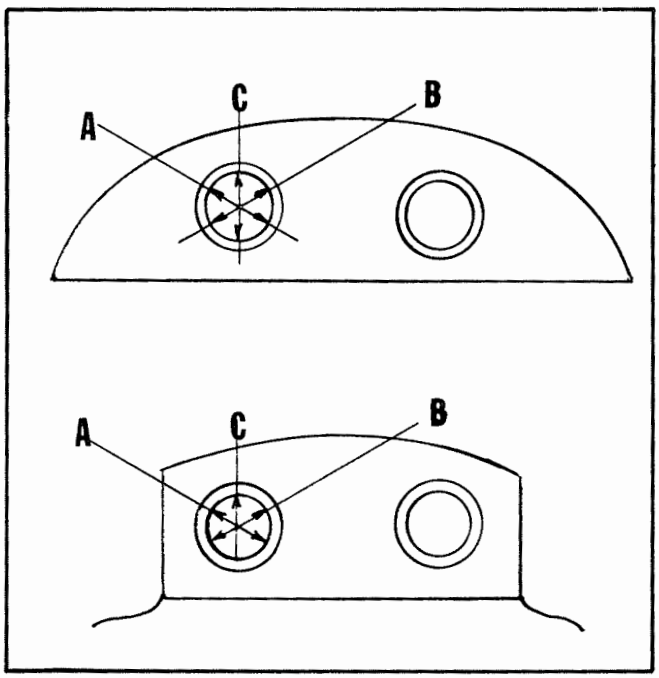
If camshaft bearings are excessively worn, the crankcase may be returned to the factory through any Continental Authorized Distributor to be line bored for a 0.020 inch oversize camshaft.

6-17. CRANKSHAFT. In addition to magnetic particle, visual and dimensional inspection, the shaft should be mounted on matched vee blocks on a surface plate (supporting the front and rear main journals) and rotated under a dial indicator placed to bear on the center main journal in order to detect excessive bending. This is of particular importance if the aircraft has been involved in an accident resulting in a broken or bent propeller. (Refer to the Table of Limits for limits of "run-out" at the center journal.)

6-18. CRANKSHAFT & COUNTERWEIGHT BUSHINGS

a. Excessive localized brinelling of the crankshaft dampener pin bushings can affect propeller blade tip stresses. It is, therefore, recommended that at each normal major overhaul the pin bushings be inspected and replaced as required. This applies to both the dampener bushings and the crankshaft blade bushings.

b. Inspect in the following manner: Measure the inside diameter of bushing across points A, B and C. Take the average of A and B and deduct this from C. If the difference exceeds .001" then the bushing should be replaced.



1. The C measurement should be the point of maximum diameter which is generally a point perpendicular to the lengthwise centerline of the crankshaft.

2. Measurements A and B should be taken at points approximately 60° either side of Point C.

3. After removing the bushings from the dampeners or the crankshaft blades, measure the inside diameter of the holes. Select a replacement bushing which will give an interference fit of .001" - .003" into each the dampener or the crankshaft blade holes.

c. Replacement bushings are available in standard, .0015, .003 and .005" oversize on the outside diameter.

d. A special tool for removing and replacing these bushings has been developed by Borroughs Tool and Equipment Corporation, 2429 North Burdick Street, Kalamazoo, Michigan. We recommend that this tool only be used for these operations. Removing and replacing bushings with makeshift tools and methods can result in irreparable damage to the crankshaft and/or dampeners.

e. The number of this tool is Borroughs' Part No. 4965. It should be ordered directly from Borroughs Tool and Equipment Corporation.

6-19. CAMSHAFT. Inspect the journals for scoring, corrosion and overheating, and the lobes for pitting at the toes and evidence of overheating or unusual wear.

6-20. CONNECTING RODS. Use a telescoping gauge and an outside micrometer caliper to measure all worn bushings and locally-replaced bushings. If a bushing was replaced locally it is also necessary to check its alignment with the big end bearing seat. The simplest method of making alignment measurements requires a push fit arbor, preferably at least eight inches long, for the bushing bore and another for the bearing seat, a surface plate, two matched vee blocks and two blocks of ground flat steel stock of equal height. To measure twist, insert the arbors into the rod bores; then lay the big end arbor in the vee blocks on the surface plate, and place the ground steel blocks under the ends of the bushing arbor at a measured distance apart. A feeler gauge may be used to detect any clearance at either end under the bushing arbor. This, divided by the separation of the blocks in inches, will give the twist per inch of length. (Refer to limit in Section VI.) To measure bushing and bearing convergence, mount a dial indicator on a surface gauge, and swing the rod around the big end arbor to the vertical position against a firm stop. Pass the indicator over the bushing arbor at points an exact number of inches apart. The difference in readings at the two ends, divided by the distance between points of measurements, again gives the misalignment per inch, as specified in Section VI.

NOTE

If desired, connecting rods may be returned to the factory through any Continental Authorized Distributor for bushing replacement.

6-21. GEARS. Inspect gear teeth for signs of overheating and excessive wear. Normal wear produces a fine polish on the tooth thrust faces. Alteration of the tooth profiles, score marks and pitting are sufficient cause for rejection.

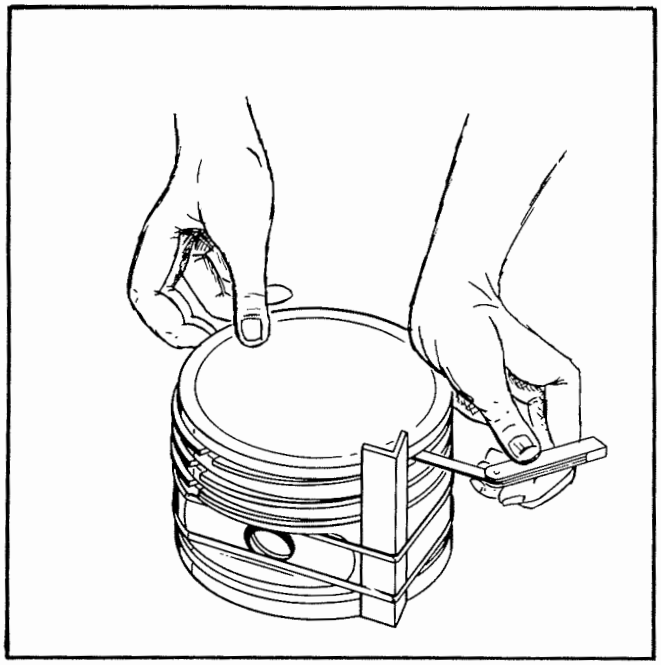


Figure 6-1. Inspecting Ring Side Clearance

6-22. PISTONS AND RINGS. Inspect the skirt for long, deep scores which indicate overheating and are sufficient cause for rejection. If a telescoping gauge is used to measure the pin bore, do not allow the spring pin to expand rapidly so as to strike the wall hard. Inspect visually for thorough cleaning, including the oil relief holes in the third ring groove. It is not necessary to remove light scores or discoloration from the exterior surfaces, and it is not advisable to use abrasive (including crocus cloth) on the skirt, since the cam-ground contour should not be altered. If the piston is dimensionally serviceable in other respects and apparently sound, measure side clearances of new rings (after measuring their gaps while squared in the cylinder barrel) by installing the slotted oil control ring assembly in the third groove, the two compression rings in the top and second grooves and the scraper ring in the fourth groove, with part numbers toward the piston head, and inserting various thickness gauges on either side of each ring (See figure 6-1). The gaps of rings in the barrel should be measured first so that those selected may be left in the piston grooves, if the grooves are not excessively worn or distorted. When installing rings, take care not to allow their sharp ends to scratch the piston lands. If the cylinder barrel has not been ground oversize and fits the piston within the allowable clearance limit, it is permissible to install either standard or 0.005 inch oversize rings, whichever have the specified gap, as measured with the ring pushed up by the piston head to a point in line with the base flange.

6-23. CYLINDERS. Measure the barrel bore near the top of the ring travel limit and at the 5-1/4 inch station from the open end in the thrust direction and at right angles to that in order to detect out-of-roundness and wear-in taper. There should be little or no wear at the open end. Look for bent barrel fins and broken head fins. Barrel fins can be straightened if not badly bent or cracked. A reduction of not over 10% in area of head fins due to breakage is allowable. Look for cracked head fins, and specify repair of any radial crack by drilling a vee notch to remove it. If a radial crack extends to the root of a fin it may have penetrated the wall; hence, the cylinder should be rejected. If the cylinder base nuts were loose at disassembly, or if the base studs were loose or bent, test the machined side of the cylinder flange for bending, which is cause for rejection. Measure valve guides for wear, and look for scoring in their bores. Valve seats should be inspected after refacing to make sure that their outside diameters are still less than the valve head diameters. Exhaust valves should be checked for warpage before refacing, and all valves should be measured in length if the stem tips were ground. Inspect the spark plug hole and intake flange screw hole "Heli-Coil" inserts for looseness, deformation and position. The outer ends should lie in the first full thread of the tapped holes in which they are installed. The spark plug hole "Heli-Coil" has teeth at the outer end which are forced into the head metal and should not be visible. If there was any evidence of overheating of cylinder or piston, check as well as possible for turning of the head in relation to the barrel flange.

6-24. HYDRAULIC VALVE LIFTERS. During examination of each part, look for sludge and carbon residues. Also check for obstructed oil holes. Inspect face of cam follower on body for any type of damage and look for deep scoring and corrosion on exterior of tubular portion. Discard any lifter body which exhibits any of these faults. To test roughly for excessive diametrical clearance between hydraulic unit plunger and cylinder and to check valve wear in cylinder, start dry plunger into dry cylinder. While holding cylinder between thumb and middle finger, depress plunger with index finger and release it quickly. Compression of air in cylinder should make plunger kick back instantly. If plunger does not return fully, either it is excessively worn or check valve is leaking. To check for leaking valve, repeat compression test while plugging end of oil inlet tube with other hand. If plunger still does not kick back promptly it and the cylinder are excessively worn. If it does kick back on the second test, either check valve seat is worn and leaking or it is dirty. Clean cylinder again and repeat first test (tube open. If plunger still does not kick back, valve is defective. Any unit failing to pass this rough check must be discarded. Discard both plunger and cylinder, since these parts are selectively-fitted and are not interchangeable.

6-25. INTAKE TUBES. Inspect intake tubes for distortion, cracks and out-of-roundness. All other types of damage will require replacement of the part.

6-26. LUBRICATION SYSTEM. Visually inspect all parts of the system in accordance with the instructions in paragraphs 6-4, 6-8, 6-9 and 6-10.

6-27. FUEL INJECTION SYSTEM. Inspection of the components and parts of this system is limited strictly to visual for evidences of damage or deterioration. Continental Motors Corporation does not authorize any disassembly and repair of the fuel pump and/or fuel control unit.

6-28. IGNITION SYSTEM. Continental Motors Corporation recommends replacement of the complete ignition harness at every engine overhaul.

TABLE II. INSPECTION CHART

Subassembly and Part	Inspect	Nature of Inspection	Special Considerations
CYLINDER ASSEMBLY Head & Barrel	Interior walls	Corrosion, pitting, scoring.	Defects not permissible after removal of glaze.
	Bore diameters	Wear in ring traversed area and step at top. Use dial-type gauge set to zero near open end of bore.	Refer to Table of Limits for standard size bore or for oversize bore.
		After honing or roughening of glaze measure bore diameters, out-of-roundness and taper.	Dimensional honing should remove ring step of more than 0.002 in. diameter. Taper limit (Table of Limits) must not be exceeded by honing.
	Bore walls	After roughening of honing, inspect scratch pattern and, if possible, measure surface roughness in micro inches RMS of 10% of cylinders as a quality check.	Refer to Table of Limits.
	Stem holes in valve guides	Scoring, diameter, flare at ends.	Diameters of stem holes in new guides must be within limits for new parts and free of tool marks.
	Valve seats	Roughness caused by burning.	If seats cannot be made serviceable by grinding within width limit (Table of Limits). Check Continental Motors Corp. policy regarding factory replacement.
	Cooling fins	Cracks and broken areas.	Cracked and/or broken cylinder head fins may be repaired, providing a total of not more than five square inches is, or has been removed.
	Base flange	If attaching nuts were found loose at disassembly, test for flatness of mounting face.	Allow not over 0.001 in. out-of-flat on machined surface.
	Pilot	Out-of-roundness of pilot below face flange.	
	Spark plug thread insert	Distortion or improper fit in cylinder head hole.	

TABLE II. INSPECTION CHART (Cont.)

Subassembly and Part	Inspect	Nature of Inspection	Special Considerations
CYLINDER ASSEMBLY (Cont.)	Pushrod housing stems	Looseness, leakage.	
Valves	Stems	Scoring, nicks in grooves, wear on tips.	Polishing must not reduce diameter below minimum for new parts.
	Heads	Use dial indicator heads to determine warp. Make sure that grinding has not cut through Stellite face of exhaust valve or entered rounded edge on intake valve head.	
	Length	Use height gauge to detect stretch and check for reduction due to tip grinding.	Stretched valves may fail. Shortened valve may exceed ability of hydraulic lifters to take up lash.
Valve Rockers	Contact foot	Scoring, diameter.	
	Oil passages	Obstruction	
	Hub	Side clearance between cylinder head supports.	Refer to Table of Limits.
Rocker Shaft	Outside surface	Diameter, scoring, rough ends.	
CONNECTING ROD ASSEMBLY			
Bushing	Inside diameter	Measure with telescoping gauge and micrometer caliper.	New bushings must be reamed within diameter limits for new parts. Sharp edges must be broken slightly. (Refer to Table of Limits, for wear limit, for new bushing limits and new bushing alignment limits.)
CRANKSHAFT ASSEMBLY			
Crankshaft	Main journals	Diameters, scoring, burning	Must be polished before magnetic inspection.
	Crankpins	Diameters, scoring, burning	Must be polished before magnetic inspection.
	Oil seal race	Scoring	Must be polished.
	Screw holes	Damaged or dirty threads.	
	Oil holes	Obstructions	
	Bending	Measure run-out at center journal end wobble on face of flange.	Required only if shaft has been subject to shock.
Gear dowel	Tight fit	Attempt to pull out by hand only.	

TABLE II. INSPECTION CHART (Cont.)

Subassembly and Part	Inspect	Nature of Inspection	Special Considerations
CRANKSHAFT ASSEMBLY (Cont.)			
Oil control plug	Presence	Obstruction of oil hole, tight fit.	
Gear	Teeth, screw	Burning, scoring, wear enough to alter profile. Damaged or dirty threads.	
CAMSHAFT ASSEMBLY			
Camshaft	Journals	Diameter and fit in crankcase bearings. Scoring, pitting and corrosion	Excessive bearing wear may be compensated by enlarging bearing and installing oversize shaft. Refer to "Crankcase".
	Lobes	Pitting along toe line, loss of slope along toe line, width across heel and toe at center of length.	Serious pitting not permissible. Toe line must taper in relation of axis to rotate valve lifters.
	Flange screw holes	Distortion of threads.	
	Edge and rear	Nicks, peening, other irregularities.	Must be smooth to align gear.
Gear	Teeth	Scoring, burning, pitting, wear enough to alter profile.	
CRANKCASE ASSEMBLY			
Crankcase castings	Valve lifter guides	Diameter, scoring	
	Bearing seats	Roughness, wear in tang notches.	Refer to Table of Limits.
	Camshaft bearings	Diameter, scoring, fit of rear bearing between camshaft flanges.	Before discarding crankcase due to excessively worn camshaft bearings, check Continental Motors Corp. policy regarding factory oversizing.
	Oil passages	Inspect visually galleries, main and camshaft bearing supply holes, using inspector's flashlight to illuminate. Probe other oil holes with brass rod.	
	Tapped holes	Deformed or dirty threads.	
Studs	Threads	Distortion	
	Height	Check for backing outs.	Refer to Stud Height Table.
	Squareness	Use toolmaker's square to check studs suspected of bending.	Refer to Stud Height Table.

TABLE II. INSPECTION CHART (Cont.)

Subassembly and Part	Inspect	Nature of Inspection	Special Considerations
CRANKCASE ASSEMBLY (Cont.)			
Idler gear support and bushings	Bore	Inside diameter, scoring	Refer to Table of Limits.
Needle bearing	Rollers	Roughness or excessive play	
Retainer	Mounting surface oil seal	Warpage, cracks Observe that old seal has been removed without damage to retainer.	
Oil filler neck	Tightness	Attempt to rock and pull out by hand only.	Must be tight in casting. IO-520-B-C only.
Oil gauge rod	Distortion	Look for bent blade, obliterated "FULL" and "LOW" marks, loose collar, deformed cap.	
Oil gauge support	Tightness	Attempt to move tube by hand only.	IO-520-A only.
Engine mounting brackets	Machined surfaces	Warpage and scratches.	IO-520-A only.
	All areas	Cracks	IO-520-A only.
Plugs	Threads	Look for distortion.	
	Wrench flats	Look for damaged corners.	
Vernatherm control valve	Bore	Inside diameter, scoring.	IO-520-A only.
	Seat	Roughness	IO-520-A only.
OIL COOLER ASSEMBLY			
Oil cooler	Headers, fins core	Inspect visually for dents, deformed fins, punctures, stripped plug hole threads, cracks and scratches.	
	Machined surfaces	Warpage and scratches.	
	All areas	Cracks	
Vernatherm control valve	Seat	Roughness	IO-520-B-C only.
OIL SUMP ASSEMBLY			
Casting	Tapped holes	Damaged threads, cracks around holes.	
	Mounting surfaces	Scratches, warpage, cracks	

TABLE II. INSPECTION CHART (Cont.)

Subassembly and Part	Inspect	Nature of Inspection	Special Considerations
OIL SUMP ASSEMBLY (Cont.)	All areas	Cracks	
Plugs	Threads	Look for distortion	
	Wrench flats	Look for damaged corners.	
Oil suction tube	Threads, tube filter	Damaged threads, dented tube, cracks in tube, distorted or plugged filter.	
Engine mounting brackets	Machined surfaces	Scratches, cracks	IO-520-B only.
OIL PUMP ASSEMBLY			
Housing	All areas	Cracks, scratches on machined surfaces, restrictions in oil holes.	
	Gearshaft	Look for scoring, measure diameter.	Gears must turn freely. (Refer to Table of Limits.)
	Plugs	Distorted threads, damaged wrenching surfaces.	
Gears	Shafts	Measure diameters and compare with bushing diameters.	Refer to Table of Limits.
	Gear teeth	Scoring, burning or wear enough to alter tooth profile.	
	Splines	Look for wear on side of splines and residual sludge.	
Gear bushings	Bore diameters	Use telescoping gauge and micrometer caliper.	Refer to Table of Limits.
Oil pressure relief valve plunger	Outside surface	Measure diameter. Look for scoring, nicks, etc.	
	Conical face	Roughness	Must seat perfectly in housing.
Oil pressure relief valve housing	Plunger seat	Spread prussian blue oil base pigment on face of plunger, and turn on seat, all around, plunger face must be lapped to seat. (Plunger held centered and aligned.)	
Oil pump cover	Shaft holes	Measure diameters.	Refer to Table of Limits.
Tachometer drive housing	Threads, flange seal bore	Thread distortion, warped mounting surface, scored seal counterbore.	See that old oil seal was removed.
Oil filter adapter	Threads, flange	Damaged threads, warped flange, cracks.	

TABLE II. INSPECTION CHART (Cont.)

Subassembly and Part	Inspect	Nature of Inspection	Special Considerations
OIL PUMP ASSEMBLY (Cont.)			
Oil filter	Threads, screen pilot cup	Damaged threads, punctured screen, out - of - round pilot cup.	
STARTER ADAPTER ASSEMBLY			
Adapter	All areas	Cracks, scratches on machined surfaces, damaged tapped holes.	
Needle bearing	Rollers	Roughness or excessive play	
Studs	Threads	Distortion or stripping	
	Height	Check for backout.	Refer to Stud Height Table.
	Alignment	Check studs suspected of bending with toolmaker's square.	
Gears	Shafts	Measure diameters and compare with bushing diameters.	Refer to Table of Limits.
	Gear teeth	Scoring, burning or wear enough to alter toothe profile	
Ball bearing	Balls, cage	Surface roughness, out-of-round, excessive depth and looseness.	
Adapter cover	All areas	Cracks, scratches on machined surfaces, damaged mounting holes.	
	Shaft bearing	Look for scoring.	
	Bore	Measure diameter.	
	Oil seal	See that old seal was removed without damage to casting.	
ALTERNATOR			
Hub assembly			IO-520-B-C only.
Hub	All areas	Scored or undersize bearing surfaces.	Refer to Table of Limits.
	Spring	Damaged or broken.	
	Gear	Look for chipped, cracked and broken teeth, scoring, burning and wear enough to alter tooth profile.	
	Gear bushing	Measure bore diameter.	Refer to Table of Limits.
	Thrust washer	Thickness, excessive wear.	

TABLE II. INSPECTION CHART (Cont.)

Subassembly and Part	Inspect	Nature of Inspection	Special Considerations
INDUCTION SYSTEM			
Intake manifold	Flanges	Check for warping by placing flanges on surface plate. Look for cracks.	
	Tubes	Look for dents, out-of-round ends, cracks.	
	Plug bosses	Damaged threads, cracks around bosses.	
Clamps	Shape	Look for distortion such as out-of-roundness and lugs converging.	
FUEL INJECTION SYSTEM			
Fuel pump adapter	All areas	Cracks, damaged mounting holes, inspect tapped holes. Measure bore diameter.	
Fuel pump drive gear	Teeth	Look for chipped, cracked and broken teeth, scoring, burning and wear enough to alter tooth profile.	
	Shaft	Measure outside diameter and compare with bore diameter.	Refer to Table of Limits.
	Gear plug	Make sure that new plug was installed after magnetic particle inspection of gear and visual inspection for cleanliness of center bore.	
Drive coupling	Fit	Check for looseness.	
Fuel pump and vapor separator assy Fuel injection control assembly Fuel manifold valve assembly	Outside area	Inspection is limited strictly to visual for evidences of damage or deterioration.	Continental Motors Corp. does not authorize any disassembly and repair of these units. If either or all of these units are in need of repair, return them to the factory through any Continental Authorized Dealer or Distributor.
Shroud assembly	All areas	Inspect visually for dents, cracks and broken joints.	
Air throttle assembly	Tapped holes	Damaged threads, cracks around holes.	
	Studs	Bent or stripped stud threads	
	All areas	Cracks	
	Shaft	Check alignment. Measure diameter.	No wear limits established.

TABLE II. INSPECTION CHART (Cont.)

Subassembly and Part	Inspect	Nature of Inspection	Special Considerations
FUEL INJECTION SYSTEM (Cont.)	Plate	Check for warpage.	
Fuel discharge tubes	All areas	Look for cracks, flat spots, out-of-round ends.	
Pipe fittings	Threads	Distortion or stripping.	
	Wrench flats	Look for damaged corners.	
MAGNETO AND ACCESSORY DRIVE ASSY			
Adapter	Gear bushing	Measure bore diameters.	Refer to Table of Limits.
	Oil seal	Observe that old seal has been removed without damage to casting bore.	
	Studs	Look for stripped and deformed threads.	
Gear	Teeth	Scoring, burning or wear enough to alter tooth profile.	
	Shaft	Measure diameters and compare with bushing diameter.	Refer to Table of Limits.

TABLE III. CRANKCASE STUD SETTING HEIGHTS

Location	Thread Sizes	Setting Height	Model IO-520 A	Model IO-520 B	Model IO-520 C
Cylinder mount pads	7/16-14 X 7/16-20	13/16	36	36	36
Engine mount pads	3/8-16 X 3/8-24	1-7/32	15		
	3/8-16 X 3/8-24	1-1/4	1		
	3/8-16 X 3/8-24	1-49/64			2
	3/8-16 X 3/8-24	1-1/2			4
	3/8-16 X 3/8-24	1-13/16			1
	3/8-16 X 3/8-24	1-7/8			2
Oil cooler mount pads	1/4-20 X 1/4-28	7/8	5		
	3/8-16 X 3/8-24	49/64		2	
	3/8-16 X 3/8-24	27/32		2	
Governor mount pads	5/16-18 X 5/16-24	1-3/8	4	4	4
Magneto mount pads	5/16-18 X 5/16-24	43/64	4	4	4
Magneto and accessory drive adapter pad	5/16-18 X 5/16-24	3/4	6	4	3
	5/16-18 X 5/16-24	7/8			1
	5/16-18 X 5/16-24	61/64		2	
	5/16-18 X 5/16-24	1-3/4			2
	3/8-16 X 3/8-24	13/16		2	2
	3/8-16 X 3/8-24	7/8	2		
Idler pin pad	1/4-20 X 1/4-28	9/16		2	2
	1/4-20 X 1/4-28	3/4	2		
Starter drive pad	5/16-18 X 5/16-24	13/16	2		
	5/16-18 X 5/16-24	3-21/32		2	2
Fuel pump pad	5/16-18 X 5/16-24	3/4	2	2	2

TABLE III. CRANKCASE STUD SETTING HEIGHTS (Cont.)

Location	Thread Sizes	Setting Height	Model IO-520 A	Model IO-520 B	Model IO-520 C
Oil pump pad	1/4-20 X 1/4-28	7/8	1		
	1/4-20 X 1/4-28	1-49/64		1	1
	1/4-20 X 1/4-28	2-9/32	2		
	1/4-20 X 1/4-28	3-3/8		5	5
	1/4-20 X 1/4-28	3-11/16	2		
	1/4-20 X 1/4-28	3-63/64	5		
	3/8-16 X 3/8-24	2-9/16		1	1
	3/8-16 X 3/8-24	2-15/16		2	2
Generator bracket	5/16-18 X 5/16-24	19/32	1		
Crankshaft oil seal retainer	#10-24 X #10-32	5/16	4	4	4
Camshaft cover pad	1/4-20 X 1/4-28	11/16		2	2
Crankcase thru 1-3-5 side accessory end	5/16-18 X 5/16-24	5-13/32		1	
	5/16-18 X 5/16-24	6-13/32			1
Governor oil transfer collar	1/4-20 X 1/4-28	15/16	2	2	2
Cylinder	1/4-20 X 1/4-28	25/32	4	4	4
Oil pump housing	1/4-20 X 1/4-28	19/32	1		
	1/4-20 X 1/4-28	21/32	1	2	2
Oil pump cover	1/4-20 X 1/4-28	3/4			4
	1/4-20 X 1/4-28	7/16			1
Magneto adapter	1/4-20 X 1/4-28	7/8	4	4	4
Starter drive adapter	5/16-18 X 5/16-24	23/32		3	3
	5/16-18 X 5/16-24	1		2	2
	3/8-16 X 3/8-24	7/8	2	2	2
Oil sump	3/8-16 X 3/8-24	31/32		12	

TABLE IV. MAGNAFLUX INSPECTION DATA

Part	Method of Magnetization	Amperes	Method of Inspection	Critical Areas	Possible Defects
Crankshaft	Circular	2500	Wet Continuous	Journals, fillets, oil holes, crankpins thrust flanges	Fatigue cracks, heat cracks
Connecting rod	Circular	1800	Wet Continuous	All areas	Fatigue cracks
Camshaft	Circular	1500	Wet Continuous	All areas	Fatigue cracks, forging laps
Piston pin	Circular	1500	Wet Residual	Shear planes, ends	Fatigue cracks, stringers
Rocker arms	Circular	1800	Wet Continuous	Rocker face, socket	Fatigue cracks
Camshaft gear	Circular	1800	Wet Continous	Teeth, splines	Fatigue cracks
Crankshaft gear	Circular	1800	Wet Continuous	Teeth, around screw holes	Fatigue, heat cracks
Starter shaftgear	Circular	1500	Wet Continuous	Teeth, drum	Fatigue, heat cracks

TABLE IV. MAGNAFLUX INSPECTION DATA (Cont.)

Part	Method of Magnetization	Amperes	Method of Inspection	Critical Areas	Possible Defects
	Longitudinal		Wet Continuous	Shaft between spur gear and drum	Fatigue cracks
Starter worm shaft	Circular	1500	Wet Continuous	Slotted end, around key slot	Fatigue cracks
Starter worm gear	Longitudinal		Wet Residual	Teeth	Fatigue cracks
Oil pump gear	Circular	1800	Wet Continuous	Teeth, splines	Fatigue cracks
Alternator drive gear	Circular	1800	Wet Continuous	Teeth, splines	Fatigue, heat cracks
Governor drive gear	Circular	1800	Wet Continuous	Teeth	Fatigue cracks
Governor driven gear	Circular	1800	Wet Continuous	Teeth, splines shaft	Fatigue cracks
Tachometer drive gear	Circular	1800	Wet Continuous	Teeth	Fatigue cracks
Tachometer shaft gear	Circular	1800	Wet Continuous	Teeth, shaft	Fatigue cracks
Idler gear	Circular	1800	Wet Continuous	Teeth	Fatigue cracks
Fuel pump gear	Circular	1800	Wet Continuous	Teeth, splines	Fatigue cracks
Fuel pump coupling	Circular	1800	Wet	All areas	Fatigue cracks

Table V. Table of Limits

Ref. No.	Chart No.	Model	Description	Serviceable Limit	New Parts Min.	New Parts Max.
1	1	All	Cylinder bore (lower 4-1/4" of barrel) . diameter:	5.256	5.251	5.253
2	1	All	Cylinder bore choke (at 5.75" from open end of barrel) . . . . . .taper:	0.001	0.003	0.005
3	1	All	Cylinder bore out-of-round :	0.003	0.000	0.002
4	1	All	# Cylinder bore . . . . . allowable o'size:	5.261	5.256	5.258
5	1	All	Cylinder bore surface roughness. . . . . RMS:	-	15	25
6	1	All	Cylinder barrel in crankcase . . . . . diameter:	-	0.004 L	0.010 L
7	1	All	Intake valve seat insert in cyl hd. . . . diameter:	-	0.009 T	0.012 T
8	1	All	Intake valve guide in cyl. hd. . . . . diameter:	-	0.0010T	0.0025T
9	1	All	Exhaust valve guide in cyl. hd . . . . . diameter:	-	0.0010T	0.0025T
10	1	All	Exhaust valve seat insert in cyl. hd . . diameter:	-	0.0070T	0.0100T
11	1	All	Intake valve seat . . . . . .width:	-	0.107	0.156
12	1	All	Exhaust valve seat . . . . . .width:	-	0.120	0.171
			Exhaust valve seat to valve guide axis . . .angle:	-	45°00'	45°30'
			Intake valve seat to valve guide axis . . . .angle:	-	59°30'	60°00'

Use 0.005" oversize piston & 0.005" oversize rings.

Table V. Table of Limits (Cont.)

Ref. No.	Chart No.	Model	Description	Serviceable Limit	New Parts Min.	New Parts Max.
			ROCKER ARMS & SHAFT			
13	1	All	Rocker shaft in cyl. hd. bosses . . . . diameter:	0.003 L	0.0000	0.0015L
14	1	All	Rocker shaft in rocker arm brg . . . . diameter:	0.004 L	0.0010L	0.0025L
15	1	All	Rocker arm bearing in rocker arm. . . diameter:	-	0.0020T	0.0040T
16	1	All	Rocker arm . . . . . .side clearance:	0.035 L	0.0040L	0.0160L
17	1	All	Intake valve in guide . . . . . diameter:	0.005 L	0.0012L	0.0027L
18	1	All	Exhaust valve in guide . . . . . diameter:	0.006 L	0.0020L	0.0035L
19	1	All	Intake valve face (to stem axis) . . . . . .angle:	-	59°45'	60°15'
20	1	All	Exhaust valve face (to stem axis) . . . . . .angle:	-	45°00'	45°30'
21	1	All	Intake valve (max. tip regrind .015) . . . .length:	4.789	4.804	4.824
22	1	All	Exhaust valve (max. tip regrind .015) . . .length:	4.791	4.806	4.826
23	1	All	Intake and exhaust valve (full indicator reading) warpage . . . . . :	0.004	0.000	0.002
24	1	All	Top of piston in cylinder . . . . . diameter:	-	0.041 L	0.045 L
25	1	All	Piston (2nd & 3rd lands) in cyl . . . . diameter:	-	0.031 L	0.035 L
26	1	All	Piston (below 3rd ring groove) in cyl. . diameter:	0.027 L	0.019 L	0.022 L
27	1	All	Piston (bottom of skirt) in cyl . . . . . diameter:	0.021 L	0.009 L	0.013 L
28	1	All	Top piston ring in groove . . . . .side clearance:	0.006 L	0.0015L	0.004 L
29	1	All	Second piston ring in groove. . . .side clearance:	0.006 L	0.0015L	0.004 L
30	1	All	Third piston ring in groove . . . .side clearance:	0.008 L	0.0035L	0.0055L
31	1	All	Fourth piston ring in groove. . . .side clearance:	0.012 L	0.0065L	0.0080L
32	1	All	Top ring gap (in cyl. barrel). . . . . .gap:	0.074	0.048	0.064
33	1	All	Second ring gap (in cyl. barrel) . . . . . .gap:	0.069	0.043	0.059
34	1	All	Third ring gap (in cyl. barrel) . . . . . .gap:	0.059	0.033	0.049
35	1	All	Fourth ring gap (in cyl. barrel) . . . . . .gap:	0.059	0.033	0.049
			Top & 2nd ring (standard gap) . . . . . .tension*:	12 lbs.	13 lbs.	17 lbs.
			Fourth ring (standard gap) . . . . . .tension*:	8 lbs.	9 lbs.	13 lbs.
36	1	All	Piston pin in piston (standard or 0.005: oversize) . . . . . diameter:	0.0015L	0.0001L	0.0007L
37	1	All	Piston pin. . . . . diameter:	-	1.1243	1.1245
			Piston pin (0.005" oversize). . . . . diameter:	-	1.1293	1.1295
38	1	All	Piston pin in cylinder. . . . . end clearance:	0.090 L	0.036 L	0.048 L
39	1	All	Piston pin in connecting rod bushing . . diameter:	0.0040L	0.0022L	0.0026L
40	1	All	Bushing in connecting rod. . . . . diameter:	-	0.0050T	0.0025T
41	1	All	Bolt in connecting rod . . . . . diameter:	-	0.0000	0.0015L
42	1	All	Connecting rod bearing on crankpin (tri-metal brg.) . . . . . diameter:	0.006 L	0.0009L	0.0034L
43	1	All	Connecting rod on crankpin . . . . end clearance:	0.016	0.006	0.010
44	1	All	Connecting bearing and bushin twist or convergence per inch of length . . . . . :	0.001	0.0000	0.0005
			CRANKSHAFT			
45	2/3	All	Crankshaft in main bearings (tri-metal). diameter:	0.005 L	0.0005T	0.0025L
46	** 2/3	All	Crankpins . . . . . .out of round:	0.0015	0.0000	0.0005
47	** 2/3	All	Main journals . . . . . .out of round:	0.0015	0.0000	0.0005
48	2/3	All	Crankshaft main and thrust journals . . diameter:	2.372	2.374	2.375
49	2/3	All	Crankpins . . . . . diameter:	2.247	2.249	2.250
50	2/3	All	Crankshaft run-out at center main journals (shaft supported at thrust and rear journals) full indicator reading. . . . . :	0.015	0.000	0.015
51	2/3	All	Crankshaft run-out at propeller flange (when supported at front and rear main journals) full indicator reading. . . . . :	0.005	0.000	0.005
52	2/3	All	Damper pin bushing in crankcheek extension . . . . . diameter:	-	0.0015T	0.0030T

* Measure piston ring tension on diameter perpendicular to gap when ring is compressed to specified inch gap.

** If crankshafts are worn beyond these limits they may be repaired by grinding crankpins and journals to 0.010" under new shaft limits and renitriding the crankshafts. Crankshafts may be returned to factory for such repairs.

Table V. Table of Limits (Cont.)

Ref. No.	Chart No.	Model	Description	Serviceable Limit	New Parts Min.	New Parts Max.
53	2/3	All	Damper pin bushing in counterweight . . diameter:	-	0.0015T	0.0030T
54 †	2/3	All	Damper pin bushing bore in counterweight and crankshaft hanger . . . . . diameter:	0.6265	0.622	0.626
			Damper pin (4th order) . . . . . diameter:	0.4735	0.474	0.475
			Damper pin (5th order) . . . . . diameter:	0.5265	0.527	0.528
			Damper pin (6th order) . . . . . diameter:	0.5549	0.5554	0.5574
55	2/3	All	Damper pin in counterweight. . . .end clearance:	0.040	0.001	0.025
56	2/3	All	Crankcheek in counterweight. . . side clearance:	0.017	0.006	0.012
57	new	BC	Alternator gear on crankshaft . . . . . diameter:	-	0.001 T	0.004 T
58	2/3	All	Crankshaft gear on crankshaft . . . . . diameter:	-	0.000	0.002
59	2	A	Crankshaft in thrust bearing . . . . end clearance:	0.019	0.008	0.016
60	3	BC	Crankshaft in thrust bearing . . . . end clearance:	0.015	0.006	0.012
			CAMSHAFT			
61	2/3	All	Camshaft journals in crankcase . . . . diameter:	0.005 L	0.001 L	0.003 L
62	2/3	All	Camshaft in crankcase . . . . . end clearance:	0.014	0.005	0.009
63	2/3	All	Camshaft run-out at center journals (shaft supported at end journals) full indicator reading :	0.001	0.000	0.001
64	2/3	All	Camshaft gear on camshaft flange . . . diameter:	-	0.0005T	0.0015L
65	2	A	Governor drive gear on camshaft. . . . diameter:	0.006 L	0.0002L	0.0020L
66	3	BC	Governor drive gear on camshaft. . . . diameter:	0.006 L	0.001 L	0.003 L
			CRANKCASE AND ATTACHED PARTS			
67	2/3	All	Crankcase oil seal in crankcase (split seal) . . . . . diameter:	-	0.011 T	0.017 T
68	2/3	All	Through bolt (10.75") in crankcase . . . diameter:	-	0.0005T	0.0013L
69	1	All	Hydraulic tappet in crankcase . . . . . diameter:	0.0035L	0.0005L	0.0020L
70	3	All	Governor drive shaft in crankcase . . . diameter:	0.005 L	0.0014L	0.0034L
71	2	A	Idler gear support pin in crankcase (frt). diameter:	0.0010L	0.0005L	0.0015T
72	3	BC	Idler gear support bushing in crankcase (front) . . . . . diameter:	-	0.0005L	0.0015T
73	2	A	Idler gear support pin in crankcase (rear) . . . . . diameter:	-	0.0005L	0.0025L
74	3	BC	Idler gear support bushing, flanged, in crankcase (rear) . . . . . diameter:	-	0.0015L	0.0035L
75	4	All	Magneto and accessory drive adapter pilot in crankcase . . . . . diameter:	-	0.000	0.004 L
76	2	All	Oil pump housing pilot in crankcase. . . diameter:	-	0.001 L	0.003 L
77	4	All	Starter shaftgear needle bearing in crankcase . . . . . diameter:	-	0.0005L	0.0015T
			OIL PRESSURE RELIEF VALVE ASSEMBLY			
78	2	A	Oil pressure relief valve adjusting screw in plunger . . . . . diameter:	0.0030L	0.0005L	0.0020L
79	3	BC	Oil pressure relief valve plunger in adjusting screw . . . . . diameter:	0.0090L	0.0030L	0.0060L
			ACCESSORY DRIVE IDLER ASSEMBLY			
80	2	A	Bushing in idler gear . . . . . diameter:	-	0.001 T	0.003 T
81	2	A	Idler gear support in bushing . . . . . diameter:	0.0050L	0.0015L	0.0035L
82	3	BC	Idler gear in support bushing (front) . . diameter:	0.0040L	0.001 L	0.003 L
83	3	BC	Idler gear in support bushing (rear) . . diameter:	0.0040L	0.001 L	0.003 L
84	2	A	Idler gear . . . . . end clearance:	0.043	0.002	0.033
85	3	BC	Idler gear . . . . . end clearance:	0.075	0.020	0.067

† If these limits are exceeded, new bushings, pins and retaining plates must be installed to maintain proper crankshaft dampening paragraph 6-17.

Table V. Table of Limits (Cont.)

Ref. No.	Chart No.	Model	Description	Serviceable Limit	New Parts Min.	New Parts Max.
			LEFT AND RIGHT MAGNETO AND ACCESSORY			
86	4	All	Bushing in magneto and accessory drive adapter . . . . . diameter:	-	0.001 T	0.003 T
87	4	All	Magneto and accessory drive gear in adapter bushing. . . . . diameter:	0.0050L	0.0015L	0.0035L
88	4	All	Oil seal in adapter . . . . . diameter:	-	0.007 T	0.001 T
89	4	All	Sleeve in magneto and accessory drive gear . . . . . diameter:	-	0.001 T	0.004 T
90	4	A	Magneto and accessory drive gear . end clearance:	-	0.0015L	0.086 L
90	4	BC	Magneto and accessory drive gear . end clearance:	-	0.011 L	0.077 L
91	4	All	Magneto coupling retainer on magneto and accessory drive gear sleeve . . . diameter:	0.055 L	0.025 L	0.045 L
92	4	All	Magneto coupling retainer in magneto drive gear slot . . . . . side clearance:	0.040 L	0.002 T	0.028 L
93	4	A	Magneto coupling rubber bushings on magneto drive lugs. . . . . side clearance:	-	0.010 L	0.052 T
93	4	BC	Magneto coupling rubber bushings on magneto drive lugs. . . . . side clearance:	-	0.014 L	0.052 T
94	4	All	Magneto pilot in crankcase . . . . . diameter:	-	0.001 L	0.005 L
			OIL PRESSURE PUMP ASSEMBLY			
95	2	A	Oil pump driver gear in pump housing. . diameter:	0.0060L	0.0015L	0.0040L
96	3	BC	Oil pump driver gear in pump housing. . diameter:	0.0070L	0.003 L	0.005 L
97	2/3	All	Oil pump driver gear shaft in pump housing . . . . . diameter:	0.0045L	0.0015L	0.0030L
98	2/3	All	Oil pump driven gear in pump housing . . . . . end clearance:	0.0050	0.0005	0.0030
99	2/3	All	Oil pump driver gear in pump housing . . . . . end clearance:	0.0050	0.0005	0.0030
100	2/3	All	Oil pump driver gear shaft in cover oil pump. . . . . diameter:	0.0045L	0.0015L	0.0030L
101	2/3	All	Oil pump driver gear shaft in tachometer drive bevel gear . . . . . diameter:	0.0040L	0.0005L	0.0025L
102	2/3	All	Oil pump driven gear shaft in oil pump housing. . . . . diameter:	-	0.001 T	0.003 T
103	2/3	All	Oil pump driven gear on shaft . . . . . diameter:	0.0040L	0.0005L	0.0025L
104	2	A	Oil pump driven gear in housing . . . . diameter:	0.0045L	0.0015L	0.0030L
105	3	BC	Oil pump driven gear in housing . . . . diameter:	0.0070L	0.0030L	0.0050L
			TACHOMETER DRIVE ASSEMBLY			
106	2/3	All	Tachometer drive shaft in oil pump cover . . . . . diameter:	0.0045L	0.0015L	0.0030L
107	2/3	AB	Oil seal in tachometer drive housing . . diameter:	-	0.001 T	0.007 T
108	2	C	Oil seal in tachometer drive housing . . diameter:	-	0.0015T	0.0065T
			STARTER DRIVE			
109	4	All	Starter shaftgear in bearing . . . . . diameter:	0.0031L	0.0005L	0.0029L
110	4	All	Starter shaftgear front (bearing) journal. diameter:	0.748	0.7495	0.7500
111	4	A	Starter clutch drum on starter shaftgear . diameter:	0.0055L	0.001 L	0.004 L
112	4	BC	Starter shaftgear in clutch drum bearing . diameter:	-	0.0005L	0.0020L
113	4	All	Clutch spring sleeve in starter adapter . diameter:	-	0.003 T	0.005 T
114	4	All	Starter shaftgear in ball bearing . . . . diameter:	-	0.0001L	0.0005T
115	4	A	Starter shaftgear in oil seal sleeve . . . diameter:	-	0.0000	0.0015L
116	4	All	Bearing in starter adapter cover . . . . diameter:	-	0.0010L	0.0001T
117	4	A	Oil seal in starter adapter cover . . . . diameter:	-	0.0017T	0.0063T
118	4	All	Starter adapter cover pilot in starter adapter. . . . . diameter:	-	0.001 L	0.003 L

Table V. Table of Limits (Cont.)

Ref. No.	Chart No.	Model	Description	Serviceable Limit	New Parts Min.	New Parts Max.
119	4	A	Worm wheel gear. . . . . end clearance:	0.080	0.0000	0.0696
120	4	BC	Worm wheel gear. . . . . end clearance:	0.025	0.0016	0.0166
121	4	All	Clutch spring on clutch drum . . . . . diameter:	0.012 T	0.015 T	0.022 T
122	4	All	Clutch spring on starter shaftgear (over knurl) . . . . . diameter:	0.013 L	0.006 L	0.009 L
123	4	All	Clutch spring in clutch spring sleeve . . diameter:	0.027 T	0.031 T	0.038 T
124	4	All	From center line of worm gearshaft to starter adapter thrust pads . . . . . :	0.252	0.246	0.248
125	4	All	Needle bearing in starter adapter . . . diameter:	-	0.001 L	0.001 T
126	4	All	Ball bearing in starter adapter . . . . diameter:	-	0.0010L	0.0001T
127	4	All	Worm gearshaft in needle bearing . . . diameter:	0.5600	0.5615	0.5625
128	4	All	Worm gearshaft in ball bearing . . . . diameter:	-	0.0001L	0.0007T
129	4	All	Starter worm gear on shaft . . . . . diameter:	0.0040L	0.0005L	0.0025L
130	4	All	Starter spring on worm drive shaft. . . diameter:	-	0.005 L	0.025 L
131	4	All	Starter pilot to starter drive adapter . . diameter:	-	0.001 L	0.0065L
132	4	All	Starter drive tongue to worm shaft drive slot . . . . . side clearance:	0.030 L	0.010 L	0.021 L
			GEAR BACKLASH			
133	4	All	Crankshaft gear and camshaft gear. . . backlash:	0.016	0.008	0.012
134	4	All	Crankshaft gear and idler gear. . . . . backlash:	0.016	0.008	0.012
135	4	All	Idler gear and magneto drive gear (right and left) . . . . . backlash:	0.016	0.008	0.012
136	2/3	All	Oil pump driver and driven gears . . . backlash:	0.016	0.009	0.013
137	3	C	Tachometer drive gear and tachometer driven gear . . . . . backlash:	0.012	0.004	0.008
138	4	All	Starter shaftgear and crankshaft gear. . backlash:	0.016	0.008	0.012
139	4	All	Starter worm wheel gear and worm gear . . . . . backlash:	0.025	0.009	0.013
140	2	A	Governor drive gear and governor driven gear . . . . . backlash:	0.009	0.002	0.006
141	3	BC	Governor drive gear and governor driven gear . . . . . backlash:	0.012	0.004	0.008
142	3	BC	Alternator face gear in engine . . . . . backlash:	0.012	0.002	0.009
			SPRING TEST DATA			
143	2	A	Vernatherm control valve 0.16 inches minimum travel at . . . . . .temperature:	-	135°	173°
144	3	BC	Vernatherm control valve 0.090 inches minimum travel at . . . . . .temperature:	-	120°	170°
	2	A	Vernatherm control valve to flow 4 gpm of oil between . . . . . .oil pressure:	-	18 psi	23 psi
	2	A	Vernatherm control valve must close between . . . . . oil temperature:	-	171°	175°
	3	BC	Vernatherm control valve must close between . . . . . oil temperature:	-	168°	174°
	2	A	Vernatherm control valve at oil temperature 180° must not open below .pressure:	18 psi	-	-
	3	BC	Vernatherm control valve at oil temperature 180° must not open below .pressure:	13 psi	-	-
145	2	A	Relief valve spring compressed to 1.24 in. length. . . . . load:	20 lbs.	22.5 lbs.	27.5 lbs.
146	3	BC	Relief valve spring compressed to 1.71 in. length. . . . . load:	13 lbs.	14 lbs.	16 lbs.
147	2	A	Oil filter by-pass valve spring in pump compressed to 1.09 inch length . . . . . load:	5.0 lbs.	5.6 lbs.	-

Table V. Table of Limits (Cont.)

Ref. No.	Chart No.	Model	Description	Serviceable Limit	New Parts Min.	New Parts Max.
			SPRING TEST DATA (Cont.)			
148	1	All	Inner valve spring No. 631521 (compressed to 1.230 inch length) . . . . . load:	82 lbs.	87 lbs.	97 lbs.
	1	All	Inner valve spring No. 631521 (compressed to 1.746 inch length) . . . . . load:	29 lbs.	32 lbs.	38 lbs.
149	1	All	Outer valve spring No. 631520 (compressed to 1.275 inch length) . . . . . load:	118 lbs.	125 lbs.	139 lbs.
	1	All	Outer valve spring No. 631520 (compressed to 1.791 inch length) . . . . . load:	46 lbs.	49 lbs.	55 lbs.

Table VI. Table of Tightening Torques

Ref. No.	Chart No.	Model IO-520	Special Applications	Thread Size	Qty.	Torque In. Lbs.	Torque Ft. Lbs.
T1	3	B&C	Crankcase through bolt	3/8-24	1	370-390	30.8-32.5
T2	2/3	All	Crankcase through bolt (nose)	7/16-20	2	490-510	40.8-42.5
T3	2/3	All	Crankcase through bolt (dowel type)	1/2-20	8	640-660	53.3-55.0
T4	3	B&C	Crankshaft face gear screw (alt.)	5/16-24	4	140-150	11.7-12.5
T5	2/3	All	Crankshaft gear screw	5/16-24	6	240-260	20.0-21.7
T6	2/3	All	Camshaft gear screw	5/16-24	4	240-260	20.0-21.7
T7	3	B&C	Oil suction tube acorn nut	3/4-16	1	175-200	14.6-16.7
T8	1	All	Connecting rod bolt nuts	7/16-28	12	550-575	45.8-47.9
T9	1	All	Cylinder hold down nuts	7/16-20	36	490-510	40.8-42.5
T10	1	All	Cylinder hold down nuts	1/2-20	12	640-660	53.3-55.0
T11	2	A	Oil filter plug (with new gasket)	1-3/4-16	1	240-260	20.0-21.6
T11	2	A	Oil filter plug (with old gasket)	1-3/4-16	1	290-310	24.2-25.8
T12	3	B&C	Oil filter center stud	5/8-18	1	180-220	15.0-18.0
T13		B&C	Alternator mounting bolt	5/16-18	4	150-180	12.5-15.0
T14		B&C	Alternator shaft nut	5/8-32	1	450-500	37.5-41.7
T15		All	Spark plugs	18mm	12	300-360	25.0-30.0

Table VII. General Use - Tightening Torques

	BOLTS, NUTS & SCREWS		DRIVING STUDS	
Size	In. Lbs.	Ft. Lbs.	In. Lbs.	Ft. Lbs.
8-32	17.5 - 22.5	1.5 - 1.9		
10-32	36.0 - 50.0	3.0 - 4.2		
1/4-20	75.0 - 85.0	6.3 - 7.1	50.0 - 70.0	4.2 - 5.8
1/4-28	90.0 - 110	7.5 - 9.1		
5/16-18	155 - 175	13.0 - 14.6	100 - 150	8.3 - 12.5
5/16-24	180 - 220	15.0 - 18.4		
3/8-16	220 - 260	18.3 - 21.7	200 - 274	16.6 - 22.8
3/8-24	275 - 325	22.9 - 27.1		
7/16-14			300 - 424	25.0 - 35.4
7/16-20	400 - 450	33.3 - 37.5		
1/2-20	550 - 600	45.8 - 50.0		

Table VIII. Pipe Plugs

Size	In. Lbs.	Ft. Lbs.
1/8-27	60 - 80	5.0 - 6.6
1/4-18	130 - 150	10.9 - 12.5
3/8-18	185 - 215	15.4 - 18.0
1/2-14	255 - 285	21.2 - 23.8
3/4-14	310 - 350	25.8 - 29.2

NOTE

Torque loads listed are for use with oil on threads. If cotter pin holes must be aligned: set torque wrench at low limit and tighten nut to first hole beyond this torque, except for connecting rods. Stud driving torques apply when studs are coated with lubricant or sealer.

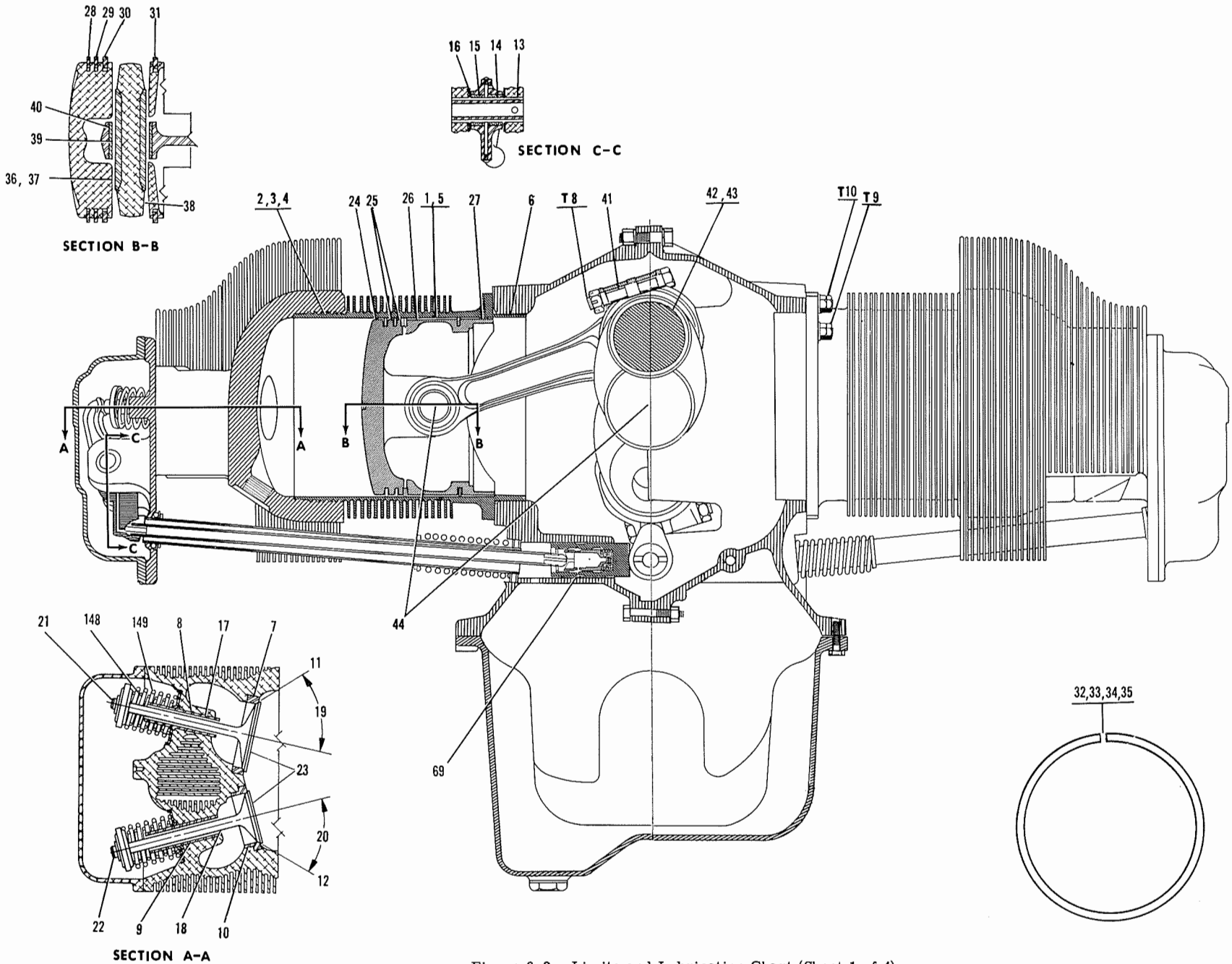
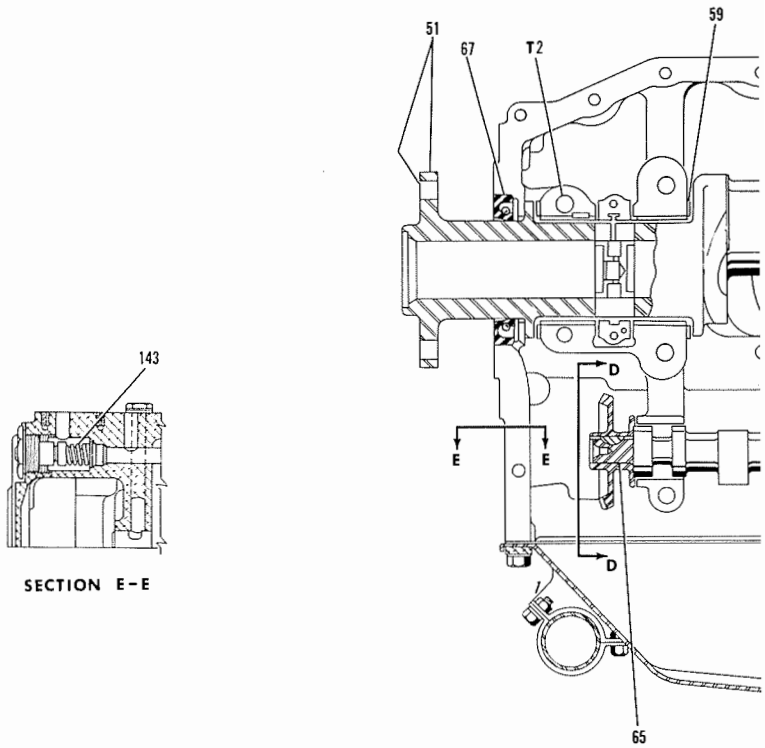
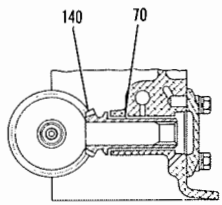


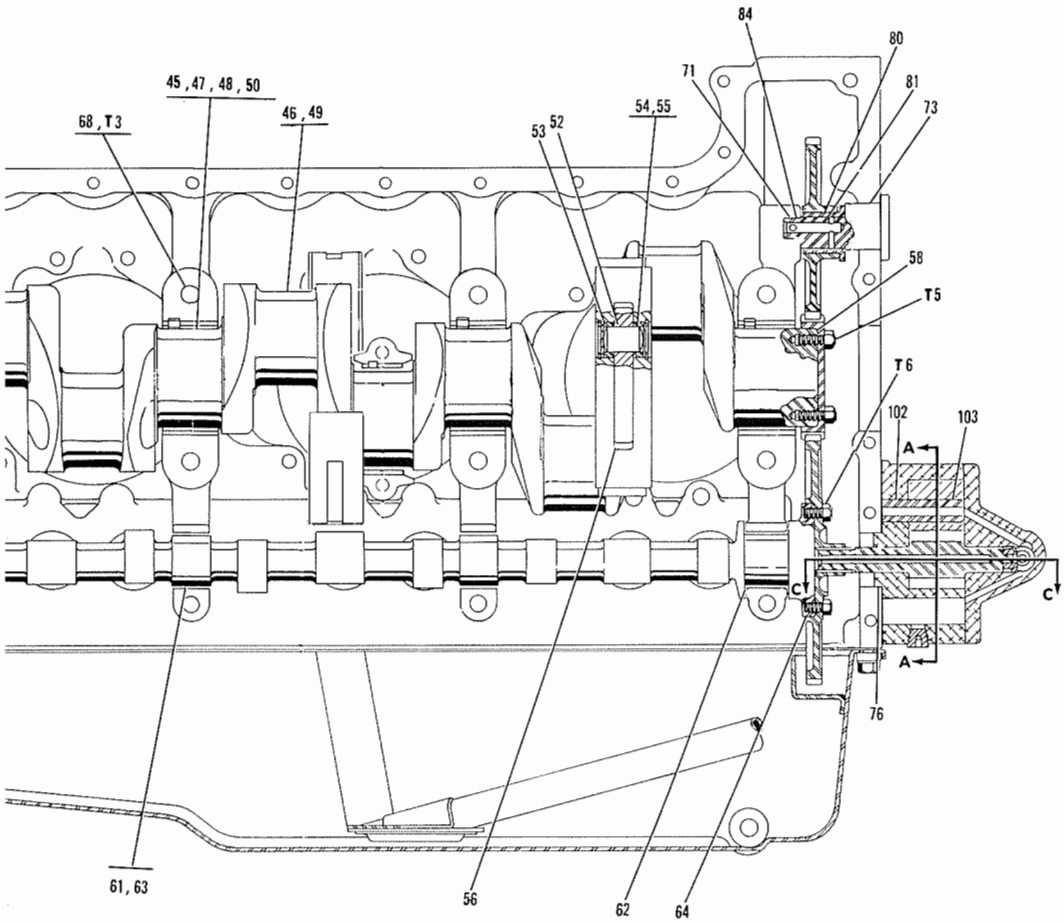
Figure 6-2. Limits and Lubrication Chart (Sheet 1 of 4)

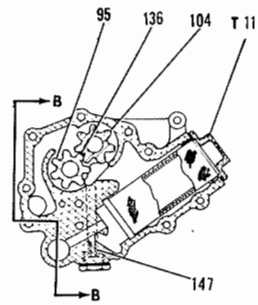


SECTION E-E

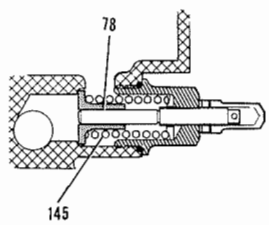


SECTION D-D

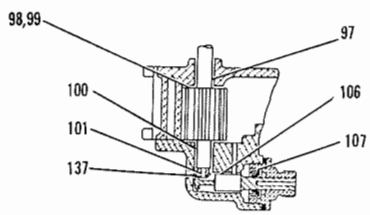




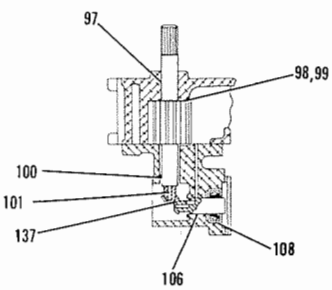
SECTION A-A



SECTION B-B

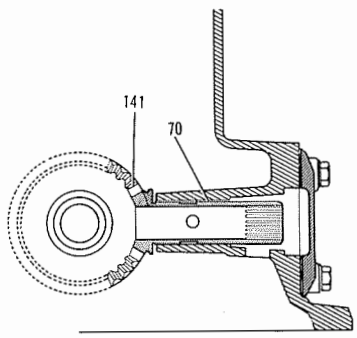


SECTION C-C

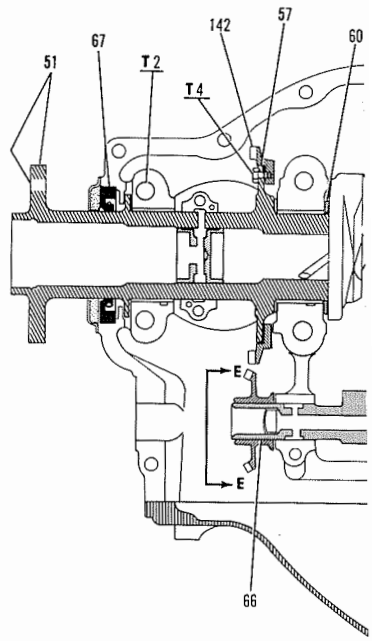


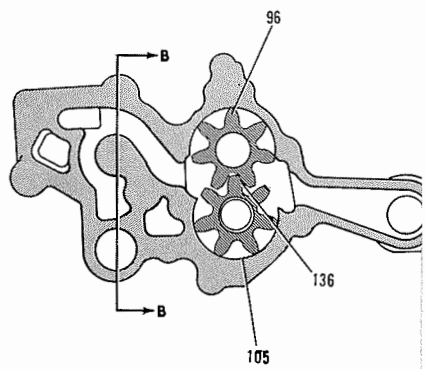
SECTION C-C

Figure 6-2. Limits and Lubrication Chart (Sheet 2 of 4)

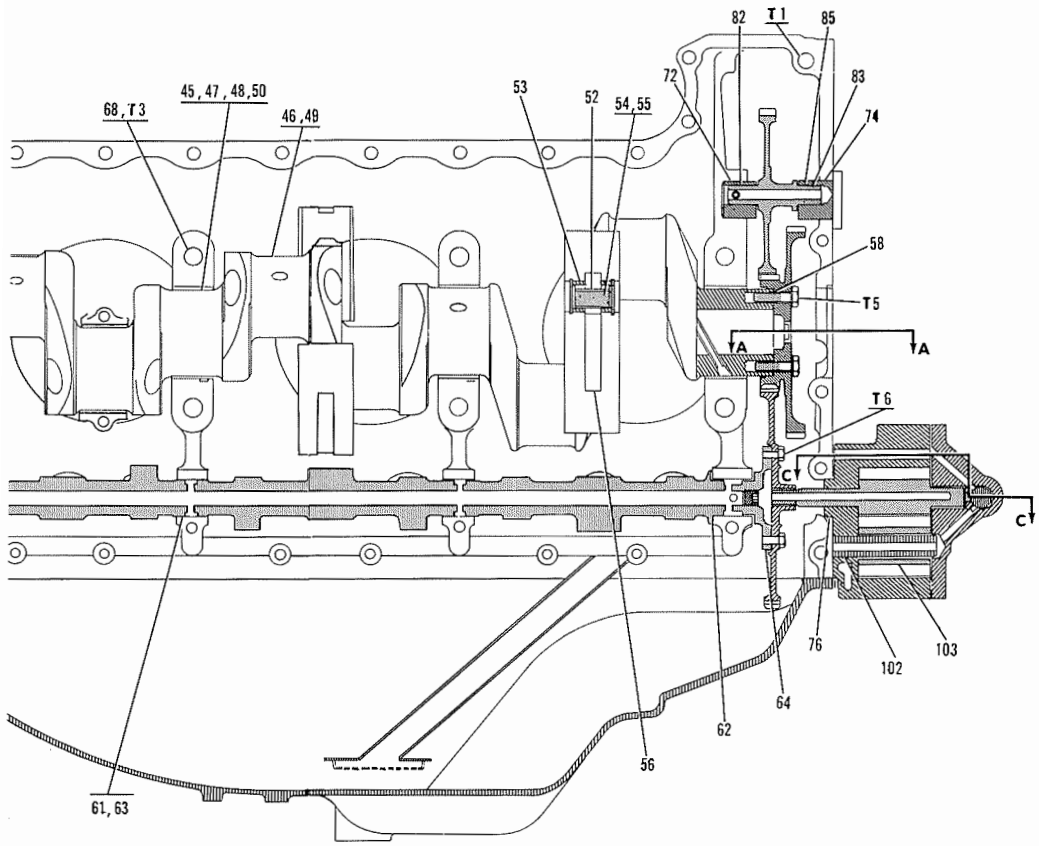


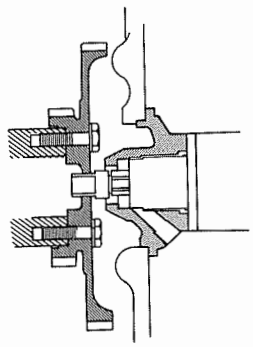
SECTION E-E

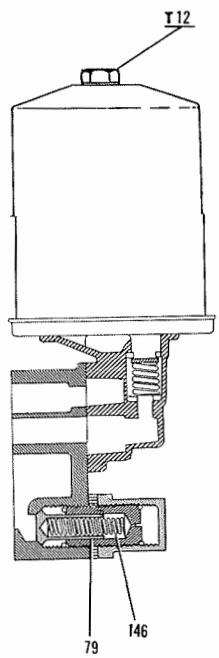


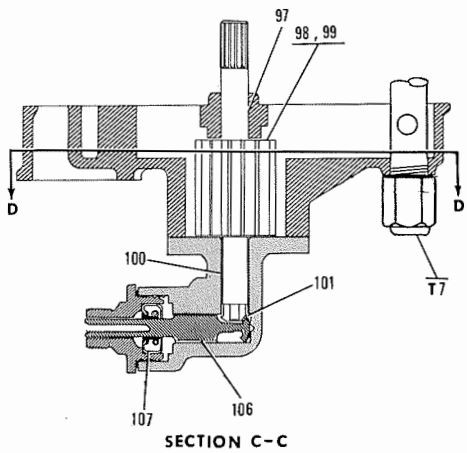


SECTION D-D









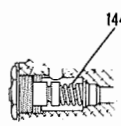
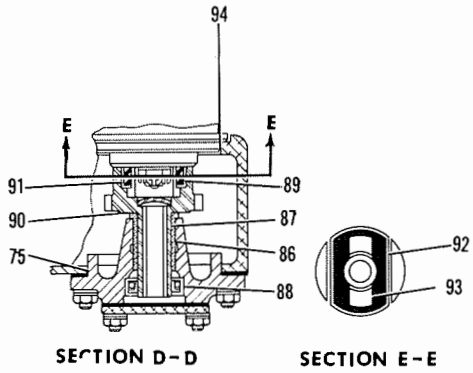
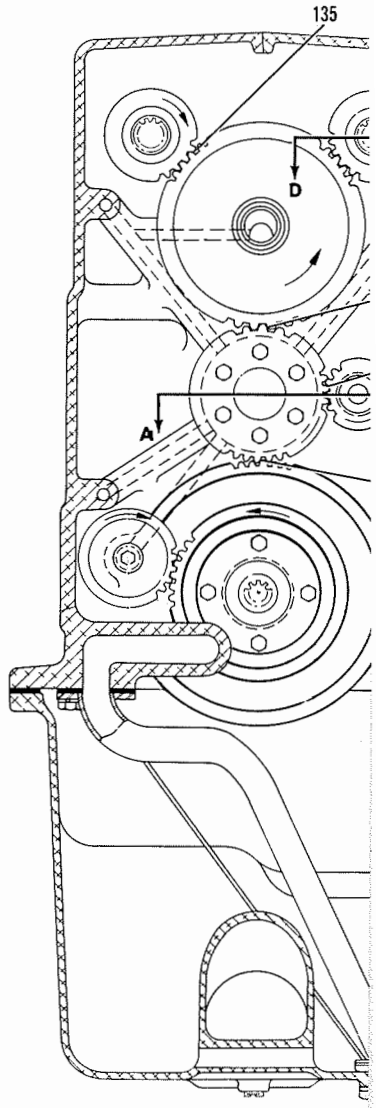


Figure 6-2. Limits and Lubrication Chart (Sheet 3 of 4)



SECTION D-D

SECTION E-E



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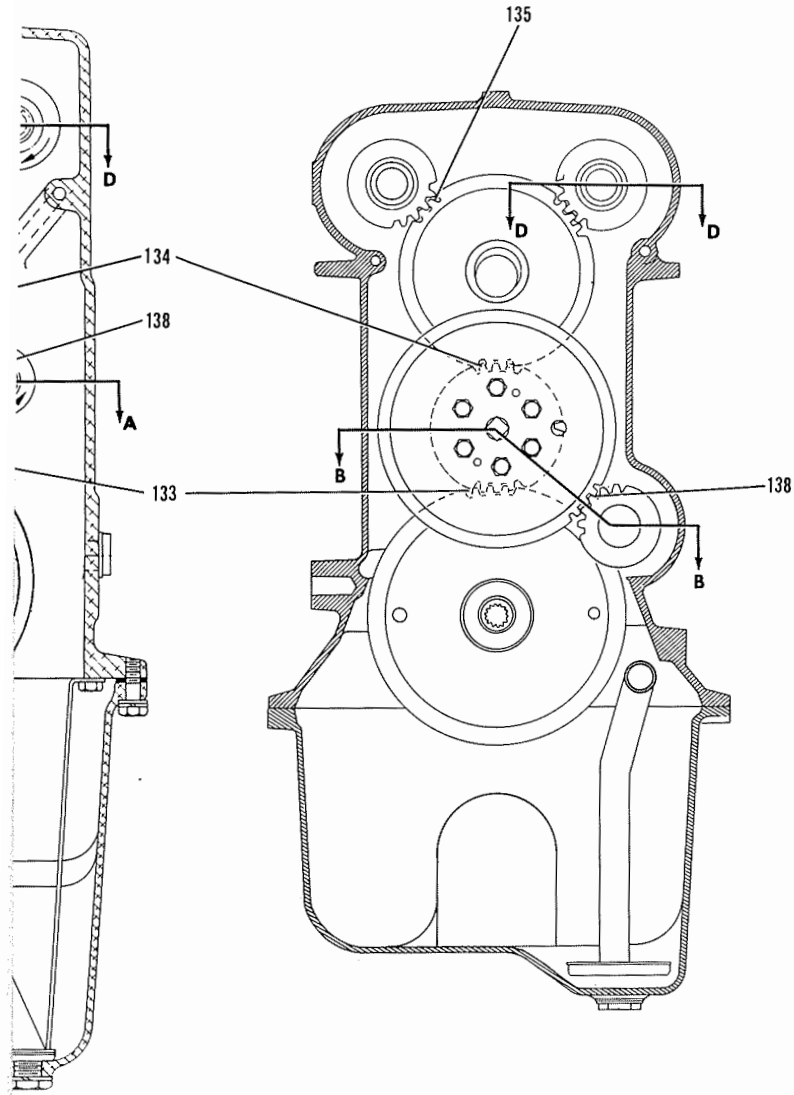
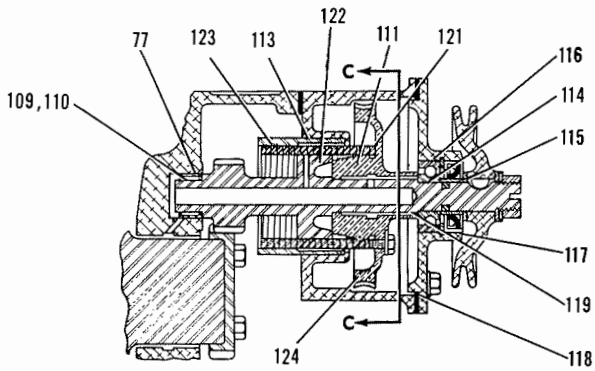
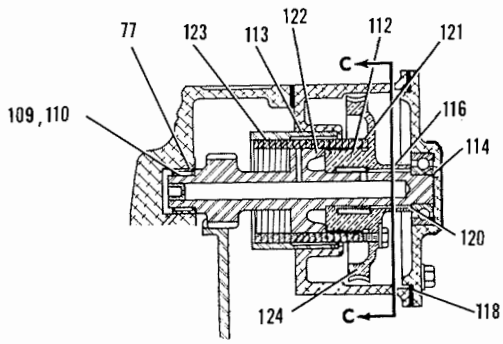
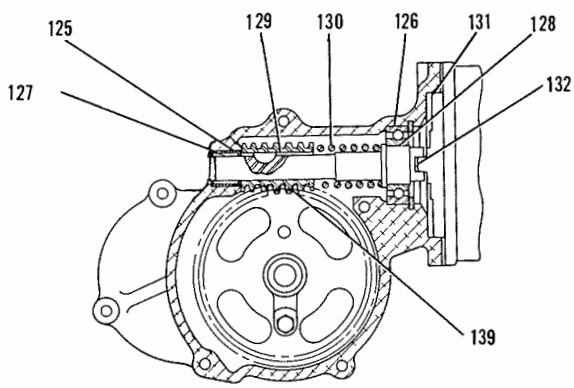




SECTION A-A



SECTION B-B



SECTION C-C

igure 6-2. Limits and Lubrication Chart (Sheet 4 of 4)

SECTION VII

ASSEMBLY OF SUBASSEMBLIES

7-1. NEW PARTS. Parts which require protection from atmospheric dust and moisture are wrapped or boxed individually or in sets. These should not be installed. This is especially true of precision bearing inserts and anti-friction bearings. Check other new parts on receipt for damage done in transit. Refer to Section IV of the parts catalog, Form IO-52-4, for part numbers of the complete gasket set, the main bearing set, the piston ring set and tubes of light weight Tite-Seal gasket paste, all of which should be on hand when work is started. Use only new shake-proof or split lockwashers, tab washers, palnuts, elastic stop nuts, cotter pins and annealed, corrosion-resistant lockwire.

7-2. TIGHTENING TORQUES. The Table of Limits in Section VI contains tightening torques for bolts, nuts and plugs installed without special thread lubricant. The accuracy of any torques indicating wrench depends on a smooth application of force. Do not back up a nut or bolt and leave it in that condition. If part is accidently tightened too much, loosen it and re-tighten it to a value within the specified limits. If a nut slot cannot be aligned with a cotter pin hole within the specified limits, substitute another serviceable nut. If the cotter pin hole in stud lies beyond the nut slots when the nut has been tightened properly, the stud has been improperly installed or has backed out, or the attached part has been reduced in thickness, or either nut or washer is incorrect part for that location. The situation must be corrected by whatever replacement is indicated by inspection.

7-3. FINAL CLEANING. Immediately before assembling a group of parts they should be washed in, or sprayed with, a clean solvent and dried with dehydrated compressed air.

7-4. LUBRICATION. Immediately after final cleaning and before installation, coat all bare steel surfaces and journals with clean engine lubricating oil, except where special lubricants are mentioned in the text. In some instances where gears and other running parts are accessible after assembly in a housing, additional oil should be applied to assure full coverage. Before installing tapered pipe plugs or straight thread plugs, to prevent seizure and leakage of oil, coat the male threads with Snap-On Tool Corp. anti-seize compound "Never-Seez". Coat both sides of gaskets with light weight tightseal compound to assure a perfect seal and to counteract the permanent "set" caused by compression.

7-5. SPECIFIC ASSEMBLY OPERATIONS.

7-6. OIL PUMP ASSEMBLY IO-520-A (See Figure 4-13).

a. Install relief valve assembly (29 through 31) using new gasket (30). Install adjusting screw (28) in housing (23) until 13/16 inch of screw shows above housing. Secure with copper washers (22), nut (21) and cap (20). Install gasket (24), washer spring seat (27), spring (26) and plunger (25) and screw assembly into housing (37).

b. Slide a new gasket (6) over oil filter (5) and insert filter into its chamber in pump housing. Tighten it by hand only.

c. Install pump drive and driven gears (16, 18) in housing chambers, and place bevel gear (15) on end of drive shaft (16). Apply permatex and silk thread to parting surface.

d. Install new oil seal (12) in tachometer drive housing (11). Install new gasket (13). Carefully work lip of oil seal over shaftgear (14) and push shaft through.

e. Hold gear end of tachometer drive shaftgear (14) up and insert shaftgear into cover (10). Screw housing (11) into cover hand tight only, keeping bevel gear upward.

f. Place cover and tachometer drive assembly on pump housing, turning drive gear to mesh bevel gears, and attach it temporarily with two sets of attaching parts (7, 8, 9).

NOTE

The oil filter cap and left-hand threaded tachometer drive housing can best be lightened after being installed on the engine.

7-7. OIL PUMP ASSEMBLY IO-520-B & C (See Figure 4-14).

a. If oil pressure relief valve setting has been lost in disassembly, screw adjusting nut (56) onto adjusting screw (57) about halfway. Install gasket (55) and cap (54) on screw (57). Slide gasket (58) against nut and spring (60) in adjusting screw (57) and plunger (59). Install assembly in pump housing.

b. Install driven gear assembly (52, 53) on shaft (61). Install driver gear assembly (50, 51) in pump housing to mesh with driven gear. Install bevel gear (49) on drive gearshaft. Apply permatex and silk thread to parting surface.

c. IO-520-B RIGHT ANGLE TACH DRIVE. Install parts indexed (23 through 30) as in paragraphs d, e, f in 7-6. (IO-520-B only.)

d. IO-520-C RIGHT ANGLE TACH DRIVE. Install new oil seal (39) in cover (48). Work shaftgear assembly (40) carefully through lips of oil seal. Install gaskets (38, 45), covers (37, 44), and secure with attaching parts (34, 35, 36 and 41, 42, 43). Install assembly on pump housing and loosely secure with two sets of attaching parts (31, 32, 33).

e. Install a new gasket (18), adapter (17) and secure with attaching parts (14, 15, 16). Install gasket (13) on stud (9) and insert stud in housing (12). Install element (11) in housing and secure with nut (10). Install assembly on adapter (17). Install spacer (8) and bracket (6) on stud and attach with washers (2, 3) and screw (1).

7-8. STARTER AND DRIVE ASSEMBLY IO-520-A (See Figure 4-11).

a. Place depressed end of spring (29) over knurled end of gear (33). Push spring away from depressed end sidewise, work end coil over drum and push spring inward until depressed end snaps into groove. Install tab washer (28) and retaining screw (27).

b. Hold adapter (41), sleeve downward, and insert shaftgear and clutch assembly. Bear down on worm wheel (32) while turning counterclockwise, thus winding up spring to start into adapter sleeve. Push spring fully into sleeve. Install "O" ring (31) in shaftgear groove.

c. Support inner race of bearing (37) on a steel ring and press worm shaft (39) through until bearing is seated against flange. Tap serviceable woodruff key (38) into worm shaft key slot. Install spring (36) and worm gear (35) on shaft.

d. Holding worm and shaft assembly vertical, slide it into adapter and needle bearing. Invert adapter. With Truarc pliers, compress and install retaining ring (34). Test by hand for end clearance.

e. With Truarc pliers, compress and install retaining ring (26) in cover (22). Press in ball bearing (30) and new oil seal (25) with seal lip towards retaining ring. Insert sleeve (24) into seal.

f. Install gasket (23) and cover assembly on adapter and secure with attaching parts (17, 18, 19). Install timing indicator (20) and secure with attaching parts (17, 18, 19).

g. Install sheave (16) and attaching parts (13, 14, 15).

h. Install "O" ring (5) on starter pilot. Turn starter shaft until its drive tongue aligns with worm drive shaft slot. Mount starter (4) and secure with two sets of attaching parts (1, 2, 3).

7-9. STARTER AND DRIVE ASSEMBLY IO-520-B & C (See Figure 4-12).

a. Press bearing (24) onto shaft (28). Install spring (26), woodruff key (27) and worm gear (25). Insert assembly into adapter and install retaining ring (23).

b. Install spring (19) on worm wheel (20). Turn spring so it tends to unwind until offset end drops into gear hub groove. Position spring on gear so screw notch is aligned with screw hole in gear web. Install tab washer (18) and screw (17).

c. Lubricate spring, sleeve and shaftgear liberally with clean oil. Press worm wheel, bearing (21) and spring assembly onto shaftgear (22). Install bearing (16) and retaining ring (15) on shaftgear. Insert shaftgear and worm wheel assembly into adapter. Make certain worm wheel and worm gear teeth are aligned. Install a new "O" ring (14) in groove of cover (13). Slide cover over shaft. Install three sets of attaching parts (10, 11, 12).

d. Install "O" ring (5) on starter adapter. Turn starter shaft until tongue is aligned with worm gear shaft slot. Mount starter (4) on adapter studs and secure with attaching parts (1, 2, 3).

7-10. CYLINDER IO-520-A-B-C (See Figure 4-15). Each cylinder should have its position number (1 through 6) stamped on edge of base flange. After assembly, cylinders should be laid on a bench in order of position number. Place piston, pin and ring assemblies in front of each cylinder in the same order. Piston position numbers are stamped on head rim. When assembled to engine, piston number will be towards propeller flange. Mark any new cylinder and/or piston accordingly.

a. Spread a film of Gredag No. 44 grease on valve stems (35, 36) and insert them in cylinders to which they have been lapped. Grasp valve stems and lift cylinder onto a post which will support valve heads. Clamp cylinder base flange to prevent it from rising. Again apply Gredag No. 44 to valve stems.

b. Plave valve spring retainers (34) over valve guide (40) cupped side up. Install inner and outer valve springs (33, 32), per instructions in figure 7-1, outer retainer (31) and rotator (30). (See figure 2.) Compress springs and install keys (29). Make certain keys are properly seated before releasing pressure on springs. Remove cylinder from fixture and set it upright on a bench. Strike end of each valve stem sharply with a rawhide mallet to seat stem keys.

c. Install new packing (28) on each cylinder skirt. Push against flange and make certain none are twisted. Coat cylinder bore walls thoroughly with Cities Service No Scuff Oil No. 9028 or castor oil.

7-11. PISTON AND RING ASSEMBLIES (See Figure 4-15).

a. Lubricate pistons (23) and rings (24, 25, 26, 27) liberally with Cities Service CMS #50 or #9028 No Scuff Oil.

b. Position first and third ring gaps on top of piston. Position second and fourth ring gaps so they will be 180° apart from first and third ring gaps.

7-12. PUSHROD HOUSINGS (See Figure 4-15).

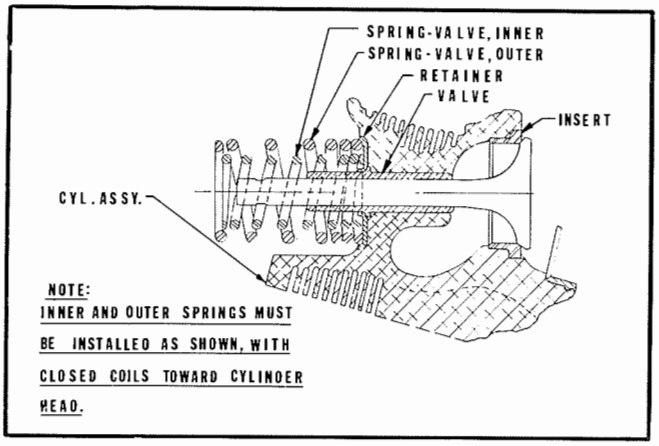


Figure 7-1. Valve Spring Installation

a. Install a washer (16), packing (17) and second washer (16) on cylinder end of housings (14).

b. Install spring (15), washer (16), packing (17) and second washer (16) onto crankcase end of housing (14).

c. Lay two housings with each cylinder.

7-13. CRANKSHAFT AND CONNECTING RODS IO-520-A (See Figure 4-19).

a. Lay crankshaft on a bench with a notched wood block under front and rear journals.

b. Lay out connecting rods, caps, bolts and nuts (9, 8, 7, 6) opposite crankpins according to position number stamped on bolt bosses. Install new bearing insert in each rod and cap so their ends project the same distance.

c. Lubricate and install each rod and cap with position numbers on top when odd number rods are extended to the right and even numbers to the left. Attach them with special bolts (7) and slotted nuts (6). Tighten nuts to specified torque and secure each with a cotter pin (5).

d. Attach two sixth order counterweights (17) to crankcheek No. 2 with tow pins (14) each and install retaining plates and rings (13, 12). Attach on fourth order and one fifth order counterweight to crankcheek No. 5. Install pins (15, 16) and secure with plates (13) and retaining rings (12).

e. Heat crankshaft gear (28) to 300° F., align gear dowel hole with crankshaft dowel (33) and tap gear onto crankshaft. Attach gear to shaft with one washer (27) over dowel pin hole and six screws (26). Tighten screws to specified torque and secure head with lockwire.

f. Remove spring (30) from new crankshaft oil seal (31) and unhook its ends. Apply Sunoco Way Oil liberally to I. D. of oil seal and propeller flange. Squeeze oil seal until egg-shaped and start seal over bottom of propeller flange, grooved side toward rods. Work seal carefully, to prevent damage to lip, upward over flange. After seal is in place, wipe oil from seal and shaft. Seal must be dry when installed in crankcase. Work spring into seal cavity.

g. Install governor oil transfer collar (20 through 25) and secure with nuts (19).

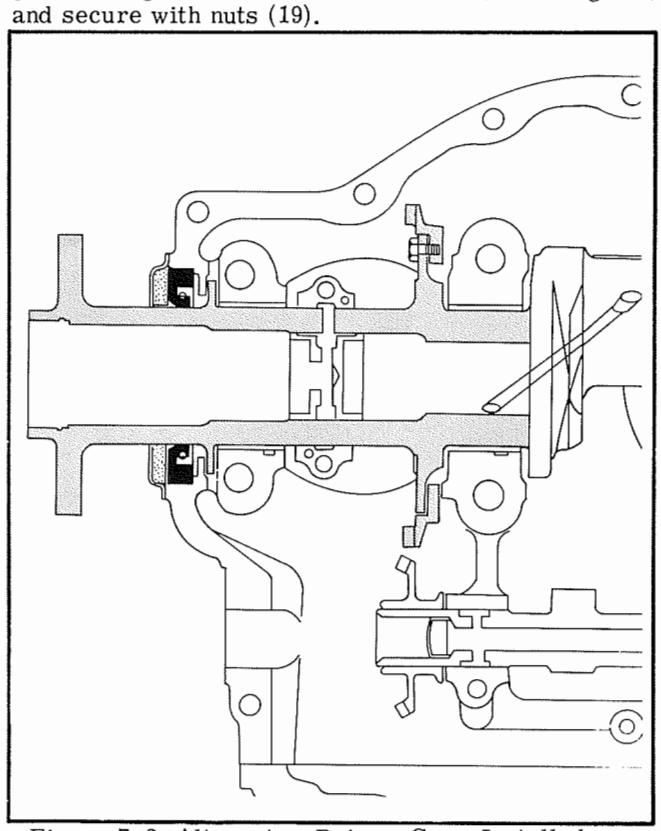


Figure 7-2. Alternater Drive Gear Installed

7-14. CRANKSHAFT AND CONNECTING RODS IO-520-B & C (See Figure 4-20).

a. Paragraphs a, b, c, d, e and f of 7-13 also apply to the IO-520-B and C crankshaft.

b. Heat gear (28) in oven at 300° F. for half hour or more and install on crankshaft (See figure 7-2). Secure with four bolts (27).

NOTE

Install gear in proper position so that timing marks are opposite No. 1 crankpin.

7-15. CAMSHAFT (See Figure 4-18).

a. Tap a woodruff key (3) on front end of camshaft (9) and install bevel gear (2).

Note 1 - Nuts on both ends of thru bolts must be torqued

2 - All stud & thru bolt threads to be lubricated with castor oil

3 - Thru bolts No. 1 thru 14 shall be torqued in sequence shown in two passes (350 in. # and final) for machining purposes

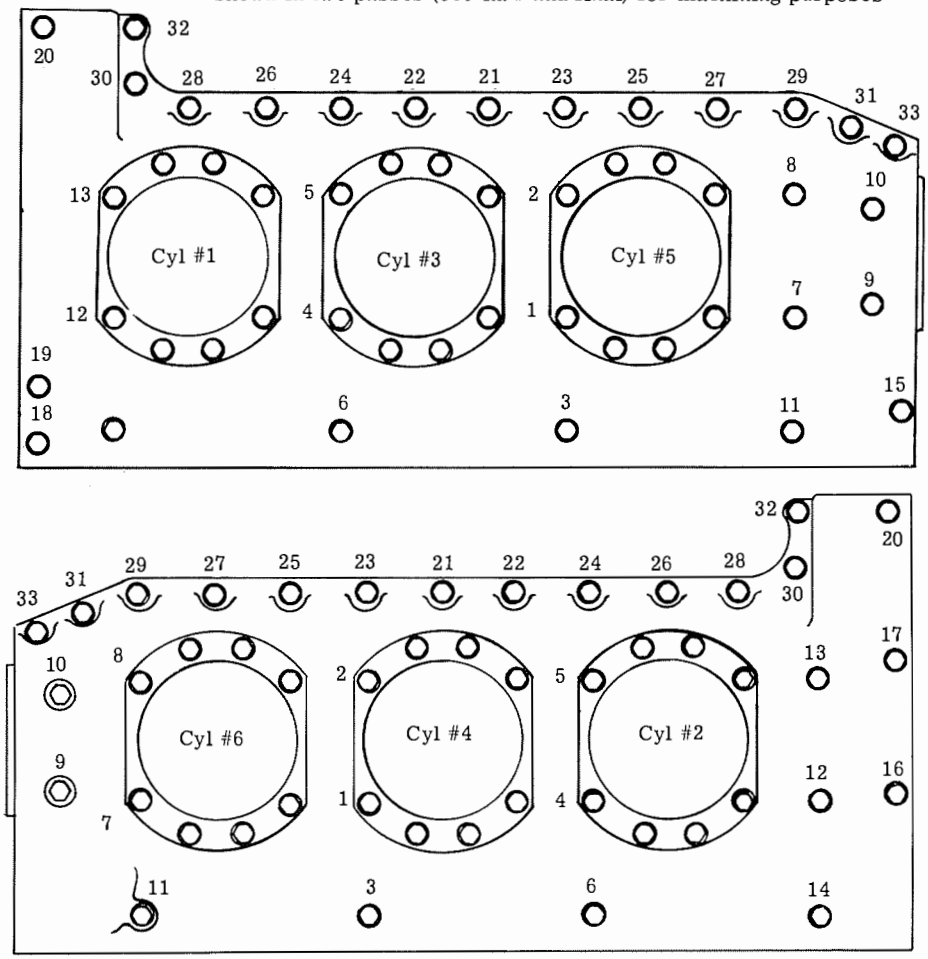


Figure 7-2

ASSEMBLY PROCEDURE

1 - Insert thru bolts

2 - Snug bolts No. 9, 10, 19 & 20

3 - Install cyls. 4 & 5 - tighten stud nuts to 350 in. #

4 - Tighten thru bolts No. 1, 2, & 3 to 350 in. # in sequence shown (see note 3 above)

5 - Tighten thru bolts & stud nuts to 500 in. #

6 - Tighten thru bolts No. 1 & 2 to 650 in. #, No. 3 to 500 in. #.

7 - Repeat above on cyls. 2 & 3

8 - Repeat above on cyl. No. 6, including bolts No. 9 & 10 in sequence shown

9 - Repeat above on cyl. No. 1

10 - Tighten bolts No. 15 thru 32 to specified torque in sequence shown

Figure 7-3. Torquing Sequence

b. Install gears (5 and 6) on the IO-520-A camshaft and gear (6) only on the IO-520-B and C camshaft, and secure with four screws (4).

7-16. CRANKCASE IO-520-A (See Figure 4-16).

a. Replace any pipe plugs removed during previous operations.

b. Install Vernatherm valve (26) in right crankcase. Tighten and secure with lockwire.

c. Install new gasket (41), governor pad cover (40) and attaching parts (36, 37, 38, 39).

d. If mount brackets (72) were removed, reinstall them and attaching parts (69, 70, 71).

e. Turn both crankcase halves open side up. If squirt nozzles (80) and screen (79) were removed, reinstall them. Lubricate all camshaft bearings and main bearing inserts. Install main bearings so that bearing ends project equally.

7-17. CRANKCASE IO-520-B & C (See Figure 4-17).

a. Remove any pipe plugs removed during previous operations. Install machine thread plugs.

b. Install gaskets (7, 6) and oil filler tube (5). Secure with attaching parts (2, 3, 4).

c. Install gasket (19), governor pad cover (18) and secure with attaching parts (14, 15, 16, 17).

d. Install gasket (24) camshaft hole cover (23) and attaching parts (20, 21, 22).

e. Install "O" rings (53) and (68) and install mounting legs. Secure with attaching parts (58, 59, 60). (Applicable to IO-520-C only.)

f. Lay crankcase halves open side up. Make sure squirt nozzle and screens 75, 74 are in place. Lubricate cam bearings and main bearings. Insert main bearings so that edges project equally.

7-18. FUEL INJECTION CONTROL AND AIR THROTTLE BODY ASSEMBLY. IO-520-A (See Figure 4-1).

CAUTION

Use only a fuel soluble thread lubricant on any injector system connection fitting.

a. See figure 7-2. Install plugs in ports 1 and 3.

b. Install 90° elbow in port 2 so that its outlet points left.

c. Install adapter and elbow in port 4 so elbow outlet points down.

d. Install nipple in port 5.

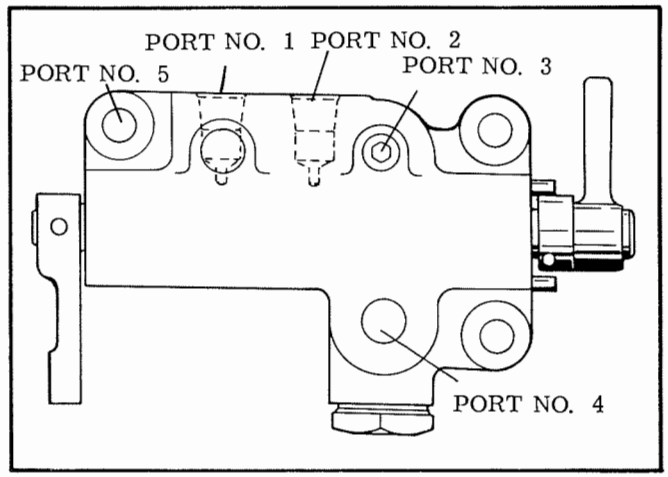


Figure 7-4. Fuel Control Port Locations.

e. Lay air throttle body on clean work bench with fuel control mounting legs up. Attach fuel control with three tab washers (24, figure 4-1) and three special screws (23). Attach fuel control to fuel manifold hose (10) and install shroud (14). Attach shroud to special screws with three sets of nuts and washers (11, 12, 13).

f. If removed, reinstall shaft (37) air throttle plate (36) attached by screws (35), washers (30, 31, 34) and levers (29, 33) retained by pins (28, 32).

g. Install link rod assembly (19, 20, 21, 22) and spring (18).

7-19. FUEL INJECTION CONTROL AND AIR THROTTLE BODY ASSEMBLY. IO-520-B (See Figure 4-2).

CAUTION

Use only a fuel soluble thread lubricant on any fuel injection system connection fitting.

a. Install plugs in ports 1 and 3 (See figure 7-2).

b. Install in port (2) an adapter, a 90° street elbow pointing out and a 90° elbow pointing down.

c. Install an adapter in port 4 with a 90° elbow pointing down and 20° to the left.

d. Install an adapter in port with a 90° elbow pointing to the left and 60° down from the vertical position.

e. Install shaft (44, figure 4-2) in air throttle body, if removed. Install throttle plate (38) and secure with screw (37). Install washers (35, 36), lever (43), nut (42), cotter pin (41), collar (34) and pin (33).

f. Attach fuel pump to fuel control hoses (9) and fuel manifold valve to fuel control hose (8) to fuel control elbows. Install shroud (31), and secure fuel control (32) and shroud to air throttle mounting legs with special screws (29), tab washer (20) and link rod assembly (22, 23, 24, 25). Install wave washer (21) and link rod assembly (22, 23, 24, 25).

SECTION VIII

FINAL ASSEMBLY AND TEST

8-1. GENERAL INSTRUCTIONS.

8-2. LUBRICATION. Apply clean engine lubricating oil liberally to all bare steel surfaces, journals, bearings and bushings, before and/or after installation, depending on accessibility, except where special lubricants are mentioned.

8-3. ITGHTENING TORQUES. See Table of Tightening Torques, Section VI and instructions in paragraph 7-2.

8-4. PALNUTS. After tightening a palnut with fingers, tighten it not more than 1/4 turn with a wrench. Excessive tightening will deform the spring teeth, making the nut difficult to remove and ineffective as a safety device.

8-5. CLEARANCES. Wherever possible, measure clearances of running parts as they are installed. When end clearances, side clearances and backlashes cannot be measured with normal thickness gauges due to the inaccessible position of the parts, test for binding and excessive looseness as well as possible by moving the running part.

8-6. COVERS. Unless the atmosphere is unusually free of dust and airborne grit, it is advisable to cover openings as soon as possible and to cover assemblies and the partial engine assembly whenever they are not in the process of being assembled. Cover all openings into which small parts might be dropped.

8-7. CRANKCASE IO-520-A (See Figure 4-16).

a. Install mount brackets on left crankcase and attach assembly to engine stand with support under casting.

b. Lubricate all main bearing inserts and crankshaft journals and install thrust washers. Lift shaft assembly by No. 1 connecting rod and propeller flange. With the aid of an assistant holding up No. 's 3 and 5 rods, lower assembly into position in left crankcase bearings with oil seal positioned so it enters the seal cavity in the crankcase. The connecting rod position numbers, if properly installed, will be toward upper case flange. Carefully lay odd numbered rods on upper case flange.

c. Insert governor driven gear (1, figure 4-18) into its bearing.

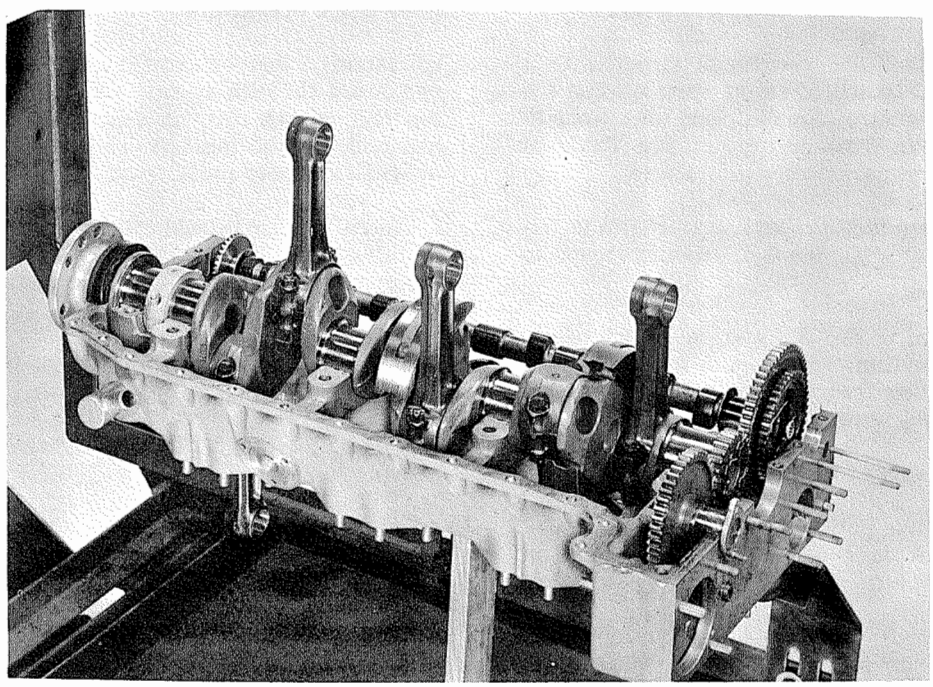
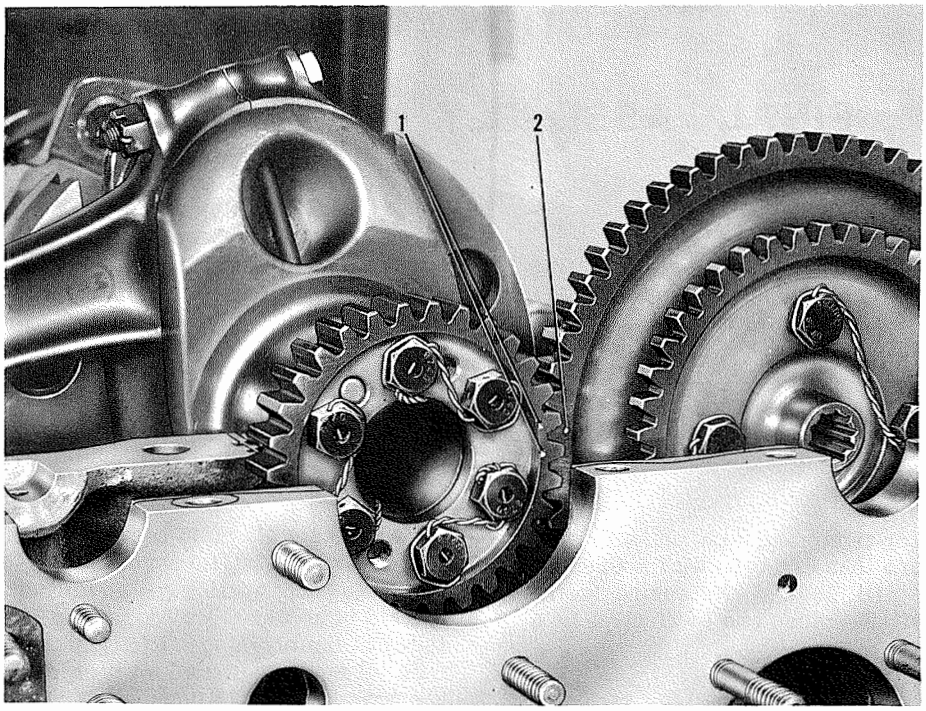


Figure 8-1. Left Crankcase and Shafts Assembled on Stand.



1. Crankshaft gear timing marks
2. Camshaft gear timing mark

Figure 8-2. Alignment of Timing Marks.

d. Lay camshaft assembly in its bearings in left crankcase, meshing spur gear teeth with those of crankshaft gear so that timing marks are aligned in the manner illustrated in figure 8-2, and turning governor driven gear to mesh it with driver gear.

e. Measure crankshaft end clearance either with a feeler gauge or a dial indicator set at zero against the propeller flange. Measure camshaft end clearance at either end of its rear main bearing. See Table of Limits, Section VI, for allowable tolerances.

f. Install idler gear assembly and support pin in left crankcase as illustrated (figure 8-1) bushing thrust to rear.

g. Spread a thin film of No. 3 Aviation Permatex on the left crankcase parting flange. Lay lengths of No. 5 silk thread on parting flange. Thread should be inside the bolt holes but never on the edge.

h. Stand up odd numbered connecting rods.

i. Lay right crankcase subassembly on the left case. Take care not to displace or damage the crankshaft oil seal.

j. Insert (from above) two 8-7/8 in. through bolts (60, figure 4-16) at front of crankcase, one 9-13/16 in. through bolt (61) in front of No. 5 cylinder mount pad, seven 10-3/4 in. through bolts (63) through cylinder mount pads and four 10-1/2 in. through bolts (62) below camshaft level. Tap all of these through to centered positions with a non-marring hammer. These bolts align crankcase castings and bearings.

k. Install a spacer and flanged nut on each end of the two front through bolts, a spacer and flanged nut on top end of two through bolts ahead of No. 5 cylinder pad and, on bottom end of upper rear through bolt nearest magneto mount pad.

l. Install fuel manifold valve over crankcase flanges. Install spacer (25) lifting eye (24) and secure with attaching parts (23, 22, 21, 20). Install attaching parts (56 through 59).

m. Install one bolt and washers (48, 49, 50) at left rear, one "O" ring (54) and two bolts and washers (48, 49, 50) at right rear and one bolt and washer (48, (49) at right front. Do not tighten any parts in this group yet.

n. Seat idler gear support pin. The eccentric shoulder must be away from crankshaft. Do not install attaching parts yet.

o. Tighten all attaching parts installed in steps "l" and "m".

p. Install two "O" rings (54), one bolt (55) and attaching parts (51, 52, 53, 54) in the upper rear case hole and tighten nut.

q. Attach right crankcase mount brackets to the assembly stand and rotate stand until engine is upright as shown in figure 8-3.

r. Install generator mount bracket (35) and secure with attaching parts (27 through 34).

s. Install, but do not tighten support pin attaching parts (64, 65, 66).

8-8. CRANKCASE IO-520-B & C (See Figure 4-17).

a. Install mounting legs on the left crankcase of the IO-520-C and attach to assembly stand, supported as shown in figure 8-1. Install engine stand bracket to crankcase with 3/8-16 bolts attached in tapped holes provided on the IO-520-B.

b. Lubricate all main bearing inserts and crankshaft journals. Lubricate both thrust washer halves with Gredag No. 44 and install. Lift crankshaft assembly by No. 1 connecting rod and propeller flange. With the aid of an assistant holding No's 3 and 5 rods, carefully lower the assembly into position in the left crankcase bearings, making certain the oil seal enters the oil seal cavity. The connecting rod position numbers will be toward the upper flange, if properly installed. Lay odd numbered rods on upper case.

c. Insert governor driven gear (1, figure 4-18) into its bearing.

d. Lay camshaft assembly in its bearings in left crankcase, meshing spur gear teeth with those of the crankshaft gear so that timing marks are aligned, and turning governor driven gear so that it meshes with governor drive gear.

e. Measure crankshaft and camshaft end clearance. See Table of Limits Section VI for allowable tolerances.

f. Install idler gear bushing (70) in left crankcase and secure with dowel pin (69). Install idler gear and idler gear flanged bushing (32).

g. Spread a thin film of No. 3 Aviation Permatex on the left crankcase parting flange. Lay lengths of No. 50 silk thread on the parting flange inside the bolt holes but not on the edge.

h. Stand up odd numbered connecting rods.

i. Lay right crankcase subassembly on the left case. Take care not to displace or damage the crankshaft oil seal.

j. Insert, from above, through bolts (64, 65, 66, 67). Tap all of these through to centered positions with nonmarring hammer. These bolts align crankcase castings and bearings.

k. Install a washer (36) and flanged nut (35) on each of the two front through bolts. Install an "O" ring (53), plain washer (52), lockwasher (51) and nut (50) on extreme upper rear through bolt on right crankcase.

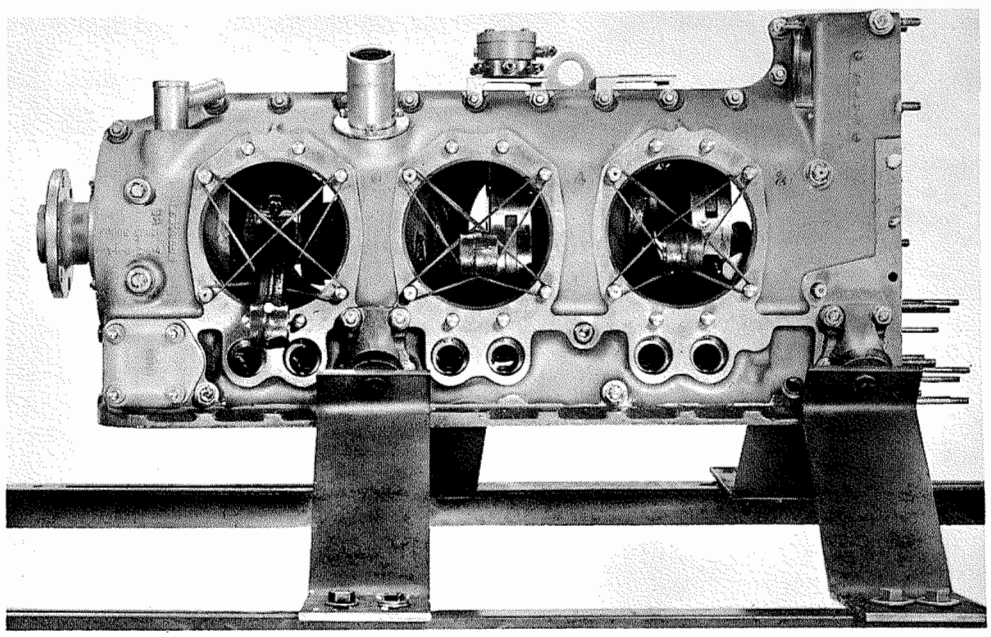


Figure 8-3. Left Side of Completed Crankcase on Stand.

l. Install fuel manifold valve and bracket, lifting eye (12), spacer (13) and secure with attaching parts (11, 10, 9, 8). Install bolts (54), washers (56, 57) and nuts (55). Install attaching parts (37 through 49).

m. Install "O" rings (53, 68) and mounting legs not previously installed (IO-520-C).

n. Seat idler gear flanged bushing (32). Do not install attaching parts yet.

o. Tighten attaching parts installed in steps "l" and "m".

p. Attach right mount bracket or crankcase to assembly stand and rotate stand until engine is upright.

q. Install, but do not tighten, idler gear flanged bushing attaching parts (29, 30, 31).

8-9. CYLINDERS AND PISTONS.

a. Before installing each cylinder and piston, rotate crankshaft to place rod in top center position.

b. Place piston over the rod with the position number toward the propeller flange.

c. Lubricate pistons and rings liberally with Cities Service No Scuff Oil, No. 9028.

d. Hang a ring compressor on the piston skirt. Holding cylinder in arm, center compressor over rings and compress fully. Push cylinder onto piston, forcing compressor off piston.

e. Remove ring compressor and cylinder base flange onto hold down studs. Make sure packing is in place and not twisted and seat cylinder flange on the crankcase cylinder pad.

f. Pistons and cylinders may be installed in any order, but to minimize turning of crankshaft and in undue loss of balance it is suggested that No. 1 and 2 be installed first, followed by 3, 4 and 5, 6.

g. As soon as each cylinder has been installed, secure it moderately with flange nuts (19, 21 figure 4-15).

h. Tighten flanged nuts according to sequence in figure 8-6.

i. Install spark plugs and gaskets in upper cylinder holes.

8-10. OIL PUMP IO-520-A.

a. Remove two sets of attaching parts and remove tachometer drive and pump cover.

b. Spread a thin film of No. 3 Aviation Permatex on the rear parting surface of the oil pump housing. Lay No. 50 silk thread inside bolt holes and studs, but clear of edge.

c. Install cover and secure it as before, with two sets of attaching parts.

d. Without delay lubricate pump shaft splines and install pump assembly on crankcase studs. Install attaching parts and torque to values specified in Table of Limits, Section VI.

e. Tighten oil filter cap and left-hand threaded tachometer drive housing.

8-11. OIL PUMP IO-520-B (See Figure 4-14).

a. Remove attaching parts (23, 24, 25, IO-520-B) or (31, 32, 33, IO-520-C) and detach cover from pump.

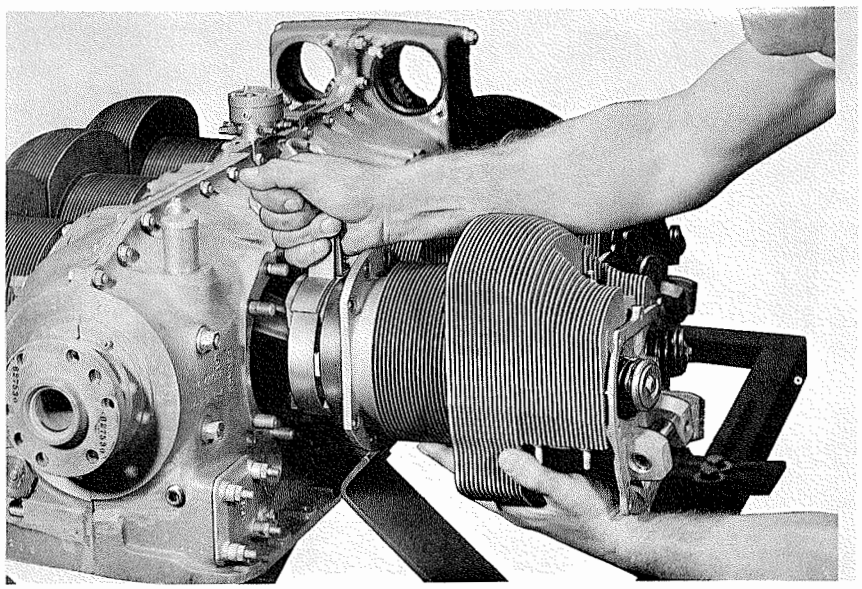


Figure 8-4. Installing No. 6 Cylinder.

b. Spread a film of No. 3 Aviation Permatex on the rear cover flange of the oil pump. Lay No. 50 silk thread inside the bolt holes and studs but clear of the edge.

c. Replace cover assembly and secure with same attaching parts.

d. Mount oil pump assembly on crankcase studs and secure with attaching parts (19, 20, 21). Torque to value given in Table of Limits, Section VI.

e. Install spacers (7) and secure bracket (6) to crankcase with attaching parts (2, 4, 5).

8-12. FUEL PUMP IO-520-A (See Figure 4-1).

a. Lubricate fuel pump drive gear and coupling with Gredag #44.

b. Install a new gasket on two lower left rear crankcase studs. Install coupling in gear and install fuel pump and vapor separator. Secure with two sets of attaching parts.

8-13. FUEL PUMP IO-520-B & C (See Figure 4-2).

a. Lubricate fuel pump drive coupling with Gredag #44.

b. Install coupling in pump. Install new gasket and mount fuel pump and vapor separator on crankcase studs. Secure with two sets of attaching parts.

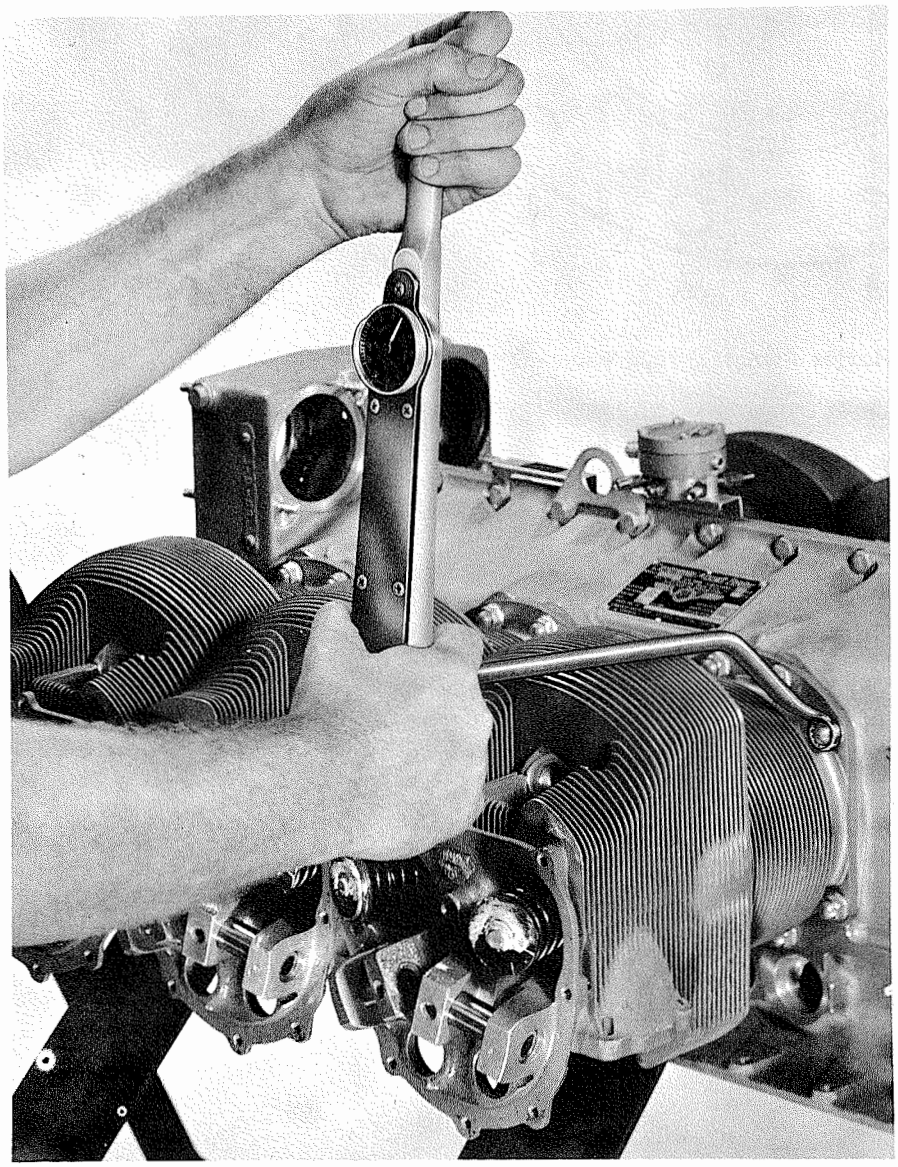


Figure 8-5. Tightening Cylinder Base Nut.

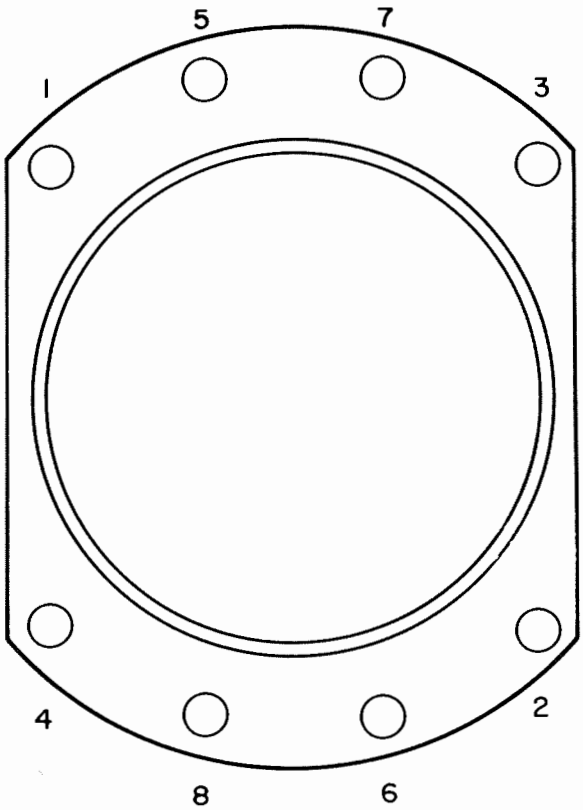


Figure 8-6. Cylinder Flange Torque Sequence.

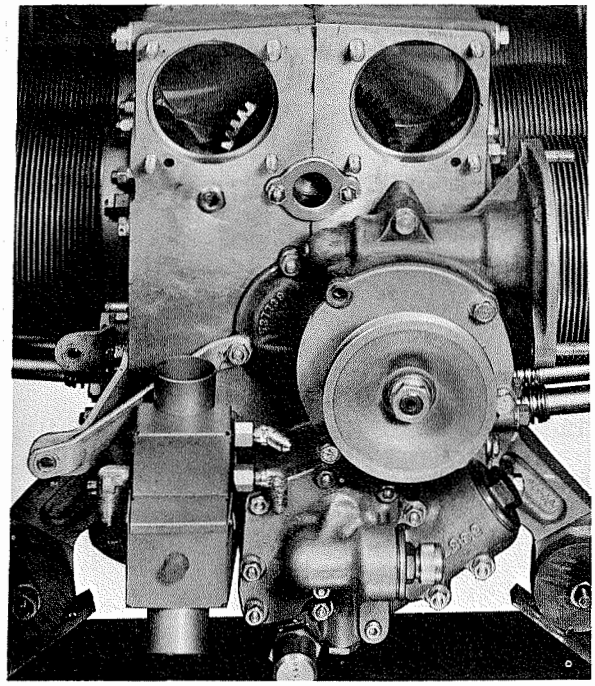


Figure 8-7. Fuel Pump, Oil Pump and Starter Adapter Installed.

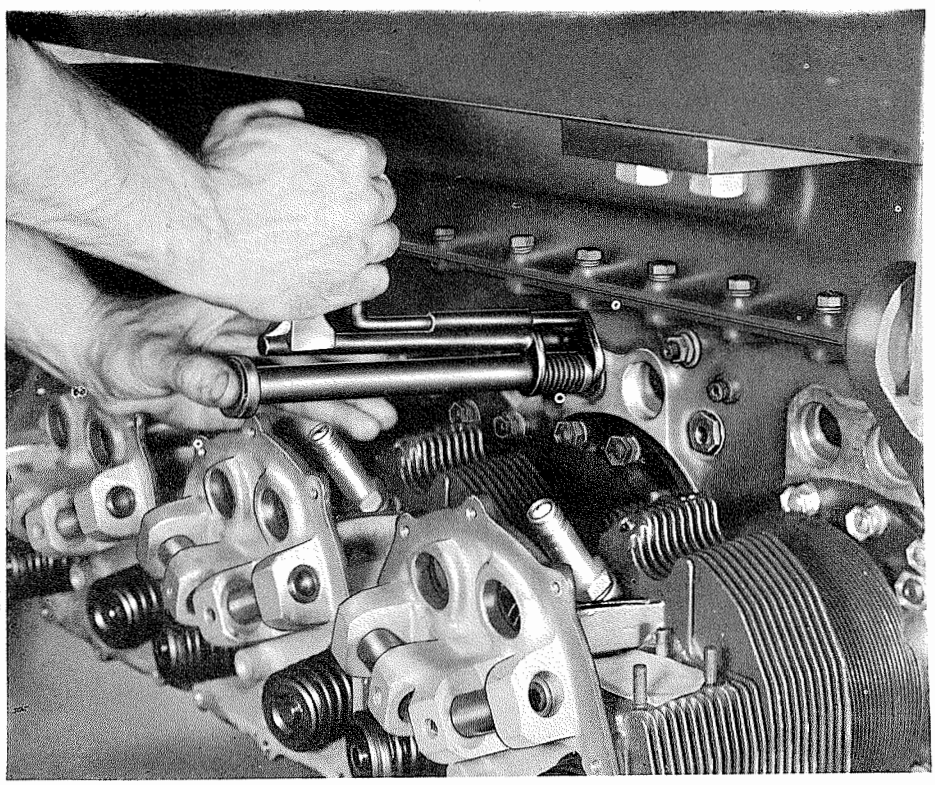


Figure 8-8. Installing Pushrod Housing.

8-14. STARTER DRIVE ADAPTER. (See Figure 4-11, IO-520-A) and (See Figure 4-12, IO-520-B & C).

a. Place a new gasket on crankcase dowels of adapter mount pad.

b. Lubricate spur gear and mesh it with crankshaft gear as adapter is placed in position. Seat adapter against gasket. Secure IO-520-A adapter with two sets of nuts and washers and two bolts and lockwashers. Attach lower generator support bracket as shown in figure 8-7. Secure IO-520-B and C adapter to crankcase with five sets of nuts, plain washers and lockwashers.

8-15. GENERATOR IO-520-A (See Figure 4-9).

a. Install upper support bracket components (7 through 12) and secure it with bolt (6).

b. Position crankcase mounting bracket bushings (21) on each side mounting hole and press sleeve (22) through bushings. Position generator (19) so that it straddles mount bracket with the rear flange between washer and support bracket. Align holes in flanges and secure bracket assembly (18), lower support bracket (23) and generator (19) to bracket (24) with washers (20) and bolts (17).

8-16. ALTERNATOR ASSEMBLY IO-520-B & C (See Figure 4-10).

a. Install the baffle support assembly (4). Secure with crankcase through bolt attaching parts.

b. Install woodruff key (7), gear hub (12), spring (11), driven gear assembly (9, 10), washer (8) and nut (6). Tighten nut to 450 in. lb. torque. If slots of nut do not align with cotter pin hole in alternator shaft, nut may be tightened further, not to exceed 500 in. lb. torque. Install cotter pin (5).

c. Install new "O" ring (13) on flange of alternator.

d. Install the alternator (3) on the crankcase mounting flange. Install four sets of attaching parts (1, 2). Torque bolts to value specified in Table of Limits. Section VI. Secure bolt heads in pairs with lockwire.

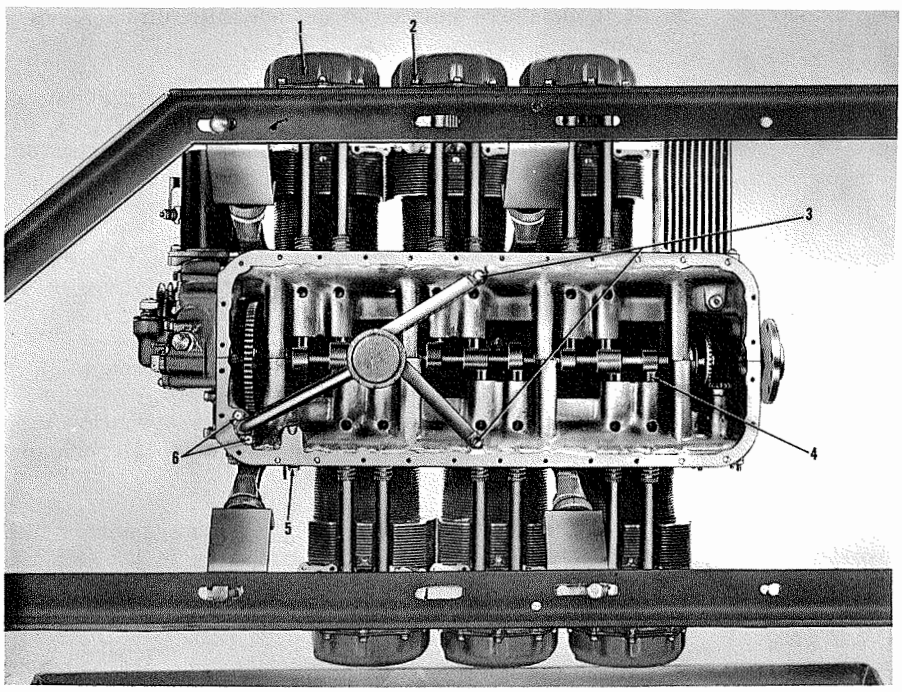
8-17. MAGNETO AND ACCESSORY DRIVE ADAPTERS (See Figure 4-3).

a. Place two new gaskets on two upper four-stud mount pads at the rear of the crankcase so that oil holes in gaskets are aligned with crankcase oil outlet holes.

b. Install two adapter assemblies with oil holes aligned with crankcase oil outlet holes. Attach both with plain washers, lockwashers and nuts.

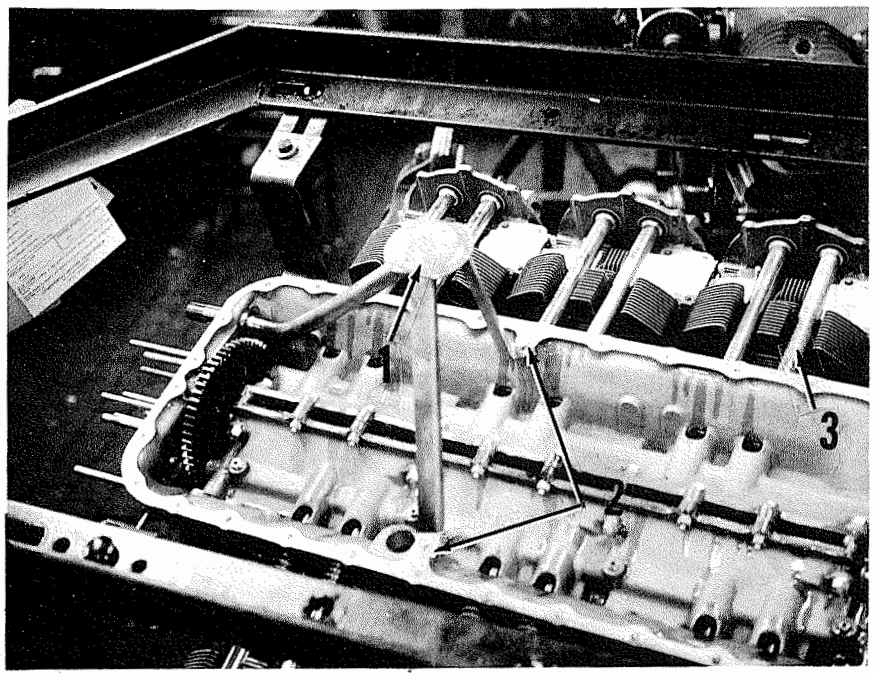
8-18. OIL COOLER IO-520-A (See Figure 4-7).

a. Install new gasket (11) on crankcase studs. Install oil cooler end plate (9) on crankcase. Secure with five sets of attaching parts (6, 7, 8).



1. Valve rocker cover
2. Washer, lockwasher screw
3. Oil suction tube
4. AN74A4 bolt
5. AN74A3 bolt

Figure 8-9. Bottom View with Valve Mechanism and Oil Suction Tube Installed IO-520-A & C.



1. Oil suction tube
2. 630966-.56 Bolt
3. Pushrod and pushrod housing.

Figure 8-10. Bottom View with Valve Mechanism and Oil Suction Tube Installed IO-520-B.

b. Install new gasket (5) and oil cooler (4) on oil cooler end plate. Secure with twelve sets of attaching parts (1, 2, 3).

8-19. OIL COOLER IO-520-B & C (See Figure 4-8).

a. Install baffle support assembly (15) on crankcase through bolts.

b. Install gaskets (11) or (9 and 10). Mount oil cooler on mounting legs (IO-520-C) or crankcase (IO-520-B). Secure with attaching parts (1 through 6).

c. Install Vernatherm valve (12).

8-20. VALVE MECHANISM. (See Figure 4-15 and Figure 2-6).

a. Turn engine upside down.

b. Lubricate exterior surface of each tappet just prior to installation. Apply oil to socket, but not into body oil holes. Install all tappets.

c. To install each pushrod housing (14) compress spring (15) and place packing (17) between two steel washers (16) on that end of housing. Insert this end of housing into crankcase guide until other end and its seal ring can be aligned with cylinder head opening. Move assembly outward until packing (17) has entered cylinder hole. Release spring slowly until it is free and remove compressor.

d. Install six pushrod housings nearest to engine mount brackets first, since compressor must lie close to horizontal in order to clear crankcase flange.

e. Before installing valve-actuating parts on each cylinder, turn crankshaft until cam lobes for that pair of tappets are pointed to the opposite side of the engine.

f. Install lubricated pushrods (13) and seat them in tappet sockets. Install proper rocker assembly (9, 10, 11), thrust washers (12) and insert rocker shaft (8). Install safety rocker shaft retaining screw (6) and washer (7).

g. Install all pushrods and rockers in other cylinders in same manner. Install valve rocker covers (4), gaskets (5) and secure with attaching parts (1, 2, 3).

8-21. OIL SUMP IO-520-A & C (See Figure 4-5).

a. Place new gasket (12) on crankcase suction tube pad and position suction tube assembly on crankcase (IO-520-A).

b. Attach suction tube assembly (11) to crankcase with two slotted screws (8) and two sets of screws and washers (9, 10). Torque screws (9) to value given in Table of Limits, Section VI (IO-520-A).

c. Install gasket (16) on suction tube (17). Insert threaded end of tube through crankcase and oil pump.

Install new gasket (16) and acorn nut (15) on protruding, threaded end of suction tube. Install washer (14) and screw (13). Secure screw to brace with lockwore. Tighten acorn nut to torque specified in Table of Limits, Section VI (IO-520-C).

d. Spread a film of Tite-Seal compound on both sides of the sump gasket (7) and position it on the crankcase.

e. Lay sump on crankcase and install attaching parts (3, 4, 5).

8-22. OIL SUMP IO-520-B (See Figure 4-6).

a. Install gasket (15) on suction tube assembly (16). Insert threaded end of tube through crankcase and oil pump. Install new gasket (15) and acorn nut (14) on proturding, threaded end of suction tube. Secure suction tube to crankcase with screw (13) and secure with lockwire. Torque acorn nut to value specified in Table of Limits, Section VI.

b. Spread a film of Tite-Seal compound on both sides of gasket (12) and position it on crankcase.

c. Lay sump (10) on crankcase, and install attaching parts (7, 8, 9).

d. Install mounting legs (6) and secure with attaching parts (3, 4, 5).

8-23. INDUCTION SYSTEM (See Figure 4-4).

a. Push a new hose (15) on either end of center intake tubes. Slide one hose clamp (14) to a position midway on overlapping portion. Turn each clamp so that a screwdriver can be aligned with its screw and yet clear of stand when tube is installed. Tighten screw only enough to hold hose in position.

b. Place a hose clamp on each end of cylinder intake tube so it faces center tube. Push end tubes into hose previously installed on center intake tubes. Work hose clamps over ends of hoses, but not past bead. Do not tighten at this time.

c. Push a hose on each front and rear intake tube and install a clamp on overlapping portion behind tube bead. Tighten these clamps.

d. Lay a new gasket on intake flange of each cylinder. Position each assembly of tubes and hoses on proper bank of cylinders and adjust each tube so it seats squarely on cylinder port.

e. Attach each intake flange to its cylinder with four sets of attaching parts (16, 17, 18). Position clamp on two center hoses on each side inside tube beads and tighten.

f. For IO-520-B engines push rear hose on No. 1 and No. 2 intake tubes back onto tube until clear of ends. Position hose (4) on rear manifold assembly. Slide clamp assembly (2) over hose. Install air throttle body assembly and control assembly on bottom of sump and secure with bolt and washer (17, 18, figure 4-2).

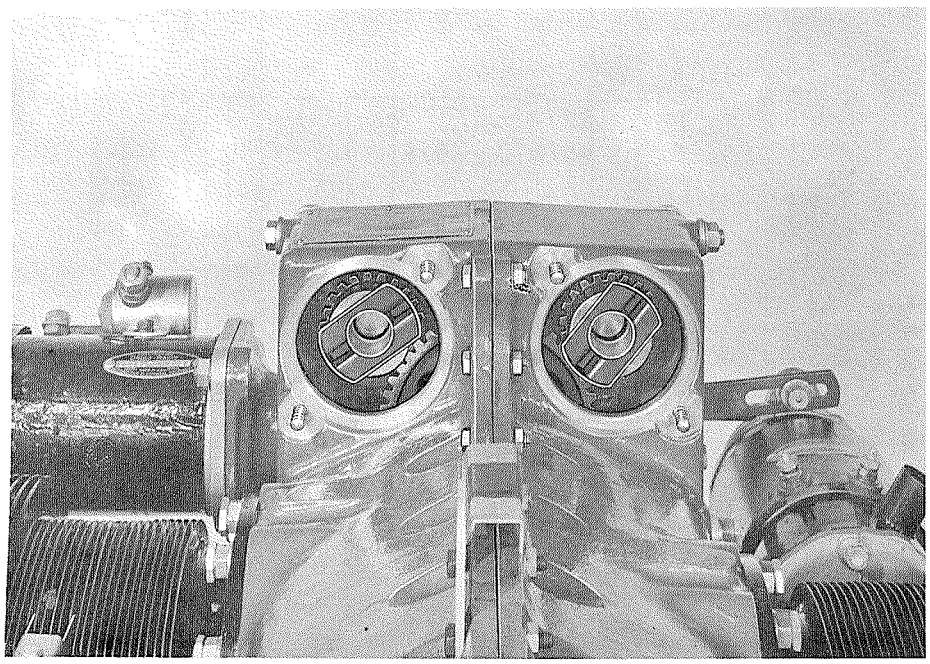


Figure 8-11. Position of Magneto Couplings.

Slide other end of hose (4) onto air throttle body, and other end of No. 1 and No. 2 intake tube hoses onto rear manifold assembly. Position clamps and tighten.

g. For IO-520-A & C push hose clamp on both elbows (5, 6) and push elbows into connecting hoses of rear intake tubes. Position clamps and tighten only enough to hold tubes.

h. Install clamp (11) and bracket (10) on balance tube (13). Push tube ends into connecting hoses installed on front intake tubes. Position clamp and secure to sump with attaching parts (8, 9). Position clamp assemblies (12) over tube beads and tighten.

i. While engine is inverted, secure brackets (38) to sump with corner sump bolts and washers (23, 24). Place bracket (36) between free ends of brackets (38) and align holes. Attach all three with screw (27), washer (26) and nut (25). Turn engine upright.

j. Secure IO-520-A support bracket (37) to upper magneto drive adapter studs and idler gear support studs with attaching parts (33, 34, 35). Assemble IO-520-C support brackets (48 through 55). Secure bracket (51) to lower magneto drive adapter studs and bracket (48) to right and tachometer drive housing.

k. Position air throttle assembly on bracket (36) and secure with attaching parts (28, 29, 30). Place hose clamp over each hose (3) on elbows (5, 6) and work hoses onto throttle body position and tighten clamp. Secure IO-520-A support bracket to air throttle body with attaching parts (31, 32). Secure IO-520-C support bracket (48) and (51) as illustrated.

8-24. FUEL INJECTION SYSTEM IO-520-A (See Figure 4-1).

a. Attach shroud assembly (49) to fuel pump and vapor separator (44) with speed nuts (47), screws (46) and spring (45).

b. Connect hose assemblies (8, 9) to fuel pump.

8-25. FUEL INJECTION SYSTEM IO-520-B (See Figure 4-2).

a. If not accomplished previously, assemble shroud (50) to fuel pump and vapor separator (49).

b. Connect hose assemblies (9) to fuel pump connections.

8-26. MAGNETO DRIVE GEARS (See Figure 4-3).

a. With engine in upright position, insert one pressed steel retainer (22) into each gear hub slot.

b. Cover each of four new rubber bushings with a film of Gredag #44 and insert two bushings (21) into each retainer, rounded long edges first.

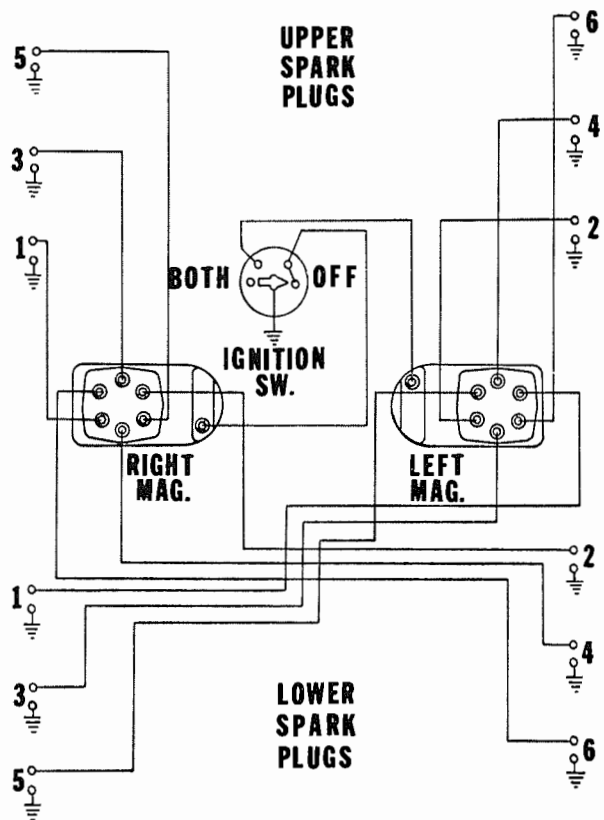


Figure 8-12. Wiring Diagram.

c. Turn the crankshaft to the No. 1 cylinder advance firing angle as described in the following paragraph. Lubricate each magneto drive gear shaft and teeth (20) and insert into bushings (15). Observe the shaft ends from the rear as they are carefully pushed through the adapter oil seals to make sure the seal lips are not reversed or damaged. Mesh the magneto drive gears to the idler gear to the approximate position shown in figure 8-11. These positions will vary slightly due to differences in magnetos and gears.

8-27. PLACING CRANKSHAFT IN TIMING POSITION (IO-520-A).

a. Cover the lower spark plug hole with the thumb and turn crankshaft clockwise until pressure is felt on thumb. The timing marks on the crankshaft flange are now turning towards the bottom parting line of the crankcase halves.

b. Using an adjustable square or depth gauge on the front of the crankshaft flange, align the 20° timing mark on the crankshaft flange with the crankcase bottom parting line flange.

8-28. PLACING CRANKSHAFT IN TIMING POSITION (IO-520-B & C).

a. Cover the lower spark plug hole of No. 1 cylinder with thumb and turn crankshaft until pressure is felt on thumb.

b. Remove plug (72, figure 4-17) in front of No. 6 cylinder and observe the timing mark on the alternator drive gear as the crankshaft is rotated slowly. When the mark on the gear is centered in the viewing hole, No. 1 piston is at the 20° BTC position.

8-29. MAGNETOS.

a. Remove inspection hole plugs from magnetos.

b. Turn impulse coupling backward, so latches will not engage, until timing pointer inside inspection hole is aligned with marked distributor gear tooth.

c. Without turning the magneto coupling, hold the magneto in the horizontal position it will occupy when installed, and check alignment of gear coupling slot and impulse coupling lugs. If not aligned, pull gear out of mesh, but not out of oil seal, and turn to correct alignment. Push gear back into mesh.

d. Place a new gasket on magneto flange and install magneto carefully so drive coupling lugs mate with slots of drive bushings. Install holding washers, lockwashers and nuts, but tighten only enough to permit turning the magneto for final timing, without looseness. Install right magneto with outer end slightly below horizontal and left magneto with outer end slightly above horizontal.

e. Connect timing light lead to the ground terminal of each magneto. Both timing lights should be on. Tap the right magneto up with a non-marring hammer until that light goes out. Tap the left magneto down until the light goes out. Secure magnetos.

f. Turn the crankshaft a few degrees counterclockwise and bring it back again until the timing marks are aligned. At this point both timing lights should go out at the same instant that the timing mark on the crankshaft flange aligns with the crankcase parting flange or the timing mark on the alternator drive gear appears in the center of the crankcase inspection hole.

g. If timing lights do not go out at the same time, loosen the magneto that is late or early and repeat the process outlined in step "f" above.

8-30. IGNITION HARNESS.

a. The high tension cable outlet plates can be attached to either magneto in only one position. The very shortest ignition cable is for No. 1 upper spark plug, and identifies proper assembly for the right magneto. Notice the "1" on the outlet plates next to the No. 1 cylinder cable outlet holes.

b. Attach cable outlet plate to magneto.

c. Lay lower spark plug cables from each magneto across the brace on crankcase top flange in two layers of three cables each. Install clamp and its attaching parts.

d. Install a clamp on each ignition cable and position fuel discharge tube bracket over cables on right cylinder bank.

e. Snap retaining clamp of cable 1R into top hole in rear leg of bracket. Following this, starting from the rear, snap 1L into first hole, 3R into 3rd hole, 3L into fourth hole, 5R into sixth hole and 5L into front leg of bracket. Position bracket so that its centerline is 6-3/4 inches from edge of No. 1R ferrule and 20-3/4 inches from edge of No. 5L ferrule. Position second bracket over cables on left cylinder bank. Snap retaining clamp of No. 2L cable into bottom and 2R into top hole in rear leg of bracket. Starting from the rear, snap cable 4R into second hole, 4L into fourth hole, 6R into sixth hole and 6L into hole in front leg of bracket. Position bracket so that its centerline is 21-1/4 inches from edge of No. 2R ferrule and 7-1/2 inches from edge of No. 6 ferrule.

f. Install all spark plugs not already in place with smooth copper gaskets. Tighten all plugs to torque specified in Table of Limits, Section VI.

g. Insert cable terminal sleeves into the proper plugs and screw on the elbow coupling nuts only enough to keep the elbows from turning. Keep the lower spark plug cables above the intake manifold and inside the intake elbows.

8-31. FUEL LINES.

a. Make sure that all nozzles have been installed and properly tightened.

b. Snap fuel discharge tube retaining clamp of No. 1 cylinder into second hole from rear, No. 3 cylinder tube clamp fifth hole and No. 5 cylinder tube clamp into seventh hole. On opposite side of engine snap No. 2 cylinder tube clamp into first hole, No. 4 tube clamp into third hole and No. 6 tube clamp into fifth hole. After tubes have been clamped to brackets, connect them to their respective fittings in manifold valve.

8-32. FINAL PARTS.

a. Install gaskets and covers on mount pads behind magneto drive gears and attach with four sets of plain washers, lockwashers and nuts.

8-33. TESTING AFTER OVERHAUL.

NOTE

Testing of overhauled engines after installation in aircraft is not recommended, because the cooling air flow induced by a static rotating propeller is usually inadequate for high speed operation. For this reason, and to assure the accuracy of test data, it is recommended that the run-in test be performed with the engine mounted on a rigid test stand within a cellular enclosure, which may be wide open at each end. A cell which is not too large in cross section and has sufficient length, will induce a higher air flow and will help to prevent immediate recirculation of cooling air.

8-34. TEST EQUIPMENT.

8-35. TEST CLUB. Unless a dynamometer is used to apply controlled loads to the crankshaft, it will be necessary to install a wood test club such as those supplied by the Hartzell Propeller Fan Co., Piqua, Ohio. Test clubs are customarily supplied in standard diameters, so that the blade length must be reduced by the "cut and try" method until the club will absorb the BHP at the RPM specified in Table IX for model on test, when used in the cell, stand and engine combination for which it was calibrated.

8-36. TEST STAND. Any rigid supporting stand of adequate strength and suitable shape and dimensions may be fitted with adapters to accept the engine mount bracket locations and sheer rubber mount bushing dimensions shown in the installation drawings. The crankshaft should be at least five feet above the cell floor so that the test club will not cause excessive disturbance in the air at floor level. If the cell does not have a paved floor the ground beneath the stand and for a reasonable distance around it should be treated so as to hold the soil in place.

8-37. COOLING AIR SCOOP. In warm climates it will probably be necessary to construct a scoop of heavy-gauge sheet metal to fit over the tops of all cylinders, with pads to seal it to the rear cylinders and to all valve rocker covers, in order to direct an adequate flow of air downward through the cylinder fins. Vanes may be found necessary to direct a portion of the cooling air to the center cylinder and/or the oil cooler, therefore the temperatures of all cylinder heads should be measured until uniformity within 50° F. has been obtained between coolest and hottest cylinder. It is advisable to provide a duct from the cylinder scoop to the generator or alternator vent tube or to provide a separate scoop for it.

8-38. INDUCTION AIR INTAKE. An air filter and housing should be attached to the air throttle body inlet flange. The filter area must be sufficient to avoid restriction of air flow. Always clean filter before each test. Calculations of filter area should be based on approximately 389 c. f. m. of air required by the engine at full throttle and on the filter capacity per unit of area. The calculated area of a clean filter should be increased by at least 50% to allow for dirt accumulation.

8-39. EXHAUST STACKS. For testing purposes the exhaust back pressure should be zero. Short stacks may be made locally to match the cylinder port diameter and the flange stud dimensions shown in applicable installation drawings.

8-40. CONTROLS. The only controls required are a mixture control and throttle control capable of operating the fuel control and metering shafts through their complete ranges, and a standard twin magneto switch connected to the magneto grounding terminals.

8-41. ELECTRICAL WIRING. A 24-volt storage battery must be connected by a No. 0 stranded copper cable from its positive terminal to the power terminal of the starter or starter solenoid. The battery negative terminal must be connected to the engine or both battery terminal and engine may be grounded. A small insulated wire should connect the starter solenoid coil terminal to a 5 Amp. pushbutton switch. The other switch terminal must be connected to the engine or both to common ground.

8-42. INSTRUMENTS. The control panel should be equipped with the following engine instruments.

a. A mechanically driven (counterclockwise, 1/2 engine RPM) tachometer and flexible shaft assembly is required.

b. An oil pressure gauge and tube connection.

c. An oil temperature gauge and capillary assembly.

d. A cylinder head temperature gauge, wiring and spark plug bayonet thermocouple. (See test operating limitations for different maximum temperatures.)

e. A water manometer with rubber hose connection to the vacuum pump oil return hole at the rear of the crankcase.

f. An ammeter connected in the generator or alternator circuit.

8-43. BREATHER. A substantial hose of 3/4 inch ID should be securely clamped over crankcase breather elbow and support so as to lead to a point above and to the rear of engine.

8-44. FUEL SYSTEM. The test stand fuel system is to incorporate an auxiliary pump capable of delivering fuel to and through engine system at a pressure of 2 to 2-1/2 psi indication on fuel pressure gauge. Means of determining, by weight, fuel consumption for given periods of time and at specified percentage of power should also be included. Connect stand fuel supply line to upper elbow projecting from left side of fuel pump shroud. Connect fuel pump-to-supply tank return line to upper elbow projecting from right side of fuel pump. Connect fuel pressure gauge line to the fitting projecting from the center rear of fuel manifold valve.

8-45. ENGINE TEST AFTER OVERHAUL.

a. After a partial or complete disassembly and repair of an engine in which no major part (cylinders, pistons, bushings, gears, etc.) was replaced, the engine will be tested in accordance with Table X.

b. Run the engine according to the schedule in Table XI after a major overhaul which included replacement of cylinders, pistons, bushings and any gear or any assembly containing gears.

c. Extend the second period of each test schedule, if necessary, to raise the oil temperature to 100° F.

NOTE

If tests must be conducted in extremely cold weather, it may be necessary to shield the crankcase from the cooling air stream, since it takes some heat from the oil.

d. Take instrument readings at the beginning, in the middle, and at the end of the full throttle period. Take one reading during each of the other periods as soon as conditions have stabilized.

e. Make one check on performance of each magneto alone at 2100 RPM (Refer to Tables IX, X, or XI). Clear spark plugs by operating with both magnetos on for a few seconds between checks.

NOTE

The maximum allowable cylinder head temperature and the maximum allowable oil temperature (Table IX) must not be exceeded at any time during the test.

8-46. STARTING PROCEDURE.

a. Open throttle to approximately 900 to 1200 RPM position.

b. Turn magneto switch to "BOTH" position.

c. Press boost pump button and hold it until 2.5 - 3.0 psi nozzle pressure is obtained; then release boost pump button and press starter button.

NOTE

During operation of the starter, the boost pump may be used intermittently to maintain 2.5 to 3.0 psi nozzle pressure. DO NOT use boost pump after engine is running smoothly.

8-47. PRESERVATION. If the engine is not to be installed in an aircraft and placed in service immediately, an additional period of 15 minutes test time will be required to preserve the engine internally. The engine must be stopped so the oil may be drained and replaced with a corrosion-preventive oil mixture (suitable for flight operation). During the same period, unleaded gasoline should be supplied to the fuel system.

TABLE IX - TEST OPERATING LIMITS

Feature	Value
Rated maximum B. H. P.	285 at 2700 RPM
Full throttle speed	2700 - 2800 RPM
Idling speed	575 - 625 RPM
Fuel Grade	100/130 Octane
Fuel consumption at full throttle	136 - 147 Lbs./Hr.
Fuel pump pressure at full throttle	30.0 - 32.8 PSI
Fuel pump pressure at idle	9.0 - 11.0 PSI
Metered fuel pressure at full throttle	16.5 - 18.2 PSI
Metered fuel pressure at idle	3.5 - 4.0 PSI
Engine intake air temperature	Ambient air temperature
Engine intake air pressure (Max.)	1.0 In. H_2O Max.
Manifold pressure at full throttle	28.5 In. Hg.
Manifold pressure at idle	14.5 - 16.5 In. Hg.
Oil grade	SAE #50 Above 40° F. SAE #30 Below 40° F.

TABLE IX - TEST OPERATING LIMITS (Cont.)

Feature	Value
Oil consumption at full throttle	4.30 Lbs./Hr. Max.
Oil temperature (desired range)	150 - 200° F.
Oil temperature (Max.)	240° F.
Oil pressure at full throttle (oil temperature 175° - 185° F.)	40 - 60 PSI Max.
Oil pressure at idle (oil temperature 140° - 150° F.)	30 PSI Min.
Ignition Timing	Left Magneto 19 -21° BTC Right Magneto 19-21° BTC
Magneto drop (at 2100 RPM)	125 RPM, max. spread
Cylinder head temperature (with bayonet thermocouple)	460° F. Max.
*Crankcase pressure	4.0 In. H_2O Max.

*Any sudden increase in crankcase pressure and rapid fluctuation of manometer usually indicates sticking of rings. Before removing cylinders check crankcase breather and manometer.

TABLE X - RUN-IN & FINAL TEST AFTER PARTIAL OR COMPLETE TEARDOWN. NO MAJOR PARTS REPLACEMENT.

Period	Time-Minutes	RPM	
1	10	900	Warm-up
2	10	1300	
3	10	1700	
4	15	2100	IO-520-A-B-C
5	15	2300	
6	15	2500	
7	15	2600	
8	10	575-625	Cool down period

NOTE

Following period No. 8, stop engine, drain oil and clean oil screens. Measure out 12 quarts of new lubricating oil into a calibrated container. Weigh and record weight of new oil and container; then pour oil into sump.

START OIL CONSUMPTION DETERMINATION

Period	Time-Minutes	RPM	
9	10	900	Warm-up
10	60	2700-2800	100% Power
11	5	2100	Magneto check
11	5	2610	90% Power
12	5	2275	60% Power
13	10	575-625	Cool down period

NOTE

Following period No. 13, stop engine, drain oil into the same calibrated container and weigh it again. If oil consumption was in excess of value specified in Table IX, replenish oil supply to original quantity and weight. Pour oil into sump and repeat periods No. 9 through 13. Upon the second completion of period No. 13 again weigh and determine consumption of oil. If consumption is still in excess of the value specified, return engine to overhaul.

TABLE XI - MAJOR OVERHAUL TEST RUN

Period	Time-Minutes	RPM	
1	15	900	Warm-up
2	15	1200	
3	15	1500	
4	15	1700	IO-520-A-B-C
5	15	1900	
6	15	2100	
7	15	2300	
8	15	2400	
9	15	2500	
10	15	2600	
11	30	2700-2800	100% Power
12	5	2610	90% Power
13	10	2275	60% Power
14	10	575-625	Cool down period

NOTE

Following period No. 14, stop engine, drain oil and clean screens. Measure out 12 quarts of new lubricating oil into a calibrated container. Weigh and record weight of new oil and container; then pour oil into sump.

START OIL CONSUMPTION DETERMINATION

Period	Time-Minutes	RPM	
15	10	900	Warm-up
16	60	2700-2800	Full throttle
		2100	Magneto check
17	10	575-625	Cool down period

NOTE

Stop engine, drain oil into same calibrated container and weigh again. If oil consumption is in excess of the value specified in Table IX, replenish oil supply to original quantity and weight. Pour oil into sump and repeat periods No. 15 through 17. Upon second completion of period No. 17, again weigh and determine consumption of oil. If consumption is still in excess of value specified, return engine to overhaul.

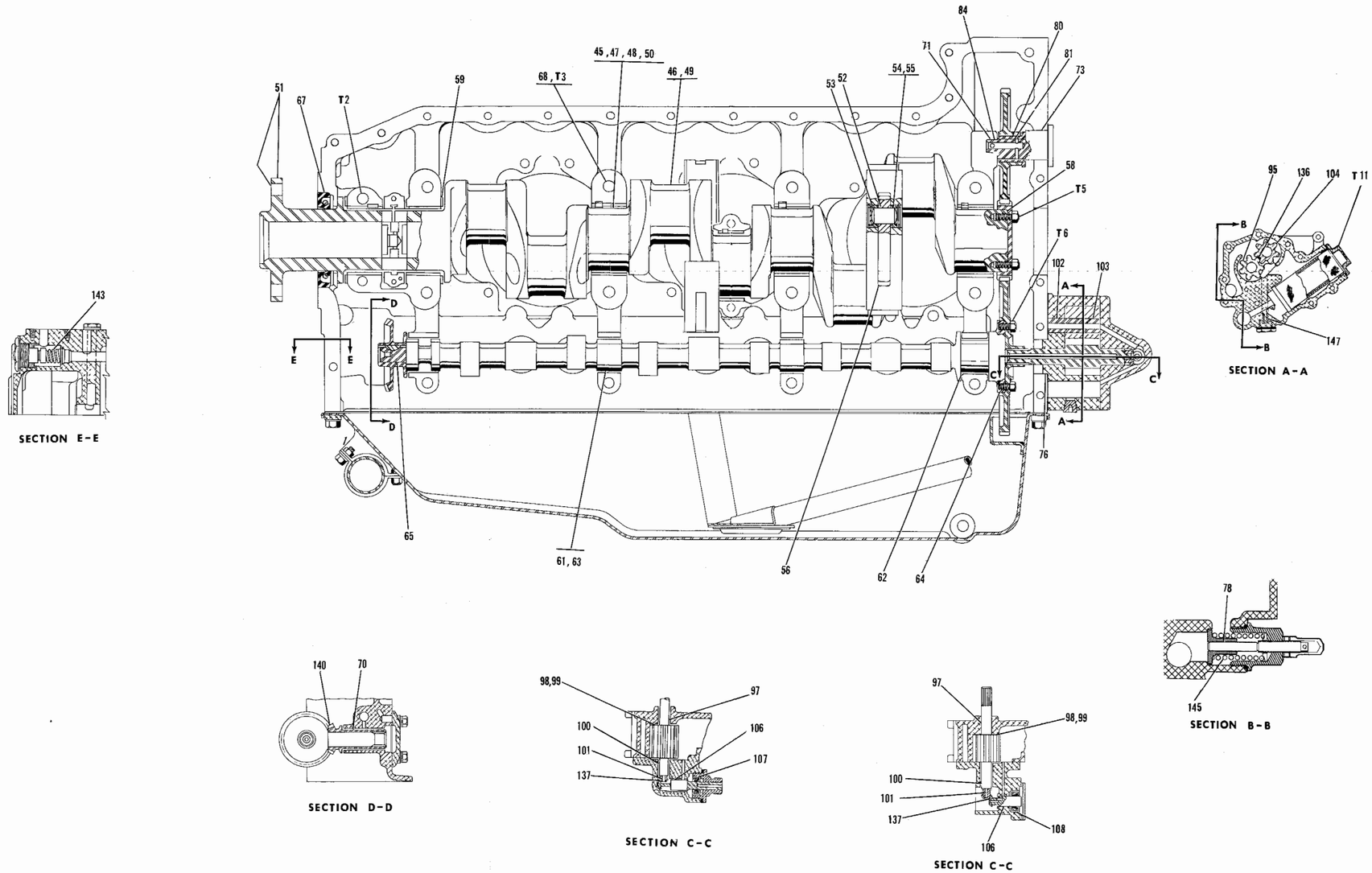
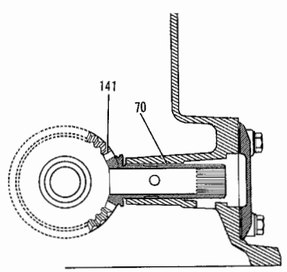
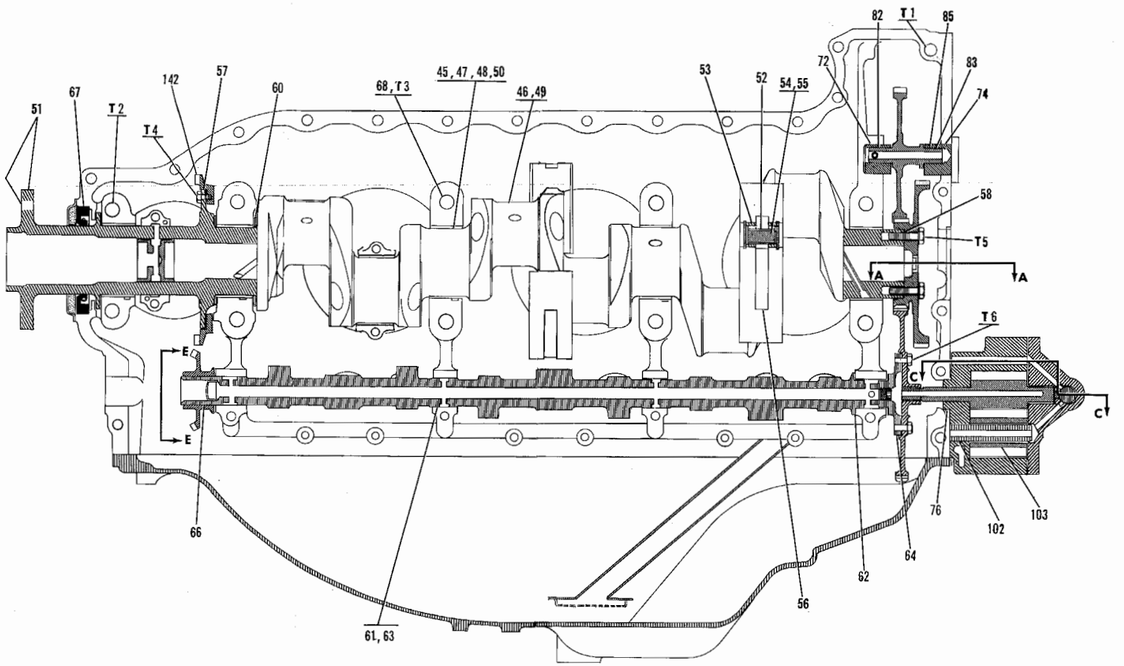
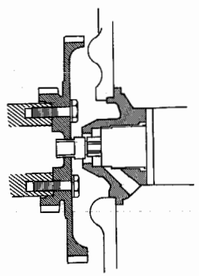


Figure 6-2. Limits and Lubrication Chart (Sheet 2 of 4)

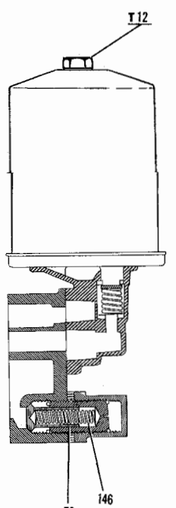


SECTION E-E

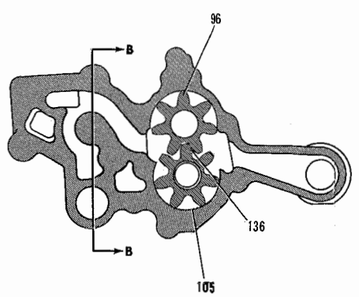




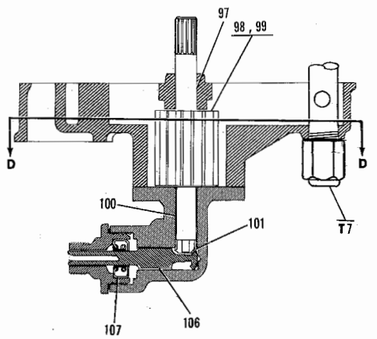
SECTION A-A



SECTION B-B



SECTION D-D



SECTION C-C

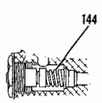


Figure 6-2. Limits and Lubrication Chart (Sheet 3 of 4)

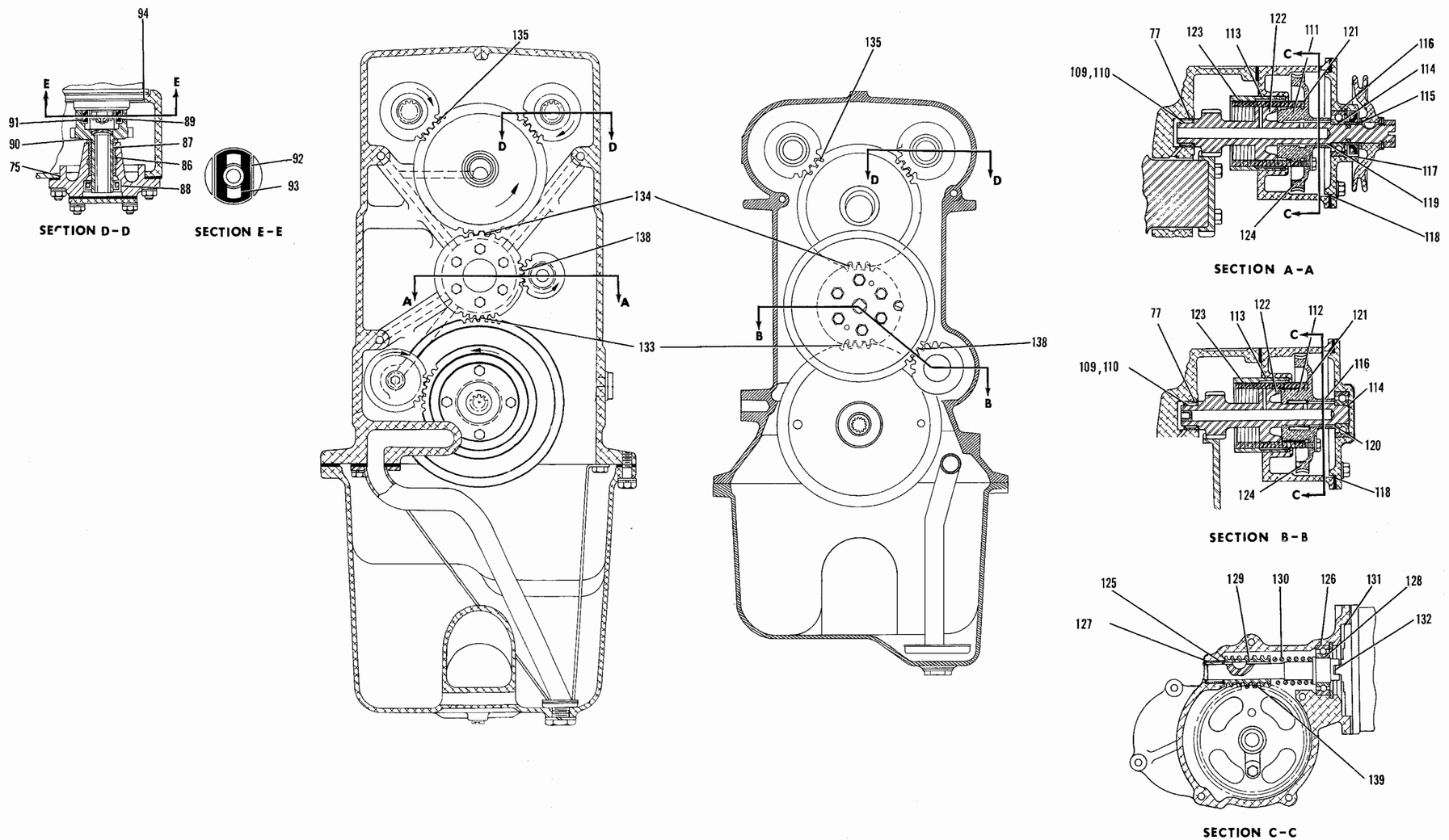


Figure 6-2. Limits and Lubrication Chart (Sheet 4 of 4)