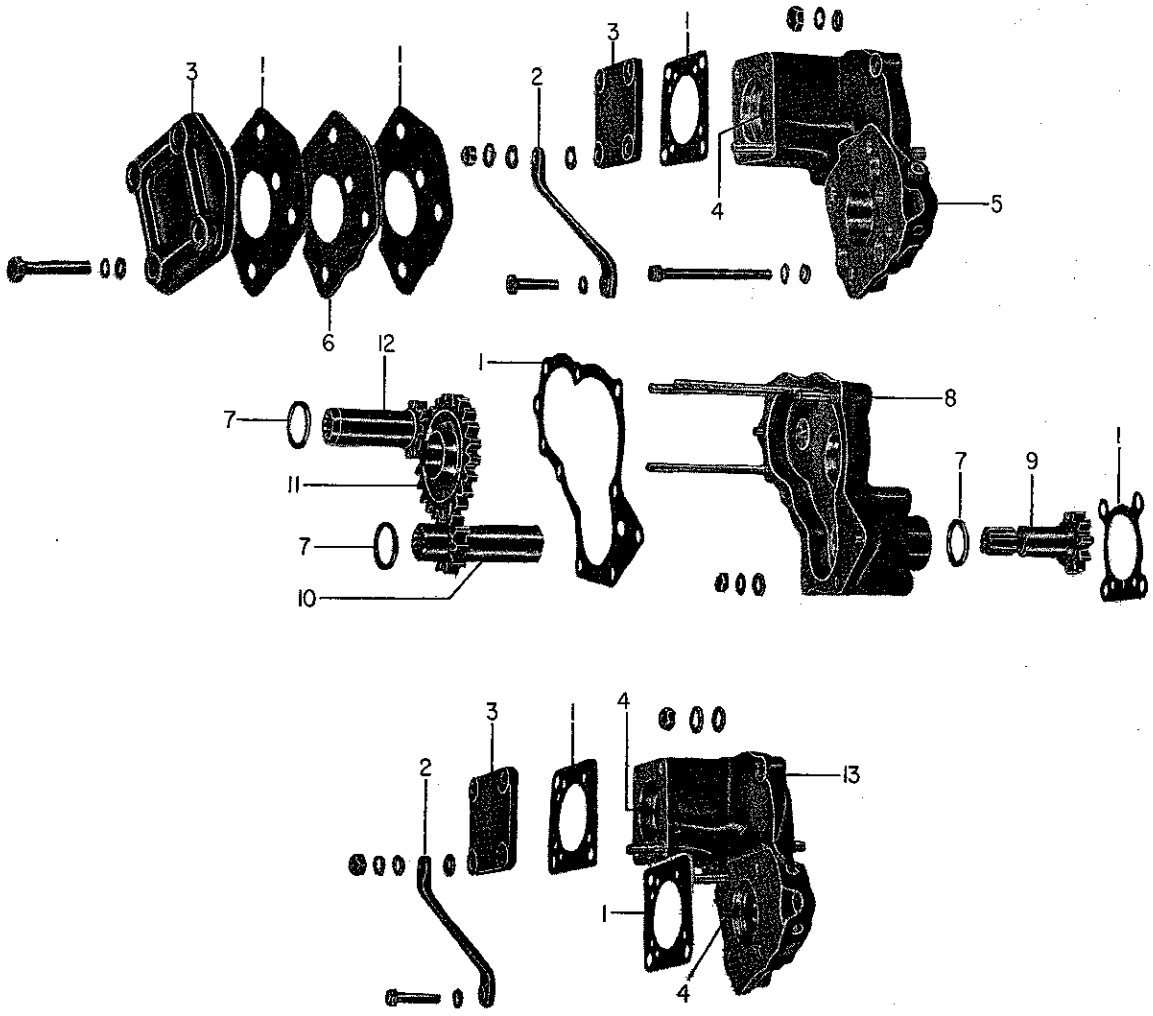


1. Gasket
2. Brace
3. Cover
4. Oil Seal
5. Vacuum Pump and Prop. Gov. Dual Drive Adapter
6. Spacer
7. Washer
8. Dual Drive Adapter
9. Accessory Drive Gear
10. Dual Accessory Drive Gear
11. Idler Gear
12. Vacuum Pump Driven Gear
13. Vacuum Pump and Hydraulic Pump Dual Drive Assembly

Figure 5-5. Vacuum Pump and Hydraulic Pump Dual Drive Assembly

(Engines with AN fuel pump drive) and install the thrust washer and retaining ring that holds the idler gear on the shaft. Be sure that a new oil seal has been inserted in the tachometer drive shaft bore. Rotate the oil pump drive shaft so that the lobes on the shaft align with slots in the crankshaft gear. Note that in the Dual Magneto Housing the oil pump drive shaft meshes with the crankshaft idler gear.

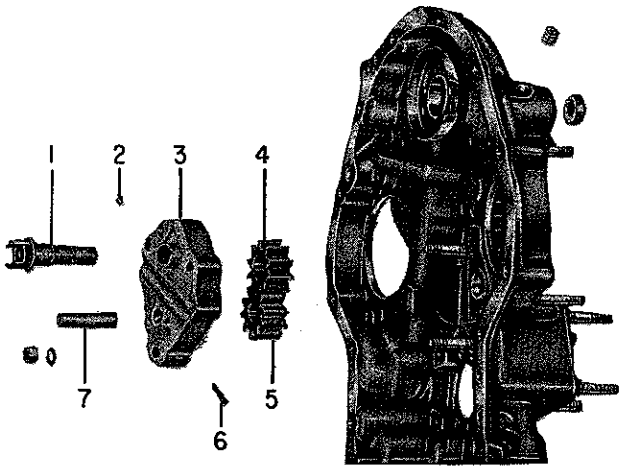
5-29. Apply a liberal coating of engine oil to the tachometer drive shaft and all other contact surfaces, such as gear teeth and idler gear hub. Carefully fit the accessory housing in place on rear of crankcase, guiding the housing first over the tachometer drive shaft and then on to the locating dowels: Secure the housing in place with ten 1/4-20 x 15/16 hex head bolts and two 1/4-20 x 1-3/4 bolts. Two of the 1/4-20 x 15/16 bolts are inserted from the crankcase side through holes in front of the right magneto. The two 1/4-20 x 1-3/4 hex head bolts are inserted in the two holes adjacent to the left magneto. Assemble all bolts with plain washers and lock washers.

5-30. Vacuum Pump Drive. See figure 5-3. If the engine is equipped with a vacuum pump drive, assemble the unit as follows: Insert a new oil seal (3) into the recess in the pump side of the vacuum pump adapter assembly (4). Make sure that seal is inserted with the grooved side toward the adapter. Place a new accessory driven gear washer (5) over the shaft of the vacuum pump driven gear (6), lubricate the shaft, and insert the gear into the adapter being careful not to push oil seal out of its seat. Using a new gasket attach the adapter to the upper right side of the accessory housing with

four 1/4-20 plain nuts, plain washers and lockwashers. If the engine is equipped with vacuum pump drive only, place a cover over the exposed end of the drive to prevent entrance of dirt and/or other foreign matter. If the engine is equipped with vacuum pump install the vacuum pump on the adapter instead of the cover.

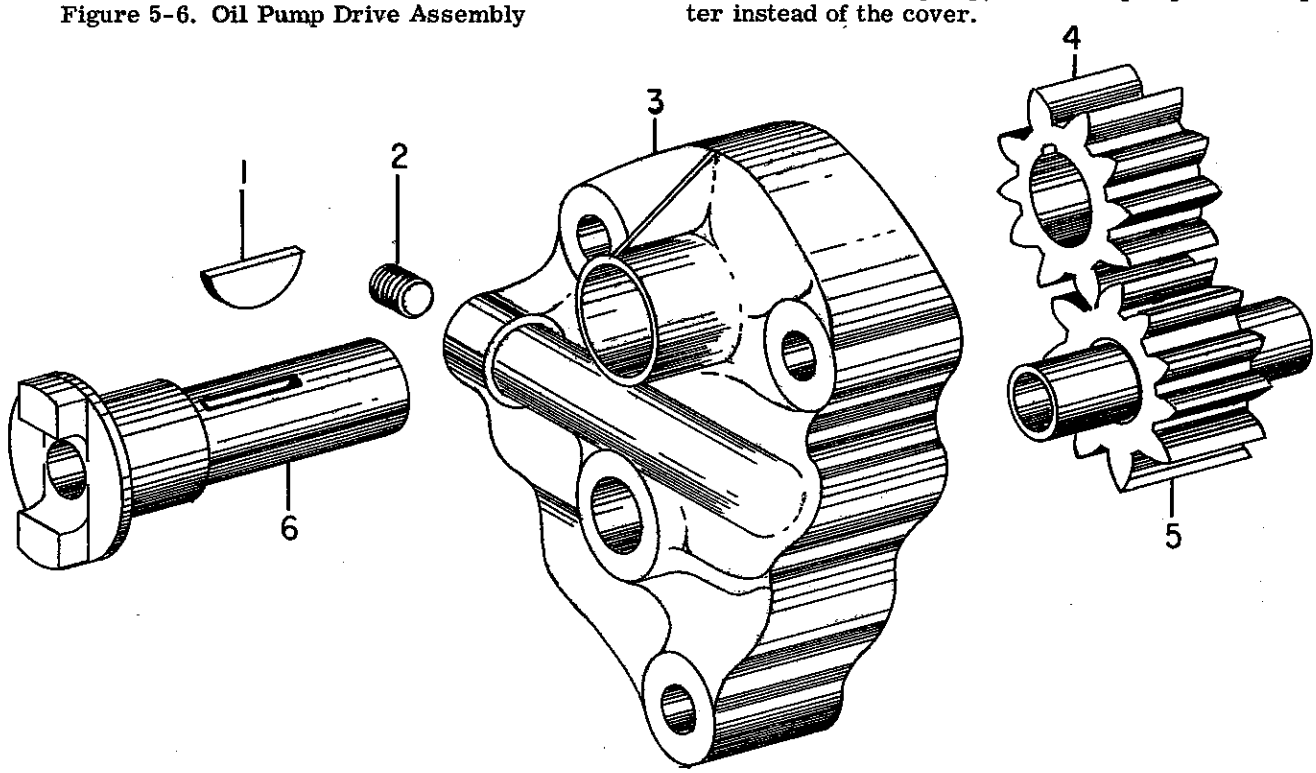
5-31. Propeller Governor Drive. See figure 5-3. On those engines equipped with a propeller governor drive, lubricate and insert the propeller governor drive shaft gear (11) into the adapter (10). Place a new accessory driven gear washer (5) over the drive end of the shaft and secure shaft in place with a 13/16 inch diameter external retaining ring (9). Using a new gasket, attach the adapter to the lower right side of the housing with four 5/16-18 plain nuts, plain washers and lockwashers. Attach cover (8) on the exposed end of the drive as protection against dirt and foreigh matter. Assemble the propeller governor oil line (12).

5-32. Hydraulic Pump Drive. If the engine is equipped with a hydraulic pump drive, assemble the unit as follows: Insert a new oil seal into the recess in the pump side of the hydraulic pump adapter assembly. Make sure that the seal is inserted with the grooved side toward the adapter. Place a new accessory drive gear washer over the shaft of the hydraulic pump drive gear and insert the gear into the adapter being careful not to damage the oil seal. Using a new gasket, attach the assembly to the lower right side accessory housing with nuts, plain washers and lockwashers. If the engine is equipped with hydraulic pump drive only, place a cover over the exposed end of the drive. If the engine is equipped with a hydraulic pump, install the pump on the adapter instead of the cover.



1. Drive Shaft
2. Plug
3. Body
4. Driving Impeller
5. Drive Impeller
6. Cotter Pin
7. Idler Shaft

Figure 5-6. Oil Pump Drive Assembly



1. Woodruff Key
2. Plug
3. Oil Pump Body
4. Driving Impeller
5. Driven Impeller and Idler Shaft
6. Oil Pump Drive Shaft

Figure 5-7. Oil Pump Drive Assembly (Sintered Iron Impellers)

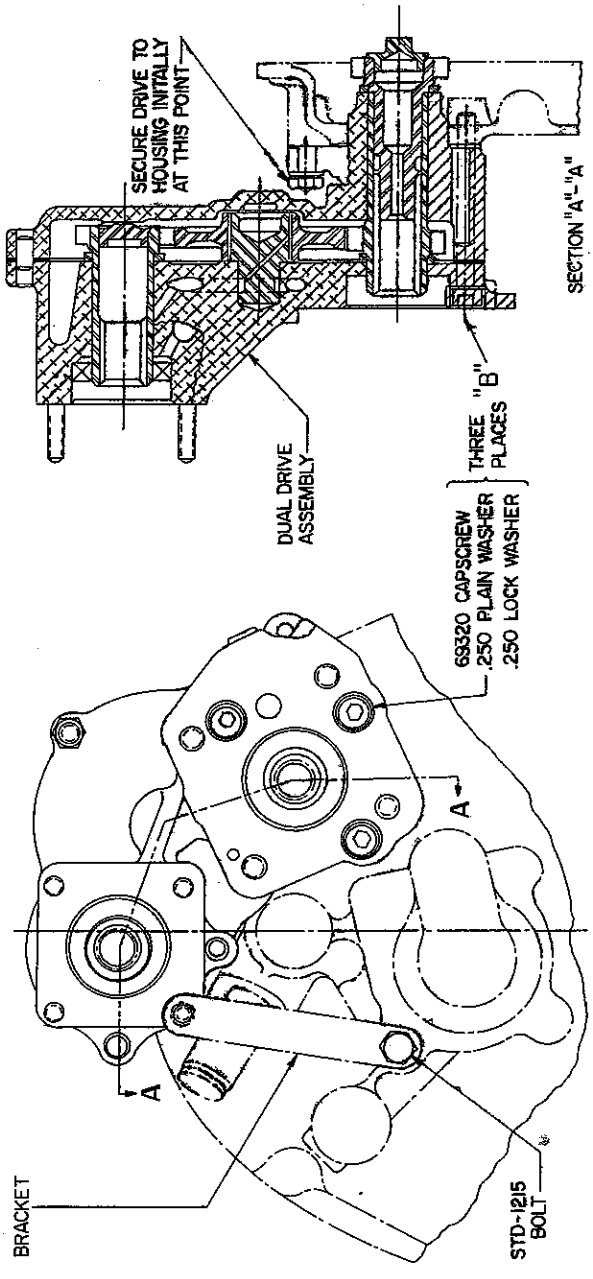


Figure 5-8. Dual Drive Assembly - Vacuum Pump and Propeller Governor

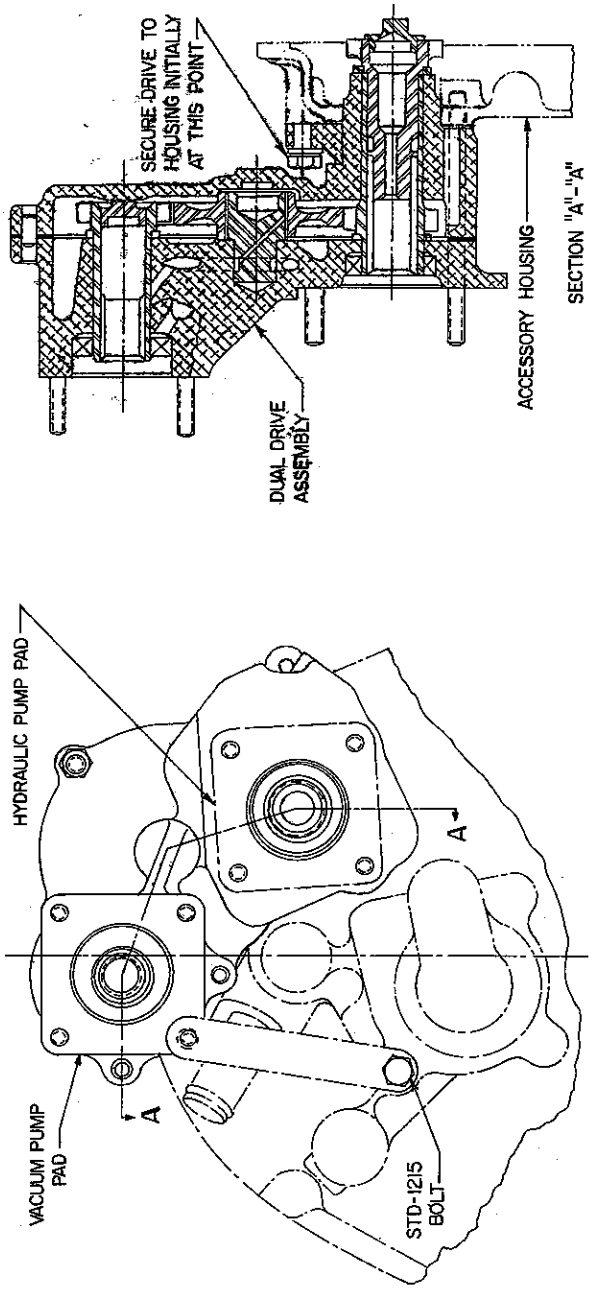


Figure 5-9. Dual Drive Assembly - Vacuum Pump and Hydraulic Pump

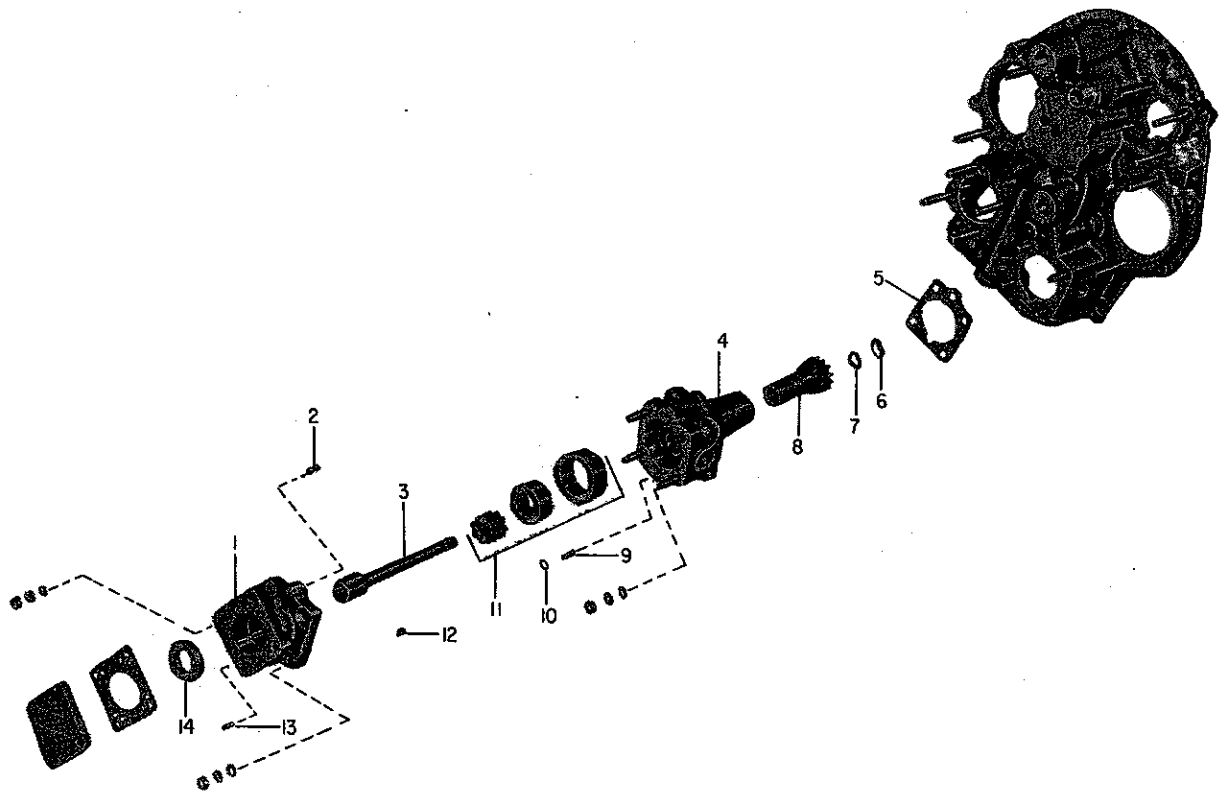
5-33. "AN" Fuel Pump Drive. See figure 5-4. If the engine is equipped with an "AN" fuel pump drive, assemble the unit as follows: Insert a new oil seal (1) into the recess in the pump side of the fuel pump adapter assembly (3). Make sure that the seal is inserted with the grooved side toward the adapter. Insert the fuel pump driven gear (5) into the adapter being careful not to damage the seal. Using a new gasket attach the assembly to the lower left side of the accessory housing with nuts, plain wahser and lockwashers. If the engine is equipped with fuel pump drive only place a cover over the exposed end of the drive. If the engine is equipped with an AN fuel pump, install the pump on the adapter instead of the cover.

5-34. See figure 5-5. Dual Drive (Vacuum Pump and Propeller Governor) If the engine is equipped with a vacuum pump and propeller governor dual drive, mount the drive assembly on the vacuum pump mounting pad at the upper right side and fasten with a 1/4-20 nut, three 1/4-20 socket head capscrews, and required plain washers and lock washers. Mount the vacuum pump and propeller governor on the dual drive housing, using a new gasket, and install the bracket between the vacuum pump pad and pressure screen housing mounting flange. Use spacer washers under ends of brace if required for proper seating.

CAUTION

Brace must be seated properly so there is no stress at either end of bracket when nuts are tightened.

5-35. See figure 5-5. Dual Drive (Vacuum Pump and Hydraulic Pump). If the engine is equipped with a vacuum pump and hydraulic pump dual drive, mount the drive assembly on the vacuum pump mounting pad at the upper right side and fasten with a 1/4-20 nut, plain washer and lock washer on the short stud in the accessory housing. Install the vacuum pump and hydraulic pump on the dual drive housing and fasten with required nuts and washers; then install the bracket between the vacuum pump pad and pressure screen housing flange. Use spacer washers under end of brace if required for proper seating.



1. Hydraulic Pump Adapter
2. Dowel
3. Hydraulic Pump Drive Shaft Gear
4. Turbo Scavenge Pump Adapter
5. Gasket
6. Retaining Ring
7. Washer
8. Hydraulic Pump Drive Gear
9. Dowel
10. Oil Seal Ring
11. Gerotor Pump
12. Woodruff Key
13. Pin
14. Oil Seal

Figure 5-10. Turbo Scavenge and Hydraulic Pump Drive Assy. (O-540)

CAUTION

Brace must be seated properly so there is no stress at either end of bracket when nuts are tightened.

5-36. Fuel Pump (Diaphragm Type) See figure 5-3. Before installing the diaphragm type fuel pump make sure that the pump drive plunger is all the way up and the cam of gear is on the low side. If the plunger is down when the pump is installed the pump arm will contact the side of plunger and inturn will break out the accessory case at bottom of plunger.

5-37. Turbo Scavenge Pump (Where applicable.) See figure 5-10 or 5-11. Assemble the pump assembly in the reverse manner of disassembly and install on the mounting pad on the lower right side of the accessory housing.

5-38. Oil Scavenge Pump (AIO-360, -320). See figure 5-12. Assemble the pump assembly in the reverse manner of disassembly and install on the mounting pad on the lower right side of the accessory housing.

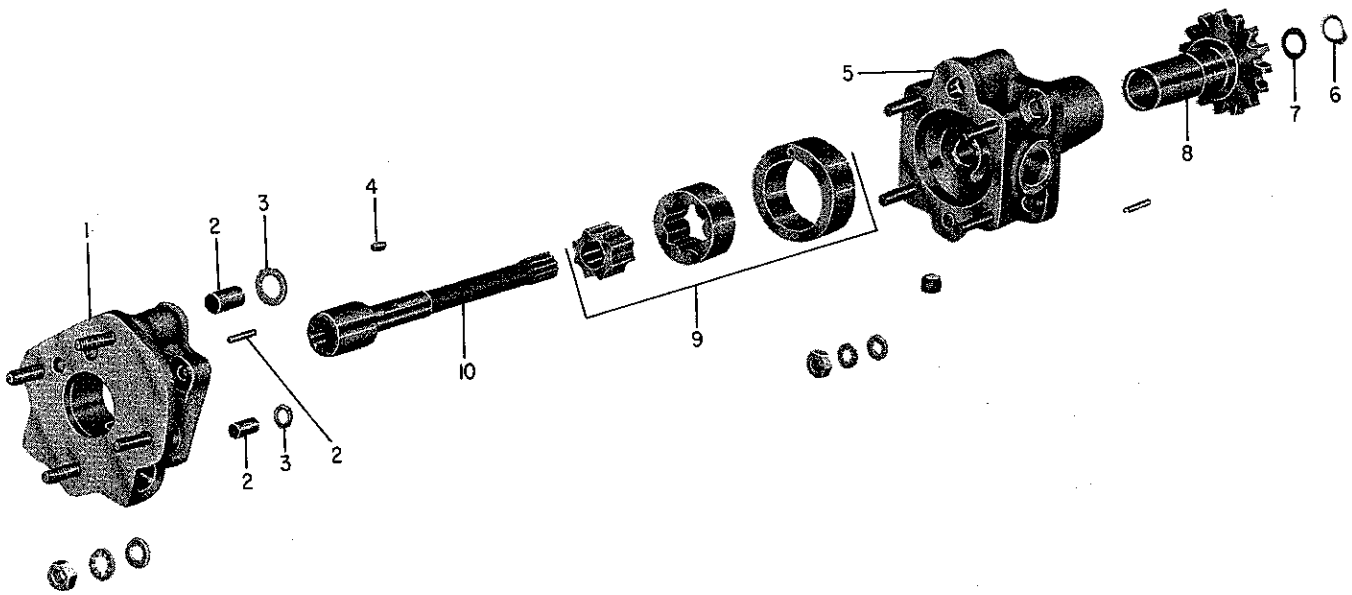
5-39. Oil Pressure Screen Housing. See figure 5-1. Assemble screen in housing, assemble gasket and housing on the mounting pad and secure with four capscrews or three capscrews and one nut (whichever is applicable).

5-40. Thermostatic Valve and Oil Pressure Screen Housing. See figure 5-1. Assemble screen, gasket and thermostatic valve in housing. Assemble gasket and housing on the mounting pad and secure with four capscrews or three capscrews and one nut (whichever is applicable).

5-41. Oil Filter and Adapter. See figure 5-1. Assemble gasket and thermostatic valve in adapter. Assemble component parts of the filter assembly and attach to the adapter with the center stud. Tighten center stud to 20-25 foot pounds torque. Consult Service Letter L-157 for detail information.

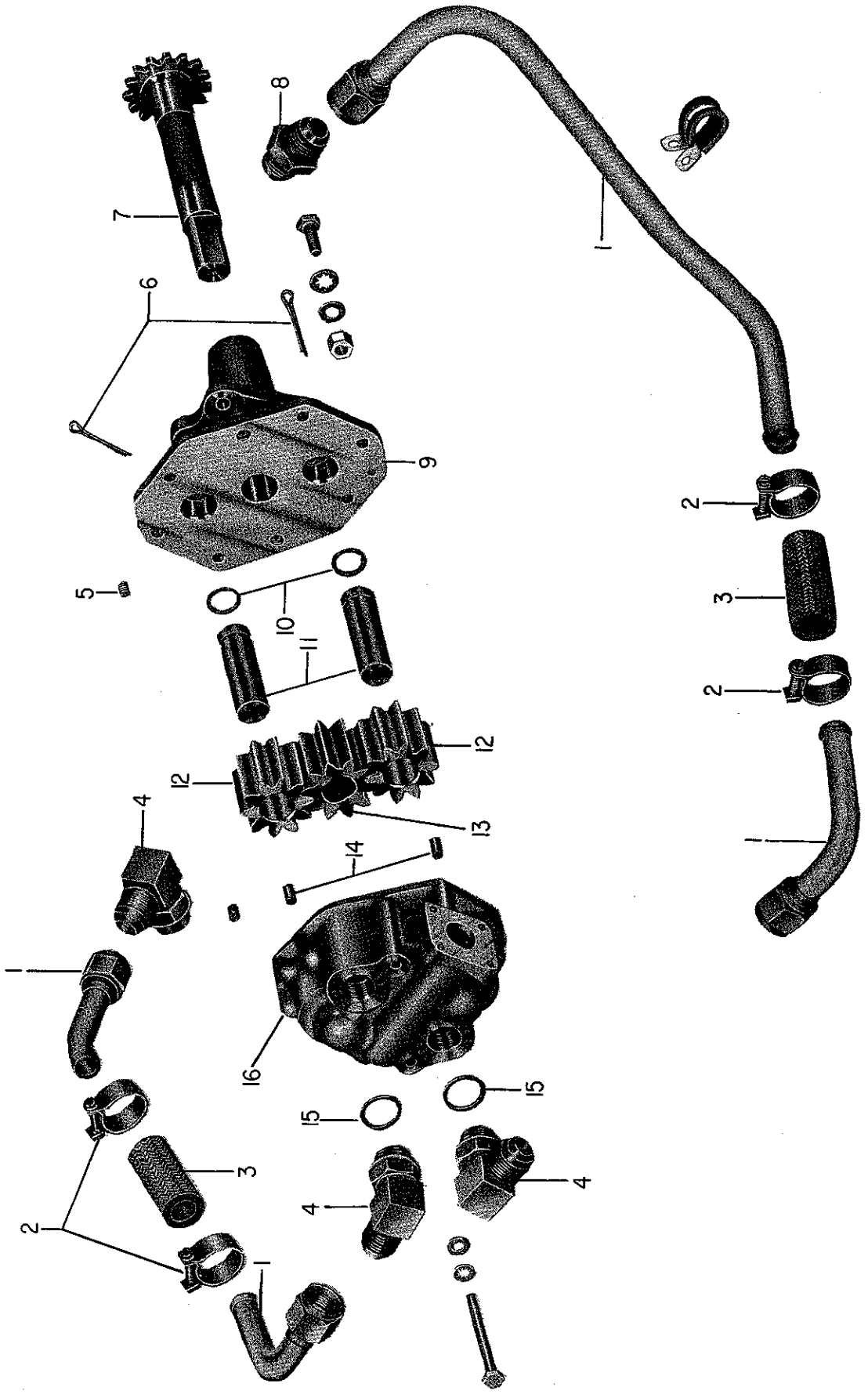
5-42. Oil Filter (Dual Magneto Housing) See figure 5-2. Assemble oil filter bypass valve spring (7), seat (8) and sleeve (9) in the accessory housing and secure in housing with an internal retaining ring (10). Assemble gasket and thermostatic oil cooler bypass valve (20) in the accessory housing. Assemble component parts of the mounting pad. Tighten center stud to 20-25 foot pounds torque. Consult Service Letter L157 for more detail information.

5-43. Oil Cooler Bypass Valve Assembly. See figure 5-1. This assembly is used only in conjunction with the oil pressure screen housing and the opening is plugged when using either a thermostatic oil cooler bypass valve and oil pressure screen assembly or oil filter and adapter. Install plunger (12), spring (7), washer (2) and plug (8).



1. Prop. Gov. Drive Adapter
2. Dowel
3. Oil Seal Ring
4. Woodruff Key
5. Turbo Scavenge Pump Adapter
6. External Ring
7. Washer
8. Prop. Gov. Drive Shaft Gear
9. Gerotor
10. Prop. Gov. Drive Shaft

Figure 5-11. Turbo Scavenge Pump and Governor Drive Assembly (O-360)



1. Tube Assembly
2. Hose Clamp
3. Hose
4. Fitting
5. Heli Coil
6. Cotter Pins
7. Pump Drive Shaft Assembly
8. Union
9. Pump Adapter Assembly
10. Oil Seals
11. Idler Shafts
12. Driver Impellers
13. Driving Impeller
14. Dowels
15. Oil Seals
16. Pump Housing Assembly

Figure 5-12. Oil Scavenge Pump Assembly (AIO-320, -360)

SECTION 6.
CYLINDERS, PISTONS AND VALVE TRAIN

6-1. The piston, being a reciprocating part, is normally grouped with the crankshaft in a theoretical breakdown of the engine into basic components. However, from a practical standpoint, it is felt that the piston should be considered with the cylinder insofar as overhaul procedures are concerned. For example, the basic configuration of the engine requires the removal and reassembly of the pistons at the same time the cylinders are removed or replaced.

6-2. For the purposes of this manual, the valve train will be considered as all parts of the valve operating mechanism beyond the camshaft, beginning with the hydraulic tappet assembly.

6-3. Although subject engines employ either parallel valve cylinders or angle valve cylinders with either up exhaust or down exhaust, basic overhaul procedures are the same for all cylinders. The overhaul procedures described in this section will be applicable to all cylinder assemblies except as noted.

6-4. Either plain steel, chrome plated, or nitride hardened steel cylinders may be employed on the engines discussed in this overhaul manual. The color code for these cylinders is as follows:

a. Plain steel	All grey
b. Chrome plated	Orange paint on cylinder fins below spark plug hole.
c. Nitride hardened steel	Blue paint on cylinder fins below spark plug hole.
d. .010 inch oversize plain cylinders	Green when applied to customer overhaul engines.
e. .020 inch oversize plain cylinders	Yellow when applied to customer overhaul engines.

NOTE

A yellow color, on fins ABOVE spark plug hole, indicates that long reach spark plugs are used.

REMOVAL FROM ENGINE

6-5. It is assumed that the ignition harness, intake pipes and primer or fuel injection lines have been previously removed.

6-6. INTERCYLINDER BAFFLES. (Where applicable) Using the intercylinder baffle tool (64885), turn the baffle retaining hook so that it disengages the retainer. Remove the intercylinder baffle and hook from between the cylinders.

6-7. OIL DRAIN TUBES. Loosen hose clamps at lower end of tube and slide tube out of hose. Loosen gland nut at cylinder head fitting and remove drain tube.

6-8. Deleted

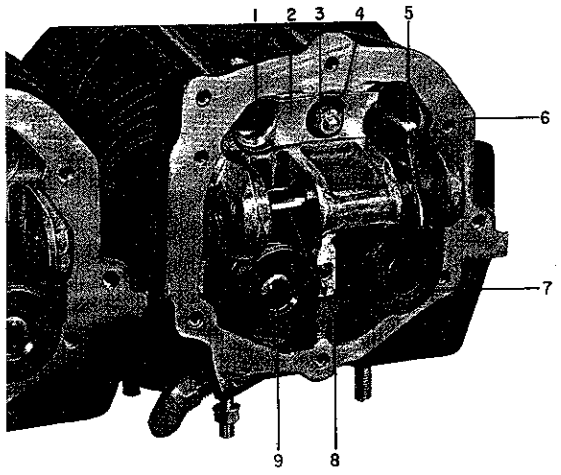
6-9. Deleted

6-10. CYLINDER ASSEMBLY (All models) Remove rocker box covers and gaskets. Rotate the crankshaft to place the piston of No. 1 cylinder at top center of the compression stroke. (With the piston in this position both valves will be closed and the piston exgended away from the crankcase to avoid damage when the cylinder is removed.)

6-11. PARALLEL VALVE CYLINDERS (Except-O-235, O-290-D, -D2) See figure 6-1. Remove the valve rocker shaft (8) and remove valve rockers (5) and valve stem cap from exhaust valve stem. Remove the push rod by grasping the end and pulling through the shroud tube (1). Remove the plain nut (4) lockplate (3) spring (2) and spacer. Pull the shroud tube (1) through the cylinder head and discard the shroud tube seals.

6-12. (O-235, O-290-D, -D2). See figure 6-3. Remove valve adjusting nuts (19) and screws (18). Note that the shroud tubes on these models cannot be removed until the cylinder is removed. Remove the valve rocker shafts (14) and valve rockers (13 or 17). Remove the push rods (12) from the shroud tubes.

6-13. ANGLE VALVE CYLINDERS. See figure 6-5 or 6-6. Remove rocker shaft covers (31) and gaskets. Push valve rockers shafts (20) outward to allow clearance for removal of valve rockers (22) and thrust washers (23). Remove valve stem cap (32). Do not attempt to remove valve rocker shafts until the cylinder is removed. Remove the push rods (13) by pulling through the shroud tube (18). Using shroud tube wrench (ST-142) turn each shroud tube 90° either way, this releases the detent on tube from spring. Remove the tubes by first releasing them from the seal seats in cylinder head and then withdrawing tubes from seal retainers in crankcase. Remove shroud tube seal sleeves (19) and seals (14) from end of shroud tubes; also remove seals from crankcase. Discard all seals. Place washer (15), springs (17) and sleeves (19) in the cleaning basket.



1. Shroud Tube
2. Shroud Tube Spring
3. Shroud Tube Lockplate
4. Plain Nut
5. Valve Rocker
6. Rocker Box
7. Valve Spring Seat
8. Valve Rocker Shaft
9. Valve Keys

Figure 6-1. Method of Securing Shroud Tubes Parallel Valve Cylinder (except O-235, O-290-D, -D2)

6-14. (All Models.) If cylinder base hold down nuts employ pal-nuts or are lockwired, remove. Neither pal-nuts nor lockwire are currently employed. Remove the cylinder base hold down nuts (and hold down plate where employed); then remove the cylinder by pulling straight away from the crankcase. As the cylinder is pulled away, catch and hold the piston to prevent it falling against the crankcase and being damaged. If the valve rocker shafts have not been previously removed, remove at this time. Discard cylinder base oil seal rings.

6-15. Pistons. Remove piston pin plugs from the piston. Using a piston pin puller (64843), pull pin from piston and remove piston.

CAUTION

After the removal of a cylinder and piston the connecting rod must be supported to prevent damage to the rod and crankcase. This is done by supporting each connecting rod with torque hold down plate ST-222, rubber band (discarded cylinder base on seal rings) looped around the cylinder base studs or using plates as shown in figure 6-2.

6-16. Removal of the other cylinders and pistons may be done in any desired order, but less turning of the crankshaft is involved if the cylinders are removed successively in the engine's firing order 1-3-2-4, 1-4-5-2-3-6 or 1-5-8-3-2-6-7-4.

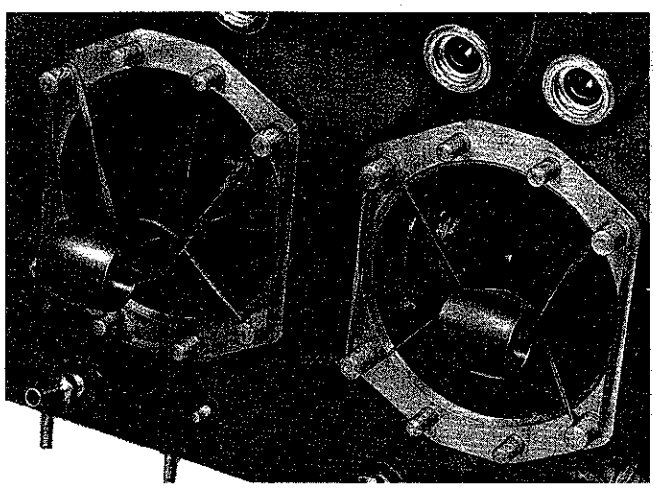
CAUTION

Do not use a magnet to remove the socket or plunger assembly from the engine as it could cause the ball to remain off its seat making the unit inoperative.

6-17. HYDRAULIC TAPPET PLUNGERS. (Where applicable) Using hydraulic tappet tool (64941), remove the push rod socket by placing heavy grease on ball end of "T", inserting the ball end in socket and withdrawing, the socket will adhere to the grease. Using the hollow end of the tool pushing it over the plunger and withdrawing the hydraulic tappet plunger. In the event the hydraulic tappet tool is not available, remove the push rod sockets with fingers or by using a pair of needle-nose pliers. (See figure 6-7.) Bend a right angle in one end of a piece of wire and insert this end into the space between the plunger assembly and the tappet body. Turn the wire 90° to engage a coil of the spring and draw out the hydraulic tappet plunger assembly as shown in figure 6-8.

CAUTION

It is imperative that the various parts of each tappet assembly be kept together during all overhaul operations, in order that all component parts may be reassembled with theri original mating parts and each completed assembly inserted in its original location in the crankcase.



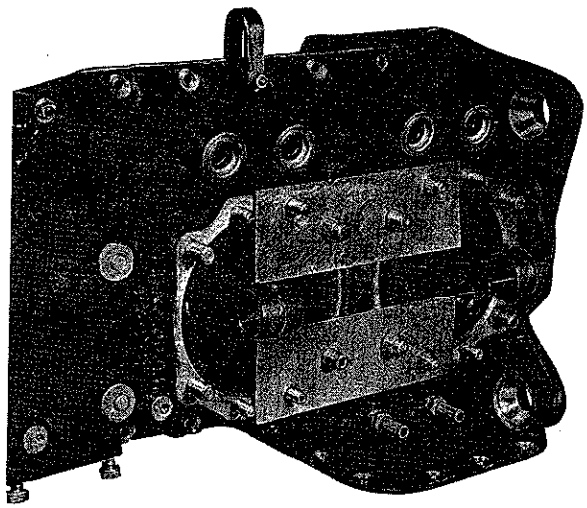
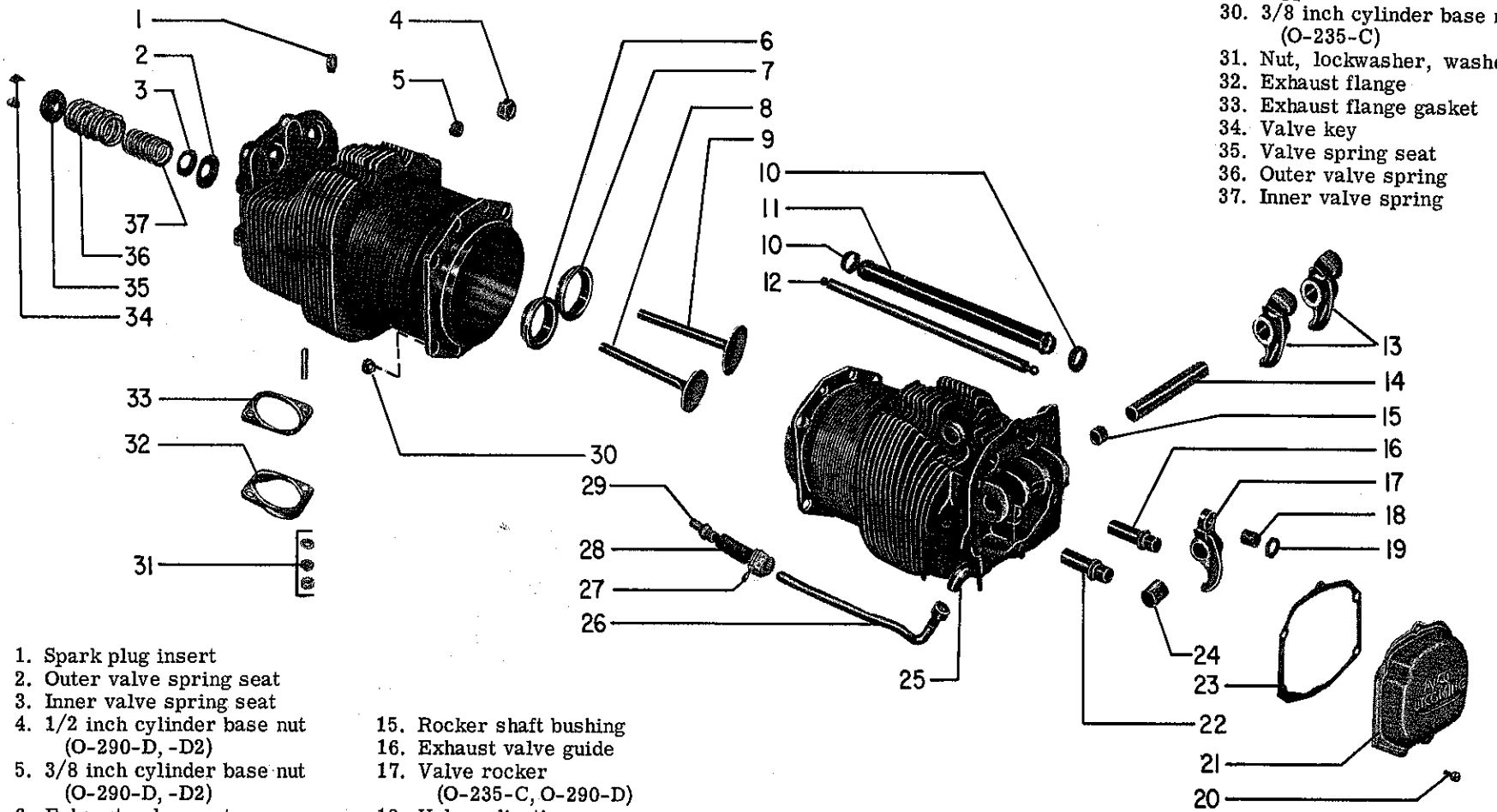
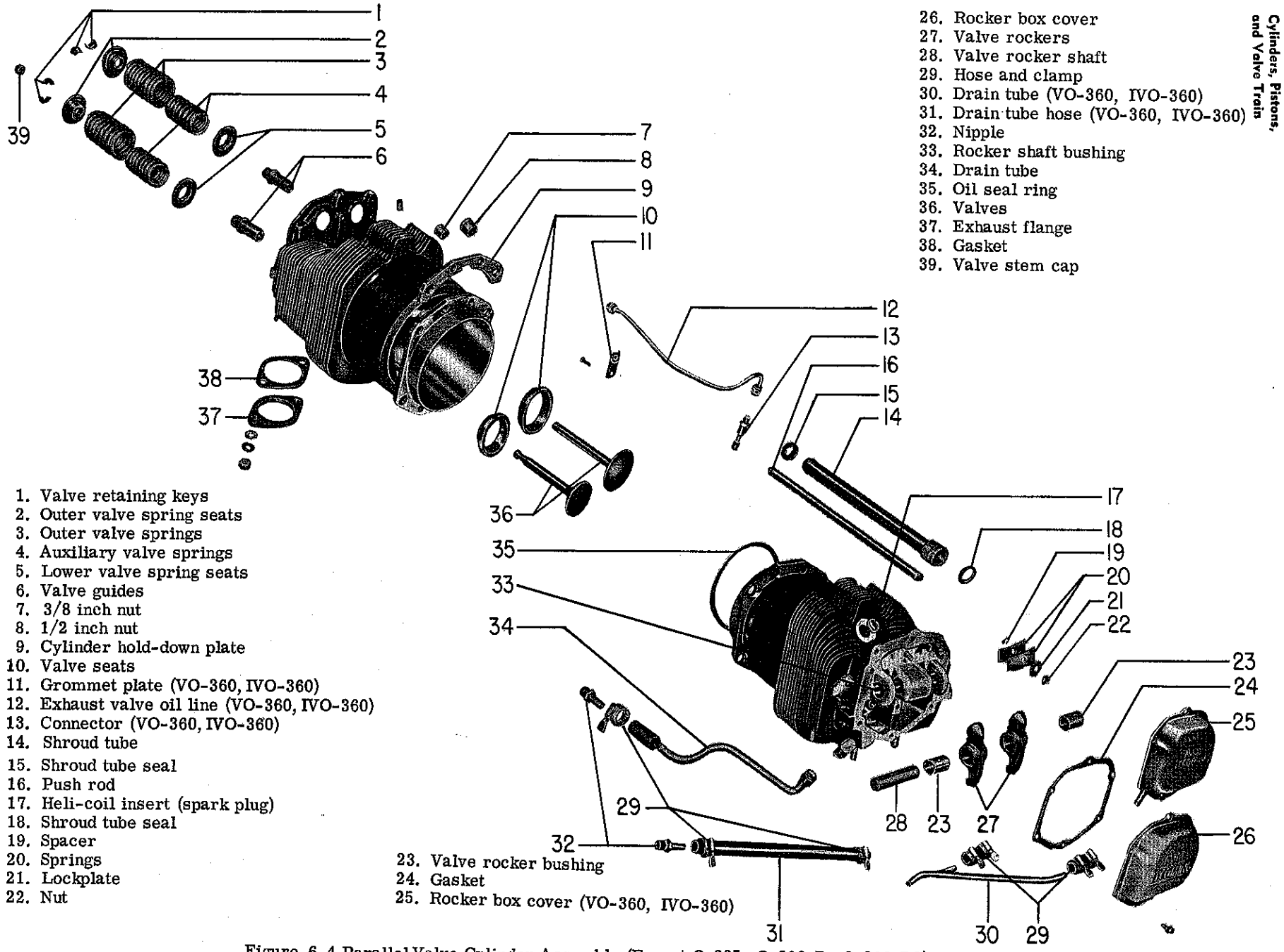


Figure 6-2. Two Methods of Supporting Connecting Rods



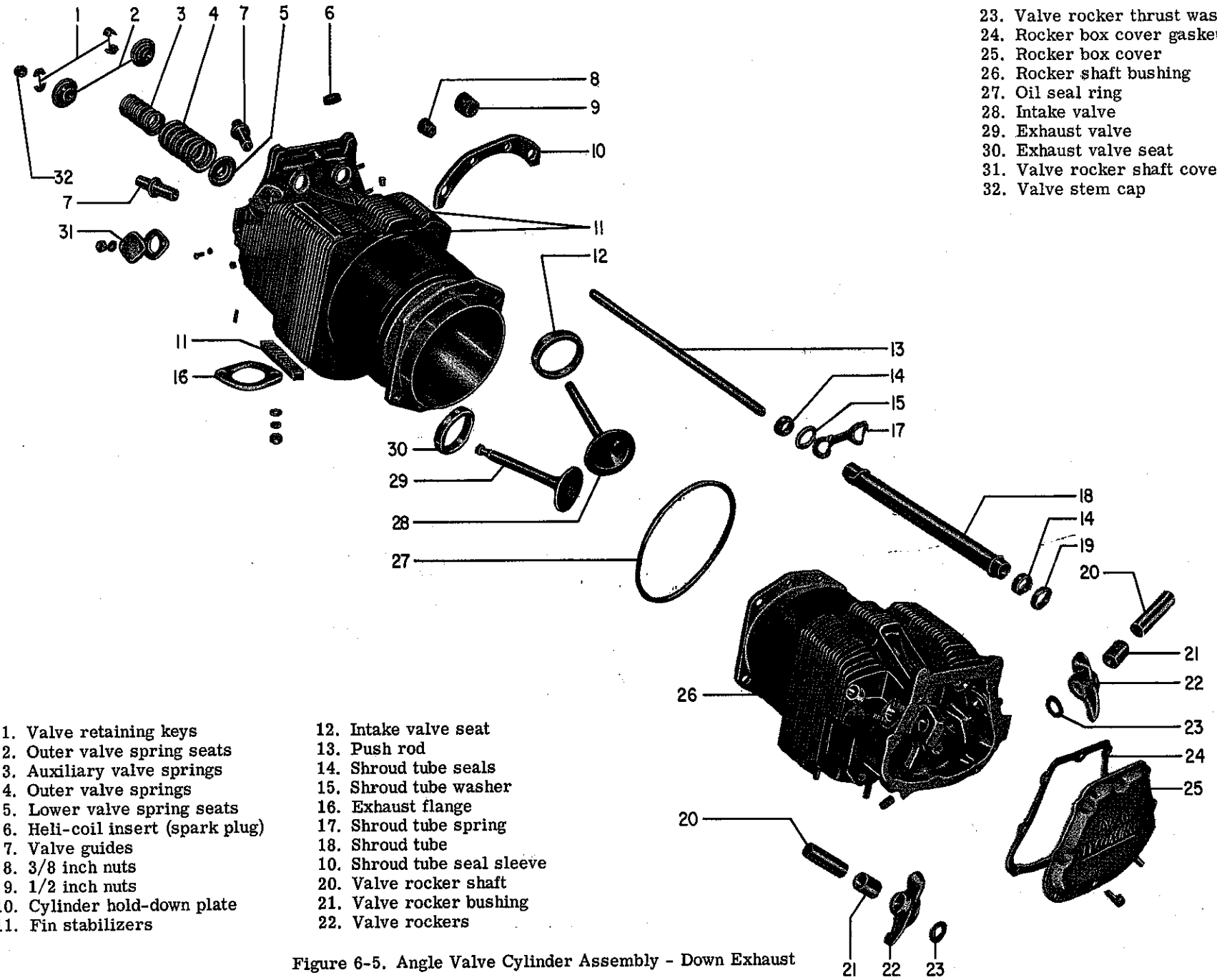
1. Spark plug insert
2. Outer valve spring seat
3. Inner valve spring seat
4. 1/2 inch cylinder base nut (O-290-D, -D2)
5. 3/8 inch cylinder base nut (O-290-D, -D2)
6. Exhaust valve seat
7. Intake valve seat
8. Exhaust valve
9. Intake valve
10. Shroud tube seal
11. Shroud tube
12. Push rod
13. Valve rockers (O-290-D2)
14. Valve rocker shaft
15. Rocker shaft bushing
16. Exhaust valve guide
17. Valve rocker (O-235-C, O-290-D)
18. Valve adjusting screw (O-235-C, O-290-D)
19. Nut (O-235-C, O-290-D)
20. Screw
21. Rocker box cover
22. Intake valve guide
23. Rocker box gasket
24. Valve rocker bushing
25. Elbow
26. Drain tube
27. Hose clamp
28. Hose
29. Nipple
30. 3/8 inch cylinder base nut (O-235-C)
31. Nut, lockwasher, washer
32. Exhaust flange
33. Exhaust flange gasket
34. Valve key
35. Valve spring seat
36. Outer valve spring
37. Inner valve spring

Figure 6-3. Parallel Valve Cylinder Assembly (O-235, O-290-D, -D2)



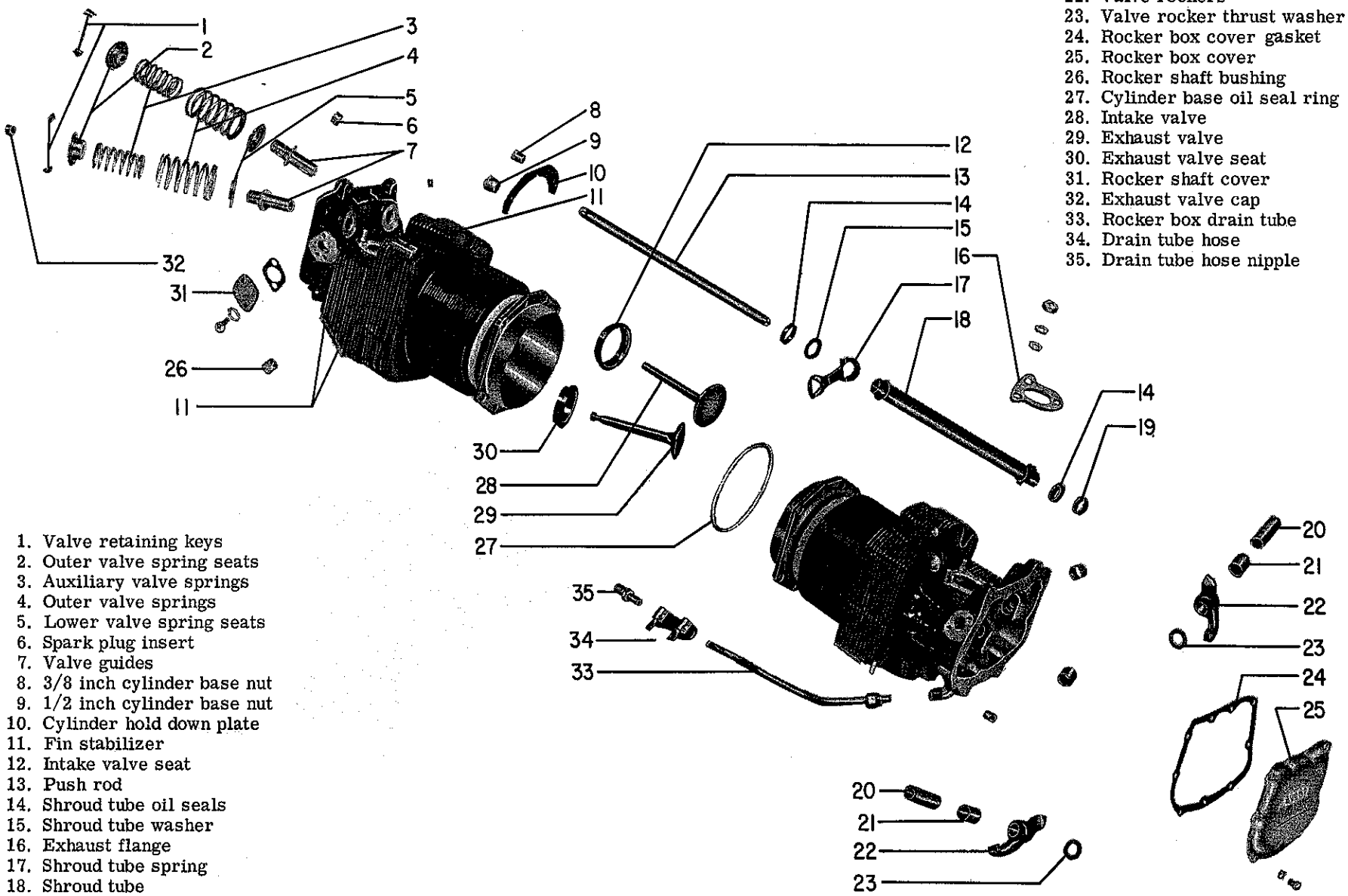
1. Valve retaining keys
2. Outer valve spring seats
3. Outer valve springs
4. Auxiliary valve springs
5. Lower valve spring seats
6. Valve guides
7. 3/8 inch nut
8. 1/2 inch nut
9. Cylinder hold-down plate
10. Valve seats
11. Grommet plate (VO-360, IVO-360)
12. Exhaust valve oil line (VO-360, IVO-360)
13. Connector (VO-360, IVO-360)
14. Shroud tube
15. Shroud tube seal
16. Push rod
17. Heli-coil insert (spark plug)
18. Shroud tube seal
19. Spacer
20. Springs
21. Lockplate
22. Nut
23. Valve rocker bushing
24. Gasket
25. Rocker box cover (VO-360, IVO-360)
26. Rocker box cover
27. Valve rockers
28. Valve rocker shaft
29. Hose and clamp
30. Drain tube (VO-360, IVO-360)
31. Drain tube hose (VO-360, IVO-360)
32. Nipple
33. Rocker shaft bushing
34. Drain tube
35. Oil seal ring
36. Valves
37. Exhaust flange
38. Gasket
39. Valve stem cap

Figure 6-4 Parallel Valve Cylinder Assembly (Except O-235, O-290-D, O-290-D2)



1. Valve retaining keys
2. Outer valve spring seats
3. Auxiliary valve springs
4. Outer valve springs
5. Lower valve spring seats
6. Heli-coil insert (spark plug)
7. Valve guides
8. 3/8 inch nuts
9. 1/2 inch nuts
10. Cylinder hold-down plate
11. Fin stabilizers
12. Intake valve seat
13. Push rod
14. Shroud tube seals
15. Shroud tube washer
16. Exhaust flange
17. Shroud tube spring
18. Shroud tube
10. Shroud tube seal sleeve
20. Valve rocker shaft
21. Valve rocker bushing
22. Valve rockers
23. Valve rocker thrust washer
24. Rocker box cover gasket
25. Rocker box cover
26. Rocker shaft bushing
27. Oil seal ring
28. Intake valve
29. Exhaust valve
30. Exhaust valve seat
31. Valve rocker shaft cover
32. Valve stem cap

Figure 6-5. Angle Valve Cylinder Assembly - Down Exhaust



1. Valve retaining keys
2. Outer valve spring seats
3. Auxiliary valve springs
4. Outer valve springs
5. Lower valve spring seats
6. Spark plug insert
7. Valve guides
8. 3/8 inch cylinder base nut
9. 1/2 inch cylinder base nut
10. Cylinder hold down plate
11. Fin stabilizer
12. Intake valve seat
13. Push rod
14. Shroud tube oil seals
15. Shroud tube washer
16. Exhaust flange
17. Shroud tube spring
18. Shroud tube
19. Shroud tube seal sleeve
20. Valve rocker shafts
21. Valve rocker bushing
22. Valve rockers
23. Valve rocker thrust washer
24. Rocker box cover gasket
25. Rocker box cover
26. Rocker shaft bushing
27. Cylinder base oil seal ring
28. Intake valve
29. Exhaust valve
30. Exhaust valve seat
31. Rocker shaft cover
32. Exhaust valve cap
33. Rocker box drain tube
34. Drain tube hose
35. Drain tube hose nipple

Figure 6-6. Angle Valve Cylinder Assembly (Up Exhaust)

DISASSEMBLY

6-18. CYLINDER. Place cylinder over the cylinder holding block (64526-1, or -2), assemble valve spring compressor (ST-25) on cylinder, and compress valve springs far enough to remove the valve retaining keys.

NOTE

If keys are stuck tight in spring seat, a light blow with a leather mallet on top of compressor will release keys.

6-19. Remove all valve spring seats and springs from rocker box, keeping parts for each valve separate. Hold valves by the stems to keep them from dropping out of the cylinder, and remove cylinder from holding block. Now reach inside of cylinder and remove valves. If difficulty is experienced in pulling the tops of the valve stems through the valve guides, push the valves back in position and clean the carbon from the stems.

CAUTION

Do not drive the valves through the guides.

6-20. Place each valve, with its springs, seats and keys in its proper compartment of the cleaning and inspection basket (64553). No further disassembly of the cylinder is necessary unless inspection warrants the replacement of valve guides, valve seats, or primer nipple.

6-21. PISTONS. Using the piston ring expander (64528 or 64713), remove the rings from all pistons. Remove the rings in order, starting with the top ring and working down. Be careful not to scratch or score piston when removing rings.

6-22. HYDRAULIC TAPPETS. (See figure 6-9.) Push spring end of hydraulic tappet plunger, turn approximately one-quarter turn in clockwise direction and pull it from the cylinder. Do not further disassemble any parts of tappet assembly.

Figure 6-7. Removing Push Rod Socket

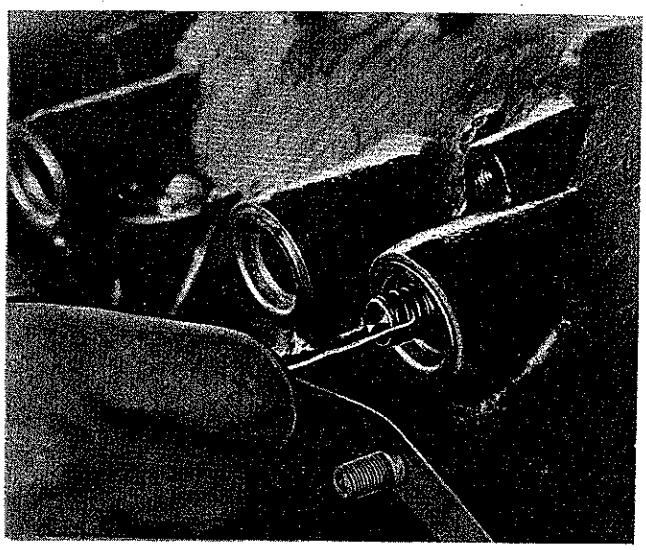


Figure 6-8. Removing Hydraulic Tappet Plunger Assembly

CAUTION

Keep plunger and cylinder of each assembly together. They are very closely and selectively fitted together during manufacture and are not interchangeable.

CLEANING

6-23. Clean all cylinder, piston and valve train parts in accordance with the general instructions described in Section III. Specific instructions follow:

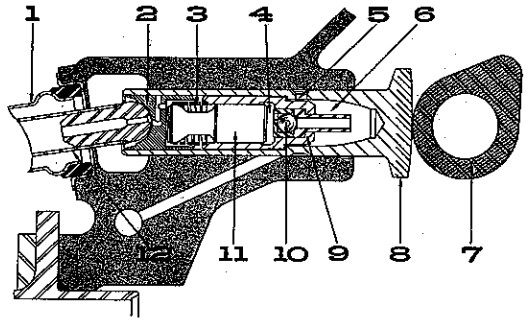
6-24. HYDRAULIC TAPPETS. Use the cleaning basket in order to keep the valve operating mechanism parts separate. Dip the basket, with all parts contained in their proper compartment, in petroleum solvent. Hold the ball check valve in each plunger cylinder off its seat by inserting a light copper wire or other relatively soft material through the tube on the cylinder and wash thoroughly so that any dirt particles that may be under the ball seat will be washed out. After washing the parts of each hydraulic tappet assembly, replace the parts in the proper compartment of the cleaning basket.

CAUTION

It is imperative that various parts of each tappet assembly be kept together during the overhaul operations, in order that all component parts may be reassembled with their original mating parts and each completed assembly inserted in its original location in the crankcase. In the event parts are intermixed, discard, and install new assemblies.

INSPECTION

6-25. Inspect all cylinder, piston and valve train parts in accordance with the general instructions described in Section III. Specific instructions will be found in the following paragraphs, possible revisions will be found later in the section.



1. Shroud Tube
2. Push rod socket
3. Plunger spring
4. Oil pressure chamber
5. Oil hole
6. Oil supply chamber
7. Camshaft
8. Tappet body
9. Cylinder
10. Ball check valve
11. Plunger
12. Push rod

Figure 6-9 Diagram of Hydraulic Tappet

6-26. CYLINDER HEAD (VISUAL INSPECTION). Examine the cylinder head thoroughly, checking for the following possible defects.

a. Loose, scored, pitted or otherwise damaged valve seats. (Mark for replacement.)

b. Loose or damaged studs. (Replace with 0.003, 0.007 or 0.012 oversize studs).

c. Loose or damaged spark plug heli-coil inserts. (Mark for replacement with oversize insert.)

d. Loose, cracked or scored valve guides. (Mark for replacement.)

e. Nicked, scored or dented mounting pads. (Intake and exhaust ports, rocker box covers.)

f. Cooling fins. The following standards shall prevail insofar as acceptance or rejection of cylinder heads are concerned.

1. Cracked fins.

(a) Fin adjacent to the exhaust port flange.

(1) Stop drilling, a 3/16 inch diameter hole through the end of the crack is permissible providing the end of the crack is at least 1/4 inch from the base of the metal.

(2) Fin removal to eliminate crack and reduce vibrating mass is permitted provided:

aa. Maximum removal is no more than one half the total fin width.

bb. Maximum removal is in accordance with figure 6-10.

cc. No burrs or sharp edges are permitted.

dd. Minimum fillet at the root of the removed portion of the fin is one quarter inch radius. Minimum corner at top of fin adjacent to the removed portion is one half inch radius.

(b) Fins other than the above may be accepted provided not more than one crack per fin and its depth is no closer than 1/4 inch from the base of the metal and a fin stabilizer is used to reduce vibration and further deepening of the crack.

2. Physically damaged, broken or bent fins.

(a) The blended area for any one fin shall not exceed 3/8 square inches, nor 3/8 inch in depth.

(b) No more than two blended areas on any one fin.

(c) No more than four blended fins on the push rod side of the head. No more than six blended fins on the anti-push rod side of the head.

(d) In addition to the above, it is recommended that a fluorescent penetrant inspection of the cylinder be made. Pay particular attention to the following areas.

(1) Between the 15th and 20th cylinder fin (counting from the top) on exhaust port side of cylinder.

(2) The area around the lower spark plug counterbore.

6-27. CYLINDER HEAD (DIMENSIONAL INSPECTION). Check the ID of each intake valve guide (it is recommended that exhaust valve guides be replaced at overhaul) with the flat plug rejection gage (ST-81). Check the diameter and out-of-roundness of the guide bore by checking with the gage at a minimum of two positions 90° apart. If the gage enters the guide at any of the positions tested, mark the guide for replacement. Check the ID of the rocker shaft bushings in the cylinder head, using the flat plug rejection gage (64613). Be sure to use the end of the gage marked "Cyl. Head". The opposite end, marked "Rocker Bushing" is 0.0015 inch larger in diameter by virtue of the greater wear limit allowed on the valve rocker bushing. As in the case of the valve guides, check for out-of-roundness by trying the gage at several different points on each diameter being checked.

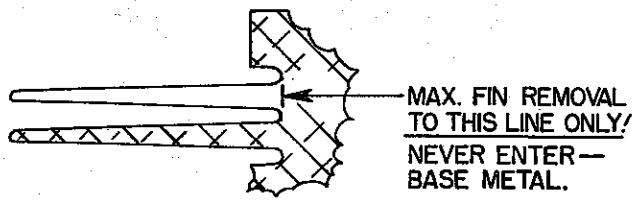


Figure 6-10. Maximum Fin Removal

6-28. CYLINDER BARREL (VISUAL INSPECTION). In addition to a thorough inspection of the cylinder barrel to ascertain its general condition, make the following specific checks:

a. Cooling Fins. It is recommended that notches or nicks be profiled with a hand grinder or file. A cracked cylinder barrel is cause for rejection of the cylinder.

b. Cylinder Skirt. Replace any cylinder having a bent, cracked or broken skirt.

c. Check mounting flange for cracks, nicks or warping.

d. Inspect interior of barrel for scoring or corrosion. Minor damage can be repaired by regrinding or honing; deep scoring or pitting, however, is cause for rejection of the cylinder.

e. Inspect interior of nitrided barrel for barrel glaze and a possible ring wear step at the point where the piston reverses travel at the top of the stroke. Repair of these items is fully described in service Instruction No. 1047.

6-29. CYLINDER BARREL (DIMENSIONAL INSPECTION). Dimensional inspection of the barrel consists of the following measurements (the numbers in parenthesis refer to the applicable reference numbers in the Table of Limits):

a. Fit between piston skirt and cylinder (519).

b. Maximum taper of cylinder walls (520).

c. Maximum out-of-roundness (521).

d. Bore diameter (522).

NOTE

All measurements involving cylinder barrel diameters must be taken at a minimum of two positions 90° apart in the particular plane being measured. All measurements of nitrided barrels must be made in the straight portion below the starting point of the choke, or at least two inches below the top of the barrel.

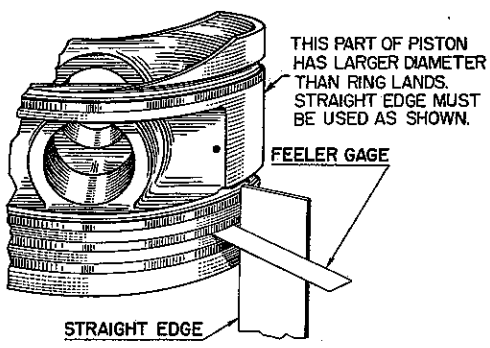


Figure 6-11. Method of Checking Piston Ring Side Clearance

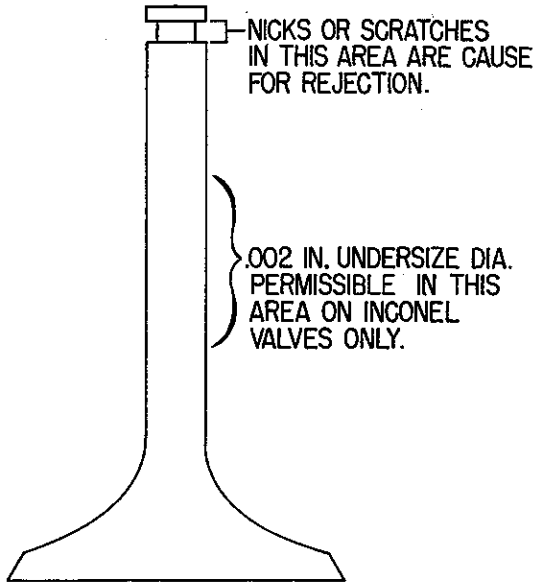


Figure 6-12. Area to Inspect Valve Stems

6-30. CYLINDER HOLD DOWN PLATE. The cylinder hold down plate must be flat within 0.003 inch when clamped with five pound pressure to a perfectly flat surface. If the plate is distorted or warped more than 0.003 inch, it must be replaced.

6-31. PISTON (VISUAL INSPECTION). Examine the top of the piston for excessive pitting, cavaties or surface distortion. The latter may be evidence of detonation, particularly if the piston has been in service for a relatively short time. Other critical points which must receive thorough visual examination are the piston ring lands and grooves, piston pin holes, and piston pin holes bosses.

6-32. PISTON (DIMENSIONAL INSPECTION). Make the following dimensional checks on each piston (the numbers in parenthesis refer to the applicable reference numbers in the Table of Limits.

a. Side clearance between piston ring and piston (514, 515, 516 and 517). Pistons for Avco Lycoming opposed engines are ground with a slight taper from the skirt to the head, with the exception of the lands between the top compression and oil control rings, which are ground parallel. The clearance on wedge type compression rings therefore, must be measured as shown in figure 6-11 in order to obtain a true check of the side clearance.

b. Inside diameter of piston pin hole (512).

c. Clearance between piston skirt and cylinder and piston diameter at top and bottom (519).

6-33. PISTON PIN AND PISTON PIN PLUGS. Check OD of piston pin against ID of hole in piston (reference 512, Table of Limits). Measure fit between piston and plugs and check OD of plugs (reference 513, Table of Limits). Examine interior surfaces of piston pin for corrosion or pitting.

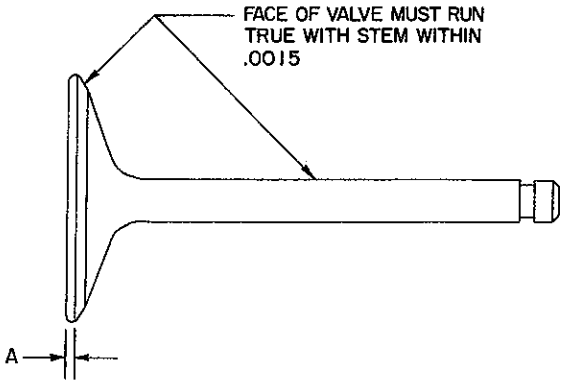


Figure 6-13. Valve Showing Locations for Checking Run-Out and Section for Measuring Edge Thickness

6-34. VALVE ROCKERS. Damaged, badly worn, pitted or scored tips and push rod sockets warrant replacement of the rocker. Check the ID of the rocker bushing at several different positions with a flat plug rejection gage (64613). This is a double-end gage; be sure to use the end marked "Rocker Bushing". If the gage enters the bushing at any point, mark the bushing for replacement.

6-35. PUSH RODS. Inspect push rods for wear or looseness of ball ends. If ball ends are loose, replace the rod. Rod must be straight within .010 inch.

6-36. VALVES. Remove the valves from the cylinder and clean to remove soft carbon and examine visually for physical damage, damage due to burning or corrosion. Valves that indicate damage of this nature must not be released.

NOTE

Exhaust valves (except Inconel exhaust valves) should never be reused. Inconel exhaust valves may be reused if they comply with requirements of the following inspection.

6-37. Do not reuse valve in which stem diameter midway of valve measures less than that measured at the key end; excepting inconel valves which may be 0.002 inch undersize on stem diameter as shown in figure 6-12.

6-38. Check runout of valve face. See figure 6-13. Total runout must not exceed .0015 inch. Do not reuse any valves that exceed this limit.

6-39. Measure edge thickness of intake valve heads. See figure 6-13. If, after refacing, "A" is less than the limit shown in Table VI-I, the valve must not be resued.

NOTE

The edge of intake valve heads are generally formed as shown in figure 6-14. The thickness "A" can best be measured with an optical comparator; however, it can be measured with sufficient accuracy by means of a dial indicator and a surface plate, as shown in figure 6-15.

6-40. Using an optical magnifier, examing the valve in the stem area and the tip for evidence of cracks, nicks, tool marks, or other indications of damage. Damage of this nature seriously weakens the valve, making it liable to failure. Any valve having a nick, with ragged edges more than 1/16 inch in length should not be reused. A nick or tool mark of any sort in the keeper groove of an exhaust valve is sufficient reason for not reusing the valve. See figure 6-12.

6-41. If superficial nicks and scratches in the valve indicate that the valve might be cracked, it should be inspected by a magnetic particle or dye penetrant method. Dye penetrant procedures should be carried out strictly within the recommendations of the manufacturer of the penetrant.

TABLE VI-I

Intake Valve Part No.	Min. Permissible Edge Thickness	Engine Series
60037 66429 LW-11901	.040 inch	O-235, O-290-D O-435-A
67905	.050 inch	O-290-D2, O-320, O-360, IO-360, VO-360, O-540
73938	.060 inch	O-290-D2, O-320, AIO-320, IO-320, LIO-320, O-340, O-360, IO-360, HO-360, HIO-360, IVO-360, VO-360, O-540, IO-540, TIO-540
73129 LW-13622	.075 inch	IO-360, LIO-360, AIO-360, IO-540, TIO-540, LTIO-540,
67518 71953 72612 73117 73876	.085 inch	IO-360, HIO-360, TIO-360, IO-540, IO-720

6-42. Critical areas include the face and tip both of which should be examined for pitting and excessive wear. Minor pitting on valve faces can sometimes be removed by regrinding; otherwise the valve should be rejected. Replace any valve that has operated with a collapsed hydraulic tappet, regardless of the number

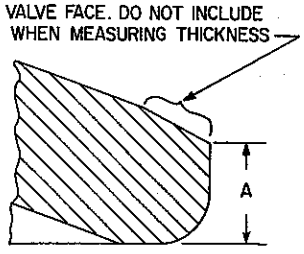


Figure 6-14. Section Through Edge of Valve

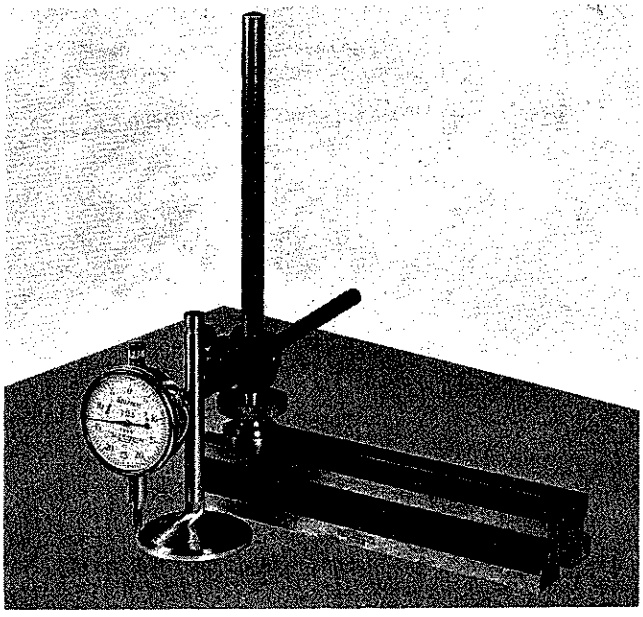


Figure 6-15. Method of Checking Valve Edge Thickness with Dial Indicator

of hours on the valve. (See inspection of hydraulic tappets.) Check the clearance between the valve stem and guide (reference 528, Table of Limits for exhaust valves, and reference 529 for intake valves).

6-43. HYDRAULIC TAPPET BODIES. If for any reason a new camshaft is to be installed in the engine, or the cam lobes are conditioned by regrinding, all of the tappet bodies must be discarded and replaced with new tappet bodies.

6-44. Check the tappet bodies for identification. Those bodies with no identification marks as shown in figure 6-16 must be discarded.

6-45. Check the face of the tappet body for signs of spalling or pitting (figure 6-17). Any face which shows this condition is cause for rejection, and the tappet body must be replaced with a new tappet body. It is recommended that a magnifying glass (min., 10 power) be used for this purpose.

6-46. When a tappet body is rejected because of spalling, a visual inspection of the nose of the cam lobe with a magnifying glass (min. 10 power) must be made.

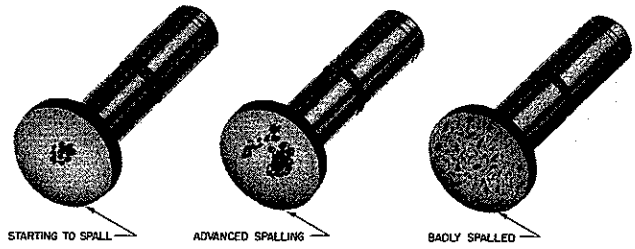


Figure 6-17. Appearance of Spalling Marks on Face of Hydraulic Tappet Bodies

Any indication of distress, surface irregularity or feathering at the edge of the lobe is cause for rejection of the camshaft.

NOTE

Each tappet face will have one or two Rockwell marks (figure 6-18) which is not cause for rejection, and this is not to be confused with a spalled or pitted condition as shown in figure 6-17.

6-47. Circular wear patterns on the face of the tappet body are also cause for rejection of the part. Each face may have circular discoloration due to rotation of the body which is not cause for rejection, however, if the surface has a wavy appearance the part should be rejected (figure 6-19).

6-48. Examine the interior of the bore in the tappet body using a small flashlight to illuminate the interior surfaces. If any appreciable amount of wear has occured at the interior shoulder (which serves as a seat for the plunger assembly) a feather or chipped edge will be visable around the shoulder (figure 6-20). The existence of this feather or chipped edge is cause for rejection of the entire tappet assembly.

6-49. Test the tappet body for structural failure through the use of the magnetic particle method. This requires a machine (which uses 440 line volts), a copper adapter and a holding fixture ST-387. The tappet bodies are inspected in the following manner:

a. Clean the edge of the face with medium grade sandpaper and any Ferrox coating (figure 6-22).

b. Place the tappet body in the holding fixture with the adapter inserted in the body.

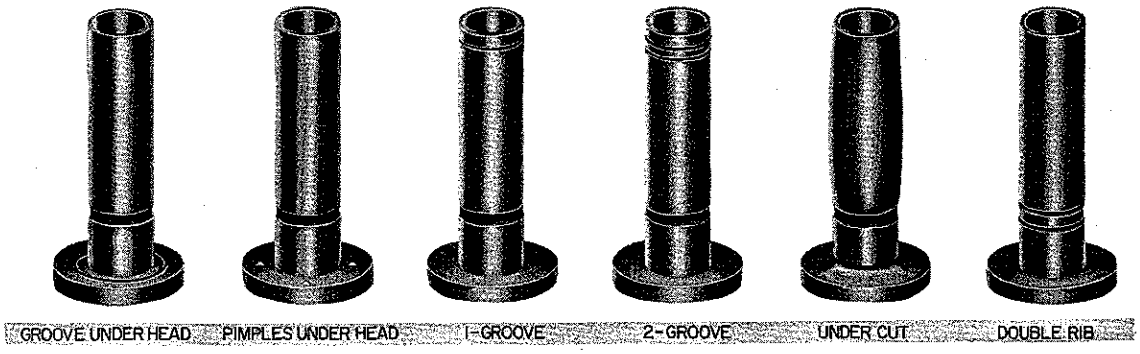


Figure 6-16. Identification of Hydraulic Tappet Bodies

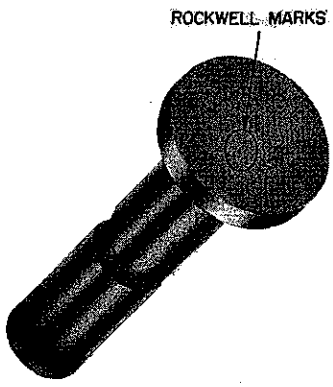


Figure 6-18. Rockwell Marks

c. Tighten to hold the assembly securely in the fixture.

d. Pass a current of 500 amps through the tappet body for 1/2 to 3/4 of a second while the solution is running over tappet body. Seams and cracks will be coated black and can be easily identified.

CAUTION

When it has been determined that a tappet body is serviceable, it must be installed in the same position from which it was removed. No attempt should be made to salvage rejected or marginal parts. Under no circumstances should the face of the tappet body be touched with abrasives as such a practice will result in early failure.

6-50. HYDRAULIC PLUNGER ASSEMBLY. Various hydraulic plunger assemblies are used in subject engines. (Consult Service Instruction No. 1011). These assemblies are differentiated by the leakdown rate. At disassembly of the engine check the P/N on the hydraulic plunger assembly. Hydraulic plunger assemblies must be used in sets and it is not permissible to mix assemblies in the same engine. It is recommended the following procedure be followed at overhaul:

CAUTION

All parts of each hydraulic plunger assembly are selectively fitted and these parts are not interchangeable. It is imperative that mating parts be kept together and not with other assemblies. If any doubt exists as to whether the parts have become mixed, install new hydraulic plunger assemblies.

6-51. As the hydraulic plunger assemblies are removed from the engine, check for chipping of the seating shoulder (figure 6-23).

6-52. Line the hydraulic plunger assemblies side by side on a flat surface and lay a straight edge across the shoulder surface (figure 6-24). Any plunger assembly that is more than 1/32 inch below the straight edge is "collapsed" and must be rejected.

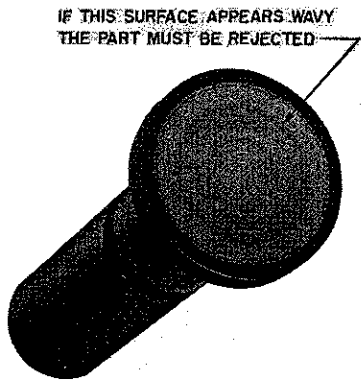


Figure 6-19. Circular Wear Pattern on Face of Hydraulic Tappet Body

6-53. Make a visual inspection of the body of the plunger assembly for cracks.

CAUTION

Although the tappet body may be submitted to the magnetic particle method, at no time is it permissible to submit any part of the hydrualic plunger assembly to this method.

6-54. The hydraulic plunger assembly may now be cleaned with clean solvent and then backflushed with clean solvent.

6-55. Check the plunger assembly for a leaking check valve in the following manner:

a. Dip the plunger in light machine or engine oil. (Extra fast leakdown only. All other plunger assemblies must be checked dry.)

b. Hold the hydraulic cylinder between the thumb and middle finger in a vertical position with one hand; then place the plunger in position so that it just enters the cylinder (figure 6-25).

c. Depress the plunger quickly with the index finger and if the plunger bounces back, the unit may be considered satisfactory.

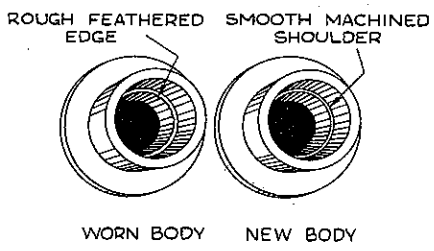


Figure 6-20. Appearance of Interior Shoulder in New and Worn Tappet Bodies

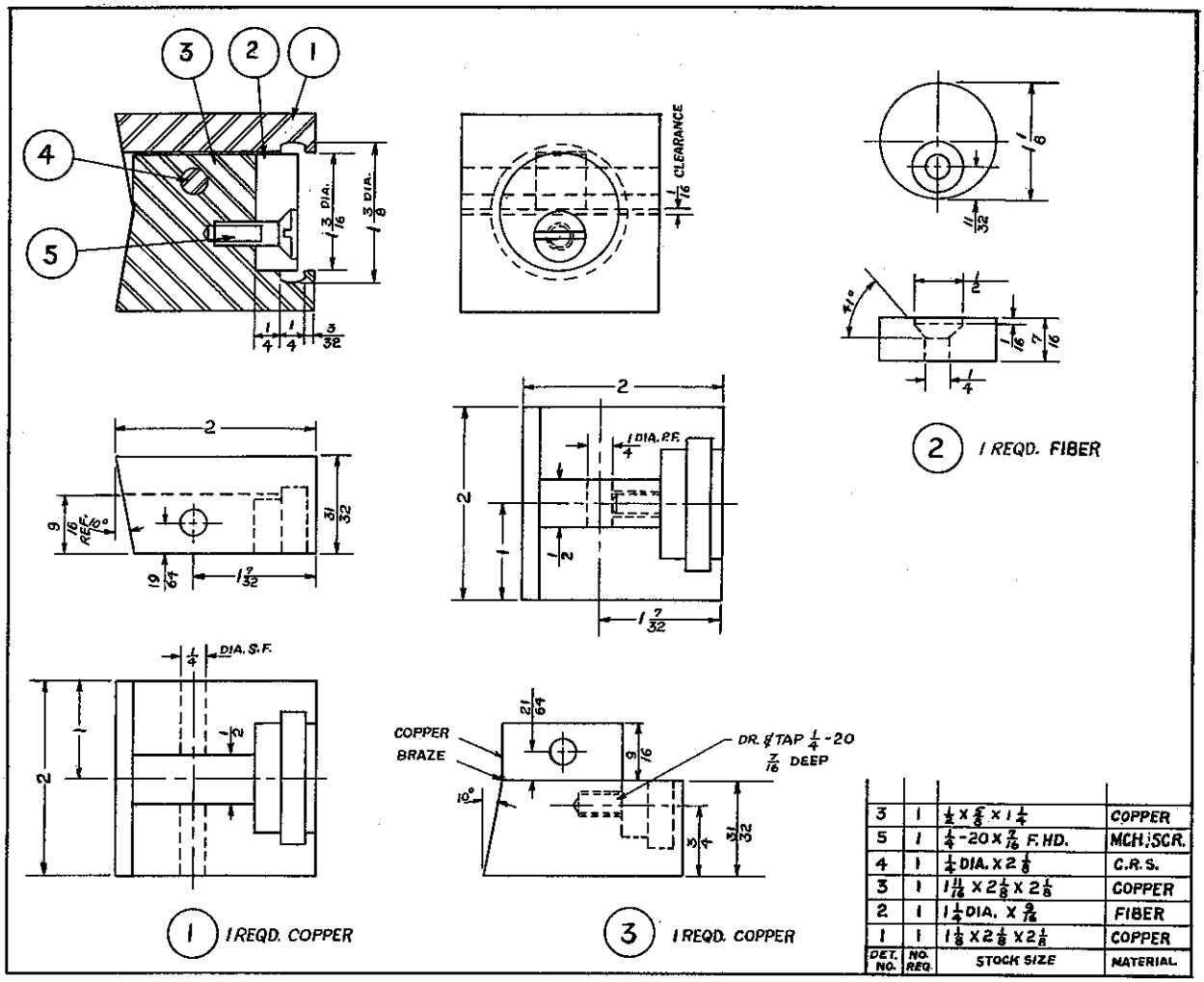


Figure 6-21. Dimensions for Making Holding Fixture

d. When the plunger does not bounce back but remains collapsed, it is an indication that the ball check valve is not seating properly. When this condition exists, the hydraulic plunger assembly is defective and must be replaced.

NOTE

When an intake or exhaust valve hydraulic plunger assembly has proven to be defective, the valve itself must be replaced as well as the hydraulic plunger assembly.

6-56. To assemble the unit, unseat the ball by inserting a thin clean bronze wire through the oil inlet hole. With the ball off its seat, insert the plunger and twist clockwise so that the spring catches.

6-57. DETECTION OF MAGNETIZED HYDRAULIC PLUNGER ASSEMBLIES. If the parts of ths plunger assembly become magnetized the plunger may remain in a collapsed position. Check the parts for magnetization with a compass or small iron wire. In the event that any of the parts are magnetized, the plunger assembly must be replaced.

6-58. VALVE SPRINGS. Check the condition of all valve springs on a suitable spring tester, using the loads and deflections as given in references 800 and 801, Table of Limits.

MODIFICATIONS

6-59. Several modifications have been made to various installations of the subject engines. It is suggested that the following publications be consulted to ascertain whether or not your particular installation has been affected. Avco Lycoming Service Bulletin No. 253 and 273. Avco Lycoming Service Instruction No. 1035, 1073, 1123, 1135, 1136, 1262, 1280 and 1302.

REPAIR AND REPLACEMENT

6-60. General instructions for the repair of cylinder, piston and valve train parts will be found in Section III. Specific Instructions follow.

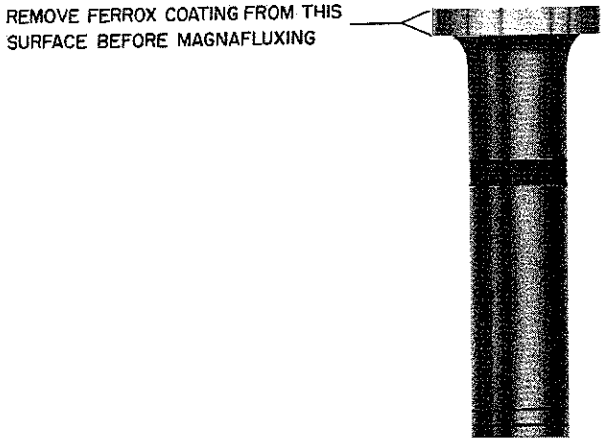


Figure 6-22. Surface to be Cleaned of Ferrox Coating

6-61. SPARK PLUG THREAD INSERT. Spark plug thread inserts which were rejected during inspection are removed and replaced as described in the following paragraphs.

6-62. Insert the extracting tool (64595) in the spark plug hole so that the edges of the tool cut into the top thread of the insert. Rotate the tool in a counter-clockwise direction, unscrewing the insert from the hole.

6-63. A new insert may be installed by use of the inserting tool (64594). Withdraw the mandrel part of the tool beyond the recessed section of its sleeve. The insert may then be assembled into the recess and the mandrel advanced to engage its slotted end with the tang of the insert. Rotate the mandrel clockwise and press forward slightly; this will engage the insert in threaded end of sleeve. Continue to rotate the mandrel while holding the sleeve thus securing the insert firmly on the inserting tool. The insert may then be wound through the threaded portion of the sleeve within one half turn from the end of the coil.

6-64. The adjustable brass screw on the sleeve tends to act as a brake, preventing the insert from unwinding. It is important that the insert be kept tight on the mandrel to facilitate its assembly in the threads of the cylinder head. The insert should be wound so that the adjacent turns of the insert are in contact with each other. This will eliminate the possibility of crossed threads.

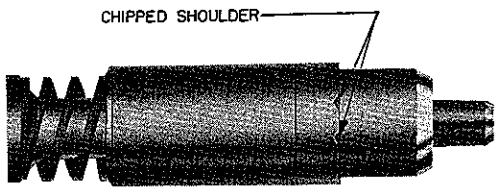


Figure 6-23. Chipped Shoulder

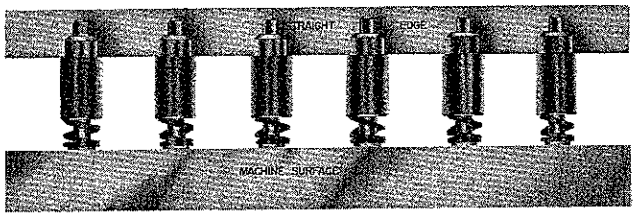


Figure 6-24. Checking Plunger Assembly

NOTE

When inspection reveals the necessity of replacing a spark plug heli-coil insert, it must be replaced with a .010 inch oversize insert. A .010 inch bottoming tap (64596-1) is available.

6-65. When screwing the insert into the hole in the cylinder head, be sure that the first coil picks up the first thread. As the tool is turned, the insert will advance into the hole. When the face of the sleeve is approximately 1/16 inch from the face of the boss, the inserting tool should be held tightly by the handle and the sleeve rotated counter-clockwise with the other hand, freeing the left half-turn of the insert. By sliding the sleeve toward the top of the mandrel, the end of the insert can be seen projecting above the boss. The mandrel should then be rotated in a clockwise direction until the insert disappears from sight. When this position is reached, the turning action should be stopped and the tool withdrawn. The top of the insert will be approximately one half turn from the face of the boss. However, if it is not, the tool should be reassembled and the insert turned until it is about one half turn from the face of the boss.

6-66. The tang of the insert can be broken off with needle-nose pliers at the location of the notch. Then

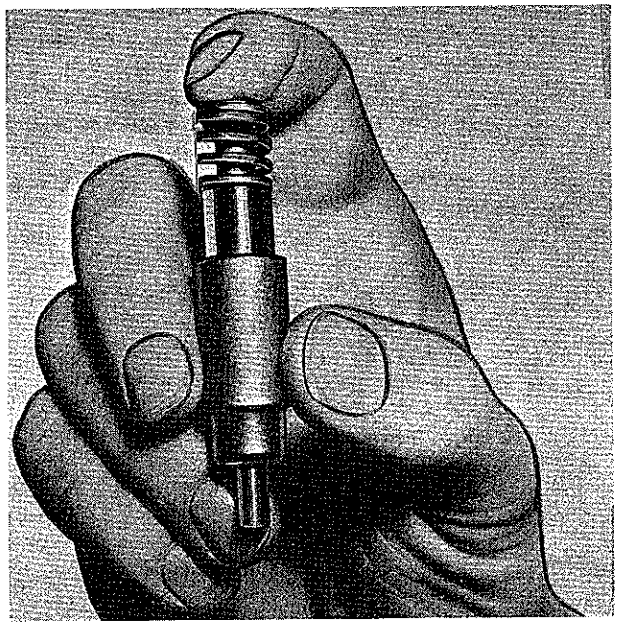


Figure 6-25. Checking Hydraulic Plunger Assembly for Leaks

using the expanding tool (64593), secure the insert firmly in the spark plug holes. The limit of expansion can be kept within the thread gage limits by fixing the stop nut on the expanding tool at the correct position. After expanding the insert, it may be staked by assembling the staking sleeve over the mandrel until the sleeve meets the boss. A slight blow on the top of the sleeve will impress a slight chamfered edge around the periphery of the tapped hole. The staking sleeve may then be removed and adjusting screw released, and the expanding mandrel removed from the insert.

6-67. GRINDING VALVE SEATS. See figure 6-26. The ID of the valve guide is used as a piloting surface for all valve seat reconditioning operations. Grind valve seats, using suitable grinding equipment, to 30° angle on intake valve seats and 45° angle on exhaust valve seats. Grind to the dimensions called out in figure 6-26. Proceed in the following manner.

6-68. On intake valve seats, use a 15° grinding wheel to grind the top surfaces of the valve seat to produce the outer face diameter (dimension "A"). Bring the face of the intake valve seats to the specified width (dimension "C") by narrowing the throat with a 75° wheel.

6-69. On exhaust valve seats, use a 15° grinding wheel to grind the top surface of the valve seats to produce the outer face diameter (dimension "B"). The width of the exhaust valve seats should not conform to dimension "D".

6-70. If seat wear has progressed to the extent that the entire face of the 15° narrowing wheel must be brought into contact with the seat in order to achieve the specified diameter, the seat must be replaced. (See figure 6-27).

6-71. VALVE SEAT REMOVAL AND REPLACEMENT. Valve seats that are loose, damaged or worn to the extent that they cannot be reground to the dimensions shown in figure 6-26 must be replaced.

NOTE

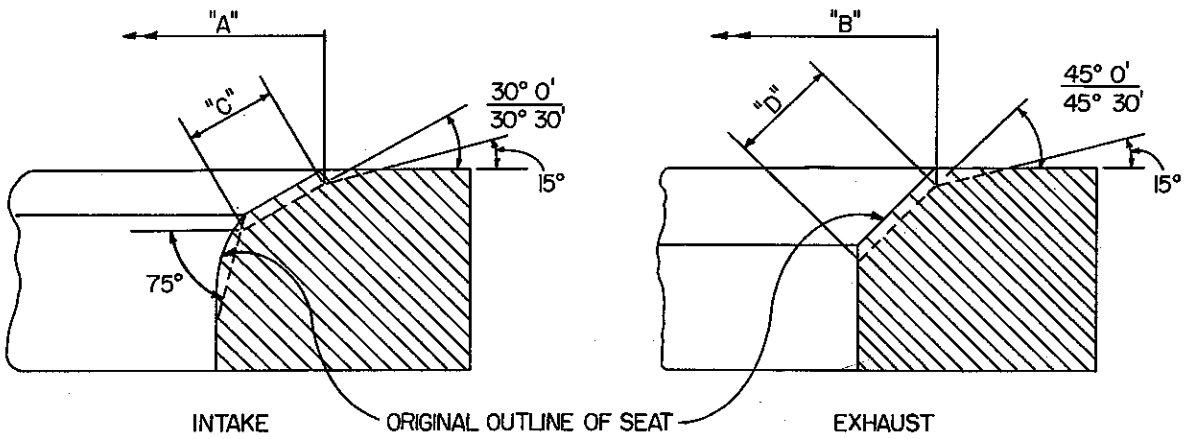
When it is necessary to replace intake or exhaust valve seats, the recess in the cylinder head must be cut .010, .020 or .030 oversize and the corresponding oversize seat installed.

6-72. VALVE SEATS. The "Flat" type seat employed on some earlier series engines differs from the "Allison" type seat employed on all current subject engines. See figure 6-28 for sectional views of both seats. These seats are not interchangeable.

6-73. Place the applicable valve seat replacement fixture on a suitable surface and fasten securely. Fabricate a removal tool in accordance with the materials and dimensions shown in figure 6-29.

6-74. Heat cylinder to a temperature of 600°F. and secure to fixture. Soak the sponge of the removal tool in cold water. Insert the tool down through the valve seat, the seat will shrink and cling to the sponge. Withdraw the tool being careful not to cock the seat. This entire procedure should be performed as swiftly as possible after removing the cylinder from the heat.

6-75. Measure the ID of the valve seat recess in the cylinder head. Compare the measurement with the original manufactured diameter of the recess (see Table of Limits) and determine which oversize seat is to be installed.



MODEL	"A" (INTAKE)	"B" (EXHAUST)	"C" (INTAKE)	"D" (EXHAUST)
All parallel valve head cylinder assemblies except O-235-C, O-290-D, O-435-A	2.145/2.155	1.740/1.750	.076/.117	.058/.077
O-235-C	1.965/1.975	1.722/1.732	.032/.067	.091/.106
O-290-D, O-435-A	2.013/2.023	1.740/1.750	.076/.117	.058/.077
All angle valve head cylinder assemblies	2.334/2.344	1.816/1.826	.074/.093	.091/.106

Figure 6-26. Valve Seat Dimensions for Reconditioning

TABLE VI-II

VALVE SEAT REPLACEMENT TOOLS

VALVE SEAT RECESS CUTTER

ID Valve Seat Hole in Cylinder Head	Part No.
2.280-2.281	ST-51-1, -2, -3
1.733-1.735	ST-52-1, -2, -3
2.073-2.075	ST-53-1, -2, -3
1.926-1.928	ST-54-1, -2, -3
1.918-1.920	ST-56-1, -2, -3
2.087-2.089	ST-57-1, -2, -3
1.994-1.996	ST-58-1, -2, -3

-1 Indicates .010 inch oversize
-2 Indicates .020 inch oversize
-3 Indicates .030 inch oversize

VALVE SEAT RECESS CUTTER PILOT

ID Valve Guide Hole in Cylinder Head	Part No.
.5913-.5923	ST-66, -1, -2, -3, -5
.6613-.6623	ST-67, -1, -2, -3, -5
.6247-.6257	ST-68, -1, -2, -3, -5

ST-66 is standard
-1 Indicates .010 inch oversize
-2 Indicates .020 inch oversize

ST-66 is standard
-3 Indicates .030 inch oversize
-5 Indicates .005 inch oversize

VALVE SEAT REPLACEMENT DRIFT

ID of Valve Seat	Part No.
1.870-2.060	ST-64
1.474-1.730	ST-65

VALVE SEAT REPLACEMENT FIXTURE

	Part No.
Parallel Valve Cylinder Heads	64520
Angle Valve Cylinder Heads	64696

VALVE SEAT RECESS CUTTER DRIVER

	Part No.
Used with all ST-series cutters	ST-62
Hand drive adapter	ST-63

6-76. Refer to Table VI-II and select the proper cutter and pilot. Install the pilot in the cutter, tighten and install cutter in special drive. Install on drill press and proceed to cut the recess in the cylinder heat to proper size. Note that the pilot engages the ID of the valve guide hole in the cylinder head. Remove no more metal from the bottom of the recess than is necessary to clean up the major diameter.

6-77. In the event the seats are to be cut by hand, install the hand drive adapter over the special drive and using a "T" handle proceed to cut the recesses as described in the proceding paragraph.

6-78. Heat cylinder to 600° to 650° F. (315° to 343° C.) and secure to applicable replacement fixture. Place new seat on replacement drift (refer to Table VI-II for correct drift) and drive seat into the recess in the cylinder head by tapping end of drift with hammer.

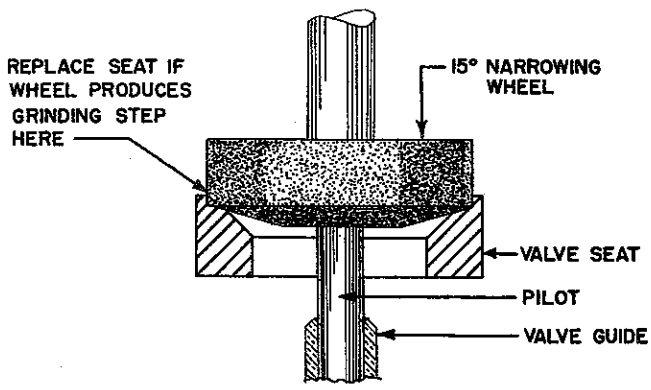


Figure 6-27. Rejection of Valve Seat

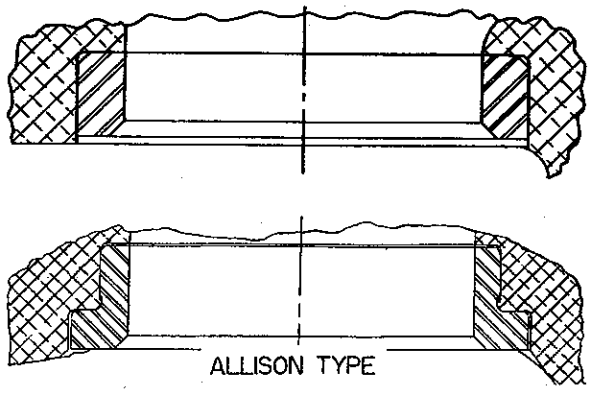


Figure 6-29. Difference Between "Flat" and "Allison" Type Valve Seat

6-79. Proceed to grind the faces of the newly installed valve seats as described in paragraphs 6-67 through 6-69.

NOTE

Whenever a new valve seat is installed, it is required that its matching valve guide be replaced. This will assure concentric grinding of the new seat.

6-80. VALVE REFACING. Place valve in a suitable valve refacing machine (Snap-On VR-300) or equivalent. Set refacer to 30° for intake valves and 45° for exhaust valves. Using a soft #80 grit wheel, remove no more metal than is necessary to clean up pits in the valve face or to correct any apparent warping condition. Round off with a hand stone any sharp or burred edges left around the valve face after refacing; this is best accomplished while valve is turning in the refacing machine.

6-81. VALVE GUIDE REPLACEMENT. Damaged or worn valve guides are removed and new guides installed in accordance with the procedures described in the following paragraphs.

6-82. VALVE GUIDE REMOVAL. Screw the nut of valve guide puller (ST-49) to the head of bolt (3/4-16). Place the retainer over valve guide inside of rocker box. Insert the bolt (3/4-16) into the retainer and valve guide. From cylinder barrel end insert the bolt (3/8-24) into the end of the 3/4 inch bolt. Tighten the 3/8 bolt until snug against the valve guide. Turn the nut in rocker box in a clockwise direction until valve guide is out of cylinder head.

6-83. VALVE GUIDE SELECTION. Check each valve guide hole in the cylinder head with the applicable valve guide hole plug gage. (See Table VI-III). Determine if the same size guide may be used or whether the next oversize guide is required.

6-84. VALVE GUIDE INSTALLATION. Mount the applicable valve guide replacement fixture (See Table VI-III) on a drill press table. Fasten cylinder securely in place on the fixture and set the fixture to the proper angle for the guide being installed. (11° 45 minutes for intake valve, 12° 40 minutes for exhaust valve).

6-85. If it has been determined that the next oversize guide is required, select the appropriate reamer (See Table VI-III) and proceed as follows. Mount the reamer in the drill press spindle and ream the valve guide hole in the cylinder head. Check the reamed hole with the corresponding gage (See Table VI-III).

6-86. Heat the cylinder to 350°F. -400°F. for a minimum of one hour. Place the new guide on the appropriate valve guide installation drift (See Table VI-III) and insert the guide in the hole in the cylinder head. Drive the guide to a firm seat with sharp hammer blows on the end of the drift. Allow the cylinder to cool. Ream the valve guide with the appropriate valve guide ID reamer and check the finished ID with the corresponding valve guide ID gage (See Table VI-III).

6-87. VALVE ROCKER THRUST WASHERS. Excessive side clearance between the valve rocker and cylinder head (reference 533, Table of Limits) caused by excessive wear on the inner rocker shaft support boss may be brought within limits in the following manner:

a. Use the inner rocker shaft spotfacer (64862) to clean up the surface of the inner rocker shaft support boss, removing no more metal than is necessary.

b. Select and fit any two of the three undersize washers that will bring the side clearance within the service limits.

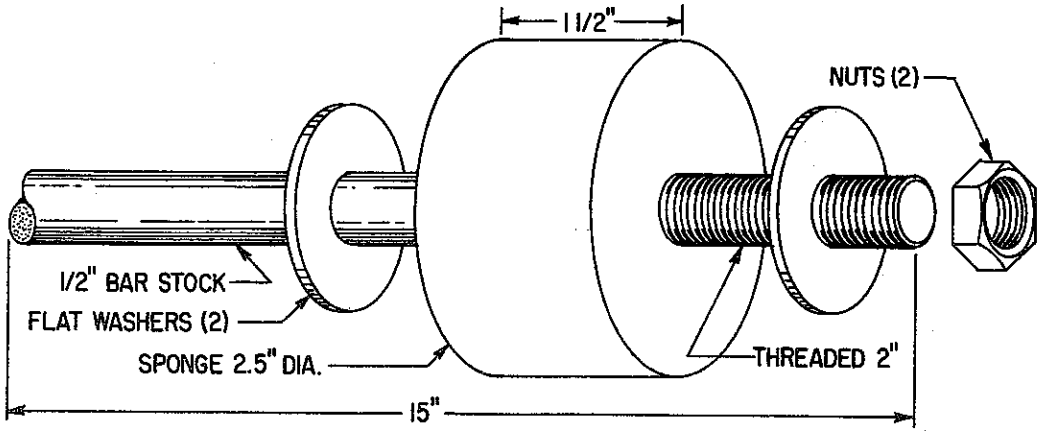


Figure 6-29. Valve Seat Removal Tool

TABLE VI-III

VALVE GUIDE REPLACEMENT TOOLS

GAGE	SIZE	REAMER
	Valve Guide Hole in Cylinder Head	
	(.5913/.5923 hole)	
64571	Standard	-------
64507	.005 oversize	64678-2
64509	.010 oversize	64678-3
64511	.020 oversize	64678-4
64639	.030 oversize	64678-5
	(.6247/.6257 hole)	
ST-89	Standard	-------
ST-89-5	.005 oversize	ST-90-5
ST-89-1	.010 oversize	ST-90-1
ST-89-2	.020 oversize	ST-90-2
ST-89-3	.030 oversize	ST-90-3
	(.6613/.6623 hole)	
64940	Standard	64924
64928	.005 oversize	64924-1
64929	.010 oversize	64924-2
64930	.020 oversize	64924-3
64931	.030 oversize	64924-4
	Valve Guide ID	
64514	All intake valves	64684
64514	.4040/.4050 exhaust valve	64684
64725	.4360/.4370 exhaust valve	64726
ST-26	.4370/.4380 exhaust valve	ST-27
64901	.4375/.4385 exhaust valve	64900
64927	.4985/.4995 exhaust valve (except ni-resist)	64925
64927	.4985/.4995 exhaust (Ni-resist) Pilot diameter	
	.4828/.4833	ST-113-1
	.4778/.4783	ST-113-2
ST-155	.4995/.5005 exhaust (Ni-resist) Pilot diameter	
	.4828/.4833	ST-143-1
	.4778/.4783	ST-143-2

REPLACEMENT FIXTURE

T/N	CYLINDER ASSEMBLY
64501	All 4-3/8" bore
64644	All 5-1/8" angle valve head
64714	All 5-1/8" parallel valve head

REPLACEMENT DRIFT

64505	All intake valve guides
64505	Valve guides with .4040/.4050 ID
64796	Valve guides with .4360/.4370, .4370/.4380, .4375/.4385 ID
64923	Valve guides with .4985/.4995, .4995/.5005 ID

6-88. REPLACEMENT OF VALVE ROCKER SHAFT BUSHING. On earlier models of some cylinder head assemblies the inner rocker shaft bushing was secured by a dowel pin. It will not be necessary to replace the dowel pin when the bushing is replaced. The dowel pin in this assembly is removed in the following manner:

6-89. Secure the cylinder to a suitable fixture on the workbench and insert the dowel hole drill jig (64808) beveled end up, through the outer bushing, securing it on the two valve rocker shaft cover studs. Bore out the dowel in the inner bushing with an 0.123/0.124 inch diameter drill.

6-90. (All Cylinders). Remove the outer and inner bushing using the rocker shaft bushing removal drift (64814).

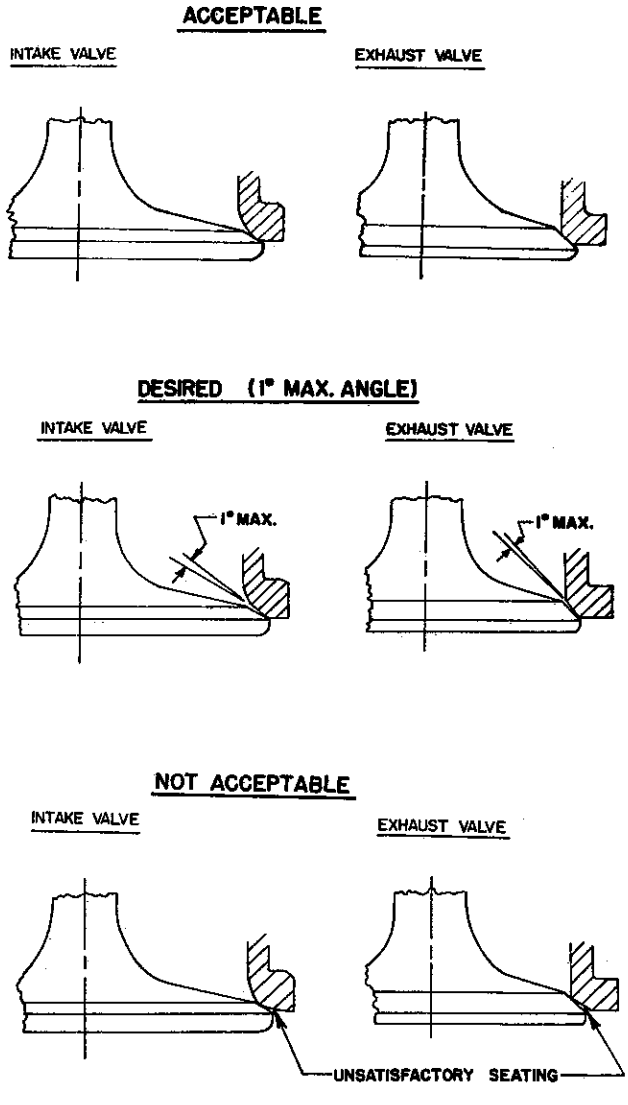


Figure 6-30. Acceptable, Desired and Not-Acceptable Valve Contact With Seat Face

6-91. Check each rocker shaft bushing hole in cylinder head with a standard plug gage (64810). If plug gage enters hole more than 1/8 inch an oversize rocker shaft bushing will be required. If the fit of plug gage in the hole is quite loose, it is evident that the bushing that was removed was an oversize bushing. Use the 0.005 oversize plug gage to determine what oversize bushing should be used for replacement. When the proper size replacement bushing has been determined, proceed to ream bushing hole in the cylinder head.

6-92. (Angle Valve Cylinder Heads.) Place the pilot of the outer rocker shaft bushing hole in cylinder head reamer (64812 or 64813) through the outer hole into the inner hole and proceed to ream the outer hole. Place the inner rocker shaft bushing hole in cylinder head reamer (64832 or 64833) through the outer hole and ream the inner hole. Clean cylinder and reamed holes thoroughly.

6-93. Parallel Valve Cylinders. Place the pilot of the rocker shaft bushing hole in cylinder head reamer (64838 or 64839) through the outer bushing and proceed to ream the parallel rocker shaft bushing holes. Clean the cylinder and reamed holes thoroughly.

6-94. Angle Valve Cylinders. Install new rocker shaft bushings in the following manner: place the stop of the outer rocker shaft bushing installation drift (64815) between the inner rocker shaft bushing boss and the outer rocker shaft bushing boss. Assemble new bushing on drift, insert drift pilot through boss into stop and tap bushing into place. Assemble the new bushing on the pilot of the inner rocker shaft bushing installation drift (64816) and position bushing and pilot. Insert drift through outer bushing into pilot and tap inner bushing into place.

6-95. Parallel Valve Cylinders. Install new rocker shaft bushings in the following manner: Place a new bushing on the driver of the inner rocker shaft bushing installation drift (64825) and locate bushing and driver in front of inner rocker shaft bushing hole in cylinder head. Insert the pilot of the inner rocker shaft bushing installation drift through the outer bushing hole and tap inner bushing in place. When installing the outer rocker shaft bushing, install the stop of the outer rocker shaft bushing installation drift (64824) between the inner and outer rocker shaft bushing holes in the cylinder head. Place a new bushing on the outer rocker shaft bushing installation drift and tap into place.

6-96. Angle Valve Cylinders. After installing new rocker shaft bushing in cylinder head, ream the bushing inside diameter. To do this, place the pilot of the outer rocker shaft bushing ID semi-finish reamer (64819) through the outer bushing. Place the inner rocker shaft bushing ID semi-finish reamer (64820) through the outer bushing and ream the inner bushing. Repeat the same procedure, this time using the outer and inner finish reamer (64821 and 64822). Check the finish ID hole in the rocker shaft bushings with the rocker shaft bushing ID plug gage (64823). Clean the cylinder and reamed hole thoroughly.

6-97. Parallel Valve Cylinders. After installing new rocker shaft bushings in cylinder head, place the pilot of the inner and outer rocker shaft bushing ID finish reamer (64826) through the outer bushing hole and ream the four bushings. Check the finished ID holes of the rocker shaft bushings with the rocker shaft bushing ID plug gage. Clean the cylinder and reamed holes thoroughly.

NOTE

After bushings have been reamed, they must be impregnated by immersing them for at least 15 minutes in engine oil that has been heated to 140°F. (60°C.).

6-98. Replacement of Valve Rocker Bushings. If valve rocker bushings are damaged or worn, they can be replaced in the following manner:

6-99. Place the valve rocker in position in the valve rocker holding fixture (64540) and, using a suitable drift, remove the bushing from the valve rocker.

6-100. Using a suitable arbor press, install a new bushing in the valve rocker. Make sure the oil hole in the bushing is aligned with the oil hole in the valve rocker.

6-101. Burnish the bushing by using an arbor press to pass the valve rocker bushing burnisher (64541) completely through the bushing. Remove the rocker from the fixture and check the finished ID with the valve rocker bushing finish ID gage.

6-102. Regrinding Cylinder Barrels. All unplated cylinder barrels which exceed allowable service limits in diameter, taper or out-of-roundness, must be reground to .010 or .020 oversize. Nitrided cylinder barrels employed on the O-360-B, -D and O-540-B low compression engines may be ground to .010 oversize. Do not attempt to regrind a barrel on light weight grinders such as block mounted automotive or similar type machine.

NOTE

Only the nitrided barrels employed on the series engines listed in the above paragraph may be reground oversize. All other nitrided barrels must be either re-barreled or reconditioned by chrome plating.

6-103. The oversize to which the cylinder is ground must be determined by adding 0.004 of an inch (clean up allowance) to the barrel diameter measured at the point of greatest wear. This measured addition should not exceed 0.002 of an inch per wall. The barrel is then ground to the oversize above this figure. Unplated barrels with wear exceeding .020 of an inch or applicable nitrided barrels with wear exceeding .010 of an inch must be replaced. See reference 522, Table of Limits.

6-104. The following data are included as a guide in selecting an efficient wheel and set up for grinding barrels to an oversize dimension.

A. Unplated Steel Barrels

1. Wheel

a. Friable Bond Material - 2A
b. Grain Size - 54
c. Grade -K
d. Structure - 5 porous
e. Vitrify Bond Treatment - V92
f. Diameter - 3-1/2 to 4 inches

2. Wheel Speed

a. 3-1/2 inch wheel - 5600 to 6000 surface feet per minute.
b. 4 inch wheel - 5350 to 5730 surface feet per minute.

3. Work Speed - 250 RPM

b. Nitrided Barrels

1. Wheel

a. Firable Bond Material - 1C
b. Grain Size - 54
c. Grade - H
d. Structure - 6
e. Vitrify Bond Treatment - V32
f. Diameter - 4 inches

2. Wheel Speed - 5350 to 5730 surface feet per minute.

3. Work Speed - 250 RPM

6-105. It is recommended that unplated steel barrels be ground to a surface finish of 25-35 micro-inches, nitrided barrels to 20-35 micro-inches. Such a finish can be obtained by grinding if the barrel diameter is brought to within 0.0005 to 0.001 inch of desired ID by roughing cuts. The wheel must then be redressed and the finished pass made. The wheel should then be allowed to run over the work four or five times. When setting up the job, make sure that the stops are arranged to prevent the edge of the wheel from running past the top of the barrel more than 1/8 of an inch. This protects the combustion chamber interior from damage.

6-106. Cylinders with barrels ground oversize must be fitted with corresponding oversize rings and pistons and identified as diredted in Service Instruction No. 1181.

6-107. In field service where one cylinder is worn beyond maximum limits, the worn cylinder and its opposite cylinder should be reground to the same oversize dimensions and oversize pistons and rings be used to maintain proper dynamic balance.

6-108. During complete engine overhaul when one or more cylinders require grinding, all cylinders should be ground to the same oversize dimension.

6-109. Reconditioning Nitrided Cylinder Barrels. Although only the series engines listed in paragraph 6-102 may be ground oversize, other nitrided barrels can be reconditioned by chrome plating or in some cases by re-barreling. Consult the latest edition of Service Instruction No. 1047 for information relative to reconditioning nitrided barrels.

6-110. Reconditioning Chrome Plated Barrels. Although it is not practical to remove wear steps by regrinding, such barrels can be restored by a stripping and replating process. Consult Service Instruction No. 1054 for facilities approved by Avco Lycoming to perform this chrome plating process.

6-111. Valve Repair. Repairs to valves are limited to removal of carbon, regrinding the face, and polishing superficial scratches. Bending processes, to straighten and puddling to restore the face must not be attempted.

6-112. Warped Exhaust Flanges. If a warped exhaust flange is noted, the flange should be straightened by grinding.

6-113. Valve Rocker Shafts (O-290-D, -D2). Sharp edges on valve rocker shafts, caused by contact with the rocker box cover may occur on this series. These sharp edges may be removed as follows. Chuck the rocker shaft in a lathe or drill press. With emery paper backed by a rubber pad or block, polish out any sharp edges from the ends of the shaft. Finish polish with crocus cloth.

NOTE

Tag rocker assembly so it will be reassembled in the original position from which it was removed at tear-down.

REASSEMBLY

6-114. Assembly of Pistons. Using the piston ring expander, assemble the new rings on pistons in the order described in the following paragraphs.

NOTE

On chrome cylinder and O-235 cylinder, the scraper ring is installed with the scraper edge toward the top of the piston. All other cylinders, the scraper edge is installed toward the bottom of the piston.

6-115. (All Pistons). With the piston lying top up on the workbench, install the oil regulating ring equalizer in the first groove above the piston pin hole. Assemble the regulating ring over the equalizer with its gap 180° opposite the equalizer gap. Compress the assembly several times with the fingers to make sure the ring lies free and loose in the groove. Both the equalizer and the regulating ring are symmetrical and may be installed with either side upward.

6-116. Install compression rings in the remaining top grooves. The compression rings are etched on one side with the work "Top" and this side must be installed with this side toward the top of the piston.

6-117. (O-235-C). Invert the piston on the bench and install the scraper ring in the groove below the piston pin hole. Install the scraper ring with the scraping edge toward the top of the piston.

WARNING

Do not under any circumstances assemble chrome plated piston rings in a chrome plated cylinder barrel. If in doubt as to the proper combination of rings to be used, refer to the latest edition of Service Instruction No. 1037 or contact the Service Department, Avco Lycoming Division.

6-118. (All Pistons.) Upon completion of assembly of the piston rings, check the side clearance of the rings in the grooves. Use feeler gage and straight edge as shown in figure 6-11.

NOTE

Under no circumstances should oversize piston rings be used in chrome plated barrels.

6-119. Assembly of Cylinder. See figure 6-5. Coat the valve guides and valves with a pre-lubricant as described in paragraph 3-39. Insert the intake and exhaust valve in their respective guides. The intake valve can be identified by the fact that it is slightly larger than the exhaust valve. Hold the ends of the valve stems and place the cylinder on the applicable cylinder holding block. Install on each valve a lower spring seat (5), outer and auxiliary valve spring (4 and 3), and outer valve spring seat (2).

NOTE

Assemble the dampener ends of springs (close wound coils marked with dye or lacquer) downward or next to lower spring seats.

6-120. Compress the valve springs with the valve spring compressor and assemble the valve retaining keys. If the valve is not seated properly the valve may be seated by using a wooden hammer handle against the tip of valve stem and hitting hammer with palm of hand. No other means should be used.

NOTE

Sodium-cooled exhaust valves are assembled with special keys and caps (32). Do not install caps until just before valve rockers are installed.

6-121. Installation of Pistons and Cylinders. See that all preservative oil accumulation on cylinder and piston assemblies is washed off with solvent and thoroughly dried with compressed air. Insert valve rocker shafts in their bores in the rocker box. Immediately prior to assembly of piston and cylinder to the engine, space the rings correctly and apply a generous coating of the oil mixture described in paragraph 3-39. Apply to the inside of the cylinder barrel and to piston and rings working the mixture well around the rings and into the grooves. Starting with No. 1 cylinder, proceed to install as follows:

6-122. Rotate crankshaft so that No. 1 piston, when installed, will be approximately at top dead center on the firing stroke; this is determined by both tappets of No. 1 cylinder being on the base circle of the cam lobes. Before any attempt is made to rotate the crankshaft support the connecting rods as shown in figure 6-2.

6-123. Assemble piston on connecting rod with piston number, which is stamped on bottom of piston head, toward the front of the engine. The piston pin should be palm or hand push fit. If the original piston pin is tighter than a palm push fit, it is porbably caused by

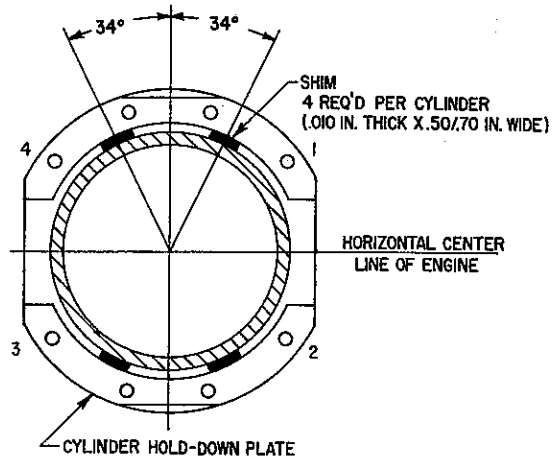


Figure 6-31. Location of Shims Between Cylinder Barrel and Hold-Down Plates

nicks or slight carbon in the piston pin bore of the piston. If a new piston pin or piston is to be installed, select the pin to give a palm push fit at room temperature of 15° to 20°C. (60° to 70°F.). After piston pin is in place and centrally located, insert a piston pin plug at each end of the piston pin.

6-124. Place a rubber cylinder base oil seal ring (27, figure 6-5) around the cylinder base, assemble the applicable piston ring compressor over the top piston rings and install the cylinder over the piston, pushing the piston ring compressor ahead with the cylinder barrel. This will encircle and compress the oil scrapper ring of O-235-C pistons at the piston skirt. As the cylinder barrel approaches the crankcase, catch the piston ring compressor as it drops off the piston skirt. When the base of cylinder is seated on crankcase pad, secure the cylinder with 3/8 inch and 1/2 inch cylinder base nuts, tightening the nuts finger tight only.

NOTE

Cylinder hold-down plates (10, figure 6-5) are not employed on all engines. Consult the applicable Parts Catalog for model application. When applicable, install the hold-down plates before assembling hold-down nuts. Also note that on o-235, O-290-D and -D2 series shroud tubes must be inserted prior to assembling cylinder to crankcase.

6-125. To assure proper assembly of the crankcase halves and to eliminate the possibility of subsequent loosening of cylinder base nuts, a definite and specific sequence of tightening all crankcase and cylinder base nuts must be followed. Be certain that crankcase halves have been brought together, and fastenings secured as directed in Section 7, before installing cylinders. The cylinder base hold-down nuts are installed as described in the following paragraphs.

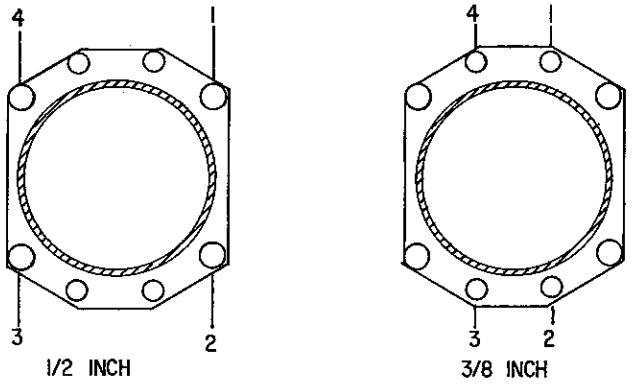


Figure 6-32. Sequence of Tightening Cylinder Base Nuts

6-126. When all cylinders have been initially installed on the crankcase as described in paragraph 6-124, begin tightening all cylinder base nuts as described below, using the proper cylinder base nut wrenches and handle in conjunction with a suitable torque indicator. Torque wrenches should employ the flexible beam design hydraulic principle or a dial indicator with rack and pinion.

NOTE

Before installing cylinder hold-down nuts, lubricate crankcase through stud threads with any one of the following lubricants, or combination of lubricants.

1. 90% SAE 50W engine oil and 10% STP.
2. Parker Thread Lube
3. 60% SAE 30 engine oil and 40% Parker Thread Lube.

a. Assemble hold down plates (where applicable) and cylinder base hold down nuts. Install shims between hold down plates and cylinder barrel as directed in figure 6-31.

b. Tighten 1/2 inch or 7/16 inch hold down nuts to 300 inch pounds (25 foot pounds) torque.

c. Remove shims and using the same sequence, tighten the 1/2 inch nuts to 600 inch pounds (50 foot pounds) torque or the 7/16 inch hold down nuts to 420 inch pounds (35 foot pounds) torque.

d. Tighten the 3/8 inch hold down nuts to 300 inch pounds (25 foot pounds) torque. Sequence is optional.

NOTE

All O-235 series engines, except the 125 HP series, employ only 3/8 inch hold down nuts. Tighten these nuts to 300 inch pounds (25 foot pounds) torque in the sequence shown for 1/2 inch hold down nuts in figure 6-32.

e. As a final check, hold the torque wrench on each nut for about five seconds. If the nut does not turn, it may be presumed to be tightened to correct torque.

f. Recheck clearance between hold-down plates and cylinder barrel. If .010 clearance is not obtained, loosen nuts and repeat steps b and c.

6-127. After all cylinder base nuts have been tightened, remove any nicks in the cylinder fins by filing or burring.

6-128. Install some type of vented plug in each spark plug hole after assembly of cylinder to prevent entrance of foreign matter and at the same time to permit the engine to be turned easily by hand.

6-129. (Except O-235, O-290-D). Install hydraulic tappet plunger and cylinder assemblies with spring end outward and sockets with concave end outward in the hydraulic tappet bodies.

CAUTION

Be sure that there is no oil inside tappet body and that the tappet plunger and cylinder assembly are thoroughly clean and dry. Wash any lubricating or preservative oil out of these parts, since tappet assemblies must be absolutely dry in order to check tappet clearance.

6-130. Assemble new shroud tube oil seals in both shroud tube oil seal retainers in crankcase and on outer end of the two push rod shroud tubes; then assemble a shroud tube seal sleeve over each of these seals, centering the sleeve on the seal.

6-131. Parallel Valve Cylinders. (Except O-235-C, O-290-D, -D2.) See figure 6-1. Install each shroud tube (1) through its hole in the rocker box and seat the end firmly in the crankcase. Place a spacer, two springs (2), a lockplate (3), and a plain 1/4-20 nut (4) over the stud provided in the rocker box. Tighten the nut to proper torque and secure by bending the lockplate over the nut and springs.

6-132. Angle Valve Cylinders. See figure 6-5. Assemble shroud tube spring (17) over the inner ends of the two shroud tubes (18) so that the detent notches in the spring are approximately 90° removed from detents on tubes. Place shroud tube washers (15), as many as necessary to bring minimum overlap between the spring and detent lugs to 1/8 inch, over end of each tube and insert tube ends through oil seals in crankcase. Hold both push rod shroud tubes with detent at inner end at unlocked position and insert the outer end of tubes in cylinder head rocker box. See that all rubber seals (14) are inserted squarely and then turn each shroud tube 90° thus locking the tubes by engaging the detents with the notches in the spring.

6-133. Select two push rods (13), dip in oil mixture described in paragraph 3-39 and insert full length through shroud tubes. Press tightly against outer ends and check for spring tension and free travel of unloaded or dry hydraulic tappet plungers.

6-134. Parallel Valve Cylinders. Pull rocker shaft out far enough to enable the rocker arm to be installed and push rocker shaft thru center hole, insert other rocker arm and secure with rocker shaft. Before installing exhaust rocker place special cap (39, figure 6-4) over the sodium cooled exhaust valve stem. Position rocker shaft until it protrudes equally from both outside bosses.

6-135. Angle Valve Cylinder. Slide rocker shaft back and install rocker (22, figure 6-6) and thrust washer (23, figure 6-6). Before installing exhaust valve rocker place special cap (32, figure 6-6) over the exhaust valve stem. Slide rocker shaft back into position. Repeat with the other rocker arm and thrust washer. If clearance between the valve rocker and cylinder head cannot be brought within limits (See Table of Limits) by the use of standard valve rocker thrust washers, clean up the worn valve rocker support boss as described in paragraph 6-87 and use any two of the selective fit undersize washers to bring clearance within limits.

CAUTION

Exhaust and intake rocker assemblies are different due to angle of valves. Be sure rockers are correctly assembled.

6-136. (All engines except O-235, O-290-D.) Check dry or unloaded valve tappet clearance by pushing in on push rod end of valve rocker and checking clearance between end of valve rocker and valve stem tip, using valve clearance gage. Valve rocker clearance on all subject engines is .028 - .080. If clearance is out of limits adjust by using a shorter or longer push rod. Inserting a longer rod will decrease the clearance. Consult Service Instruction No. 1060 for identification of push rods. At conclusion of valve rocker clearance check, assemble rocker shaft covers (31 figure 6-5 or 6-6) on angle valve cylinders temporarily to prevent displacement of valve rockers.

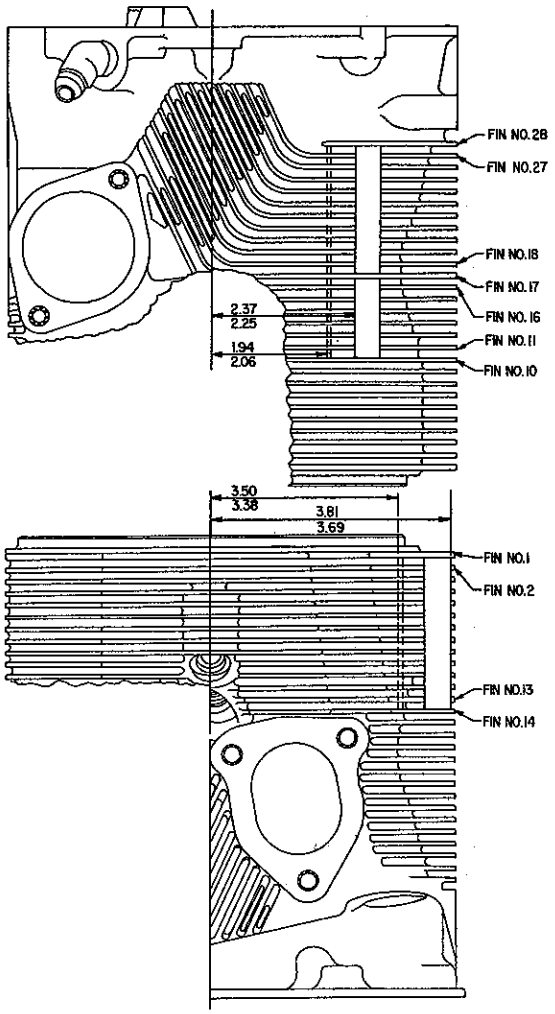


Figure 6-33. Cylinder Head Fin Stabilizers
Angle Head - Up Exhaust

6-137. (O-235-C, O-290-D.) Set tappet clearance on these models in the following manner:

a. Set tappets on numbers 2 and 4 cylinders at zero clearance. This will load the camshaft on one side.

b. Rotate the crankshaft until No. 1 piston is at TDC of the compression stroke. Both valves will now be closed. Adjust each for a 0.007/0.009 clearance.

c. Following the procedure set forth in step "B" for numbers 3, 2 and 4 in that order.

d. Tappet clearance must be checked after engine run-in. At that time clearance desired is 0.010 inch. However, 0.006/0.012 is acceptable.

6-138. At completion of valve clearance check on each cylinder, recheck clearance on all cylinders and make necessary corrections. Coat all mechanism parts within rocker boxes as described in paragraph 3-37 and 3-39. Assemble rocker box cover gaskets and covers on each rocker box and tighten to specified torque. On the angle valve cylinder tighten rocker shaft covers to specified torque.

NOTE

On earlier models of the IO-540 series some leaking at the rocker shaft cover stud was experienced. This can be corrected by the application to the studs of Gasoila, a sealant manufactured by the Federal Process Co. Be certain to wipe off excessive sealant from the rocker shaft cover mounting surface.

6-139. Installation of Cylinder Head Fin Stabilizers. (Angle Valve Cylinders). Clean the stabilizers and affected fin areas thoroughly to remove all traces of grease, dirt or other foreign matter.

6-140. Apply Dow Corning Silastic 140 adhesive to the fin stabilizers and press surfaces together in the locations described in figures 6-33 and 6-34.

NOTE

Because of engineering changes two widths of fin stabilisers (one approximately .63 inch and one approximately .31 inch) may be encountered. See figures 6-33 and 6-34. Dotted lines call out measurements for narrow stabilizers, solid lines for wide stabilizers.

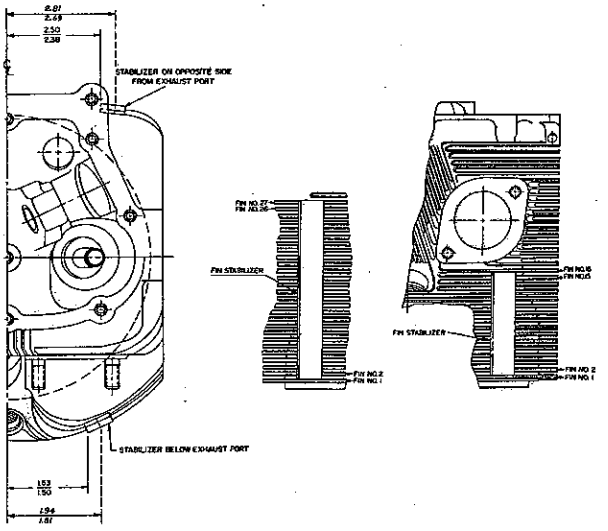


Figure 6-34. Cylinder Head Fin Stabilizers Angle Head - Down Exhaust

6-141. Cylinder Painting. (All Models employing Cylinder Hold Down Plates.) This paragraph is intended to alert personnel to the extreme caution necessary when painting the cylinder base flange. Any excessive amount of paint between the cylinder hold down plate and the cylinder flange will lead to a loss of torque on the cylinder base nuts and eventual stud and/or cylinder failure. The following procedure should be followed when painting a cylinder:

a. Remove all old paint from the cylinder. A vapor degreaser is best suited for this purpose.

b. Mask off the following parts of the cylinder: Masking tape, corks, plugs, metal covers, etc. are acceptable for masking purposes.

1. Rocker box section including the rocker box flange. Both valve ports and flanges. Thermocouple hole. Spark plug holes. Push rod shroud tube holes. Valve rocker shaft cover flange. All other exposed threaded surfaces in which paint might accumulate.

c. Spray a very light coat of zinc chromate primer (.0005 maximum thickness) on the cylinder flange. See figure 6-35. If the correct amount of paint has been applied the color of the paint will be green with a yellowish tint and the metal will show through. If the paint is too thick the color will be zinc chromate yellow.

CAUTION

It is imperative that the paint thickness on the flange be held to .0005 maximum. To measure the thickness of the paint layer, one of two methods may be used. A Tinsley thickness gage which incorporates a magnetic needle and is scaled in tenth of thousandths is the most satisfactory method. If this type equipment is not available, use a micrometer to measure the thickness of the flange before and after painting. If the paint is too thick it must be removed and repainted.

d. Mask off the flange area as shown in figure 6-35. Proceed to paint the cylinder with a Phthalate resin type enamel (AMS3125C or equivalent MIL-E-7729) properly thinned with Toluene or equivalent (AMS3180 or equivalent Federal Spec. TT-T-548).

e. Use a cloth dipped in thinner to clean paint from all surfaces where paint may have accidentally accumulated.

f. The best finish will result if the cylinder is air dried for fifteen minutes and then baked in an oven until completely dry.

6-142. Intercylinder Baffles. (Where applicable.) All intercylinder baffles must be attached with an "S" type retaining hook and a slotted retainer. Hook the baffle retaining hook through the hole in the baffle. Place the baffle in position beneath and between the cylinders, running the hook up between the cylinder barrels. Place a baffle retainer in place between the cylinders and using a baffle installation tool, bring the retainer hook through the slot in the retainer. During the operation the retainer is forced down until the hook comes above the surface of the retainer far enough to be turned and hooked over the bridge between the slots in the retainer.

NOTE

The baffles on up exhaust cylinder assemblies are placed above and between the cylinders. The retainer is placed below and fastened in the same manner as described above.

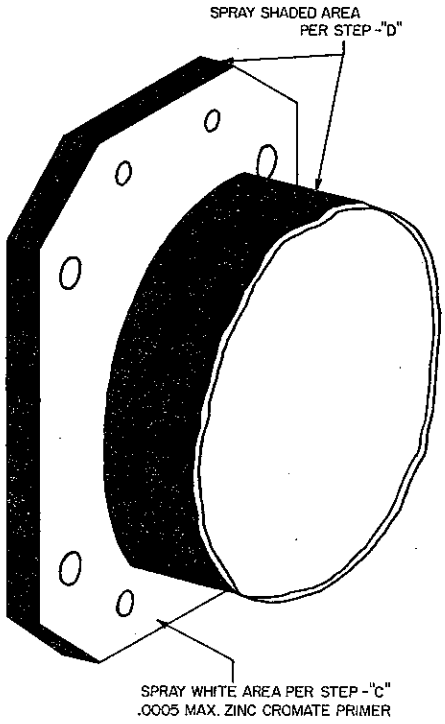


Figure 6-35. Cylinder Flange Area

SECTION VII

CRANKCASE, CRANKSHAFT AND RECIPROCATING PARTS

7-1. At this time it is assumed that all accessories, cylinders, accessory housing and sump have been removed from the engine.

DISASSEMBLY

7-2. Starter Ring Gear Support - Remove the starter ring gear support assembly (32, figure 7-5) from the crankshaft propeller flange by tapping lightly on the rear face of the assembly. The alternator or generator drive belt will be removed with this unit.

7-3. Propeller Governor Oil Line. (Engines equipped with propeller governor on accessory housing.) If this line was not disassembled when removing the accessory housing, remove from the front of the crankcase by unscrewing the threaded fitting.

7-4. See figure 7-5. Remove the crankshaft idler gears (22) from the idler gear shafts (29). On engines employing camshafts with separate gears, remove the breather slinger (19), camshaft gear (14), and tachometer shaft spacer (18) by removing the 4 hex head bolts (21) and lockplate (20) securing the assembly to the camshaft. Remove the tachometer drive shaft (16) by removing the pin (15). See figure 7-6. On engines using integral camshafts, remove the retaining ring (14) and tachometer shaft spacer (13). Remove pin (11) and tachometer shaft (12).

7-5. Remove the nuts and bolts, from the parting surface of the crankcase, which hold the crankcase halves together. Remove the crankcase from the overhaul stand and place on the work bench.

7-6. Remove oil filler tube. See figure 7-1. Remove oil pressure relief valve assembly (23 or 24). Remove oil seal retainer plates (19) (used on engines that do not have crankcase modified with machined groove to accept oil seal with retaining lip on OD).

7-7. Hydro Control Valve. (O-235, O-290 series. Where applicable.) See figure 7-15. Remove cotter pin, slotted shear nut and hex head screw and remove lever. Remove the two 1/4 inch bolts securing the cover to the crankcase and remove the cover and valve body.

7-8. Crankcases that are doweled at the thru-studs (#2 saddle on 4 cylinder engines, #2 and 3 saddles on 6 cylinder engines and #2 - 3 and 4 saddles on 8 cylinder engines) must be separated by the use of pressure plates (ST-122). Instructions for the use of the plates are given in figure 7-16. After the crankcase is separated past the dowels remove the plates and lay the crankcase on the right side. Crankcases that are not doweled may be separated by laying on the right side and gently tapping the thru-studs with a soft hammer. Wire the camshaft to the left crankcase half as shown in figure 7-2.

7-9. From this point disassembly is the same for all crankcases. Reach down through the cylinder pads and push the left half of each main bearing insert down on the crankshaft so they will not fall when the crankcase half is removed. Separate the crankcase by hand and remove the bearing inserts, tappets, camshaft and crankshaft assembly. Place each tappet body, as it is removed, in its proper location in the cleaning basket. This is important as tappet bodies must be replaced in the same location from which they were removed.

NOTE

In the left crankcase half the intake tappet for its corresponding cylinder is located nearest the front of the crankcase, while in the right crankcase half the intake tappet is nearest the rear of the crankcase.

7-10. Propeller Governor Drive (Located on front left side of crankcase). See figures 7-3 and 7-4. Remove the hex head plug (6) and gasket (5) from the propeller governor housing. Remove the idler shaft (4) through the opening in the housing at the same time supporting the idler gear (9) to prevent dropping and damaging. Note that the idler shaft on four cylinder engines is pinned to the housing. Pull the governor driven gear (8) from the housing.

7-11. Crankcase - Remove all threaded plugs to facilitate cleaning. Remove and discard the rubber oil seals encircling the studs. (Doweled crankcases do not employ oil seals at the dowels). Where applicable remove the piston cooling oil jets (17, figure 7-1).

7-12. Remove the two crankshaft idler gear shafts from the rear of the crankcase halves. On the eight cylinder engines remove also the two magneto drive gear shafts.

7-13. Camshaft Governor Drive Gear (6 and 8 cylinder engines using camshaft with separate gears). See figure 7-5. Remove the governor drive gear (2) by removing the two external retaining rings (1) that secure it to the camshaft.

7-14. Crankshaft - With the crankshaft properly supported at front and rear main bearings, remove the nuts securing the rod caps to the connecting rod. Remove the rods by tapping on the rod bolts with a soft hammer. Discard the bearing inserts, bolts and nuts. Reassemble each cap with its corresponding rod. Rods and caps are not interchangeable.

7-15. To remove the crankshaft gear (26), flatten out the lockplate (24) and remove the hex head screw (23). Tap the crankshaft gear gently, with a fibre drift, to remove from the crankshaft. Do not remove the dowel from the rear end of the crankshaft unless it has been obviously damaged.