

OVERHAUL INSTRUCTIONS

Section 9

DISASSEMBLY, CLEANING, AND INSPECTION

1. GENERAL.

a. Before proceeding with the operations of engine overhaul as outlined in this section, remove the engine from its packing box or the airplane in which it is installed, as outlined in Section 4 and 5. Mount engine on an engine overhaul stand.

b. Spray the exterior of the engine with an approved cleaner to remove all traces of dirt and grease.

c. Remove all safety wiring, palnuts and cotter pins where necessary before each part is disassembled from the engine.

2. PRELIMINARY OPERATIONS.

a. **Ignition Wiring Assembly** — Unfasten at spark plugs, magnetos, remove nuts securing brackets and remove ignition wires from engine.

b. **Spark Plugs** — Remove upper and lower plugs.

c. **Magnetos** — Remove nuts that fasten magnetos to crankcase cover and remove magnetos.

d. **Carburetor Air Intake** — Remove the four nuts that hold the carburetor air intake to the carburetor and remove air intake.

e. **Carburetor** — Remove four nuts which fasten the carburetor to the intake manifold and remove carburetor.

3. DISASSEMBLY.

a. **Oil Sump and Suction Tube** — Remove the six nuts that hold the oil sump to the crankcase, and the nut that fastens the oil filler bracket to the crankcase and remove oil sump. The oil suction tube inside the oil sump and attached to the crankcase cover can be removed by unscrewing the hex portion at the top, using a $\frac{7}{8}$ -inch open-end wrench.

b. **Intake Pipes and Manifold** — Unfasten clamps which secure hose connections to intake elbow at cylinder. Slide the rubber hose down toward carburetor. Remove the two $\frac{3}{8}$ -inch nuts holding intake manifold to crankcase. Remove intake manifold and pipes by dropping straight down.

c. **Rocker Box Covers** — Remove the $\frac{1}{4}$ -inch screws that fasten the rocker box covers to the cylinder head and remove covers.

d. **Push Rods and Rocker Arms** — After covers are removed, push out rocker arm shaft with the finger, or, if necessary, use aluminum drift and lightly tap out. Remove rocker arms from cylinder head and push rods from their housings.

CAUTION: Make certain that the cam is in such a position that the intake and exhaust valves are completely closed before removing rocker shafts.

e. Cylinder and Pistons.

(1) Loosen clamps holding hose connections at foot of the push rod housing. Push clamp and rubber hose back up on the housing toward cylinder head.

(2) Turn crankshaft until piston within cylinder to be removed is at top of the stroke.

(3) Remove the six cylinder hold-down nuts and pull off cylinder from the crankcase.

CAUTION: Do not allow piston and connecting rod to drop down when cylinder is removed, as damage will result.

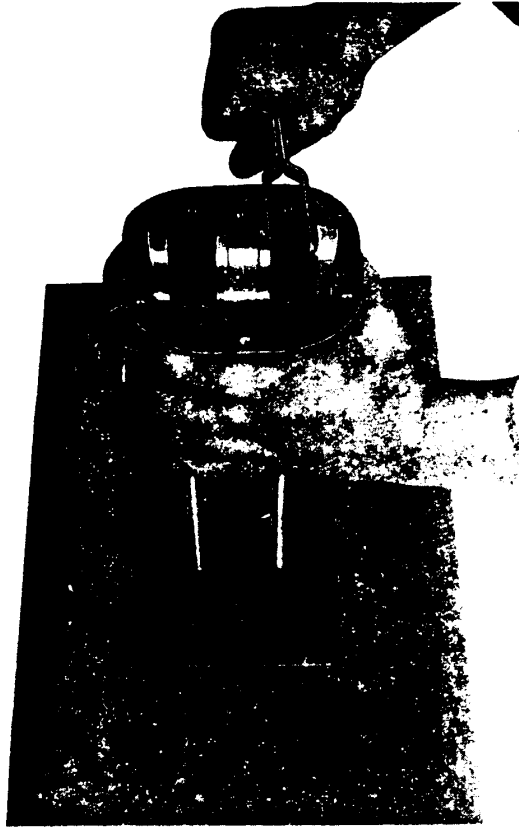
(4) After removal, place cylinders on wood or appropriate carrier to prevent damage at bottom end of barrels. Cover crankcase openings to prevent dust or grit from entering the crankcase.

(5) Push piston pin out and remove piston from connecting rod. If necessary, use aluminum drift to drive out piston pin, being careful to support the piston in the hand during this operation to prevent damage to the connecting rod.

(6) Remove the piston rings from the ring grooves of all pistons. Tie the set of rings for each piston together and tag. Number each tag with the number of the piston from which the rings were removed.

(7) Placing the cylinder over a wooden stand, shaped to fit the inside of the cylinder head, compress valve springs in rocker box, using a suitable

OVERHAUL INSTRUCTIONS — Continued



Compressing Valve Springs for Installation and Removal of Locks — Figure 13

valve spring compressor, (figure 13), such as supplied by the Kent-Moore Organization, remove the seat locks with thin-nosed pliers, release the compressor, and remove the spring seat, inner and outer springs, spring retainers and valves.

CAUTION: In removing valves, care must be taken that they do not scratch or mar cylinder walls or valve guide bores.

f. Crankcase.

(1) Remove the four push rod housing flanges by unscrewing the nuts which secure them to the crankcase.

(2) Remove the valve tappet cups on the push rod end of the hydraulic valve tappets. Remove the hydraulic units of each tappet with the aid of a small wire hook. (Figure 14.) Keep tappets numbered according to the order removed — keeping assemblies grouped together.

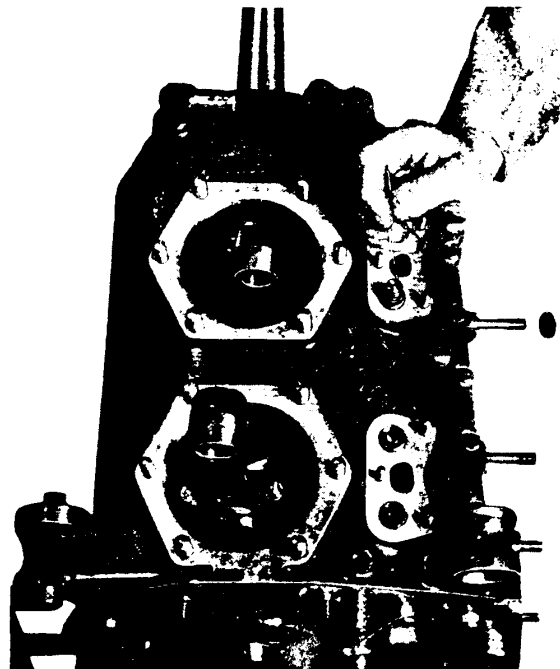
NOTE: If the cylinder and piston of the hydraulic units do not come out together, it may be necessary to wedge a wooden plug into the cylinder of the hydraulic unit and remove cylinder in this manner. Care must be taken that the wooden plug does not damage cylinder.

NOTE: The valve tappet cam follower body cannot be removed until the crankcase is disassembled. Place push rod housing connections over ends of cam follower to prevent their falling into crankcase when crankcase is lifted off. See Fig. 21, page 36.

(3) Remove the ten 5/16 inch nuts holding the crankcase cover to the crankcase. Lift the cover off as a complete unit — the oil pump, relief valve and tachometer drive units remain intact in the crankcase cover.

(4) Remove the four 1/4 inch cap screws holding the cam gear to the camshaft and remove gear.

(5) Remove the four 1/4 inch cap screws holding the crankshaft gear to crankshaft and remove gear.



Removal of Hydraulic Unit from Cam Follower Body — Figure 14

OVERHAUL INSTRUCTIONS — Continued

On Series 9 engines, remove the castle nut holding the starter gear to the crankcase and remove the washer, retainer screw, retainer, and starter gear.

(6) Remove all $\frac{1}{4}$ inch nuts from the bolts holding halves of crankcase together, located on centerline of crankcase on both top and bottom of the engine.

(7) Remove two $\frac{7}{16}$ inch nuts attached to long studs at front of crankcase on the No. 2-4 cylinder side, two $\frac{7}{16}$ inch nuts on the No. 1-3 cylinder side above the intake pipes between the cylinders.

(8) Rotate the engine stand until No. 2-4 crankcase is lying on its side, check all crankcase-to-crankcase studs to see that all nuts have been removed, and carefully lift the No. 1-3 crankcase off and lay aside with contact surface up. Do not pry the parting faces of the crankcase apart with a screw driver as the contact surfaces may be damaged.

On Series 9 engines, after removing the 1-3 crankcase from the 2-4 crankcase, remove the starter gear bushing.

(9) Lift crankshaft, with connecting rods attached, out of the crankcase.

(10) Remove crankcase oil seal from front of shaft.

(11) Remove camshaft and bearing shells from both halves of the crankcase.

(12) Remove all connecting rods from the crankshaft, carefully noting their position on the shaft (Fig. 15). Point up rod numbers before disassembling.

(13) Remove push rod housing connections from ends of cam followers and remove cam followers from both halves of the crankcase.

g. Crankcase Cover Assembly (Series 8)

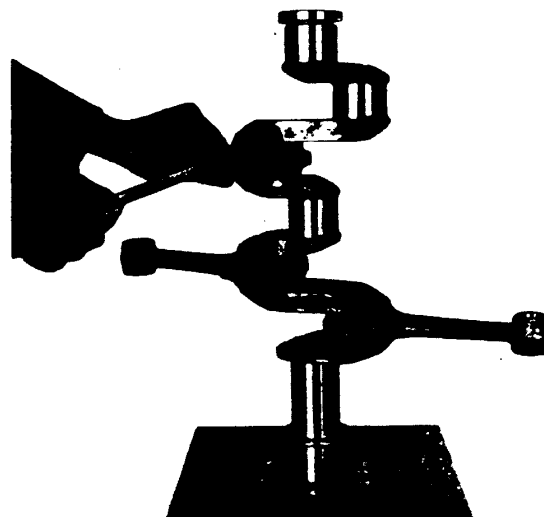
(1) Remove oil pump cover nuts holding the oil pump gear plate to the inside of the cover and lift out the two oil pump gears.

(2) Unscrew the tachometer drive housing from the outside of the cover.

NOTE: The housing is attached to the crankcase cover with a left-hand thread.

(3) Remove the oil pressure relief valve cap, gasket, spring and plunger from the outside of the cover.

(4) Remove oil screen and gasket from outside of cover.



Assembling and Removing Connecting Rods — Figure 15

h. Crankcase Cover Assembly (Series 9)

(1) Remove oil pump cover nuts holding the oil pump gear plate to the inside of the cover and lift out the two oil pump gears.

(2) Remove the three $\frac{1}{4}$ inch nuts and palnuts from the tachometer drive housing and remove the housing, oil seal, and gasket.

(3) Unscrew the oil screen assembly from the oil screen housing and remove.

(4) Remove the $\frac{1}{4}$ inch nut holding the oil screen housing to the crankcase cover. (It is necessary to remove two $\frac{1}{4}$ -inch nuts when crankcase cover is removed from the crankcase.)

4. CLEANING.

a. General.

(1) After the engine has been dismantled, clean the major sub-assemblies and miscellaneous parts in accordance with the instructions below.

(2) The cleaning fluids prescribed herein must be of such a type that will not attack metals — particularly bronze and aluminum alloy parts.

(3) After the sub-assemblies and miscellaneous parts have been cleaned, thoroughly drain of excess cleaning fluid and dry with compressed air.

(4) Treat steel parts with a rust preventive after they have been cleaned and dried.

b. **Cleaning of Engine Parts** — Spray the following assemblies and parts with kerosene. Particular attention will be given to the special cleaning instructions which are prescribed for each of the sub-assemblies and parts.

CONTINENTAL A 50, A 65, A 75, A 80 ENGINES

OVERHAUL INSTRUCTIONS — Continued

(1) **Crankcase** — Clean out both halves of crankcase; blow out oil passage tubes in both halves. Examine cam journal supports for scores or deep scratches and smooth out with crocus cloth if necessary.

(2) **Cylinders** — Remove accumulation of oil and dirt from between the cooling fins. Remove carbon from inside of cylinder head with wire brush.

(3) **Valve Mechanism** — Clean thoroughly of accumulated oil the rocker arms, rocker shaft, spring seat, springs, retainer and intake and exhaust valves.

(4) **Oil Sump** — Unscrew drain plug and flush out the sump, removing all accumulated sludge.

(5) **Crankshaft and Connecting Rods** — Clean thoroughly with kerosene, blowing out all oil lines.

CAUTION: The cleaning fluid must be free from grit and foreign particles.

(6) **Pistons and Piston Pins**

a. Wash off oil from pistons with kerosene.

b. Immerse pistons in a carbon-removing compound. The purpose of this operation is to facilitate cleaning by loosening the carbon deposits on the pistons.

c. Scrape carbon out of ring grooves, using every precaution not to distort, cut or damage the lands.

d. Remove carbon from inner and outer walls of the piston heads by scraping. Do not scratch or cut piston heads.

e. Clean out the oil bleed holes with an under-sized drill.

f. Clean piston pins and plugs thoroughly with kerosene.

(7) **Gears** — Clean cam, magneto drive and crankshaft gears thoroughly with kerosene, and dry with compressed air.

5. INSPECTION.

a. **General.**

(1) After the sub-assemblies and parts of the engine have been cleaned and dried, place on a table for visual inspection. This inspection will be a basis for determining which parts have been defective or damaged in the course of operation. Parts that are damaged beyond repair, or worn in excess of the permissible tolerances, must be replaced.

b. **Inspection of Engine Parts.**

(1) **Crankcase.**

a. Check thoroughly for fatigue cracks.

b. Examine bearing seats for cracks and scratches and excessive wear.

c. Check studs for damaged threads and straightness.

(2) **Cylinders.**

a. **Cylinder Heads** — Examine cylinder head for cracks. Small cracks found at head fins are not cause for rejection. However, if cracks are of appreciable size and indicate ultimate failure, replace the cylinder.

b. **Cylinder Barrels** — Inspect cylinder barrel flange for nicks, evenness and for condition of cylinder hold-down nut recesses. Inspect inside of cylinder barrel for dents and scoring, for corrosion as indicated by rust and pitting, and for ring wear as evidenced by a ridge near the top and bottom of the barrel. Also check inside of barrel for out-of-round and taper, using dial indicator.

c. **Spark Plug Inserts and Pins** — Examine for crossed or otherwise damaged threads and looseness of insert in head.

d. **Rocker Shaft Bosses** — Examine rocker shaft bosses for oversize and galling of bearing surfaces.

e. **Valve Seat Inserts** — Examine for signs of erosion, burning, pitting or warping.

f. **Valve Guides** — Examine for wear and looseness. If loose in cylinder head, or if excessive clearance is found between valve stem and guide, replace.

g. **Rocker Boxes** — Examine for smoothness of finished surfaces.

h. **Intake and Exhaust Flanges** — Examine for nicks and burrs and smoothness of surfaces.

(3) **Valve Mechanism.**

a. Inspect exhaust and intake rockers for cracks, particularly around lubrication holes. Also inspect rockers for straightness, nicks and condition of bushing. Check rocker shaft for wear.

b. Examine push rods for straightness by rolling them on a flat plate. See that lubrication holes on ball ends are not obstructed.

c. Check valve springs for fractures, corrosion and for proper pressure and length as specified in Table of Limits. Inspect ends of each spring for splitting and cracks.

OVERHAUL INSTRUCTIONS — Continued

d. Inspect valve spring retainers and seats for cracks and wear.

e. Inspect valve spring retainer locks for wear and galling on outside diameter, and for wear and fit on valve stem.

f. Inspect exhaust valves carefully, using a magnifying glass and magnaflux equipment, for cracks on end of valve stem, valve head and in grooves for retainer locks. Inspect valve stem and tip for scoring, pitting and wear. Check valve face for warpage, pitting and burning.

g. Inspect intake valves as described in preceding paragraph.

h. Check hydraulic tappets in accordance with instructions given in accessory section.

(4) **Oil Sump** — Examine body of sump for excessive dents and possible fractures or cracks. Inspect oil filler body. Check drain hole for damaged threads.

(5) Crankshaft and Connecting Rods.

a. Carefully inspect crankshaft, using magnaflux equipment. A fractured shaft must be replaced.

b. Check keyway on front of shaft for nicks or burrs.

c. Inspect connecting rod bearing surfaces for galling, scoring and for proper clearance with connecting rods in accordance with the Table of Limits.

d. Inspect oil tubes for tightness in shaft and for freedom from obstructions.

e. Inspect oil plug and propeller hub nut threads at front of crankshaft.

f. Inspect all connecting rods and caps for cracks. Check alignment of crankshaft bushing with piston pin bushing. The crankshaft hole and the piston pin hole must be parallel with each other within .001 per inch of bearing length.

(6) Pistons and Piston Pins.

a. Check piston pin plugs for smoothness, wear and proper fit in the piston pins. Discard piston

pin plugs which are cracked or show excessive wear.

b. Check piston pins carefully for cracks, using magnaflux equipment. Also check piston pins for scoring, flat spots, out-of-round, straightness and for proper fit in piston. Piston pins which are cracked, out-of-round, bent, scored, or excessively worn must be replaced.

c. Carefully inspect pistons for cracks, scores, corrosion and for proper size of skirt. Check ring lands for cracks by applying a light side pressure. Also check ring grooves and lands for proper width. Inspect bearing surfaces in piston pin bosses for wear and scoring.

d. Replace cracked or badly-corroded pistons. Piston rings must be replaced at each overhaul. If cylinder barrels have been reground, or if piston ring grooves have been remachined, exercise care that proper oversize piston rings are installed.

(7) Crankcase Cover.

a. Inspect cover for cracks, particularly around stud holes and using a magnifying glass and, if necessary, by etching any doubtful portions for possible cracks. Inspect magneto mounting flanges for corrosion, burrs, scratches and flatness.

b. Check all studs on cover for cracks and tightness. Stretched or loose studs must be replaced.

c. Inspect threads for oil pressure relief cap, oil suction tube, oil screen and tachometer housing.

(8) Camshaft.

a. Inspect cam lobes for scoring, wear and pitting. Crankcase bearing surfaces for camshaft should be checked for out-of-round condition, for cracks and scoring.

(9) Gears.

a. Check magneto drive, cam and crankshaft gears for cracks, nicks, burrs, wear and proper fit.

Section 10

REPAIR AND REPLACEMENT

1. GENERAL.

a. Special Tools required for repair and assembly work may be purchased from the Kent-Moore Organization, 5112 General Motors Bldg., Detroit 2, Michigan.

b. Repair such damage to finished surfaces as scores, nicks, burrs and roughness by careful hand stoning, using a fine stone and gasoline. Polish with crocus cloth and gasoline.

c. Lap flanged surfaces which are bent or uneven to a flat surface.

d. Repair slightly-damaged threads with proper thread chasers.

e. All loose, bent or otherwise damaged studs will be replaced by the next oversize stud. Replacement of steel studs driven in aluminum alloy parts requires good judgment as well as a great deal of care on the part of the mechanic. Unless the replacement is properly made, more difficulties may be encountered than would have been evident had no attempt been made to correct the original difficulty.





(1) The first problem is not just to get the broken or damaged stud out, but to get it out without injury to the part in which it has been set. If the outside threads have been stripped, it is usually a simple matter to remove the stud. A stud driver or a small pipe wrench, if necessary, may be used. Apply pressure on the handle of whatever tool is used in such a manner that there will be no tendency to bend the stud. Back the stud out slowly to avoid overheating of the threads. It should be remembered that any thread lubricant or sealing material used when the part was originally installed has probably congealed, and rapid withdrawal of the parts may cause damage to the housing threads. Either of two methods has been used successfully to remove studs broken off at or near the base. The center section of the stud may be drilled out and a square shanked stud remover installed. Use a wrench of the proper size and back the stud out carefully. If this method does not work satisfactorily, it may be possible to electric weld a short piece of steel bar stock or a steel nut to the broken stud. The bar stock or the nut may then be used to withdraw the broken piece. The welding must be done carefully to avoid melting or damaging the metal around the base of the stud.

(2) The threads in whatever part the stud is to be replaced should be cleaned up before attempting to drive a new stud. Be sure that the tap to be used is the correct size. New taps usually cut oversize, and the mechanic should handle them carefully. If the tap appears to be cutting material away instead of just cleaning out the threads, withdraw it and use an older tool. Rough edges or burrs on a tap may also cause it to cut oversize. Carefully inspect all taps for evidence of this difficulty before they are used.

(3) If a stud was removed because it was loose, the next oversize stud should be installed. Oversizes of .003 inch, .006 inch, and .009 inch are supplied to replace the standard studs. These studs may be identified by the machining on the end that is driven into the housing. Refer to figure 16 for section drawings showing the identifying shapes on the ends of the studs. Examine the stud removed to determine what size it is, and install the next oversize stud available. If the stud being removed was broken and is not being replaced merely because it fit loosely, install the same size stud that was taken out.

(4) An approved lubricant should be applied to the threads on all studs before they are installed. The lubricant should be stirred before using and applied in conservative quantities.

(5) Before installing a stud, make certain that it is the correct part and that the right end will

PART NUMBER & DESIGNATION	STUD IDENTIFICATION (END FINISH)
XXXX	
	STANDARD SIZE
XXXX-03	
	.003 IN. OVERSIZE
XXXX-06	
	.006 IN. OVERSIZE
XXXX-09	
	.009 IN. OVERSIZE

Stud Identification — Figure 16

OVERHAUL INSTRUCTIONS — Continued

be inserted in the housing. Examine the new stud carefully, since these parts easily become mixed in stock.

(6) There is a definite height that each stud in the engine must protrude when it has been installed. Check this height with the blueprint when such information is available.

(7) When driving the stud, feed it in carefully until reasonably sure the threads are meshing properly. Then turn in slowly and steadily until the stud is approximately in position. A T-handle stud driver should always be used.

(8) Do not turn the studs in rapidly, or it is possible that the threads may overheat and either seize or be damaged.

f. Dress washers, nuts, lock nuts and screw heads to remove burrs, nicks, or scratches from outside surfaces. Nuts, washers and screws used externally should be zinc or cadmium plated to prevent corrosion.

g. Replace any part found to be cracked unless it is an unstressed part that can be repaired by welding without further damage or distortion to it.

h. Replace all gaskets and packings at the time of a major overhaul.

2. REPAIR AND REPLACEMENT OF ENGINE PARTS.

a. Crankcase.

(1) Make repairs to the crankcase in accordance with instructions given in paragraph 1 of this section. Particular attention should be given to removing nicks and burrs from all finished surfaces, using a fine stone and polishing with crocus cloth.

b. Cylinders.

(1) Replace cylinder and head assemblies which are found to have loose heads or cracks, except for small cracks near the surface of the cylinder fins. Small cracks on the end of cylinder fins should be carefully removed by filing. Round off sharp corners.

(2) Remove nicks on flanged surface of cylinder barrel flanges by hand stoning. Polish flanges with crocus cloth.

(3) Repair cylinder bores which are slightly corroded, scored or pitted by honing. If the maximum permissible out-of-round condition, the maximum permissible taper, or the average maxi-

mum barrel diameter is exceeded, the cylinder bore should be reground and honed to the first standard oversize that will remove all out-of-round and taper. If cylinders are ground oversize, it will be necessary to fit oversize pistons and piston rings. Pistons are available to fit cylinders .015 inch oversize.

(4) Reface valve seats which are pitted, burned or worn by removing the least amount of metal possible. Following the repair of valves, the valve seats may then be lapped in with suitable valve-grinding compound.

CAUTION: After the valves have been ground and checked for proper seating, remove all traces of grinding compound with an approved cleaner.

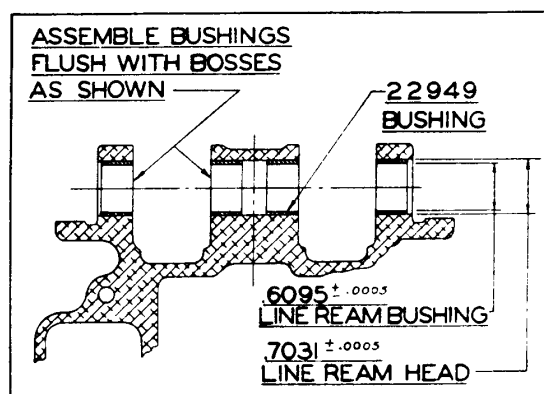
(5) Replace valve guides if loose in cylinder head or if excessive clearance is found between valve stem and guide. If guides are scored, they should be replaced. Remove guides with the use of the proper tools and an arbor press.

(6) Remove and replace spark plug inserts which are loose or leaking. Remove hard carbon from threads in inserts with a tap, being careful not to remove any metal.

(7) Remove burrs, nicks and roughness from exhaust flanges with a fine file or scraper.

(8) Repair intake flanges by removing nicks with a stone. Polish flange with crocus cloth. Tighten studs on intake flange, if necessary, and dress threads, using thread chaser.

(9) Stone finished surfaces of rocker boxes for nicks and scores. Polish surface with crocus cloth. Check rocker box covers for true flatness by rubbing on a sheet of sandpaper placed on a surface plate.



Assembling Rocker Shaft Bushings — Figure 17

OVERHAUL INSTRUCTIONS — Continued

NOTE: If rocker shaft bosses are excessively worn, bushings (No. 22949) may be installed as shown in Fig. 17.

c. Valve Mechanism.

(1) Remove nicks and scores from exhaust and intake rockers and polish finished surfaces with crocus cloth.

(2) Polish valve rocker bushings for slight scores and roughness.

(3) Straighten push rods which are slightly bent by tapping into proper shape, using a light mallet. Polish ball ends with crocus cloth. Loose or badly worn ball ends must be replaced by complete push rod assembly.

(4) Valve springs which are broken at flat ends cannot be repaired satisfactorily and therefore should be replaced.

(5) Remove scores or burrs from valve spring seats by stoning and polishing.

(6) Polish valve spring seat locks with crocus cloth inside and outside diameter.

(7) Stone valves to remove burrs and scores in the lock grooves and on stem tips. If tips are worn, they should be dressed with a fine emery wheel to secure a flat surface, square with valve stem. Replace warped or badly pitted valves. Use a standard valve refacing machine for conditioning valve contact faces and lap into valve seats as described in paragraph 2. (b). (4) above.

d. Crankshaft and Connecting Rods.

(1) Dress with proper dies damaged threads on front end of crankshaft. Remove all nicks and scores on bearing surfaces by careful stoning and polishing with crocus cloth. Stone keyway on front of shaft to remove scores, nicks, and burrs.

(2) If main and connecting-rod bearings are worn, or if checks or cracks are visible, make replacement.

(3) Remove all nicks and scores from connecting rods by stoning and polishing with crocus cloth. Remove slight scores in piston pin bushing by polishing with crocus cloth. If bushing appears burned or rough, replace. Repair slightly damaged threads on connecting rod bolts, using proper dies.

e. Pistons and Piston Pins.

(1) Repair pistons, pins and plugs which are slightly scored or burred by careful use of a fine stone and by polishing with crocus cloth.

CAUTION: Stone only enough to remove the metal which has piled up — deep scratches can-

not be removed. If scoring is heavy, piston and piston pin must be replaced. Do not at any time use a wire brush or buffer wheel on the pistons.

(2) Replace piston rings at the time of a major overhaul. If cylinder barrels have been reground or if piston ring grooves have been remachined, care should be exercised in securing the proper oversize piston rings.

(3) Replace cracked or badly eroded pistons with pistons which are within 1/4 ounce of the same weight.

f. Crankcase Cover Assembly.

(1) Make repairs to crankcase cover in accordance with instructions given in paragraph 1. (d) and (g) of this section. Particular attention should be given to removing nicks and burrs from all finished surfaces, using a fine stone and polishing with crocus cloth.

(2) Carefully dress and chase with proper dies damaged threads in cover for the oil screen assembly, oil pressure relief valve cap and tachometer drive housing.

(3) Repair with proper thread chasers damaged threads on oil screen assembly, oil pressure relief valve cap and tachometer drive housing.

(4) If oil pump gears are nicked or scratched, stone lightly. Remove all burrs. If the gears are badly dented or worn, replace.

(5) Replace tachometer drive oil seal at the time of a major overhaul.

g. Camshaft and Hydraulic Tappets.

(1) If lobes on the cam are scuffed, stone lightly.

(2) If cam followers are scuffed, stone light. Examine the tappets for wear and damage. If either the piston or cylinder is damaged, replace both parts. For complete information on Hydraulic Tappets refer to section 19.

CAUTION: Do not drop hydraulic tappets or allow them to come in contact with other metallic objects, as damage will result.

h. Gears — Stone lightly crankshaft, magneto drive and cam gears if nicked or scratched. Remove all burrs. If the gears are badly dented or worn, they should be replaced. Cap screws should be replaced if heads or threads are damaged.

i. Intake Pipes, Connections and Clamps.

(1) Remove small dents from intake pipes by careful hammering on a suitable mandrel and without reducing the wall thickness of the pipe,

OVERHAUL INSTRUCTIONS — Continued

to obtain a smooth and even surface. Replace cracked or leaking intake pipes.

(2) Replace rubber hose connections for intake pipes at the time of a major overhaul.

(3) Replace intake hose clamps if broken or cracked.

j. Push Rod Housing Flanges, Connections and Clamps.

(1) Stone lightly all finished surfaces of the flanges to remove all nicks and scratches. If

flange is cracked, it must be replaced.

(2) Replace the rubber push rod housing connections at the time of a major overhaul.

(3) Replace push rod housing clamps if broken or cracked. If threads of tightening screws are damaged, replace.

k. Ignition System — Replace all ignition cables at overhaul. For instructions on repair and replacement of ignition cables refer to Section 8, page 22.

Section 11

REASSEMBLY, FINAL ASSEMBLY, TIMING AND TESTING

1. GENERAL.

This section covers the procedure of the reassembly of the major sub-assemblies, the final assembly of the complete engine, the timing of magnetos to the engine and the final testing of the engine following the overhaul of each major sub-assembly and separate parts as described in the previous section.

2. REASSEMBLY OF MAJOR SUB-ASSEMBLIES.

a. Cylinder and Valve Assembly Procedure.

(1) Apply a light coat of oil on valve stems. From inside of cylinder and head assembly, assemble intake valve through intake valve guide. In same manner, assemble exhaust valve through exhaust valve guide.

(2) Holding both valve stems so that head of each valve is against valve seat, mount cylinder and head assembly over suitable holding block on bench. Assemble intake and exhaust valve spring retainers over valve guides.

(3) Assemble inner and outer valve springs over exhaust valve and guide and onto the valve spring retainer. Assemble valve spring seat over valve stem with spring lands toward springs.

(4) Using a suitable valve-spring compressor, (Fig. 13), assemble valve-spring seatlocks in groove on valve stem so that large diameter of locks is toward end of valve stem.

(5) Assemble valve spring over intake valve and guide in same manner as described above.

(6) Assemble new rubber push rod housing connections and clamps on the push rod housings, pushing them toward the cylinder head for clearance when cylinder is assembled to crankcase.

(7) Install new cylinder base packing on cylinder barrel base, using a very thin film of sealing compound on the cylinder flange on the flat surface that will contact the crankcase.

CAUTION: Do not pick up cylinders by push rod housings as they are only pressed into the rocker box and are easily bent. Any bending or misalignment will result in an oil leak.

b. Connecting Rods to Crankshaft.

(1) Snap both halves of the connecting rod bushings into the connecting rod and cap.

(2) Assemble connecting rods in their proper positions on the crankshaft with the connecting rod numbers pointing up. (Fig. 15.)

NOTE: The connecting rod bolts must be assembled on the connecting rods with the threaded end pointed toward the piston pin bushing. Fasten securely with castle nuts and cotter pins.

c. Pistons and Piston Pins.

(1) With top of piston downward on bench, assemble one oil scraper ring with **undercut edge toward open end of piston**, in the ring groove nearest the open end of piston. Turn piston with top up on the bench, assemble the other oil scraper ring with **undercut edge down** in the third ring groove from top of piston. Assemble plain ring in second groove and compression ring with **beveled edge toward top of piston** in the top groove.

OVERHAUL INSTRUCTIONS — Continued

(2) Assemble the piston pin and plugs temporarily into pistons.

d. Crankcase Cover Assembly (Series 8).

(1) Install oil screen assembly into crankcase cover.

(2) Install oil pressure relief valve plunger, spring, gasket and cap into crankcase cover. See that the plunger works freely in its cage without sticking.

(3) Press tachometer drive oil seal into tachometer housing. Assemble oil pump drive gear into cover with square coupling on the inside of the cover. Insert driven gear into mesh with drive gear. Assemble oil pump cover over studs and gear shaft on inside of cover. Holding cover in place with one hand, assemble tachometer drive housing (with oil seal pressed in place) and gasket over end of drive gear shaft on outside of cover, pushing the shaft through the oil seal. It is advisable to use a $\frac{3}{8}$ inch rod to lead the shaft through the packing in order that it will not be pushed out of position. Screw tachometer drive housing securely to cover.

NOTE: The tachometer drive housing has a **left-hand thread** which secures it to the crankcase cover.

(4) Test the oil pump gears for free running in the case. If they are free from binding, assemble washers and nuts to the pump cover and safety wire.

e. Crankcase Cover Assembly (Series 9).

(1) Press tachometer drive oil seal into tachometer housing. Assemble oil pump drive gear into cover with square coupling on the inside of the cover. Insert driven gear into mesh with drive gear. Assemble oil pump cover over studs and gear shaft on inside of cover. Holding cover in place with one hand, assemble tachometer drive housing (with oil seal pressed in place) and gasket over end of drive gear shaft on outside of cover, pushing the shaft through the oil seal. It is advisable to use a $\frac{3}{8}$ inch rod to lead the shaft through the packing in order that it will not be pushed out of position.

(2) Push tachometer drive housing on the studs and fasten securely with washer, nut and palnuts.

(3) Test the oil pump gears for free running in the case. If they are free from binding, assemble washers and nuts to the pump cover and safety. See that wire is pressed tightly against the oil pump plate to prevent interference.

(4) Install oil pressure relief valve plunger, spring, gasket and cap into crankcase cover. See that the plunger works freely in its cage without sticking.

(5) Install oil screen housing on the one $\frac{1}{4}$ stud provided on the crankcase cover. See that the housing is properly located on the pad and secured with nut and palnut.

f. Intake Pipes and Hose Connections.

(1) Push one $1\frac{1}{2}$ inch hose and one $1\frac{3}{4}$ inch hose (one inserted into the other) over one end of intake pipe.

(2) Run four hose clamps over end of intake pipe.

(3) Push another set of hose connections over other end of intake pipe. (See (1) above.)

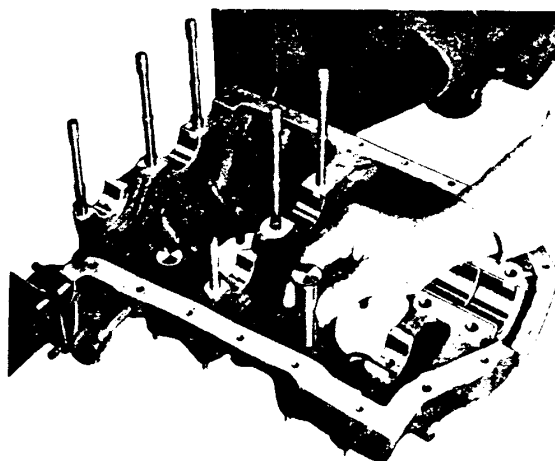
3. FINAL ASSEMBLY PROCEDURE.

a. Preliminary.

(1) Mount No. 2-4 crankcase (referring to cylinder numbers) with contact face, or inside of crankcase, up, on a suitable engine stand which will permit tilting the crankcase to horizontal and upright position. Lay crankcase No. 1-3 with contact face up on bench. Put a very thin film of sealing compound on the contact face of crankcase No. 2-4 and on the front of the No. 1-3 crankcase where the oil seal is pressed in.

(2) Dip cam followers in light oil and insert into the push rod housing pads from the inside of the crankcase (Fig. 18). Install in both halves of the crankcase.

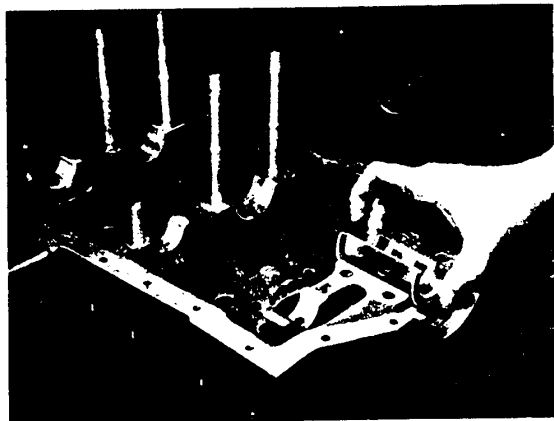
NOTE: Insert push rod hose connections over the ends of the cam followers installed in the



Installing Cam Follower Body into Crankcase — Figure 18

CONTINENTAL A50, A65, A75, A80 ENGINES

OVERHAUL INSTRUCTIONS — Continued



Installing Crankshaft Bearings into Crankcase — Figure 19

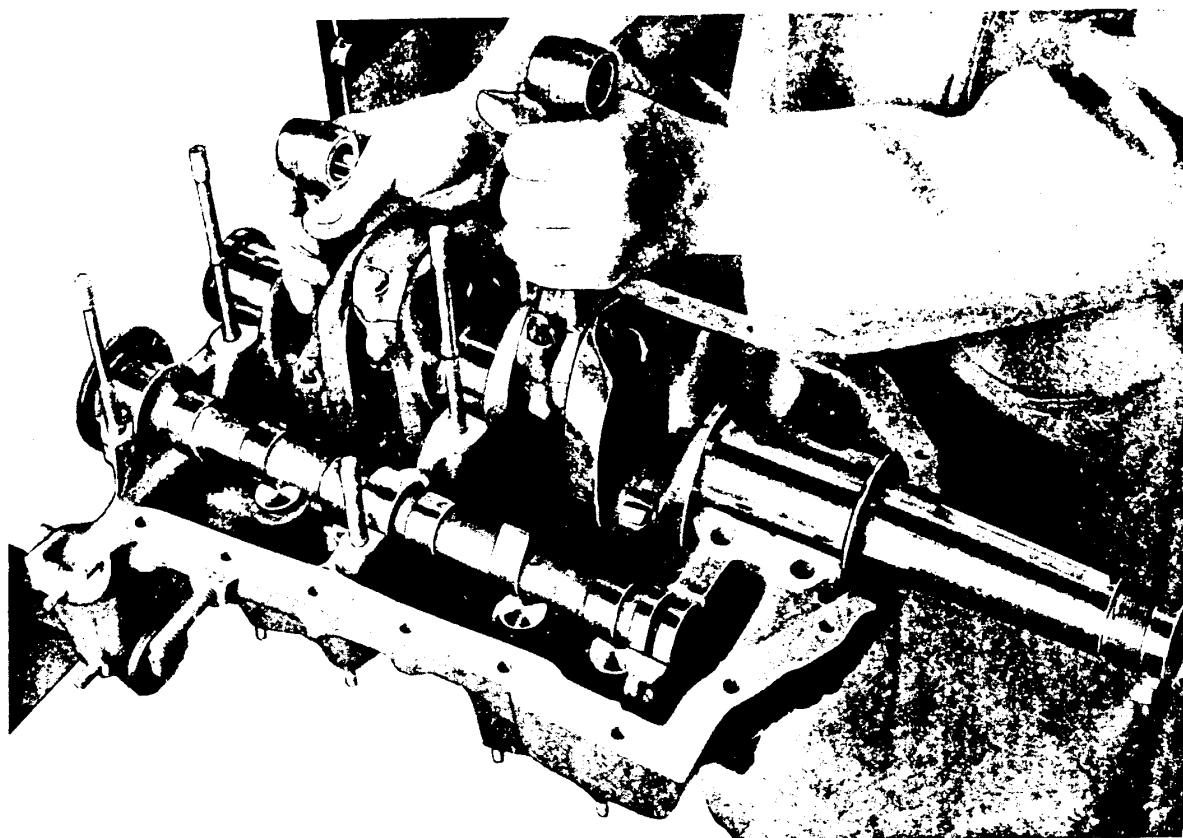
No. 1-3 crankcase to prevent them from slipping out when crankcases are assembled together.

(3) Insert bearings in both cases and gently tap into place, (Fig. 19). The shell-type bearings have "tangs" and can only be replaced in their proper positions. On Series 9 engines lay starter gear bushing in position on the No. 2-4 crankcase with flange on outside of the crankcase and with the oil hole in the bushing in line with the oil passage in the crankcase.

(4) Oil camshaft and lay in No. 2-4 crankcase. Check camshaft for end clearance in accordance with limits as set forth in the Table of Limits.

b. Installing Crankshaft and Connecting Rods.

(1) Oil bearings thoroughly. Lay crankshaft, with connecting rods assembled, into place in the No. 2-4 crankcase. (Fig. 20.) The No. 2 and No. 4 connecting rods must be carefully guided through the No. 2 and No. 4 cylinder ports of



Installing and Removing Crankshaft and Connecting Rods — Figure 20

CONTINENTAL A 50, A 65, A 75, A 80 ENGINES

OVERHAUL INSTRUCTIONS — Continued

the crankcase, taking care that they do not strike and damage the openings.

(2) Check end clearance of crankshaft in the crankcase as specified in the Table of Limits.

c. Assembly of Crankcases and Component Parts.

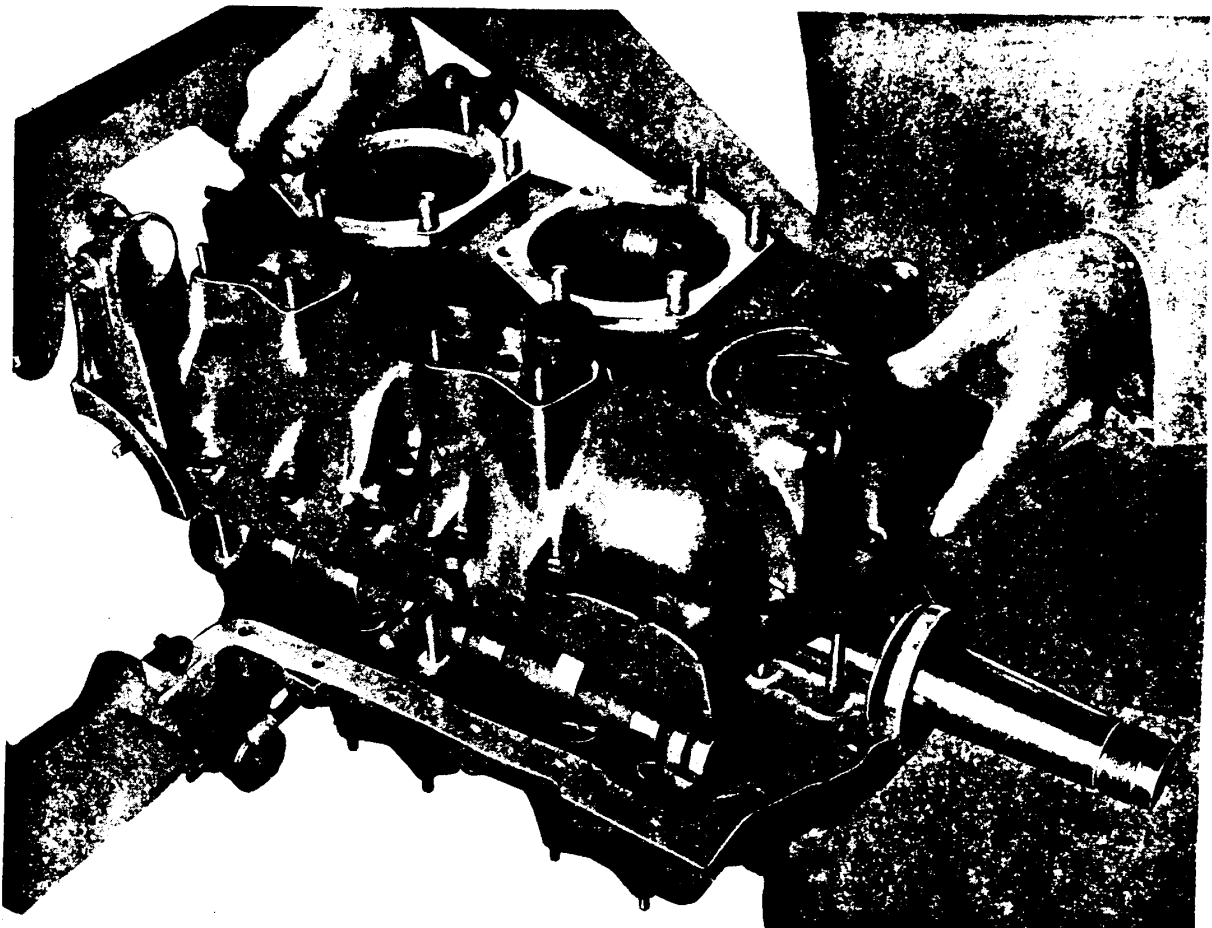
(1) Install oil seal on front of crankshaft, pushing securely into place on the No. 2-4 crankcase.

(2) Lay No. 1-3 crankcase in place on No. 2-4 crankcase, carefully guiding connecting rods No. 1 and No. 3 through cylinder ports. (Fig. 21.) Be sure dowel bolts are in their proper locations. Check camshaft and crankshaft for free running to see that crankcases are installed in their

proper positions. Remove push rod hose connections from cam followers on No. 1-3 crankcase.

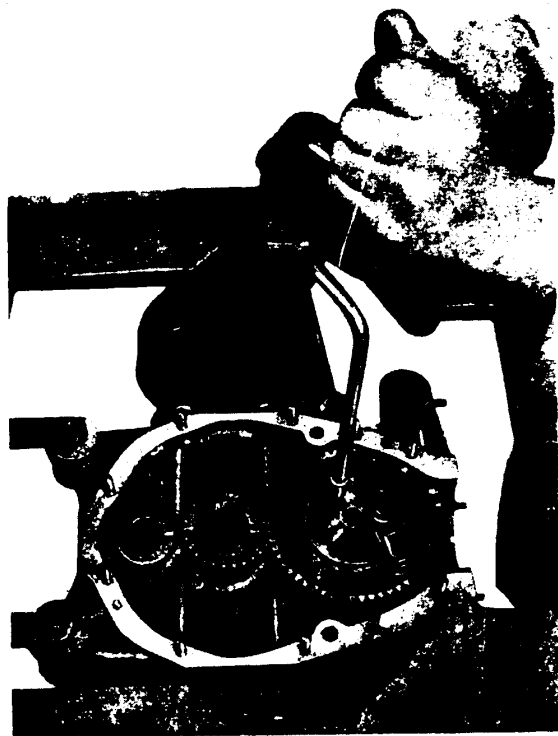
NOTE: On Series 9 engines when the No. 1-3 crankcase is laid in place over No. 2-4 crankcase, extreme care must be taken to insure that the starter gear bushing is in its proper position. A shouldered dowel is provided in the journal on the crankcase which fits into the dowel hole in the starter gear bushing, locking the bushing in position and preventing it from turning.

(3) Assemble the six (6) $\frac{1}{4}$ inch cap screws, washers and nuts at top of the crankcase. Assemble the five (5) $\frac{1}{4}$ inch cap screws, washers, and nuts at bottom of crankcase. Three dowel cap screws are used for properly lining up the crankcases. Assemble remaining cap screws, washers,



Installation of Crankcase 1-3 over Crankcase 2-4 — Figure 21

OVERHAUL INSTRUCTIONS — Continued



Installation of Gears in Crankcase — Figure 22

and nuts on front end of crankcase. Assemble remaining washers and nuts to crankcase studs. Install breather connection in tap provided in side of No. 1-3 crankcase opening pointed toward the bottom of the crankcase.

(4) Rotate engine stand so that front of engine is pointing straight up. Tighten all nuts holding the two halves of the crankcase firmly and evenly. Install propeller hub key in keyway — tapping carefully in place with mallet. Install palnuts on all nuts holding crankcase together.

d. Installing Gears and Crankcase Cover.

(1) Rotate engine stand until rear end of crankcase is pointing straight up.

(2) Assemble crankshaft gear to crankshaft with four 1/4 inch cap screws, turning them down as far as possible by hand.

NOTE: The holes in the crankshaft gear and camshaft gear are so spaced that it is impossible to assemble the gears to the shafts incorrectly.

(3) Install cam gear to camshaft with four 1/4 inch cap screws. The timing mark on the cam gear must mesh between the two timing marks on the crankshaft gear (Fig. 6). Place a screw

driver in one of the lightening holes in the cam gear and rotate gear until screw driver is locked against the crankcase, preventing gears from turning when cap screws are tightened. Tighten cap screws on cam gear and crankshaft gear with standard 1/4 inch wrench (Fig. 22).

NOTE: For Series 9 engines proceed as follows.

a. Install starter gear into starter gear bushing in mesh with crankshaft gear.

b. Place the starter gear retainer over the 5/16 inch screw.

c. Reaching through the No. 1 Cylinder port, install the screw (with retainer) into the starter gear. Make certain that the retainer shoulder is seated properly on the starter gear.

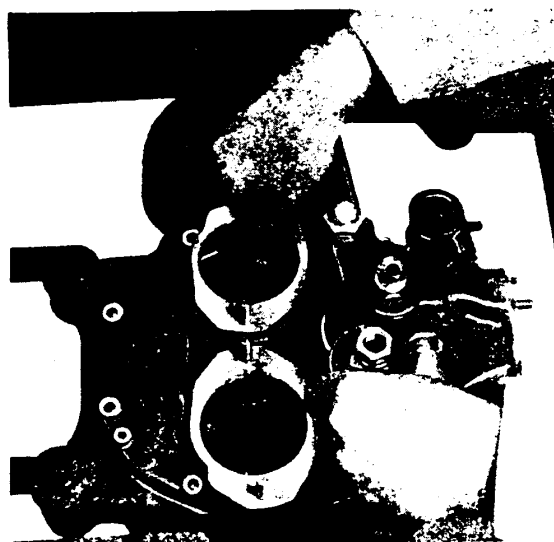
d. Install 1 1/4 inch washer in place on starter gear and secure with castle nut and cotter pin.

CAUTION: Do not tighten starter gear retainer nut excessively tight as it may result in binding and unnecessary wear.

(4) Remove screw driver from cam gear and check backlash of gears.

(5) Safety wire cap screws on both gears. Care must be taken to press wire tightly against the gear body to avoid a possibility of interference with the studs of the oil pump cover.

(6) Place crankcase cover gasket over end of crankcase and mounting studs. Assemble crankcase cover assembly over gasket and studs (Fig. 23).



Installation of Crankcase Cover to Crankcase — Figure 23

OVERHAUL INSTRUCTIONS — Continued

NOTE: For Series 9 Engines: Place crankcase cover gasket in position over end of crankcase and mounting studs. Install crankcase cover assembly over gasket and studs, properly meshing the oil pump drive gear into the cam gear. It will be noted that two studs secure both the crankcase cover and oil screen housing to the crankcase.

(7) Rotate engine stand so that crankshaft is horizontal. Install washers and nuts to studs. Tighten nuts securely and install palnuts.

NOTE: Safety wire oil pressure relief valve cap to nearest stud holding crankcase cover to crankcase, and secure with palnut.

e. Installing Oil Sump and Oil Suction Tube.

(1) Rotate engine stand so that the crankcase cover is facing up.

(2) Cut off the portion of the crankcase cover gasket which crosses the oil sump opening.

(3) Install oil suction tube in the tapped hole in the bottom of the crankcase cover, tightening with a $\frac{7}{8}$ inch wrench. Safety wire suction tube to crankcase cover in holes provided.

(4) Install oil sump gasket to mounting studs on bottom of crankcase and cover. Mount oil sump on the six mounting studs on the case and cover and fit oil filler bracket over stud in crankcase mounting arm. Secure sump with washers and castle nuts on the case and cover and install nut and palnut on stud holding oil filler bracket.

f. Installing Hydraulic Units and Push Rod Housing Flanges.

(1) Rotate engine stand so that crankshaft is horizontal. Oil hydraulic units with thin coat of light oil.

NOTE: Be sure that the hydraulic unit is working properly and smoothly by depressing the piston with the thumb several times. Units should be partially deflated of trapped air and oil by releasing the ball check by inserting a $\frac{3}{32}$ inch diameter rod tapered for approximately $\frac{1}{2}$ inch to dull point on the end that will contact ball check. This will prevent damage to ball check seat. Refer to page 96 for complete information.

(2) Insert hydraulic units, tube end first, into the cam follower body. Insert tappet cups on top of hydraulic units in the cam follower body.

(3) Place push rod housing flange gaskets over studs on housing pads in crankcase. Install push rod housing flanges over studs and gaskets.

(4) Secure flanges to crankcase with washers and nuts.

NOTE: Tighten middle nut of flange first. Do not tighten nuts excessively, as the flange may be cracked.

(5) Install palnuts on all nuts holding push rod housing flanges to the crankcase.

g. Installing Cylinders.

(1) Rotate engine stand so that the front of the engine is facing up.

(2) Oil piston pin bushing on connecting rods. Install piston pin plugs into piston pin. Oil piston thoroughly and work oil into piston ring grooves. Oil piston pin and install piston (with rings assembled) to the connecting rod. Install piston with the numbers toward the front of the engine. The connecting rod must be fully extended through the port.

(3) Stagger gaps in piston rings on the piston so that they are evenly distributed around the piston to prevent blow-by. Assemble steel clamping band around the piston, compressing the piston rings and also retaining the piston pin and plugs in the piston.

(4) Coat inside cylinder barrel with a thin coat of engine oil.

(5) With one hand compressing the steel clamping band around the rings, insert the cylinder barrel over the top of the piston. (Fig. 24.)

CAUTION: Do not pick up cylinders by push rod housings as they are only pressed into the rocker boxes and are easily bent. Any bending or misalignment will result in an oil leak.

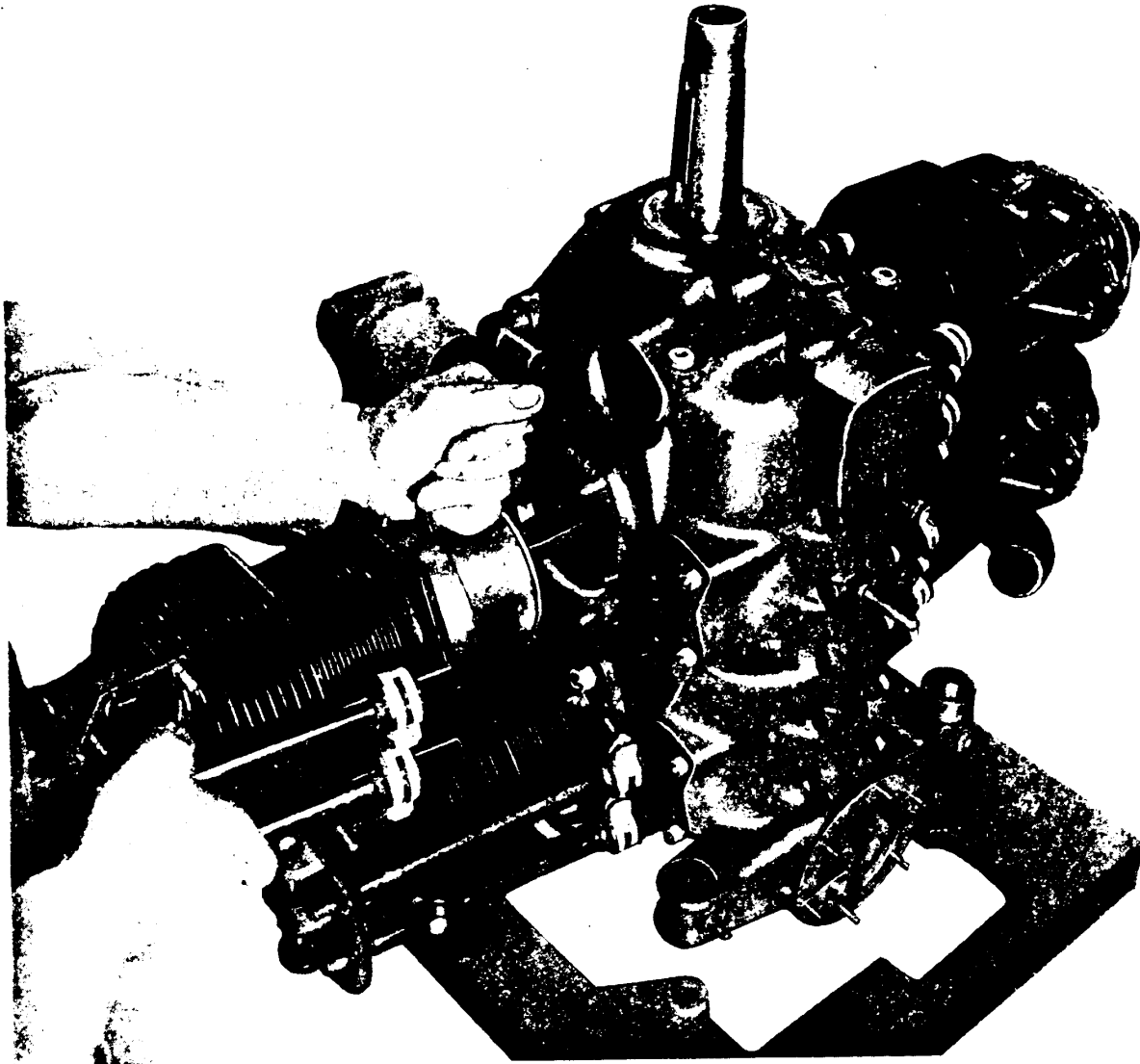
(6) Steady the cylinder with the body, push the cylinder carefully back to the mounting studs, moving the steel band back on the piston. Remove steel band when cylinder is pushed on the full length of the piston.

(7) Assemble cylinder flange over studs on crankcase. Be sure that cylinder base packing is properly in place and not twisted. Assemble nuts on studs and tighten slowly and evenly. Install palnuts.

CAUTION: Do not tighten nuts excessively as the studs may be stretched or broken. See Table of Limits for the proper amount of torque to be applied on nuts.

(8) Rotate crankshaft so that intake and exhaust valves are closed. Insert push rods into the

OVERHAUL INSTRUCTIONS — Continued



Installation of Cylinder on Crankcase — Figure 24

housings, hold rocker arms in place, and push in the rocker arm shaft.

(9) Assemble gaskets on rocker box flanges and install valve rocker box covers and secure with fillister screws.

(10) Slip push rod connections and clamps down over push rod housing flange, and tighten clamp moderately.

(11) Assemble remaining cylinders in the same manner as described above.

h. Installing Air Intake System.

(1) Assemble carburetor to intake manifold securing with four elastic stop nuts. The nut nearest the altitude control of the carburetor should be installed first to facilitate assembly.

(2) Assemble intake manifold (with carburetor attached) to the crankcase on the two studs provided at the bottom. Secure with nuts and pal-nuts. Tighten nuts moderately.

CONTINENTAL A50, A65, A75, A80 ENGINES

OVERHAUL INSTRUCTIONS — Continued

(3) Place gaskets on intake flanges. Attach intake elbows on the two studs on the flange, and secure with nuts and palnuts.

(4) Assemble intake pipes (with hose connections and clamps installed) to intake manifold and elbow, pushing outer hose connections over ends of manifold and intake elbows. Install clamps on both ends of each connection and tighten securely.

i. Installing Ignition System.

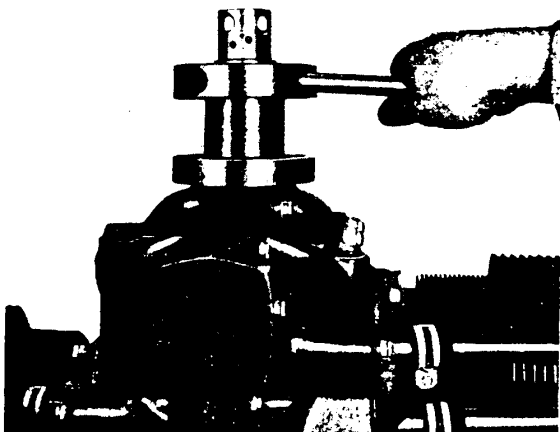
(1) Assemble lower spark plugs with gasket in each cylinder.

(2) Determine the firing position of cylinder No. 1 in the following manner:

(a) Place timing disc on the tapered crankshaft so that the slot in the hub fits over the key on the shaft. The top center (T.C.) mark stamped on the timing disc must line up with the split of the two crankcases on the **top dead center of the compression stroke**.

(b) To determine that the piston is on the compression stroke, place thumb over upper spark plug hole and turn crankshaft in **direction of rotation**. The intensity of the pressure will indicate that the piston is on the compression stroke.

(c) When the piston is on top dead center with the top center (T.C.) mark in line with the split of the crankcases, turn crankshaft in a **clockwise direction** until the timing disc is set as specified in the Table of Specification, Section 1, for the particular engine being timed. The piston is then set at its firing position. (See figure 25.)



Determining Firing Position — Figure 25

(3) Installing and Timing Magneto to the Engine.

(a) Before installing magnetos, insure that they have been correctly timed and checked in accordance with the section covering the accessories.

(b) Rotate the magneto drive gear, attached to the magneto, until the timing marks on the chamfered tooth of gear and timing pointer are opposite each other as seen through the timing window in the magneto cover. At this position the breaker contacts should begin to open.

(c) All adjustments for exact timing to the engine are made at the drive end and not by altering the position of the contact points. See that the mounting faces are clean and smooth. With the timing marks (as described in (b) above) opposite each other, install the magneto on the engine and secure with its mounting nuts. Exact timing is obtained by turning the magneto through the angle provided by the slots in the magneto flange. (Figure 42, page 96.)

(d) Before checking the exact breaker opening position, rotate magneto counter-clockwise by tapping the mounting flange until it is near the end of the travel permitted by the slots.

(e) Turn crankshaft backward a quarter turn, then bring up slowly to firing position to take the backlash out of driving gear train.

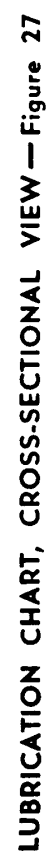
(f) Insert a .0015 inch feeler between breaker points (cellophane may be used as a substitute), and tap mounting flange in a clockwise direction until the exact point of release is obtained. (Figure 26.)

NOTE

If a Bendix Scintilla No. 11-851 timing light or equivalent is available, it should be used to determine the opening of the contacts rather than using a feeler gage or cellophane strip. The use of shim stock or cellophane feeler strips invariably introduces a possibility of fouling the points, since oil and dirt is nearly always present on such feeler strips. If the strip is of soft material such as cellophane, brass, or foil, particles of the strip itself are likely to remain between the contacts, causing unsatisfactory magneto operation.

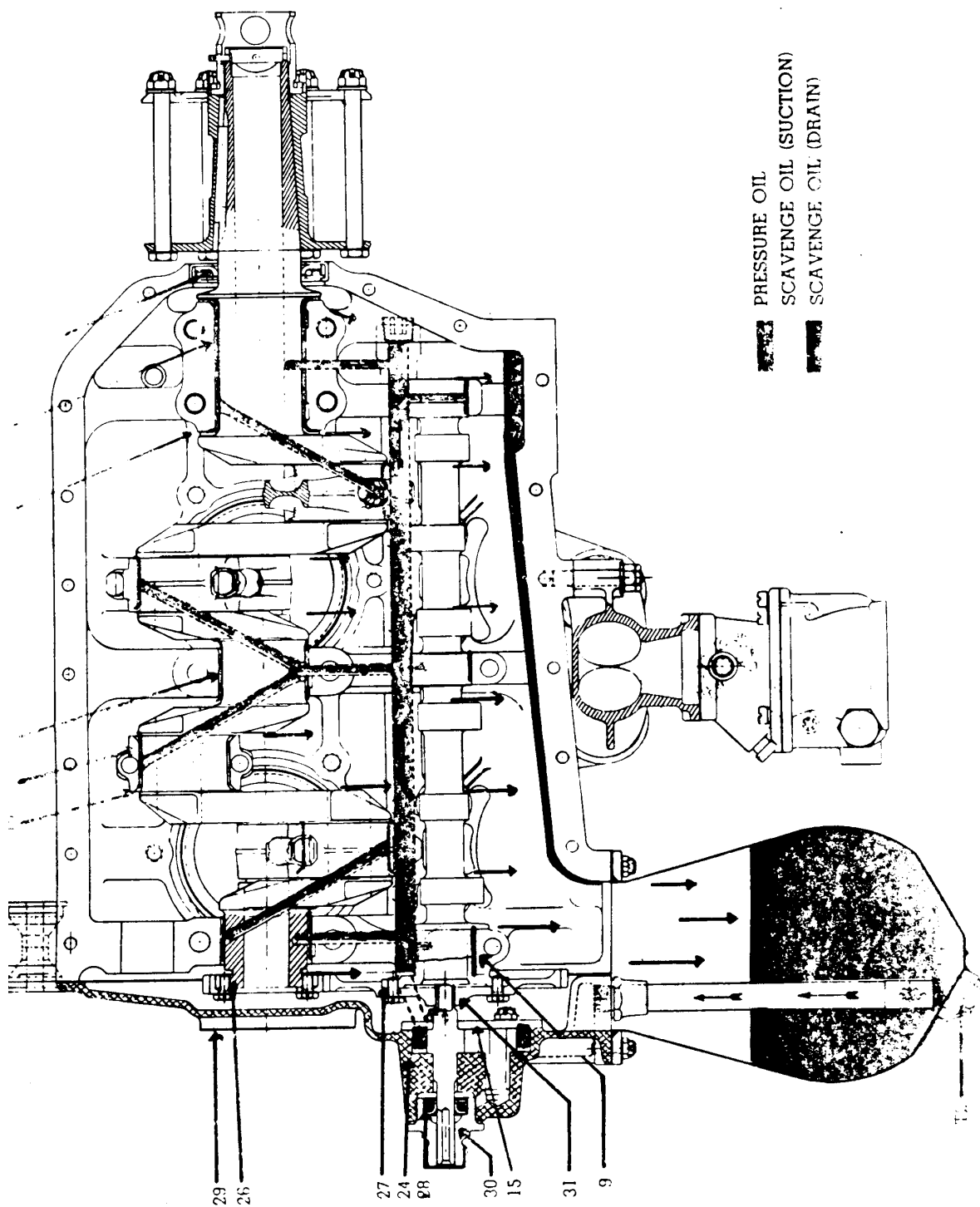
(g) Tighten the mounting nuts. Check timing

OVERHAUL INSTRUCTIONS — Continued



CONTINENTAL A50, A65, A75, A80 ENGINES

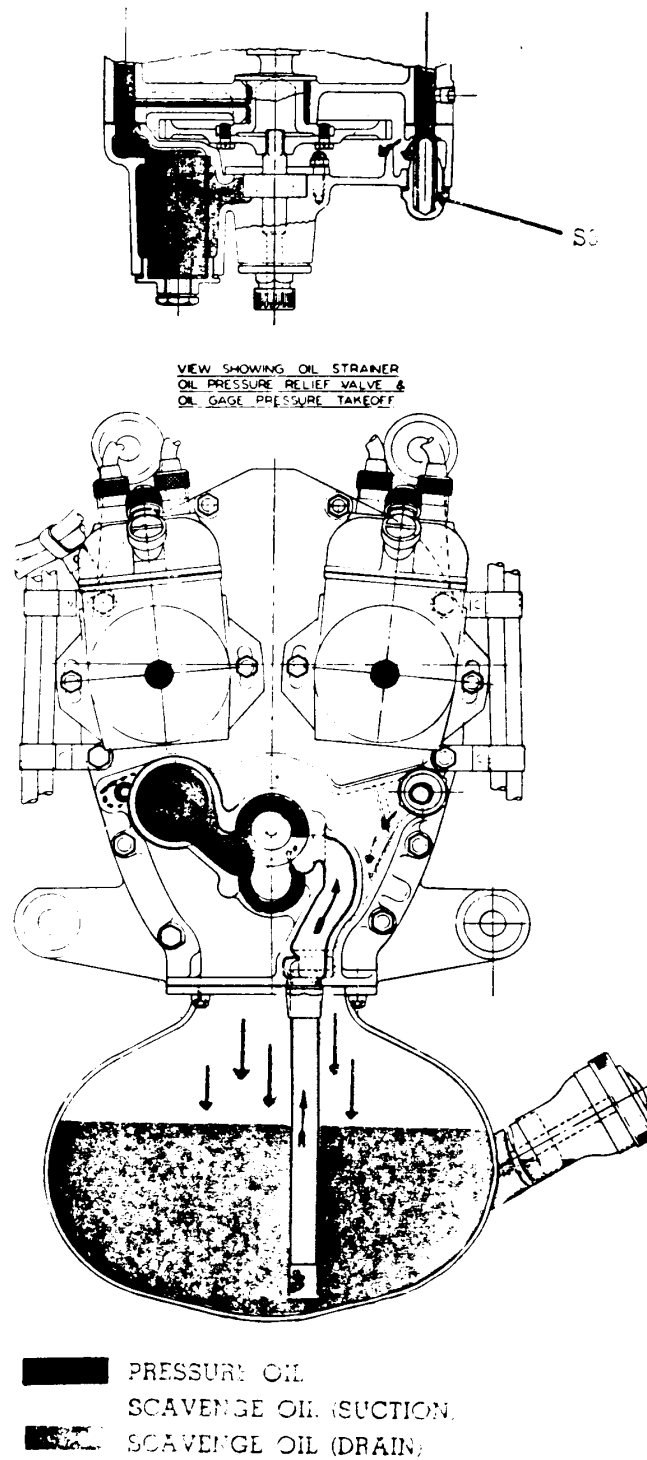
OVERHAUL INSTRUCTIONS — Continued



LUBRICATION CHART, LONGITUDINAL VIEW — Figure 28

CONTINENTAL A50, A65, A75, A80 ENGINES

OVERHAUL INSTRUCTIONS — Continued



LUBRICATION CHART, REAR VIEW — Figure 29

CONTINENTAL A50, A65, A75, A80 ENGINES

Section 12

TABLE OF LIMITS

A50, A65, A75, A80

Ref. No.	Fig. No.	Description of Limits	Refit To		Replace Beyond
			Min.	Max.	
		Piston (4544) in Cylinder (A50)			
1	27	Top 3 lands Diameter	.027L	.033L	*.038L
		Skirt Diameter	.014L	.019L	*.022L
		Piston (40731) or (40312) in Cylinder (A65)			
1	27	Top 3 lands Diameter	.028L	.032L	*.037L
		Top of skirt Diameter	.009L	.013L	*.018L
		Bottom of skirt Diameter	.005L	.011L	*.014L
		Piston (40577) in Cylinder (A75)			
1	27	Top land Diameter	.023L	.027L	*.032L
		2nd. and 3rd. lands Diameter	.028L	.032L	*.037L
		Skirt Diameter	.014L	.019L	*.022L
		Piston (4701) in Cylinder (A80)			
1	27	Top 4 lands Diameter	.023L	.027L	.032L
		Skirt Diameter	.014L	.019L	.022L
		Bottom land Diameter	.058L	.070L	.....
		Piston Ring (side Clearance)			
2	27	Piston Ring in top groove (comp.) (A50) .....	.0015	.0035	.009
		Piston Ring in 2nd. groove (plain) (A50) ....	.0015	.003	.007
2	27	Piston Ring in 3rd. & 4th. grooves (scraper) (A50) .....	.001	.003	.005
		Piston Ring in top groove (comp.) (A65) .....	.0045	.0065	.010
		Piston Ring in 2nd. groove (comp.) (A65) ....	.003	.005	.009
2	27	Piston Ring in 3rd. groove (oil) (A65) .....	.0015	.004	.007
		Piston Ring in top groove (comp.) (A75) .....	.0045	.0065	.010
2	27	Piston Ring in 2nd. groove (comp.) (A75) ....	.0015	.004	.007
		Piston Ring in 3rd. groove (oil) (A75) .....	.0015	.004	.007
		Piston Ring in top groove (comp.) (A80) .....	.0045	.006	.010
17	27	Piston Ring in 2nd. groove (comp.) (A80) .....	.002	.004	.009
		Piston Ring in 3rd. groove (plain) (A80) .....	.002	.004	.009
		Piston Ring in 4th. groove (scraper) (A80) ....	.002	.004	.009
		Piston Ring in 5th. groove (scraper) (A80) ..	.001	.003	.0075
		Piston Ring (gap)			
		Comp. and scraper rings .....	.012	.017	.020
		Oil rings .....	.015	.020	.020
		Compression Ring (gap closed)	12½ lb.	15 lb.	12½ lbs. (Min.)
		Scraper Ring (gap closed)	9 lb.	12 lb.	9 lbs. (Min.)
		Oil Ring (gap closed)	10 lb.	14 lb.	10 lbs. (Min.)
		Piston Pin			
		Plug in Piston Pin .....	.001L	.004L	.005L
		Piston Pin and Plug in Cylinder .....	.010L	.042L	.050L
		Piston Pin in Piston .....	.0001L	.0009L	.0001L (Min.)
5	27	Piston Pin in Connecting Rod			
		Bushing Diameter	.0014L	.0021L	.0031L
		Connecting Rods			
		Connecting Rod Bearing on			
		Crankshaft Diameter	.0005L	.004L	.005L

CONTINENTAL A 50, A 65, A 75, A 80 ENGINES

TABLE OF LIMITS—Continued

Ref. No.	Fig. No.	Description of Limits	Min.	Refit To Max.	Replace Beyond
16	28	Connecting Rod to Crankshaft.....end clearance	.006	.011	.015
4	27	Piston Pin Bushing in Connecting Rod.....Diameter	.002T	.004T	.....
Crankshaft & Main Bearings					
Crankshaft Main Journals					
		(standard).....Diameter	1.871	1.873	†1.870
6	28	Crankshaft in Front Bearing.....end clearance	.005	.017	.025
8a	28	Crankshaft in Main Bearing (front).....Diameter	.0005L	.004L	.005L
8	28	Crankshaft in Main Bearings (center & rear).....Diameter	.0005L	.0045L	.0055L
		Crank Pins.....Diameter	1.935	1.937	†1.934
7	28	Crank Pins out of round.....	.000	.0005	.0015
8	28	Crankshaft run out (center main) (supported at front and rear mains).....			.0035
		Crankshaft run out (at front of taper) (supported at front and rear mains).....			.008
		Crankshaft Flange run out (near perimeter on face of Flange) — Shaft supported at front and rear mains.....			.005
Camshaft Journal					
9	28	Journals in Crankcase.....Diameter	.001L	.004L	*.005L
		Rear Journal in Crankcase.....end clearance	.004	.013	.017
10	27	Valve Tappet in Crankcase.....Diameter	.0005L	.003L	.004L
Valve Rockers, Shafts, Pushrods					
11	27	Rocker Shaft in Rocker Bearing.....Diameter	.0011L	.0021L	.004L
		Rocker Shaft in Cylinder Head Bosses.....Diameter	.0002L	.0017L	†.003L
21	27	Valve Rocker Bushing in Valve Rocker.....Diameter	.002T	.004T	.....
22	27	Valve Rocker.....side clearance	.004	.016	.020
23	27	Push Rod — overall length.....	10.797	10.817	10.787 (Min.)
Cylinder					
12	27	Exhaust Valve in Guide.....Diameter	.0027L	.0047L	.006L
12	27	Intake Valve in Guide.....Diameter	.001L	.003L	.005L
19	27	Exhaust Valve Insert in Cylinder Head.....Diameter	.0045T	.0075T	.....
18	27	Intake Valve Insert in Cylinder Head.....Diameter	.005T	.008T	.....
13	27	Valve Guide in Cylinder Head.....Diameter	.001T	.0025T	.....
		Spark Plug Insert in Cylinder Head.....Pitch Diameter	.0001T	.0026T	.....
14	27	Cylinder Barrel Bore Maximum Allowable Taper.....			***.0025
14	27	Cylinder Bore Out of Round.....			***.0015
14	27	Cylinder Bore (standard size) — Max. Diameter at any point.....			***3.882
		Cylinder Bore (Reground to .015" O.S.).....Diameter	3.890	3.892	3.897

CONTINENTAL A 50, A 65, A 75, A 80 ENGINES

TABLE OF LIMITS — Continued

Ref. No.	Fig. No.	Description of Limits	Refit To		Replace Beyond
			Min.	Max.	
14	27	Cylinder Bore Surface Roughness (Micro Inches, R.M.S.)	20	30	20 (Min.)
20	27	Cylinder Barrel in Crankcase.....Diameter	.003L	.012L	.012L
Oil Pump					
Oil Pump Shafts in Crankcase					
		Cover .....Diameter	.0015L	.004L	.0045L
		Oil Pump Shaft in Plate .....Diameter	.0015L	.004L	.0045L
24	28	Gears in Oil Pump Housing.....end play	.002	.006	.006
		Gears in Oil Pump Housing.....Diameter	.003L	.007L	.007L
25	28	Front Crankshaft Oil Seal			
		in Crankcase .....Diameter	.001T	.007T	.....
26	28	Crankshaft Gear on Crankshaft			
		Pilot .....Diameter	.0005T	.0035L	.0035L
27	28	Camshaft Gear on Camshaft Pilot.....Diameter	.0005T	.0035L	.0035L
28	28	Oil Seal in Tachometer Housing.....Diameter	.001T	.007T	.....
29	28	Magneto Pilot in Accessory Case.....Diameter	.001L	.008L	.....
30	28	Tachometer Drive Shaft in Housing.....Diameter	.015L	.045L	.....
31	28	Oil Pump Drive Shaft in Camshaft			
		Gear — across flats.....	.008L	.011L	.020L
GEAR TEETH BACKLASH					
		Crankshaft Gear to Cam Gear.....	.0005	.013	.020
		Magneto Drive Gears to Crankshaft Gear.....	.005	.012	.020
		Oil Pump Gears.....	.007	.018	.020

TORQUE LIMITS

T5	1/4" Nuts and Cap Screws	75-100 in. lbs.
	5/16" Nuts and Cap Screws	160-200 in. lbs.
T1	Spark Plugs	300-360 in. lbs.
T2	Plug — Oil Sump Drain.....	Oil Tight
T3	Nuts 1/8"-20, Cylinder to Crankcase	400-500 in. lbs.
T4	Nuts 3/8"-24, Cylinder to Crankcase	300-360 in. lbs.
	Nuts 1/8"-20, Crankcase to Crankcase	400-500 in. lbs.
	Nuts 3/8"-24, Crankcase to Crankcase	300-360 in. lbs.
	Nuts 3/8", Engine Mount	60- 80 in. lbs.

SPRING PRESSURES

	Wire Dia.	Compress to	New Parts Lbs. Min.	New Parts Lbs. Max.	Used Parts Lbs. Min.
S1 Spring, Valve Inner .....	.105 in.	55/64"	31-1/2	34-1/2	30
S2 Spring, Valve Outer .....	.135 in.	61/64"	52	56	50
S3 Spring, Oil Press. Relief Valve.....	.041 in.	1-9/16"	5-1/8	5-3/8	.....

- NOTES: (1) Fits marked thus (*) allowed only when .005" O.S. Piston Rings are installed with standard size Pistons and worn Cylinders. Piston Ring gaps must conform to values specified in this table.
- (2) If Camshaft Bearings exceed limit marked (**) they must be reamed and .020" O.S. shafts fitted.
- (3) If Cylinder Barrel exceeds these limits (***), replace, re-barrel, or regrind to .015" O.S.
- (4) Crankshafts worn below limit marked (†) must be reground to .010" U.S.
- (5) If Rocker Shaft Bearings exceed loose fit marked (††), install bushings, Part No. 22949.
- (6) Torque limits apply to oiled studs (not Alcoa Thread Lube).