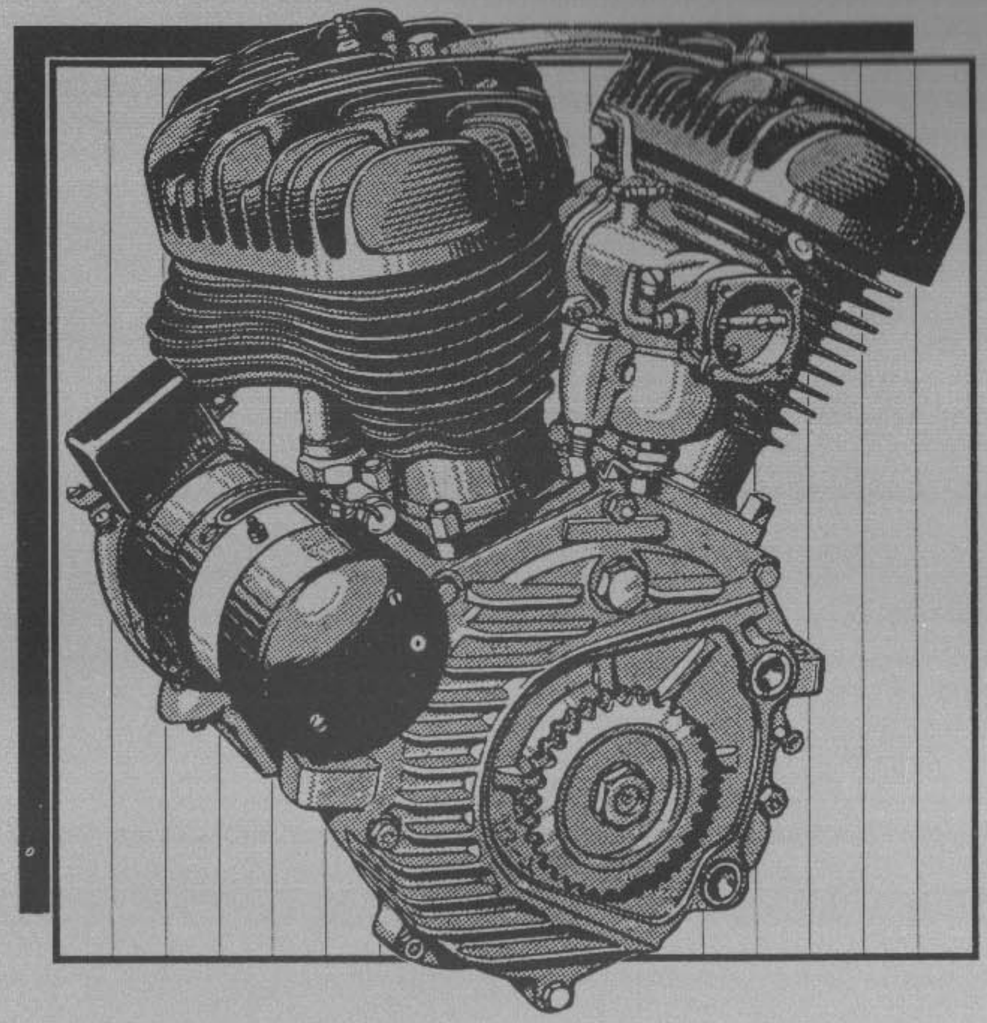

45"

ENGINE OVERHAUL MANUAL

SOLO 45" MODEL WLA 1929-1952

SERVICE MANUAL

APPLYING TO
THE FOLLOWING
45 MODELS

1941-1952

Side Valve Engine Models
45 cu. in. (750 c.c.)

Basic Drive Train
1941 and Later Servi-Car

Generally to
1929-40 45 models

Printed in the United States of America

CONTENTS

CONTENTS

CHAPTER 1

INTRODUCTION

1. SCOPE.

a. The instructions contained in this manual are for the information and guidance of personnel charged with the maintenance and repair of Harley-Davidson motorcycle, model WLA. These instructions are supplementary to field and technical manuals prepared for the using arm. This manual does not contain information which is intended primarily for the using arm, since such information is available to ordnance maintenance personnel in 100-series TM's or FM's.

b. This manual contains a description of, and procedure for, disassembly, inspection and repair of engine, fuel system, ignition system, generating system, transmission and clutch, and chassis.

c. TM 9-879 contains the replacement instructions of many components of this vehicle. This information is not repeated in this manual.

2. MWO AND MAJOR UNIT ASSEMBLY REPLACEMENT RECORD.

a. Description. Every vehicle is supplied with a copy of A.G.O. Form No. 478, which provides a means of keeping a record of each MWO completed or major unit assembly replaced. This form includes spaces for the vehicle named and U.S.A. Registration No., instructions for use, and information pertinent to the work accomplished. It is very important that the form be used as directed and that it remain with the vehicle until the vehicle is removed from service.

b. Instructions for Use. Personnel performing modifications or major unit assembly replacements must record clearly on the form a description of the work completed and must initial the form in the columns provided. When each modification is completed, record the date, hours and/or mileage, and MWO number. When major unit assemblies, such as engines, transmissions, transfer cases, are replaced, record the date, hours and/or mileage and nomenclature of the unit assembly. Minor repairs and minor parts and accessory replacements need not be recorded.

c. Early Modifications. Upon receipt by a third or fourth echelon repair facility of a vehicle for modification or repair, maintenance personnel will record the MWO numbers of modifications applied prior to the date of A.G.O. Form No. 478.

CHAPTER 2

OVERHAUL OF ENGINE IN VEHICLE

Section I

DESCRIPTION AND ENGINE DATA

3. DESCRIPTION AND ENGINE DATA.

a. Description. The vehicle is powered by a two-cylinder, V-type, L-head gasoline engine, operating on four-stroke, four-cycle principle. The bearings, pistons and rings, cylinder walls, bushings and gears are lubricated by a force-feed circulating oil system. Engine oil supply is maintained in a separate tank. Tolerances and fits are held to close standards, calling for precise and fine workmanship on the part of the mechanic.

b. Engine Data.

Engine type	V-type, L-head
Number of cylinders	2
Engine cooling	Air
Cylinder bore	2¾ in.
Stroke	3 13/16 in.
Displacement	45.12 cu in.
Horsepower (N.A.C.C. rating)	6.05
Compression ratio	5.0 to 1
Inclination of cylinders	45 deg
Lubrication	Circulating oil system
Fuel, gasoline	72 octane or higher
Engine (power unit) weight	114 lb
Rotation (sprocket side)	Counterclockwise
Ignition	Battery

CHAPTER 2

OVERHAUL OF ENGINE IN VEHICLE (Cont'd)

Section II

REMOVAL OF CYLINDERS AND PISTON ASSEMBLIES

4. PRELIMINARY INSTRUCTIONS.

a. General. When an engine needs repair, it is not always possible to definitely determine beforehand whether repair can be made with only upper end disassembled, or whether engine must be completely disassembled for lower end repair. Most commonly only upper end repair is needed (valves, rings, pistons, etc.) and it is recommended procedure to first disassemble upper end only, allowing engine base to remain in frame. After disassembling upper end only, be sure to inspect connecting rod bearings for wear (par. 6). If connecting rod bearings are worn and must be replaced, refer to chapter 3.

b. Emergency Piston and Ring Service. Need of replacement of rings, or possibly pistons and rings, is indicated by loss of normal compression, loss of power, abnormal oil consumption, excessive exhaust smoke and piston slap or knock. When pistons develop excessive clearance and slap due to wear or damage, and cylinders are found worn more than 0.002-inch, smooth and true up cylinder bore by honing, or boring and honing, to the next regular oversize piston step. However, piston slap alone, due to wear and excessive cylinder-piston clearance, does not necessarily mean poor and undependable performance. A good compression seal is the requirement for good performance. Good compression depends on smooth cylinders and proper clearance between piston rings and grooves.

c. Test for Leaky Valves and Worn Piston Rings. Before making this test, see that oil is in the tank, spark plugs are tight, cylinder head bolts are tight, valve tappets have sufficient clearance and that engine is warm. It is difficult to determine whether valves or rings (or both) are at fault when compression is poor. In either case, the cylinders must be removed to do a first class job.

(1) COMPRESSION TEST. Operate engine until it is thoroughly warmed up and with the ignition switch off, crank the engine slowly, placing entire weight of the body on the starter crank. Engine compression should offer some resistance to the weight of an average-size rider before the starter crank passes through complete range of its travel. If the engine offers little resistance to the starter crank in testing either or both cylinders, it is an indication that compression is not adequate in one or both cylinders. In vehicle operation engine will lack power, overheat, fuel and oil consumption will be excessive and engine performance will be sluggish in general.

d. Abnormal Engine Noise. Owing to constructional design of the motorcycle (power and drive units are exposed) certain mechanical noises not noticeable in a motorcar or truck are evident in normal

operation. Many operational noises may sound like they originate in the engine. For example: Front drive chain too loose or too tight will cause scraping, grinding, or pounding noise, besides causing jerky operation. Loose engine mountings will cause thumping, pounding noises. Transmission loose on its frame mounting base will cause pounding noise. Loose valve tappets will cause excessive noise in the engine gear case. Incorrect spark timing (advanced) will cause knocking and engine roughness. Therefore, see that all units are securely mounted and correctly adjusted before attempting to diagnose engine noises. Too many motorcycles have been deadlined and engines and transmission units exchanged because simple preventive maintenance service that would eliminate abnormal noises, has been neglected.

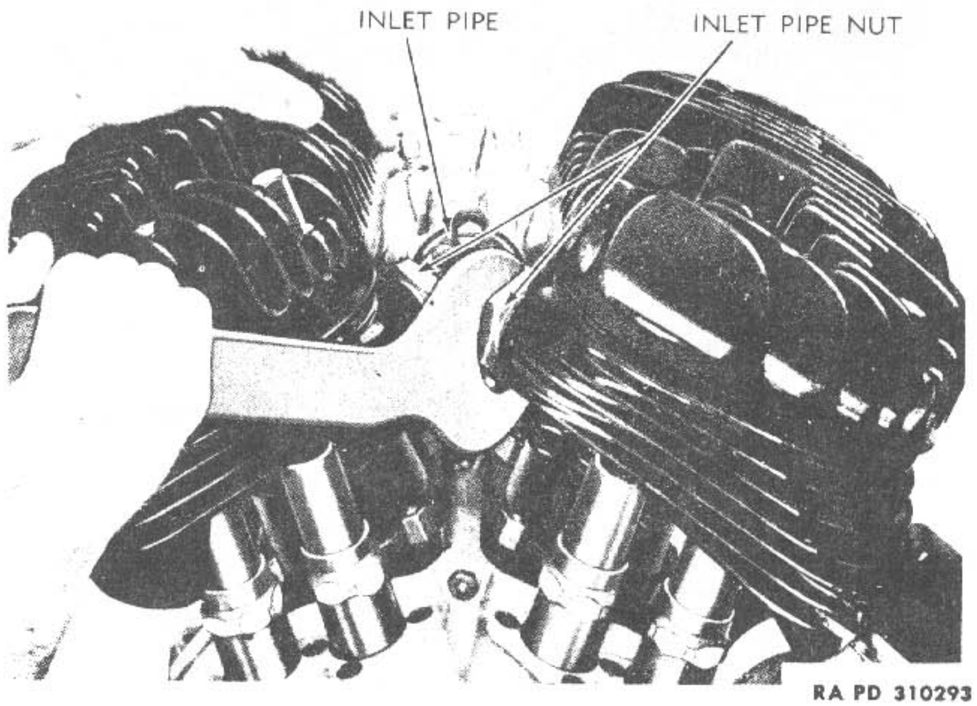

Figure 1—Removing Carburetor and Intake Pipe Assembly with Wrench (41-W-1570-10)

(1) UPPER END NOISES. Operate engine until it is thoroughly warmed up and idle engine from closed throttle to fast idling speed with vehicle standing. Listen for abnormal metallic noises that would indicate loose pistons, loose piston pins and possibly broken piston rings. Operate vehicle on the road up to 25 or 30 miles per hour and listen for metallic knocking sound that would be caused by loose pistons, piston pins or loose rings. Observe knocking (ping) in engine when accelerating that would be caused by excessive carbon deposits. NOTE: *Spark control must be correctly adjusted and operated properly, to distinguish between carbon and spark knocks.*

(2) ENGINE BASE NOISES. Before attempting to diagnose engine base noises, make sure that engine and transmission mountings are secure, front and rear drive chains are adjusted correctly, and valve tappets have specified clearance. Operate engine from closed throttle to fast idling speed and listen for abnormal metallic noise in the vicinity of the crankcase and gear case. With vehicle in operation at speeds from 15 to 30 miles per hour, listen for thumping, pounding, or scraping noise that may indicate engine main bearing trouble.

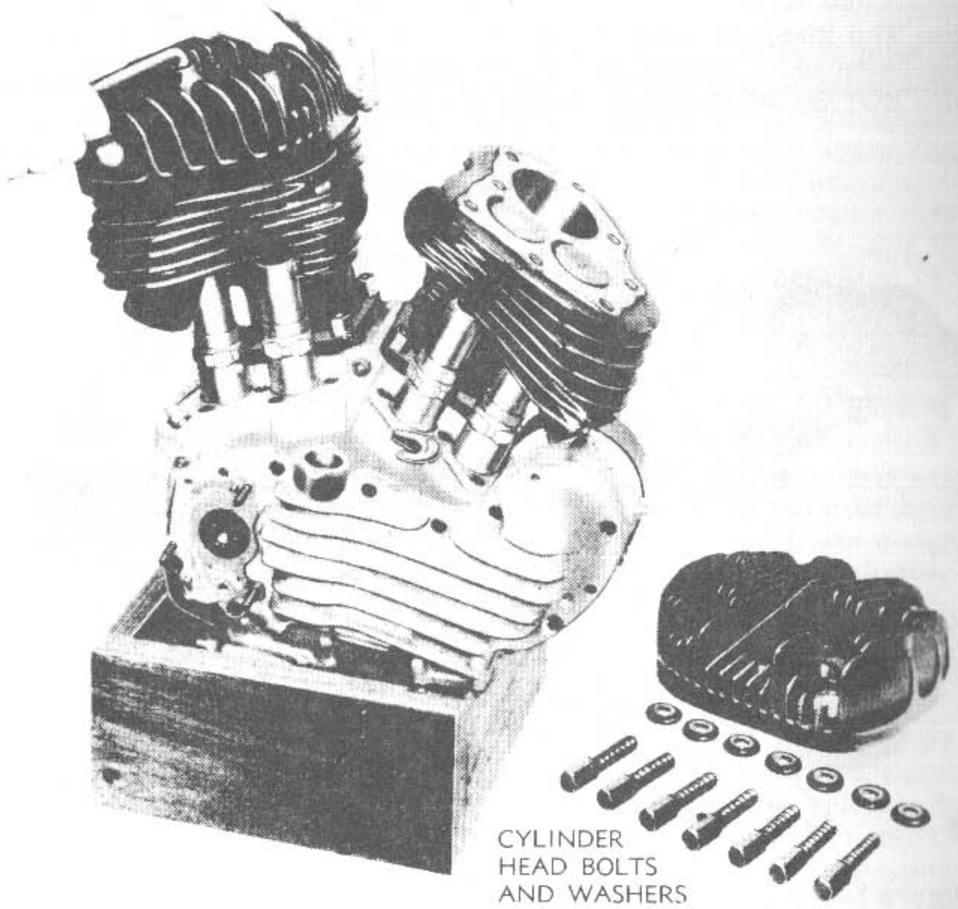

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Figure 2—Removing Cylinder Head Bolts with Wrench (41-W-1525)

5. REMOVAL.

a. Remove Instrument Panel and Tanks. Refer to TM 9-879 for instructions.

b. Remove Carburetor and Intake Pipe (fig. 1). Disconnect throttle control wire at carburetor. Disconnect air intake hose fitting from carburetor and leave attached to hose. Loosen air hose clamp at air cleaner and remove hose with carburetor fittings. Remove fuel line and strainer from carburetor bowl. With special wrench (41-W-1570-10), loosen and unscrew inlet pipe nuts from

cylinder nipples; then remove carburetor and inlet assembly from engine.

c. Remove Cylinder Heads (fig. 2). Remove spark plugs before removing cylinder heads. Use special wrench (41-W-1525) and remove cylinder head bolts. Remove bolt which secures cylinder head bracket to frame.

d. Remove Cylinders. Clean crankcase around cylinder bases and valve covers to prevent dirt from entering crankcase when lifting cylinders.

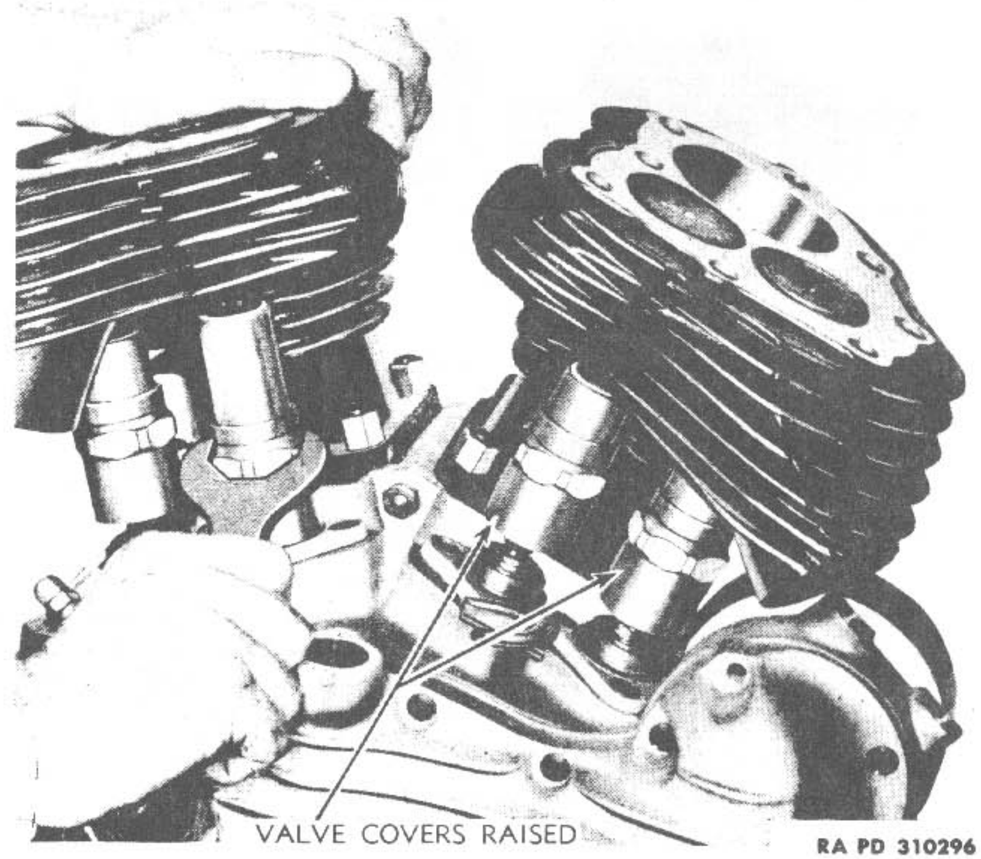

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Figure 3—Freeing Valve Covers with Wrench (41-W-3617)

(1) Use valve cover wrench (41-W-3617) to loosen and unscrew lower valve covers (fig. 3). To faciltate lifting valve covers, and prevent damage to packing gaskets, use small amount of light oil around top edge of covers.

(2) Disconnect spark control wire at circuit breaker lever.

(3) Remove nut and bolt from clamp securing front exhaust pipe to right footboard side bar.

(4) Use special cylinder base nut wrench (41-W-872-10) and remove all base nuts (fig. 4), except one on rear cylinder. While crank-

ing engine to raise front piston, raise front cylinder enough to place clean rag over crankcase opening. This will prevent dirt or any pieces of broken rings from falling into crankcase. Crank engine to locate front piston at bottom of stroke, then lift front cylinder upward and free of engine.

(5) Remove remaining stud nut from rear cylinder and remove rear cylinder in same manner front cylinder was removed.

e. Remove Pistons.

(1) Remove lock ring from slotted end of piston pin. Slot permits use of screwdriver blade underneath ring to pry and force it off of

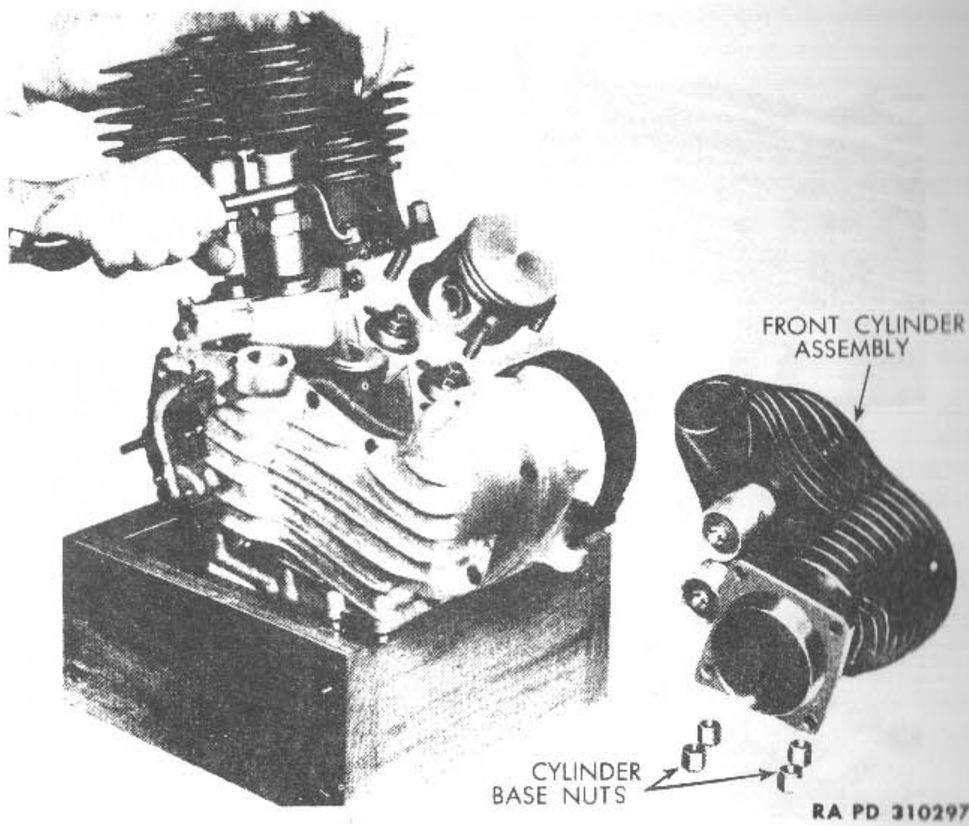

Figure 4—Removing Cylinder Base Nuts with Wrench (41-W-872-10)

pin. Special tool (41-T-3260) will serve as a rest for the screwdriver (fig. 5).

(2) Use a soft drift slightly smaller ($^{25}/_{32}$ in. dia) than the piston pin and drift pin (with light hammer blows) out of piston, taking care not to damage pin, piston bosses, or bend the connecting rod.

6. INSPECTION OF CONNECTING ROD BEARINGS FOR WEAR.

a. Inspect Rods for Up and Down Play and Upper End Side Shake (fig. 6). When appreciable up and down play is found and

REMOVAL OF CYLINDERS AND PISTON ASSEMBLIES

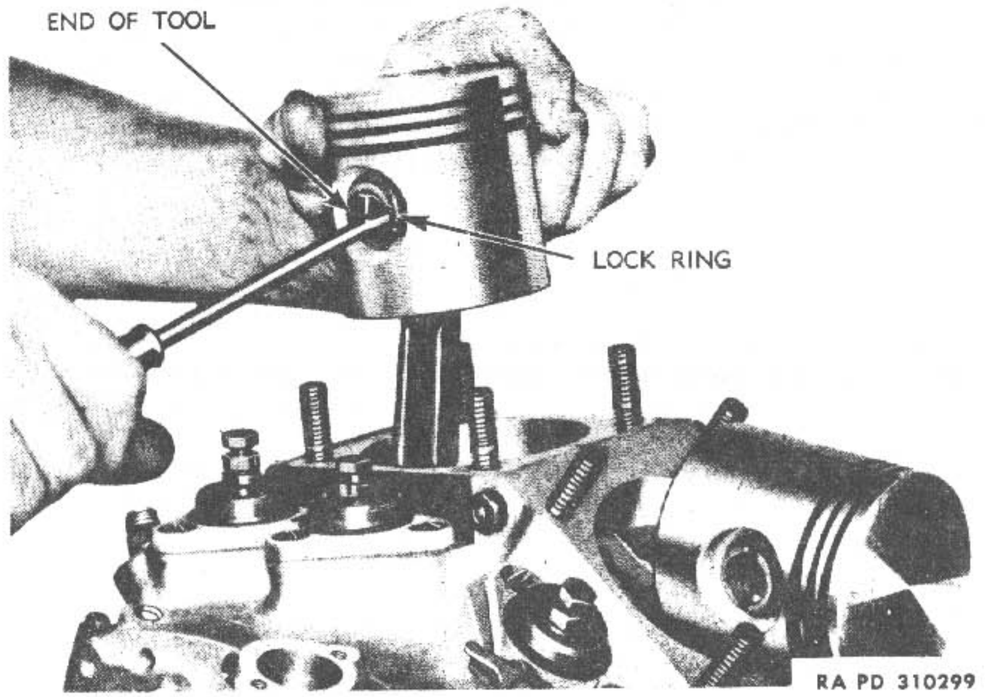

Figure 5—Removing Lock Ring from Piston Pin, Using Tool (41-T-3260)

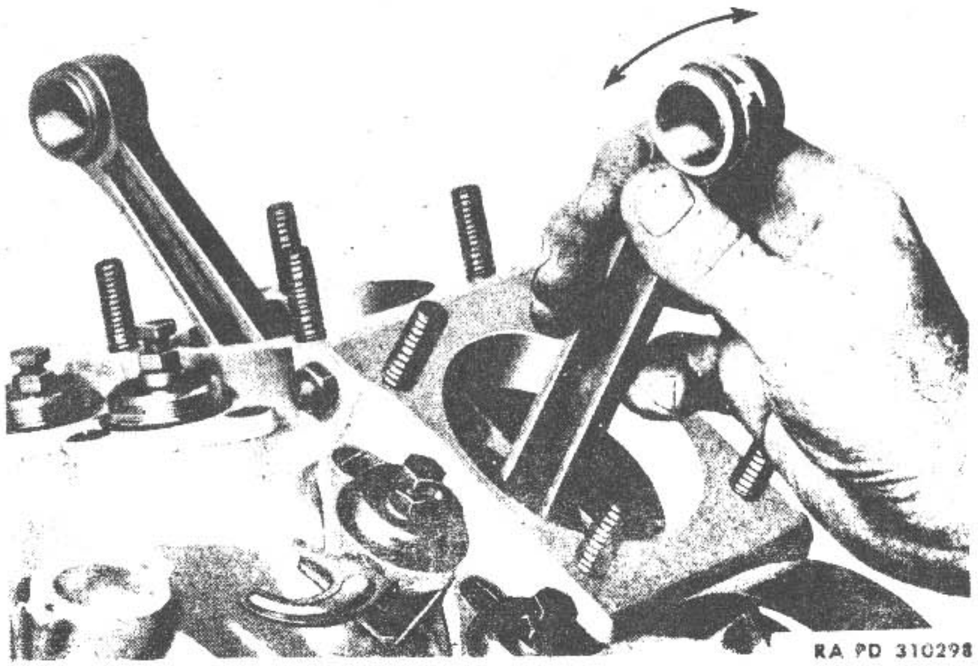

Figure 6—Inspecting Connecting Rod for Bearing Play

either or both rods have ⅛ inch or more side shake at extreme upper end, the connecting rod roller bearing should be refitted. This requires removing and disassembling engine, as outlined in chapter 3. When inspection finds rod bearings in good condition, or good enough for considerably further engine service, proceed with the upper end service procedure which follows in section III of this chapter.

CHAPTER 2

OVERHAUL OF ENGINE IN VEHICLE (Cont'd)

Section III

DISASSEMBLY, CLEANING, INSPECTION, REPAIR AND ASSEMBLY

7. CYLINDER DISASSEMBLY.

a. Use spring lifter (41-L-1409) to compress valve springs and remove split keys from ends of the valve stems (fig. 7). Valve spring collars, valve springs, valve covers and valves can then be removed. Mark valves so they can be installed in the same cylinders from which they were removed.

8. CLEANING AND INSPECTION OF CYLINDERS AND RELATED PARTS.

a. Cleaning.

(1) Clean outside of cylinder and head with wire brush to remove dirt and rust, getting in between cooling fins as much as possible. Use dry-cleaning solvent. CAUTION: *Cylinder heads are cast of aluminum and care must be exercised in handling and cleaning so as not to break off cooling fins. Do not use any lye or other cleaning solution that is harmful to aluminum.*

(2) Scrape carbon from cylinder head, top of cylinder around valves, top of cylinder bore above ring path and from inlet and exhaust ports. When scraping carbon, be careful not to scratch or nick cylinder and head joint faces, as a deep scratch may result in a leak. Blow off loosened carbon, dirt, rust, etc., with compressed air and wipe cylinder bore and joint faces with a clean rag.

(3) Remove carbon and gum deposits from cylinder valve guides with reamer (41-R-2309-65). See figure 8.

(4) Remove carbon deposits from cylinder valve seats.

(5) Remove carbon deposits and crust from valve head and stem, using a knife and wire brush wheel. CAUTION: *Never use a file or other hard tool that will scratch or nick metal. Polish valve stem lightly with very fine abrasive cloth or steel wool.*

b. Inspection of Cylinders (fig. 9).

(1) BORE. Standard cylinder bore is 2.7445 to 2.7455 inches. Cylinders must be accurately measured with micrometers for extent of wear. By subtracting piston measurement from bore measurement amount of piston-cylinder clearance is obtained. Bore measurements of a used and worn cylinder should be taken ½ inch from top of cylinder in ring path, measuring from front to rear where thrust faces of piston bear.

(a) During a top overhaul, if cylinders are not scored and are worn less than 0.002-inch, it is not advisable to refinish oversize at that time. Do this operation at the next complete overhaul. However, in this case, if the total piston clearance is as much as 0.006

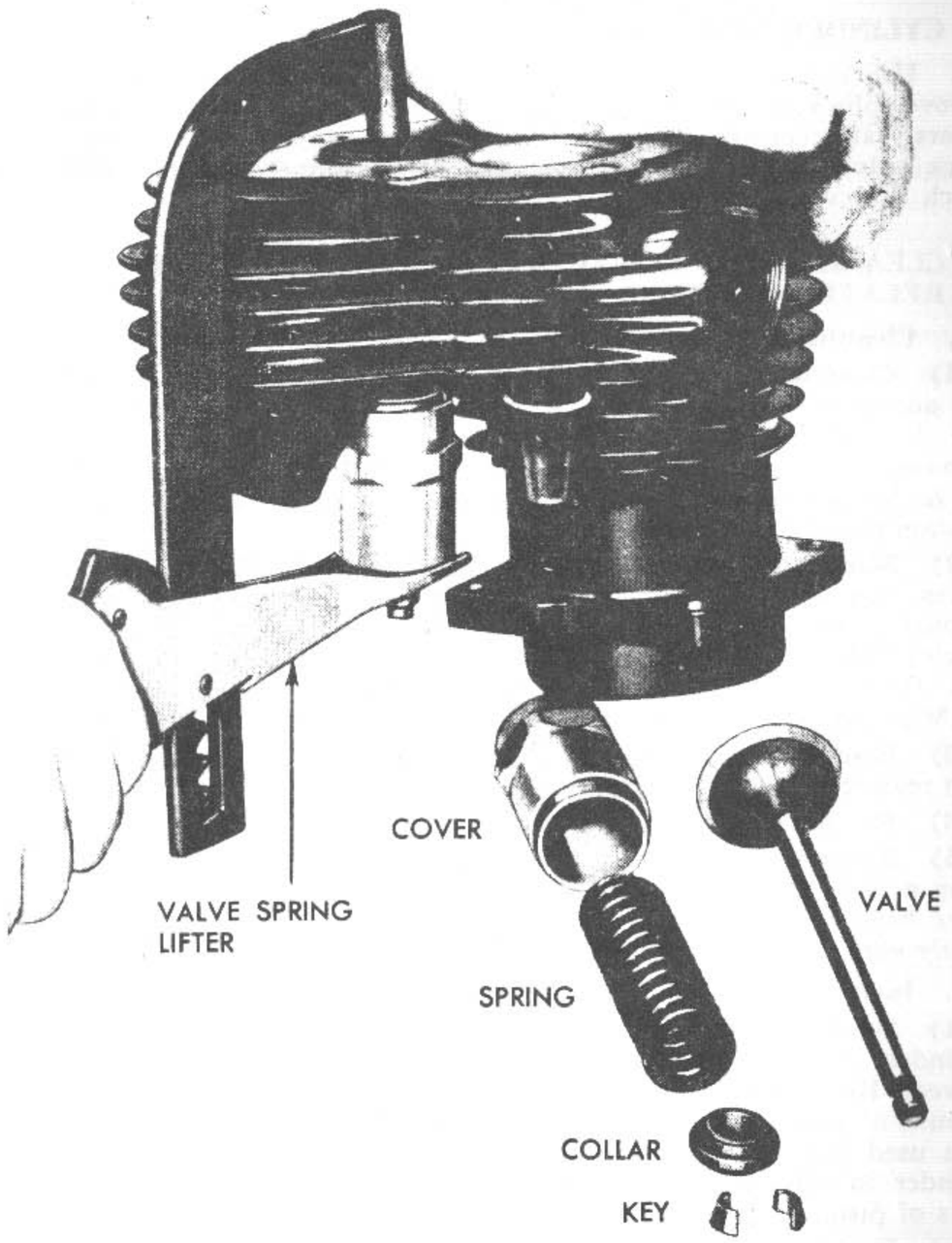

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Figure 7—Removing Valves with Spring Lifter (41-L-1409)

inch, a new standard piston or a piston of the same oversize to which the cylinder was last refinished should be fitted to reduce clearance and obtain reasonably quiet operation.

(b) If, in completely overhauling engine and putting it in a satisfactory condition for a long period of further service, cylinders show more than 0.002-inch wear, they should be refinished to the next oversize step and fitted with new pistons. Refer to paragraph 11 of this section for sizes of oversize pistons and rings available.

(2) VALVE GUIDES. Standard stem-guide clearance is 0.0035 to 0.0055 inch. Clearance should not be allowed to exceed 0.008 inch

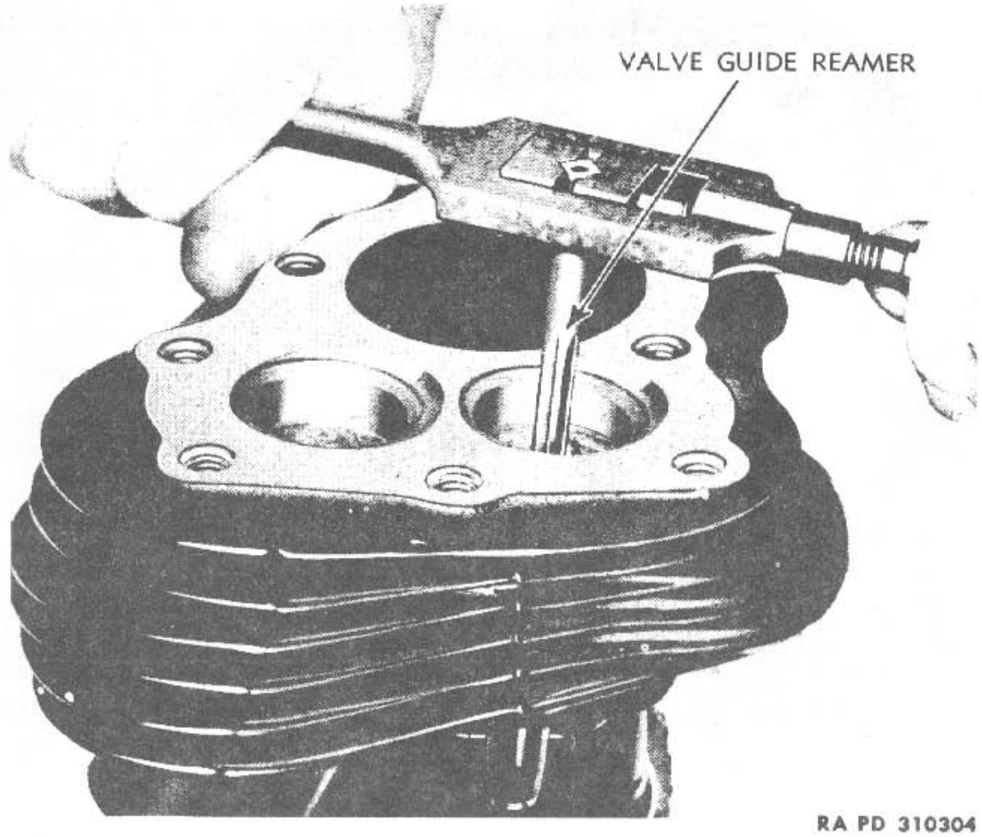

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Figure 8—Removing Carbon from Valve Guide with Reamer (41-R-2309-65)

before replacing guide, or possibly both valve and guide. Valve guides are pressed into cylinders.

(3) VALVES. Inspect the valve stem for excessive wear. Standard valve stem diameter is 0.339 to 0.340 inch. Valve warp will be indicated when face is reground. Intake valves are marked "IN" on the head and exhaust valves are marked "EX" on the head.

(4) CYLINDER VALVE SEATS. Valve seats, like valves, are subject to wear, pitting, and burning and should be refaced with cutter or grinder each time the valves are refaced. As valves and seats are

refaced from time to time, the valve seats widen and the valves will seat in a lower position when fully closed. Also, passage around valve when fully open is somewhat restricted. To correct this condition, cut additional clearance above valve seat so top edges of angular valve face and valve seat match exactly.

(5) VALVE SPRINGS (fig. 10). Inspect each valve spring in comparison with a new one. If free length of spring is 1/8 inch, or less

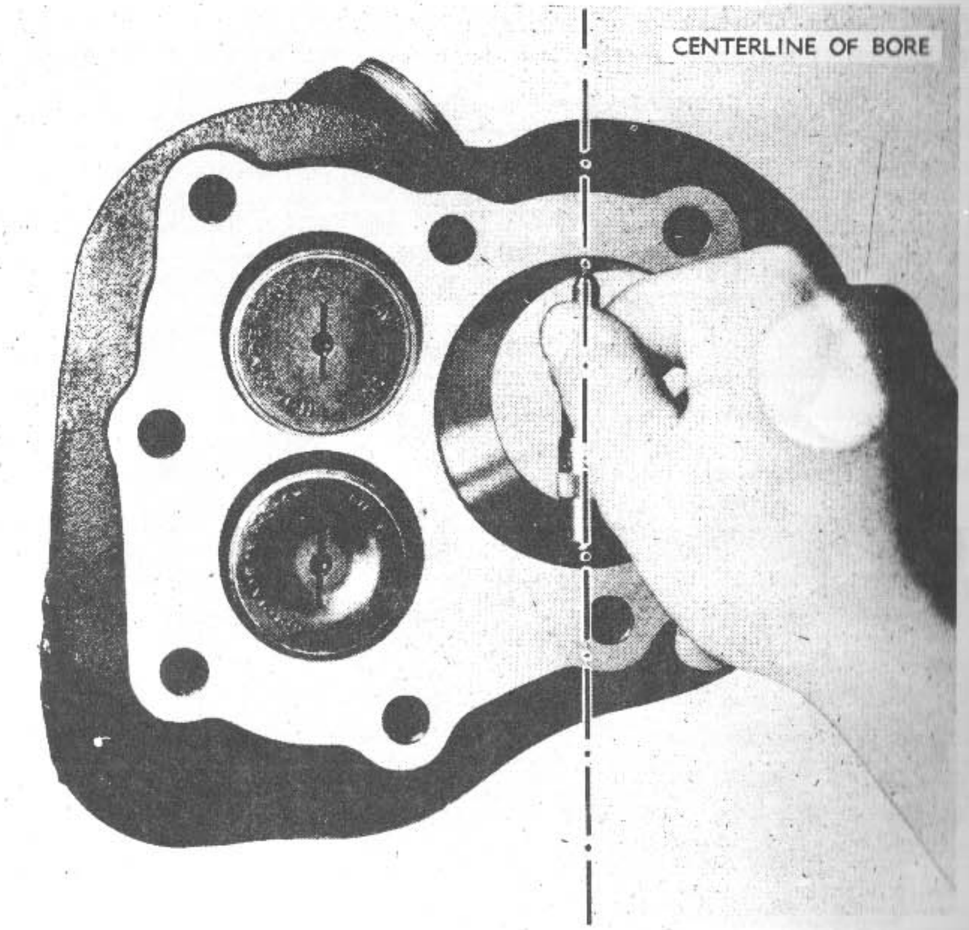

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Figure 9—Measuring Cylinder Bore One-half Inch From Top, with Inside Calipers (41-C-304)

than length of new spring, replace with a new spring. New valve springs will average 2 19/32 inches free length. Compression of new spring will be between 95 and 105 pounds when compressed to 1 7/8 inches.

9. REPAIR OF CYLINDER AND VALVES.

a. Cylinder. Cylinders can be refinished oversize either with a hone only, or with a boring bar followed by a finishing hone. Cylinders

badly worn or deeply scored are first rebored to nearly the required oversize and then are finish-honed to exact size.

(1) When refinishing cylinders oversize, add the oversize step apparently required to clean up bore to standard cylinder bore size; this gives the exact size to which cylinder should be refinished; example: 2.745 inches (standard bore) plus 0.020 inch (oversize) equals

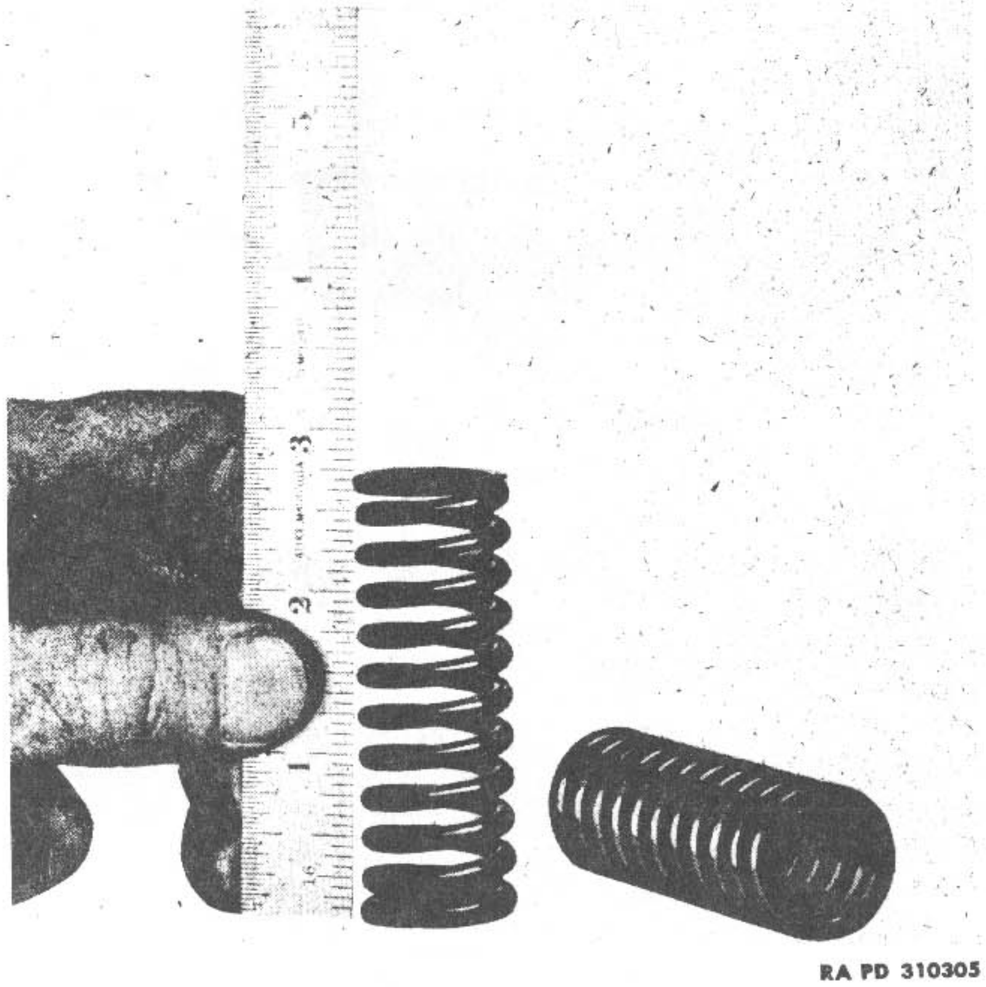

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Figure 10—Measuring Length of Valve Springs

2.765 inches (size to which cylinder should be refinished). Check carefully with micrometers to be sure of refinishing to this size (fig. 9). If this is accurately done, oversize pistons furnished in various oversize steps will fit with normal clearance (0.0015 to 0.0025 inch). Oversize pistons have their oversize stamped on their head; for example: 10, 20, etc.

b. Valve Guides.

(1) If valve stem and guide clearance exceeds 0.008 inch, press out guides and install new ones. Press or drift guides out of cylinder

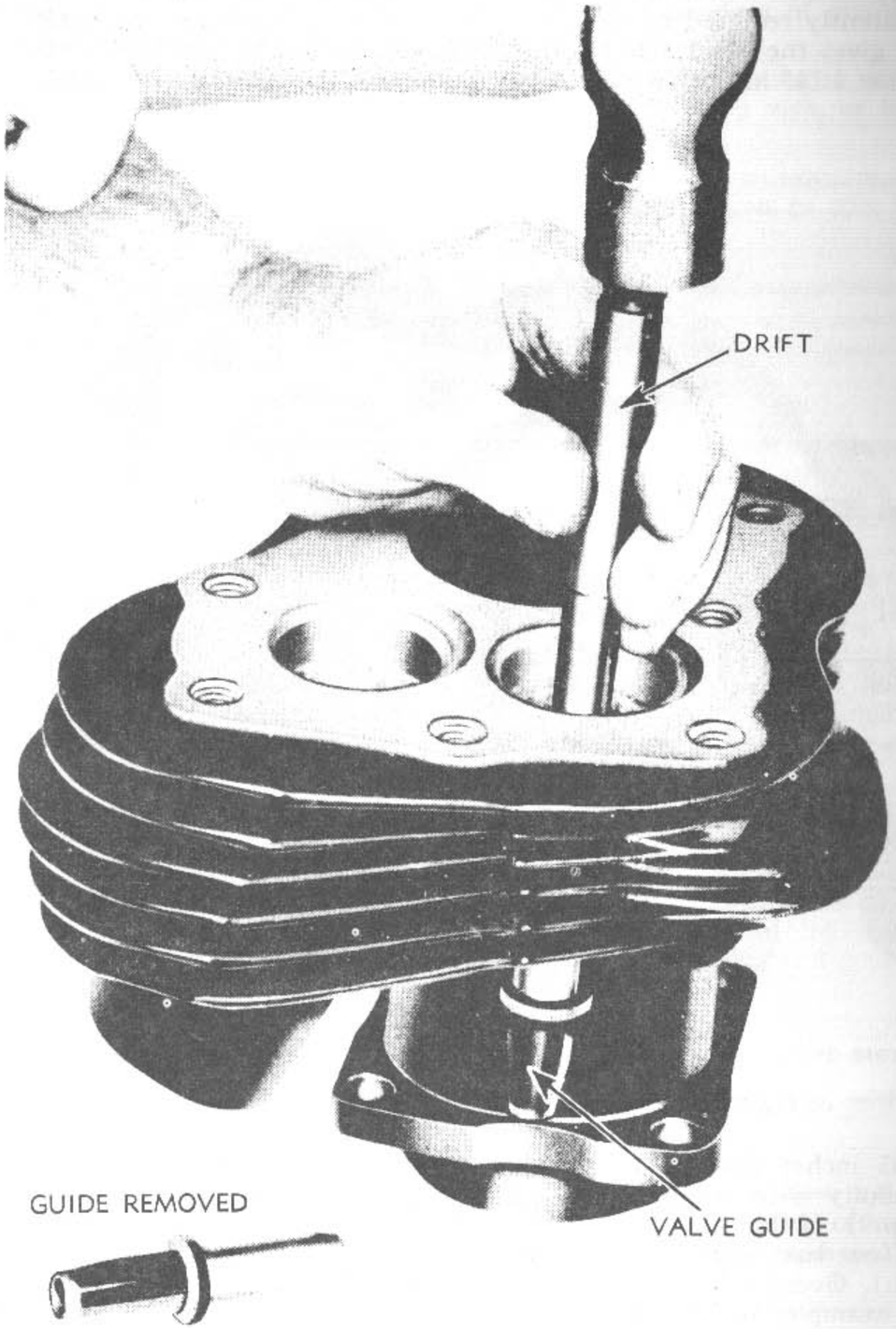


Figure 11—Removing Valve Guides

from inside of the valve chamber (fig. 11). Intake and exhaust valve guides are interchangeable.

(2) Install new valve guides by inverting cylinder and pressing guides into guide hole until shoulder on the guide is tight against the cylinder. New valve guides are reamed to correct size. However, when guides are pressed into cylinders they may close up slightly; also the ends may be burred. Therefore, after new guides are in place, they should be sized and cleaned up with special reamer (41-R-2309-65). Refer to figure 8. After installing new guides, valve seats must be refaced to true them with the new guides.

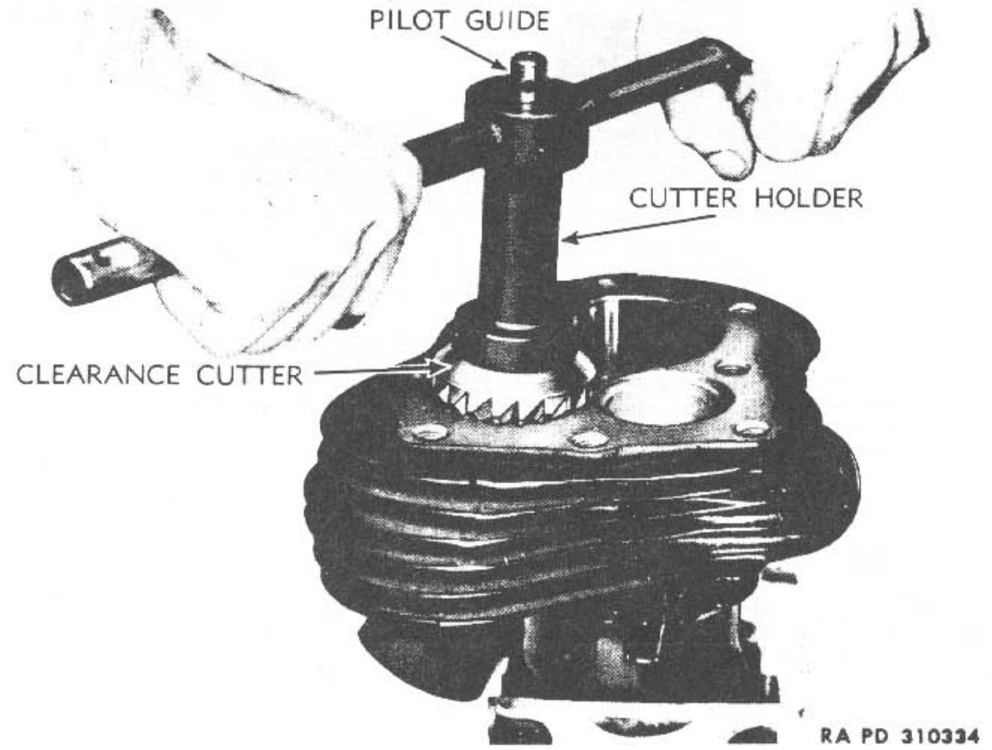


Figure 12—Increasing Valve Passage with Cutter (41-C-2822-30), Handle (41-H-2270) and Pilot Guide (41-P-412)

c. Valves. Valve face angle is 45 degrees for both intake and exhaust valves, and valve refacing grinder must be adjusted exactly to this angle. It is important not to remove any more metal than is necessary to clean up and true valve face. If grinding leaves the width of valve edge $\frac{1}{32}$ inch or less, at the thinnest place, use a new valve. If the end of the valve stem shows uneven wear, true the end of the stem on a valve refacer, using V-block provided for that purpose.

d. Cylinder Valve Seats. When a new valve guide is installed, it is not likely to have exactly the same relation that the old guide had to valve seat. Therefore, it is especially important, after fitting new guides that seats be carefully refaced to make them concentric

with guides and assure perfect alinement and matching of valve face and valve seat. NOTE: *Remove no more metal than absolutely necessary to clean up and true valve seats.*

(1) CORRECTING VALVE SEAT CLEARANCES (fig. 12). As valves and seats are refaced from time to time, the valve seats widen and the valves seat in a lower position when fully closed. Passage around the valve, when fully open, would be somewhat restricted. Correct this condition by using clearance cutter (41-C-2822-30) to remove metal so that top edge of angular valve face and the cylinder seat

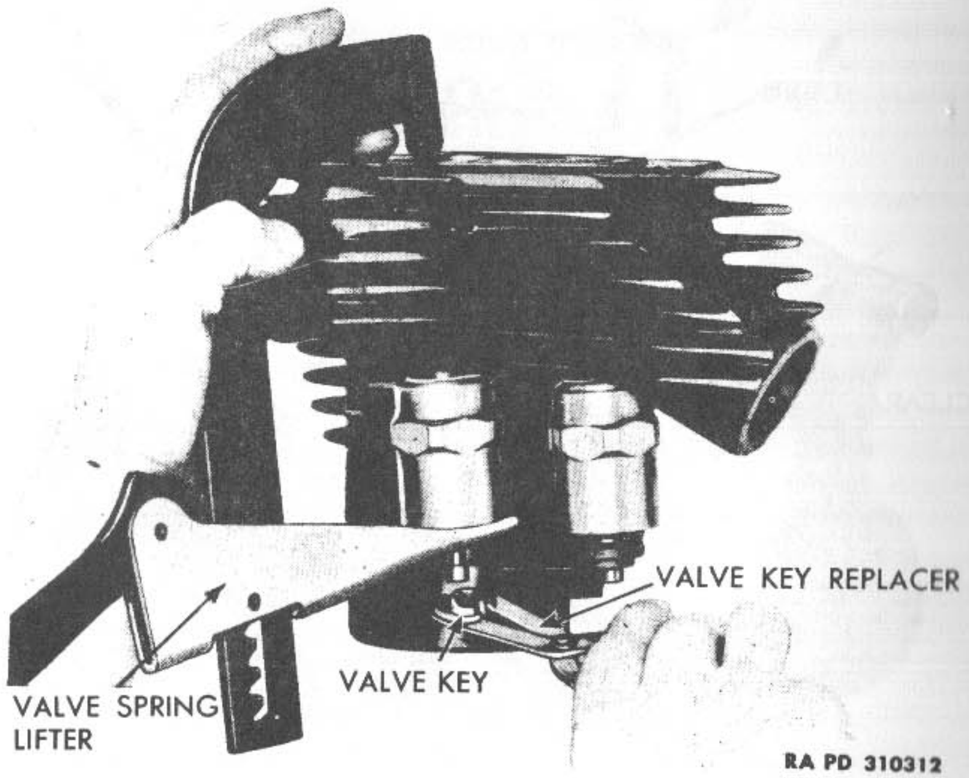


Figure 13—Installing Valve Stem Collar Keys, Using Lifter (41-L-1409) and Replacer (41-R-2398)

match perfectly. Use clearance cutter with handle (41-H-2270) and pilot guide (41-P-412).

(2) GRINDING AND TESTING VALVE SEATS. Intake and exhaust valves are made of different materials and must not be interchanged when seating. Intake valves are marked "IN" on head; exhaust valves are marked "EX."

(a) Valve seats and valve faces that have been smoothly and accurately refaced with grinders, will require very little grinding or lapping to complete the seating operation. Apply a light coat of fine compound to valve face. Insert valve stem in guide and oscillate it

with a screwdriver, just enough to give valve face and seat a lapped finish.

(b) Testing Valve Seat for Trueness. Remove valve, wash valve face and seat thoroughly with clean gasoline and dry with compressed air. Test seat for trueness by making pencil marks about ⅛ inch apart all around the face of the valve; then place valve in guide and put considerable pressure on the valve head with a large screwdriver, at the same time giving it a slight back-and-forth motion. Remove the valve to examine the face and observe how the pencil marks have been erased. Pencil marks should show that the valve and seat faces are bearing all the way around for a perfect job. If lapped finish is not complete around either the valve or the valve seat, further seating is required.

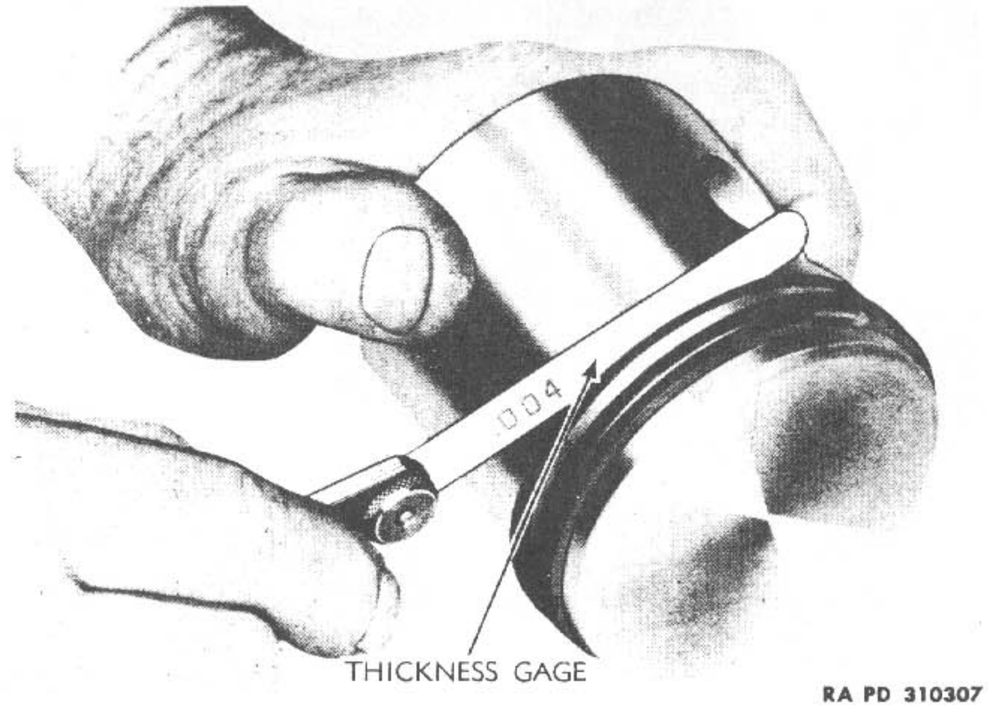


Figure 14—Measuring Ring Clearance in Piston Groove

10. CYLINDER ASSEMBLY.

a. Locate marked valves in their respective cylinders, taking care to install intake valves (marked "IN") in chamber nearest intake pipe opening, and exhaust valve (marked "EX") in chamber nearest exhaust port.

b. Locate spring cover asbestos gasket on the valve guide and install upper cover, composition gasket, and lower cover.

c. Install valve spring and collar over valve stem and compress spring with lifter (41-L-1409) enough to install the split valve stem keys in valve stem groove, small end of cone upward, with replacer (41-R-2398) (fig. 13).

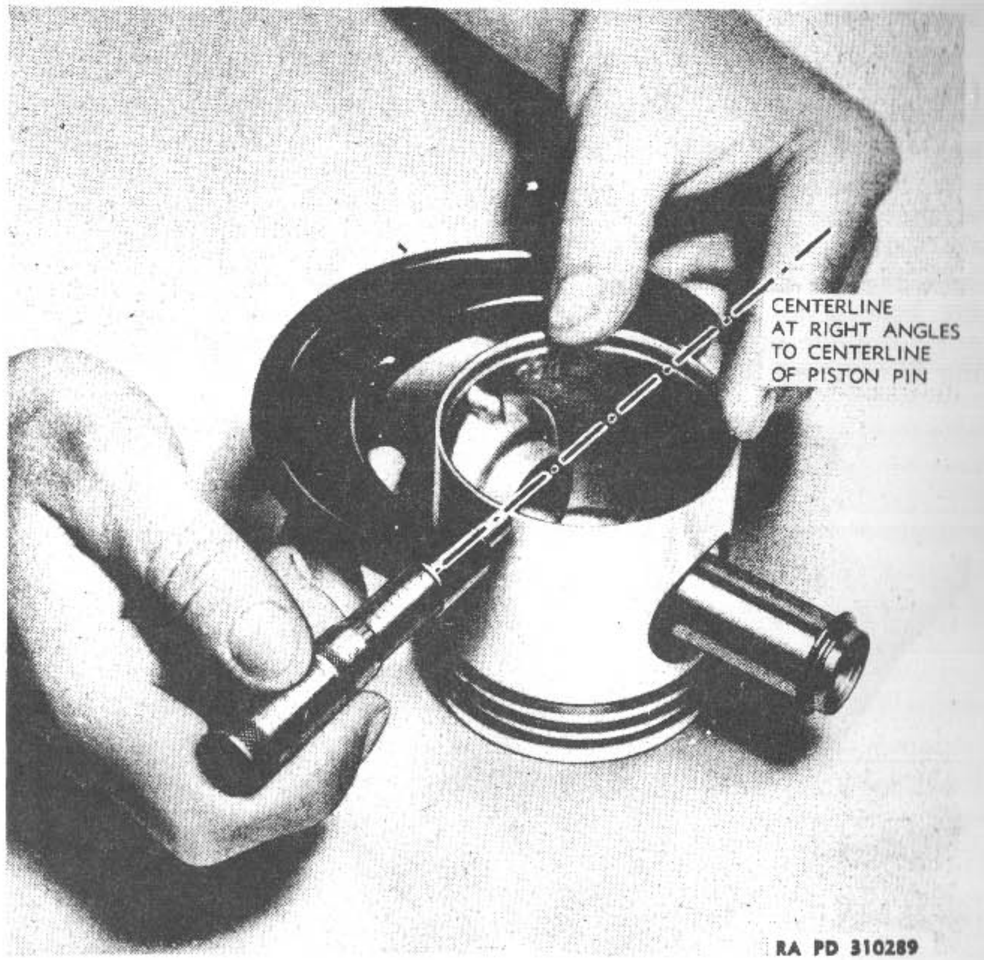


Figure 15—Measuring Piston with Micrometer Calipers (41-C-307)

d. Release pressure on spring compressor to engage valve spring collar and valve stem key.

e. Repeat above procedure for each valve and spring assembly.

11. PISTONS, PISTON PINS, AND RINGS.

a. Pistons. Pistons are special taper-cam ground; the diameter at the top of the skirt (just below bottom ring) being 0.0025-inch smaller than at the bottom of the skirt. Two horizontal slots, one front and one rear, are cut in the bottom ring groove. NOTE: *Large oversize pistons are slotted horizontally and also have a vertical slot in one thrust face.* All pistons (standard or oversize) obtained from the manufacturer are furnished with a piston pin correctly fitted and with rings installed. Oversize pistons in steps of 0.010, 0.020, 0.030, and 0.040 inch are available and are stamped "10," "20," etc.

b. Piston Clearance in Cylinder. Standard piston size at bottom of skirt is 2.734 inch, measured front to rear and at right angles to

center line of piston pin. Piston clearance (standard or oversize) in cylinder is 0.0015 to 0.0025 inch. If a fit within these limits cannot be obtained with facilities at hand, it is preferable to allow more clearance rather than less. Check inside and outside micrometers together to make sure they read exactly the same for correct piston and cylinder clearance fitting measurements. Do not "squeeze" the piston skirt with the micrometers and obtain a false measurement.

c. Disassembly of Piston. Remove piston rings with thin strips of metal, taking care not to scratch or damage piston surface.

d. Cleaning and Inspection (figs. 14 and 15). Remove carbon deposits from top of piston, exercising care not to cut or nick the aluminum. Clean the ring grooves free of carbon and gum deposits. Any excess of carbon or sludge accumulation on inside of piston can be removed with dry-cleaning solvent.

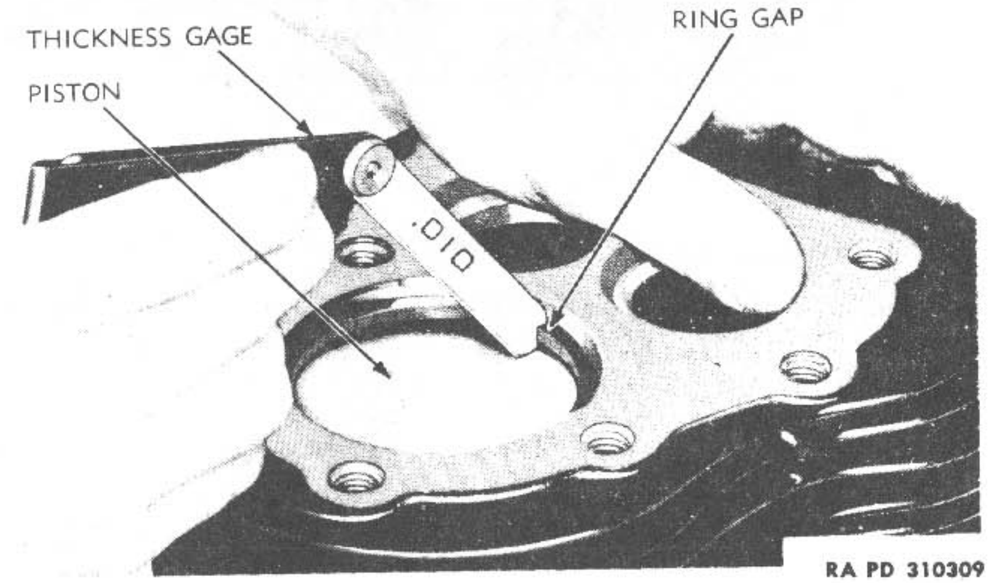


Figure 16—Measuring Piston Ring Gaps

(1) Inspect piston for cracks, scored, cut, or damaged surface. Place standard ring in ring grooves and with a feeler gage, measure clearance. Maximum permissible side clearance is 0.008 inch (fig. 14). If piston ring grooves are worn to give more than 0.008 inch side clearance, replace piston.

(2) Measure piston at bottom of skirt, front to rear and at right angles to piston pin hole (fig. 15). If piston and/or cylinder are worn to give more than 0.006 inch clearance, piston must be replaced (par. 8 **b** (1) *(a)* and *(b)*).

(3) Oversize piston rings are available in steps of 0.010, 0.020, 0.030, and 0.040 inch.

e. Fitting New Rings to Cylinder. It is recommended that piston rings be replaced each time the old rings are removed from the piston, or at each top overhaul.

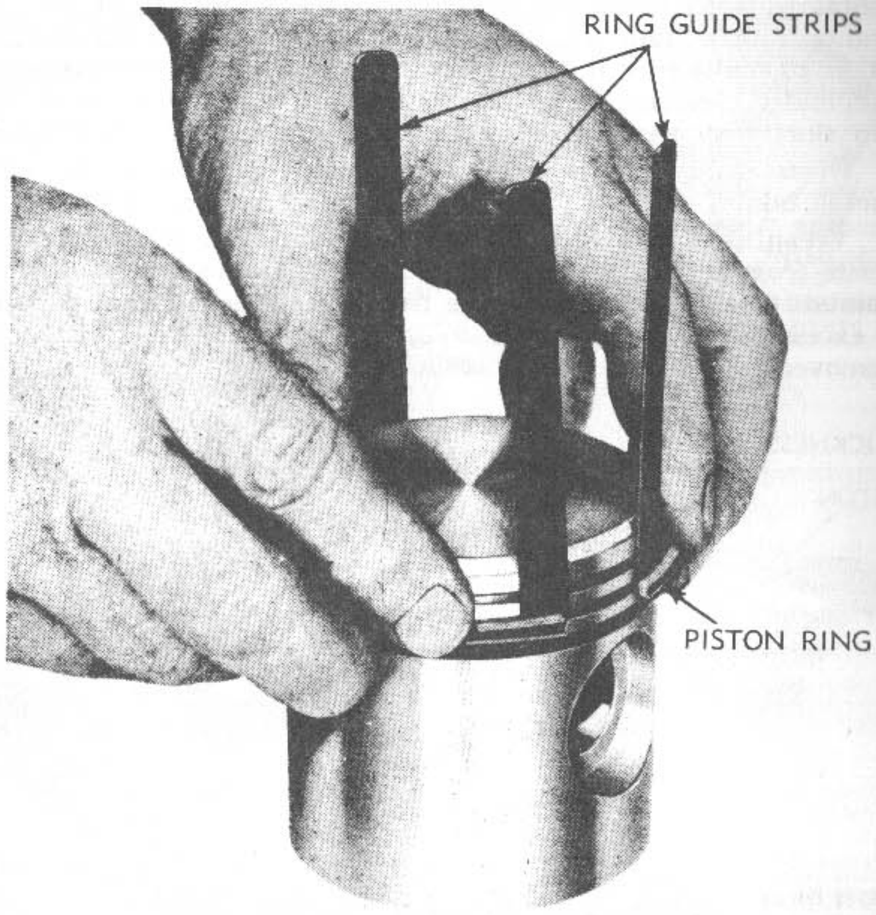


Figure 17—Removing Piston Rings

(1) To inspect ring gap, place a piston in cylinder with bottom end of piston about ½ inch from end of cylinder (fig. 16). Set the ring to be inspected inside the cylinder and squarely against the piston. Use a set of thickness gages and determine the ring gap. Normal ring gap is 0.010 to 0.020 inch. Even though the ring gap may be slightly greater than these limits, only standard size piston rings should be used in the cylinder unless the cylinder has been reground.

(2) If cylinder has been reground, lapped or honed oversize, then use the correct oversize rings, fitting rings to give gap clearance of 0.010 to 0.020 inch. If gap at ring ends is less than 0.010 inch, ring ends may butt together under expansion and rings may be scored or broken. Gap may be increased by filing the ring ends with a fine-cut flat file.

f. Fitting Piston Pin to Piston. New pistons are furnished with standard size pins correctly fitted to piston bosses. Pin is a light, hand-press fit in piston bosses. If oversize pin is used; then piston bosses

and rod upper bushing must be honed or reamed accordingly. Oversize piston pins are available in steps of 0.002, 0.004, 0.006, 0.008, and 0.010 inch.

g. Installing Rings on Piston. When new rings are being installed, exercise care in properly locating rings on the piston as follows:

(1) Compression rings (plain) are installed in the two upper piston ring grooves.

(2) Oil control ring (channeled) is installed in the lower piston ring groove.

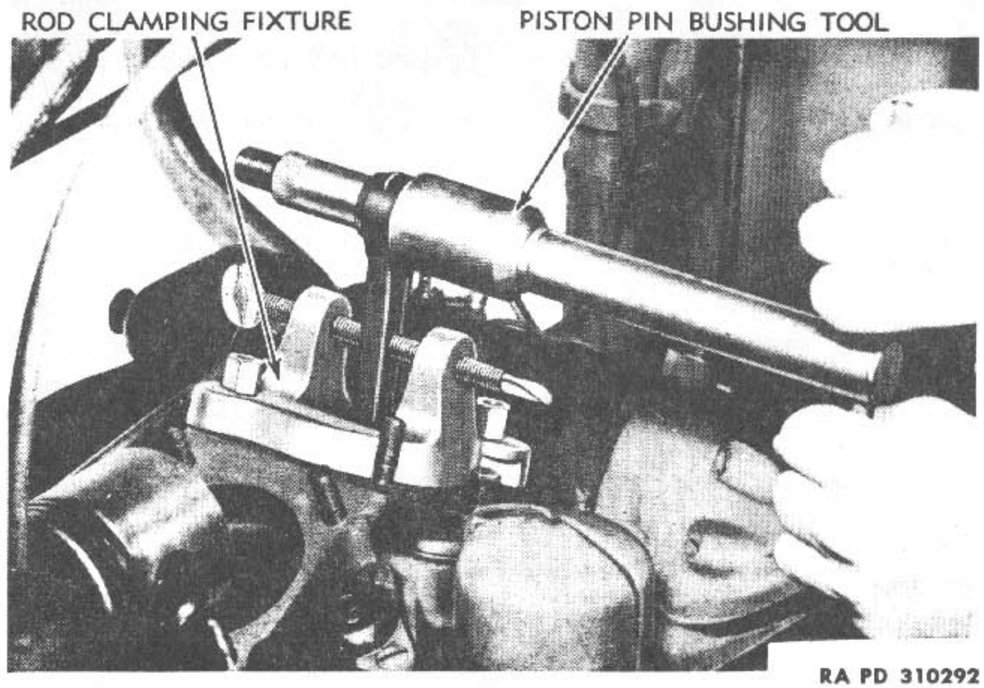


Figure 18—Installing Connecting Rod Bushing, Using Tool (41-T-3305) and Tool (41-T-3091)

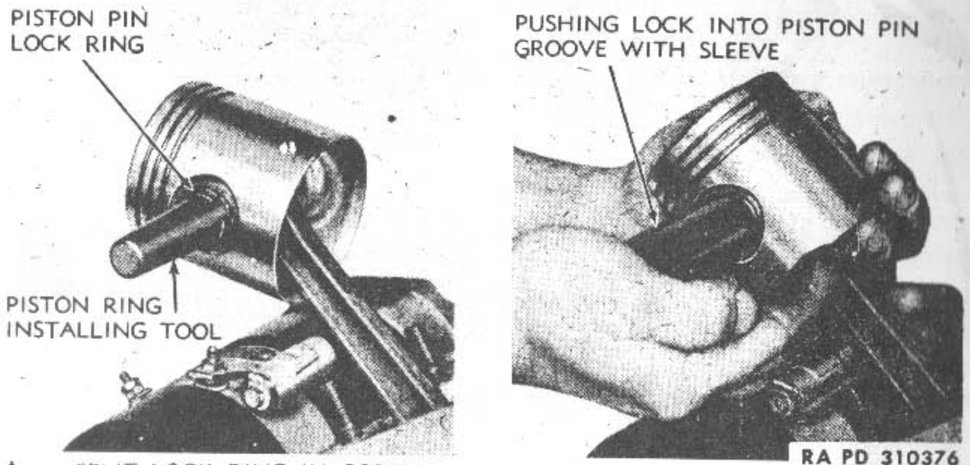
(3) Use thin pieces of soft metal to guide and slip the rings over the piston into their respective grooves without overexpanding or twisting the rings and damaging the finely finished piston surface (fig. 17).

12. FITTING UPPER END CONNECTING ROD BUSHING TO PISTON PIN.

a. Fitting Rod Bushing to Piston Pin (fig. 18). Replace connecting rod upper end bronze bushing because of wear and excessive pin clearance or looseness in rod. Inspect for both conditions. When bushing is found tight in rod but is worn to excessive pin clearance (0.002 inch or more) it is possible to service it by reaming oversize and fitting an oversize pin. However, it is better practice to install a new

bushing and ream and hone it to fit a standard pin, except when piston to be used has previously been fitted with oversize pin or pin is loose in bosses, necessitating fitting with larger pin. The principal objection to fitting the rod upper end oversize is that, in the event of emergency field service requiring quick fitting of pistons, considerably more time is required for the job if upper end bearing is oversize. New pistons are fitted with standard size pins, and installing one is a short job if the rod bushing is already reamed to standard size. If bushing has been reamed oversize, either new bushing must be installed and reamed to standard size, or piston must be reamed oversize to fit an oversize pin, which involves extra time.

(1) When renewing bushings in connection with only a top overhaul, use special bushing tool (41-T-3305) and rod holding fixture



A SPLIT LOCK RING IN CORRECT POSITION ON TAPER OF TOOL

B FORCING SPLIT LOCK RING INTO PISTON PIN GROOVE WITH TOOL SLEEVE

Figure 19—Installing Piston Pin Lock Ring with Tool (41-T-3260)

(41-T-3091). Raise rod just enough to give clearance for bushing tool when rod is held in holding fixture (fig. 18). Be careful to start new bushings with bushing oil slot in alinement with oil slot in rod.

(2) Ream new bushing nearly to size and finish to exact size with special hone (41-H-2382). A properly fitted pin should have 0.001 inch clearance; with this clearance, pin will have just noticeable shake in bushing. A tighter fit is likely to result in a "seized" pin, or bushing may become loosened in rod.

13. INSTALLING PISTONS ON CONNECTING RODS.

a. Install Pistons.

(1) Standard pistons with horizontal slots only may be fitted with either thrust face to the front. Large, oversize pistons with vertical slot in one thrust face must be fitted with that thrust face to the front.

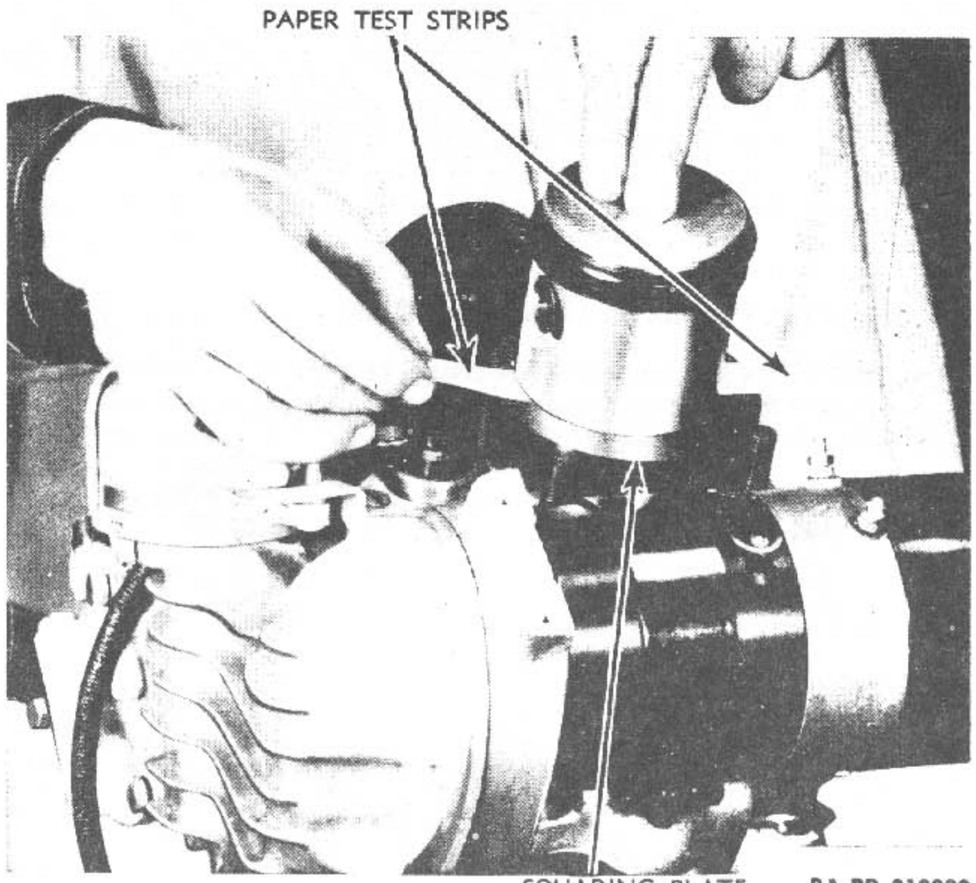


Figure 20—Checking Connecting Rod Alinement with Squaring Plate (41-P-1550-25)

(2) To facilitate installing piston pin, heat piston (but not pin) about as hot as it can be handled.

(3) With piston pin in place and one lock ring already in its groove, install the remaining lock ring. CAUTION: *Always use a new piston pin lock ring.* Use special tool (41-T-3260) to install ring, thus prevent overexpanding with consequent damage to the lock ring (fig. 19). Be sure that lock ring seats firmly in its groove because a lock ring loosely installed will rapidly loosen further in service and finally come off of the pin, resulting in piston and cylinder damage.

14. ALINE CONNECTING RODS.

a. Alining Pistons and Connecting Rods. When refitting and reassembling connecting rods and finally fitting pistons, rods may possibly be bent or twisted, throwing upper bearing and lower bearing out of alinement with each other to some extent. Therefore, after pistons have been fitted, rods must be checked and realined if necessary. If a rod is bent or twisted, piston has a cocked relation to

cylinder bore and the result is excessive noise and rapid wear. Connecting rod alinement is determined by seating of piston skirt end on a special thickness surface plate (piston squaring plate) placed on crankcase cylinder base face (fig. 20). The flywheel crankpin positions, forward and backward, in relation to the piston position on the squaring plate influence the seating of piston on the squaring plate and indicate whether or not the connecting rod is in alinement. Flywheels must be rotated forward and backward to change the crankpin positions when checking piston and connecting rod alinement.

b. Installing Pistons on Connecting Rods. See paragraph 13.

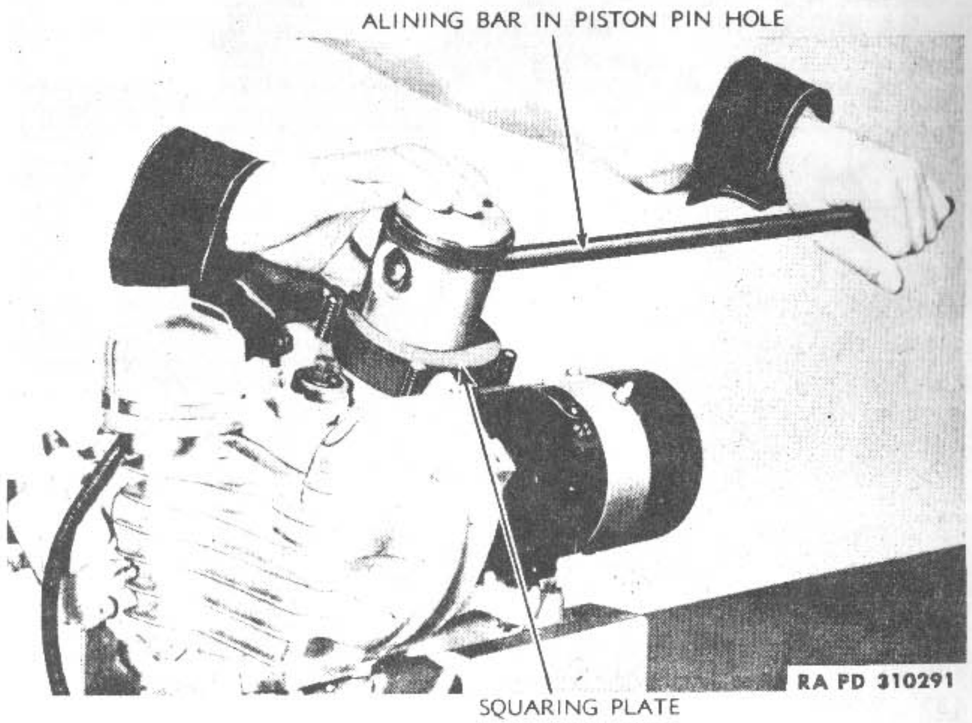


Figure 21—Straightening Bent or Twisted Connecting Rod

c. Locating Squaring Plate on Crankcase. Make sure crankcase cylinder base face is clean and free from burs so that piston squaring plate (41-P-1550-25) seats firmly and squarely on crankcase for accurate inspection. Also see that skirt end of piston is not nicked or damaged. Alinement inspection must be made for each connecting rod and piston.

d. Checking Alinement with Tissue Paper (fig. 20). Insert narrow strips of thin tissue paper (not wider than ½ inch and of equal thickness) underneath piston, one piece of paper on each side and directly below (in line with) the piston pin. Press piston down lightly with finger tips resting on center of piston head. With piston located on squaring plate in one crankpin position, first pull one

piece of paper, then the other, partially from underneath piston. In removing the paper, one of two things will happen; both will have the same amount of drag, or one will be free and the other tight. If one is tighter than the other, remember which side of the engine the tight piece of paper was on; then turn engine so that flywheel locates the crankpin in the other position and repeat the "paper check" procedure. Behavior of paper in making connecting rod alinement check will reveal either of the four conditions as follows:

(1) CONNECTING ROD IS IN ALINEMENT. When the connecting rod being checked is in perfect alinement, the pieces of paper under piston will have the same amount of drag in both flywheel crankpin positions.

(2) CONNECTING ROD IS BENT. If the connecting rod is bent, only one of the pieces of paper (on the same side of the engine) will be free when check has been made in both flywheel crankpin positions. To repair, refer to step **e** of this paragraph.

(3) CONNECTING ROD IS TWISTED. This condition will cause the high, or loose paper side of a piston (on one side of the engine) to shift to the other side of the engine as the flywheel crankpin position is changed. Locate flywheel in one crankpin position and make "paper check" and note which side of engine the loose piece of paper is on; then rotate flywheel to the other crank position and the piece of paper on the opposite side of the piston will be found loose. To repair refer to step **f** of this paragraph.

(4) CONNECTING ROD IS BENT AND TWISTED. This condition will cause both pieces of paper to be tight (or nearly so) under the piston with flywheel crank in one position, and when the flywheel is rotated to the other crank position, one of the pieces of paper will be quite free. Remember which side of engine the tight piece of paper was on, as well as the flywheel crank position, and refer to step **g** of this paragraph for repair.

e. Straightening a Bent Connecting Rod (fig. 21). Insert a $^{9}/_{16}$-inch diameter rod through the piston pin hole, on the *low* side of the piston, and apply upward force to straighten the rod. Recheck alinement after each straightening operation. NOTE: *Raise piston to highest position, before straightening a rod, to prevent damage to piston skirt.*

f. Straightening a Twisted Connecting Rod. Insert straightening bar through piston pin hole, on the high side of the piston, and pull away from the crankpin position. Example: Inspection shows that rod is twisted, and with crankpin in forward position, the piston is high on the right side (gear case side). Straightening bar force is applied on the right side of the piston, pulling away (toward the rear) from crankpin position.

g. Straightening a Bent and Twisted Connecting Rod. This is a combination of a bend and twist and the bend must be removed first. With the flywheel crank located in the position that caused the piston to be low (tight paper) on one side, insert the straightening bar through piston pin hole, on the low side, and apply upward force

to straighten the rod. After the bend has been removed, then the twist can be removed as outlined in **f** above. Recheck alinement after each straightening operation.

h. Inspecting Connecting Rods for Center Alinement. After rods have been alined, inspect to see that pistons center in crankcase cylinder opening, without side pressure on rod upper ends. If rod ends are off center enough to prevent pistons from centering, they must be corrected by replacement of flywheel thrust washers of equal thickness or by replacement of flywheels.

CHAPTER 2

OVERHAUL OF ENGINE IN VEHICLE (Cont'd)

Section IV

INSTALLATION

15. INSTALLATION.

a. Install Cylinder Assemblies.

(1) Lubricate cylinder walls, pistons, pins, and rod upper bushings generously with engine oil. Space ring gaps about equidistant around piston but do not locate any gap near exhaust valve port, as in this position ring ends may be overheated and burned.

(2) Turn engine until crankpin is at bottom center. See that crankcases are clean and fit cylinder base gaskets. See that valve cover gaskets on tappet guides are all in place and in good order. If any are damaged or broken, replace them. Cylinders with valves and valve covers assembled can now be installed over pistons and rings, being careful not to change ring gap location. Work cylinders carefully down over rings to avoid any possibility of ring breakage. Install rear cylinder first and as cylinder seats, turn engine so tappets are at their lowest position. Install cylinder base nuts and pull them down just snug. (This is to allow alinement of intake pipe when installed.) Follow same procedure with front cylinder. Do not screw down valve covers until tappets have been adjusted (par. 16 **a**). Insert exhaust pipes into cylinders as they are seated.

(3) Attach front exhaust pipe clamp to footboard side bar.

b. Install Carburetor and Intake Pipe.

(1) Inspect intake manifold packing bushings to see that they are in good condition. Assemble nuts and bushings to manifold after applying a light coat of oil or grease so bushings will freely adjust themselves to manifold and cylinder nipples as nuts are tightened. Install nuts on cylinder nipples and tighten securely (wrench 41-W-1570-10). Refer to figure 1. Unless manifold packing bushings are in good condition and manifold nuts securely tightened there are likely to be air leaks around manifold-cylinder points. With this condition it will not be possible to get a satisfactory low speed carburetor adjustment.

(2) After manifold is tight, loosen cylinder base nuts slightly to allow final shifting and lining up of cylinders and manifold, then tighten base nuts securely with wrench (41-W-872-10).

c. Check Ignition Timing. With cylinder heads removed, ignition can be timed accurately by piston location as follows:

(1) Turn engine until front piston is coming up on compression stroke (directly after front cylinder intake valve closes).

(2) Remove circuit breaker cover and advance spark lever by turning left handlebar grip inward as far as it will go. Spark lever should be inward as far as it will go and, if necessary, adjust control wire to obtain this position.

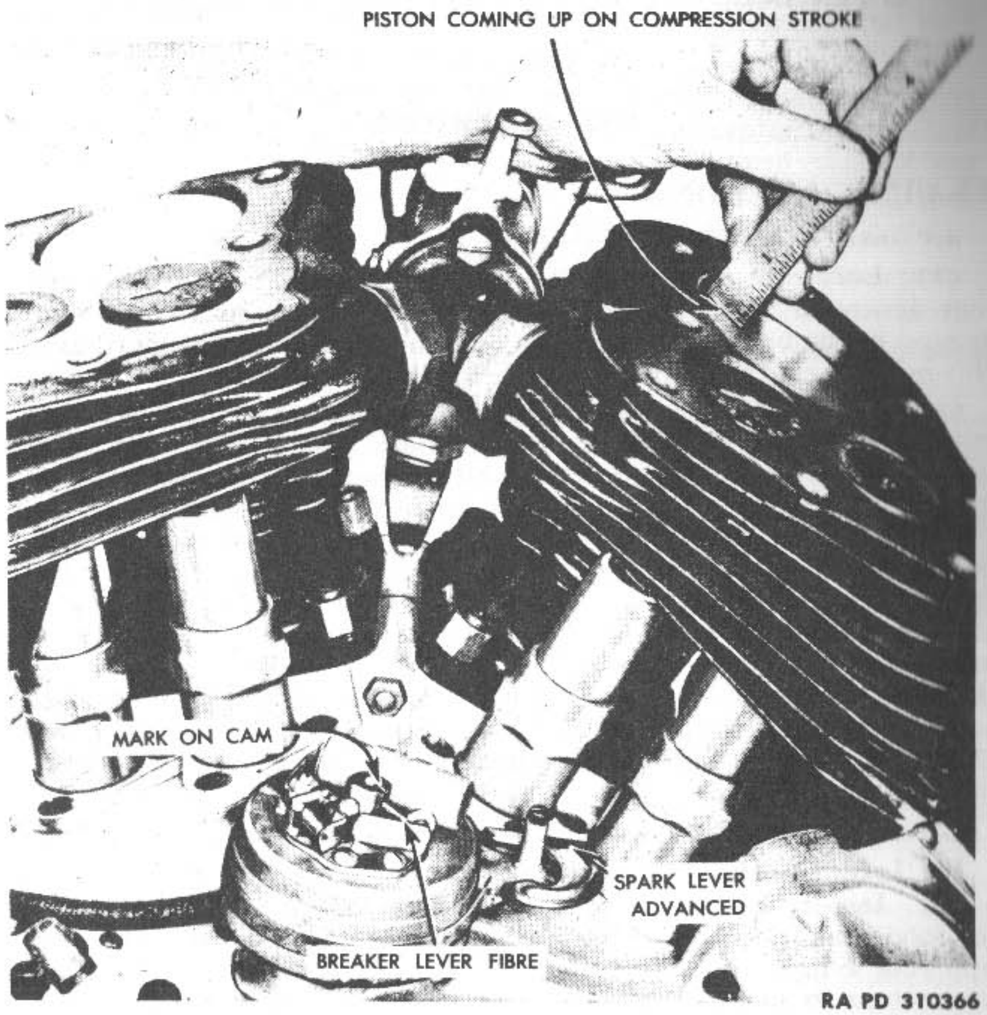


Figure 22—Timing Ignition by Piston Location

(3) Turn engine in direction in which it runs until front cylinder piston is $\frac{9}{32}$ inch before top dead center on the compression stroke (fig. 22). At this point, the small end of the ignition timer cam should be just opening the points. NOTE: *Point gap must be adjusted to 0.022 inch before correcting ignition timing.*

(4) To correct ignition timing, loosen timer lever band screw and shift timer head until points just open with front piston set at $\frac{9}{32}$ inch before top dead center; then tighten timer head band screw. Recheck timing after timer head band screw has been tightened to make sure timer head has not shifted.

d. Install Cylinder Heads.

(1) Use a new cylinder head gasket each time heads are installed. This assures leak-free joints. Old gaskets should be reused only in an emergency when new gaskets are not available.

(2) Make sure tops of cylinders and cylinder head faces are clean. Apply a light coat of engine oil or grease to both sides of gaskets and install gaskets.

(3) Place heads on cylinders and install heavy washers and head bolts. Attach cylinder head bracket (top mounting bracket) with the two long bolts, spacers and flat washers. Spacers go between the cylinder heads and bracket. A flat washer goes under the head of each long bolt above bracket. Some engines have flat washers between spacers and bracket.

(4) Secure engine top mounting bracket (cylinder head bracket) to frame lug, installing required number of thin shim washers, together with clamp for front spark plug cable, to fill space between bracket and frame lug before tightening bolt. NOTE: *Frame lug must be free from paint or grease to make clean electrical connection with plated shim washers and mounting bracket for adequate radio bonding.*

(5) Head bolts must be tightened evenly to attain a tight joint. First turn bolts down just snug; then tighten each of them one-eighth to one-quarter turn at a time until all are securely tightened. Use special head bolt wrench (41-W-1525). If torque wrench is available, tighten head bolts to 60 foot-pounds minimum, 65 foot-pounds maximum tension when engine is cold.

(6) Install spark plugs (use new gaskets if old ones are in bad condition) and tighten securely. Attach the high tension cable terminals.

e. Install Tanks, Instrument Panel, Air Intake Hose, and Fuel Pipe. Install tanks as described in TM 9-879. Install instrument panel as described in TM 9-879. Attach air hose to air cleaner and secure hose fitting to carburetor with four screws. Tighten air hose clamps. Attach fuel strainer and fuel pipe to carburetor and tank fuel supply nipple. Open tank fuel supply valve and inspect fuel line and connection for leaks.

CHAPTER 2

OVERHAUL OF ENGINE IN VEHICLE (Cont'd)

Section V

ADJUSTMENT AND TESTS

16. ADJUSTMENT.

a. Valve Tappets. Valve tappets must be adjusted after valve grinding before attempting to start engine. Inlet valves are those nearest carburetor intake pipe.

(1) Make sure each tappet is at its lowest position by turning engine ahead until like tappet in the other cylinder is at its highest position (valve fully open).

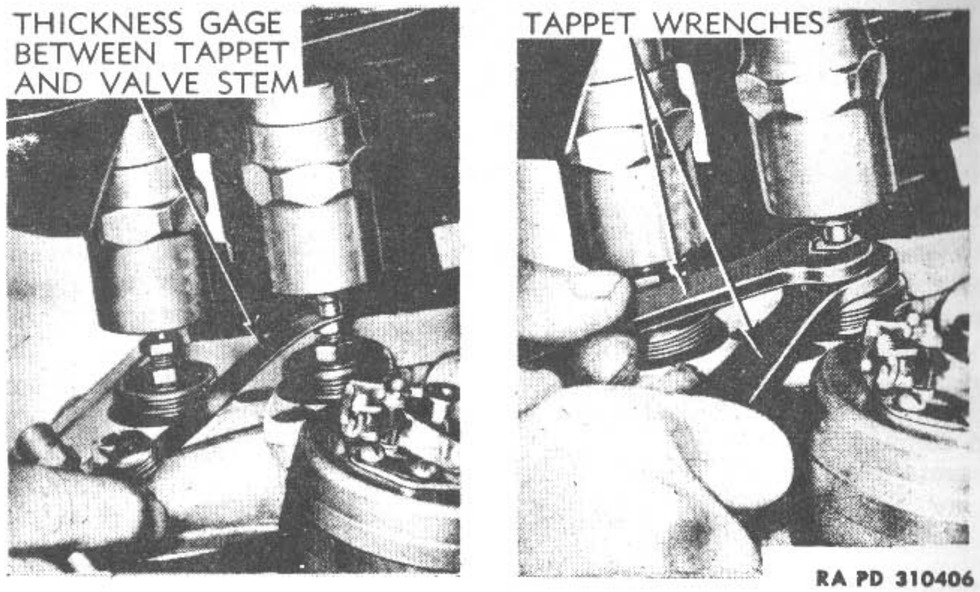


Figure 23—Adjusting Valve Tappets with Wrenches (41-W-3572)

(2) After loosening adjusting screw lock nut, turn tappet adjusting screw as necessary to obtain specified tappet clearance (fig. 23). Inlet valve stem and tappet clearance is 0.004 to 0.005 inch. Exhaust valve stem and tappet clearance is 0.006 to 0.007 inch. Measure with an accurate thickness gage. After obtaining correct tappet clearance, tighten adjusting screw lock nut. Inspect tappet clearance after tightening lock nut because adjustment sometimes changes when nut is tightened. Readjust if necessary.

(3) See that paper gasket between valve cover and tappet guide is in good condition. If broken or damaged, install a new gasket to prevent an oil leak.

(4) Turn down valve spring covers with special wrench (41-W-3617).

b. Carburetor Control (fig. 25). Adjustment for full opening and closing of throttle to correspond with full inward and outward motion of the handlebar grip is made at the junction of the control wire end and the throttle lever connection.

(1) Enter end of control wire in throttle lever connection hole. Turn right handlebar grip outward as far as it will go; then turn it inward slightly. Holding throttle grip in this position, move throttle lever forward against its stop (closed position) and secure wire in connector block with clamp screw. Check closing of throttle after

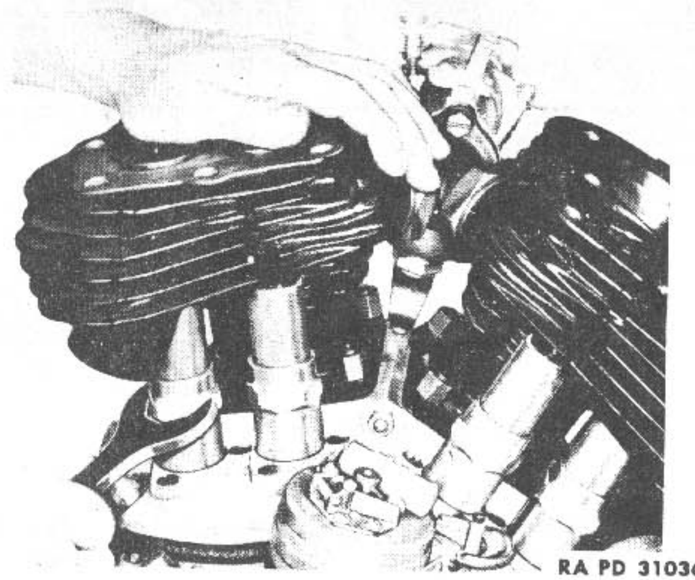


Figure 24—Tightening Valve Spring Covers with Wrench (41-W-3617)

tightening control wire set screw. If necessary, reset the control wire in the connector block until throttle is closed with full outward movement of the right grip.

(2) Check full opening of throttle by turning right grip inward as far as it will go and see that throttle lever is against its stop (full open position). If necessary reset the control wire in connector block until full open and closed positions are obtained.

c. Carburetor Adjustment (fig. 25). A carburetor that is badly out of adjustment, or a new carburetor just installed, must be adjusted as follows:

(1) Turn the low speed needle valve (on rear of carburetor body) all the way down (to right); then back it out (to left) about three full turns. With needle valve in this position, engine will start, but mixture will probably be too rich.

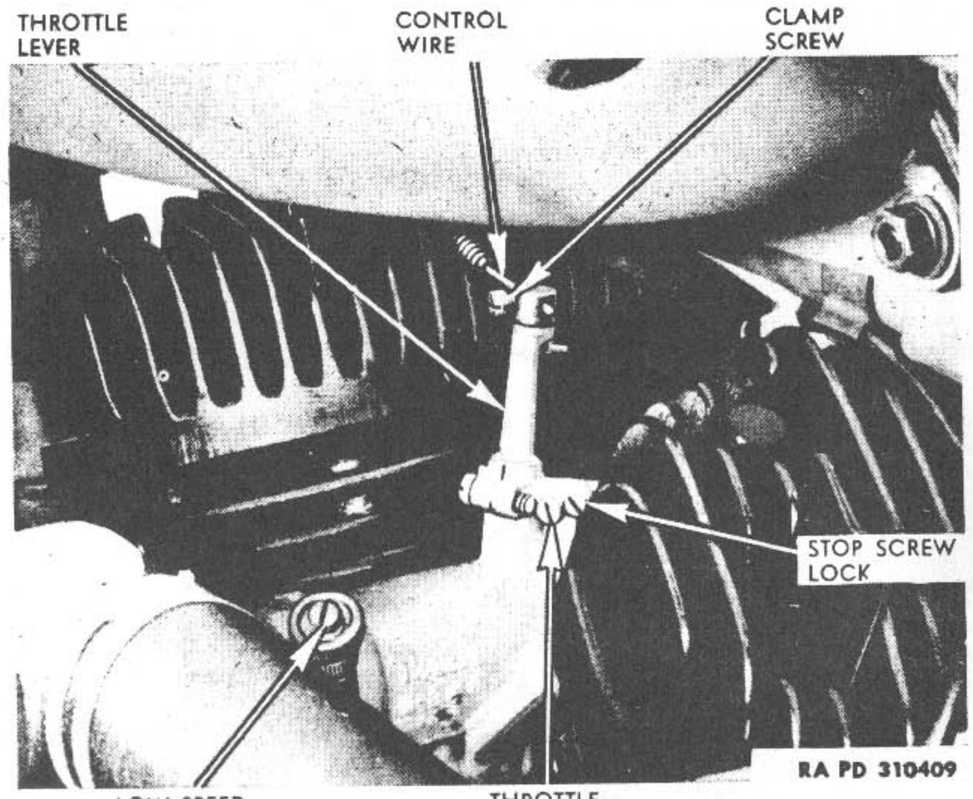


Figure 25—Carburetor Control Lever and Low Speed Needle Valve

(2) Start engine and, after choke lever has been moved to normal open running position and engine is normally hot, correct adjustment of needle valve by turning needle valve down (to right) one notch at a time until mixture becomes so lean that engine "misses" and is inclined to stop; then back out (to left) needle valve 5 to 10 notches or until engine fires regularly with spark advanced and throttle closed (or as nearly closed as it can be set and still have engine run at idling speed).

(3) Adjust engine idling speed by means of throttle lever stop screw with throttle in fully closed position. Turning stop screw to right makes engine idle faster, and turning it to the left makes engine idle slower. **NOTE:** *Do not idle engine at slowest possible speed because an extremely slow idling adjustment causes hard engine starting.* Changing engine idling speed with throttle lever stop screw is likely to change the low speed fuel mixture to some extent; therefore, it will be necessary to again check and correct the low speed needle valve adjustment (see (1) above).

(4) Engine starting and all-around carburetion will be better with low speed fuel adjustment slightly rich rather than extremely lean.

(5) If engine idling and low speed adjustment is difficult to obtain, inspect inlet pipe nipple connections for air leakage. Apply a few drops of gasoline around nipple nuts with engine idling and observe action on engine operation.

d. Spark Control. Spark retard and advance is controlled by left handlebar grip. Spark lever operates within a quadrant mounted on engine. Spark must be fully advanced (lever inward toward engine) when left grip is turned inward to full extent of its travel. When grip is turned outward, spark lever retards (lever outward, away from engine).

(1) Loosen spark control wire clamp screw at spark lever and turn left grip fully inward; then back it out just a little. Holding grip in this position, shift spark lever inward toward engine as far as it will go; then tighten control wire clamp screw. Test by turning left grip fully inward and noting position of spark lever. Spark lever should be against inner side of quadrant. Retard spark and check position of spark lever. It should be against outer side of quadrant.

(2) Readjust as necessary for full advance and retard of timer lever positions when left grip is turned inward and outward respectively.

17. ROAD TEST.

a. General Performance. Road test vehicle for general performance, giving attention to adjustment of chains, action of clutch and gear shifter controls and brakes. Engine newly fitted with pistons and/or rings should be operated not faster than 30 miles per hour for the first 100 miles; 35 miles per hour for the next 300 miles and 40 miles per hour for the next 400 miles. Avoid running at or near top speed for long distances during the first 1,000 miles.

(1) Observe action of panel signal lights for generator charging rate and engine oil pressure.

(2) Observe engine performance with regard to carburetor adjustment with vehicle in operation.

(3) Observe pulling power of engine at low speeds and its ability to accelerate when throttle is opened.

(4) Watch for excessive engine heating.

(5) Look for oil leaks around cylinder heads, cylinder bases, valve covers and spark plugs.

b. Noises. While road testing vehicle, listen for unusual noises in engine, clutch, transmission, wheels, and other members that might indicate developing trouble.

(1) Listen for engine knocking when pulling at medium speed, considering spark knock which should cease when spark is retarded.

(2) Listen for pounding, thumping noises in engine, considering the usual timing gear noises. NOTE: *Do not confuse scraping, pounding noise caused by excessively loose front drive chain with engine internal noise.*

(3) Check for unusual vibration that may be caused by loose engine mounting or loose transmission mounting (also causes thumping noise).

(4) Locate and remedy any rattles and squeaks caused by loose, broken, or dry chassis members.

CHAPTER 2

OVERHAUL OF ENGINE IN VEHICLE (Cont'd)

Section VI

FITS AND TOLERANCES

18. FITS AND TOLERANCES.

a. The following table of fits, tolerances, and specifications covers upper end items pertinent to repair of engine in the vehicle.

(1) CONNECTING ROD PISTON PIN BUSHING. Standard hole diameter, 0.7925 inch. Standard piston pin in connecting rod bushing clearance is 0.001 inch. Ream and hone for oversize pin when clearance exceeds 0.002 inch. Replace to accommodate new piston fitted with standard pin.

(2) CONNECTING ROD UPPER END SIDE PLAY. To determine condition of connecting rod roller bearings, shake top end of rod sideways and when either or both rods have $\frac{1}{8}$ inch or more side shake, lower end bearing must be repaired.

(3) CYLINDER BORE. Standard bore is 2.7445 to 2.7455 inches. When worn 0.002 inch or more, larger than standard or an oversize bore, refinish cylinder.

(4) CIRCUIT BREAKER POINT GAP. 0.0022 inch when points are held open at highest point on timer cam.

(5) IGNITION TIMING. Circuit breaker points just starting to open when piston is $\frac{1}{4}$ to $\frac{9}{32}$ inch before top dead center, coming up on the compression stroke.

(6) PISTON-CYLINDER HEAD CLEARANCE. The distance between cylinder head and piston (at highest position) is $\frac{1}{16}$ to $\frac{3}{32}$ inch.

(7) PISTON. Standard size is 2.743 inches measured at bottom of the skirt, front to rear, at right angles to center line of pin.

(8) PISTON CLEARANCE IN CYLINDER. The piston must have 0.0015 to 0.0025-inch clearance in the cylinder (standard or oversize).

(9) PISTON SIZES AVAILABLE. Standard and 0.010, 0.020, 0.030 and 0.040 inch oversizes available. Oversize pistons stamped on top "10," "20," etc.

(10) PISTON RING SIDE CLEARANCE IN PISTON GROOVES. Standard clearance 0.004 inch. Maximum allowable clearance before new ring (or piston) is necessary 0.006 inch.

(11) PISTON RING GAP. New rings must have 0.010 to 0.020-inch gap in cylinder.

(12) PISTON RING SIZES AVAILABLE. Standard and 0.010, 0.020, 0.030 and 0.040 inch oversizes are available.

(13) PISTON PIN. Standard size 0.7915-inch diameter. Replace when worn 0.0005 inch.

(14) PISTON PIN FIT IN PISTON BOSSES. Light hand press fit in piston.

(15) PISTON PIN CLEARANCE IN CONNECTING ROD BUSHING. 0.001 inch. Refit when pin and bushing clearance is in excess of 0.002 inch.

(16) PISTON PIN SIZES AVAILABLE. Standard and 0.002, 0.004, 0.006, 0.008 and 0.010 inch oversizes.

(17) VALVE STEM IN GUIDE CLEARANCE. 0.0035 to 0.0055 inch. Replace valve and/or guide when clearance exceeds 0.008 inch.

(18) VALVE SPRINGS. Free length of a new intake or exhaust valve spring is approximately $2\frac{19}{32}$ inches. Replace when shrunken more than $\frac{1}{8}$ inch.

(19) VALVE TAPPET CLEARANCE (engine cold). Intake valves, 0.004 to 0.005 inch. Exhaust valves, 0.006 to 0.007 inch.

CHAPTER 3

ENGINE

Section I

ENGINE DISASSEMBLY INTO SUBASSEMBLIES

19. PRELIMINARY INSTRUCTIONS.

a. Engine Removal. Refer to TM 9-879.

b. Mount Engine on Stand. A strong wooden box with an opening about 8 x 8 inches and at least 4 inches deep can be used to support engine (fig. 26).

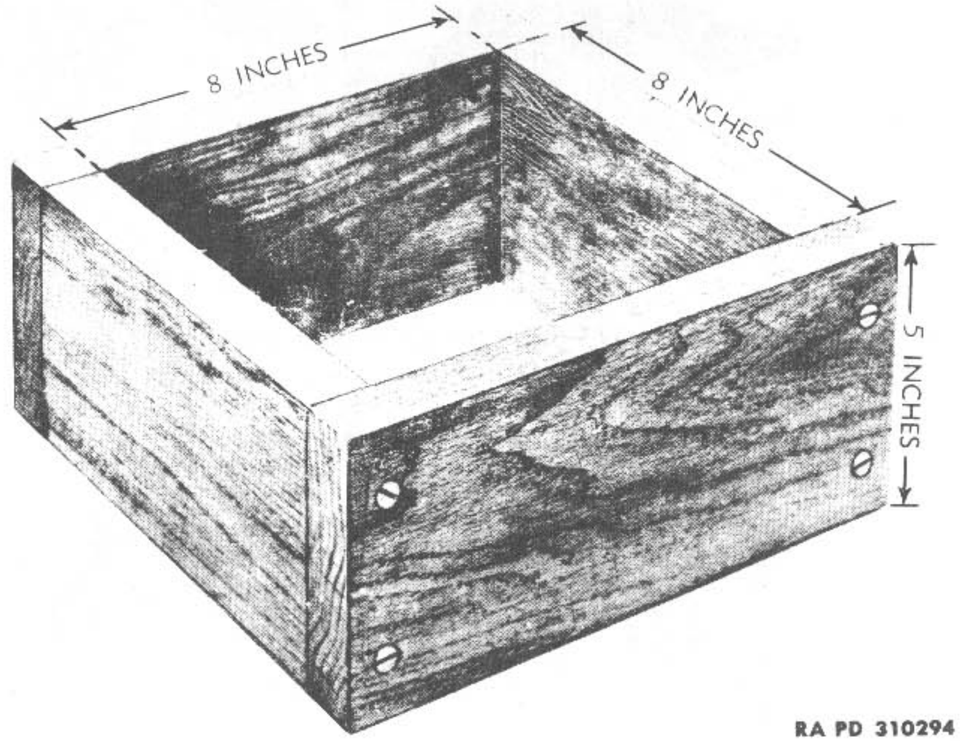


Figure 26—Engine Mounting Stand

c. Remove Accessories. Refer to TM 9-879 for removal instructions for the following accessories: carburetor, generator, spark plugs, relay and circuit breaker assembly.

d. Clean Exterior of Engine. Plug all openings to the interior of the engine, and remove all dirt and grease with dry-cleaning solvent or steam-cleaning equipment.

20. DISASSEMBLY.

a. Engine Disassembly Sequence. The sequence in engine disassembly is as follows: cylinder heads, cylinder assemblies, piston

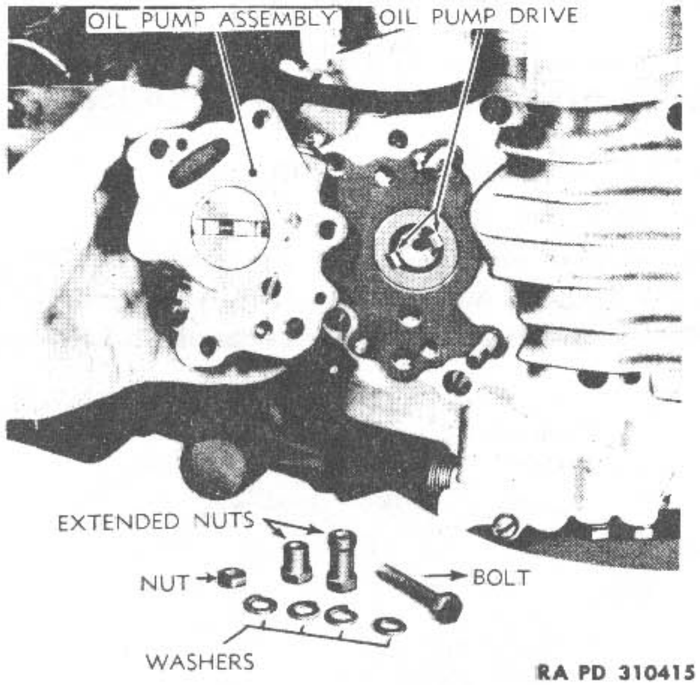


Figure 27—Removing Oil Feed Pump

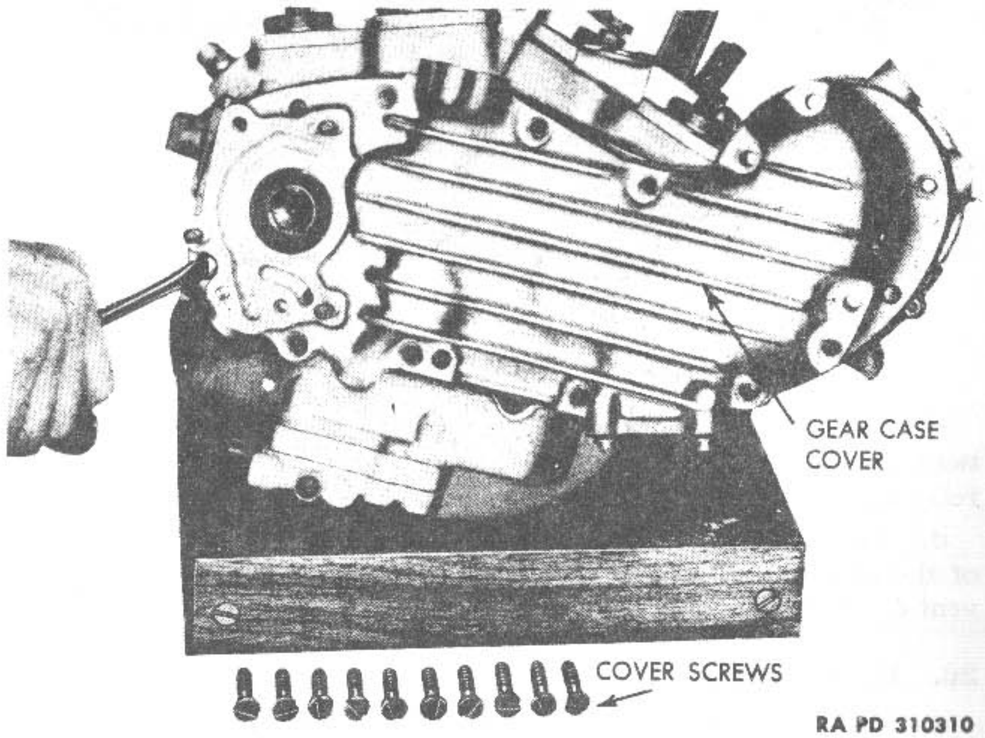


Figure 28—Removing Gear Case Cover

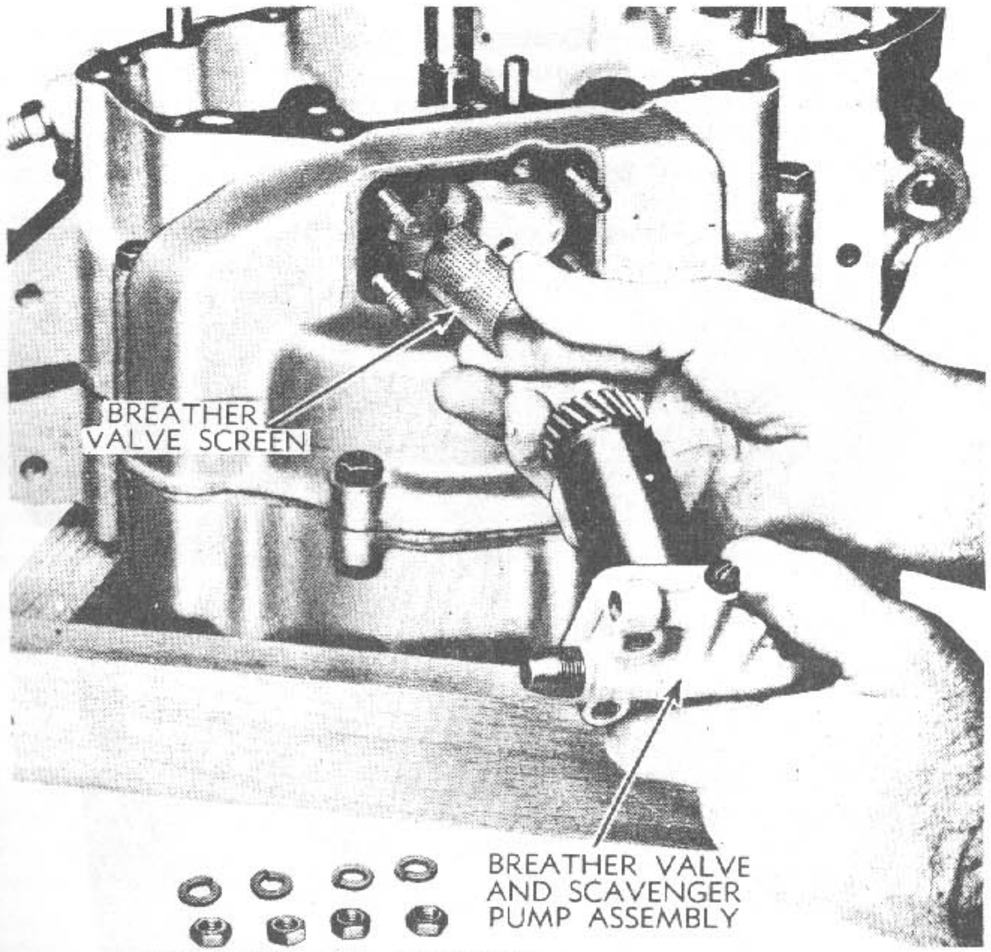


Figure 29—Removing Scavenger Pump and Breather Valve Assembly

assemblies, oil feed pump, gear case cover, scavenger pump, timing gears, crankcases and flywheels.

b. Order and Care of Components. Keep all components of individual engine in one box or pan and exercise care in handling of parts to prevent loss and damage.

c. Disassembly. Instructions and references to instructions pertinent to engine disassembly follow:

(1) REMOVE CYLINDER HEADS. See paragraph 5 **c**.

(2) REMOVE CYLINDER ASSEMBLIES. Refer to paragraph 5 **d**.

(3) REMOVE PISTON ASSEMBLIES. See paragraph 5 **e**.

(4) REMOVE OIL FEED PUMP (fig. 27). Remove the hexagon head screw and three nuts and feed pump can then be pulled off of gear case cover. CAUTION: *Unless a new gasket is available, be careful not to damage the old one as this is a very special gasket concerning both thickness and location of holes for oil channels.*

(5) REMOVE GEAR CASE COVER (fig. 28). If tappets and guides must be replaced, perform operation under (8) below before removing gear case cover. Remove all remaining gear case cover screws. Use a hammer and a block of wood (tapping lightly at the ends where cover projects beyond the gear case) to drift cover free from registering dowel pins. NOTE: *Do not use a screwdriver or other sharp tool inserted between joint faces to remove cover.* The thin steel shim washers installed on outer ends of front cylinder cam gears may come off with the cover; be careful they are not lost. Take care, also, to protect cover gasket as this is a very special gasket concerning both thickness and location of holes for oilhole channels.

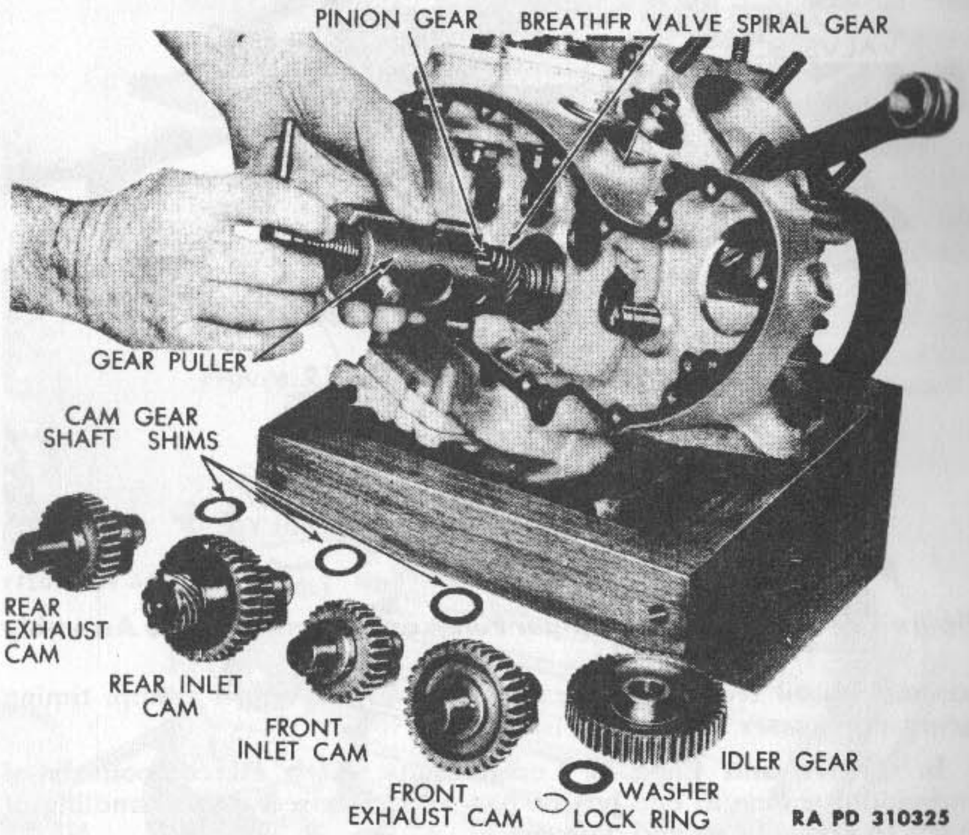


Figure 30—Removing Timing Gears with Puller (41-P-2903)

(6) REMOVE SCAVENGER PUMP AND CRANKCASE BREATHER VALVE ASSEMBLY (fig. 29). Remove four nuts and this assembly can be pulled off the four mounting studs, out of crankcase gear chamber. Crankcase breather valve is an integral part of the scavenger pump. CAUTION: *Take care not to lose the screen located between breather valve and crankcase port when pump assembly is removed.*

(7) REMOVE TIMING GEARS (fig. 30). Remove front and rear cylinder cam gears by pulling them out of crankcase bushings. Large intermediate gear is retained on stud by means of spring lock ring. When removing timing gears take care not to lose any shims that may

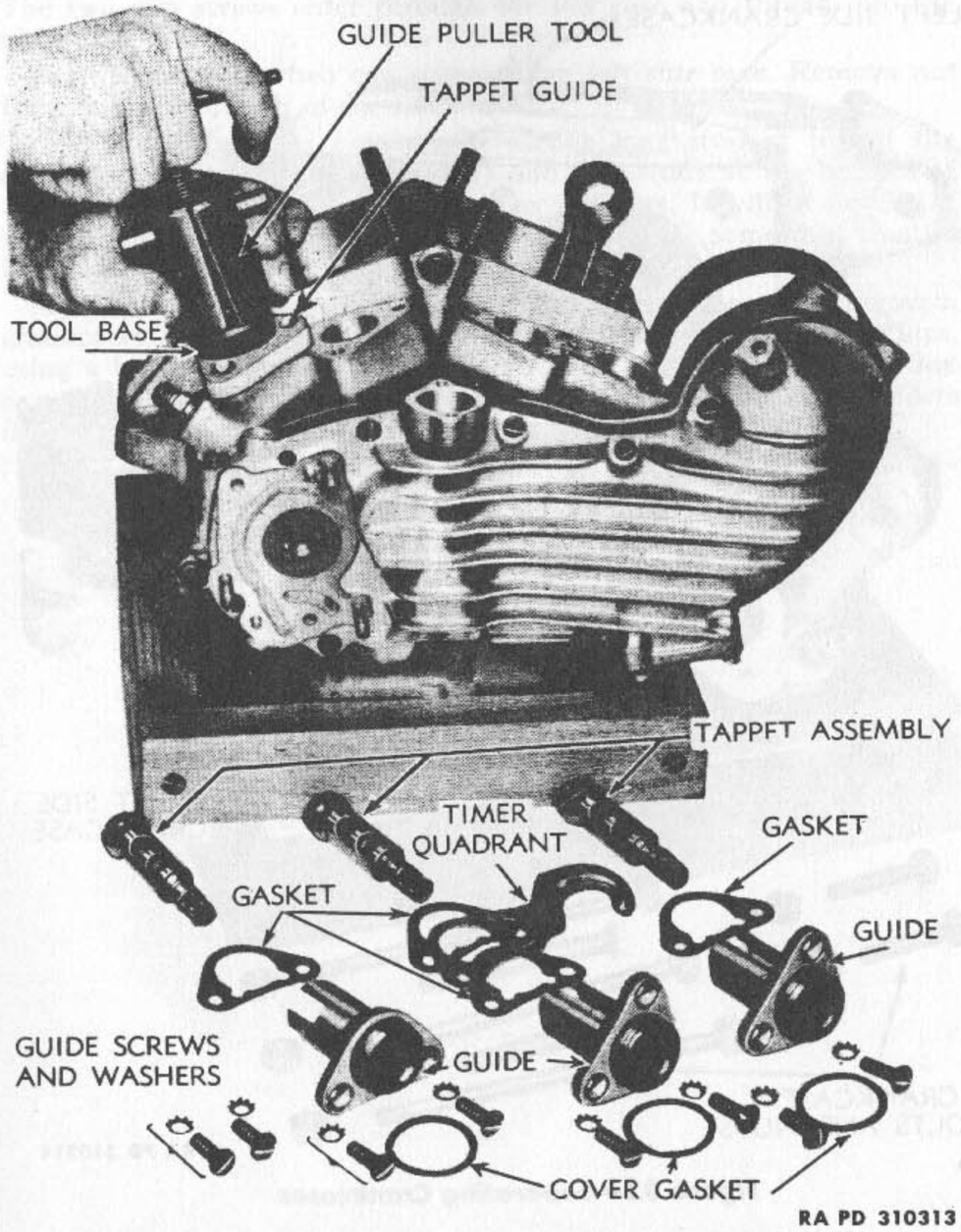


Figure 31—Removing Tappet Guides with Puller (41-P-2956)

be located between gear hub faces and crankcase. Remove pinion gear, breather valve and scavenger pump drive (worm) gear, bearing seal ring spring and gear shaft bearing oil seal ring from gear shaft. Gears are a slip fit on shaft spline and should slip off of shaft easily. If gears are difficult to remove from gear shaft, use puller (41-P-2903).

(8) REMOVE VALVE TAPPETS AND VALVE TAPPET GUIDES (fig. 31). Tappet guides are long-life members that seldom require replacement.

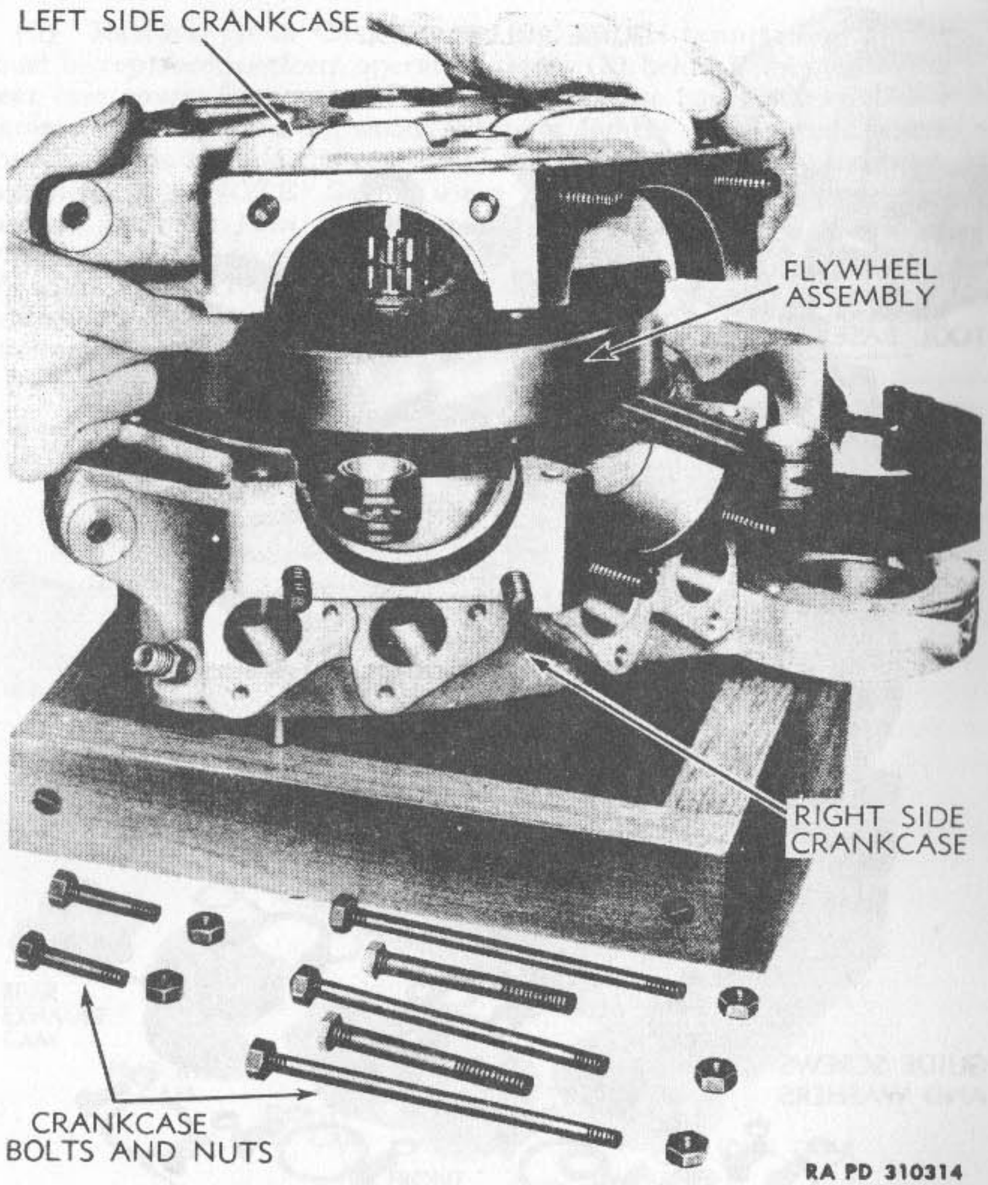


Figure 32—Separating Crankcases

However, if it has been determined that tappet clearance in the old guide is in excess of 0.002 inch, then remove guides and tappet as follows:

(a) Tappet guides are a light press fit in crankcase and are retained by screws. Remove screws. NOTE: *Cam gear must be assembled in case for the tappet to rest against when using puller (41-P-2956).*

(b) Heat crankcase around tappet guide and pull guide with special puller (41-P-2956).

(9) DISASSEMBLE CRANKCASES (fig. 32). Crankcases are held together with two cap screws, and five studs with a nut on each end.

ENGINE DISASSEMBLY INTO SUBASSEMBLIES

The two cap screws enter through the left case and thread into the right case.

(a) Remove the two cap screws from left side case. Remove nut from one end of each of the five studs.

(b) Studs serve as case registers. The long stud at top of the crankcase (between cylinder bases) and two studs at the bottom of the crankcase are a tight fit to serve as registers. It will be necessary to drift these studs out of crankcase, using a drift somewhat smaller in diameter than the studs.

(c) Separating Cases. With all studs and cap screws removed, crankcases can be separated by tapping lightly at mounting lugs, using a block of wood and a hammer. CAUTION: *When separating cases, exercise care to keep flywheel shaft roller and retainer sets intact.*

CHAPTER 3

ENGINE (Cont'd)

Section II

DISASSEMBLY, CLEANING, INSPECTION AND REPAIR AND ASSEMBLY OF CYLINDERS AND PISTONS, AND CONNECTING ROD ALINEMENT

21. CYLINDERS, PISTONS AND CONNECTING RODS.

a. Disassembly, cleaning, inspection, repair, and assembly of cylinder pistons and connecting rod alinement are covered in chapter 2, overhaul of engine in vehicle. Following are the paragraph references for these subassemblies.

(1) Cylinder disassembly, refer to paragraph 7.

(2) Cleaning of cylinders and related parts, refer to paragraph 8.

(3) Repair of cylinders and valves, refer to paragraph 9.

(4) Assembly of cylinders, refer to paragraph 10.

(5) Information on pistons, piston pins and rings, refer to paragraph 11.

(6) Information on alining connecting rods, refer to paragraph 14.

CHAPTER 3

ENGINE (Cont'd)

Section III

DISASSEMBLY, CLEANING AND INSPECTION, FITTING CRANK PIN AND MAINSHAFT ROLLER BEARINGS, AND ASSEMBLING FLYWHEEL ASSEMBLY

22. DISASSEMBLY.

a. Remove Right Flywheel from Crank Pin. Secure flywheel sprocket side mainshaft in vise with copper jaws when disassembling flywheels.

(1) Remove retaining screw and lock washer from crank pin right end (gear shaft side) nut.

(2) Remove crank pin nut.

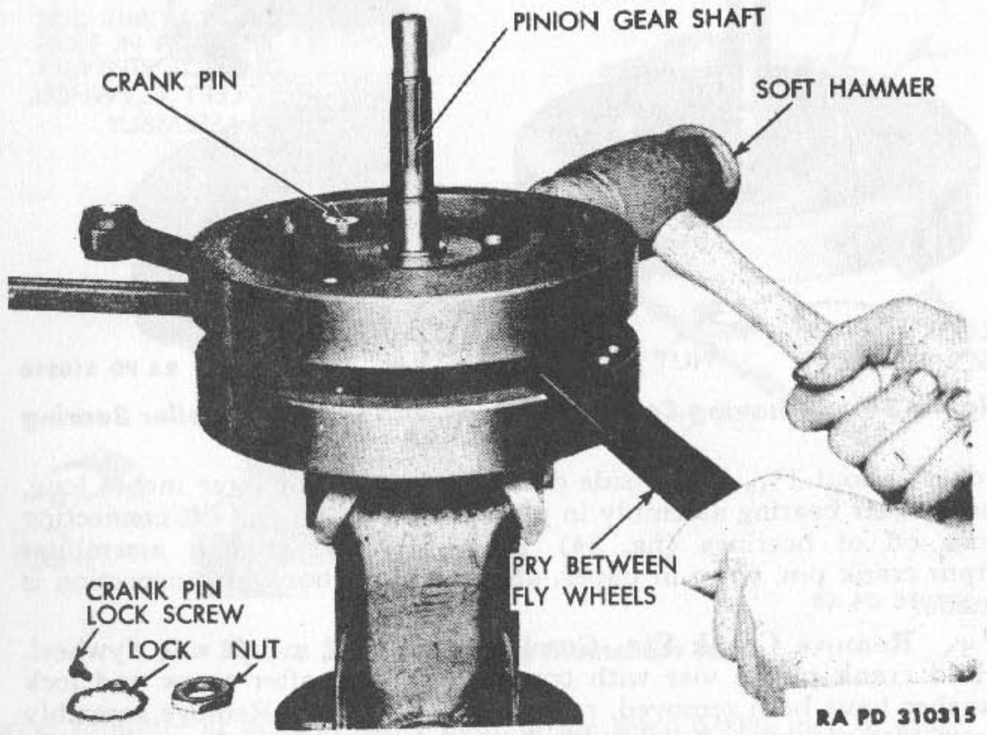


Figure 33—Separating Flywheels

(3) Separate flywheels by striking rim of right side flywheel with a soft hammer about 90 degrees away from crank pin (fig. 33). One or two sharp blows will usually loosen wheel. CAUTION: *Do not strike wheel on its side, as doing so might either break flywheel or damage the tapered crank pin hole.*

b. Remove Connecting Rods and Roller Bearing Assembly from Crank Pin. Using a piece of pipe (or the lower half of a valve spring

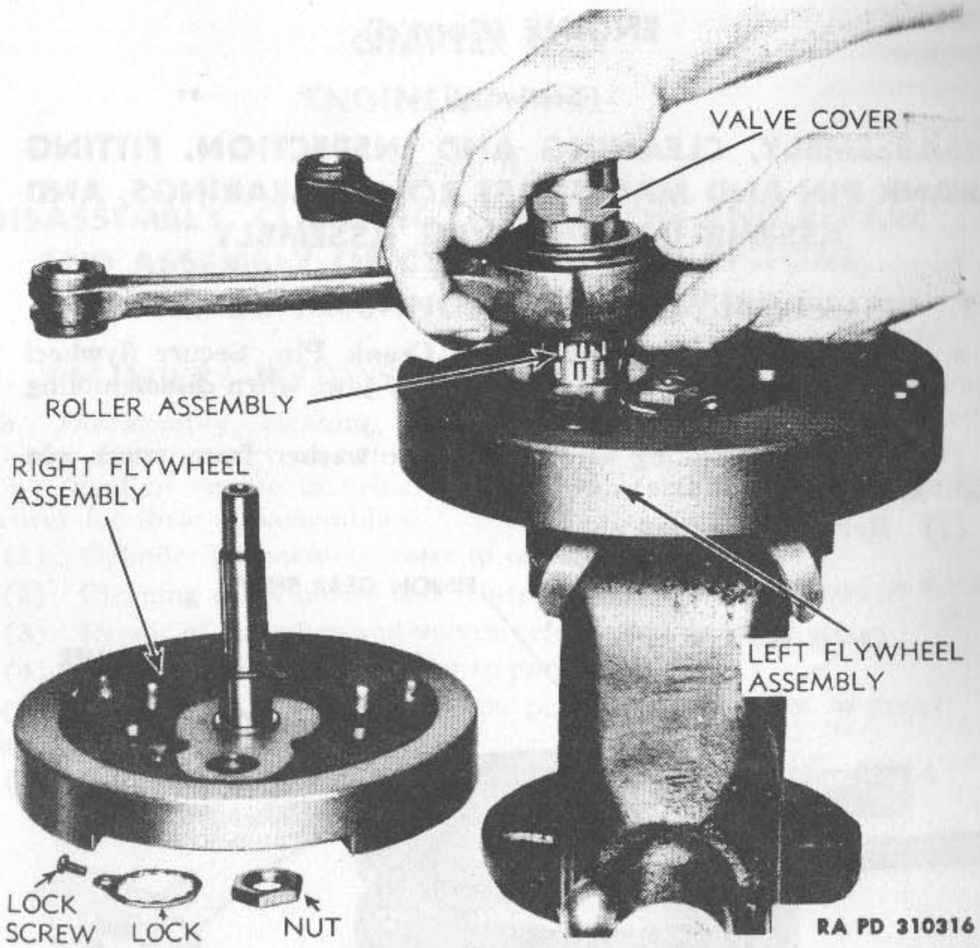


Figure 34—Removing Connecting Rods with Crank Pin Roller Bearing

cover) about $1\frac{1}{16}$ inch inside diameter and two or three inches long, hold roller bearing assembly in place on crank pin and lift connecting rods off of bearings (fig. 34). Lift roller and retainer assemblies from crank pin, wrap in paper, and store in a box until inspection is made.

e. Remove Crank Pin. Crank pin is keyed in left side flywheel. Hold crank pin in vise with copper jaws, and after screw and lock washer have been removed, remove crank pin nut. Remove assembly from vise and while holding flywheel strike end of crank pin squarely and lightly with copper or lead hammer to drift it out of flywheel.

d. Remove Mainshafts. Remove mainshaft locks and nuts. Secure mainshaft in vise with copper jaws and after screw and nut lock is removed, remove nut from mainshaft (fig. 35). Holding each flywheel, drift shaft from wheel, using copper or lead hammer.

23. CLEANING AND INSPECTION.

a. Cleaning. Before attempting to inspect and size bearings, shafts and races, clean all parts thoroughly in dry-cleaning solvent and dry

with air. Exercise care not to lose or mix up the crank pin roller bearings.

b. Inspection. Inspection of roller bearings and shafts requires use of a precision micrometer to determine extent of wear. Outer races must be closely inspected and gaged with size plug or shaft and oversize rollers to determine amount of wear.

(1) INSPECT SHAFTS AND RACES. Carefully examine all shafts and bearing races for damaged and pitted surfaces. If any parts are found with rough or pitted surfaces, replace them. Measure shafts with micrometer for wear. Replace shafts that show any trace of a

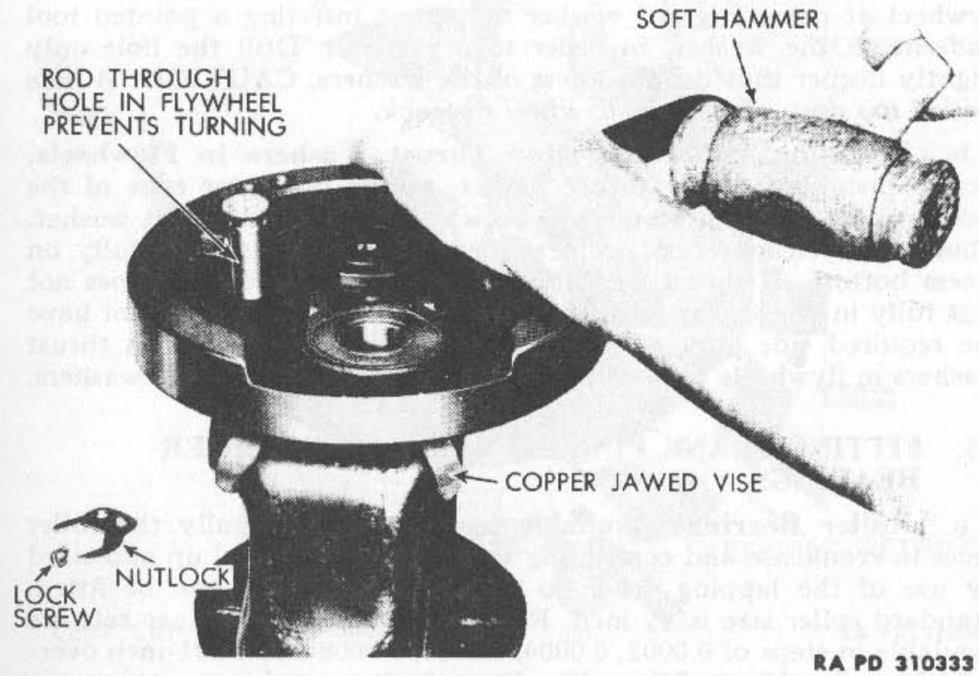


Figure 35—Removing Mainshaft Nut

wear shoulder at sides of roller path, or are worn 0.0005 inch or more. Bearing races that show any trace of a wear shoulder at sides of roller path must be lapped true or replaced if worn more than 0.0005 inch. Refer to paragraph 25 for directions for lapping and sizing main bearings. NOTE: *Connecting rod lower bearing races when worn in excess of 0.0005 inch or when pitted, must be replaced with new rod assemblies. Refer to paragraph* 12 **a** *for inspection and repair of piston pin bushing.*

(2) INSPECT ROLLER RETAINERS. Inspect all roller retainers for cracks and extent of wear; comparing them with a new retainer is best method.

(3) INSPECT FLYWHEELS. After flywheels are thoroughly cleaned, inspect for breaks or cracks, especially at taper holes. A wheel with crack at taper hole cannot be made to stay in alinement after assembly.

(a) Inspect Flywheel Connecting Rod Thrust Washers. If washer in either wheel is worn and/or grooved to any extent, it must be replaced.

24. FLYWHEEL REPAIR.

a. The only repair that can be made to flywheels is the replacement of the connecting rod thrust washers which fit into recesses in flywheel faces, around the crank pin holes. These thrust washers are hardened steel and cannot be drilled.

(1) REMOVAL OF THRUST WASHERS. Drill a 1/8-inch hole in flywheel at outer edge of washer to permit inserting a pointed tool underneath the washer, in order to pry it out. Drill the hole only slightly deeper that the thickness of the washers. CAUTION: *A hole drilled too deep may cause flywheel to crack.*

b. Installing Connecting Rod Thrust Washers in Flywheels. Before installing a new thrust washer, scrape the outer edge of the recess where flywheel metal was punched against old thrust washer. Thoroughly clean recess, as new thrust washer must seat fully on recess bottom. If thrust washer is incorrectly installed and does not seat fully in recess, the female (forked) connecting rod may not have the required side play when flywheels are assembled. Retain thrust washers in flywheels by several punch marks at outer edge of washers.

25. FITTING CRANK PIN AND MAINSHAFT ROLLER BEARINGS.

a. Roller Bearings Available in Oversizes. Usually the roller races in crankcase and connecting rods can be smoothed up and sized by use of the lapping arbor so that oversize rollers can be fitted. Standard roller size is 1/4 inch. Rollers or roller and retainer sets are available in steps of 0.0002, 0.0004, 0.0006, 0.0008 and 0.001-inch oversize. In cases where roller races have worn to such extent that the largest oversize rollers do not give the required clearance, then the races must be replaced.

b. Fitting Mainshaft Bearings (fig. 36). When fitting mainshaft bearings, the shafts to be used when flywheels are reassembled can be used as gages to determine when roller bearings are fitted to correct clearance. After crankcase mainshaft bearing races have been trued by lapping (par. 29 **a** (3)) roller bearings can be fitted as follows:

(1) SPROCKET SHAFT MAIN BEARINGS. Two sets of 12 rollers (0.360 in. long) and retainers are used in this bearing. Using the sprocket shaft as a size plug, select the largest roller size that will allow the shaft just noticeable shake in the bearing. NOTE: *Roller bearings, shafts, and races must be perfectly clean and dry when*

DISASSEMBLY, CLEANING AND INSPECTION, FITTING CRANK PIN AND MAINSHAFT ROLLER BEARINGS, AND ASSEMBLING FLYWHEEL ASSEMBLY

determining roller bearing fit. Bearing must not be so tight that the shaft has no shake at all. Sprocket shaft main bearing clearance is 0.0005 to 0.001 inch.

(a) After sprocket shaft main bearing fitting is completed, left side of crankcase with roller and retainer assembly can be set aside until flywheels are assembled.

(2) GEAR SHAFT MAIN BEARING. One set of 12 rollers (0.550 in. long) with two retainers is used in this bearing. With gear shaft for size plug, select largest roller size that will allow the shaft just a little more noticeable shake in the bearing than that allowed for the

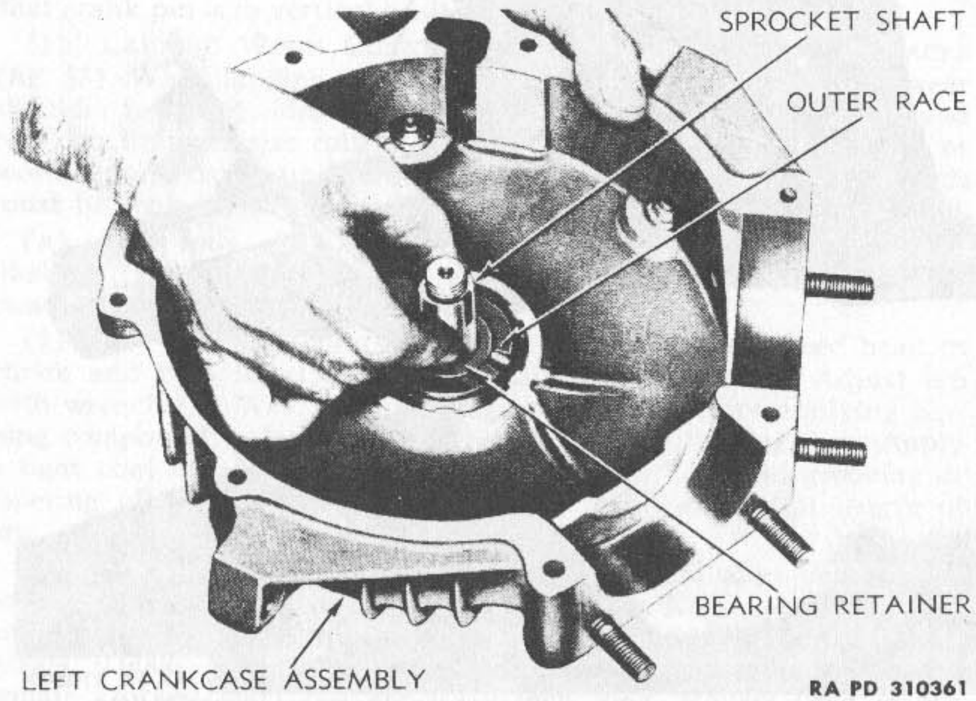


Figure 36—Using Gear Shaft as Size Plug to Determine Bearing Fit

sprocket shaft bearing (fig. 36). Gear shaft main bearing clearance is 0.0008 to 0.0012 inch.

c. Assemble Sprocket Side and Gear Side Mainshafts to Flywheels. It is necessary to assemble mainshafts to their respective flywheels at this time in order to proceed with connecting rod and crank pin bearing fitting. Shaft tapers and flywheel tapers must be perfectly clean and free of oil, and keys must be in place when installing mainshafts in flywheels. NOTE: *Nut lock washers can be installed either side up and either lock screw hole may be used.* If lock screw cannot be inserted with lock washer in any of its various positions, turn shaft nut tighter, rather than looser, to bring lock washer to position where screw holes line up.

(1) Left side (sprocket side) flywheel is quickly identified by timing mark on outside rim face and keyway for crank pin. Install sprocket shaft and tighten nut very tight, striking wrench with a hammer (fig. 35). Install nut lock and tighten retaining screw.

(2) Right side (gear shaft) flywheel is quickly identified by oil feed hole drilled to connect crank pin and gear shaft holes. Install gear shaft, nut and lock as in (1) above. After gear shaft is installed,

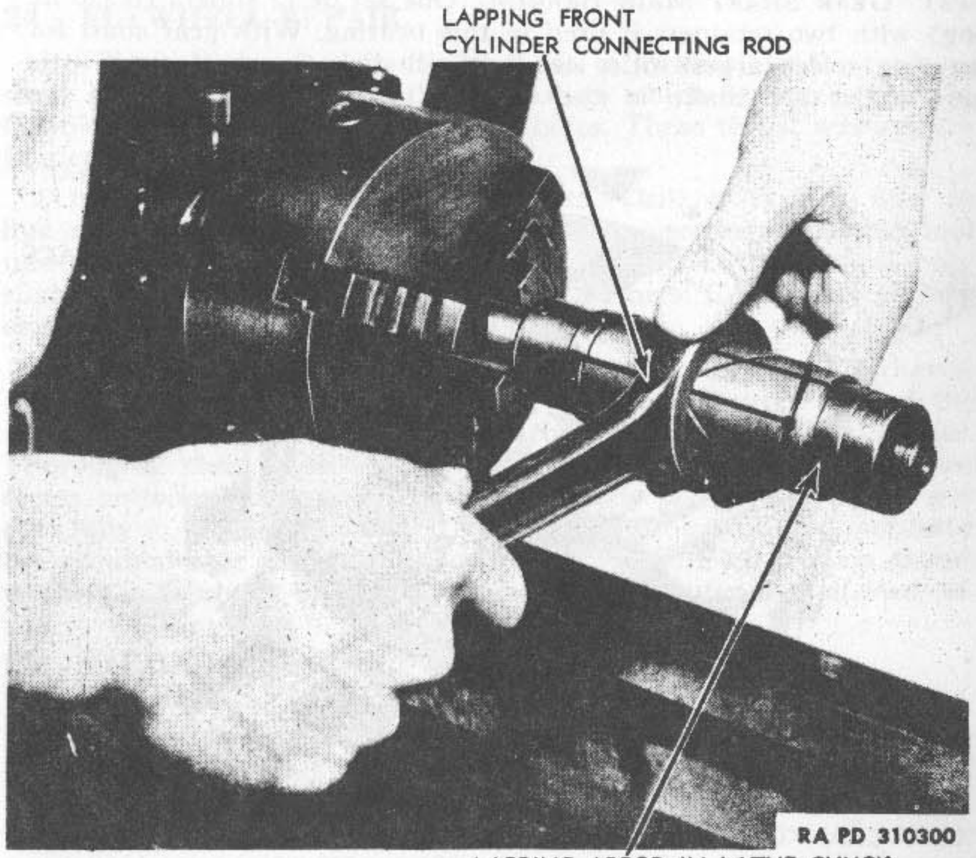


Figure 37—Lapping Connecting Rod Roller Race with Lapping Arbor (41-A-337-10)

check oil passage through shaft and side of flywheel (to crank pin hole) with compressed air, to be sure oil passage is open.

d. Install Crank Pin in Left Side Flywheel. In order to correctly fit crank pin and connecting rod roller bearing, crank pin must be installed in left flywheel and mainshaft held in vise copper jaws.

(1) Crank pin taper and flywheel hole must be perfectly clean and free to oil and key must be in place when crank pin is installed. Turn on crank pin nut, striking wrench with a hammer to securely tighten nut. Install nut lock and securely tighten retaining screw.

DISASSEMBLY, CLEANING AND INSPECTION, FITTING CRANK PIN AND MAINSHAFT ROLLER BEARINGS, AND ASSEMBLING FLYWHEEL ASSEMBLY

(2) Temporarily install right side flywheel and shaft assembly on crank pin and check oil passage through pinion gear shaft, flywheel side and crank pin with compressed air. Make sure this passage is open.

e. Fitting Crank Pin and Connecting Rod Bearings. New rods or used rods returned for rebushing are usually fitted with crank pin and rollers. In this case, the rods and bearing assembly can be assembled to flywheels without further attention, other than thorough cleaning to remove antirust preparation. New rods, or rebushed rods, also are fitted with new piston pin bushings reamed to standard size. Hold left side flywheel and gear shaft assembly in vise copper jaws so that crank pin is in vertical position.

(1) LAPPING WORN CONNECTING ROD ROLLER BEARING RACES (fig. 37). When lapping a set of worn rods, lap until no trace of wear shoulder is left at sides of roller path; also lap both rods (front and rear) to fit same size rollers. When rod roller races are damaged or worn beyond truing up and refitting with largest oversize rollers, rods must be replaced with new rods or rods rebushed and reconditioned.

(a) New rods, not already fitted with rollers and crank pin, are likely to need lapping to fit available rollers and give specified clearance.

(2) Use special arbor (41-A-337-10). Use lathe or speed head to chuck and turn lap 150 to 200 revolutions per minute. Adjust lap with wrench (41-W-475) to fit snug in rod race before applying lapping compound; a loose lap will bell mouth the bearing race. Apply a light coat of fine lapping compound to lap. To avoid grooving or tapering of lap, work the rod back and forth along full length of lap.

(3) ROLLER BEARING FITTING. Rollers must always be new and assembly must not be made up of mixed sizes. Roller sets and roller and retainer sets are available in standard (0.250 in.) and 0.0002, 0.0004, 0.0006, 0.0008 and 0.001 inch oversizes. Rollers used in the female (forked end) rod are 0.270 inch long. Rollers used in the male (single end) rod are 0.550 inch long. If old retainers are used, inspect them for good condition by comparing with new retainers. NOTE: *Over-all width of roller retainer assembly must be less than width of female (forked end) rod; check to make sure of this.*

(a) With flywheel sprocket shaft gripped in vise copper jaws so that crank pin is in vertical position, install a set of rollers and retainers in crank pin. Check fit of each rod on bearing assembly. If neither rod will start over the roller assembly, select a smaller size set of rollers. CAUTION: *Do not mix up bearings. Keep each size in its respective container.* If rods go over bearings easily and there is considerable shake at top end of rods, install a larger oversize set of rollers. If lower end of one rod is found to be slightly larger than the other, it is best to select a roller size that comes closest to correctly fitting the larger rod race and then lap the smaller rod race to bring it up to the same size, rather than fit bearing with rollers of two sizes.

(b) When rods are correctly fitted with required bearing clearance, extreme upper end of female (forked) rear cylinder rod will have just noticeable side shake. Upper end of male (single end) front cylinder rod will have $\frac{1}{32}$ to $\frac{3}{64}$-inch side shake. This check should be made with bearings clean and free of oil. Fitting this important bearing tighter is likely to result in a "seized" and damaged bearing shortly after engine is back in service.

(c) After correct connecting rod and crank pin bearing fit has been attained, thoroughly clean all parts and lubricate with engine oil preparatory to assembling flywheels.

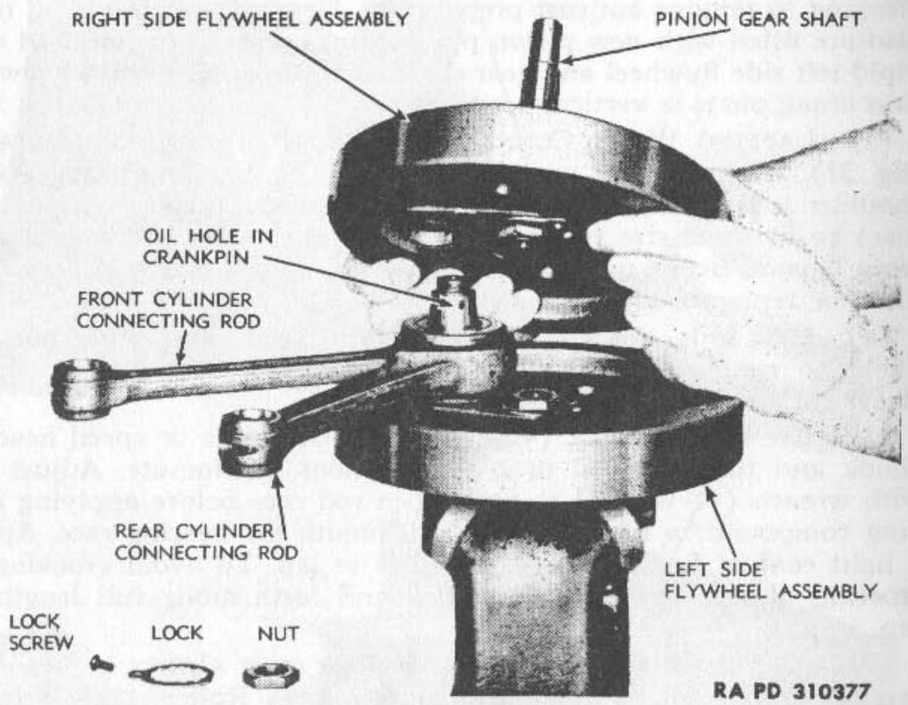


Figure 38—Assembling Flywheels

26. ASSEMBLING FLYWHEELS.

a. The flywheel assembly is a built-up crankshaft and must be as true as possible (as if in one piece) after alinement. When assembling flywheels, make sure that connecting rods are installed on crank pin bearing so that female (forked end) rod will fit into rear cylinder, and male (single end) rod will fit into front cylinder (fig. 38). This rod arrangement provides better crank pin bearing lubrication. Do not assemble flywheels until crankcase main bearings have been repaired (par. 25).

b. Install Right Side Flywheel. With left side flywheel and rod assembly held in vise copper jaws, wipe all traces of oil from crank pin taper and right flywheel taper hole and install wheel on crank pin. Aline wheel as nearly as possible concentric with left side wheel by means of a straightedge held against outer face of wheel rims

90 degrees from crank pin. Tighten crank pin nut lightly. Check rim faces again with straightedge (fig. 39) and if tightening of nuts has shifted wheel, correct its position by striking rim of wheel with a soft hammer. Do not use a hard steel hammer. Turn crank pin nut tighter and repeat straightedge check. To prevent flywheel assembly from turning in vise copper jaws while tightening nut, insert a rod or bolt ($\frac{1}{2}$ inch x 5 or 6 inches long) through holes in flywheels and shift wheels in vise so that rod or bolt bears against some part of vise.

c. Checking Rod Side Play Between Flywheels. It is important that side play of female (forked) rod be between 0.006 and 0.010

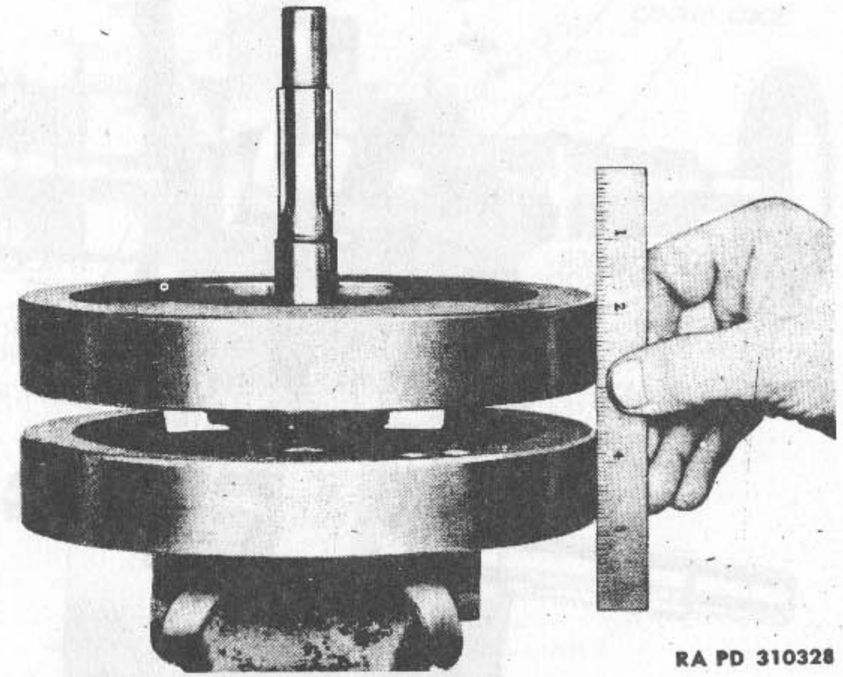


Figure 39—Checking Flywheel Rim Faces

inch when wheels are finally trued and crank pin nut finally and securely tightened. A minimum rod side play check before wheel truing is advisable to prevent further possible trouble and extra work.

(1) ROD MINIMUM SIDE PLAY CHECK. Before attempting to true flywheels, check side play between female (forked) rod and flywheel thrust washers for minimum side play (clearance). Push the rod tight against one flywheel thrust washer and check clearance between rod and the other wheel with thickness gage (fig. 40). If rod side play is less than 0.007 inch, correction must be made before continuing with assembly and truing operations. If the side play between forked rod and flywheels is less than 0.007 inch, it may be due to one of the following conditions: Flywheels and crank pins assembled with oil on tapers and crank pin nuts overtightened; new flywheel thrust

washers installed and not fully seated; tapered holes in flywheels enlarged as a result of flywheels having been taken apart and reassembled several times; flywheel cracked at tapered hole.

(2) CORRECTING ROD SIDE PLAY (BETWEEN FLYWHEELS) WHEN LESS THAN 0.007-INCH. In a case of this kind, the first thing to do is to disassemble flywheels and recheck flywheel thrust washers. If these washers are found fully seated and secure in flywheels, the next best thing to do is determine which flywheel seats farthest on the crank pin taper, due to enlarged tapered hole or a crack, and replace that flywheel with a new one.

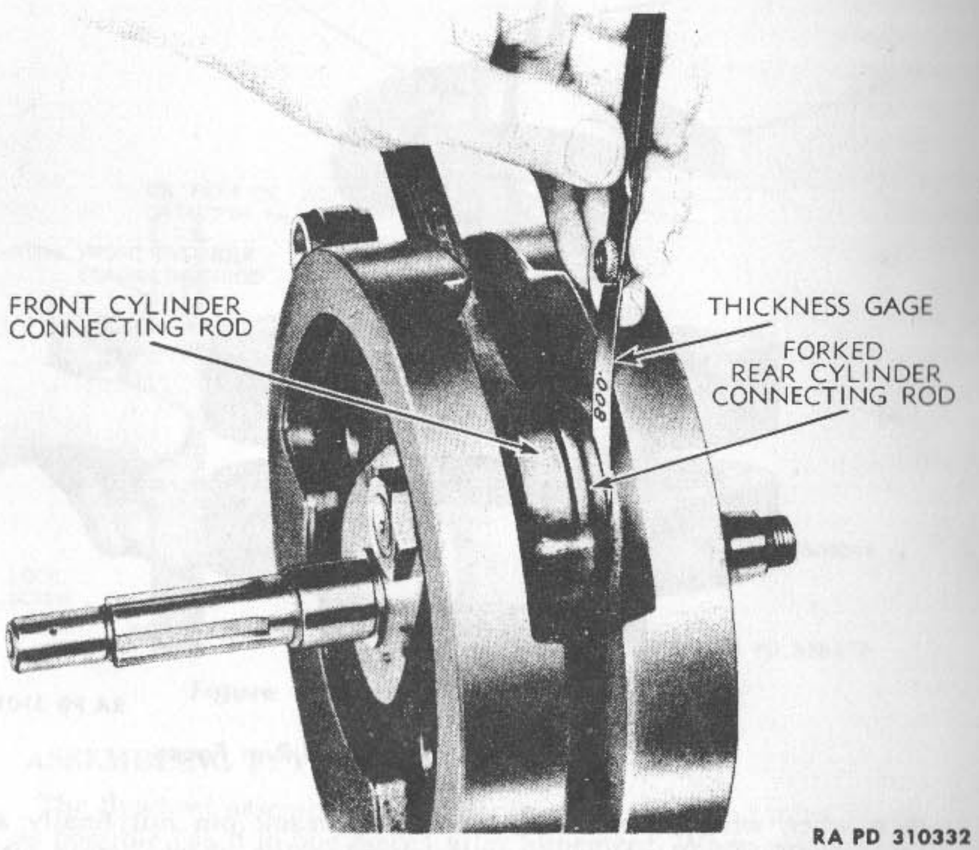


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Figure 40—Checking Connecting Rod Clearances

(3) CORRECTING ROD SIDE PLAY (BETWEEN FLYWHEELS) WHEN IN EXCESS OF 0.010-INCH. After flywheels are trued and crank pin nut finally and securely tightened, the end play of the female (forked) rod between flywheel thrust washers should not exceed 0.010 inch. If thickness gage check reveals excessive side play, probably all or most of the excess play can be taken up by tightening crank pin nuts a little tighter.

(4) RECHECK ROD SIDE PLAY BETWEEN FLYWHEELS AFTER FLYWHEELS ARE TRUED. The crank pin nut is not drawn up to final tightness before truing flywheels, and drifting of wheels on crank pin while

truing is the reason why final side play recheck is necessary after truing flywheels and tightening crank pin nut.

d. Make Final Gear Shaft, Flywheel, and Crank Pin Oil Passage Test. After flywheels and rods are assembled, make final check to be sure oil passage is open to rod bearing. Apply compressed air to hole in side of gear shaft, near its outer end, and observe that air escapes around connecting rod lower end. If this passage becomes blocked in some manner and engine is assembled and put in service

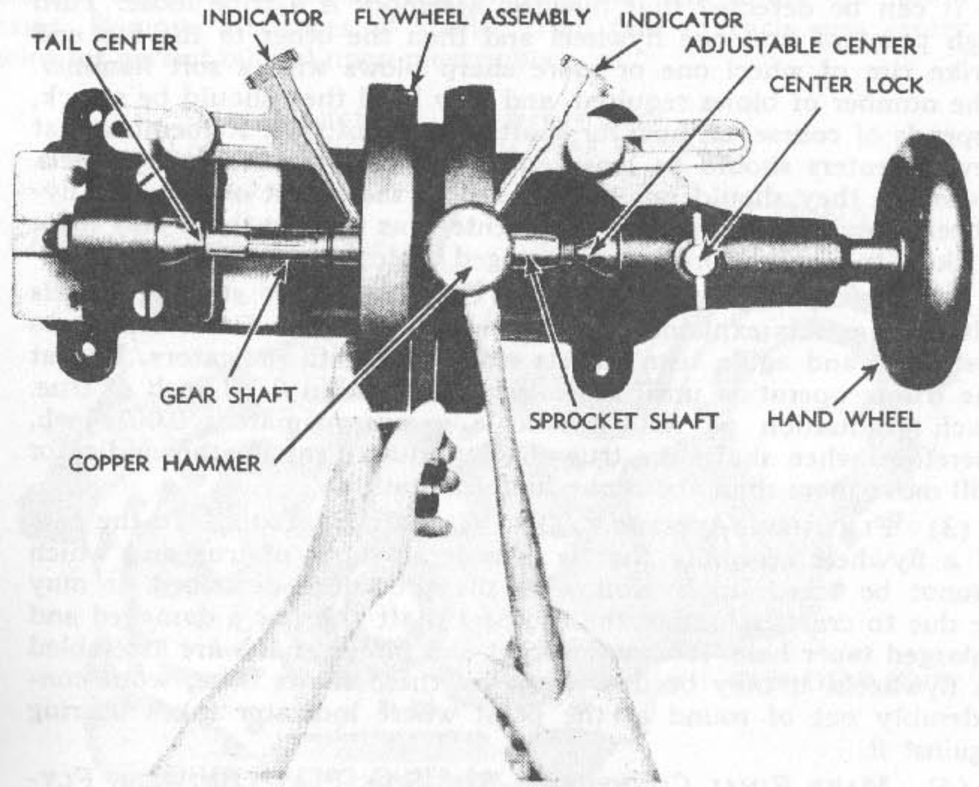


Figure 41—Truing Flywheels to Aline Mainshafts in Stand (41-S-4970)

with it blocked, engine will get no lubrication except in timing gear case. This is not likely to be detected until serious damage has been done, as the oil circulation indicator in instrument panel will give no warning when the oiling system is blocked in this passage.

27. TRUING FLYWHEELS.

a. Bear in mind that, while a straightedge across rim faces is used when assembling flywheels to keep them as near as possible true with each other, final truing is a matter of truing sprocket shaft and pinion shaft to perfect alinement with each other, rather than truing

flywheel rims. Install wheel assembly in truing stand (41-S-4970) and adjust so that centers are just snug (wheels must turn freely). If flywheel assembly is either loose between centers or is squeezed, indicators will not indicate accurately. Indicators should be adjusted as closely as possible to flywheels, and so that pointers rest about in the middle of graduated scales (fig. 41).

(1) TURN FLYWHEELS AND OBSERVE THE MOVEMENT OF INDICATOR POINTERS. Movement of pointers toward flywheels indicates high points of shafts. Find highest point of each shaft and mark flywheel rims at those points. Loosen device centers slightly, just enough so it can be detected that flywheel assembly is a trifle loose. Turn high point of first one flywheel and then the other to the top and strike rim of wheel one or more sharp blows with a soft hammer. The number of blows required, and how hard they should be struck, depends of course, on how far shafts are out of true. Remember that device centers should be loosened slightly before striking flywheels. However, they should not be loosened to the extent of allowing flywheels considerable play between centers, as making them very loose is likely to result in broken or damaged centers.

(2) READJUST TRUING DEVICE CENTERS. After striking wheels with hammer as explained in a (1) above, readjust device centers to just snug and again turn wheels and check with indicators. Repeat the truing operation until indicators show within 0.001 inch of true. Each graduation on indicator scale is approximately 0.002 inch, therefore, when shafts are true within requirements neither indicator will move more than about one-half graduation.

(3) FLYWHEEL ASSEMBLY THAT CANNOT BE TRUED. In the case of a flywheel assembly that is considerably out of true and which cannot be trued up by following the procedure described, it may be due to crack at one of the flywheel shaft holes or a damaged and enlarged taper hole. If used sprocket and pinion shafts are assembled in flywheels, it may be due to one of these shafts being worn considerably out of round at the point where indicator takes bearing against it.

(4) MAKE FINAL CONNECTING ROD SIDE PLAY (BETWEEN FLYWHEELS) INSPECTION. See paragraph 26 c (1), (2), (3) and (4) for instructions on connecting rod side play between flywheels after crank pin nut has been securely tightened by striking wrench with a hammer. NOTE: *After rod side play has been checked and adjusted, crank pin nut pulled very tight and nut lock washer fitted, again install wheel assembly in truing device and recheck for trueness.*

CHAPTER 3

ENGINE (Cont'd)

Section IV

CLEANING, INSPECTION, AND REPAIR OF CRANKCASE ASSEMBLIES AND GEAR CASE COVER

28. CLEANING AND INSPECTION OF CRANKCASE.

a. Cleaning. After flywheel assembly has been removed from crankcase, clean cases thoroughly in dry-cleaning solvent. CAUTION: *Do not use cleaning solution or method that will injure aluminum cases.* Remove all traces of shellac from face of each case center joint for perfect oil seal upon reassembly.

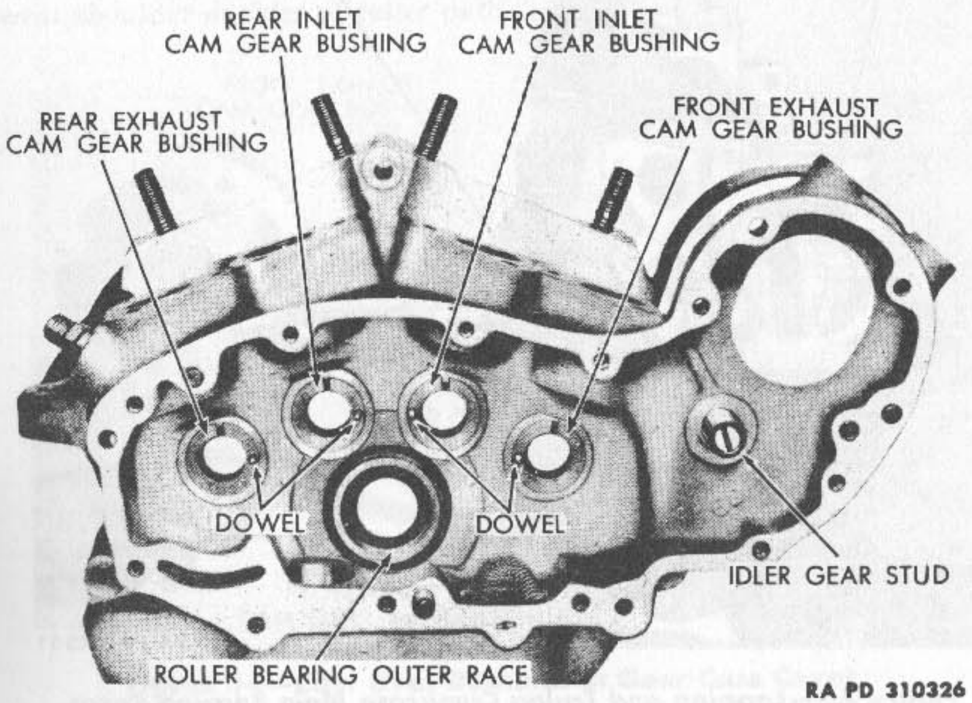


Figure 42—Cam Gear Bushings in Right Crankcase

b. Inspection. Inspect cases for good condition, examining closely for cracks, holes, and/or broken parts. Crankcases are supplied in matched sets to ensure perfect cylinder base and bearing alinement. If one side of case is damaged beyond welding or local repair, it must be replaced with a matched pair.

(1) INSPECT TIMING GEAR SHAFT BUSHINGS. When bushings are worn to the extent that gear shafts have 0.002 inch or more clearance, such bushings must be replaced.

(2) INSPECT MAIN BEARING RACES. Wear shoulder must be removed from roller races before accurate sizing inspection can be made. Refer to paragraph 23 b (1). Usually, the race can be trued

by lapping to remove any wear shoulder and oversize rollers can be installed. When race is worn to such extent that use of 0.001 inch oversize rollers will give more than specified clearance, replace the race (par. 29 **a** (2)).

29. REPAIR OF CRANKCASE.

a. In cases where welding can effect a satisfactory repair without warping or distorting case or necessitating use of special tools and jigs for accurate machining after repair is made, it is recommended procedure. General practice is to replace broken or damaged case.

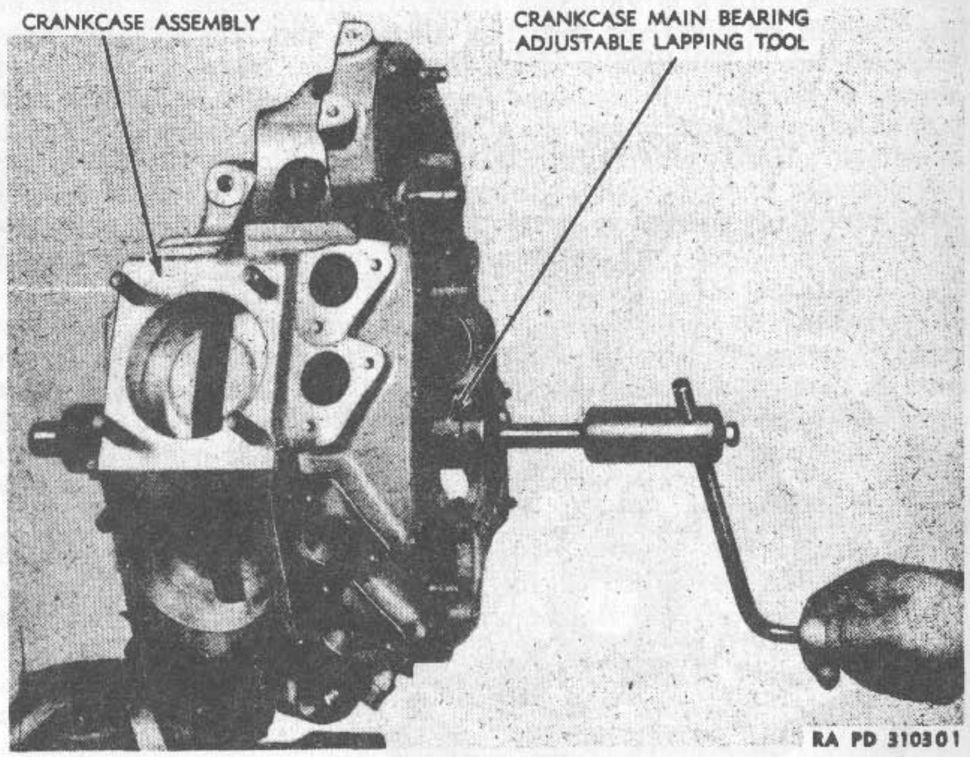


Figure 43—Lapping and Truing Crankcase Main Bearing Races with Lap (41-L-203)

(1) Replacing Timing Gear Bushings in Crankcase. The four timing gear bushings in crankcase can be replaced with an arbor press (fig. 42). Press bushings out from inside of case. Remove the steel dowel pins with pliers.

(a) When new bushings are pressed into place, make sure that the oil grooves in shoulder face are in upward position.

(b) After bushings are pressed into crankcase they must be dowel pinned (to prevent bushings from turning), by drilling a No. 31 drill hole, $\frac{9}{32}$ inch deep, through bushing flange and into aluminum case. The hole should be of correct depth so when dowel pin is driven in and bottomed, its end will be slightly below face of bushing flange. Peen bushing around dowel pin hole to retain it.

(c) Bushings must be line-reamed, after gear case cover has been repaired and it is in place, with special reamer (41-R-2265, fig. 46). Gear shaft clearance in cover bushing is 0.0005 to 0.001 inch.

(2) Replacing Main Bearing Races. When renewing main bearing races, heat cases (not above 300°F) around races. Heating expands cases slightly and less force is required to press old races out and new races in. New races, after installation, must be lapped to smooth, true and aline them, and to size them so that specified bearing clearance can be attained with smallest roller sizes available.

(3) Truing and Sizing Main Bearing Races in Crankcase (fig. 43). Assemble crankcase (without flywheel assembly) and lap (41-L-203) bearing outer races to true them and remove any trace of wear shoulder at sides of roller path.

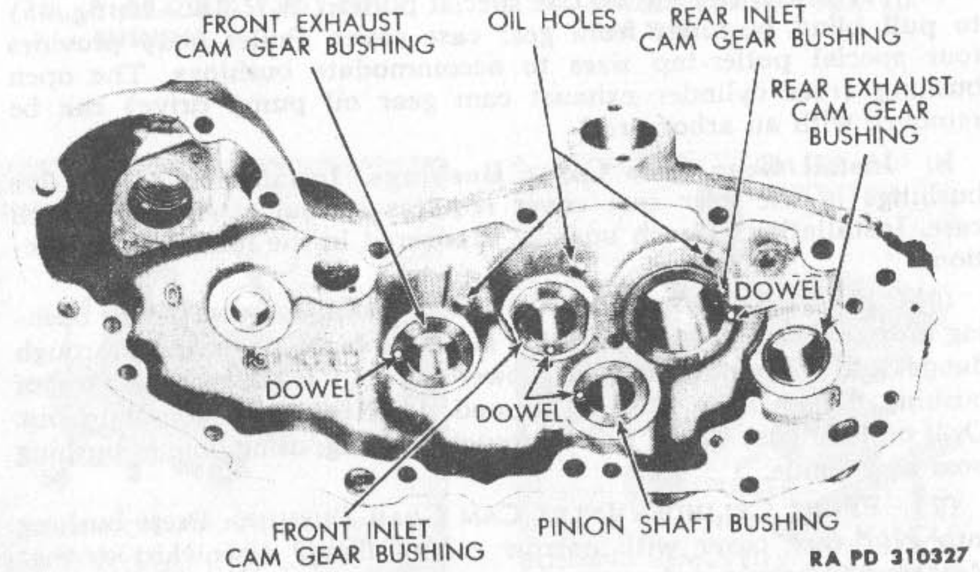


Figure 44—Cam Gear Bushings in Gear Case Cover

(a) Lap first one case side race and then the other, guiding lap by means of pilot bushing in opposite case side race. Adjust lap snugly in race and use only a light application of fine lapping compound. CAUTION: *A loose lap and the use of excessive amount of compound results in a tapered bearing surface.*

(b) Sprocket Shaft Bearing Race. Lap sprocket shaft bearing outer race to obtain a clearance of 0.0005 to 0.001 inch, using the desired set of rollers and using the sprocket shaft that will be installed in the flywheel assembly.

(c) Gear Shaft Bearing Race. Lap gear shaft bearing outer race to obtain a clearance of 0.0008 to 0.0012 inch, using the desired set of rollers and using the gear shaft that will be installed in the flywheel assembly.

30. CLEANING AND INSPECTION OF GEAR CASE COVER.

a. Clean. Clean gear case cover in dry-cleaning solvent, exercising care not to scratch or mar face finish.

b. Inspect Timing Gear Shaft Bushings (fig. 44). When bushings in gear case cover are worn to such extent that shaft clearance is 0.002 inch or more, cam gears are likely to become very noisy. Replace bushings if this is found.

31. REPAIR OF GEAR CASE COVER

a. It is not advisable to make a weld repair to gear case cover. A broken or badly damaged cover should be replaced. Before removing old bushings, note location of oil transfer hole (rectangular shape) in pinion shaft bushing. Gear case cover bushings can be removed as follows:

(1) REMOVE BUSHINGS. Use special puller (41-R-2372-20, fig. 45) to pull blind bushings from gear case cover. Puller body provides four special puller-tap sizes to accommodate bushings. The open bushing (rear cylinder exhaust cam gear oil pump drive) can be removed with an arbor press.

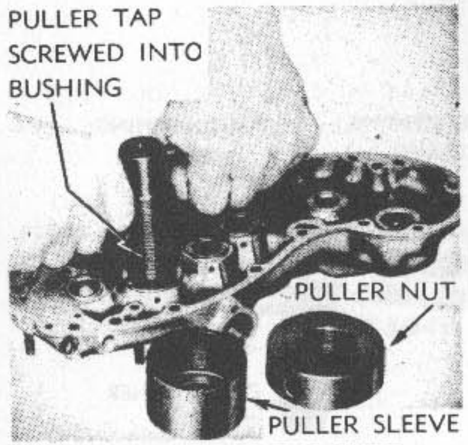
b. Install Gear Case Cover Bushings. Installation of the five bushings in the gear case cover requires special attention in each case. Installation of each bushing is covered in the following instructions:

(1) FRONT CYLINDER EXHAUST CAM GEAR BUSHING. Press bushing into gear case cover and drill a No. 31 hole, $\frac{9}{32}$ inch deep, through flange into aluminum so that dowel pin end is just below face of bushing flange. Peen bushing around dowel pin hole to retain pin. Drill oil hole (use $\frac{5}{32}$ in. drill) through bushing, using hole in bushing boss as a guide.

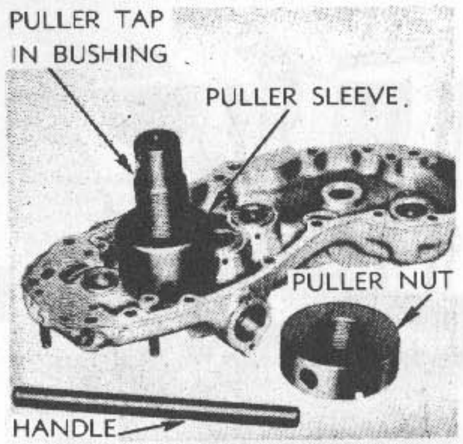
(2) FRONT CYLINDER INLET CAM GEAR BUSHING. Press bushing into gear case cover with narrow end of flange downward so that clearance is provided for cam gear teeth. Drill No. 31 hole through flange for dowel pin, and drill a $\frac{5}{32}$-inch oil hole in bushing as outlined in **b** (1) of this paragraph.

(3) REAR CYLINDER INLET CAM GEAR BUSHING. Follow instructions outlined under **b** (1) of this paragraph.

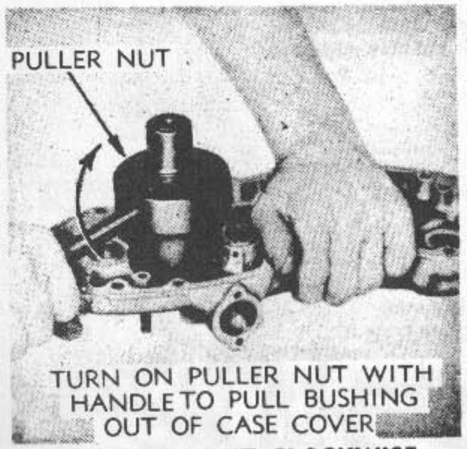
(4) REAR CYLINDER EXHAUST CAM GEAR—OIL PUMP DRIVE SHAFT BUSHING. This large flange bushing must be pressed into case cover until face of bushing is flush with machined surface of case to provide correct seating and clearance for oil pump. Use a smooth surfaced disk or plate a little larger than the bushing flange diameter when pressing bushing into case cover to ensure flush fit. If available bushing flange is $\frac{1}{8}$ inch thick, put on lathe mandrel and remove $\frac{1}{32}$ inch from outside face and 0.015 inch from inside face to make flange 0.078-inch thick. Later bushings will be made to these specifications. Drill a No. 31 drill size hole, $\frac{9}{32}$-inch deep, in the bushing flange to right of original pin hole, to accommodate dowel pin. Drive dowel



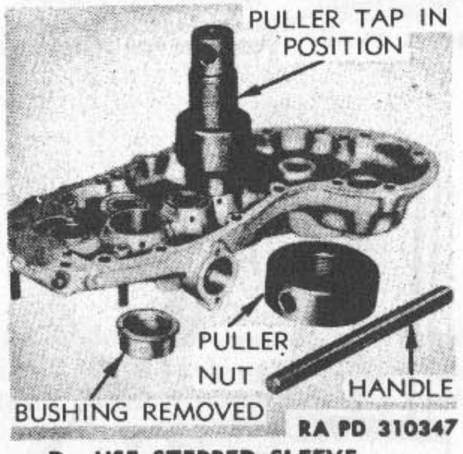
A—THREADING TAP INTO BUSHING



B—PULLER SLEEVE LOCATED ON TAP



C—TURN UNIT CLOCKWISE TO PULL BUSHING

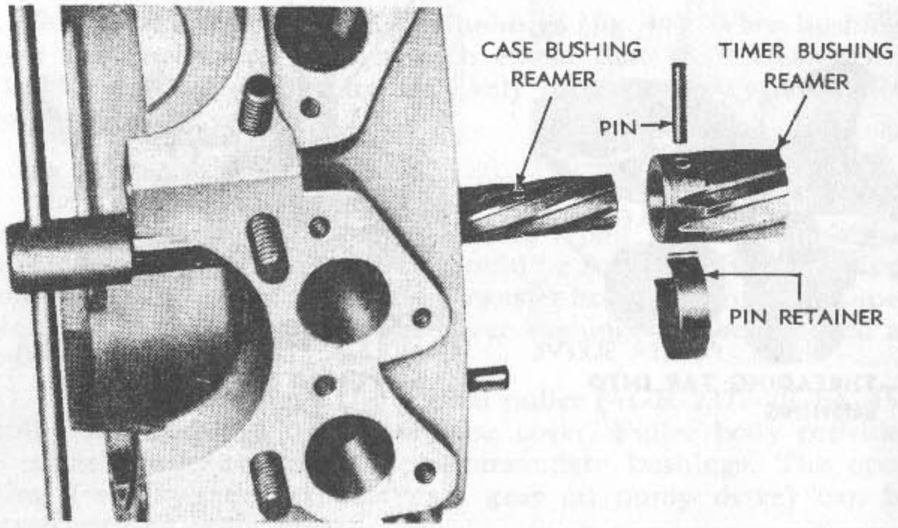


D—USE STEPPED SLEEVE TO CLEAR BUSHING BOSS

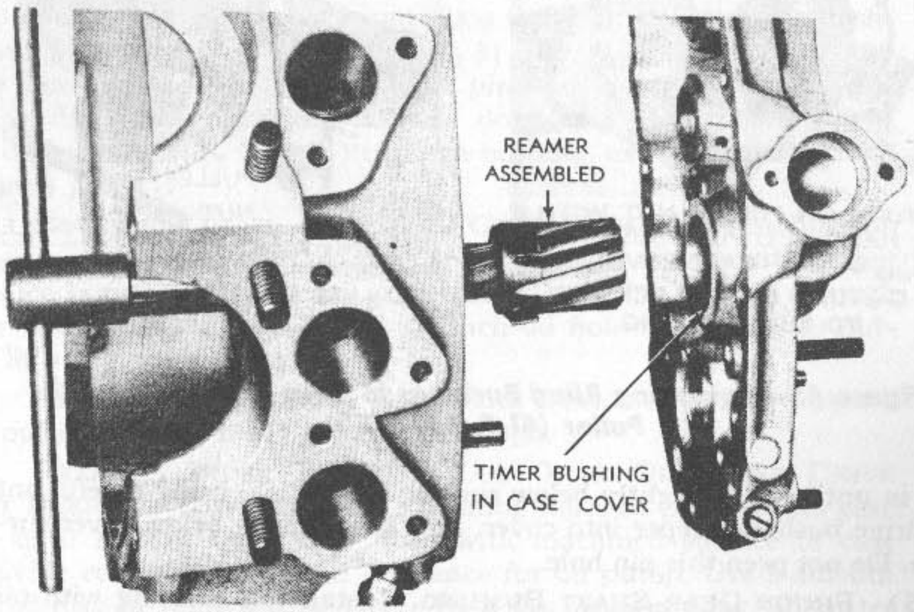
Figure 45—Removing Blind Bushings in Gear Case Cover with Puller (41-R-2372-20)

pin in until end is slightly below surface of bushing, being careful not to drive bushing deeper into cover, and lower flange below cover surface. Do not peen this pin hole.

(5) PINION GEAR SHAFT BUSHING. Install this bushing with oil transfer hole (rectangular shape) upward and 30 degrees ahead (toward front of engine) of vertical center line. Normal functioning of engine oiling system depends upon correct location of this hole. Drill a No. 31 drill size hole, $\frac{9}{32}$-inch deep, through flange into aluminum and drive dowel pin in. The end to be just below face of bushing flange. Peen metal around hole to retain pin.



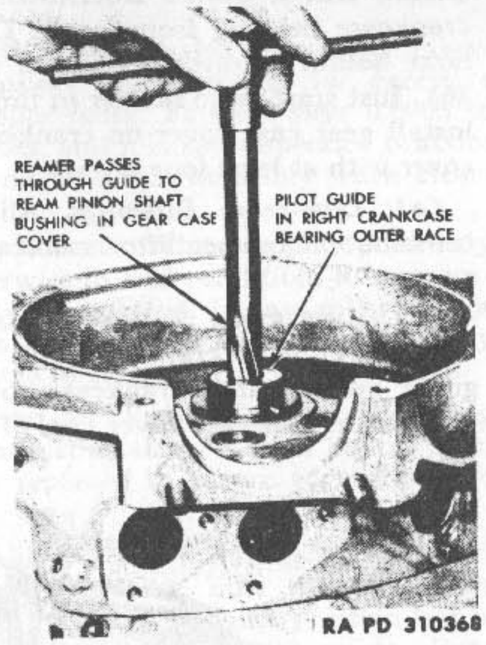
A—REAMER PASSED THROUGH CRANK CASE BUSHING IN POSITION FOR TIMER BUSHING REAMER ASSEMBLY



B—REAMER ASSEMBLED TO REAM CASE COVER TIMER BUSHING AFTER CASE COVER IS INSTALLED ON CRANK CASE

RA PD 310388

Figure 46—Preparing to Line-ream Crankcase and Gear Case Cover Bushings with Combination Reamer (41-R-2265)



RA PD 310368

Figure 47—Pilot Guide Located in Bearing Race to Line-ream Pinion Shaft Bushing in Gear Case Cover with Reamer (41-R-2304)

RA PD 310369

Figure 48—Line-reaming Oil Pump Drive Shaft Bushing and Crankcase Rear Exhaust Cam Bushing with Reamer (41-R-2303)

c. **Line-ream Bushings.** Assemble gear case cover to crankcase to correctly line-ream all timing gear and gear shaft end bushings. NOTE: *Reamer (41-R-2265) for cam gear shaft and timer drive shaft bushing is of two-piece construction and large reamer end must be installed before case cover is assembled to crankcase as follows:*

(1) REAMING REAR CYLINDER INLET CAM GEAR SHAFT AND TIMER DRIVE SHAFT BUSHINGS. Pass reamer (41-R-2265) through crankcase bushing from inside. Do not turn reamer in bushing. Slip large hollow reamer over end of smaller reamer and engage pin (fig. 46). Just start large reamer in timer drive shaft (1⅛ in.) bushing and install gear case cover on crankcase, registering dowels and securing cover with at least four screws.

(a) Line-ream Bushings. Aline and size bushings by turning combination reamer into crankcase and case cover as far as it will go.

(2) LINE-REAM PINION SHAFT BUSHINGS. Line-ream (reamer 41-R-2304) with crankcase and gear case cover assembled. Insert guide bushing into crankcase roller race and turn reamer until it bottoms in gear case cover (fig. 47).

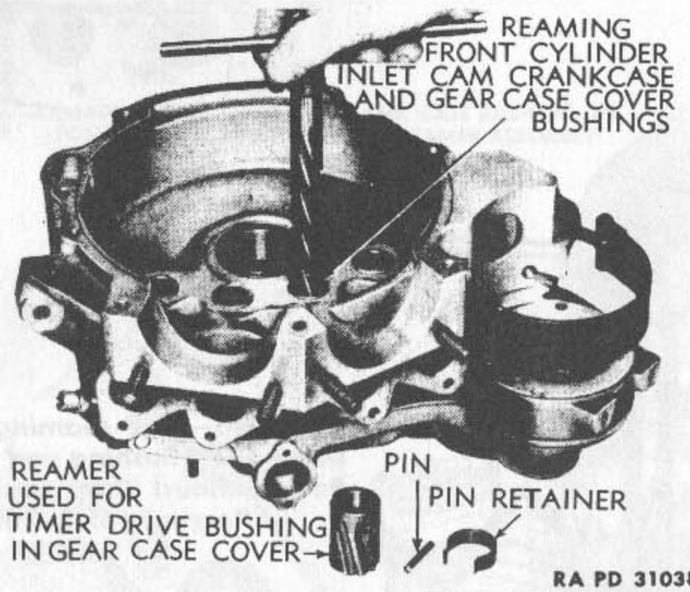


Figure 49—Line-reaming Front Cylinder Inlet and Exhaust Cam Bushings in Crankcase and Gear Case Cover with Reamer (41-R-2265)

(3) LINE-REAM REAR CYLINDER EXHAUST CAM GEAR SHAFT AND OIL PUMP DRIVE SHAFT BUSHINGS. Use reamer (41-R-2303) and with crankcase and gear case cover assembled, pass reamer through bushings from gear case cover side (fig. 48). Turn reamer just sufficient to clean up and aline bushing holes.

(4) FRONT CYLINDER EXHAUST AND INLET CAMSHAFT BUSHINGS. Line-ream with reamer (41-R-2265) using only smaller size of reamer combination (fig. 49). Pass reamer through bushings from inside of crankcase and turn just sufficient to clean up and aline bushing holes.

CLEANING, INSPECTION, AND REPAIR OF CRANKCASE ASSEMBLIES AND GEAR CASE COVER

32. INSPECTION AND REPAIR OF VALVE TAPPETS AND VALVE TAPPET GUIDES.

a. Inspection of Valve Tappets. Inspect valve tappets for excessive clearance in guides. Also inspect tappet rollers for excessive bearing looseness and damaged roller faces. Tappets have 0.0005 to 0.001-inch normal clearance in guides, and it is recommended practice to install new tappet and roller and/or guide assembly when clearance exceeds 0.0025 inch.

(1) REPLACEMENT OF TAPPET ROLLER. When tappet roller only is excessively loose on pin, or otherwise in bad condition, it is recommended that entire tappet assembly be replaced. In case roller only is replaced, roller must turn freely on pin and have 0.008-inch side play after new roller pin is securely riveted in tappet.

b. Inspection and Replacement of Valve Tappet Adjusting Screw. When end of valve tappet adjusting screw is worn hollow from action of valve stem, it should be replaced to ensure accurate valve tappet-valve stem adjustment.

c. Installing Valve Tappet Guides. When installing valve tappet guides (with tappet assemblies) in crankcase, note that guide for front cylinder can be used in either intake or exhaust position but is not interchangeable with rear cylinder valve tappet guide. Rear cylinder tappet guides are interchangeable with each other, but not with front cylinder tappet guides. Make sure paper gaskets are between guides and crankcase.

(1) VALVE TAPPET AND ROLLER ASSEMBLIES ARE INTERCHANGEABLE.

33. INSPECTION OF TIMING GEARS.

a. Timing gears, cams, and shafts must be considered as integral units and must be replaced as such when necessary. Inspect for worn shafts and gear teeth, damaged gear teeth and worn and/or pitted cam lobe face.

(1) TIMING GEAR CAMSHAFT ENDS FOR CRANKCASE BUSHINGS. Standard size is 0.6875 inch.

(2) REAR CYLINDER EXHAUST CAM-OIL PUMP DRIVE SHAFT (GEAR CASE COVER BEARING). Standard size is 0.7805 inch.

(3) REAR CYLINDER INLET CAM-TIMER DRIVE SHAFT (GEAR CASE COVER BUSHING). Standard size is 1.2425 inches.

(4) FRONT CYLINDER INTAKE AND EXHAUST CAMSHAFT ENDS (GEAR CASE COVER BEARING). Same as step (1) above.

34. DISASSEMBLY, CLEANING, INSPECTION, REPAIR AND ASSEMBLY OF OIL FEED PUMP.

a. Description. Main oil feed pump is of the vane-type. A rotating member, driven by rear cylinder exhaust camshaft, retains and drives two vanes within a slightly eccentric housing. Pump incorpo-

rates an automatic (centrifugal) by-pass valve, reducing oil feed supply at low engine speeds and increasing oil feed supply at high engine speeds. Pump is provided with ball spring adjustable pressure regulating valve and two ball-spring check valves. Maximum oil pressure is approximately 30 pounds. Rotation of rotor is counter-clockwise, looking at pump from back side.

b. Disassembly. When disassembling oil feed pump, exercise care not to lose parts, balls, and springs. Also note location of all parts for correct reassembly (fig. 50).

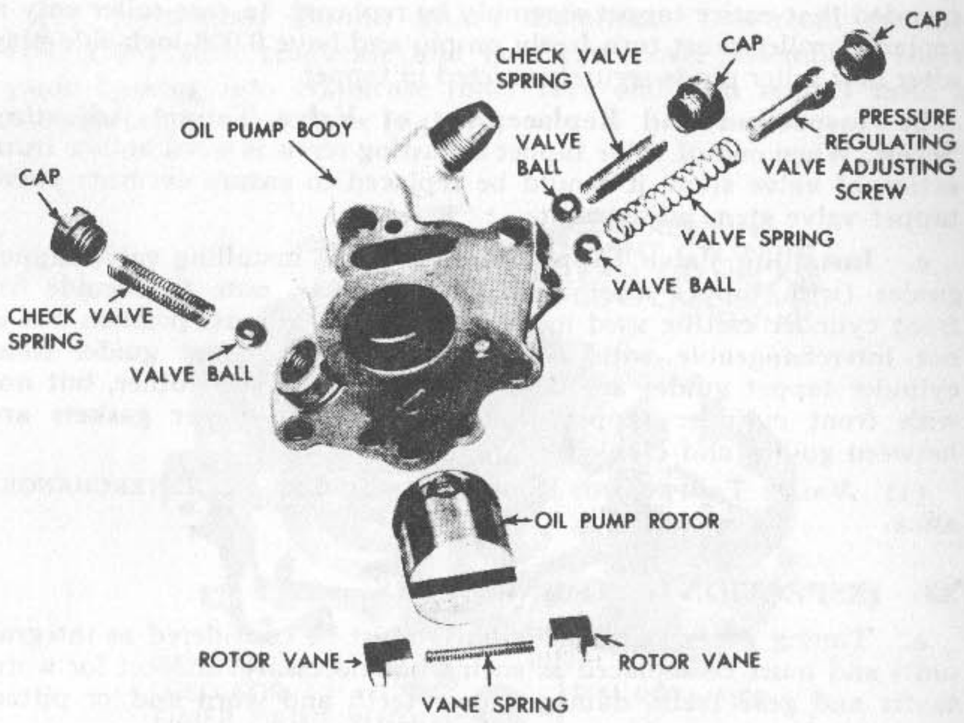


Figure 50—Oil Feed Pump, Disassembled

(1) REMOVE ROTOR AND VANE ASSEMBLY. Remove rotor, with vanes and spring, from pump body, holding vanes to prevent expansion of spring and possible loss of parts.

(2) REMOVE REGULATING BALL-SPRING VALVE. Remove valve cover screw exposing adjusting screw. Remove adjusting screw, spring, and steel ball.

(3) REMOVE CHECK AND REGULATING VALVES. Remove the screws, springs, and balls of the check and regulating valves. NOTE: *Both check valve springs are the same and are interchangeable.* Special steel balls used in the three ball-spring valves are of same size and are interchangeable.

c. Cleaning, Inspection and Repair. Clean all parts in dry-cleaning solvent and blow out all pump body passages with air.

CLEANING, INSPECTION, AND REPAIR OF CRANKCASE ASSEMBLIES AND GEAR CASE COVER

(1) INSPECT PUMP BODY. Inspect rotor chamber closely for excessive wear caused by vanes. Pump body with badly worn rotor chamber should be replaced.

(2) INSPECT VANES AND SPRING. Inspect vane spring for breakage and rusted condition. Spring has normal free length of $1\frac{5}{32}$ inches. Replace if found in bad order. Vanes will usually be found in good condition, unless excessively worn (rotor chamber would also be worn). Replace worn or damaged vanes.

(3) INSPECT BALL-VALVE SEATS. Using a flashlight, inspect ball seats in pump body for pits and/or dirty condition. NOTE: *A small particle of string, fiber, or other foreign matter lodged on valve seat will prevent ball from seating, thus preventing correct operation of pump.* Body with damaged ball seats should be replaced.

(4) INSPECT BALLS AND SPRINGS. Inspect springs for breakage and rusted condition. Replace if not in good condition. Regulating (by-pass) spring is $\frac{3}{8}$-inch in diameter and has normal free length of $2\frac{1}{16}$ inches. Upper and lower check valve springs are interchangeable, being $\frac{5}{16}$-inch in diameter with normal free length of $1\frac{9}{32}$ inch. Steel balls may have rings formed by action on valve seats. Balls not perfectly smooth and round should be replaced.

(5) INSPECT ROTOR ASSEMBLY. Rotor and centrifugal by-pass valve assembly should show no appreciable wear.

d. Assemble Oil Feed Pump. Pump body, ball valve seats, and all passages must be thoroughly clean and free from dust, dirt, or grit before assembly. Also, see that rotor, vanes, springs, balls, and screws are clean before assembly. Refer to figure 50.

(1) INSTALL BALLS AND SPRINGS. Install the two check valve balls and springs and secure with fillister head cap screws. Install regulating valve (by-pass) ball and spring, turning down adjusting screw until head is $\frac{3}{8}$-inch below top of pump body. Replace oval-head cap screw.

(2) INSTALL ROTOR AND VANES. Install spring between rotor vanes and install rotor and vane assembly in pump body chamber. Make sure that chamber rotor and vanes are perfectly clean before installation.

35. DISASSEMBLY, CLEANING, INSPECTION, REPAIR, AND ASSEMBLY OF SCAVENGER PUMP AND CRANKCASE BREATHER VALVE.

a. The crankcase rotary breather valve is an integral part of the scavenger (oil return) pump. The rotary valve (which drives gears in scavenger pump) is driven by a spiral gear located on engine pinion shaft. Rotary breather valve must be accurately timed to control the scavenging of oil from the engine crankcase. The scavenger pump also provides oil for rear chain lubrication, allowing a small amount of oil to flow past an adjustable needle valve through a small pipe to rear chain. It is possible to inspect and make repairs to scavenger pump gears without removing pump body and breather valve from

the engine (e of this paragraph). Breather valve and scavenger pump give very little trouble and ordinarily a thorough cleaning is all the service required.

b. Disassembly, Cleaning, and Inspection. Thoroughly clean exterior of assembly in dry-cleaning solvent before disassembly.

(1) REMOVE SCAVENGER PUMP COVER. Remove the two cap screws and separate cover from pump body, exercising care not to damage the paper gasket. With cover removed, pump gears are exposed (fig. 51). The drive gear is keyed on the rotary breather valve and the drive gear idles on the cover stud. Remove the split retaining ring from end of rotary breather valve and drive gear is free for removal.

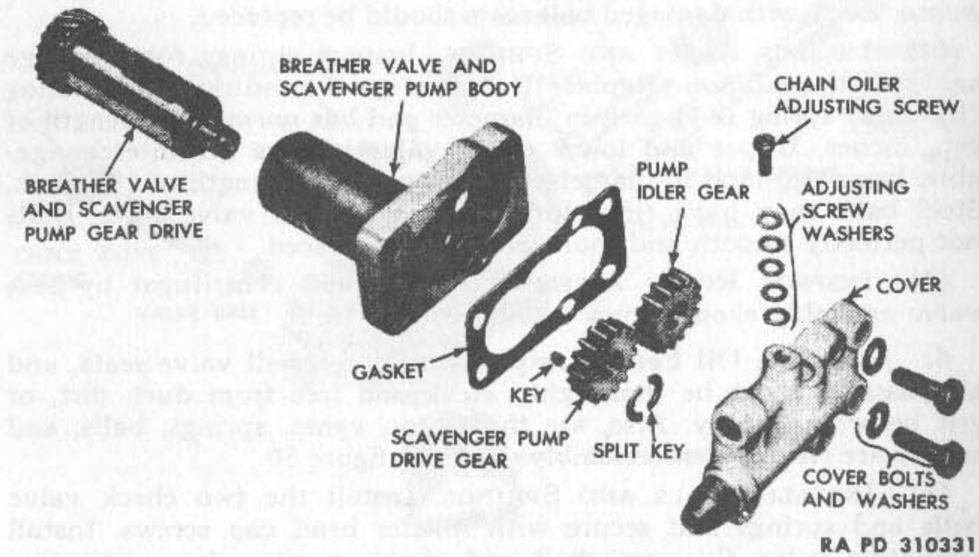


Figure 51—Scavenger Pump and Breather Valve, Disassembled

(2) REMOVE ROTARY BREATHER VALVE. After pump drive gear has been removed, pull breather valve out of housing.

(3) REMOVE REAR CHAIN OILER ADJUSTING SCREW. Remove rear chain oiler adjusting screw and thickness washers so that cover oil channels may be cleaned out.

(4) CLEAN ALL PARTS. Clean all parts thoroughly in dry-cleaning solvent. Blow out oil holes and passages with air.

(5) INSPECTION OF PARTS. Inspect rotary breather valve spiral gear teeth for good condition. Inspect housing and cover for breaks, cracks, or other damage that requires replacement of these parts.

c. Repair. Any damaged and/or badly worn parts should be replaced. If rotary breather valve is damaged, it is advisable to replace entire unit.

d. Assembly. All parts must be thoroughly clean before assembly. Do not assemble unit to engine until crankcase has been assembled and pinion shaft gears installed, ready for timing.

CLEANING, INSPECTION, AND REPAIR OF CRANKCASE ASSEMBLIES AND GEAR CASE COVER

(1) INSTALL ROTARY BREATHER VALVE (fig. 51). Apply engine oil to rotary breather valve and body chamber and assemble. Install key (new one if necessary) in rotary valve end and slip pump drive gear in place. Install split retaining ring. Coat gasket (use new gasket if necessary) with engine oil and locate on pump body. Install pump idler gear on cover stud and assemble cover and gear to pump body. Install the two cover cap screws and lock washers. CAUTION: *Do not tighten cap screws until complete assembly has been installed in engine crankcase.*

(2) INSTALL REAR CHAIN OILER ADJUSTING SCREW. Make sure that all of the thin adjusting washers removed from oiler adjusting screws are back in place before installing the oiler adjusting screw. Oil supply for the rear drive chain is adjusted on the vehicle (TM 9-879).

e. Scavenger Pump Fails to Return Oil to Tank. Should scavenger pump fail to return oil to tank, as evidenced by excessive smoking at exhaust and absence of oil at return pipe in tank, the pump drive gear key is more than likely sheared. It is not necessary to remove entire pump body from crankcase (throw breather valve out of time) for inspection and repair.

(1) REMOVE SCAVENGER PUMP COVER. Remove the four pump cover nuts and washers and the two cover retaining cap screws and washers and remove cover, taking care not to pull pump body out of crankcase.

(2) REPLACE PUMP DRIVE GEAR KEY. Remove split ring which retains drive gear and withdraw gear from shaft. Remove broken key from shaft and gear. Install new key, gear, split lock ring, and pump cover. Check cover gaskets. Install the lock washers, nuts, and cap screws and securely tighten.

CHAPTER 3

ENGINE (Cont'd)

Section V

FITTING AND ASSEMBLY OF FLYWHEEL AND CRANKCASE ASSEMBLY

36. CRANKCASE ASSEMBLY.

a. The two halves of the crankcase completely enclose the flywheel assembly, providing main bearing races and bases for cylinder mounts (fig. 32). The important item in crankcase assembly is the adjustment of side play (clearance) for the flywheels, the mainshaft roller bearings having already been selected and fitted (par. 25). When assembling crankcase, it is best to support it on an open-end box with an opening about 8 x 8 inches, and at least 4 inches deep (see fig. 26 for construction details).

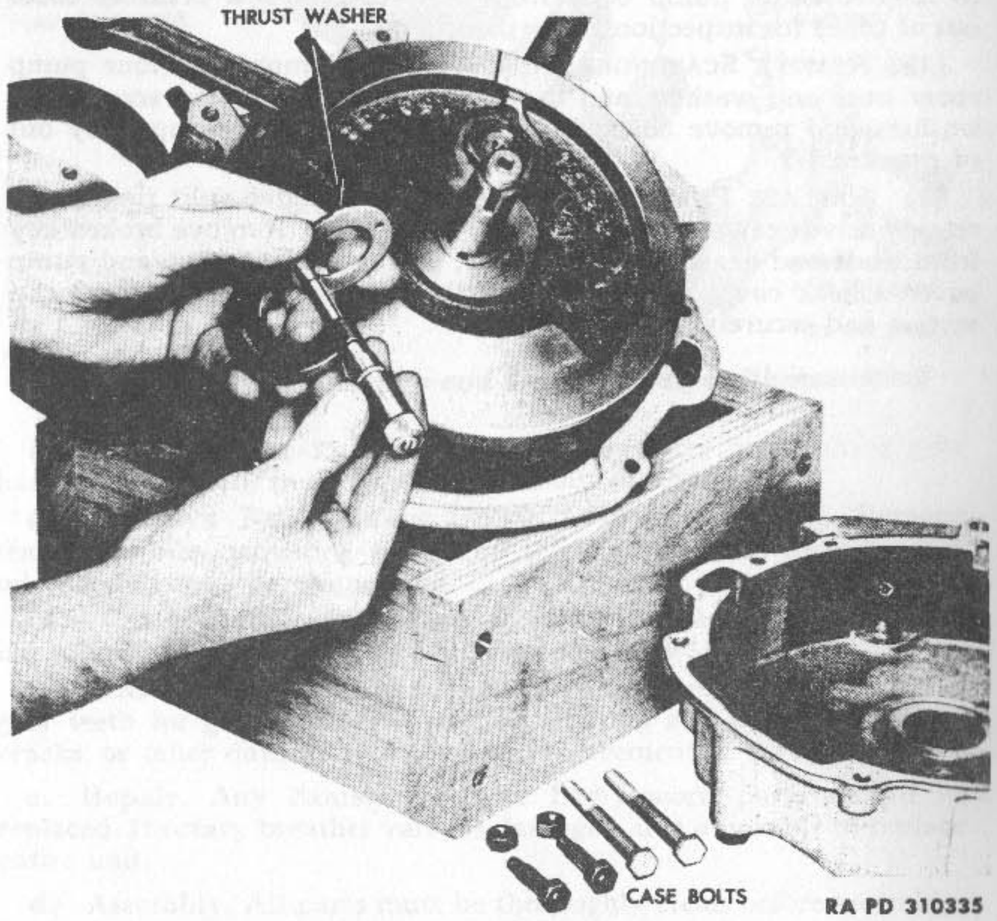


Figure 52—Measuring Thrust Washer Thickness with Micrometer Calipers (41-C-307)

37. ALINE AND ADJUST FLYWHEEL ASSEMBLY IN CRANKCASE ASSEMBLY.

a. Flywheel end play (side clearance) within crankcase is adjusted by means of steel thrust collars (washers) available in thicknesses of 0.066, 0.070, 0.074, 0.078, 0.082, 0.086, 0.090, 0.094, 0.098 and 0.102 inch. These thrust collars come in sets of 10, containing one each of the above thicknesses. Thrust collars fit on flywheel hubs and are registered on dowel pins to prevent them from turning. The average thrust collar thickness used in assembly of a new engine is 0.080 inch. Flywheel end play gage (41-G-198) is used to determine, with aid of thickness gage, exact end play of flywheels after crankcase is assembled.

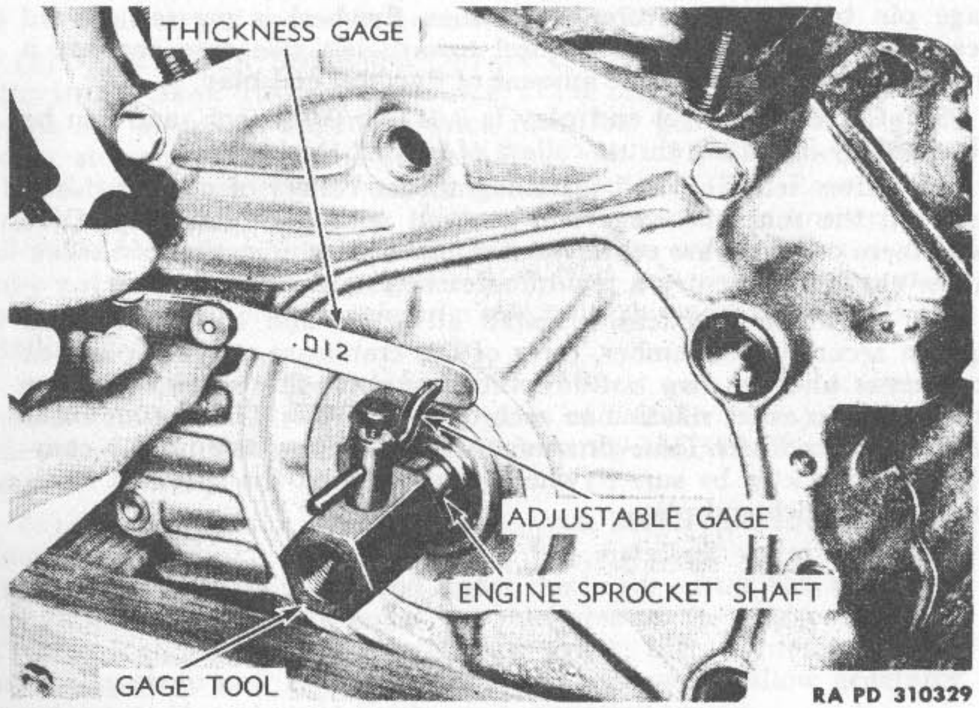


Figure 53—Checking End Play of Flywheels in Crankcase with Gage (41-G-198)

b. Selecting and Fitting Thrust Collars. With right crankcase supported on open box, and with gear shaft bearing spring ring engaged in groove in roller race, install bearing washer and gear shaft roller bearing assembly.

(1) Select two thrust collars (between 0.080 and 0.090 inch) and install them on flywheel hubs, making sure that collars register on dowel pins and seat against flywheel faces (fig. 52). Both thrust collars should be approximately the same thickness in order to keep flywheels centered in crankcases and connecting rod upper ends centered between piston bosses.

(2) Install flywheel assembly in right side crankcase and install roller bearing and bearing washer on sprocket shaft and install left side crankcase. NOTE: *No gasket is used between crankcase center joint, nor should joint be shellacked as yet.* Insert the two cap screws at top of crankcases and two studs at bottom of crankcases and tighten to clamp cases securely together.

(3) With crankcase and flywheel assembly supported in vertical position, push back and forth on ends of sprocket and pinion shafts to check end play of flywheel in crankcase. If no end play is found, cases must be disassembled and thinner thrust collars fitted to flywheels. Reassemble and again check end play. If it is found that flywheels now have end play, continue check with end play gage (41-G-198) as follows:

(4) Install end play gage on sprocket shaft (fig. 53), and adjust gage pin to just touch crankcase when flywheel is pressed toward gear case side. Now push flywheel toward left side case and use a thickness gage to determine amount of flywheel end play.

(5) Correct flywheel end play is 0.012 to 0.014 inch, and can be obtained by installing thrust collars of correct thickness.

(6) After selecting and installing thrust collars of correct thickness, oil the main bearings and proceed with final assembly. Give both faces of crankcase center joint a moderate application of shellac. Allow shellac to air-dry a few minutes before assembling cases.

(7) Assemble crankcases, install all studs and cap screws and tighten securely. Remember, three of the crankcase studs, the one at top center and the two bottom studs are drive-fit studs that locate crankcases in exact relation to each other. NOTE: *These studs must not be replaced with loose-fit studs.* After crankcase assembly is completed, recheck to be sure flywheels have at least the specified minimum, 0.012-inch end play.

CHAPTER 3

ENGINE (Cont'd)

Section VI

ENGINE ASSEMBLY

38. ENGINE ASSEMBLY.

a. Install Generator.

(1) INSTALL GENERATOR IDLER GEAR. Install generator idler gear and fiber end thrust washer on stud and retain with split lock ring.

(2) INSPECT GENERATOR END GASKET. Make sure that paper gasket used between generator end and gear case is in good condition. If not, replace and secure to generator end with shellac.

(3) USE PAPER SHIMS TO OBTAIN CORRECT GENERATOR GEAR AND IDLER GEAR TOOTH CLEARANCE. If the original number of paper shims are at hand, use them when installing generator. If original paper shims are not available, then start out with three new shims, placed between generator and crankcase cradle. NOTE: *Paper shims are approximately 0.004-inch thick with hole located to line up with oil drain holes in generator frame and crankcase cradle.* Later models may not have drain hole in generator frame. Just a small amount of grease applied to crankcase cradle will hold shims in place while installing generator.

(4) GENERATOR MOUNTING STRAP. With generator located in cradle (oil drain hole alined with shim and cradle holes), assemble curved washer, lock washer, and nut on strap end, but do not tighten as yet.

(5) TEMPORARILY INSTALL GENERATOR MOUNTING END SCREWS. Inasmuch as gear case cover is not yet installed, suitable spacers (nuts or collars) must be used under the heads of the two generator mounting end screws, to equal the thickness of the gear case cover. Tighten mounting screws snugly (not tight); then tighten generator mounting strap nut. Loosen end mounting screws to allow generator to adjust itself, and again tighten end mounting screws.

(6) INSPECT CLEARANCE BETWEEN GENERATOR AND IDLER GEAR TEETH. Generator and idler gears must mesh so that gear teeth do not bind at any point, yet are free with very small amount of lash. If gears have considerable lash, remove paper shim (or shims) from generator mounting cradle and check again. If gears do not have sufficient lash, add paper shim (or shims) between generator and mounting cradle. NOTE: *Generator mounting strap end nut must be securely tightened when making gear lash check.*

b. Install Bearing Oil Seal Ring and Spring. The bearing oil seal ring must be installed on pinion shaft with flat side facing roller bearing, and hub side outward with driving lugs engaged in shaft splines. The spring bears against oil seal ring and breather valve spiral gear.

(1) INSTALL SPIRAL GEAR. The breather pinion shaft spiral gear and pinion shaft are spline-engaged and gear is a slip fit on pinion shaft. Install spiral gear on pinion shaft against spring, with marked side outward.

(2) INSTALL PINION GEAR. The pinion gear and pinion shaft are spline-engaged and gear is a slip fit on shaft. Install pinion gear on pinion shaft, against spiral gear, with marked side outward.

c. Install Scavenger Pump and Breather Valve Assembly (fig. 29). CAUTION: *Locate the semicircular screen between breather valve housing and crankcase port before installing scavenger and*

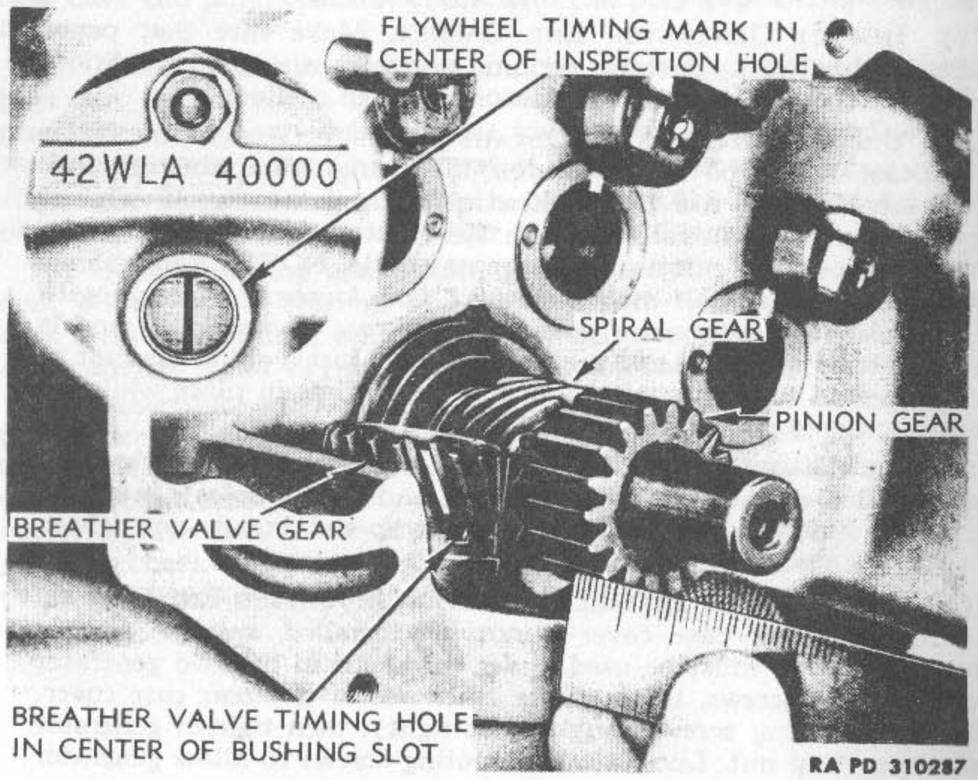


Figure 54—Timing Breather Valve

breather assembly. A recess is machined in rear side of crankcase port chamber to accommodate the screen which is retained in place by breather valve housing. The breather sleeve valve must be timed so that the elongated ports in valve sleeve and crankcase aline at the correct time for proper scavenging of oil from engine crankcase.

(1) See that crankcase and pump body faces are clean and that paper gasket is in place (a light film of grease will hold gasket in place), and install pump and breather assembly. Install the washers and nuts on studs and securely tighten nuts.

d. Time Breather Valve (fig. 54). In timing breather valve, it will be necessary to shift spiral and pinion gears outward and inward on

the shaft and engage spiral and sleeve gears so that sleeve timing hole is located when pinion gear is in running position on the shaft.

(1) Turn engine until timing mark is exactly in the center of the timing inspection hole in left side crankcase (see inset in fig. 54).

(2) Push pinion and spiral gears inward, against pressure of the spring, and try and engage spiral and breather sleeve gear teeth so that hole in sleeve is in center of housing slot when pinion gear outer face is $\frac{5}{16}$ inch from gear case joint face (this is the actual location of the pinion and spiral gears on the pinion shaft when gear case cover is in place). It may require several attempts before spiral and sleeve gears can be meshed to give desired results.

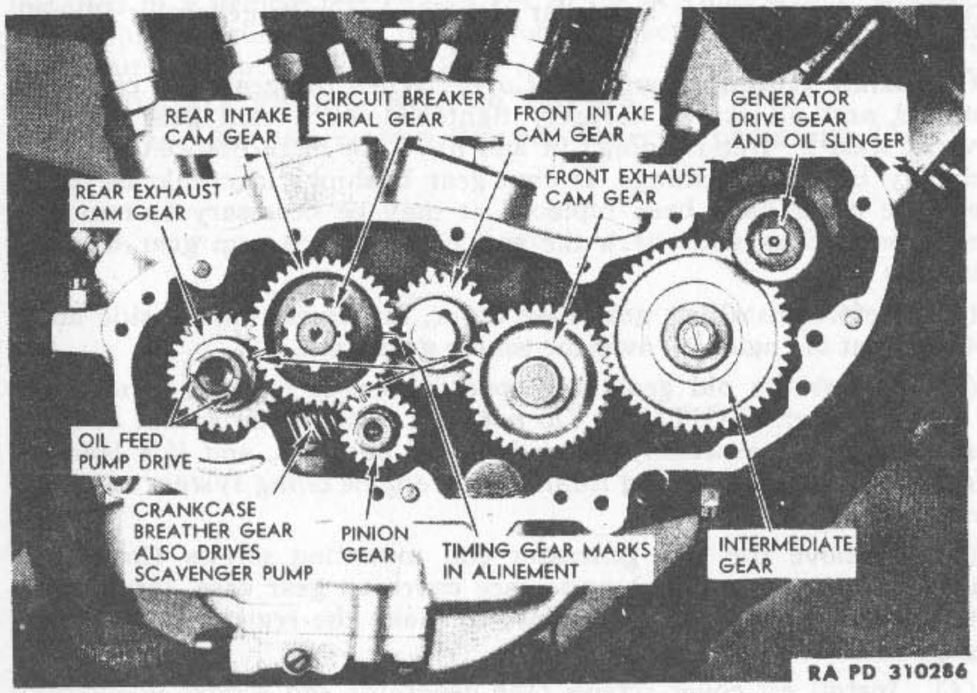


Figure 55—Timing Gears Installed

(3) In summarizing the above breather timing instructions, refer to figure 54. Spiral gear must be so engaged with breather sleeve gear that when flywheel mark is in center of inspection hole and pinion gear is $\frac{5}{16}$-inch from joint face, timing hole in the sleeve registers in slot as shown.

(4) After timing breather valve, exercise care that timing gears are not pulled out of mesh, permitting timing to change, while installing the valve timing gears.

e. Install Timing Gears. All timing (cam) gears are marked for correct valve timing when installed with marks in alinement. The timing gears are ordinarily installed with one 0.006-inch thick steel shim washer behind each of the four cam gears and on outside of the two front cylinder cam gears. Occasionally an engine may be found

that was originally assembled with more than one spacing shim at one or more points. In this case, reassemble with the same number of washers found when disassembling.

(1) INSTALL THE CAM GEAR TRAIN IN THE FOLLOWING ORDER:

(a) Rear cylinder exhaust cam.

(b) Front cylinder intake cam.

(c) Rear cylinder intake cam, alining marks with pinion, rear cylinder exhaust and front cylinder intake cam gear marks.

(d) Front cylinder exhaust cam, alining mark with front cylinder intake cam gear mark. This gear also meshes with generator idling (intermediate) gear.

f. Install Timing Gear Case Cover. When the gear case cover is installed and all screws securely tightened, each cam gear should have at least a "free running" fit and have not more than 0.005-inch end play between bushings. If cam gear bushings in crankcase and gear case cover have been replaced, it may be necessary to remove the tappet guides and check the end play of each cam gear with a thickness gage.

(1) Before installing gear case cover, lay engine on its side and pour ¼ pint of engine oil over the timing gear train.

(2) Unless the old gear case cover gasket is in good condition, fit a new gasket. CAUTION: *Do not fit a home-made gasket as this gasket has holes especially located for oil passages, and if a hole is left out or put in the wrong location, the engine oiling system will not function correctly.*

(3) Remove the two generator end mounting screws (installed while mounting generator) and place cover on gear case, tapping it with a block of wood and hammer to make the register holes fully engage the three dowel pins.

(4) Install all cover screws (the generator end screws included) except hexagon head bolt which also holds oil feed pump, and tighten securely.

(5) Turn engine and note whether or not it turns freely. If considerable drag is noticeable, possibly too many steel shims have been fitted to one or more cam gear shafts. In this case, make necessary correction.

g. Install Oil Feed Pump. Examine gasket closely. If condition of gasket is at least questionable, use a new gasket. Never use a home-made gasket on the oil feed pump as leaving out one hole or locating a hole in the wrong place may put engine oiling system completely out of order.

(1) Install pump assembly on the mounting studs, turning engine slowly and pressing lightly against pump until the driving dogs on the rear exhaust cam gear line up with and engage driving slots in the oil pump rotor.

(2) Install hexagon head bolt and lock washer and the three lock

washers and nuts on the mounting studs. Note that two of the nuts are of the long extension type. These special nuts must be installed on the studs from which they were originally removed. Tighten all nuts securely.

h. Install Pistons. Refer to paragraph 12 **a**.

i. Install Cylinders. Refer to paragraph 15 **a**.

j. Install Ignition Circuit Breaker and Time Ignition. Refer to TM 9-879.

k. Install Cylinder Head and Gaskets. Refer to paragraph 15 **d**.

l. Install Carburetor and Intake Pipe. Refer to paragraph 15 **b**.

m. Install and Test Reconditioned Engine. Engine should be installed in a vehicle test chassis (or in the original vehicle chassis) and adjusted, tuned, and tested for satisfactory operation before being put back into service.

(1) INSTALL ENGINE. Refer to TM 9-879.

(2) TEST RECONDITIONED ENGINE. Refer to paragraph 17.

CHAPTER 3

ENGINE (Cont'd)

Section VII

FITS AND TOLERANCES

39. FITS AND TOLERANCES.

a. The following list of fits, tolerances, and wear allowances are accepted standards of practice to be followed when servicing and/or rebuilding the WLA engine.

(1) CAM GEAR END PLAY. Free running to 0.005 inch.

(2) CAM GEAR SHAFTS. Replace cam gear and shaft assembly, when shaft is worn in excess of 0.001 inch.

(a) Front cylinder exhaust camshaft, both ends 0.68675 inch.

(b) Front cylinder intake camshaft, both ends 0.68675 inch.

(c) Rear cylinder intake camshafts; crankcase end 0.68675 inch, timer end 1.12425 inch.

(d) Rear cylinder exhaust camshafts; crankcase end 0.68675 inch, oil pump drive end 0.7805 inch.

(3) CAM GEAR SHAFT IN BUSHING CLEARANCE. 0.0005 to 0.001 inch.

(4) CAM GEAR BUSHINGS. Replace when worn in excess of 0.002 inch.

(a) All cam gear bushings in crankcase, line reamed $1\frac{1}{16}$ inch.

(b) Front cylinder intake and exhaust cam bushings in gear case cover, line reamed $1\frac{1}{16}$ inch.

(c) Rear cylinder intake cam and timer drive bushing in gear case cover, line reamed $1\frac{1}{8}$ inches.

(d) Rear cylinder exhaust cam and oiler drive bushing in gear case cover, line reamed $25\frac{1}{32}$ inch.

(5) CIRCUIT BREAKER POINT GAP. The gap should be 0.022 inch.

(6) CONNECTING ROD ROLLER RACES (STEEL). Standard size is 1.5 inches. Lap when worn to true and smooth races and to accommodate oversize rollers. Replace rods when necessary lapping leaves races so large they will not refit with largest oversize rollers.

(7) CONNECTING ROD PISTON PIN BUSHING. Standard hole diameter 0.7925 inch. Ream and hone for oversize pin when pin clearance in bushing exceeds 0.002 inch. Replace to accommodate new piston fitted with standard pin.

(8) CONNECTING ROD SIDE PLAY BETWEEN FLYWHEELS. 0.006 to 0.010 inch.

(9) CRANKCASE GEAR SHAFT ROLLER RACE (STEEL). Standard size, 1.376 inches. Lap when worn to true and smooth race and to

accommodate oversize rollers. Replace steel bushing when necessary lapping leaves it so large it will not refit with largest oversize rollers.

(10) CRANKCASE SPROCKET SHAFT ROLLER RACE (STEEL). Standard size, 1.376 inches. See (9) above.

(11) CRANK PIN. Standard size, 0.999 inch. Replace when worn 0.0005 inch or at such time as roller path wear shoulder is evident.

(12) CRANK PIN CONNECTING ROD BEARING CLEARANCE. Rollers fitted to give 0.0007 to 0.001 inch clearance.

(13) CYLINDER BORE. Standard bore is 2.7445 to 2.7455 inches.

(14) FLYWHEEL SIDE PLAY IN CRANKCASE. 0.012 to 0.014 inch. Adjustable by collars varying in thickness (0.066 to 0.102 inch) in steps of 0.004 inch.

(15) GEAR SHAFT. Standard size, 0.875 inch. Small end diameter, 0.62425 inch. Replace when worn 0.0005 inch or at such time as roller path wear shoulder is evident.

(16) PISTON CYLINDER HEAD CLEARANCE. Distance between cylinder head and piston (at highest position) is $\frac{1}{16}$ to $\frac{3}{32}$ inch.

(17) PISTON DIAMETER AT BOTTOM OF SKIRT. Standard size is 2.743 inches measured at bottom of skirt, front to rear, at right angles to center line of pin.

(18) PISTON CLEARANCE IN CYLINDER. Must have 0.0015 to 0.0025-inch clearance in the cylinder (standard or oversize). Replace when clearance exceeds 0.006 inch. Above specifications apply only to taper-cam ground piston, which is 0.0025 inch smaller at top of skirt (underneath lower ring) than at bottom of the skirt. This clearance (0.0015 to 0.0025 inch) is not sufficient for a straight-cam ground piston.

(19) PISTON SIZES AVAILABLE. Standard, 0.010, 0.020, 0.030 and 0.040 inch oversizes available.

(20) PISTON RING SIDE CLEARANCE IN PISTON GROOVE. 0.004 inch. Maximum allowable clearance before new ring (or piston) is necessary, 0.006 inch.

(21) PISTON RING GAP. 0.010 to 0.020-inch gap in cylinder.

(22) PISTON RING SIZES AVAILABLE. Standard and 0.010, 0.020, 0.030, and 0.040 inch oversize.

(23) PISTON PIN. Standard size, 0.7915 inch diameter. Replace when worn 0.0005 inch.

(24) PISTON PIN FIT IN PISTON BOSSES. Light hand press fit.

(25) PISTON PIN CLEARANCE IN CONNECTING ROD BUSHING. 0.001 inch. Maximum allowable clearance before new oversize pin is necessary, 0.002 inch.

(26) PISTON PIN SIZES AVAILABLE. Standard and 0.002, 0.004, 0.006, 0.008, and 0.010 inch oversize.

(27) ROLLERS, CRANK PIN. Two lengths used. Standard size, 0.250 inch diameter. Short rollers for forked rod are 0.270 inch long. The long rollers for narrow rod are 0.550 inch long.

(28) ROLLERS, GEAR SHAFT. Standard size 0.250 inch diameter. Length, 0.550 inch.

(29) ROLLERS, SPROCKET SHAFT. Standard size 0.250 inch. Length 0.360 inch.

(30) ROLLER SIZES AVAILABLE. Standard (0.250 in.) and in steps of 0.0002, 0.0004, 0.0006, 0.0008, 0.001 inch oversize.

(31) SPARK PLUG GAP. 0.025 to 0.030 inch.

(32) SPROCKET SHAFT. Standard size, 0.875 inch. Replace when worn 0.0005 inch or at such time as roller path wear shoulder is evident.

(33) TIMING, IGNITION. 1/4 to 9/32 inch before top dead center on compression stroke.

(34) TIMING, BREATHER VALVE. See paragraph 38 d.

(35) TIMING, VALVES. Time by alining gear marks. Valve timing by piston location: Intake opens 5/32 to 7/32 inch before top dead center; intake closes 37/64 to 45/64 inch after bottom dead center. Exhaust valve opens 37/64 to 45/64 inch after bottom dead center; exhaust valve closes 5/32 to 7/32 inch after top dead center.

(36) VALVE TAPPET CLEARANCE (ENGINE COLD). Intake valves, 0.004 to 0.005 inch. Exhaust valves, 0.006 to 0.007 inch.

(37) VALVE TAPPET IN GUIDE CLEARANCE. 0.0005 to 0.001 inch. Replace tappet and/or guide when clearance exceeds 0.002 inch.

(38) VALVE TAPPET GUIDES. Press fit in crankcase, 0.0005 to 0.001 inch.

(39) VALVE STEM IN CYLINDER GUIDE CLEARANCE. 0.0035 to 0.0055 inch. Replace valve and/or guide when clearance exceeds 0.008 inch.

CHAPTER 4

FUEL, INTAKE, AND EXHAUST SYSTEMS

Section I

DESCRIPTION OF SYSTEMS

40. FUEL AND INTAKE SYSTEMS.

a. Fuel System. The fuel supply is kept in the left side tank and is gravity fed to the Linkert model M88 carburetor which is located between the engine cylinders. A supply valve is located in the tank and a strainer is located at carburetor bowl intake. The carburetor is of the side-outlet, plain-tube type with a fixed venturi. Carburetor

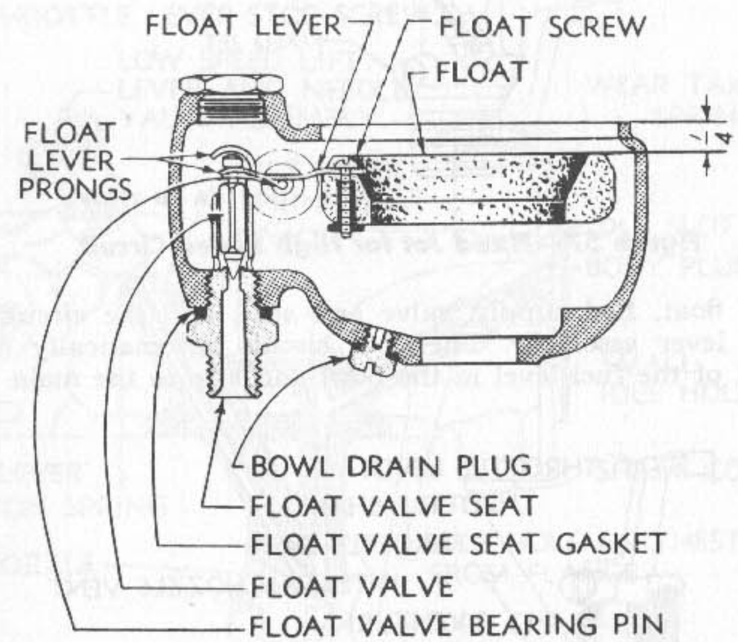


Figure 56—Cross Section of Carburetor Float Bowl

has two manual controls, the throttle, which is operated by the right handlebar grip, and the choke, which is operated by a lever located on the front side of the carburetor. The high speed fuel supply is governed by a fixed (non-adjustable) jet. The idling to medium speed, 30 miles per hour, fuel supply is governed by an adjustable (low speed) needle valve located on the rear side of the carburetor body.

(1) CARBURETOR FUEL CIRCUITS. The motorcycle carburetor may be said to consist of four circuits. By describing and treating each circuit separately, study and repair of the carburetor is made easier.

(a) The Float Circuit (fig. 56). The float circuit consists of the

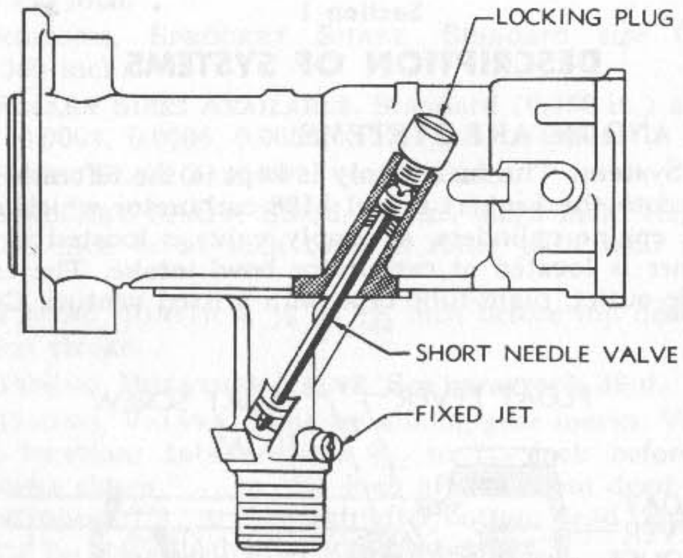


Figure 57—Fixed Jet for High Speed Circuit

bowl, the float, fuel supply valve and seat, and the circular cork float and lever assembly. The float circuit automatically controls the height of the fuel level in the bowl and also in the main nozzle.

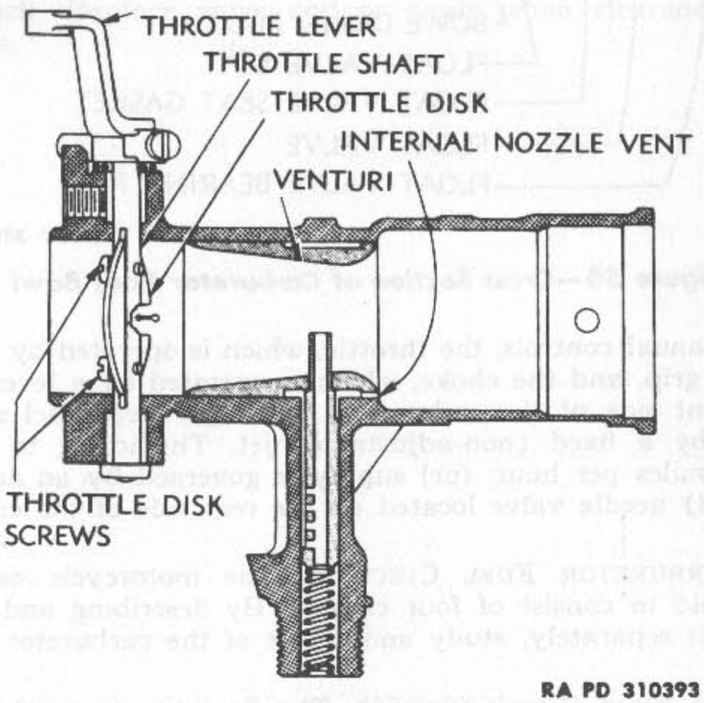


Figure 58—Section Showing Throttle Disk, Venturi and Spray Nozzle

(b) The High Speed Circuit (figs. 57 and 58). The high speed circuit consists of the main nozzle, fuel well, air bleed, fixed metering jet, fixed size venturi, and the throttle disk. As the throttle is opened, the air flow over the main nozzle is increased, thus increasing the fuel supply which is atomized and vaporized on its way into the engine cylinders. The main nozzle is located in the narrowest part of the venturi, where the air stream through the carburetor is traveling at its greatest velocity.

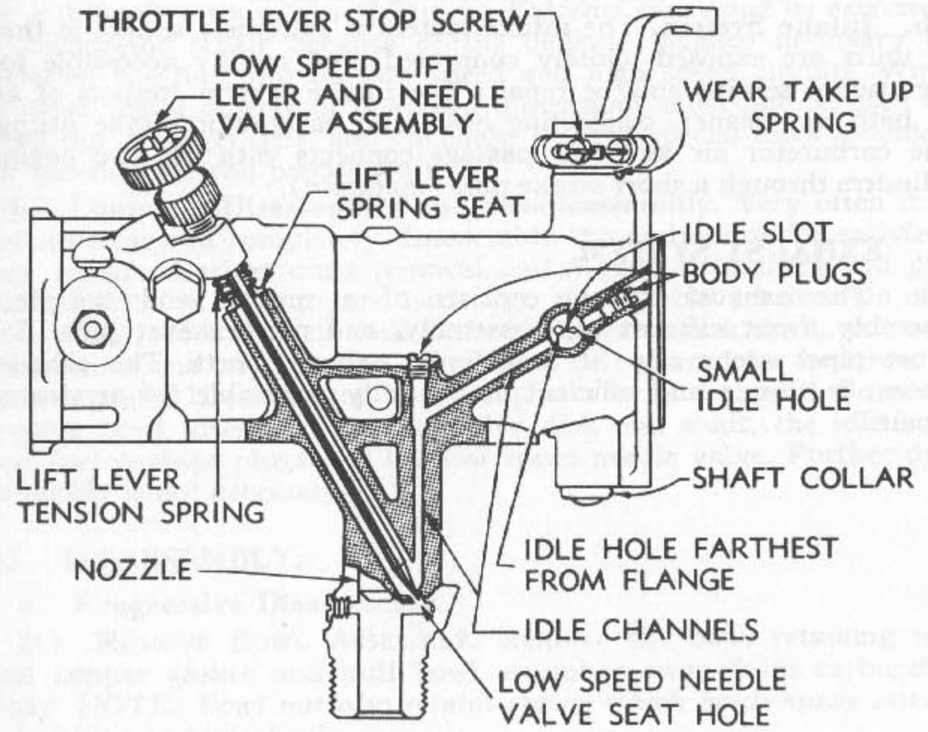


Figure 59—Needle Valve and Idle Channels for Low Speed Circuit

(c) The Low Speed Circuit (fig. 59). The low speed circuit principal parts are: the metering jet, fuel well, idling (low speed) needle and seat, supply channels and idle ports. The idling (low speed) circuit controls the engine fuel supply during idling and light load speeds up to approximately 30 miles per hour. The main metering jet supplies fuel into the well (same as in the high speed circuit), but with the throttle in closed position, the fuel is drawn off past the adjustable low speed needle valve, into the low speed channels (mixed

with air from the low speed air bleed) into the carburetor bore through small holes and a narrow slot located at the edge of the throttle disk. The adjustable low speed needle valve controls the fuel supply feeding into the low speed channels. As the throttle is opened, the air stream through the venturi becomes more active, thus shifting from the low speed circuit to the high speed circuit.

(d) The Choke Circuit. The choke circuit is used to supply a rich fuel mixture, from which sufficient vapor will be obtained to start a cold engine. This circuit consists of a choke valve (disk) to close off practically all of the air supply through the carburetor bore, a shaft, lever, and cam assembly. The cam allows the low speed needle valve to rise off its seat so that a richer mixture can reach the idle holes. The choke lever is provided with several stops for full choke, starting, warming-up, and running positions.

b. Intake System. The intake system is extremely simple in that all units are exposed, closely connected, and readily accessible for operational service and/or repair. The intake system consists of an oil bath air cleaner, connecting hose, and carburetor intake fitting. The carburetor air and fuel passage connects with the two engine cylinders through a short intake pipe (manifold).

41. EXHAUST SYSTEM.

a. The exhaust system consists of a muffler and tail-piece assembly, front exhaust pipe assembly, and rear exhaust pipe. Exhaust pipes are a slip fit in cylinder exhaust ports. The exhaust system is simple and efficient and readily accessible for service or repair.

CHAPTER 4

FUEL, INTAKE, AND EXHAUST SYSTEMS (Cont'd)

Section II

CARBURETOR

42. PRELIMINARY INSTRUCTIONS.

a. By proper cleaning and replacing of worn and/or damaged parts the carburetor can be reconditioned good as new. Carbon (crust) formations in the barrel, around the throttle valve and in the small idle holes and slot affect engine speeds up to approximately 30 miles per hour. Usually a lean spot results and no manner of adjustment will correct it. Dirt in the low speed channels also makes for a difficult carburetor adjustment. Extreme care must be exercised in carburetor repair because of the delicate balance necessary in metering the fuel into the low speed and high speed circuits. Wire, or other metal objects of unknown dimensions must not be used to clean out passages, jets, and channels. Use the special tools provided for this delicate and precise work.

b. Complete Disassembly and Subdisassembly. Very often it is not necessary to completely disassemble the carburetor for satisfactory repairs. Carbon crust removal and a general cleaning will put the majority of carburetors back into dependable service. On the other hand, worn throttle disk shaft, choke valve disk shaft, and any other worn and/or damaged parts must be replaced for best reconditioning job. If carburetor needs only a crust and general cleaning, remove bowl assembly, throttle valve disk and shaft, the idle hole and fuel passage plugs and the low speed needle valve. Further disassembly is not necessary.

43. DISASSEMBLY.

a. Progressive Disassembly.

(1) REMOVE BOWL ASSEMBLY. Remove the bowl retaining nut and copper gasket and pull bowl assembly away from carburetor body. NOTE: *Bowl nut also retains spring which holds spray nozzle in position in central tube.*

(2) DISASSEMBLE BOWL. Remove float valve chamber cap screw and valve seat (bowl union nipple) and fiber washer from lower side of float valve chamber. Remove the two screws which retain the float lever and carefully withdraw the float and lever. Float valve will either come out with float or will be free for removal. Remove the bowl drain screw and fiber washer.

(3) REMOVE THROTTLE DISK. Before removing throttle disk screws, back off lever stop screw so that throttle disk closes fully in the carburetor barrel. Next, with a scriber, scratch a deep mark on the throttle disk and also on the wall of the barrel for perfect register (alinement of scribed marks) when reassembling carburetor. Remove throttle disk screws and lock washers and pull disk out of slot in throttle shaft. Exercise care not to damage disk when removing it

with pliers. Remove throttle shaft after loosening throttle lever clamp screw. Take care not to lose the bronze helical spring located between body and lever.

(4) REMOVE THE VENTURI (CHOKE TUBE). After spray nozzle has been removed from bottom of central fuel passage remove the venturi. CAUTION: *The venturi is made of soft metal; do not damage it upon removal.* Also note small bore end faces the choke valve in the barrel.

(5) REMOVE LOW SPEED NEEDLE VALVE AND LIFT LEVER ASSEMBLY AFTER REMOVING PIVOT SCREW. Do not lose the small washer and spring located between the lift lever and the needle valve channel end.

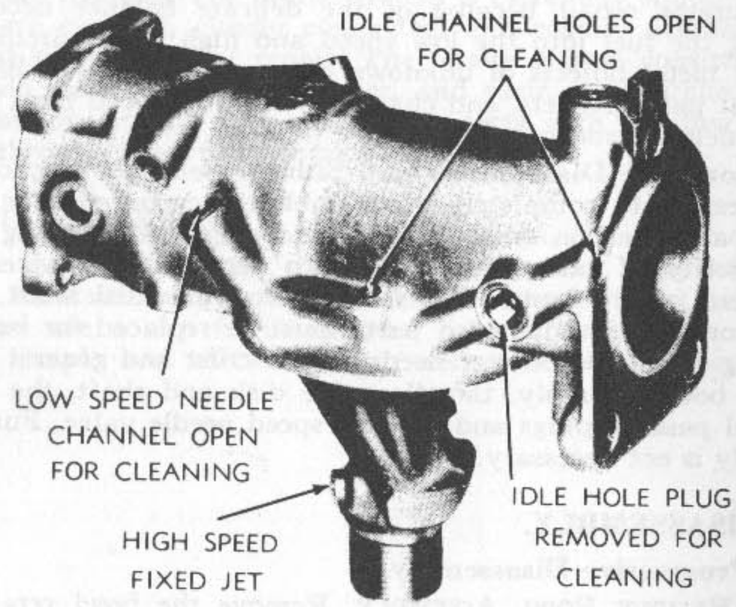


Figure 60—Idle Channel Hole Screws and Low Speed Needle Valve Removed for Cleaning

(6) REMOVE CHOKE VALVE SHAFT. After removing set screw which retains the lever and the two screws and washers which retain the disk, remove disk from shaft. A small steel ball and spring will drop out of position when the choke lever is removed from the shaft. After pulling disk out of shaft slot, shaft with cam can be withdrawn from carburetor body.

(7) REMOVE IDLE HOLE AND CHANNEL PLUGS. Remove the idle hole, cover plug screw, and the two low speed circuit channel end plug screws (fig. 60). Also plug screw located in central body tube can be removed for "blowing out" passages. NOTE: *Do not remove the locking plug and short needle used to close off high speed needle valve seat* (fig. 57).

(8) HIGH SPEED FIXED JET. High speed fixed jet should not be removed unless found in damaged condition or that the wrong jet is in use. Model M88 carburetor uses fixed jet No. 1. If jet must be removed, see that screwdriver bit fits slot of jet perfectly and that neither the head, slot nor hole are damaged when jet is removed.

44. CLEANING AND INSPECTION.

a. Clean all carburetor parts (except cork float) carefully in dry-cleaning solvent. The carbon crust formation within the barrel may be scraped off with a suitable tool, taking care not to cut or damage the parts, and the throttle disk may be rubbed on fine emery cloth (on plane surface). After cleaning, wash parts in dry-cleaning solvent.

b. Inspection. Inspect all parts for excessive wear and/or damage. Any excessively worn and/or damaged parts should be replaced to place carburetor back in first class condition.

(1) THROTTLE SHAFT AND BUSHINGS. Throttle shaft and body bushing wear in excess of 0.004 inch will affect idling (closed throttle) speeds. Standard throttle shaft is 0.251 inch diameter. Replace the throttle shaft but do not replace the monel bushings.

(2) CHOKE VALVE SHAFT AND LIFTER CAM ASSEMBLY. When the choke valve shaft shows wear shoulders or has in excess of 0.010 inch clearance in body holes it should be replaced. Standard shaft is 0.251 inch diameter. Body holes are not bushed. If lifter cam on end of shaft is excessively worn and/or damaged, replace shaft and cam assembly.

(3) LOW SPEED NEEDLE VALVE LIFTER LEVER AND PIVOT SCREW. Lift lever has $^{9}/_{32}$-inch hole and pivot stud is 0.276 inch in diameter, giving 0.005 inch clearance. When clearance exceeds 0.010 inch, replace. When spring and ball tension of lifter lever does not retain needle valve in selected position, replace the lever assembly.

(4) LOW SPEED NEEDLE VALVE. If the valve needle is bent or its point worn and damaged, replace the needle.

(5) SPRAY NOZZLE. If spray nozzle is found damaged upon removal, replace it.

(6) SPRAY NOZZLE SPRING. The spray nozzle spring may be found rusted and stuck in the body hole. If so, replace it.

(7) VENTURI. If venturi is excessively loose in barrel and the hole through which the spray nozzle end passes is worn elongated, replace it. A loose fitting venturi will wear a groove around the spray nozzle end.

(8) CARBURETOR BODY. Inspect the body closely for condition of the small idle holes and the connecting slot, condition of idle passages and condition of all threaded holes.

(9) BOWL ASSEMBLY (fig. 56). Inspect the bowl (aluminum) for good condition, especially as to condition of threads.

(a) Inspect the cork float for logged condition; cracked, discolored, or bad protecting finish. Inspect the float lever fingers for excessive wear and inspect lever and float connection for security.

(b) Inspect the float valve and seat for wear. If seats are ringed both valve and seat must be replaced. See that fiber washer between valve seat and body is in good condition.

(c) Inspect float lever pin (retained in one of the pin cap screws) for wear.

45. REPAIR.

a. Clean Idle Holes and Passages (fig. 60). Use special carburetor tool (41-T-3081-45) when cleaning all carburetor holes and passages. NOTE: *Turn cleaning drills by hand, being careful not to damage passages or seats.* Before attempting to clean holes and passages, see that carbon crust is removed (par. 44 **a**).

(1) CLEAN IDLE HOLES. For the large idle hole (farthest from flange end) use drill No. 55. For the small idle hole (nearest flange end), use No. 70 drill. Clean the connecting slot between the large and small idle holes with special tool having a 0.009-inch thick blade.

(2) CLEAN IDLE CHANNELS. Use the No. 42 drill to clean out idle channels. CAUTION: *When cleaning out the vertical idle channel do not completely "bottom" the drill, as doing so may damage the low speed needle seat, thus ruining carburetor body beyond repair.*

(3) CLEAN LOW SPEED NEEDLE VALVE SEAT HOLE. Use drill No. 53L, passing it down into needle channel until it bottoms; then turn drill with fingers to clean out hole.

(4) USE OF DRILL IN HIGH SPEED JET HOLE. Never under any circumstances should a drill or hard object be used to clean out high speed jet hole. Doing so would alter the metering of the fuel and throw carburetor out of adjustment. If high speed jet appears in bad condition (damage from screwdriver or tampering) replace it with a new No. 1 jet.

(5) CLEAN WITH COMPRESSED AIR. Blow out all holes, nozzles, jets and channels with compressed air and wash all parts in clean gasoline.

b. Replace Throttle Shaft. The monel metal throttle shaft bushings need not be replaced during the life of the carburetor. The throttle shaft can be replaced, however, at the time the carburetor is reassembled.

c. Replace Float. Remove old float by cutting seal (varnish or shellac) around float screw which fastens float to float lever. The seal can be cut with a pocketknife. Remove float screw and assemble new float to the lever. This should be done with float valve, float valve lever, float hinge pin, and float valve seat and gasket assembled in bowl. Before tightening float screw securely, adjust as follows:

(1) ADJUSTING FLOAT OFFSET IN BOWL. The float must be offset to one side to provide body clearance as float raises and lowers in the bowl. Looking down the bowl (gasoline inlet side away from you), pull the float toward you to the limit of the slot in the lever, and then shift (offset) about $\frac{1}{16}$-inch to the left of the center line. Tighten float screw securely.

(a) Cement the top of the float screw to the float (form a seal)

with celluloid cement or with thick shellac. Do not attempt to adjust float level until cement or shellac seal has thoroughly set.

(2) ADJUSTING FLOAT LEVEL. Hold the bowl upside down and measure the distance from the float to the edge of the bowl (measurement taken directly opposite float valve). Float should be $\frac{1}{4}$ inch from edge of bowl (fig. 61). CAUTION: *Do not bend float lever in bowl to obtain correct setting, as this procedure would bend the float lever fingers and cause lost motion between the lever and float valve.* Float and lever assembly must be removed from the bowl, and the lever bent up or down, as required, to obtain the $\frac{1}{4}$-inch float level distance.

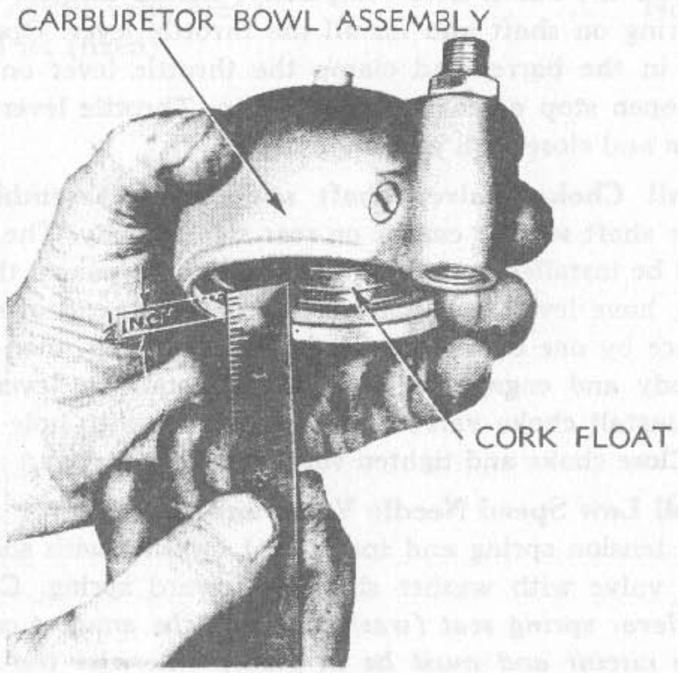


Figure 61—Measuring Float Setting in Bowl

(3) FLOAT VALVE HEAD AND LEVER FINGER CLEARANCE. Before carburetor is assembled, see that float valve head is a free fit between the fingers of the lever with not more than approximately 0.003-inch free play. Check this clearance after float and lever assembly is assembled in the bowl by carefully placing a small screwdriver against the valve head to hold the valve firmly against the seat, yet not bind the lever. Moving the lever up and down will reveal amount of actual clearance between the valve head and the lever fingers. NOTE: *If the float valve head and lever finger clearance is excessive, the float mechanism will not feed properly.* After the float and lever have been assembled to the bowl, see that the float is approximately square with the top of the bowl.

46. ASSEMBLY.

a. Install Throttle Shaft and Throttle Disk. Install the throttle shaft and pass the throttle disk through the shaft slot so that counterbored set screw holes and the scribed mark face the flange end of the carburetor body. The throttle disk must close tightly in the carburetor barrel. Close the throttle disk, making sure the scribed mark on disk lines up with scribed mark in the barrel (if new disk is installed, disregard this), press upward on the shaft so that collar bears against the carburetor body and tighten the disk screws. Try opening and closing the throttle disk to see that it does not bind, and also closes off the barrel hole completely. Install throttle shaft wear take-up spring on shaft and install the throttle lever. Open throttle wide open in the barrel and clamp the throttle lever on the shaft with wide open stop against the body stop. Throttle lever and shaft should open and close with just slight drag.

b. Install Choke Valve, Shaft and Lever Assembly. Install choke valve shaft so that cam is on rear side of body. The lever stop ball should be installed as follows: As the shaft is passed through the body holes, have lever stop notch ball located on end of spring and held in place by one of the notches in the lever stop, then pass shaft through body and engage the lever hole. Install the lever retaining screw and install choke valve disk in shaft slot with hole at bottom of barrel. Close choke and tighten valve retaining screws.

c. Install Low Speed Needle Valve and Lifter Lever Assembly. Locate the tension spring and spring seat (washer with shoulder) on the needle valve with washer shoulder toward spring. CAUTION: *The lifter lever spring seat (washer) limits the amount of air bleed to the idle circuit and must be in place; otherwise the carburetor cannot be adjusted for satisfactory engine idling.* Engage needle in body channel and press down on lifter lever assembly so that pivot screw can be installed.

d. Install All Channel Opening Plug Screws. Install idle hole plug screw and the two body channel plug screws.

e. Install Spray Nozzle and Venturi. Install venturi with choke end near carburetor flange and pass spray nozzle up through body channel until end of nozzle seats in venturi hole. Spray nozzle is retained by spring and bowl nut.

f. Install Bowl Assembly. Install spray nozzle retaining spring in body hole, locate bowl assembly on body, install copper washer, and turn on bowl retaining nut. See that bowl fuel line nipple is in correct position and tighten bowl nut.

47. SPECIFICATIONS FOR LINKER MODEL M88 CARBURETOR.

a. Data.

Indentification	(Model No. M88 stamped on top)
Size	1¼ inches (actual barrel dia 1⅜ in.)
Venturi	15/16 in.
Small idle hole	No. 70 drill
Large idle hole	No. 55 drill
Idle slot (between holes)	Use 0.009-inch blade
Vertical and diagonal idle channels	No. 42 drill
Low speed needle valve seat	No. 53L drill
High speed jet (fixed)	No. 1

CHAPTER 4

FUEL, INTAKE, AND EXHAUST SYSTEMS (Cont'd)

Section III

FUEL STRAINER AND FUEL SUPPLY VALVE

48. FUEL STRAINER.

a. The only repair necessary to the fuel strainer is the replacement of the screen, cork washers, or the retaining cap. A damaged housing (bad threads, etc.) should be replaced.

49. FUEL SUPPLY VALVE.

a. Description. The fuel supply valve, located in left tank forward position, is a two-purpose valve, serving as a shut-off and also controlling reserve fuel supply of approximately 3 quarts. When valve is turned down, finger-tight, the fuel supply is shut-off. When loosened fully, the valve is normally open. When in the open position and lifted to the limit of its travel, the valve releases the reserve fuel supply.

b. Repair. About the only thing that requires replacement (outside of damaged parts) in the fuel valve, is the rubber seal washer, located at the upper end (under valve knob) of the rod. This rubber seal offers resistance to the rod and retains it in the raised position for reserve fuel supply use.

(1) REPLACE RUBBER SEAL WASHER. Remove the screw which retains knob on the end of the valve rod. Unscrew the knurled upper seat cap. Remove plain washer, spring, and rubber seal. Install rubber seal with cone side down and retain with spring, flat washer, and seat cap. Assemble knob on end of rod and retain with screw.

(2) REMOVE AND INSTALL VALVE ROD. Valve rod must be removed and installed from underside of tank.

(a) Remove. Close valve, remove knob and remove valve nipple from tank. Rod will pull out of tank when nipple is removed.

(b) Install. At time valve rod and nipple are assembled to tank, see that the two nipple washers (one on either side of spacer) are in good condition. Assemble knob to upper end of rod and retain with screw.

CHAPTER 4

FUEL, INTAKE, AND EXHAUST SYSTEMS (Cont'd)

Section IV

INTAKE PIPE, AIR CLEANER, AND FITTINGS

50. INTAKE PIPE (MANIFOLD).

a. The intake pipe connects between the two cylinders and supports the carburetor. Gland nuts and packing bushings secure the inlet pipe to the cylinder nipples, making an airtight joint. The carburetor is mounted on inlet pipe flange with four cap screws.

51. AIR CLEANER AND FITTINGS.

a. Description. The air cleaner is mounted on a bracket on the left side of the vehicle, near battery box, and is connected to the carburetor by means of a flexible hose, carburetor end fitting, and clamps. The air cleaner contains two filter elements, retained by a baffle plate and thumb screw, enclosed by the oil cup. The oil cup is retained in position by two spring clips. Gaskets are located above the filter elements and between the body and cup to prevent leakage.

b. Disassembly. Unlatch oil cup retaining clips, remove oil cup, and after removing the baffle plate, the filter elements can be withdrawn from the body. If filter elements stick in the body, use a piece of hooked wire to assist in their removal.

c. Cleaning and Inspection. Clean all parts in dry-cleaning solvent and inspect for good condition.

d. Repair of Cleaner. If body is badly dented, twisted, or in otherwise bad condition, it should be replaced. Damaged filter units, gaskets, baffle plate, and oil cup should also be replaced. Broken or damaged latches and springs can be easily replaced.

(1) REPAIR OF FITTINGS. Damaged air cleaner connecting hose, hose clamps, and/or carburetor fittings should be replaced.

e. Assembly. See that the two gaskets are in good condition and are in place before assembling the air cleaner. Install filter units and retain with baffle plate. Attach the oil cup to the filter body by means of the spring latches. It should seat firmly and squarely against gasket in body groove. See that the latch springs fully engage the lip of the oil cup.

CHAPTER 4

FUEL, INTAKE, AND EXHAUST SYSTEMS (Cont'd)

Section V

EXHAUST SYSTEM

52. MUFFLER.

a. The muffler and tail piece (fish tail) are made integral and repair to this assembly is not practical. The muffler end, however, must be kept open and free from caked mud (or other matter) which will restrict the outlet of the burned gases. No attempt should be made to clean the inside of the muffler, cut off end of fish tail or enlarge fish tail holes. A badly damaged muffler and/or tail piece must be replaced.

53. EXHAUST PIPES.

a. The front cylinder exhaust pipe with connection for the rear cylinder exhaust pipe is of welded, one-piece construction and when found in badly damaged condition must be replaced. A badly dented exhaust pipe will restrict exhaust gases and cause engine overheating. When the rear cylinder exhaust pipe is bent, dented, and damaged to the extent it does not fit the cylinder port or pipe "V" connection, and offers too much restriction to the exhaust gases, it must be replaced.

CHAPTER 5

IGNITION SYSTEM

54. DESCRIPTION.

a. Description (fig. 62). This ignition system differs from the conventional automotive types, in that it has no high tension rotor or distributor cap. A circuit breaker (timer) alone is used. High tension cables lead directly from the spark coil secondary winding ends to the spark plugs, both plugs sparking at the same time. When one cylinder is on a compression stroke (ready for ignition), the other cylinder is on an exhaust stroke; thus only one cylinder fires when the circuit breaker points are opened. No. 3 spark plugs are used.

55. CIRCUIT BREAKER (TIMER) DISASSEMBLY.

a. Circuit breaker can be disassembled for replacement of timer base, timer shaft, and spiral gear (fig. 63). The circuit breaker timer head mounts the circuit breaker lever, adjustable contact point, and condenser which are readily accessible (on or off the vehicle) for adjustment and/or replacement when timer cover is removed. Timer base bushings are not replacable.

(1) REMOVE TIMER SHAFT. Remove the pin from spiral gear hub and drift or press the timer shaft out of gear. Withdraw timer shaft from base. Do not lose steel spacer washer located between gear and housing.

(2) DISASSEMBLE CIRCUIT BREAKER (TIMER) HEAD. If examination of the circuit breaker head components show it to be necessary, disassemble the unit as follows (fig. 64):

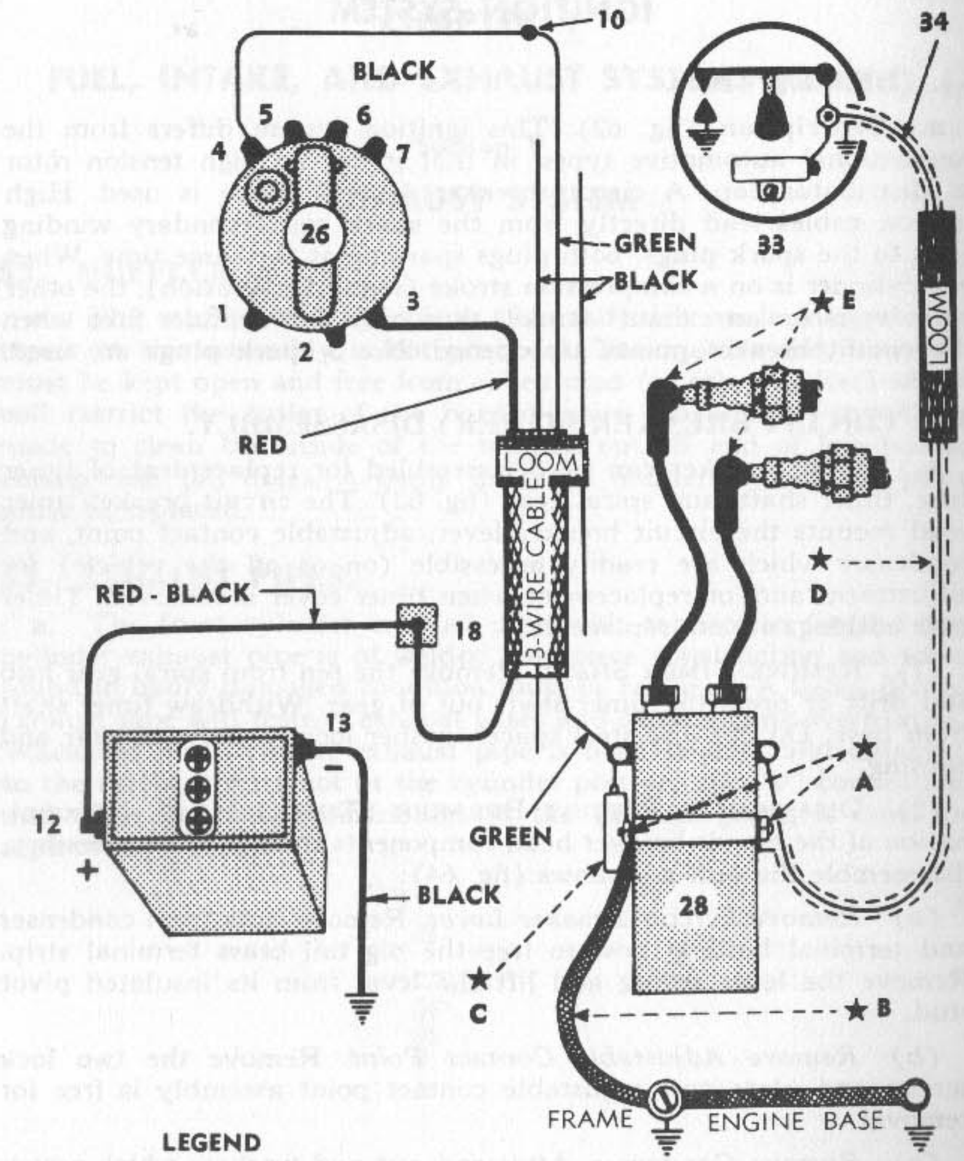
(a) Remove Circuit Breaker Lever. Remove nuts from condenser and terminal binding post to free the pig tail brass terminal strip. Remove the lever spring and lift the lever from its insulated pivot stud.

(b) Remove Adjustable Contact Point. Remove the two lock screws and plate and adjustable contact point assembly is free for removal.

(c) Remove Condenser. After end nut and washers which secure the circuit breaker lever pig tail brass terminal strip are removed, remove the condenser mounting screw (this screw also grounds condenser to the timer head).

(d) Remove the Coil-to-Timer Wire. If inspection shows it to be necessary to replace the coil-to-timer shielded wire, simply remove terminal stud nut and washer and remove wire.

(e) Timer Head Insulated Terminal Stud. Unless inspection shows that the timer head insulated terminal stud (secures the coil-to-timer wire, underneath the timer head, and circuit breaker lever pig tail brass terminal strip, on top of the timer head) is in bad condition, or that insulation is defective, it is not necessary to remove and/or replace this part.



LEGEND

1 to 7—SWITCH TERMINALS
10—SIGNAL LIGHT TERMINAL
12—BATTERY POSITIVE TERMINAL
13—BATTERY NEGATIVE TERMINAL
18—FRONT JUNCTION TERMINAL (UNDER SADDLE)
26—IGNITION-LIGHT SWITCH
28—IGNITION COIL
33—IGNITION CIRCUIT BREAKER
34—COIL-TO-CIRCUIT BREAKER WIRE

★ **A**—COIL SHIELDING GROUND
★ **B**—COIL-FRAME-ENGINE SHIELDING GROUND
★ **B**—COIL-FRAME-ENGINE SHIELDING GROUND
★ **C**—NOISE SUPPRESSION CONDENSER
★ **D**—SHIELDED COIL-TO-CIRCUIT BREAKER WIRE
★ **D**—SHIELDED COIL-TO-CIRCUIT BREAKER WIRE
★ **E**—SPARK PLUG SUPPRESSORS

RA PD 310317

Figure 62—Ignition Circuit Diagram

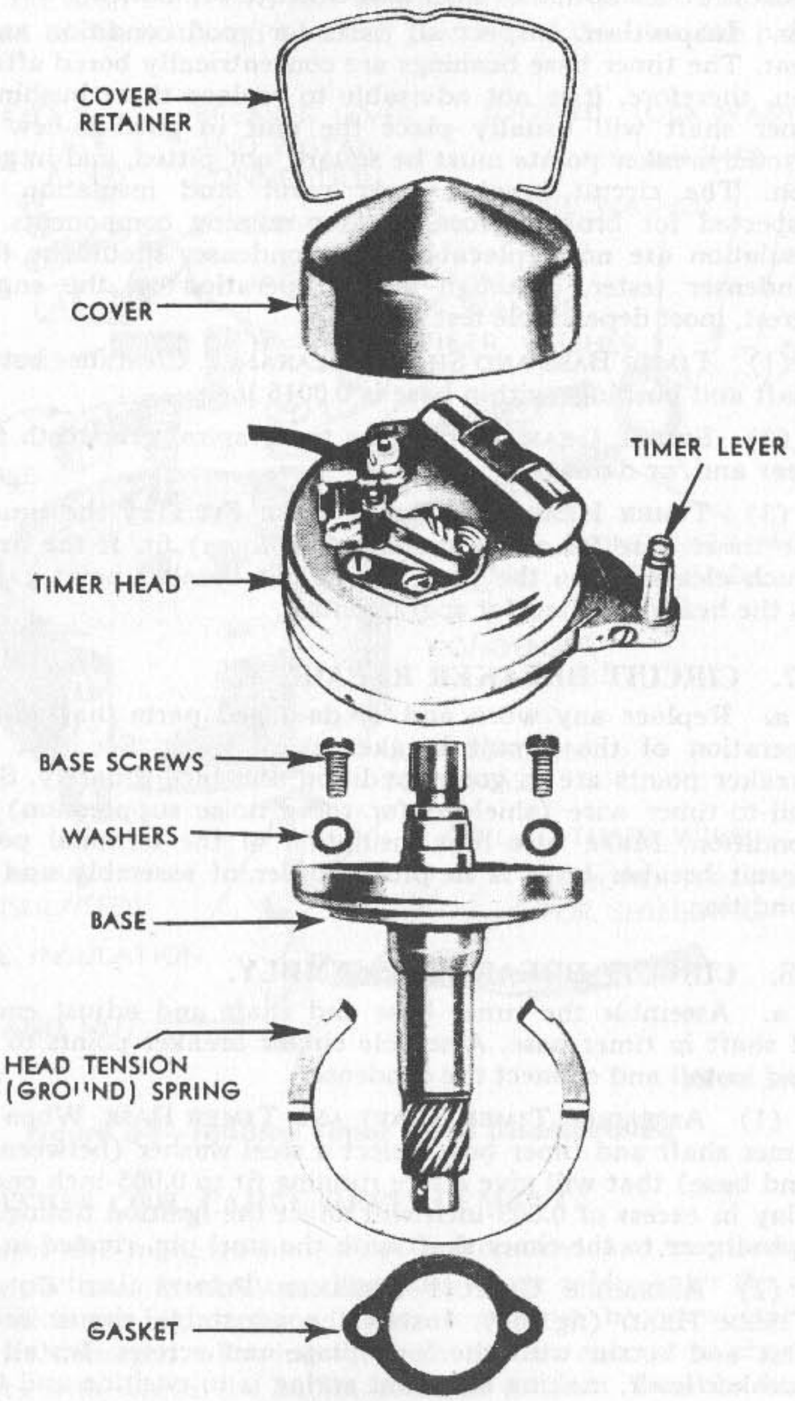


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Figure 63—Ignition Timer Disassembled

56. CIRCUIT BREAKER CLEANING AND INSPECTION.

a. Cleaning. Clean all parts in dry-cleaning solvent that will not injure wire insulation or fiber and bakelite components.

b. Inspection. Inspect all parts for good condition and signs of wear. The timer base bushings are concentrically bored after installation, therefore, it is not advisable to replace these bushings. A new timer shaft will usually place the unit in good-as-new condition. Circuit breaker points must be square, not pitted, and in good condition. The circuit breaker lever pivot stud insulation should be inspected for broken, worn, and/or missing components. Stud and insulation are not replacable. The condenser should be tested on a condenser tester, although actual operation on the engine is the surest, most dependable test.

(1) TIMER BASE AND SHAFT CLEARANCE. Clearance between timer shaft and bushings within base is 0.0015 inch.

(2) SPIRAL GEAR. Inspect the timer spiral gear teeth for signs of wear and/or damage.

(3) TIMER HEAD AND TIMER BASE FIT. Try the timer head on the timer base for a free turning (not loose) fit. If the head has too much clearance on the base, the circuit breaker point gap will vary as the head is shifted for spark control.

57. CIRCUIT BREAKER REPAIR.

a. Replace any worn and/or damaged parts that will affect the operation of the circuit breaker as a whole. See that the circuit breaker points are in good condition and face squarely. See that the coil-to-timer wire (shielded for radio noise suppression) is in good condition. Make sure that insulation of the terminal post and the circuit breaker lever is in proper order of assembly and is in good condition.

58. CIRCUIT BREAKER ASSEMBLY.

a. Assemble the timer base and shaft and adjust end clearance of shaft in timer base. Assemble circuit breaker points to timer head and install and connect the condenser.

(1) ASSEMBLE TIMER SHAFT AND TIMER BASE. When assembling timer shaft and timer base, select a steel washer (between spiral gear and base) that will give a free running fit to 0.005-inch end play. End play in excess of 0.005-inch will affect the ignition timing. Secure the spiral gear to the timer shaft with the steel pin, riveted in place.

(2) ASSEMBLE CIRCUIT BREAKER POINTS AND CONDENSER TO TIMER HEAD (fig. 64). Install the adustable circuit breaker point first and retain with the lock plate and screws. Install the circuit breaker lever, making sure that spring is in position and that pig tail brass terminal plate is secured to the insulated binding post. Install the condenser and see that fiber and spacer washers are in proper order of assembly, with the brass terminal plate on the condenser terminal stud; then install and tighten nut.

(3) COIL-TO-TIMER WIRE. One end of the metal shielding on the coil-to-timer wire must be grounded under the head of one of the base mounting screws. In order that the coil-to-timer wire will be free within the head for retard and advance movement, the wire must be connected to the insulated terminal post and coil within the head.

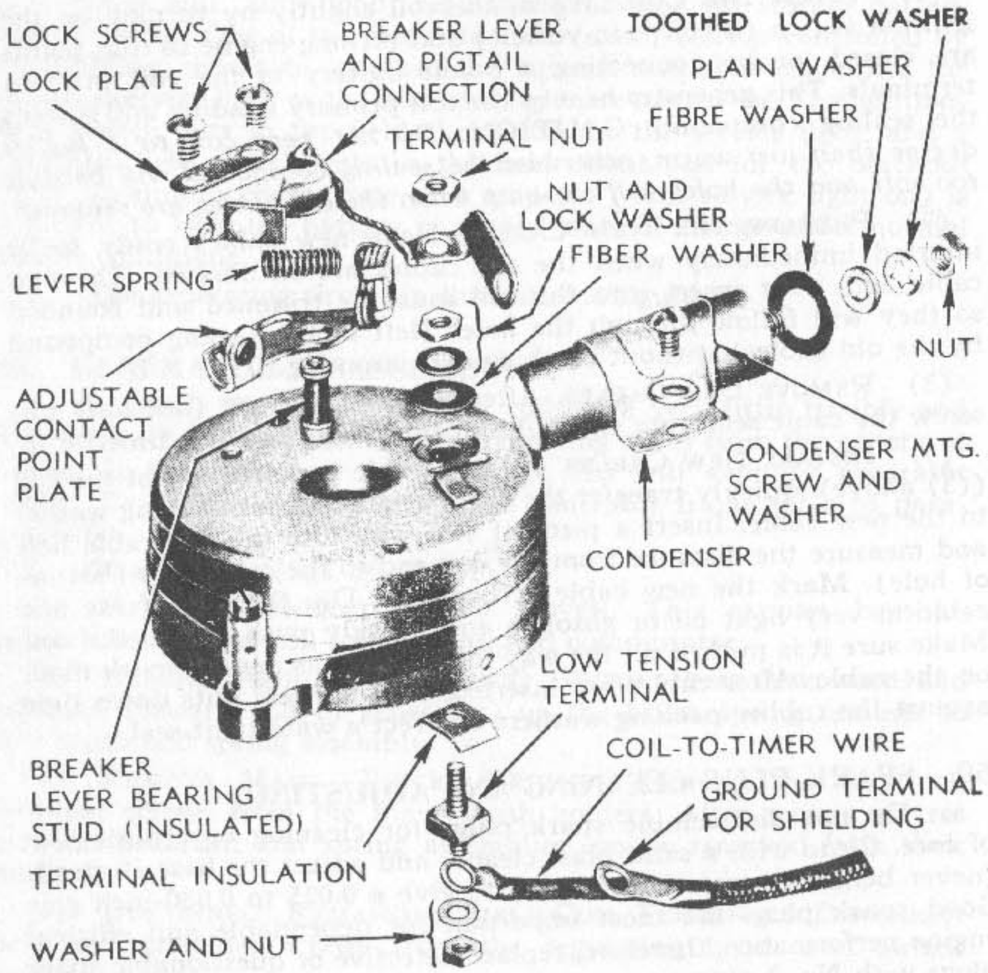


Figure 64—Ignition Timer Head Disassembled

59. IGNITION COIL CABLE REPLACEMENT.

a. Inspect the high tension cables for cracked and/or damaged insulation, particularly at the sealing nuts where cables enter the coil. The insulation on high tension cables sometimes becomes cracked or otherwise damaged, allowing the high tension current to short to metal parts with which the cables come in contact. Trouble due to this condition is most noticeable when operating in wet weather or just after vehicle has been washed. Replacing high tension cables is the only repair that can be made to the ignition coil. If faulty per-

formance of coil is not corrected by replacement of cables, then the coil unit must be replaced.

b. Replacing Cables. Coil cable ends are embedded in sealing compound for insulation and waterproofing and cable replacement must be done quickly and correctly as follows:

(1) WARM THE COIL. Warm the coil slightly by turning on the ignition switch (if coil is in vehicle) and turning engine so that points are closed, or by connecting a 6-volt battery to the coil primary terminals. This generates heat in the coil primary winding and softens the sealing compound. CAUTION: *Do not heat coil to a higher degree than just warm, otherwise the sealing compound will become too soft and the holes will close up when the old cables are removed.*

(2) PREPARE THE NEW CABLES. Have new cables ready to be inserted immediately when the old cables are withdrawn. The new cable ends that insert into the coil must be trimmed and rounded so they will follow through the holes (left in the sealing compound by the old cables) without catching and jamming.

(3) REMOVE OLD CABLES. After the coil is warm (not hot) unscrew the cable seal nuts and pull out the cables one at a time.

(4) INSTALL NEW CABLES. As each cable is pulled out of the coil ((3) above), quickly transfer the seal nut and rubber packing washer to the new cable. Insert a piece of stiff wire into the coil cable hole and measure the distance from the coil end to the cable seat (bottom of hole). Mark the new cable accordingly. Dip the end of the new cable in very light oil or gasoline and quickly push it into the coil. Make sure it is pushed all the way into its seat as per the mark made on the cable. After cables are inserted, turn the seal nuts down tight against the rubber packing washers to effect a watertight seal.

60. SPARK PLUG CLEANING AND ADJUSTING.

a. Do not disassemble spark plugs for cleaning or replacement of core. Clean with a sand-blast cleaner and adjust the base electrode (never bend the central electrode) to give a 0.025 to 0.030-inch gap. Good spark plugs are most important for dependable and efficient engine performance, therefore, replace defective or questionable spark plugs with No. 3 plugs.

CHAPTER 6

GENERATING SYSTEM

61. DESCRIPTION OF SYSTEM.

a. The generating system consists of the 6-volt, shunt-wound, third-brush and "lamp-load" regulated generator, the storage battery and the relay. One of the two field coils (shunt coil) is controlled by the lighting circuit to increase the current output when either the running service light or the blackout light are turned on. The ignition-light switch cuts in the field shunt coil for the service light, and a magnetic field switch cuts in the field shunt coil for the blackout light. Maximum charge rate of 4 amperes (with service light on) is sufficient to keep the battery in a good state of charge under normal service conditions.

b. The generating circuit is illustrated in figure 65.

62. GENERATOR DISASSEMBLY.

a. General. The generator field coils give very little trouble and it is advisable to test them before removing them from the generator frame. If the coils test satisfactorily, this will simplify generator repair. To test field coils within the generator frame refer to paragraph 63.

b. Disassembly (figs. 66 and 67).

(1) REMOVE GENERATOR END COVER. This exposes brushes, brush holders, field coil connections, and commutator.

(2) REMOVE REGULATING (THIN) BRUSH. Press downward and outward (toward end of generator) on the brush spring retainer to free brush and spring assembly.

(3) REMOVE MAIN (THICK) BRUSHES. Remove the field coil terminal screws from the main brush holders. After screws are removed, the brush and spring assemblies can be removed from their holders.

(4) DISCONNECT REMAINING FIELD COIL TERMINALS. Disconnect field coil terminal screws from the regulating brush and switch terminal plates.

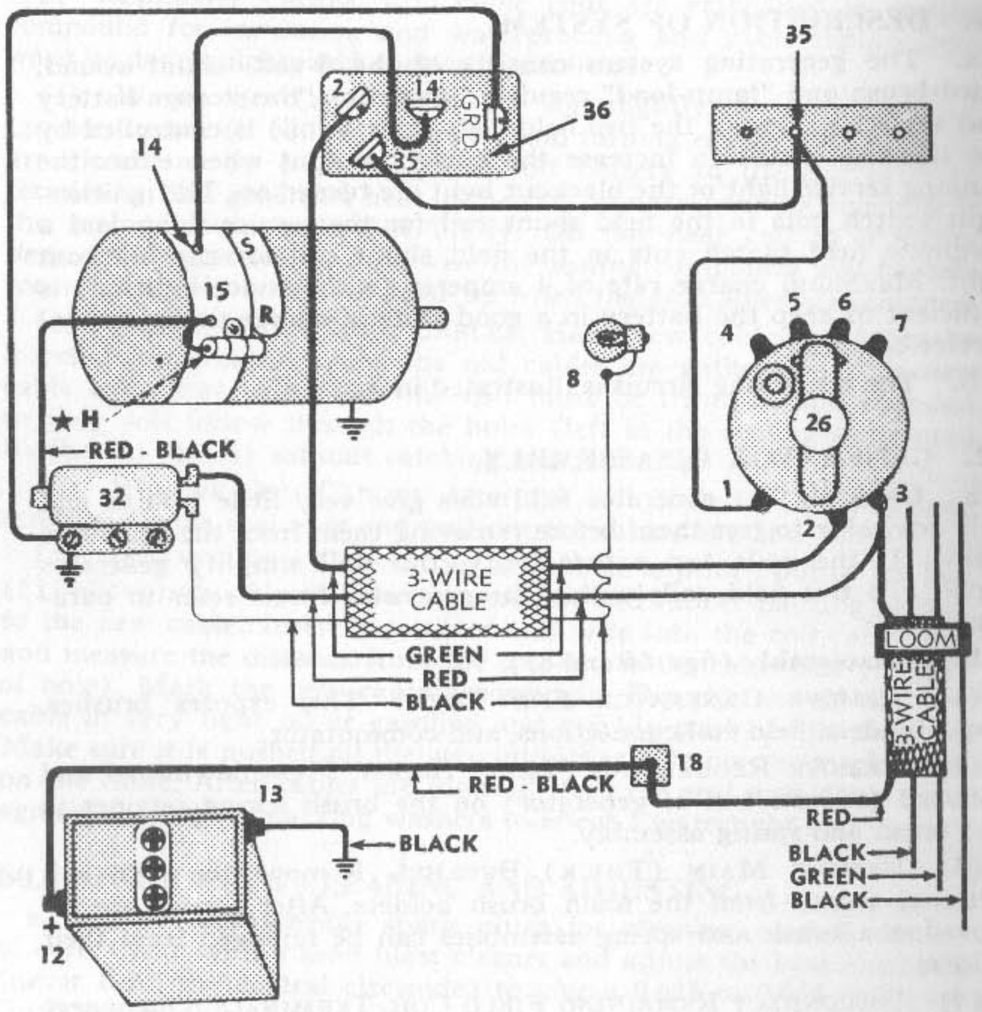
(5) REMOVE DRIVE GEAR. Drift the pin out of the drive gear and remove gear, spring and oil deflector from the armature shaft.

(6) MOUNT GENERATOR. Clamp the armature shaft in copper-faced vise jaws, with generator in upright position to work on commutator end.

(7) REMOVE OUTER GREASE RETAINER. Remove the three screws which retain the outer grease cover, gasket and the regulating brush holder. Bearing and end of armature shaft are exposed after outer grease cover is removed.

(8) REMOVE ARMATURE SHAFT END NUT. Use $\frac{9}{16}$-inch socket wrench and remove armature shaft lock nut and washer.

(9) REMOVE BEARING HOUSING. Drift the bearing housing off of generator end casting, striking the end of the housing on opposite



1 to 7—SWITCH TERMINALS
8—GENERATOR SIGNAL LIGHT
12—BATTERY POSITIVE POST
13—BATTERY NEGATIVE POST
14—GENERATOR TERMINAL TO SWITCH
15—GENERATOR TERMINAL TO RELAY
18—FRONT JUNCTION TERMINAL (UNDER SADDLE)
26—IGNITION-LIGHT SWITCH
32—RELAY
35—TERMINAL FOR BLACKOUT LIGHT
36—MAGNETIC SWITCH FOR BLACKOUT LIGHT
★—NOISE SUPPRESSION CONDENSER

RA PD 310318

Figure 65—Generator to Battery Wiring Diagram

sides to free it from bearing. In some cases, the bearing may remain in the housing and in other cases it may remain tight on the armature shaft. Remove the paper gasket and steel thrust washer after housing is removed.

(10) REMOVE BEARING. If bearing does not slide off of armature shaft at the time the bearing housing is removed, it will be necessary to pry it off by means of the inner grease retainer. Insert screwdriver ends under the grease retainer and carefully pry retainer away from generator end casting. Pry at solid section of the generator end casting to prevent breakage.

(11) REMOVE FRAME END SCREWS. Remove generator from copper-faced vise jaws and remove the two end screws. If the paper gasket is still on end of generator, it must be removed to expose the end screws. Before turning the end screws all the way out, tap them lightly to drive aluminum frame end casting off of the generator frame.

(12) REMOVE ARMATURE. Remove the armature from the frame by tapping drive end of the shaft lightly with a soft hammer.

(13) REMOVE DRIVE END BEARING. Remove drive end bearing from end of generator frame and remove the spring ring and felt oil seal.

(14) REMOVE POLE SHOES AND FIELD COILS. Refer to paragraph 63 for instructions on testing the field coils in the generator frame. Pole shoes and field coils should be removed only for good reason, as difficulty will be experienced in reassembling so as to allow specified armature clearance. If tests show that either or both of the field coils must be replaced, proceed as follows:

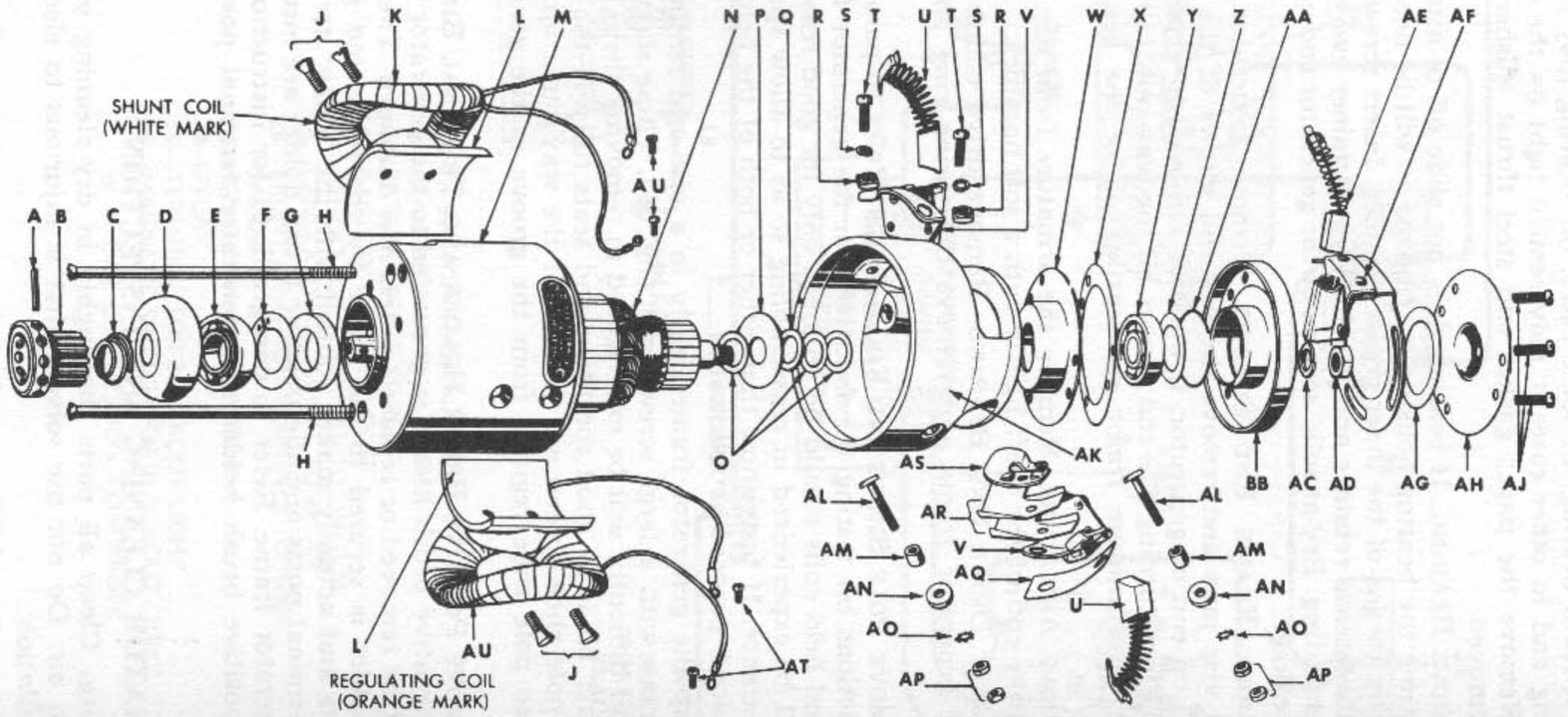
(a) Clamp the generator frame lightly in a vise and remove the pole shoe screws with a large screwdriver (fig. 68). These screws are very tight and difficulty will be experienced in removing them unless the screwdriver bit is in good condition and seats fully in the screw slot. Before pole shoe screws are turned all the way out, tap them lightly to free pole shoe register from the groove in the generator frame.

(15) REMOVE POSITIVE BRUSH HOLDER AND TERMINAL BINDING POSTS. The negative brush holder is grounded to the generator frame and need not be removed or replaced unless it is damaged. The positive brush holder is secured to the frame by the relay and switch terminal posts and actually makes contact with the "relay" terminal post. Both terminal posts and the positive brush holder are insulated from the generator frame. Refer to paragraph 63 for instructions on testing the positive brush holder and generator terminal posts for grounds.

63. GENERATOR CLEANING AND INSPECTION.

a. Cleaning. Clean all parts thoroughly in dry-cleaning solvent and dry with air. Do not use solvent that is injurious to electrical wiring or insulation.

b. Inspection. Inspection will consist of physical examination of



RA PD 310323

Figure 66—Generator, Disassembled

A—DRIVE GEAR PIN

B—DRIVE GEAR

C—SPRING

D—OIL DEFLECTOR

E—DRIVE END BEARING (LARGE)

F—SPRING RING

G—FELT OIL RETAINER

H—FRAME END SCREW (2)

J—POLE SHOE SCREW (4)

K—SHUNT FIELD COIL (WHITE MARK)

L—POLE SHOE (2)

M—GENERATOR FRAME

N—ARMATURE ASSEMBLY

O—ARMATURE SPACERS, 0.025 IN. THICK

P—ARMATURE BAKELITE WASHER

Q—ARMATURE SPACER, 0.072 IN. THICK

R—NUT (2)

S—WASHER (2)

T—NEGATIVE BRUSH HOLDER SCREW (2)

U—MAIN BRUSH ASSEMBLY (2)

V—MAIN BRUSH HOLDER (2)

W—INNER GREASE RETAINER

X—GASKET

Y—COMMUTATOR END BEARING

Z—SPACING SHIM, 0.020 IN. THICK

AA—SPRING RING (1-5/16 IN. DIA.)

AB—BEARING HOUSING

AC—WASHER

AD—ARMATURE END NUT

AE—REGULATING BRUSH ASSEMBLY

AF—REGULATING BRUSH HOLDER

AG—GASKET

AH—OUTER GREASE RETAINER

AJ—SCREWS

AK—FRAME END CASTING

AL—TERMINAL SCREW (2)

AM—INSULATING BUSHING (2)

AN—INSULATING WASHER (2)

AO—TOOTHED LOCK WASHER (2)

AP—TERMINAL SCREW NUT (4)

AQ—POSITIVE BRUSH HOLDER INSULATION

AR—SHUNT FIELD TERMINAL INSULATION (2)

AS—SHUNT FIELD TERMINAL

AT—FIELD TERMINAL SCREWS (4)

AU—REGULATING FIELD COIL (ORANGE MARK)

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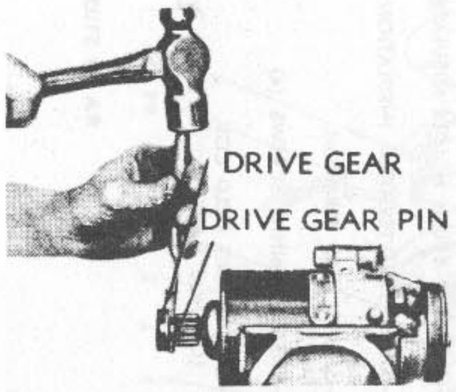
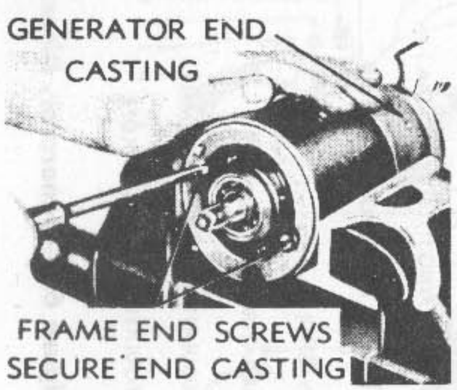
Legend for Figure 66—Generator, Disassembled



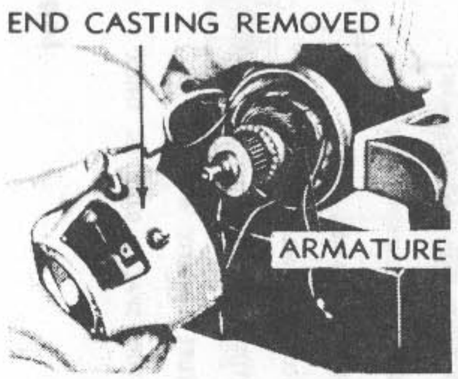
A—REMOVING DRIVE GEAR PIN WITH DRIFT.

B—REMOVE ARMATURE END NUT. BRUSHES REMOVED.



C—REMOVE THE TWO LONG FRAME END SCREWS.

D—REMOVE BEARING HOUSING WITH DRIFT OR PULLER.



E—REMOVE GENERATOR END CASTING.

F—FREE ARMATURE FROM FRAME BEARING FOR REMOVAL.

Figure 67—Disassembling Generator

all components and electrical tests to determine condition of the armature field coils, brush holders, and terminal binding posts.

(1) INSPECT AND TEST ARMATURE. Inspect for condition of wiring, commutator, shaft ends, and bearing seats. Observe whether or not core laminations have been striking pole shoes and are bent

Figure 68—Removing Generator Field Coils

or damaged. If commutator is brush worn until it will require removal of $^{3}/_{32}$ inch of metal to true it, replace the armature assembly. Before testing the armature on a growler, make sure that the commutator is free from carbon and copper dust deposits. Clean thoroughly between segments and at ends of commutator, blow off with compressed air and proceed to test as follows:

(a) Test Armature and Commutator for Ground (fig. 69). The commutator and the armature coil windings must be insulated from

the metal core and shaft. Turn the growler on and touch one test prod to the metal core and the other test prod to several of the commutator segments (bars). If a ground exists, the circuit will be completed and so indicated by the growler. If no ground exists (circuit is open), there will be no indication by the growler. Replace a grounded armature.

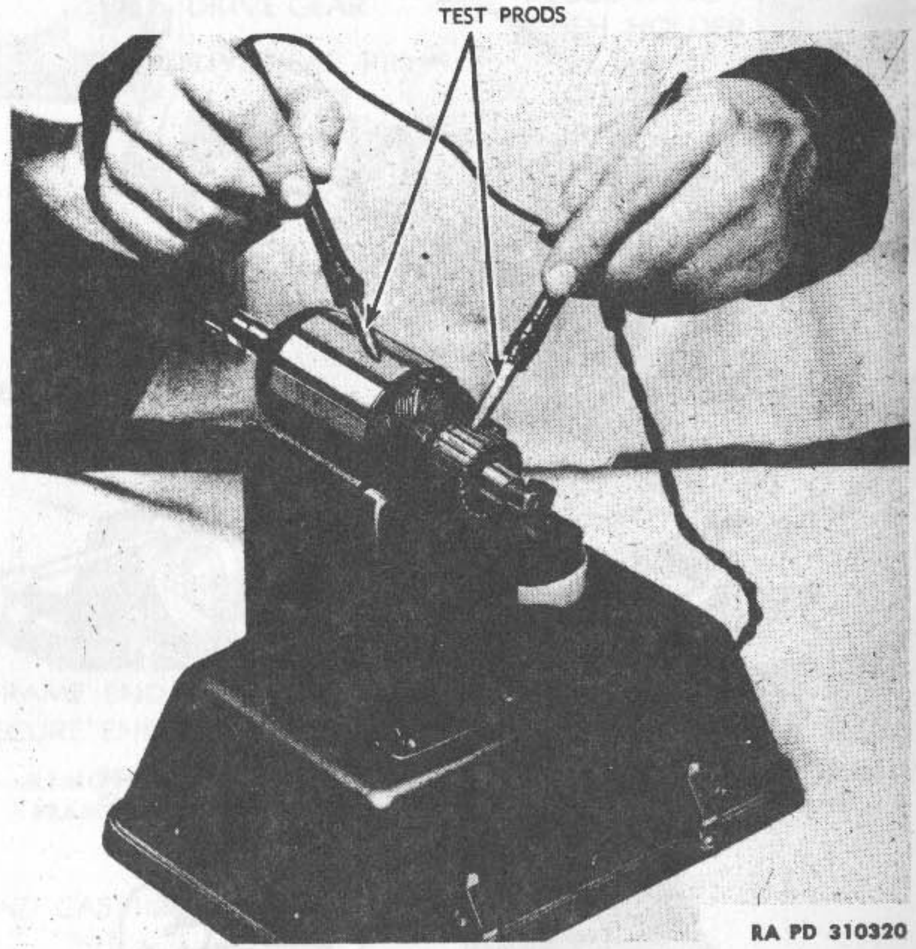


Figure 69—Testing for Grounded Coils and Commutator Using Growler (41-G-5940)

(b) Test Armature for Short (fig. 70). Place the armature in growler and hold a piece of hacksaw blade in loose contact with the armature core. Turn growler on. Rotate the armature slowly, one or more full turns. If the armature is shorted, the piece of hacksaw blade will be attracted to the armature core and will vibrate violently at one or more points around the armature. If short is found and cannot be eliminated, replace armature assembly.

(c) Test Armature for Open (fig. 71). Turn growler on. Insert tip of hacksaw blade between the segments that are closed in alinement with the point of contact of armature core and the growler V. Make

and break contact between the segments with the hacksaw blade. A strong flash should be seen as contact is broken. No flash or a very weak flash indicates an open circuit. Repeat this test between all segments. If an open circuit is indicated, inspect for loose or broken wires at commutator connections. If none are found that can be repaired, replace armature assembly and commutator assembly.

(2) TEST REGULATING FIELD COIL. Use a fully charged 6-volt storage battery, an accurate ammeter (3-ampere scale preferable)

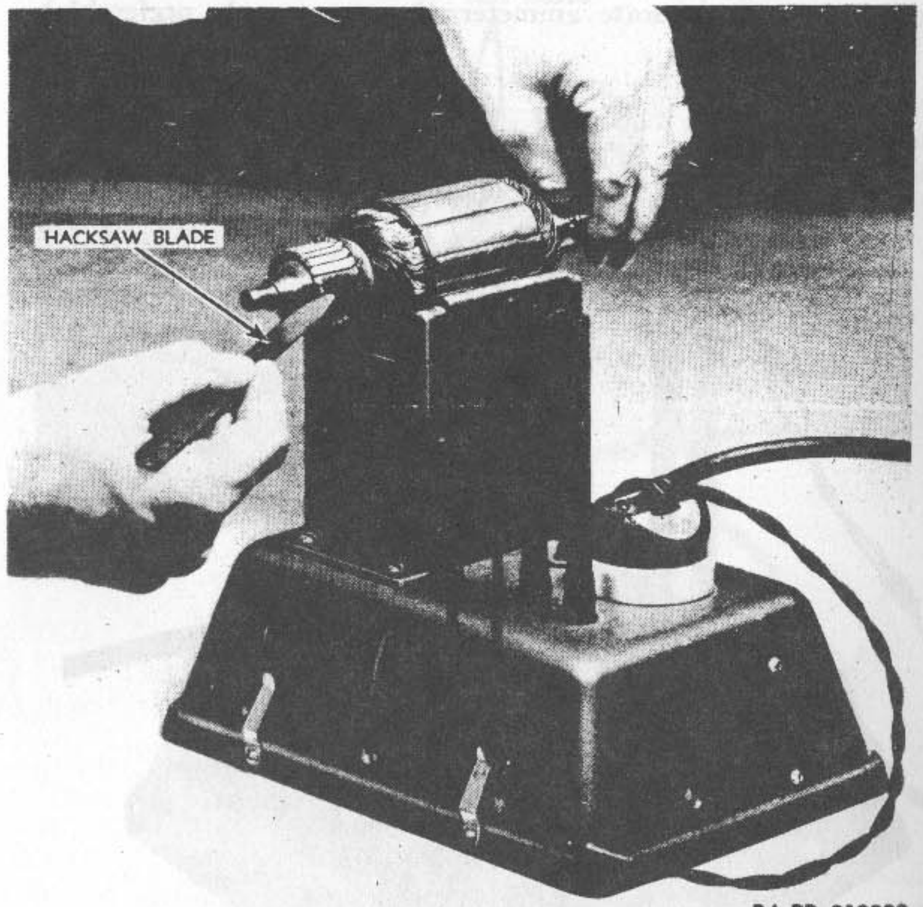
Figure 70—Testing for Shorted Armature Coils Using Growler (41-G-5940)

and a pair of test prods. This is a current draw test and results will depend upon condition of battery and accuracy of the ammeter. The regulating field coil is located in the upper side of the frame and is identified by an orange paint mark.

(a) Test for Open or Internal Short (fig. 72). With tester, battery and test prods correctly connected, touch the coil and terminals of the coil. Tester should register 1.4 to 1.9 amperes. If no tester reading

is recorded, field coil is open. If tester reading exceeds 2.2 amperes, the coil is shorted. Replace the coil.

(b) Test for Ground. Touch one of the coil end terminals with one test prod and touch the generator frame with the other test prod. Ammeter should register "NO READING." If a reading is observed, coil is grounded to the generator frame and must be replaced.

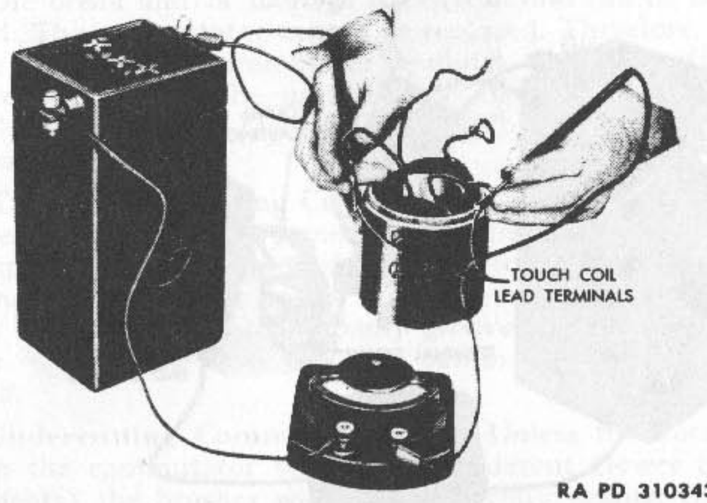


RA PD 310322

Figure 71—Testing for Open Coils in Armature Using Growler (41-G-5940)

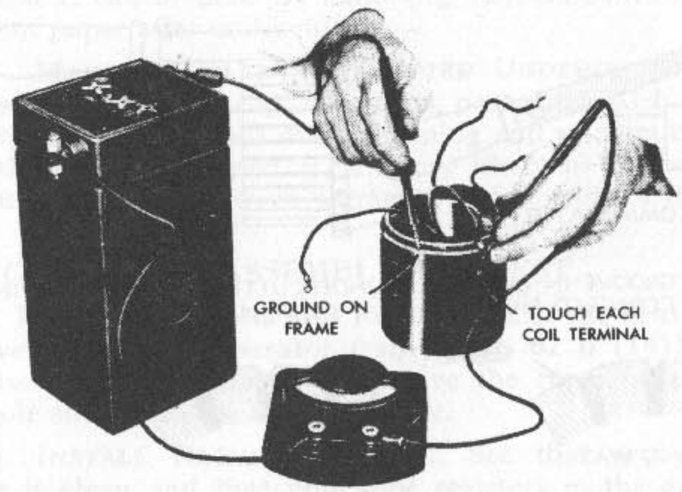
(c) Test Shunt Field Coil (figs. 72 and 73). Follow same procedure outlined in (2) *(a)* above. The shunt field coil is located in the lower side of the frame and is identified by a white paint mark. A higher resistance winding is used in the shunt coil and the normal current reading will be less. A normal coil will draw from 0.6 to 1.0 ampere. If tester reading exceeds 1.5 amperes, it is shorted within and must be replaced. Make ground test per instructions in *(b)* above.

(d) Test Positive Brush Holder and Terminal Posts for Ground (fig. 74). The positive brush holder and the two terminal posts are insulated from the generator frame. Touch frame with one test prod and the positive brush holder and terminal posts respectively with



RA PD 310343

Figure 72—Testing Field Coil for Open or Internal Short (Tester 41-T-5575)



RA PD 310342

Figure 73—Testing Field Coil for Ground to Generator Frame (Tester 41-T-5575)

the other test prod. Circuit should be open. If a ground is indicated, remove and reinsulate affected parts.

c. Inspect Bearings. Thoroughly clean bearings in dry-cleaning solvent and inspect for wear. If a bearing shows excessive wear (looseness), replace it. Bearing must be a snug fit (light press fit) on the armature shaft and the outer race should be a slip fit within its housing.

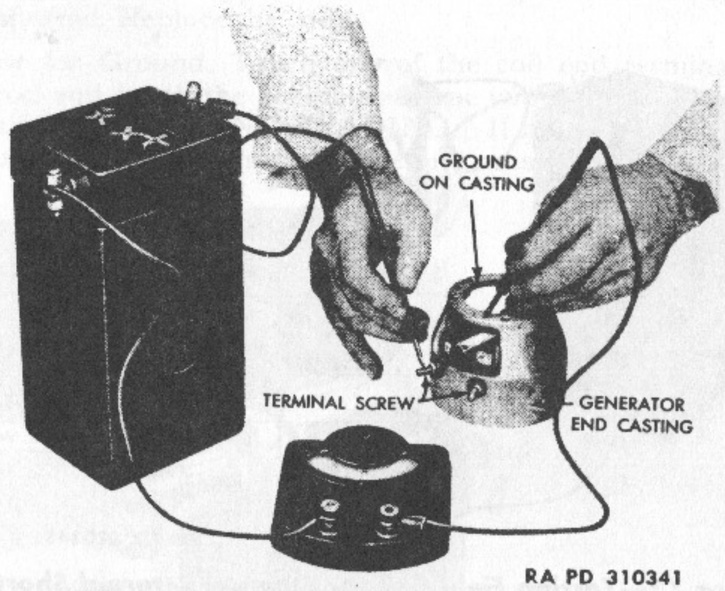


Figure 74—Testing Generator Terminal Posts for Ground to Frame End (Tester 41-T-5575)

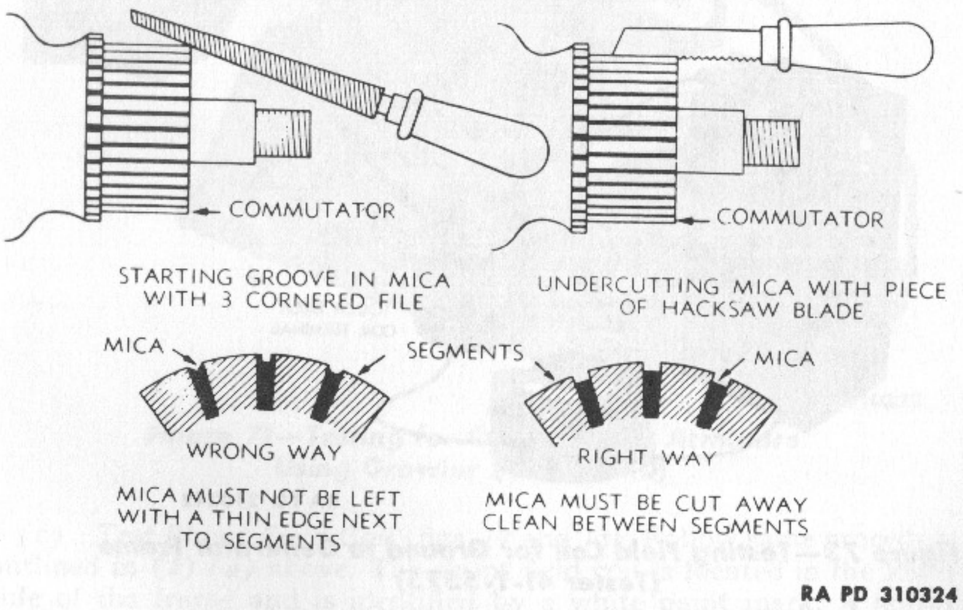


Figure 75—Method of Undercutting Commutator Mica

d. Inspect Brush and Spring Assemblies. The main positive and negative brushes are interchangeable. The regulating brush is thin in section. When brushes have become worn to such extent the longest side measures $\frac{3}{8}$ inch or less, they should be replaced. At the time a generator is completely overhauled, it is advisable to install a new set of brushes.

64. GENERATOR REPAIR.

a. No attempt should be made to repair the armature windings unless the break and/or damage is external and can be satisfactorily repaired. The commutator cannot be replaced. Therefore, any serious damage to either the commutator windings, core or shaft will necessitate replacement of the unit. Faulty and/or damaged field coils must also be replaced. Damage to other parts will be obvious and replacement made.

b. Turning and Truing Commutator. If the commutator is worn and irregular, it must be turned on a lathe and smoothed with 2/0 flint paper. When turning and truing a commutator, the armature shaft must be mounted on its bearings. Do not use shaft centers. NOTE: *If the commutator is badly grooved by brush wear (groove exceeds $\frac{3}{32}$ in.) the armature and commutator assembly must be replaced.*

c. Undercutting Commutator Mica. Unless the mica insulation between the commutator segments is undercut (lower than surface of segments) the brushes will not seat firmly against the segments, and the generator output will not be normal. Also, there will be excessive arcing at the brushes. After the commutator has been trued, the mica must be undercut to a depth of 0.025 inch. Mica undercutting is usually done on a machine. If such a machine is not available it can be done by hand (fig. 75). Smooth commutator with 2/0 flint paper after undercutting.

(1) MAKE GROWLER TEST AFTER UNDERCUTTING MICA. It is advisable to repeat the growler tests, paragraph 63 **b** (1), *(b)*, to see if a short has developed during turning and undercutting operations. If a short has developed, it can very likely be corrected by a more thorough cleaning between segments and at ends of the commutator.

65. GENERATOR ASSEMBLY AND TEST.

a. Install Field Coils and Pole Shoes. If the field coils have been removed from the generator frame (par. 62 **b** (14)), care must be exercised in their installation to give the correct clearance between the pole shoes and the armature core.

(1) INSTALL REGULATING COIL. See that groove in generator frame is clean and that pole shoe registers in the groove and seats against the frame. Assemble regulating coil (identified by orange paint mark) on pole shoe and locate in upper side of the generator frame with coil leads facing open end of frame. Hold the frame lightly in a vise and tighten the pole shoe screws. Use a large screwdriver with bit ground to fit screw slot perfectly. Unless pole shoe screws are very tight, and the poles seated firmly against the frame, the armature core will not have the required 0.007-inch clearance between each pole.

(2) INSTALL SHUNT COIL. The shunt field coil is identified by a white paint mark and must be assembled in the lower side of the generator frame. See that coil and pole shoe are tight against the

frame to provide armature core clearance of 0.007 inch. Coil leads must face the open end of the frame.

b. Install Brush Holders. If the main brush holders have been removed from the frame end casting, reinstall them as follows:

(1) NEGATIVE BRUSH HOLDER (fig. 76). The positive and negative brush holders are interchangeable. The installation difference being that the positive brush holder is insulated from the generator frame end, and the negative brush holder is in contact (grounded) with the frame end.

(2) RELAY TERMINAL POST, SWITCH TERMINAL POST, POSITIVE BRUSH HOLDER AND SHUNT FIELD COIL TERMINAL PLATE INSTALLATION (fig. 76). Both the relay and switch generator terminal posts

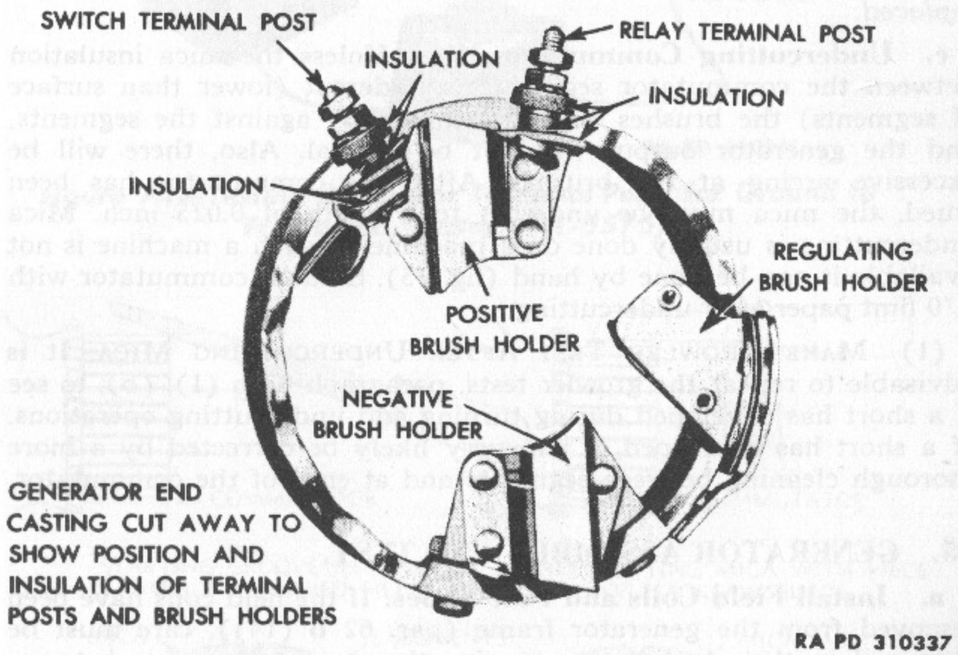


Figure 76—Generator End Section Showing Terminal Post and Brush Holder Installation

are utilized to mount the positive brush holder to the generator frame end. Exercise care when assembling these parts to ensure correct connections, location, and insulation.

(a) Relay Terminal Post. The relay terminal post makes contact with the positive brush holder and is insulated from the generator frame end by a fiber bushing and washer.

(b) Positive Brush Holder. The positive brush holder is insulated from the generator frame end by a thick fiber paper insulator.

(c) Shunt Field Coil Terminal Plate. The shunt coil terminal plate is insulated from the positive brush holder by two thin fiber paper insulators.

(d) Switch Terminal Post. The switch terminal post makes contact with the shunt coil terminal plate and is insulated from the positive brush holder and the generator frame end by a fiber bushing and washer.

e. Install Armature. Before installing armature, pack the bearings with general purpose grease.

(1) INSTALL OIL RETAINING WASHER AND BEARING. Install the felt oil retaining washer in drive end of frame and retain with spring ring registered in frame bearing housing groove. Install bearing in housing.

(2) INSPECT ARMATURE AND POLE SHOE CLEARANCE. This inspection is not necessary unless one or both pole shoes and field coils have been removed and reinstalled. Select a piece of paper 0.007 inch thick (or a double sheet totaling this thickness) by $2\frac{3}{16}$ inches wide and $6\frac{1}{2}$ inches long. Wrap paper around armature core and insert armature in the frame. If armature and pole shoe clearance is up to the 0.007 inch required clearance, the armature can be inserted and will turn freely. If armature does not have required 0.007 inch clearance between each pole shoe, pole shoe screws must be tightened.

(3) INSTALL GENERATOR FRAME END. The generator frame end fits over the register in the frame and is located in correct position by a dowel pin. Secure frame end with the two long screws, entering from the drive end of the frame. Tighten screws securely. Bring out field coil leads in correct position for terminal connections, *(f)* of this paragraph.

(4) INSTALL WASHERS ON ARMATURE SHAFT. Install one 0.025 inch thick spacer washer on shaft, then the bakelite washer, followed by two more 0.025 inch thick spacer washers. Four of the 0.025 inch thick spacer washers may be found on some generators.

(5) INSTALL INNER GREASE RETAINER. Locate the inner grease retainer on the generator frame end.

(6) INSTALL BEARING ON SHAFT. Press the bearing onto the armature shaft. Locate paper gasket on the inner grease retainer. Engage the split ring in the bearing housing groove and locate the 0.020 inch spacing shim next to the split ring. Install the bearing housing, with spacer and split ring, on the bearing, pressing it tight against the frame end. Install lock washer and nut on end of armature shaft and tighten nut.

d. Install Regulating Brush Holder. Install the regulating brush holder, the paper gasket, and the outer grease retainer plate and secure with three screws. After the three screws are tightened, the armature must revolve freely in its bearings.

e. Install Drive Gear on Shaft and Check Location of Armature in Frame. After the drive gear has been installed on the shaft, the armature can be checked for correct location in the frame to ensure correct position and alinement of the drive gear and oil slinger within the gear case.

(1) INSTALL OIL DEFLECTOR, SPRING AND DRIVE GEAR. Install the oil deflector with cupped side over the bearing boss in end of

generator frame and install the coil spring with large end next to the deflector. Engage drive gear on splined end of shaft and partially engage new retaining pin. NOTE: *Do not rivet pin until (2) below has been performed.* Rivet pin at both ends.

(2) CHECK DISTANCE OF OIL SLINGER TO FRAME END. After drive gear and oil slinger have been installed, measure the distance from the outer face of the oil slinger to the end of the generator frame (gasket removed). Distance should be between $1\frac{53}{64}$ inches, and $1\frac{27}{32}$ inches, and can be adjusted as necessary by removing or adding a 0.025-inch thick spacer washer on commutator end of armature.

f. Install Brushes and Connect Field Coil Wire Terminals. All

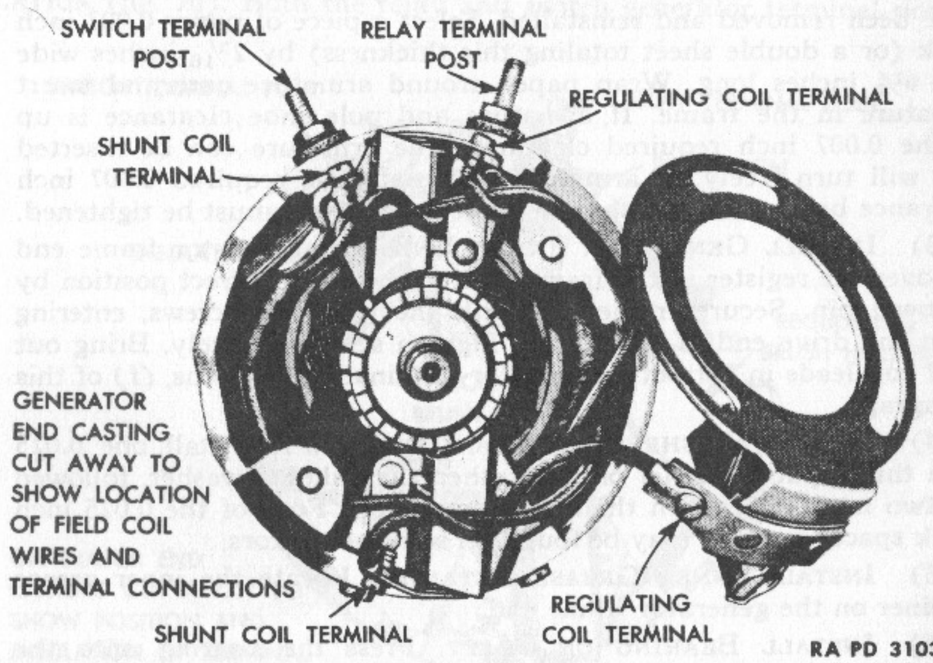


Figure 77—Generator Section Showing Arrangement and Connection for Field Coil Leads

brushes must be installed so that the concave ends seat firmly against the commutator and conform to the curvature of the commutator. The main (positive and negative) brushes and springs are retained by clips which are held in place by the field coil terminal screws. The regulating (narrow) brush and spring is retained by the clip soldered to the end of the brush pig tail. Clip fits into notches in the brush holder.

(1) SEATING BRUSHES. If brush faces do not seat fully on the commutator, they should be dressed and faced with 2/0 flint paper until they fit commutator curvature perfectly.

(2) CONNECT FIELD COIL TERMINALS (fig. 77). Arrangement of the field coil leads must be just right so they will clear the armature.

(a) Shunt Field Coil Leads. The upper lead to the shunt field

coil is brought out and connected directly to the negative (main) brush holder terminal screw. The lower head of the shunt field coil is brought out and over the top of the aluminum frame end, directly to the switch terminal plate.

(b) Regulating Field Coil Leads. The lower lead of the regulating field coil is brought out to pass between the generator frame and the lower frame end screw and is then wound around the negative brush wire two times to take up slack, and then connected to the regulating brush holder terminal. The upper lead of the regulating field coil is brought out and is wound around the switch terminal wire two turns and then connected to the positive brush holder terminal screw.

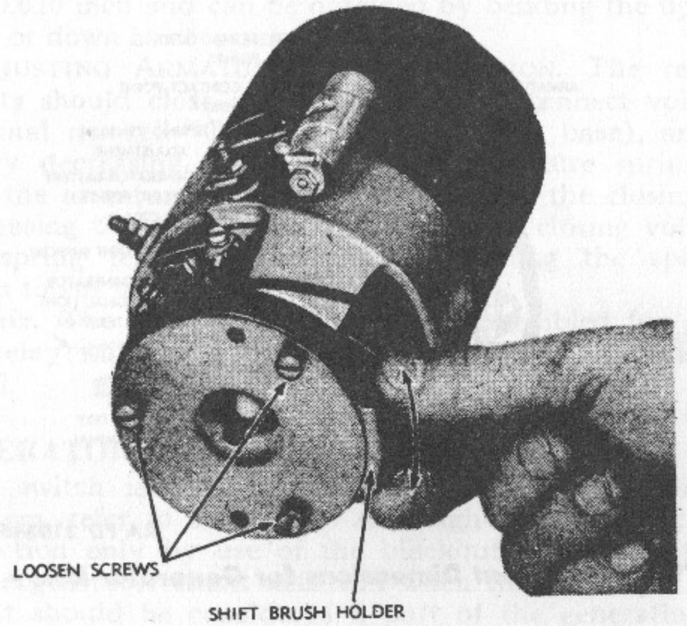


Figure 78—Shifting Regulating Brush to Adjust Current Output of Generator

g. Test and Regulate Generator. Mount the generator on a conventional test stand so as to drive generator counterclockwise (looking at generator drive gear end). Connect positive lead from ammeter to the relay terminal. The other ammeter lead must be connected to a 6-volt storage battery positive post and the battery negative post grounded to the test stand (generator frame). This connects the generator to use the regulating field coil only, the same as operating the vehicle with the lights off. If the test stand has variable speed drive, operate the generator through full range of speeds from lowest to the highest. Run generator until it becomes quite warm.

(1) REGULATE AT 2,500 REVOLUTIONS PER MINUTE. With generator quite hot, shift the regulating brusn to obtain a four ampere reading (operating on regulating coil only, fig. 78). Connect a jumper

between the switch terminal post and frame (ground). This cuts the shunt field coil into the circuit and increases the current output. At 2,500 revolutions per minute the current output should be between 7 and 7½ amperes.

(a) To Increase Current Output. Shift the regulating brush holder toward the negative brush. Minimum distance between the regulating brush and negative brush to be not less than ⅛-inch. Tighten the three outer grease retainer plate screws after making regulating brush adjustment.

(b) To Decrease Current Output. Shift the regulating brush holder away from the negative brush. Tighten the three regulating brush clamp screws.

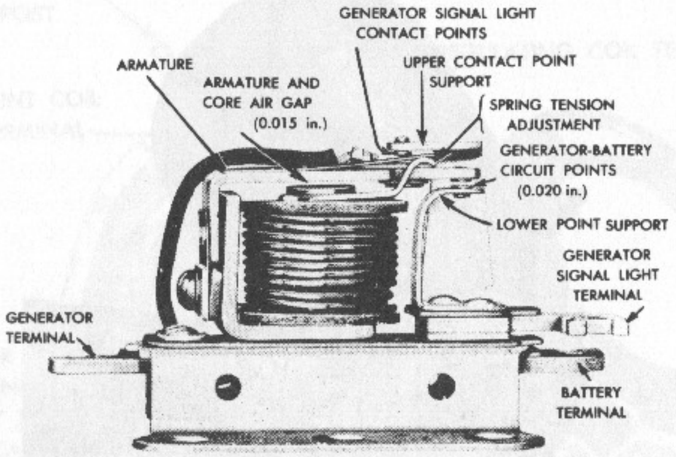


Figure 79—Adjustment Dimensions for Generator Relay Cut-out

(2) INSPECT FOR EXCESSIVE ARCING. After the generator has been run at least 30 minutes, inspect for excessive arcing at the brushes. If necessary, re-dress the brushes with 2/0 flint paper to eliminate arcing as much as possible.

(3) TIGHTEN REGULATING BRUSH HOLDER PLATE. After the desired current output has been obtained, securely tighten the three screws which mount the outer grease retainer and clamp the regulating brush plate.

66. RELAY ADJUSTMENT AND REPAIR.

a. Description. The relay is provided with an additional contact for the normally open position to control the signal light in the instrument panel. When the generator voltage exceeds the battery voltage (between 6.3 and 6.8 volts) the relay closes the battery-generator circuit. At this time, the upper contact points break and the panel green indicator light goes off, indicating that the generator is charging the battery. This occurs at approximately 20 miles per hour in high gear.

b. Adjustment (fig. 79). The relay contact points must be correctly adjusted and the armature must have correct spacing above the magnet core for sensitive and correct cut-in and cut-out operation.

(1) ARMATURE AND CORE AIR GAP. The space (air gap) between the armature and magnet core end is 0.015 inch when the two upper points are in contact. Bend upper contact point support and adjust armature to obtain this gap.

(2) MAIN CONTACT POINT GAP. After the armature and magnet core end air gap have been adjusted, gage the main contact point gap. It should be 0.020 inch and can be obtained by bending the lower point support up or down as may be necessary.

(3) SIGNAL POINT GAP. Press the armature down until the lower main points are in contact and gage the upper contact point gap. It should be 0.020 inch and can be obtained by bending the upper point support up or down as necessary.

(4) ADJUSTING ARMATURE SPRING TENSION. The relay main lower points should close at 6.3 to 6.8 volts (connect voltmeter to relay terminal marked "GEN" and to the relay base), and can be adjusted by decreasing or increasing the armature spring tension. Increasing the armature spring tension increases the closing voltage, while decreasing the spring tension reduces the closing voltage. The armature spring tension is altered by bending the spring stop, mounted on top of the magnet, up or down.

c. Repair. The relay should not be disassembled for attempted repair. A relay worn or damaged beyond adjustment service, must be replaced.

67. GENERATOR FIELD MAGNETIC SWITCH.

a. This switch is fitted to late WLA models. For diagram of earlier system, refer to TM 9-879. Although this magentic switch is put into action only by use of the blackout headlight, it actually controls the generator shunt field coil when this headlight is in use; therefore, it should be considered a part of the generating system. Refer to wiring diagram, figure 65. The generator field magnetic switch is a sealed unit, and if found faulty and/or damaged it must be replaced.

68. FITS AND TOLERANCES.

a. Table of Fits and Tolerances.

(1) ARMATURE CLEARANCE BETWEEN POLE SHOES. 0.007 inch clearance between armature core and each pole shoe.

(2) BRUSH LENGTH. New brushes are approximately 13/16 inch long on the longest side. Replace when longest side is ⅜ inch or less in length.

(3) ARMATURE SHAFT BEARING DIAMETER, COMMUTATOR END. Shaft diameter for the small ball bearing is 0.472 inch.

(4) ARMATURE SHAFT BEARING DIAMETER, DRIVE GEAR END. Shaft diameter for the large ball bearing is 0.5912 inch.

(5) BEARING FITS. Ball bearing inner and outer races are a light press fit on the armature shaft and in the housings respectively.

CHAPTER 7

HORN AND LIGHTING SYSTEM

Section I

SWITCHES AND INSTRUMENT PANEL

69. DESCRIPTION.

a. The lighting system may be divided into two circuits; the service light system and the blackout light system (fig. 80). Both are master controlled by the ignition-light switch and the blackout headlight is provided with an auxiliary switch. The panel switch has a lock-out feature, preventing use of the service lights until a button has been pressed to release the switch knob for the third, or service light position. The lighting system is related to the generating system in that either the ignition-light switch or a magnetic switch (for blackout headlight) cuts in the shunt field coil to increase the generator current output with lights on. The service headlight beam is controlled by a toggle switch located on the left handlebar.

70. IGNITION-LIGHT SWITCH.

a. The ignition system, service and blackout lighting systems, horn circuit, panel lights and generator shunt field coil (cuts in with service lights) are all controlled by the ignition-light switch.

(1) SWITCHES ON EARLIER MODELS. The ignition-light switch used on earlier models was provided with lock and key. Principle of operation and electrical connection is the same for both nonlocking and locking types.

b. Switch Positions.

(1) KNOB STRAIGHT AHEAD IN OFF POSITION.

(2) FIRST POSITION TO RIGHT. Ignition, horn, oil pressure signal light, generator signal light.

(3) SECOND POSITION TO RIGHT. Ignition, horn, oil pressure signal light, generator signal light, blackout headlight, blackout taillight, blackout stop light, blackout driving light.

(4) PRESS LOCKOUT BUTTON FOR THIRD POSITION TO RIGHT. Ignition, horn, oil signal light, generator signal light, service headlight, service taillight, service stop light, shunt field coil, speedometer light.

c. Disassemble Switch (fig. 82). All switch positions mentioned below apply with switch "upside-down" and in off position.

(1) Remove cotter pin, plain washer, coil spring, and movable contact plate from end of center pin.

(2) Grasp end of contact bar with pliers and pull and shift sideways to release contact bar from retaining notch in the center pin (fig. 82).

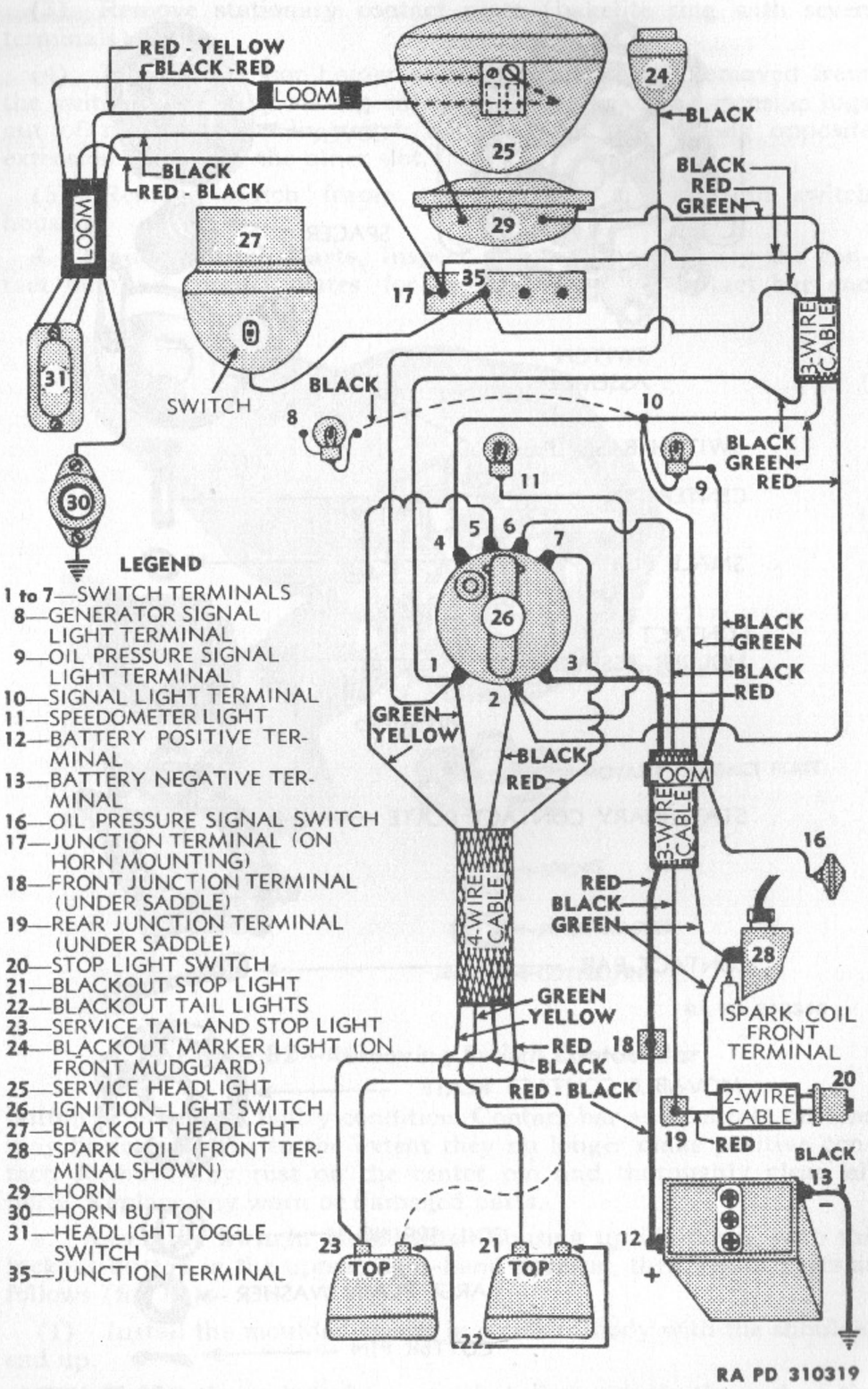


Figure 80—Lighting System Wiring Diagram

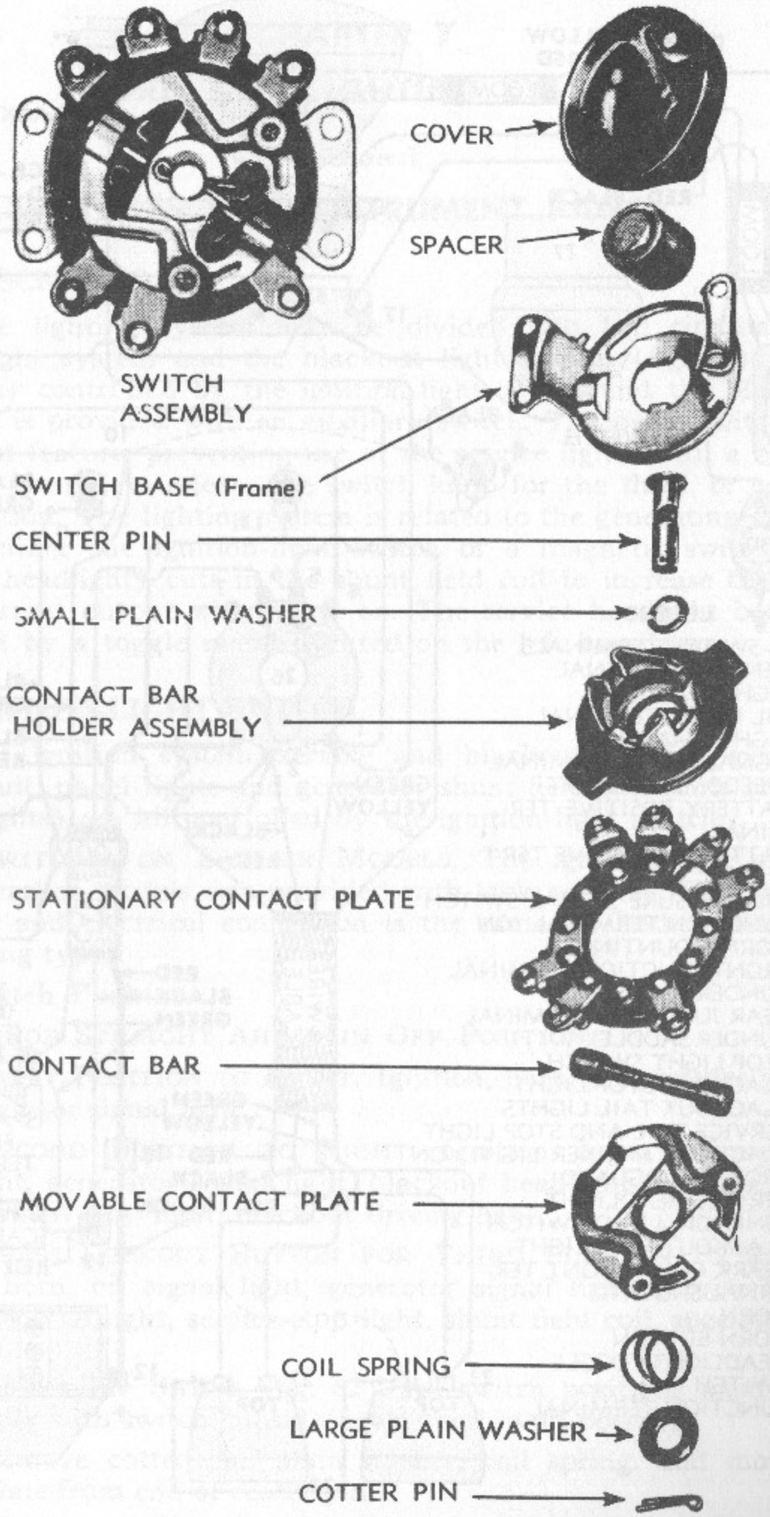


Figure 81—Ignition-light Switch, Disassembled

(3) Remove stationary contact plate (bakelite ring with seven terminals).

(4) The contact bar holder assembly can now be removed from the switch housing by sliding either one of its bakelite extension lugs out of retaining slot in switch housing and then sliding opposite extension lug out of the other slot.

(5) Remove switch frame and moulded spacer from switch housing.

d. Inspect Switch Parts. Inspect all parts, particularly the contact bar and contact plates for excessive wear of contact bar and

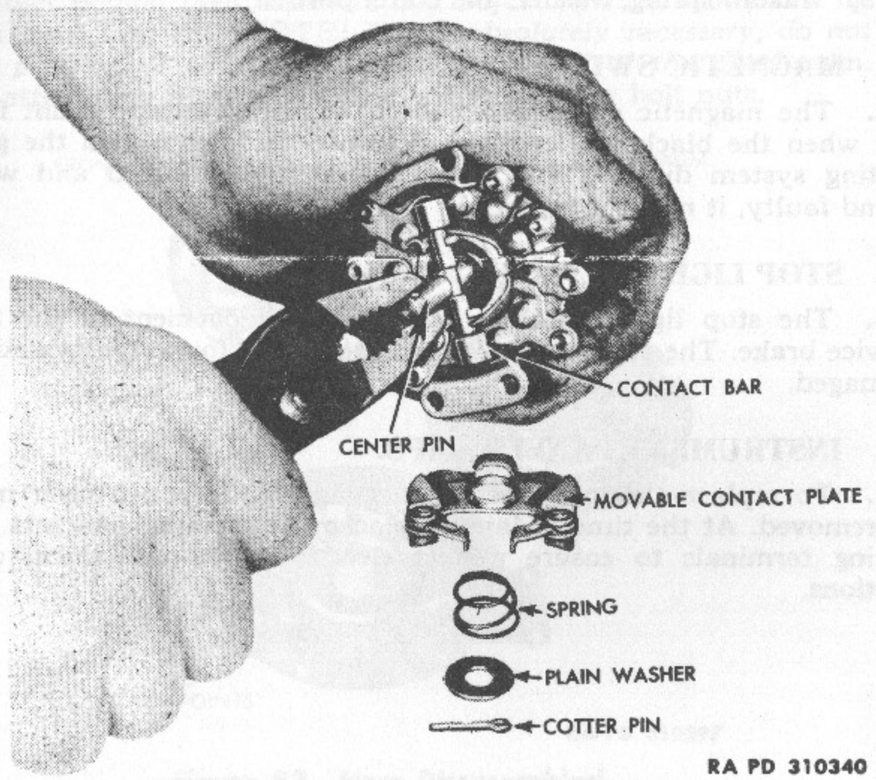


Figure 82—Removing Switch Contact Bar

button or otherwise faulty condition. Contact bar and contact buttons may be found worn to the extent they no longer make positive contact. Remove any rust on the center pin and thoroughly clean all parts. Replace any worn or damaged parts.

e. Assemble Switch. Hold switch housing upside-down, with the lockout button in the upper, right-hand position, then install parts as follows (fig. 81):

(1) Install the moulded spacer in recess of body with the shoulder end up.

(2) Install the switch frame so that slot engages the end of the lockout button.

(3) Install the small plain washer on the center pin and pass the pin up through the spring in the contact bar holder assembly.

(4) Engage the extension lugs of bar holder bakelite plate in the slots of the switch housing.

(5) Install the stationary contact plate in the switch frame with the four terminal lugs away from you.

(6) Locate the contact bar in holder slots and pull center pin with pliers to engage contact bar in center pin retaining notch.

(7) Install movable contact plate so that the two buttons are the right-hand side of switch.

(8) Install spring, washer, and cotter pin.

71. MAGNETIC SWITCH.

a. The magnetic switch used to cut-in the generator shunt field coil when the blackout headlight is turned on is shown in the generating system diagram (fig. 80). This switch is sealed and when found faulty, it must be replaced.

72. STOP LIGHT SWITCH.

a. The stop light switch is operated by movement of the foot service brake. The switch must be replaced when found faulty and/or damaged.

73. INSTRUMENT PANEL LAMPS.

a. To replace the instrument panel lamps, the panel cover must be removed. At the time of lamp replacement, examine contacts and wiring terminals to ensure perfect electrical and mechanical connections.

CHAPTER 7

HORN AND LIGHTING SYSTEM (Cont'd)

Section II

HORN AND LIGHTS

74. HORN.

a. Other than the replacement of cover, cover bolts, terminal screws, and adjusting screw, repair cannot be made to horn because of construction. If horn does not operate, remove the cover and clean the contact points; then assemble and adjust by means of screw on back of horn (fig. 83). NOTE: *Unless absolutely necessary, do not change position of the screw located in center of the diaphragm.* Before attempting horn adjustment, tighten all six bolt nuts.

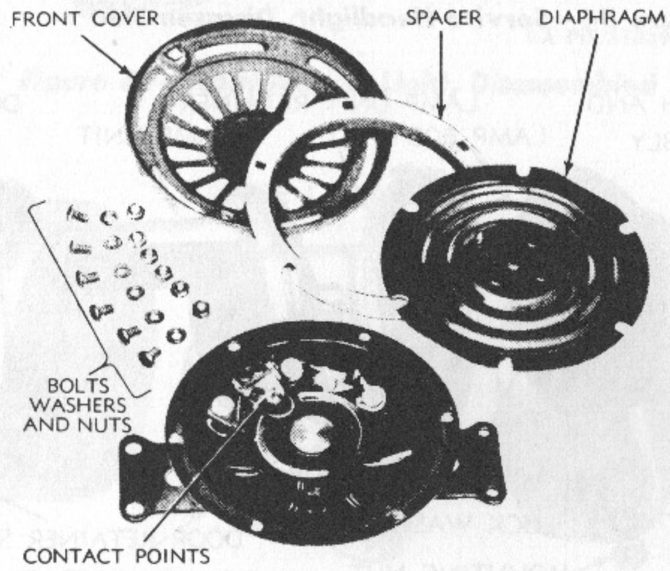


Figure 83—Horn Disassembled

75. SERVICE HEADLIGHT.

a. If the service headlight body and/or mounting stud are damaged, replace with a new body. Other components of the headlight assembly are easily replaced (fig. 84). Use prefocused lamp (32-21 CP, 6 V double contact).

76. BLACKOUT HEADLIGHT.

a. The blackout headlight uses a sealed lamp-unit. Lamp housing is provided with a toggle switch to control blackout headlight separately when ignition-light switch is in blackout (second) position. Any parts badly damaged must be replaced. For correct order of assembly, refer to figure 85.

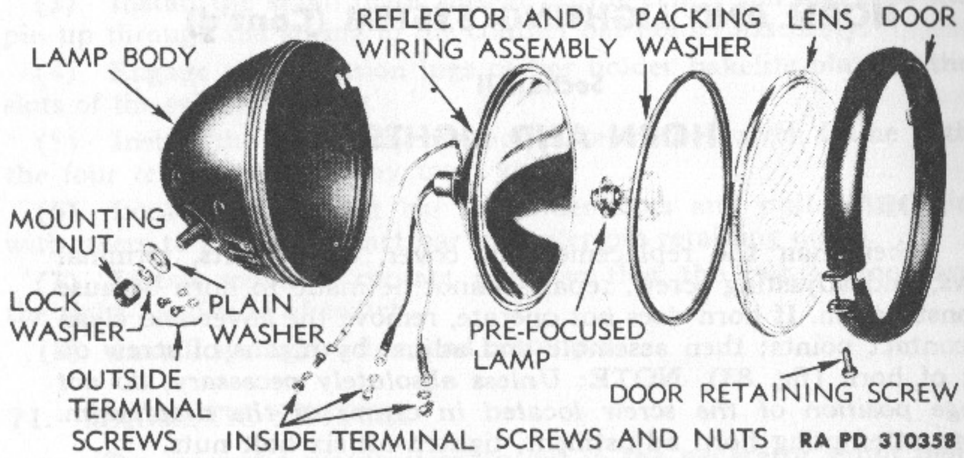


Figure 84—Service Headlight, Disassembled

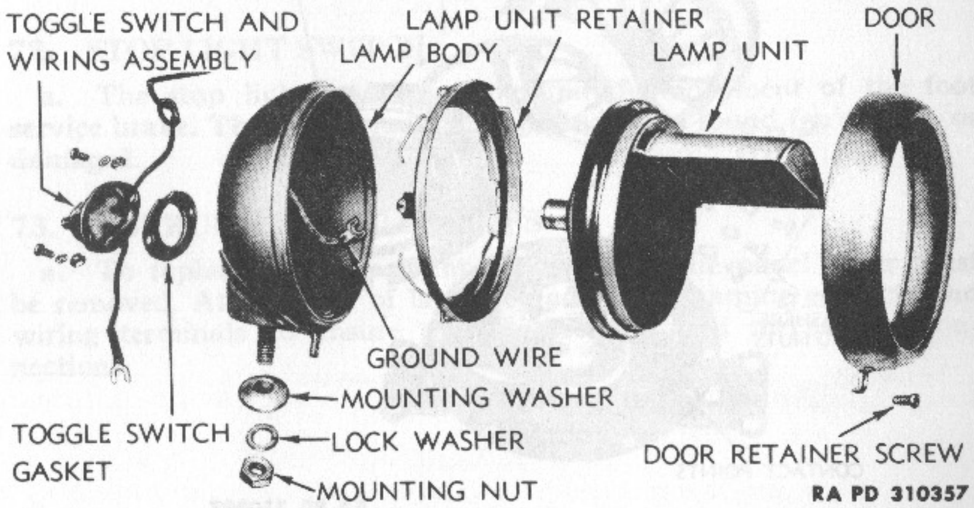


Figure 85—Blackout Headlight, Disassembled

77. FRONT MARKER LIGHT.

a. The front marker light mounts on the front mudguard. Use a single contact lamp (3 cp, 6-8 V, single contact). Replace light body and parts found in damaged condition. For correct order of assembly see figure 86.

78. TAILLIGHTS AND STOP LIGHTS.

a. **Service Taillight** (fig. 87). The service taillight is mounted on the left side of the mounting bracket. The upper socket in light housing is for service taillight and stop light. The service stop light does not operate in daytime when ignition only is on. Lamp is in a unit.

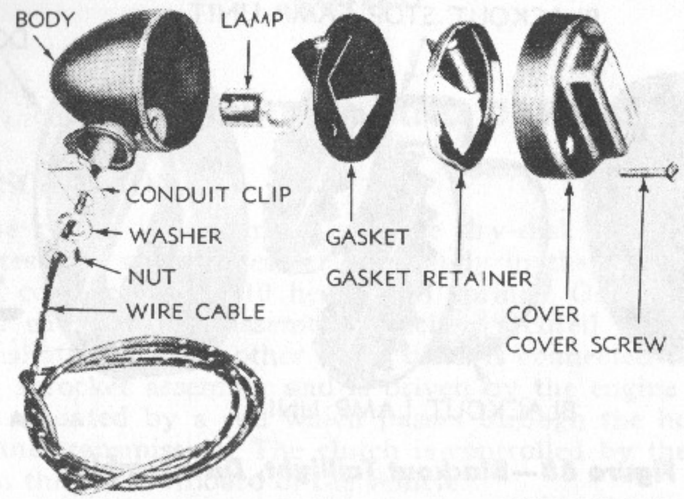


Figure 86—Front Marker Light, Disassembled

Figure 87—Service Taillight, Disassembled

(1) SPARE BLACKOUT LIGHT. The lower socket in the *left* taillight is the spare blackout taillight. Simply switch lower plug from right side taillight to this socket.

b. **Blackout Stop Light.** The top socket in the *right* taillight is used for the blackout stop light. Lamp is in a unit.

(1) BLACKOUT TAILLIGHT (fig. 88). The lower socket in the right taillight serves as the regular blackout taillight. The lamp is in a unit, and is interchangeable with the lamp unit in the lower half of the left taillight.

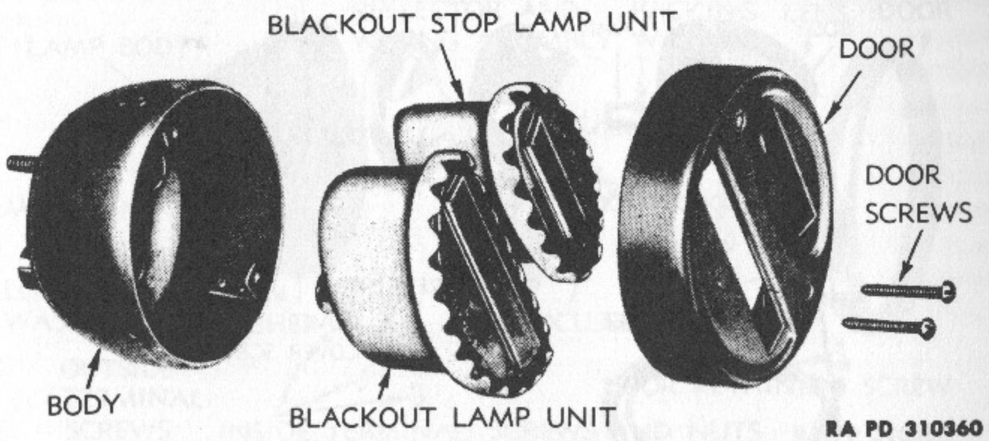


Figure 88—Blackout Taillight, Disassembled

CHAPTER 8
CLUTCH

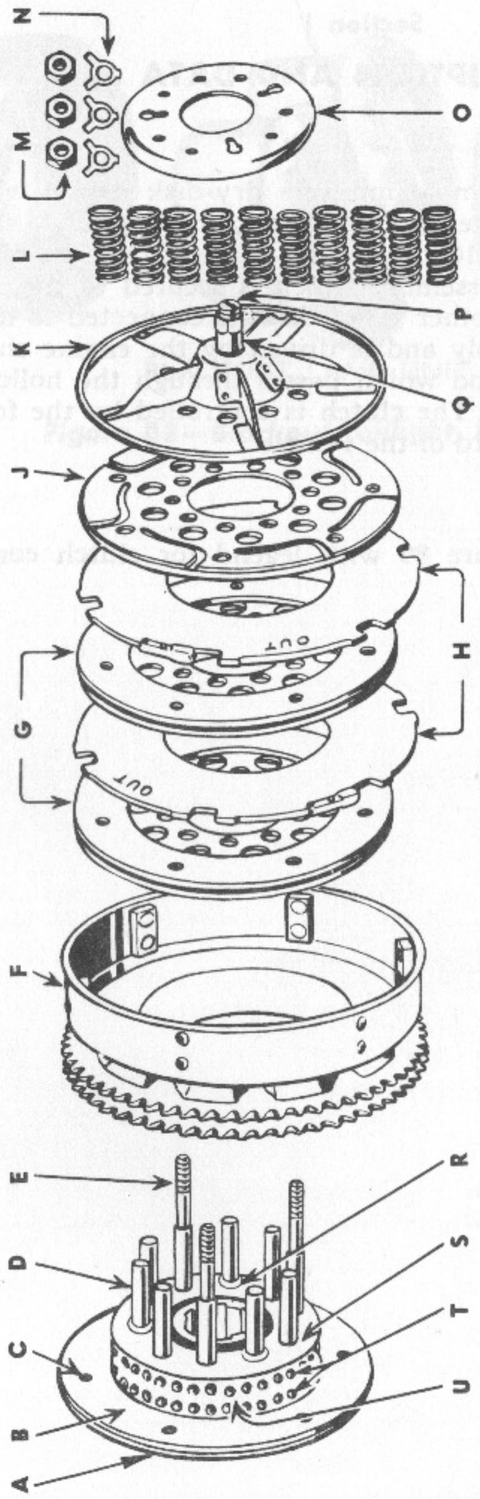
Section I
DESCRIPTION AND DATA

79. DESCRIPTION.

a. The clutch is of simple multiple dry-disk design with fiber-lined plates and steel plates set alternately in the clutch shell. The disks are compressed by 10 heavy coil springs. One set of disks is connected with the hub assembly which is secured to the transmission mainshaft gear. The other set of disks is connected to the clutch shell and sprocket assembly and is driven by the engine chain. The clutch is actuated by a rod which passes through the hollow mainshaft in the transmission. The clutch is controlled by the foot pedal located on the left footboard of the vehicle.

80. DATA.

a. Data. Refer to figure 89 with legend for clutch components and data.



A—CLUTCH HUB COMPLETE, WITH LINER, BEARING, STUDS, ETC.
B—HUB DISK LINING.
C—LINING RIVET (6 USED).
D—PIN (7 USED).
E—STUD.
F—SPROCKET COMPLETE WITH DISK SPLINE RING.
G—LINED DISKS (2 USED).
H—PLAIN STEEL DISKS (2 USED).
J—SPRUNG STEEL DISK WITH ONE LINING.
K—RELEASING DISK (WITH PUSH ROD ADJUSTING SCREW AND ADJUSTING SCREW).
L—CLUTCH SPRINGS (10 USED).
M—STUD NUT LOCKING WASHER (3 USED).
N—STUD NUT (3 USED).
O—SPRING COMPRESSION COLLAR.
P—PUSH ROD ADJUSTING SCREW.
Q—ADJUSTING SCREW LOCK NUT.
R—RETAINING PLATE LOCK RING (3 USED).
S—BEARING RETAINING PLATE.
T—60 7/32-INCH STEEL BALLS.
U—BALL BEARING RETAINER.

Figure 89—Clutch Disassembled

CHAPTER 8

CLUTCH (Cont'd)

Section II

REMOVAL, DISASSEMBLY, CLEANING, INSPECTION, AND REPAIR

81. REMOVAL AND DISASSEMBLY.

a. Removal of Clutch from Late Vehicle. Refer to TM 9-879, then remove clutch hub from transmission gear as follows:

(1) REMOVE CLUTCH HUB NUT (fig.. 90). Remove nut (right-hand thread) with special wrench (41-W-866-10).

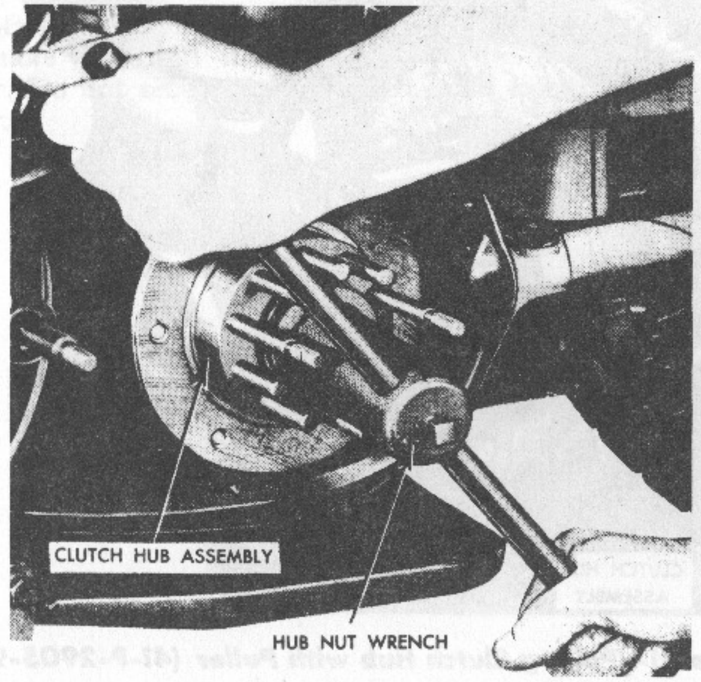


Figure 90—Removing Clutch Hub Nut with Wrench (41-W-866-10)

(2) REMOVE CLUTCH HUB FROM TRANSMISSION GEAR (fig. 91). Use puller (41-P-2905-90) and pull clutch hub from splined transmission gear.

b. Removal of Clutch from Early Models. On 1940 and earlier WLA models, the clutch hub is a taper fit on the transmission gear. Use a hammer and a soft punch to remove the hub, striking close to the center but being careful not to strike the bearing.

82. CLEANING AND INSPECTION.

a. Cleaning. Clean all parts thoroughly in dry-cleaning solvent.

b. Inspection. Inspect all parts for good condition. Any questionable parts must be replaced because the clutch is the most important control in the power line.

(1) CLUTCH SHELL AND SPROCKET ASSEMBLY. The clutch shell (splined ring) and sprocket are of integral construction and wear and damage to either makes replacement of this unit necessary.

(2) CLUTCH HUB ASSEMBLY. Inspect studs and pins for good condition and ball race for wear. If fiber liner is worn or glazed, replace it. This is the same liner as used on the lined clutch disks.

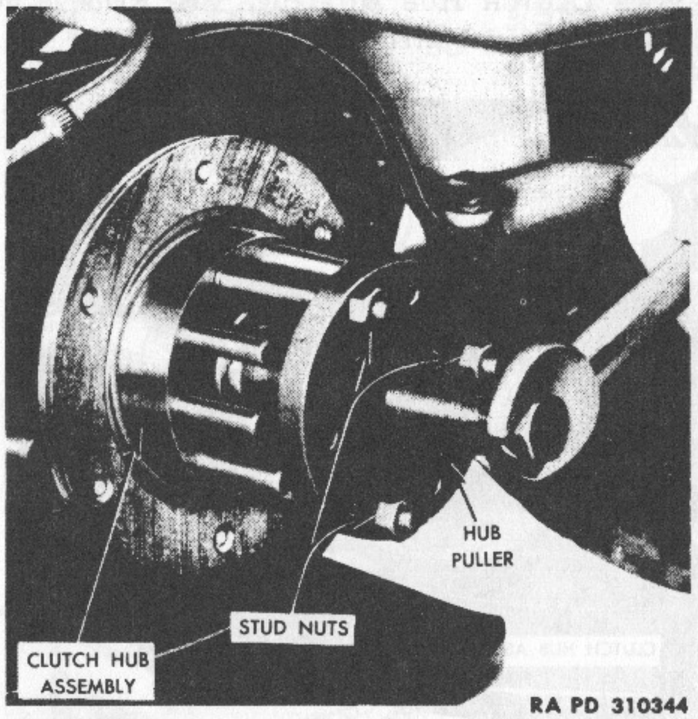


Figure 91—Pulling Clutch Hub with Puller (41-P-2905-90)

(3) LINED DISKS. Disk liners must be in good condition, not excessively worn, glazed or loose on the steel disk. New liners can be installed, or the disk assemblies can be replaced. Make sure that the antirattle (ball and spring) devices are in working order to prevent disk rattle in the spline ways. Note that one disk is lined only on one side and that the disk is sprung, to provide smooth clutch action. The same liner is used in all lined positions in the clutch.

(4) STEEL DISKS. If the steel disks are worn, cut or burned, replace them.

(5) INSPECT BALL RACES. Inspect the inner and outer ball races, balls and ball retainer for good condition. Replace worn parts.

(6) OUTER RELEASING DISK. This is a built-up assembly forming the compression and releasing disk. The ten springs compress it against the disks to engage the clutch and the push rod is actuated by the clutch control to "push" it away from the disks (against compression of springs) to release the clutch. The clutch push rod adjustment screw and lock nut are engaged with the releasing disk. Worn or damaged releasing disk must be replaced.

(7) CLUTCH SPRINGS. Free length of new clutch spring is approximately 1½ inches. (They may vary plus or minus 1/32 inch.) Old springs found to be shrunk ⅛ inch must be replaced with springs.

83. REPAIR.

a. The only repair to the clutch is relining the disks and the clutch hub. All other badly worn or damaged parts must be replaced to ensure a perfect, dependable operating clutch.

b. Install New Disk Liners. If new disk and hub liners are installed, make sure that the rivets are set below the surface of the fiber liner. Do not set rivets with such force to crack or damage the fiber liner.

CHAPTER 8

CLUTCH (Cont'd)

Section III

ASSEMBLY, INSTALLATION, AND ADJUSTMENT

84. ASSEMBLY AND INSTALLATION.

a. The clutch cannot be completely assembled until the clutch hub and sprocket assembly is installed on the splined end of the transmission clutch gear. Refer to figure 89 for correct order of assembly.

b. Install Clutch Hub on Transmission Clutch Gear. Engage the hub and gear shaft splines and drift the hub onto the splines with a block of wood and a hammer. Install the lock washer and nut and tighten nut (fig. 90) securely with wrench (41-W-866-10). Lock the nut by setting the washer in one of the nut slots with a punch.

c. Ball Bearing, Bearing Retainer Plate and Retainer Plate Lock Rings. Install the ball bearing retainer (with sixty $\frac{7}{32}$-inch balls) on the clutch hub race; then install the bearing retainer plate on the studs with the shoulder edge inward (toward the ball retainer). The retainer plate is held in place by three steel rings, slipped over three of the short studs. CAUTION: *If the three long studs have grooves, do not engage the rings in the grooves.*

d. Install Clutch Hub on Transmission Clutch Gear. Apply a light coat of grease to ball bearing before installing the hub shell. With the clutch hub in place on the ball bearing, the disks can be installed in the shell and sprocket assembly.

e. Install Disks (refer to TM 9-879). It will be noted that the two steel disks are stamped "OUT" on one side. These sides must face outward when installed in the shell. The two steel disks are also provided with antirattle (ball and spring) devices to prevent disk noise when engaged with the spline keys within the shell. Correct order of disk assembly is as follows:

(1) Lined disk fitted correctly on the hub studs.

(2) Steel disk fitted to shell spline keys with side stamped "OUT" facing outward.

(3) Lined disk fitted correctly on the hub studs.

(4) Steel disk fitted to shell spline keys with antirattle device staggered in position from antirattle device on the first steel disk installed. Side stamped "OUT" facing outward.

(5) Spring disk (lined on one side) is installed on the hub studs with the lined side inward, facing the steel disk.

f. Assemble and Install Releasing Disk, Springs and Spring Collar (figs. 92 and 93). Place the 10 springs upright on the releasing disk to centrally locate each of the 10 stud holes in the disk. Place the spring collar (flanged edge down) over ends of springs, locating

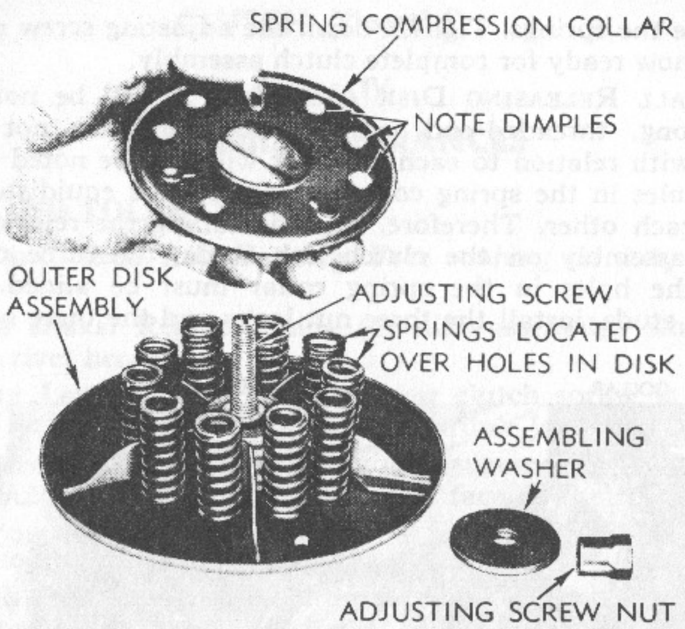


Figure 92—Springs Assembled on Releasing Disk

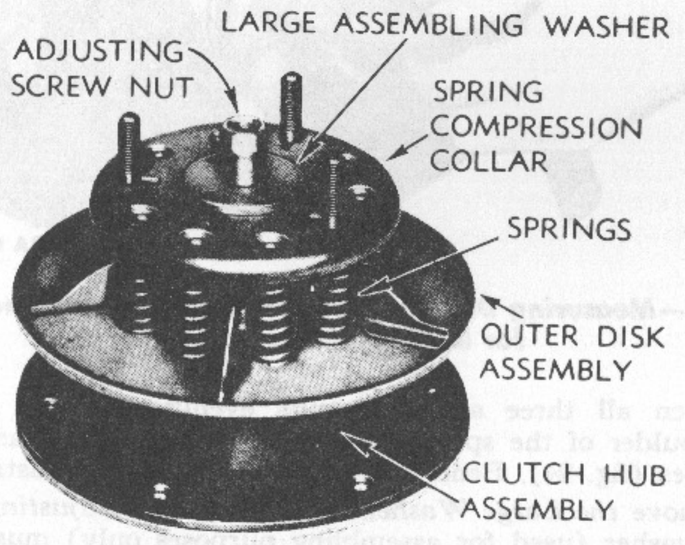


Figure 93—Alining Springs, Disk and Collar on Clutch Hub Studs

the collar "dimples" in ends of 7 of the springs. Place a large washer ($1\frac{3}{4}$ in. dia x $\frac{1}{8}$ in. thick with a $\frac{3}{8}$ in. center hole) over the push rod adjusting screw; turn on the adjusting screw lock nut and compress the springs lightly. Turn assembly over and observe alinement of springs and disk holes. If necessary, insert a $\frac{3}{8}$-inch rod through

holes to aline the springs. Tighten down the adjusting screw nut. The assembly is now ready for complete clutch assembly.

(1) INSTALL RELEASING DISK ASSEMBLY. It will be noted that the three long, threaded-end, clutch hub studs are not spaced equidistant with relation to each other. It will also be noted that the three stud holes in the spring collar are not spaced equidistant with relation to each other. Therefore, when installing the releasing disk and spring assembly on the clutch hub studs, the three threaded studs and the holes in the spring collar must be alined. Install assembly on studs, install the three nut locks and the three adjusting

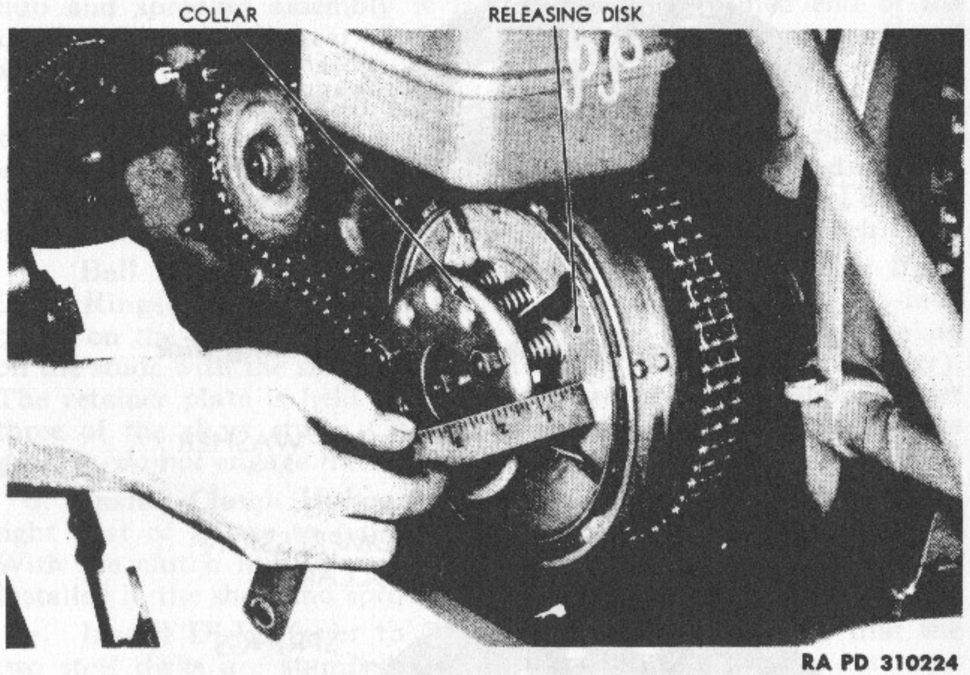


Figure 94—Measuring Distance Between Spring Collar and Disk for Initial Adjustment

nuts. Tighten all three adjusting nuts evenly until the distance between shoulder of the spring collar and face of the releasing disk is $1\frac{1}{32}$ inches (fig. 94). Bend up nut locks to retain adjusting nuts

(a) Remove the Large Washer from Push Rod Adjusting Screw. The large washer (used for assembling purposes only) must be removed from the push rod adjusting screw and the adjusting screw lock nut reinstalled on the screw.

85. ADJUSTMENT.

a. Adjustment of the clutch push rod is made after transmission and clutch assembly has been installed in the vehicle because the action of the clutch operating cable, clutch release lever and push rod is closely related. For instructions covering clutch control adjustment in vehicle, refer to TM 9-879.

CHAPTER 8

CLUTCH (Cont'd)

Section IV

FITS AND TOLERANCES

86. FITS AND TOLERANCES.

a. Hub and Shell Ball Bearing. Free running on sixty $\frac{7}{32}$-inch steel balls.

b. Lined Disks. Replace lining (or disk assembly) when liners are worn to rivet heads.

c. Spring Length. Free length of new clutch spring is approximately $1\frac{1}{2}$ inches. Replace spring when shrunk $\frac{1}{8}$ inch.

d. Compression Collar to Disk Measurement. The distance between shoulder of the spring collar and face of the releasing disk should be $1\frac{1}{32}$ inches, and never less than $\frac{3}{8}$ inch to ensure equal and correct tensioning of the 10 springs (fig. 94).

e. Clutch Hub on Gear Shaft Spline. Light press fit between the clutch hub and transmission clutch gear shaft spline.

CHAPTER 9

TRANSMISSION

Section I

DESCRIPTION AND DATA

87. DESCRIPTION AND DATA.

a. Description. Transmission is of constant-mesh, progressive type. Gears are always in mesh and when shifting from low to high or vice versa, it is necessary to shift through neutral and second positions. Transmission is of three-speed design and on WLA models, reverse gear is not provided. Sliding shifter clutches, actuated by the shifter drum cam, engage with dogs in the clutch gear and recesses in the second and low gears depending on the gear selected. Use of needle rollers, close fitting bronze bushings, and close tolerances necessitates use of engine oil for lubrication.

b. Data (fig. 95).

Gear ratios:

High gear	1 to 1
Low gear reduction	2.47 to 1
Second gear reduction	1.57 to 1
Oil capacity	¾ pint

CHAPTER 9

TRANSMISSION (Cont'd)

Section II

DISASSEMBLY, CLEANING, INSPECTION, AND REPAIR

88. DISASSEMBLY.

a. Clean Housing. Before disassembling the transmission, clean exterior to remove caked dirt, grease, and grit.

b. Mount Transmission. Secure transmission in a copper-jawed vise by clamping the mounting studs. Proceed with disassembly as follows:

(1) REMOVE CLUTCH. If clutch is assembled on transmission, remove according to instructions in paragraph 81.

(2) REMOVE STARTER CRANK. Remove the starter crank clamp bolt nut and bolt and pull starter crank off of squared end of countershaft.

(3) REMOVE SPROCKET COVER AND CLUTCH RELEASE LEVER ASSEMBLY (fig. 96). Remove the four stud nuts which secure the sprocket cover to the transmission case. It may be necessary to pry or drift cover off of the studs.

(4) REMOVE COUNTERSHAFT SPROCKET (fig. 96). Bend down nut lock and remove nut. It will be necessary to strike wrench with a hammer to loosen nut. Remove the sprocket from shaft taper by giving it a light but sharp rap with a hammer, near outer edge, being careful not to strike and damage the sprocket teeth.

(5) REMOVE CLUTCH PUSH ROD ASSEMBLY. The clutch push rod and bearing assembly can now be withdrawn from the mainshaft.

(6) REMOVE TRANSMISSION CASE TOP COVER. Remove the 10 screws and lock washers which secure the case top inspection cover. Drain oil from case.

(7) REMOVE SHIFTER CAM (fig. 96). Remove the lock screw and pull the shifter camshaft out of transmission case by using a forked pry tool in the shaft slot. The shaft may be quite tight in the case, and if the head should break off in removal, it will be necessary to drill a hole in the case (at shaft opposite end) and drift the shaft out. Partly engage high gear so that notch in right end of shifter cam clears boss in side of case for removal.

(8) REMOVE SHIFTER FORK ASSEMBLIES (fig. 96). Drift the shifter fork shaft out through the hole in the transmission side cover.

(9) REMOVE TRANSMISSION CASE SIDE COVER (fig. 97). Remove the five screws and two stud nuts which secure side cover to case. Free the cover from case by tapping around edge. At the time cover is removed, the mainshaft needle rollers (21 in number) will probably fall out of position. Keep needle rollers in a container and identify them. With the cover removed, gears, shafts, and bearings can now be removed from open side of case.

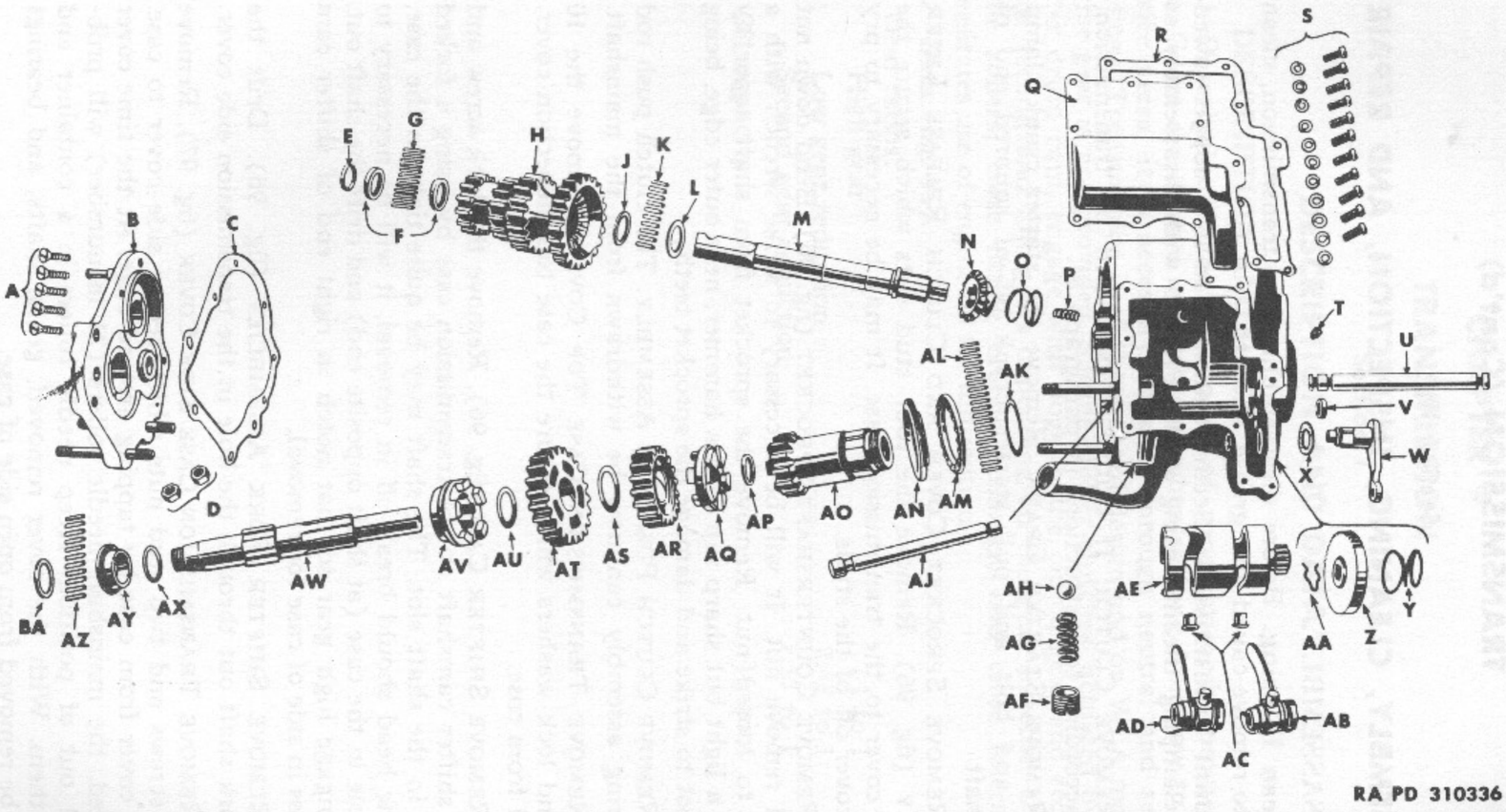


Figure 95—Transmission, Disassembled

A—SIDECOVER SCREWS (5)

B—SIDECOVER ASSEMBLY

C—GASKET

D—COVER NUTS

E—COVER RUBBER OIL SEAL

F—ROLLER END WASHER (OD. 1 IN. x 0.180 IN. THICK) (2)

G—RIGHT SIDE BEARING ROLLER (3/4 IN. x 0.114 IN.) (24)

H—COUNTERSHAFT GEAR

J—ROLLER END WASHER (OD, 1-5/64 IN. x 0.092 IN. THICK)

K—LEFT SIDE BEARING ROLLER (5/8 IN. x 0.152 IN.) (19)

L—GEAR END WASHER (OD, 1-3/16 IN. x 0.080 IN. THICK)

M—COUNTERSHAFT

N—STARTER CLUTCH

O—STARTER CLUTCH SPRING

P—COUNTERSHAFT END SPRING

Q—GEARCASE COVER

R—GASKET

S—COVER SCREWS AND WASHERS (11 EACH)

T—CAMSHAFT LOCK SCREW

U—SHIFTER CAM SHAFT

V—CAM SHAFT RUBBER OIL SEAL

W—SHIFTER LEVER AND SHAFT

X—SHIFTER SHAFT LEATHER WASHER

Y—SHIFTER SHAFT SPRING

Z—SHIFTER GEAR

AA—SHIFTER GEAR RETAINING SPRING

AB—SHIFTER FORK ASSEMBLY—SECOND AND HIGH

AC—SHIFTER FINGER ROLLER

AD—SHIFTER FORK ASSEMBLY—LOW

AE—SHIFTER CAM

AF—SHIFTER CAM PLUNGER SCREW

AG—SHIFTER CAM PLUNGER SPRING

AH—SHIFTER CAM PLUNGER BALL

AJ—SHIFTER FORK SHAFT

AK—ROLLER END WASHER

AL—CLUTCH GEAR BEARING ROLLER (0.615 IN. x 0.125 IN.) (40)

AM—THRUST BALLS AND RETAINER

AN—THRUST BEARING RACE

AO—CLUTCH GEAR

AP—MAINSHAFT ENDPLAY SPACER (OD. 15/16 IN. x 0.078 TO 0.113 IN. THICK)

AQ—SHIFTER CLUTCH—SECOND AND HIGH

AR—SECOND GEAR

AS—LOW AND SECOND GEAR END PLAY WASHER (OD 1-7/16 IN. x 0.040 TO 0.075 IN.)

AT—LOW GEAR

AU—LOW GEAR END THRUST WASHER (OD 1-7/32 IN. x 0.052 IN. THICK)

AV—SHIFTER CLUTCH—LOW GEAR

AW—MAINSHAFT

AX—THRUST WASHER (OD 1-7/64 IN. x 0.052 IN THICK)

AY—SPACING COLLAR

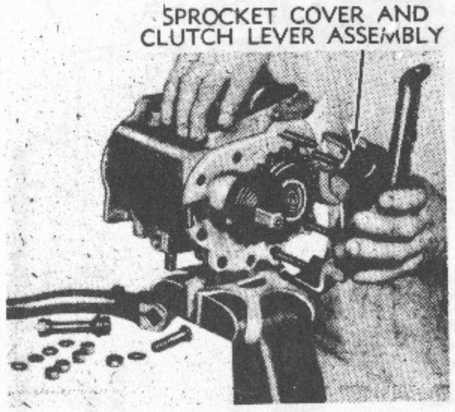
AZ—MAINSHAFT ROLLERS (5/8 IN. x 0.152 IN.) (21)

BA—ROLLER END WASHER (OD 1-3/16 IN. x 0.063 IN. THICK)

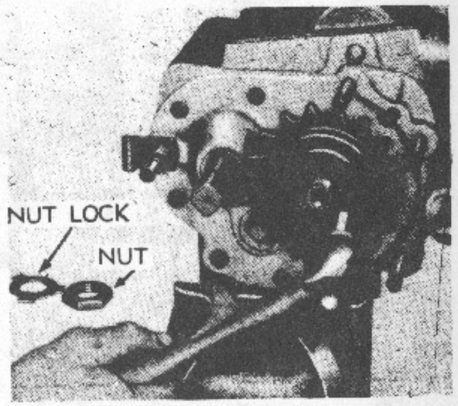
RA PD 310336B

Legend for Figure 95—Transmission, Disassembled

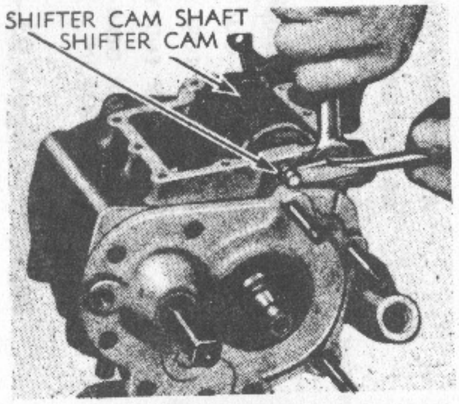
(10) REMOVE MAINSHAFT, GEARS, ETC. Withdraw the mainshaft, with gears, spacers, shifter cams, etc., from the transmission case. The clutch gear will probably stay in position due to friction of the oil seal. Remove the clutch gear, thrust race, thrust ball bearing and the needle rollers. Keep needle rollers in a container and identify location. Remove the lock ring, push rod guide, seal, washer, spring,



A REMOVING SPROCKET COVER AND CLUTCH LEVER ASSEMBLY



B REMOVING SPROCKET FROM MAINSHAFT TAPER



C REMOVING GEAR SHIFTER CAM SHAFT BY PRY METHOD

D REMOVE SHIFTER FORK SHAFT BY DRIFTING FROM CASE

Figure 96—Disassembling Transmission

spring cup disk, and small seal from the spline end of the clutch gear (fig. 98).

(11) REMOVE COUNTERSHAFT, GEAR, BEARINGS, STARTER CLUTCH, ETC. Withdraw the countershaft assembly, taking care not to lose starter clutch springs. Remove gear from shaft and keep needle rollers in container to identify location.

(12) REMOVE SHIFTER CAM PLUNGER, BALL AND SPRING. Remove the cam plunger cap screw, spring and ball.

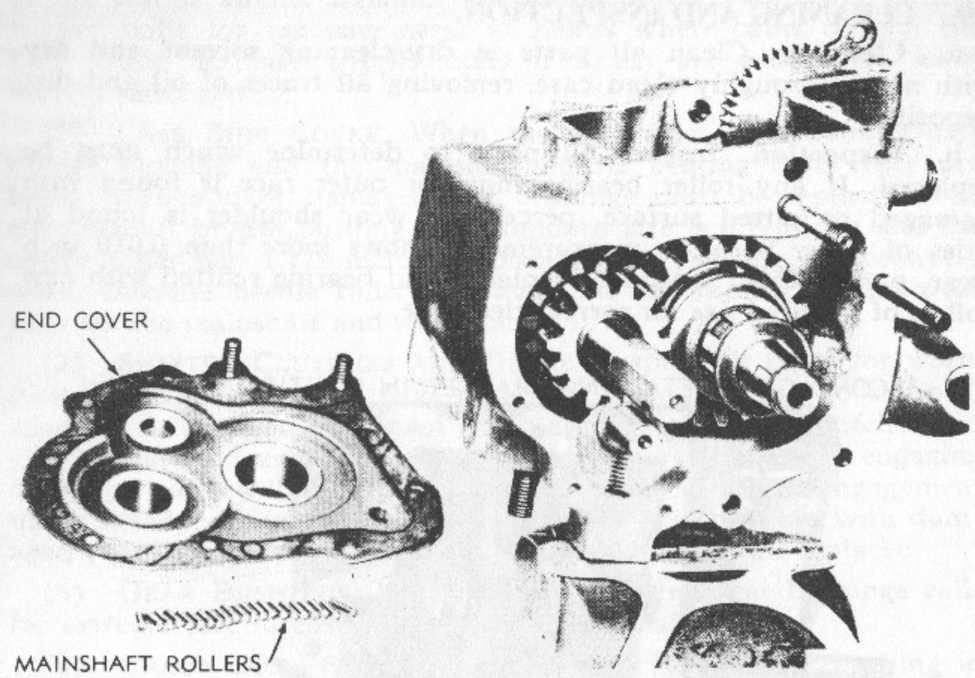


Figure 97—Gear Case End Cover Removed

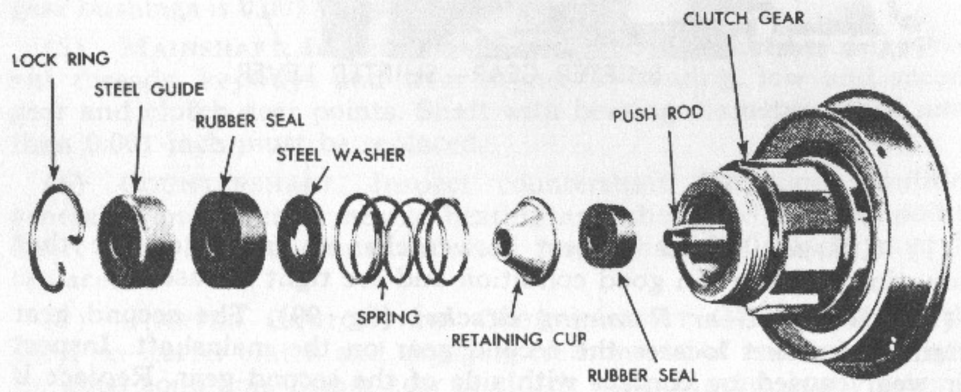


Figure 98—Clutch Gear and Push Rod Oil Seal, Disassembled

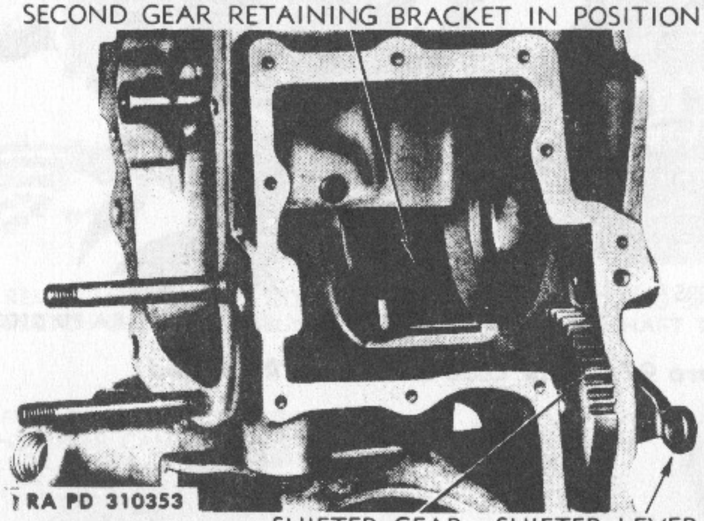
(13) CLUTCH GEAR SHAFT OIL SEAL. Inspect the oil seal pressed into the outer side of the clutch gear shaft roller race for worn and/or damaged condition. If seal is in good condition, do not remove it. If seal appears in bad condition, remove by drifting it out from inside of case. The left side roller bearing retaining washer is located back of oil seal, next to the outer race. It is not necessary to further disassemble the transmission case until it has been cleaned and inspected.

89. CLEANING AND INSPECTION.

a. Cleaning. Clean all parts in dry-cleaning solvent and dry with air. Thoroughly clean case, removing all traces of oil and dirt deposits.

b. Inspection. Inspect all parts to determine which must be replaced. If any roller bearing inner or outer race is found with damaged or pitted surface, perceptible wear shoulder is found at sides of roller path, or measurements shows more than 0.010 inch wear, part affected should be replaced and bearing refitted with new rollers of required size for correct clearance.

SECOND GEAR RETAINING BRACKET IN POSITION



(1) INSPECT CASE. Inspect for cracks or breakage. See that mounting studs are in good condition and are tight in case.

(a) Second Gear Retaining Bracket (fig. 99). The second gear retaining bracket locates the second gear on the mainshaft. Inspect for wear caused by contact with side of the second gear. Replace if badly worn where face contacts side of the second gear.

(b) Clutch Gear Outer Roller Race. Inside diameter 1.722 inches. Inner face of race is for thrust ball bearing. Inspect races for signs of wear. Oversize needle rollers (0.0004-in. and 0.0008-in. oversizes only) are available to take up normal wear of race. Excessively worn or damaged race must be replaced.

(c) Countershaft End Bushing. Bushing is pressed into a cup and cup is pressed into case. Normal hole diameter of bushing is 0.611 inch. Replace when countershaft end and bushing clearance exceeds 0.003 inch.

(d) Starter Clutch Tripper Bolts. The tripper bolt heads are used to disengage the starter clutch from the countershaft gear at the end

of the starter stroke. Examine the heads of the two starter clutch tripper bolts for excessive wear at points where cams contact the bolt heads. Replace tripper bolts if heads are excessively worn and/or damaged.

(2) CASE SIDE COVER. When the case side cover countershaft bronze bushing and the mainshaft needle bearing outer race are badly worn and/or damaged, the bushings must be replaced. The countershaft bronze bushing hole standard size is 0.775 inch and the needle roller race 1.179 inches. Replace bronze bushing if excessively worn. Oversize needle rollers are available to take up normal wear between the mainshaft and roller race.

(3) SHIFTER CLUTCHES AND GEARS. Inspect all gears for worn, pitted or damaged teeth. Give especially close attention to chipped, rounded, or battered corners of engaging dogs on shifter clutches and clutch gear and engaging slots in other gears. Damaged engaging dogs and slots will cause transmission to creep out of engagement under steady driving load. All gears and shifter clutches with damaged (badly rounded) engaging dogs and slots must be replaced.

(4) GEAR BUSHINGS. Installing and reaming gear bushings calls for extreme care to ensure correct sizing and alinement.

(a) Clutch Gear. Standard hole size for the bronze bushing in the clutch gear is ¾ inch. Clearance between shaft and bushing is 0.002 inch.

(b) Low Gear and Second Gear. Standard hole size in low gear and second gear bushings is $^{15}/_{16}$ inch. Clearance between shaft and gear bushings is 0.001 inch.

(5) MAINSHAFT. Inspect mainshaft for good condition of sprocket nut threads, keyways and wear at needle bearing, low and second gear and clutch gear points. Shaft with bearing diameters worn more than 0.001 inch must be replaced.

(6) COUNTERSHAFT. Inspect countershaft for good condition generally and wear at needle bearing and shaft end bearing points. Shaft with bearing diameters worn more than 0.001 inch must be replaced.

(7) STARTER CLUTCH AND COUNTERSHAFT GEAR. Inspect the teeth on starter clutch and engaging teeth in end of countershaft gear for good condition. Either gear or clutch with chipped, badly worn or broken teeth must be replaced.

(8) MAINSHAFT THRUST BEARING AND RACE. Inspect the thrust bearing race for pits, roughness or noticeably worn condition. Inspect the retainer and balls for good condition. Replace both bearing and race if found in bad condition.

(9) SHIFTER CAM AND SHAFT. Inspect shifter cam for wear condition. The cam gear teeth must not be excessively worn or broken. Cam bearing and shaft clearance is 0.001 inch. Standard shaft diameter is 0.374 inch.

(10) SHIFTER GEAR AND SHAFT. Inspect shifter gear for condition of teeth. When found excessively worn or broken, replace the

gear. The shifter gear shaft standard diameter is 0.561 inch for the large size and 0.374 inch for the small (end) size.

(11) SHIFTER FORK ASSEMBLIES. Note that shifter forks are assembled on the bushings for right and left positions on the shaft. If assemblies are taken apart, pay attention to location of all parts, especially the thin spacing washers between the shifter finger and shifter fork.

(a) Shifter Fork Shaft. Shaft is 0.3745-inch diameter.

(b) Shifter Fork Bushing. Standard hole size in bushing is ⅜ inch.

(c) Shifter Finger and Finger Roller. The finger roller rides within the cam-ways of the shifter drum with a normal clearance of

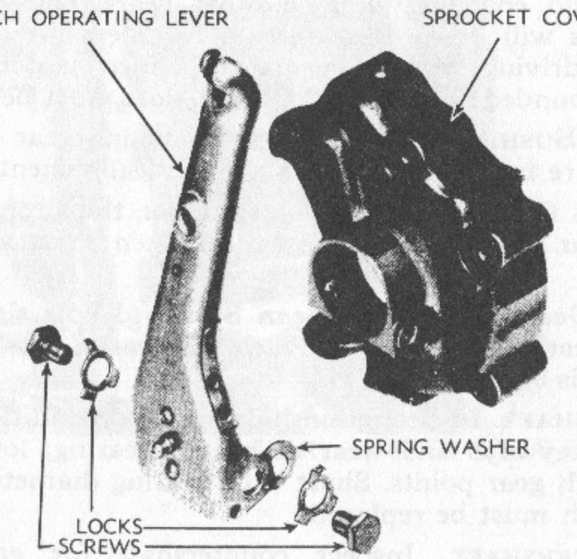


Figure 100—Sprocket Cover and Clutch Lever, Disassembled

0.005 inch. Roller size is 0.370 inch, and hole size is 0.289 inch. The finger stud size is 0.287 inch.

(d) Shifter Fork. Shifter fork width is 0.121 inch.

(e) Gear Shifter Drum and Shaft. The gear shifter drum shaft is 0.374-inch diameter. The cam-ways (finger roller slots) in the gear shifter drum are ⅜ inch wide. The gear shifter drum shaft holes are ⅜-inch diameter.

90. REPAIR.

a. Welding of broken transmission cases can be done providing the finishing does not call for machine operations or special alinement fixtures not available. All other repairs must be made by replacement of worn or damaged parts.

(1) REPLACING GEAR BUSHINGS. If general condition of either

the low, second or clutch gear is good enough for satisfactory further service, then replace bushings. Usually the shifter dogs or engaging slots are so rounded and damaged as to make further use of the part impractical.

(2) TRANSMISSION CASE BUSHINGS. The bronze countershaft bushing in the transmission case can be replaced when clearances exceed wear limits. (Owing to the fact that the starter is used very little, the starter shaft bronze bushings in the case and case side cover seldom need replacement.) The clutch gear outer roller race can be pressed out after the case is warmed (not to exceed 300° F). **NOTE:** *Case must also be warmed before pressing in new roller race.*

(3) CLUTCH GEAR SHAFT OIL SEAL. If the oil seal is replaced, install the roller bearing retaining washer in the outer race; then press oil seal squarely into race with lipped side facing inward. The tensioning spring is visible from the lipped side of the seal.

(4) TRANSMISSION CASE SIDE COVER. The starter shaft bronze bearing seldom needs replacement. However, if wear limits show replacement is necessary, replace bushing, making sure that the flat side is in correct location to provide sprocket tooth clearance. If the outer roller race must be replaced, use arbor press and make sure new race is started and pressed squarely into the case side cover hole.

(5) SPROCKET COVER AND CLUTCH LEVER ASSEMBLY. If either sprocket cover or clutch lever are broken or damaged, replace parts. Figure 100 shows correct order of clutch lever assembly.

b. Replacing Oil Seal in Assembled Transmission. Use combination tool (41-R-2389-47). The clutch gear shaft oil seal can be replaced in assembled transmission either in or out of vehicle. Illustrations in figure 101 show oil seal replacement with transmission in vehicle.

(1) REMOVE CLUTCH AND CLUTCH HUB. To remove clutch and clutch hub from transmission clutch gear, refer to paragraph 81.

(2) REMOVE OIL SEAL. Refer to illustrations in figure 101, and applying the following removal steps:

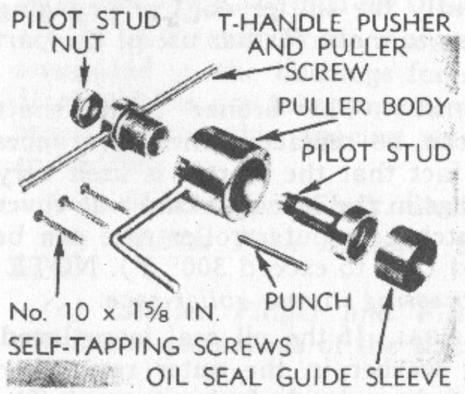
(a) Screw the pilot stud onto the clutch gear until it bottoms against the end of the gear as shown in B, figure 101.

(b) Slide the puller body over the guide stud (with T-handle pusher and puller screw removed) with the body stop (extended arm) in downward position. Turn the body clockwise until the body stop bears against either the inner chain guard or the gear box, as shown in C, figure 101.

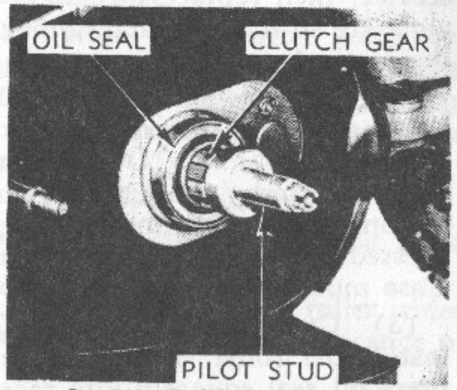
(c) Insert punch (refer to fig. 101) through each of the three holes in the puller body and punch-mark the oil seal for drilling.

(d) Remove the puller body and pilot stud and drill a $\frac{3}{32}$-inch hole through the outer face of the oil seal, at each punch-mark.

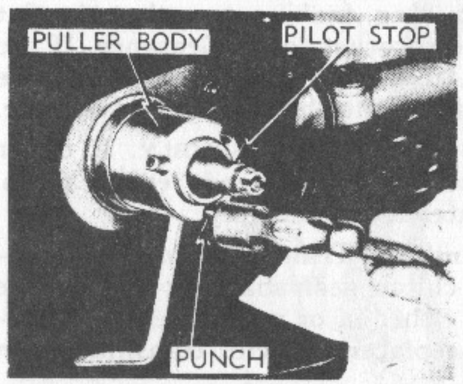
(e) Again assemble pilot stud and puller body on the clutch gear. Screw the three self-tapping screws into the holes drilled in the oil seal (through holes in puller body). Make sure all three screws are tight so that puller body is tight against oil seal.



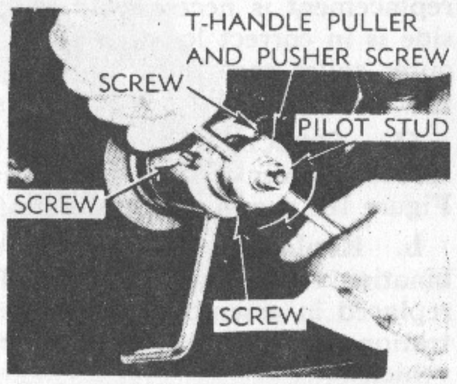
A—TOOL NOMENCLATURE



B—PILOT STUD SCREWED ONTO CLUTCH GEAR

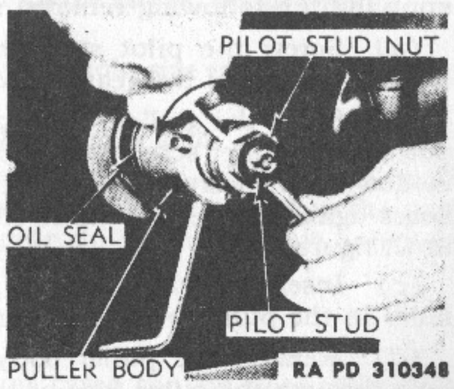


C—PUNCH MARKING OIL SEAL FOR DRILLING



D—TOOL ASSEMBLED, TURN CLOCKWISE TO PULL SEAL

E—OIL SEAL IN POSITION FOR INSTALLATION



F—TOOL ASSEMBLED, TURN COUNTERCLOCKWISE TO INSTALL OIL SEAL

Figure 101—Removing Clutch Gear Oil Seal with Tool (41-R-2389-47)

(f) Screw the T-handle puller and pusher screw (turn to right) into the puller body until the oil seal is withdrawn, free from the bearing race. Refer to D, figure 101.

(g) Remove tool from clutch gear shaft. Also remove the three self-tapping screws and discard the old oil seal.

(3) INSTALL NEW OIL SEAL (fig. 101). Before installing a new oil seal, remove all burs and nicks at the outer edge of the oil seal recess and in bearing race, then proceed with installation as follows:

(a) Apply a little oil or grease to inner composition surface of oil seal, to prevent turning member from burning and damaging new oil seal when transmission first goes back into service. (Note that one end of oil seal guide sleeve has a slight counterbore and the other end is flanged.) Insert counterbored end of sleeve through closed side of oil seal and place guide sleeve and seal onto gear. Correctly assembled, spring tension side of seal will be inward, toward transmission. Refer to E, figure 101.

(b) Again screw the pilot stud onto the clutch gear, until stud bottoms against end of gear as shown in F, figure 101.

(c) Place the puller body over the guide stud and push the oil seal inward against gear box.

(d) Screw the T-handle puller and pusher screw into the puller body as far as possible without moving the puller body away from the oil seal.

(e) Place the pilot stud nut on the threaded end of the pilot stud and turn nut on tight. Assembly will then appear as shown in F, figure 101.

(f) Unscrew the body handle to press in the oil seal (F, fig. 101). NOTE: *The pilot stud has a screwdriver slot in outer end to tighten or hold the stud if it loosens while unscrewing T-handle to press in oil seal.* Make sure the new oil seal is bottomed in its recess. Do not apply further heavy pressure after seal bottoms, as doing so may damage the seal.

(g) Remove oil seal tool from clutch gear.

(h) Stake the oil seal bushing lightly, with a blunt chisel or punch at three equidistant points to prevent the oil seal from turning or working out of its recess.

CHAPTER 9

TRANSMISSION (Cont'd)

Section III

ASSEMBLY

91. ASSEMBLY.

a. General. Assembly of the transmission calls for correct clearance fitting of the needle rollers; correct adjustment of the mainshaft end play; correct end play of low and second gears; correct adjustment of the shifter clutches and correct timing between the shifter lever gear and gear shifter drum gear. Reference to the disassembled parts in figure 95 will assist in the correct assembly of parts.

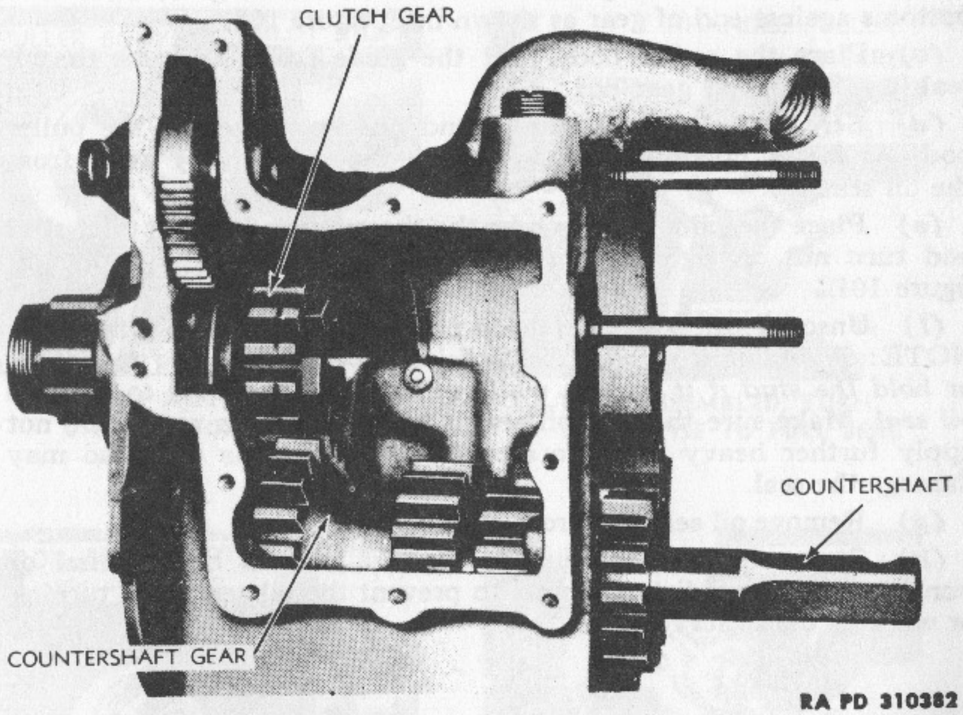


Figure 102—Countershaft Assembly and Clutch Gear Installed

b. Fitting Needle Roller Bearings. All needle roller bearings must be fitted to give from 0.0006 to 0.001 inch (0.0008 in. preferred) bearing clearance. The needle rollers are not assembled in retainers and must, therefore, be held in the outer bearing races with a light application of grease for easy assembly.

(1) CLUTCH GEAR NEEDLE ROLLERS. Standard size, 0.125 inch x 0.615 inch available in 0.0004 inch and 0.0008 inch oversizes only. Forty rollers used in the bearing.

(2) MAINSHAFT AND CASE SIDE COVER ROLLERS. Standard size, 0.152 inch x 5/8 inch available to 0.001 inch oversize in steps of 0.0002 inch. Twenty-one rollers used in the bearing.

(3) COUNTERSHAFT GEAR LEFT END ROLLERS. Same as (2) above, except that only 19 rollers are used in this bearing.

(4) COUNTERSHAFT GEAR RIGHT END ROLLERS. Standard size 0.114 inch x 3/4 inch available in 0.0004 to 0.0008 inch oversizes only. Twenty-four rollers used in the bearing.

(5) INSTALL COUNTERSHAFT GEAR AND STARTER CLUTCH ASSEMBLY (fig. 102). Refer to figure 95 for correct order of assembly for countershaft gear and starter clutch assembly (items E to P inclusive).

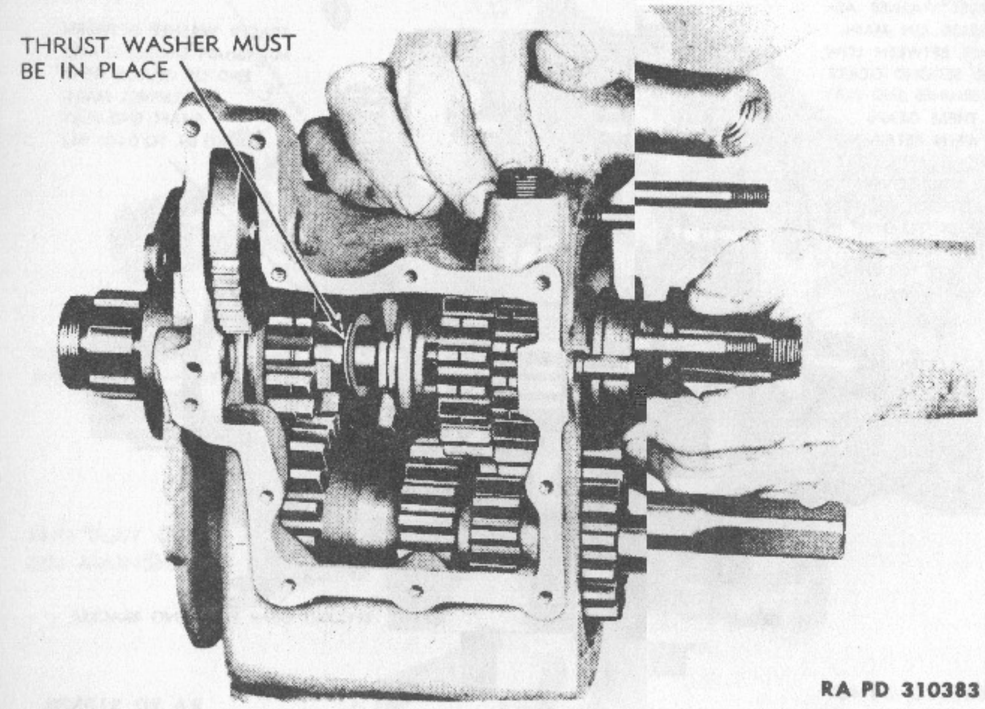


Figure 103—Installing Mainshaft and Gear Assembly in Clutch Gear

c. Install Clutch Gear (fig. 102). Install the roller bearing end washer in the outer race. Secure the selected roller to the outer race with grease. Insert oil seal guide (41-G-125-5) through the oil seal from the outside so that it will be in place to meet the clutch gear when it is inserted through the bearing from the inside. Assemble the ball thrust bearing race and ball and retainer assembly on the clutch gear. Insert the clutch gear through the bearing from the inside of the case, making sure that the gear end is engaged with the oil seal tool before pushing the gear shaft through the oil seal.

d. Adjust the Mainshaft End Play (figs. 103 and 104). The mainshaft end play adjusting spacer washer (item AP, fig. 95) is avail-

able in thicknesses 0.078 to 0.113 inch, in steps of 0.005 inch to obtain mainshaft end play of 0.003 to 0.005 inch.

(1) Assemble spacer washer on mainshaft (do not assemble gears or clutches on shaft) and insert shaft end in the clutch gear bushing. Install thrust washer and spacing collar (items AX and AY, fig. 95), on the other end of the mainshaft.

(2) Install the roller bearing end washer in the case side cover race and retain the selected rollers to the outer race with a light coat of grease. Assemble the case side cover and gasket to the case and securely tighten with the five cover screws and the two stud nuts. NOTE: *Case cover screws and stud nuts must be as tight as in final assembly; otherwise the end play in final assembly will be incorrect.*

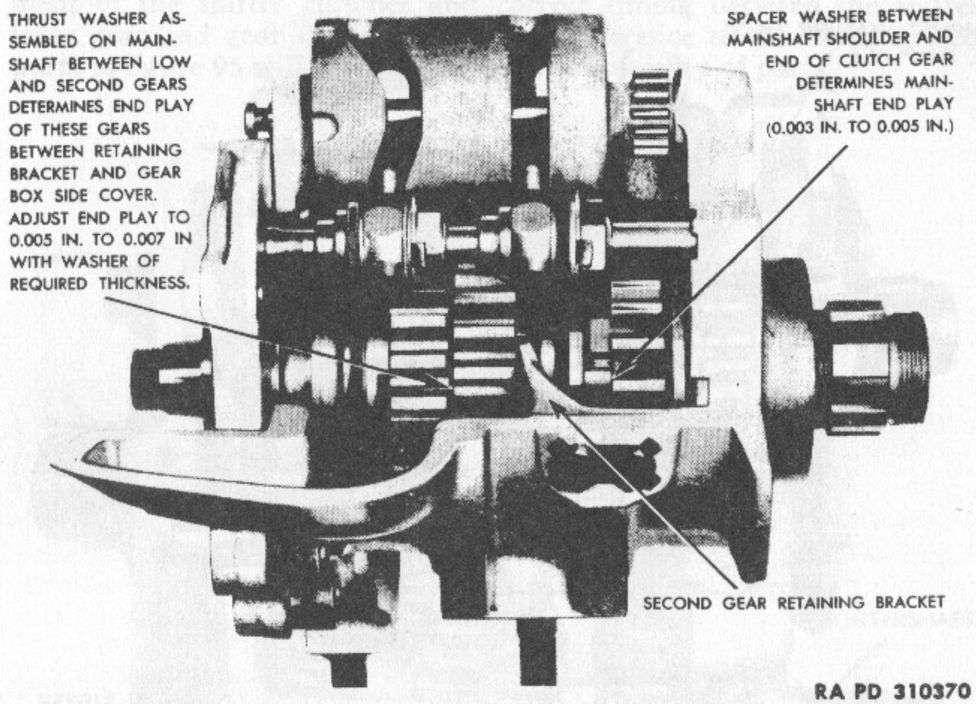


Figure 104—Points to Check for Mainshaft End Play Adjustment

(3) Check the end play of the mainshaft with special end play gage (41-G-198) and thickness gage (fig. 105). If end play does not come within the 0.003 to 0.005 inch limits, remove mainshaft and install a spacer washer selected to give the correct end play.

(4) After the correct mainshaft end play adjustment has been established, remove mainshaft from case and set aside the spacer washer selected, to be sure that it goes into the final assembly.

e. Adjust End Play of Low and Second Gears Between the Retaining Bracket and Case Side Cover (fig. 106). The second gear retaining bracket is mounted in the transmission case to locate and retain the low and second gears on the mainshaft. The low and second gears must have 0.005 to 0.007 inch end play between the face of the

second gear bracket and case cover bearing race. This end play is obtained by selecting a low and second gear end play adjusting washer (item AS, fig. 95) of correct thickness to fit between the low and second gears on the mainshaft. Adjusting washer is available in thicknesses of 0.040 to 0.075 inch, in steps of 0.005 inch. Adjust low and second gear end play as follows:

(1) Assemble only the low gear end thrust washer, low gear end play adjusting washer and second gear on the left end of the main-

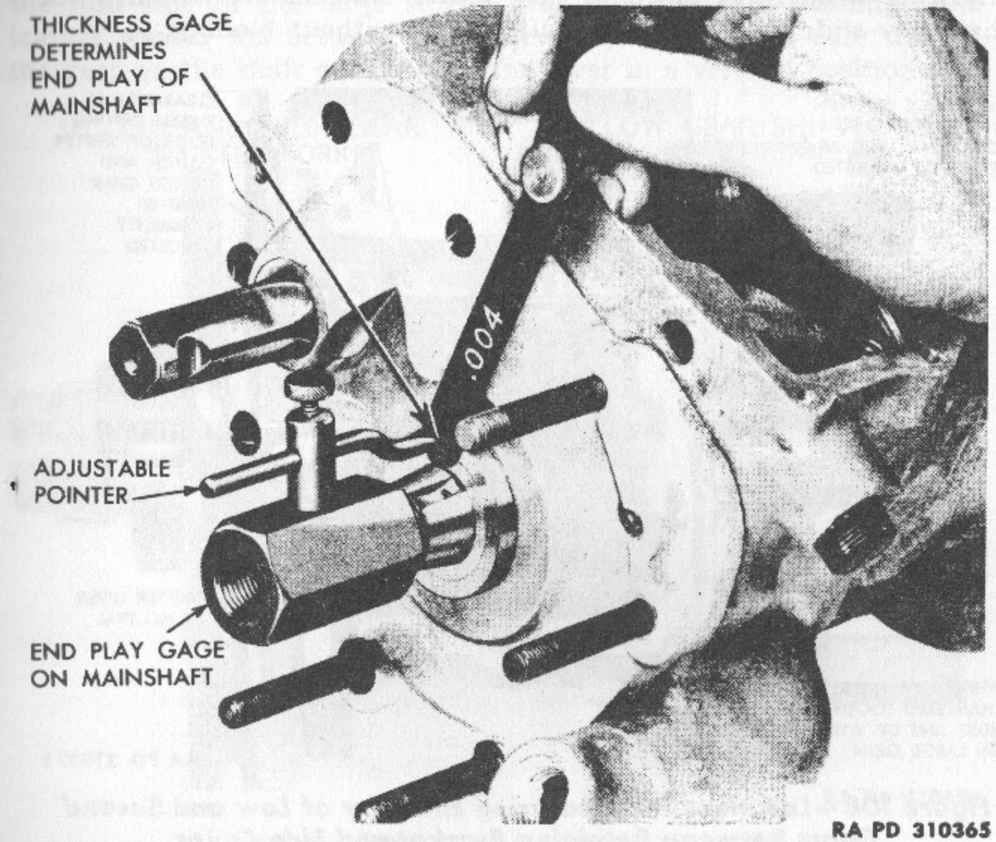


Figure 105—Checking Mainshaft End Play with Thickness Gage and End Play Gage (41-G-198)

shaft. On the right end of the mainshaft, assemble the thrust washer and spacing collar.

(2) Install rollers in the side cover race, retaining with a light coat of grease. Install cover and gasket on the case and securely tighten the five cover screws and the two stud nuts. Tighten the cover screws just as tight as in final assembly.

(3) Check end play of low and second gears between the side cover and the second gear retaining bracket with a thickness gage. NOTE: *Insert gage blade between the face of the second gear and the bracket.* End play must be between 0.005 and 0.007 inch.

(4) Select adjusting washer of proper thickness to give required end play.

(5) After correct end play adjustment has been attained, remove the mainshaft assembly from transmission case and make sure that selected end play washer remains with the assembly. Reinstall the countershaft, starter clutch, bearings, and countershaft gear with all parts in correct order of assembly. Reinstall the mainshaft assembly with all parts in correct order, and with the two selected end play adjusting washers in place. If new shifter clutches are installed see that they slide freely on the shaft splines without binding.

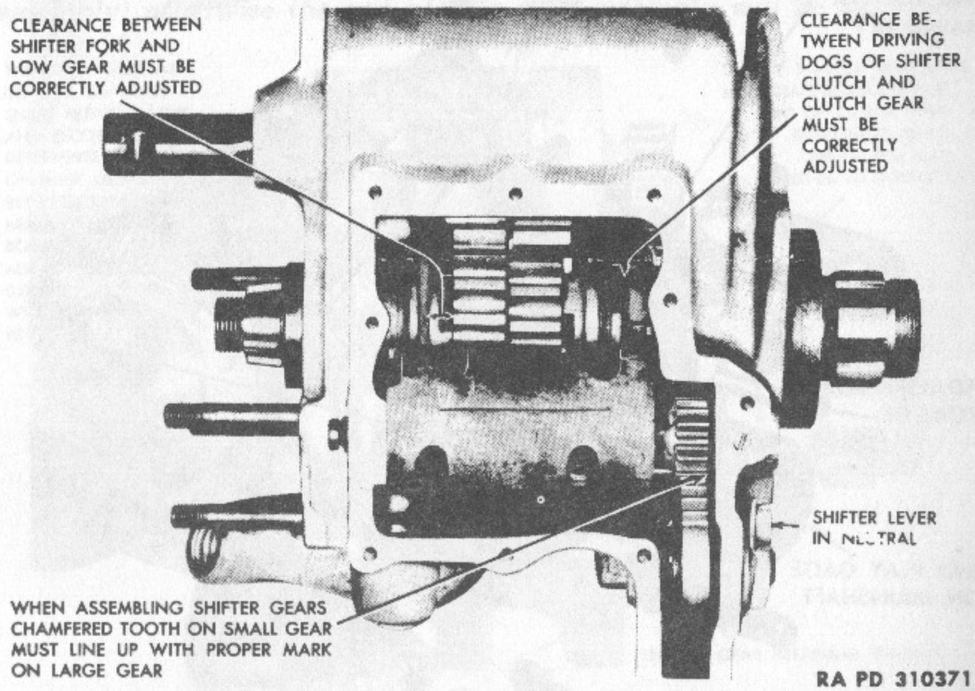


Figure 106—Locations for Measuring End Play of Low and Second Gears Between Retaining Bracket and Side Cover

(6) Reinstall side cover and gasket and securely tighten the five cover screws and the two stud nuts. Make sure that side cover rubber oil seal is in place on countershaft. Press inward on countershaft gear to compress the starter clutch spring; then engage the starter clutch cams under the tripper bolt heads by turning the countershaft so that crank bolt notch is in upward position. This permits easy assembly of end cover to case. Shifter forks and shifter cam can now be installed.

f. Install Shifter Forks and Shifter Cam (fig. 107). When installing the shifter forks, make sure they correctly locate on the shaft with relation to the slots in the shifter cam and the grooves in the shifter clutches. The shifter fork spacing (adjusting) washers may have to be changed in order to obtain the correct distances between

driving dogs of the shifter clutch and the clutch gear and the shifter fork and the low gear. These distances are determined after the shifter cam is in place.

(1) INSTALL SHIFTER FORK ASSEMBLIES (fig. 107). Pass the shifter shaft through hole in right side of case and through holes in the shifter fork bushings. The forks must be engaged with the grooves in the shifter clutches.

(2) INSTALL SHIFTER LEVER AND GEAR. The spring fits between the hub side of the large shifter gear and the case bushing. The leather washer fits between shifter lever and outside of case. Install the gear on the shaft square with the lever in a vertical position and

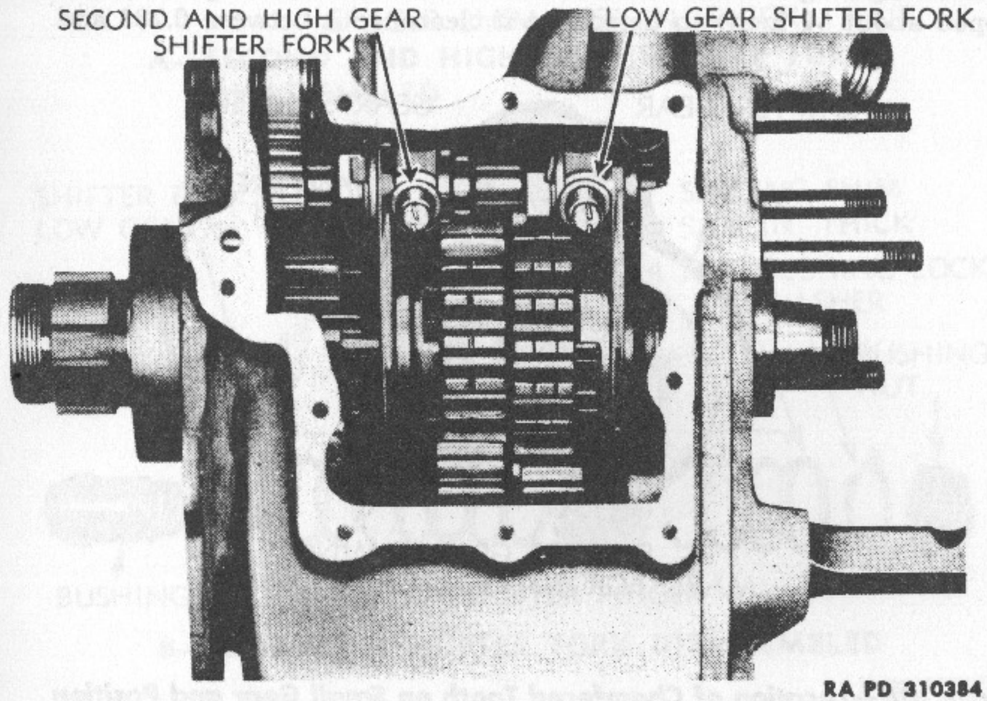


Figure 107—Shifter Forks Installed

the gear teeth facing shifter cam gear. The shifter gear is retained on its shaft by the retaining spring. It will be noted that the figure "3" and letter "R" are stamped on the face (hub side) of the shifter gear. The figure "3" mark will be used to time the shifter cam and lever.

(3) INSTALL SHIFTER CAM. Before installing the shifter cam, make sure that the shifter finger rollers are in place. Notch in right end of shifter cam is cut out to clear boss in side of case. Engage the shifter fingers and rollers in the cam slots; turn the cam so that the chamfered tooth (ground off corner) of the small gear registers in the space marked "3" between the teeth of the large gear; then insert the shifter cam shaft (fig. 108). NOTE: *See that the small rubber seal washer is in place in the shaft groove before shaft is installed.*

(4) INSPECT SHIFTER CLUTCH AND LOW GEAR SHIFTER FORK CLEARANCES (fig. 106). Locate the shifter cam in neutral position so that the highest points of the high gear driving dogs overlap about ⅛ inch.

(a) Make Gages. Dress one end of a piece of metal down to 0.083 inch. This gage will be for shifter clutch and clutch gear (high gear) measurement. From another piece of metal, dress one end down to 0.053 inch and the other end to 0.058 inch. This gage will be for shifter fork and low gear measurement.

(b) Check Clearances (fig. 106). Insert the thickness gage between the driving dogs of the shifter clutch and the clutch gear (overlapped about ⅛ inch) to determine if clearance is between 0.283 and

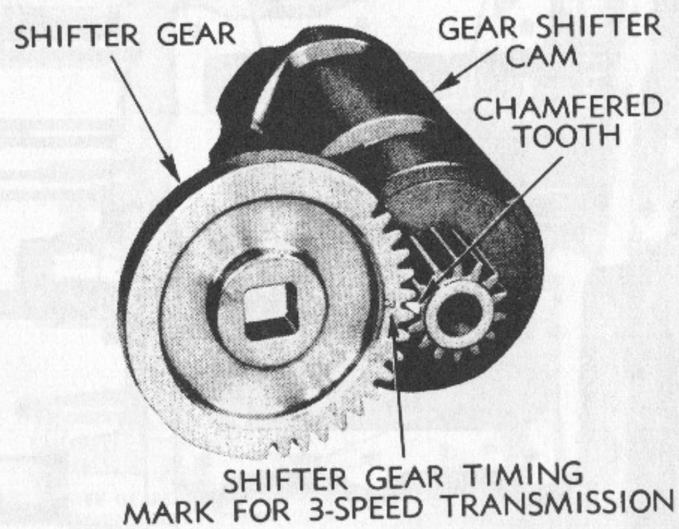


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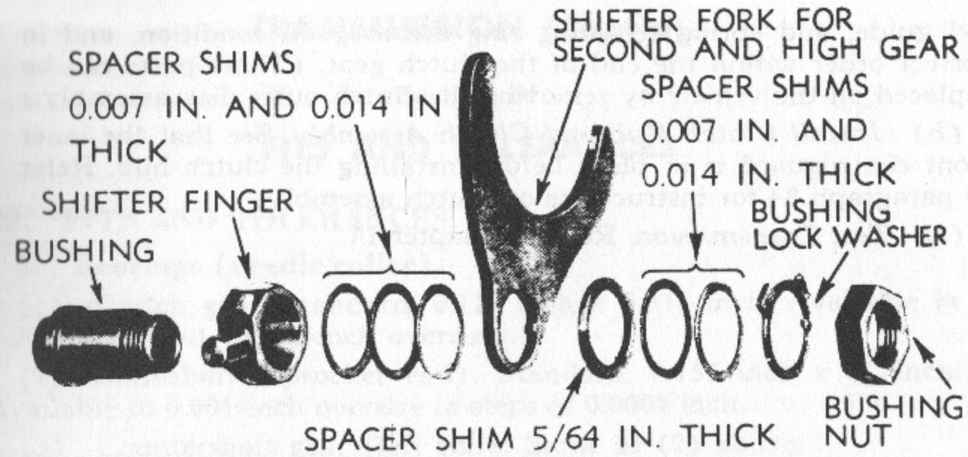
Figure 108—Location of Chamfered Tooth on Small Gear and Position "3" on Shifter Gear for Correct Gear Shifter Timing

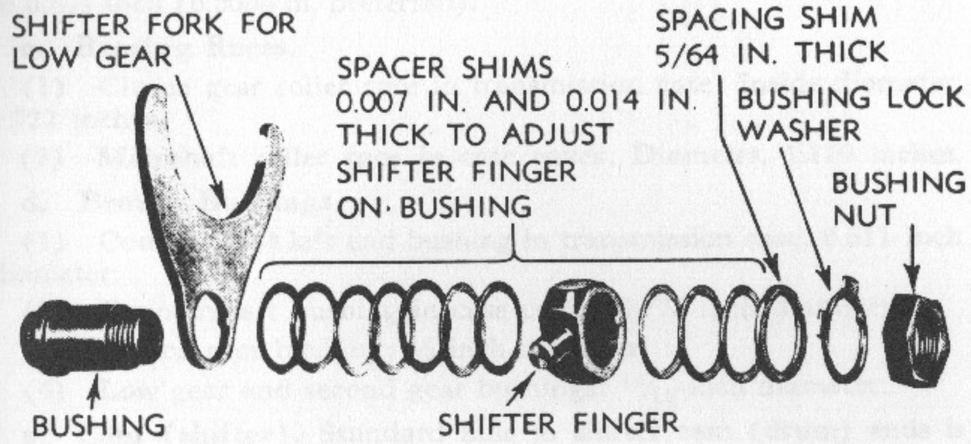
0.288 inch. Insert the thin gage between the shifter fork and side of the low gear to determine if clearance is between 0.053 and 0.058 inch.

(c) Correct Clearances. The relative adjustment between the shifter fingers and the shifter forks is determined by 0.007 and 0.014 inch thick spacing shims (fig. 109). By increasing or reducing the number of these shims between the shifter forks and shifter fingers, a corresponding change is effected in clearance of the shifter clutches. Transfer shims as necessary to correctly locate the clutches and reassemble the shifter fork assemblies to the transmission and recheck clearances.

(d) Secure Shifter Camshaft. After correct shifter fork and shifter clutch adjustment has been made, secure the shifter camshaft in the case with the lock screw.



A—SECOND AND HIGH GEAR SHIFTER FORK DISASSEMBLED



B—LOW GEAR SHIFTER FORK DISASSEMBLED

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Figure 109—Shifter Forks Disassembled

(e) Install Inspection Cover. Before installing the inspection cover, pour about ¾-pint of engine oil, crankcase grade, into the transmission case. See that gasket is in good condition and install cover, securely tightening the cover screws.

(f) Install Sprocket, Push Rod, and Cover Assembly. Locate the two keys on the mainshaft; install the sprocket, lock washer, and nut and securely tighten the nut by striking the wrench with a soft hammer. Bend up nut lock washer lip. Install the clutch push rod assembly. Install the sprocket cover and clutch lever assembly, and securely tighten cover nuts.

(g) Install Push Rod Seal and Guide Assembly (fig. 98). Before installing the clutch, see that the push rod seal, disk-cup, spring, push

rod guide, and spring retaining ring are in good condition, and in correct order within the end of the clutch gear. (These parts can be replaced on the vehicle by removing the clutch outer disk assembly.)

(h) Install Clutch Hub and Clutch Assembly. See that the inner front chain guard is in place before installing the clutch hub. Refer to paragraph 84 for instructions on clutch assembly.

(i) Test Transmission. Refer to chapter 14.

CHAPTER 9

TRANSMISSION (Cont'd)

Section IV

FITS AND TOLERANCES

92. FITS AND TOLERANCES.

a. Bearings (needle roller).

(1) Clutch gear: standard, 0.125 inch x 0.615 inch. Available in 0.0004-inch and 0.0008-inch oversizes.

(2) Mainshaft (sprocket end): Standard, 0.152 inch x 5/8 inch. Available to 0.001-inch oversize in steps of 0.0002 inch.

(3) Countershaft gear (left end): Same as (2) above.

(4) Countershaft gear (right end): Standard 0.114 inch x 3/4 inch. Available in 0.0004 and 0.0008-inch oversizes.

b. Bearing Clearances. All roller bearing clearances to be 0.0006 to 0.001 inch (0.0008 in. preferred).

c. Bearing Races.

(1) Clutch gear roller race in transmission case: Inside diameter, 1.722 inches.

(2) Mainshaft roller race in case cover: Diameter, 1.179 inches.

d. Bronze Bushings.

(1) Countershaft left end bushing in transmission case: 0.611-inch diameter.

(2) Countershaft bushing in case cover: 0.775-inch diameter.

(3) Clutch gear bushing: 3/4-inch diameter.

(4) Low gear and second gear bushings: 15/16-inch diameter.

e. Cam (shifter). Standard hole in shifter cam (drum) ends is 3/8 inch. End play in case, free to 0.005 inch.

(1) Clearance on shaft, 0.001 inch.

f. Cam (shifter) Shaft. 0.374-inch diameter.

g. Clutch Gear. Roller race diameter, 1.471 inches. Refer to clutch gear bushing d (3) above.

h. Countershaft. Small end diameter, 0.609 inch. Roller race (for countershaft gear rollers) diameter, 0.7736 inch.

(1) Clearance in case bushing, 0.002 inch.

(2) Clearance in side cover bushing, 0.001 inch.

i. Countershaft Gear. Replace the countershaft gear when teeth are badly worn and/or when roller races are in bad order.

j. Finger (shifter). Roller stud, 0.287-inch diameter.

k. Finger (roller). Roller inside hole, 0.289 inch; outside diameter, 0.370 inch.

l. Fork (shifter) Shaft. 0.3745-inch diameter.

m. Fork (shifter) Bushing. Bushing hole, 0.375 inch.

(1) Clearance on fork shifter shaft, 0.0005 to 0.001 inch.

n. Gear End Play. Low and second gear end play between the second gear retaining bracket and case side cover 0.005 to 0.007 inch.

o. Mainshaft.

(1) Diameter: End that runs in clutch gear, 0.748 inch. Diameter at low and second gear positions, 0.9365 inch. Diameter at roller bearing end, 0.874 inch.

(2) End Play: 0.003 to 0.005 inch.

(3) Clearance in clutch gear bushing: 0.002 inch.

p. Shifter Clutch Side Clearance.

(1) Shifter cam must be in neutral position. Clearance between driving dogs on high and second shifter clutch and driving dogs on clutch gear highest point on gear dogs overlapping 1/8 inch, 0.053 to 0.058 inch.

(2) Side clearance of low gear shifter clutch, checked between sides of shifter fork and low gear 0.283 to 0.288 inch.

q. Shifter Gear Shaft. Diameter of small end, 0.374 inch. Diameter of shaft body, 0.561 inch.

r. Shifter Gear Shaft Clearance in Bushings.

(1) Shaft end in small bushing, 0.001 inch.

(2) Shaft body in large bushing, 0.0015 inch.

CHAPTER 10

BRAKES

Section I

REAR WHEEL BRAKE

93. DESCRIPTION (fig. 110).

a. The brake is of the internal expanding, two-shoe, fixed-pivot mechanical type, operated by foot pedal on the right footboard. Brake shoes are centered within the drum by shifting the pivot. The shoes are operated (spread) by a cam which is actuated by the brake lever. Shoes are kept tight against pivot and cam faces by means of two coil springs. Adjustment is external, by altering length of brake rod. Brake side cover is attached to vehicle frame, and drum is combined with the sprocket and wheel driving hub assembly. Driving hub also operates the speedometer drive gear.

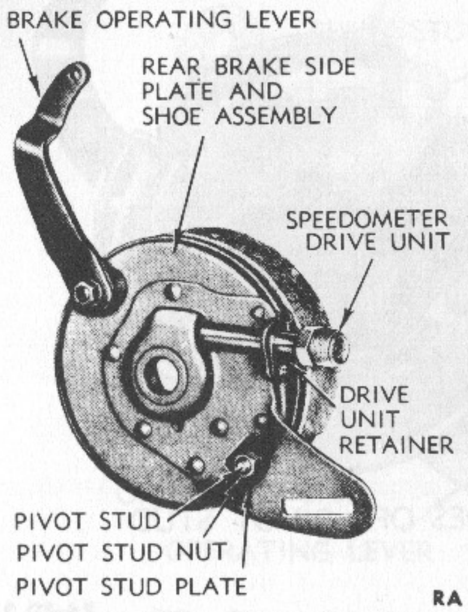


Figure 110—Rear Wheel Brake Assembly

94. REMOVAL AND DISASSEMBLY.

a. If brake is in vehicle, remove the rear wheel and brake drum as instructed in TM 9-879. Then remove side cover assembly from vehicle frame after removing the brake sleeve nut. If shoes and/or liners only are to be replaced or repaired, it is not necessary to remove the side cover assembly from the vehicle frame.

b. Disassembly.

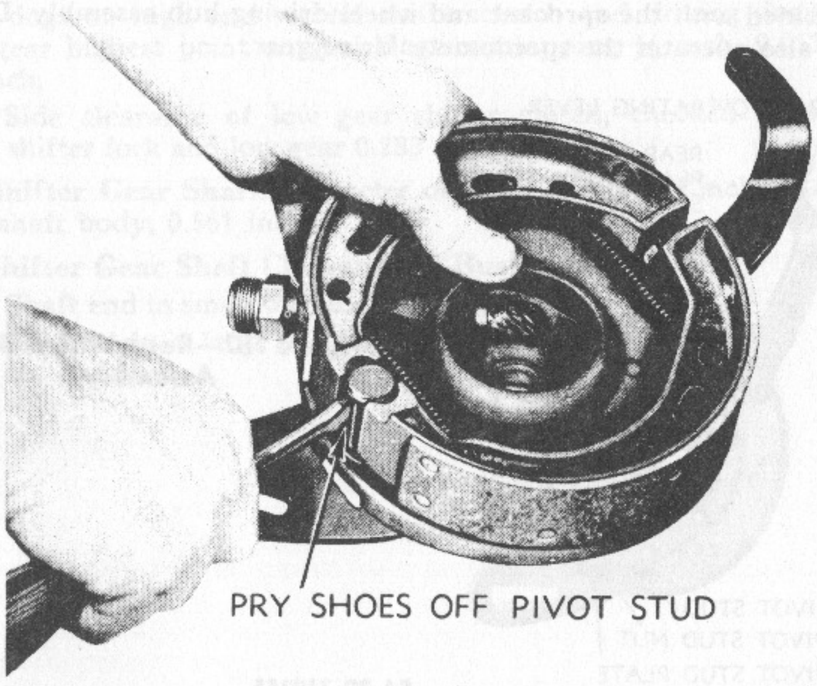
(1) REMOVE BRAKE SHOES FROM SIDE COVER. Place end of a large screwdriver blade between the ends of brake shoes at the pivot stud. Move brake operating lever forward to hold brake shoes in full expanded position and pry ends of shoes off of the pivot stud without removing the shoe springs (fig. 111).

(2) REMOVE PIVOT STUD AND OPERATING CAM. Remove nut, washer, and plate which secures pivot stud to side cover. Remove nut, washer, and operating lever from operating cam, and remove cam from side cover.

(3) REMOVE SPEEDOMETER DRIVE UNIT ASSEMBLY. Remove the screw and retainer and withdraw the drive unit from the brake side cover.

95. CLEANING AND INSPECTION.

a. Cleaning. Clean all parts in dry-cleaning solvent and wipe dry or air dry.



RA PD 310351

Figure 111—Removing Brake Shoes

b. Inspection.

(1) SHOES AND LINERS. Inspect shoes for cracks and breaks. Broken shoes must be replaced. Inspect liners for wear and glazed condition. Liners worn down to rivet heads must be replaced. If shoes are to be used in replacement service, it is advisable to replace any found worn or glazed.

(2) SIDE COVER. Inspect the side cover for bent and twisted condition and for wear of operating camshaft hole. Operating shaft hole is $\frac{9}{16}$ inch.

(3) OPERATING CAMSHAFT. Operating cam faces must be in good condition. Shaft diameter is 0.558 inch.

(4) PIVOT PIN. Inspect pivot pin for bent, damaged, or worn condition. Pivot pin diameter is 0.496 inch.

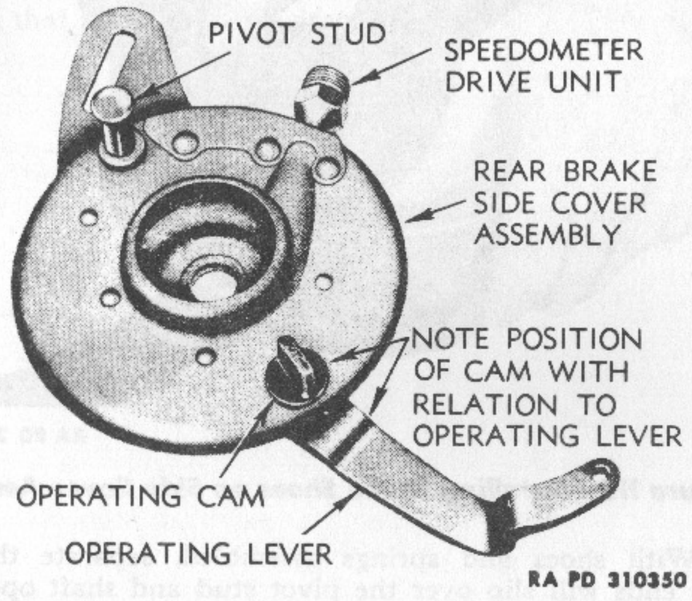
(5) SPRINGS. Must be in good condition.

(6) SIDE COVER BUSHING. The side cover bushing should show very little sign of wear, unless vehicle has been operated with bushing nut loose and side cover bearing has worn the bushing. Replace bushing if excessively worn or in damaged condition.

(7) BRAKE DRUM AND SPROCKET. Inspect brake drum for good, smooth, condition. With brake drum in satisfactory condition, the sprocket can be replaced if badly worn.

96. REPAIR.

a. The only repairs to be made to brake side cover assembly is replacement of parts and relining of shoes. The sprocket can be replaced, providing the brake drum is in good condition.



RA PD 310350

Figure 112—Operating Cam and Brake Lever Assembled

(1) Refer to paragraph 116 for sprocket replacement.

(2) Refer to paragraph 97 for instructions covering speedometer drive unit.

b. Relining Shoes. Rivets are inserted from the outside, through the liner and brake shoe. When lining a shoe, start at one end and work to the other end in order to make the liner bear tightly against the shoe and not buckle in the middle. If a liner riveting machine is not available, set the rivets by hand, making sure they draw the liner tight against the shoe.

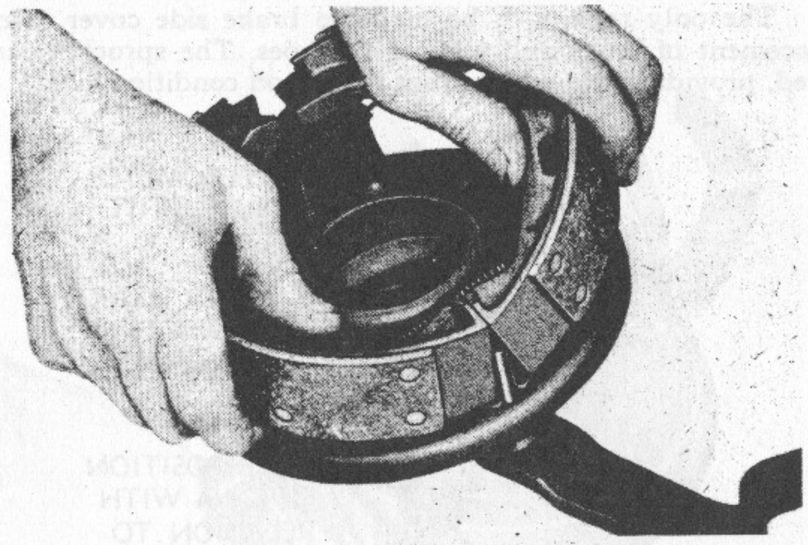
c. Linkage. Other than straightening slightly bent parts (rods, levers, etc.) brake linkage repair is made by replacement of badly worn or damaged parts.

97. ASSEMBLY AND INSTALLATION.

a. Install Operating Cam and Pivot Stud. Install the operating cam with the arrow (on end of cam) pointing outward, toward the brake lever (fig. 112). Install the pivot stud, pivot stud plate (serrated side next to side cover), washer and nut.

b. Brake Shoes and Springs. Observe that brake shoes are made for upper and lower positions on the side cover and are not interchangeable. Recess in end of shoe for pivot stud head determines position of shoe in assembly.

(1) Engage the ends of springs in shoe casting holes from the inside before installing shoes on side cover.



RA PD 310354

Figure 113—Installing Brake Shoes on Side Cover Assembly

(2) With shoes and springs assembled, separate the shoes so that the ends will slip over the pivot stud and shaft operating cam (fig. 113).

c. Install Speedometer Drive Unit. Install the speedometer drive unit in the side cover and secure with retainer, lock washer, and screw (fig. 110).

d. Installation on Vehicle. Assemble brake side cover assembly to vehicle frame with brake sleeve and nut. Do not tighten nut as side cover is shifted in the frame to adjust the rear chain.

(1) CONNECT BRAKE LINKAGE. Connect brake rod end clevis to the brake operating lever.

(2) INSTALL DRUM AND SPROCKET. Install the drum and sprocket assembly and install rear drive chain.

(3) INSTALL WHEEL AND ADJUST CHAIN. Refer to instructions in TM 9-879 for rear wheel installation, chain adjustment, and wheel alinement instructions.

(4) CENTER (EQUALIZE) SHOES IN DRUM. Loosen the nut on the shoe pivot stud, and while applying pressure on the brake pedal (to center the shoes within the drum) retighten the pivot stud nut. The serrations in the stud plate and side of cover will prevent the stud from shifting after the nut is tightened.

e. Adjusting Rear Wheel Brake. The normal free play of brake foot pedal before operation is one inch. After brake takes effect in vehicle operation, the brake foot pedal should have one inch reserve travel before bottoming on the footboard. Adjust brake as follows:

(1) Disconnect clevis from brake operating lever and loosen the clevis lock nut on the rod.

(2) Turn clevis onto brake rod to shorten rod and take up foot pedal free play.

(3) Turn clevis off of brake rod to lengthen rod and increase foot pedal free play.

(4) Reconnect rod clevis to brake lever and check adjustment, making sure that brake does not drag.

CHAPTER 10

BRAKES (Cont'd)

Section II

FRONT WHEEL BRAKE

98. DESCRIPTION (figs. 114 and 115).

a. The front wheel, hand-controlled auxiliary brake is of internal-expanding type. Two shoes, on a fixed pivot, are mechanically operated. Brake is controlled by a flexible steel wire (stranded cable) operating with a flexible housing. Brake drum is an integral part of the front wheel hub. Brake side cover is connected to the rigid fork by a shackle arm to allow for front fork spring action.

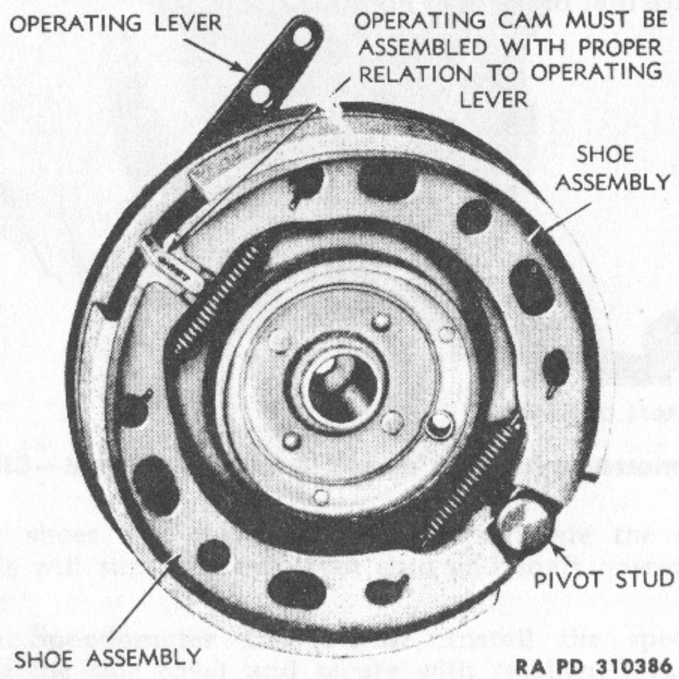


Figure 114—Front Wheel Brake Side Cover and Shoe Assembly (Inside)

99. REMOVAL AND DISASSEMBLY.

a. Remove Wheel and Disconnect Linkage. If brake is in vehicle, remove front wheel, following instructions in TM 9-879. Disconnect control wire clevis from brake operating lever to free side cover and shoe assembly from control linkage.

b. Disassemble Side Cover. Remove shoes. Use a large screwdriver and spread pivot ends of shoes so that both shoes and springs can be pried off of stud and operating cam (fig. 111). Remove pivot stud and operating cam from side cover. Remove shackle arm. Re-

move stabilizer. Remove grease fitting, cover plate, spring disk, bronze disk, stabilizer and bronze disk from side cover.

100. CLEANING AND INSPECTION.

a. Clean all parts in dry-cleaning solvent and wipe or air dry.

b. Inspection. Inspect all parts for bent, worn and/or broken condition.

(1) SIDE COVER BUSHING. Diameter, 7/8 inch. Has 0.0015-inch clearance on axle sleeve.

(2) OPERATING CAM BUSHING. Riveted in side cover. Diameter, 9/16 inch. Has 0.005-inch clearance on camshaft.

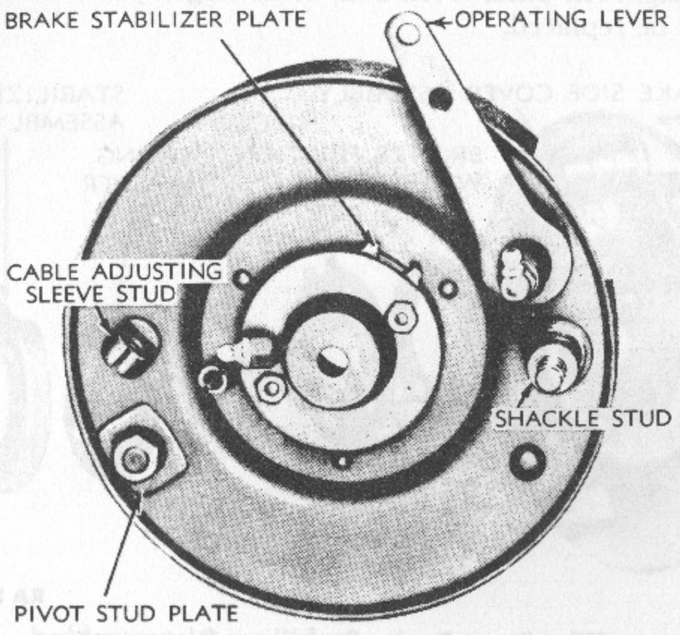


Figure 115—Front Wheel Brake Side Cover Assembly (Outside)

(3) OPERATING CAM. Diameter, 0.558 inch.

(4) SHACKLE STUD. Riveted to side cover. Diameter, 0.623 inch. Clearance in shackle arm bushing, 0.002 inch.

(5) SHACKLE ARM. Steel bushings. Diameter, 5/8 inch.

(6) SHACKLE STUD (IN RIGID FORK). Diameter, 0.623 inch. Clearance in shackle arm bushing, 0.002 inch.

(7) CONTROL WIRE, HOUSING, AND FITTINGS. Inspect control wire (flexible cable), housing, clevis and pin, handle and all linkage fittings for good condition. Badly worn, bent, or broken parts must be replaced. Frayed or broken control wire (flexible cable) must be replaced.

(8) GREASE FITTINGS. See that all grease fittings are in good order and are in good working condition.

(9) BRAKE SHOES. Inspect shoe castings for cracks, breaks, or excessive wear at cam and stud ends. Liners must be replaced when worn down to rivet heads. At time of brake repair, if liners show signs of wear, it is advisable to replace liners for shoe replacement service.

(10) STABILIZER PARTS (fig. 116). Inspect the stabilizer hub, bronze washers, disk, spring, and cover plate for good condition. Replace any badly worn or damaged parts.

101. REPAIR.

a. Side Cover. Other than replacing the bronze bushing in the side cover, repair to the side cover is not recommended because of structural design. All other worn and/or damaged parts of brake and linkage must be replaced.

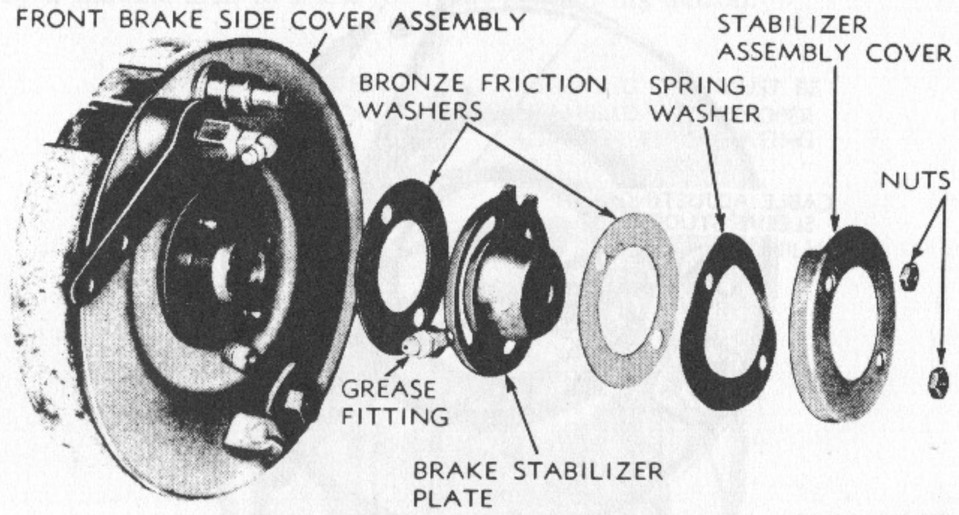


Figure 116—Front Brake Stabilizer Disassembled

b. Brake Shoes. When relining brake shoes, start from end of liner and work toward the other end in order to make the liner lay tight against the shoe. Rivets are passed through the liner from the outside and are set against the shoe.

102. ASSEMBLY AND INSTALLATION.

a. Install Operating Cam and Pivot Stud. Install the operating cam with the arrow (on end of cam) pointing outward, and with brake lever at right angles to cam (fig. 114). Install the pivot stud, pivot stud plate (serrated side next to side cover), washer and nut.

b. Brake Shoes and Springs. Observe that brake shoes are made for upper and lower positions on the side cover and are not interchangeable. Recess in end of shoe for pivot stud head determines position of shoe in assembly.

(1) Engage the ends of the springs in shoe casting holes from the inside before installing shoes on side cover.

(2) With shoes and springs assembled, separate the shoes so that the ends will slip over the pivot stud and shaft operating cam (fig. 113).

c. Installation on Vehicle. Refer to TM 9-879 for installation and adjustment instructions.

CHAPTER 11

CHAINS, SPROCKETS, WHEELS, AND HUBS

Section I

WHEEL RIMS AND SPOKES

103. DESCRIPTION AND DATA.

a. Description. Both wheels are wire spoked with 40 spokes in each. Front and rear wheels are not interchangeable. 18-inch drop center rims accommodate 18-inch x 4.00-inch drop center tires. Rims are not interchangeable because of spoke nipple diameter and angles. Front wheel rim is identified by "SF 705 TA" stamped near valve hole. Rear wheel rim has larger nipple holes and has number "XF 705" stamped near valve hole. Rims must be centered on hubs for correct alinement on vehicle.

RA PD 310401

Figure 117—Dimensions for Correctly Centered Front and Rear Wheel Rims

b. Data.

(1) FRONT WHEEL.

Rim, 18-inch, 40 holes (identified by "SF 705 TA" stamped near tire valve hole).

Spokes on brake flange side; 20 used, $5\frac{5}{16}$ inches long.

Spokes on hub flange side; 20 used, $8\frac{3}{8}$ inches long.

Nipples, 40 used.

(2) REAR WHEEL.

Rim, 18-inch, 40 holes (identified by "XF 705" stamped near tire valve hole).

Spokes, 40 used, $8\frac{5}{32}$ inches long, and 0.161-inch diameter.

Nipples, 40 used.

104. INSPECTION.

a. Wheel rims must be inspected for bent, twisted and kinked condition and condition of nipple holes. Replace badly bent, kinked and twisted rim, or rim with nipple holes pulled out. NOTE: *Do not replace spokes or bearings until condition of hub is ascertained.* Section II of this chapter.

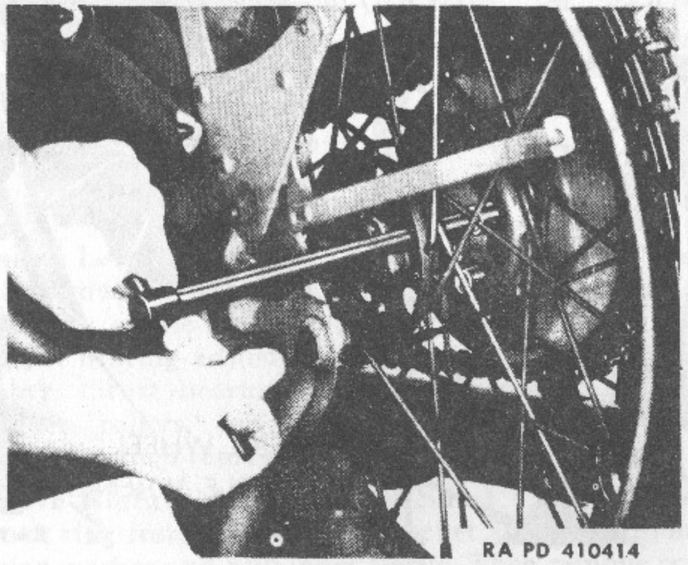


Figure 118—Removing Rear Wheel Mounting Screws with Wrench (41-W-3832)

b. Spokes and Nipples. All spokes and nipples must be in good condition and each spoke tightened to carry its load in the wheel. Bent, cut, and stripped thread and/or broken spokes must be replaced. Nipples must be in good condition.

c. Trueness and Correct Rim Centering. Wheel assembly must be inspected for true running rim and rim center in relation to hub (fig. 117).

105. SPOKE REPLACEMENT.

a. Wheels must be removed from vehicle for spoke replacement. Use special wrench (41-W-3832) to remove mounting screws when

removing rear wheel (fig. 118). Replace any damaged, bent, broken or stripped thread spokes. Use wrench 41-W-3340 for rear wheel spoke nipples, and wrench 41-W-3339 for front wheel spoke nipples (fig. 119). Replace any nipples not in good condition. Where only several spokes are replaced, tighten accordingly, and see that wheel rim is true after spoke tightening.

106. LACE WHEELS.

a. Wheel lacing is a most difficult procedure to describe, even with pictures. The best and surest method is to follow the pattern of a wheel already laced.

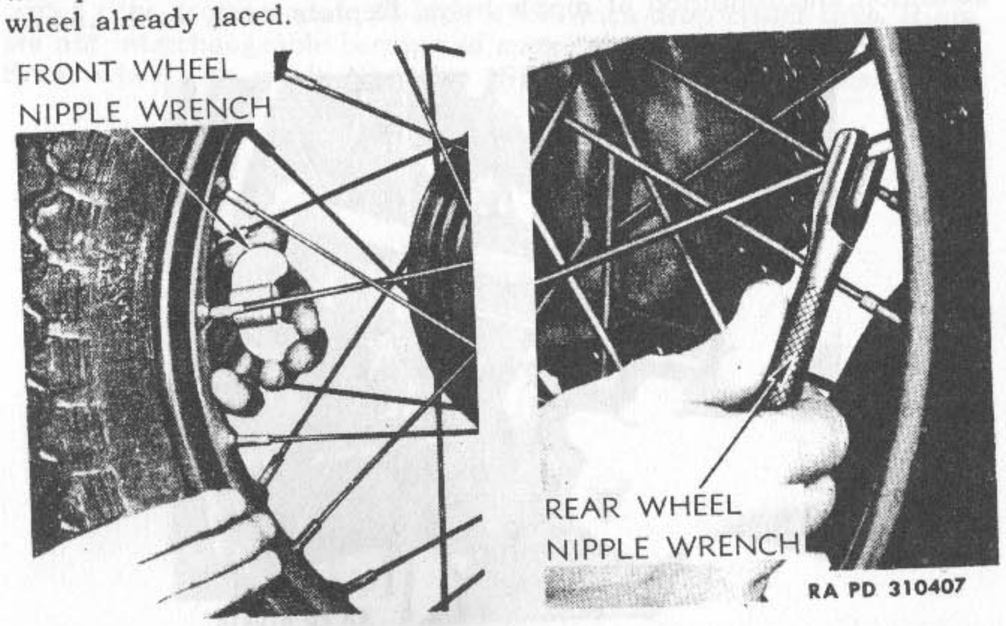


Figure 119—Front and Rear Wheel Spoke Replacement, Using Spoke Nipple Wrenches (41-W-3340) Rear and (41-W-3339) Front

107. TRUING WHEELS.

a. Mount in Stand. Mount wheel in truing stand, and adjust stand gages to determine position of rim as regards side wobble and eccentricity.

b. Center and True Rim. Use wrench 41-W-3340 for rear wheel spoke nipples and wrench 41-W-3339 for front wheel spoke nipples (fig. 119). When tightening the spoke nipples, bear in mind that the rim must be centered in relation to the hub. From time to time, check the distance from the rim to the straight edge (or a point on the truing stand) to determine rim center.

(1) True rim so that side weave or wobble and eccentricity are within $\frac{1}{16}$ inch of true.

(2) Tighten all nipples so that each spoke is carrying its share of the wheel load.

CHAPTER 11

CHAINS, SPROCKETS, WHEELS, AND HUBS (Cont'd)

Section II

WHEEL HUBS

108. DESCRIPTION.

a. Rear Hub (fig. 120). Knock-out axle with roller bearing hub. Fourteen $\frac{1}{4}$-inch rollers used on brake end and twelve $\frac{1}{4}$-inch rollers used on the other (outside) end. (Rollers are 0.490 in. long.) End play adjustment is made by shims. Bearing wear is taken up by use of oversize rollers. To take up excessive side play only, it is not necessary to completely disassemble hub (par. 110).

b. Front Hub (fig. 121). Knock-out axle. Ball bearing hub, adjustable cone similar to bicycle hub design. Thirteen $\frac{5}{16}$-inch balls used in each end. No ball retainers used. Front hub and brake shell are of integral construction. Grease gun lubrication.

109. REAR HUB DISASSEMBLY.

a. Remove Left Side (Brake Side) Components. Remove five thrust bearing cover screws and washers. Then remove thrust bearing outer cover, cork grease retainer, thrust bearing housing, and gasket. Remove thrust bearing adjusting shims (shims are 0.002 inch thick), thrust washer, thrust bearing sleeve, and remaining thrust washer. Roller retainer, rollers, and left side (brake side) roller retainer thrust washers are then removed.

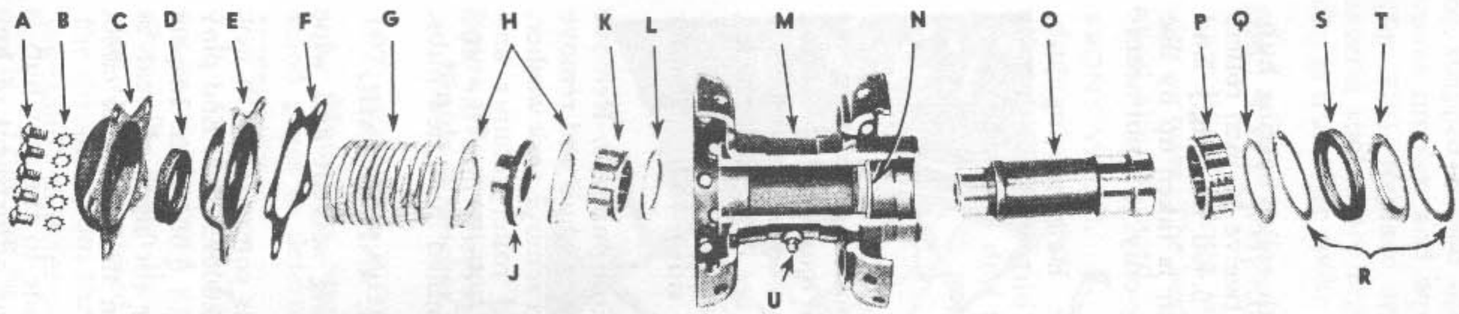
b. Remove Right Side (Sprocket Side) Components. Remove retaining lock ring from right side (sprocket side) of hub and remove cork retaining washer and hub inner sleeve. Then remove cork washer, retaining lock ring, roller bearing washer, and roller retainer and rollers. The right side roller retainer washer, pressed into the hub shell, need not be removed. This washer is assembled in all new hubs.

110. REAR HUB CLEANING, INSPECTION, AND REPAIR.

a. Cleaning. Clean all parts in dry-cleaning solvent and wipe or air dry.

b. Inspection. Inspect for good condition as compared with new parts. Hub clearance on the rollers is 0.0005 to 0.00075 inch. End play of hub on the inner sleeve is between 0.003 and 0.005 inch. Inspect roller races within hub and on the inner sleeve for signs of wear or roughness. Cork washers must be a snug fit on their seats to effect good grease seal.

c. Repair. The only repair that can be made to the rear hub is replacement of worn or damaged parts and the adjustment of hub end play on the inner sleeve. The hub end play can be adjusted without complete hub disassembly, as follows:



A — THRUST BEARING COVER SCREW

B — THRUST BEARING COVER SCREW WASHERS

C — THRUST BEARING OUTER COVER

D — CORK GREASE RETAINER

E — THRUST BEARING HOUSING

F — THRUST BEARING HOUSING GASKET

G — THRUST BEARING ADJUSTING SHIMS (0.002" THICK)

H — THICK THRUST WASHERS (2)

J — THRUST BEARING SLEEVE

K — ROLLER BEARING ASSEMBLY (LEFT END)

L — LEFT ROLLER RETAINER THRUST WASHER

M — HUB SHELL (SECTIONED)

N — RIGHT ROLLER RETAINER WASHER (PRESSED INTO HUB SHELL)

O — HUB INNER SLEEVE

P — ROLLER BEARING ASSEMBLY (RIGHT END)

Q — ROLLER BEARING WASHER

R — RETAINING LOCK RING (2)

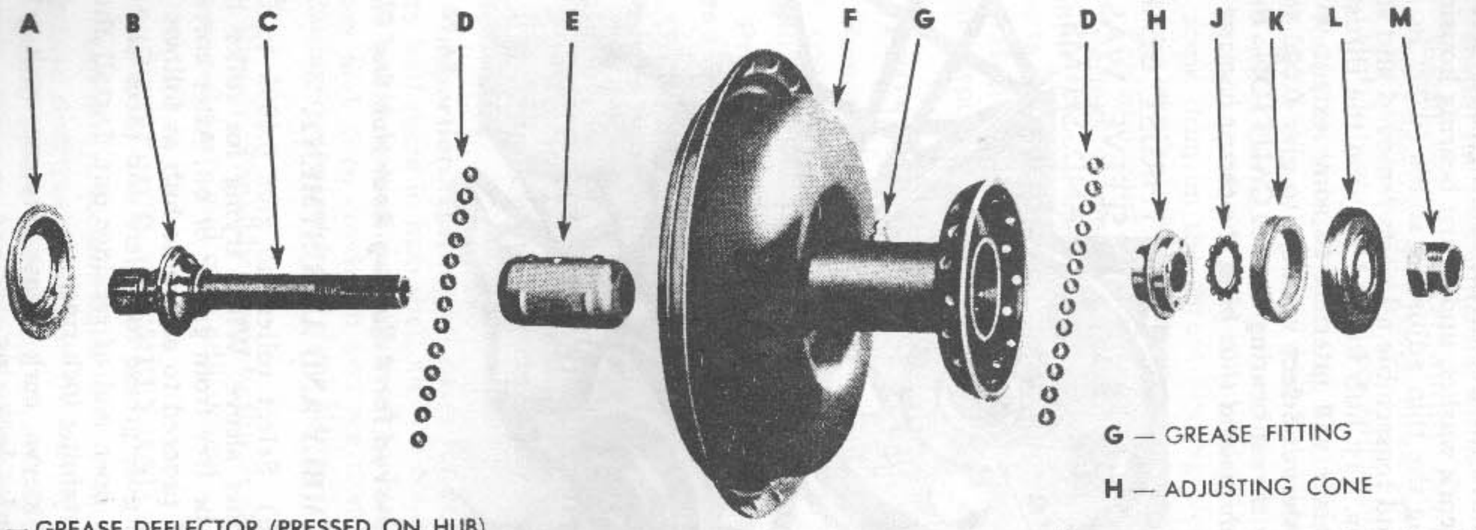
S — CORK GREASE RETAINER

T — CORK RETAINING WASHER

U — GREASE FITTING

RA PD 310283

Figure 120—Rear Wheel Hub Disassembled



A — GREASE DEFLECTOR (PRESSED ON HUB)

B — CONE SPRING RING

C — FRONT AXLE SLEEVE AND CONE (INTEGRAL PART)

D — 5/16 INCH STEEL BALLS (13 IN EACH END)

E — GREASE DISTRIBUTING SLEEVE

F — FRONT HUB AND BRAKE SHELL ASSEMBLY

G — GREASE FITTING

H — ADJUSTING CONE

J — ADJUSTING CONE LOCK WASHER

K — GREASE SEAL

L — GREASE SEAL RETAINER

M — ADJUSTING CONE LOCK NUT

RA PD 310284

Figure 121—Front Wheel Hub Disassembled

(1) ADJUSTING HUB END PLAY WITHOUT COMPLETE DISASSEMBLY (fig. 122). Remove the five thrust bearing cover screws and lock washers. The cover, cork washer, and thrust bearing housing may then be removed, exposing the thin adjusting shims (0.002 in. thick). Add one or more shims and reassemble all parts removed and securely tighten cover plate screws. Try hub for end play on the thrust bearing sleeve. The cork retainer will interfere to some extent with free movement of the thrust sleeve. Select washers to give 0.003 to 0.005 inch hub end play on the thrust bearing sleeve. CAUTION: *Be careful not to add too many shims and thus bind the thrust bearing sleeve.*

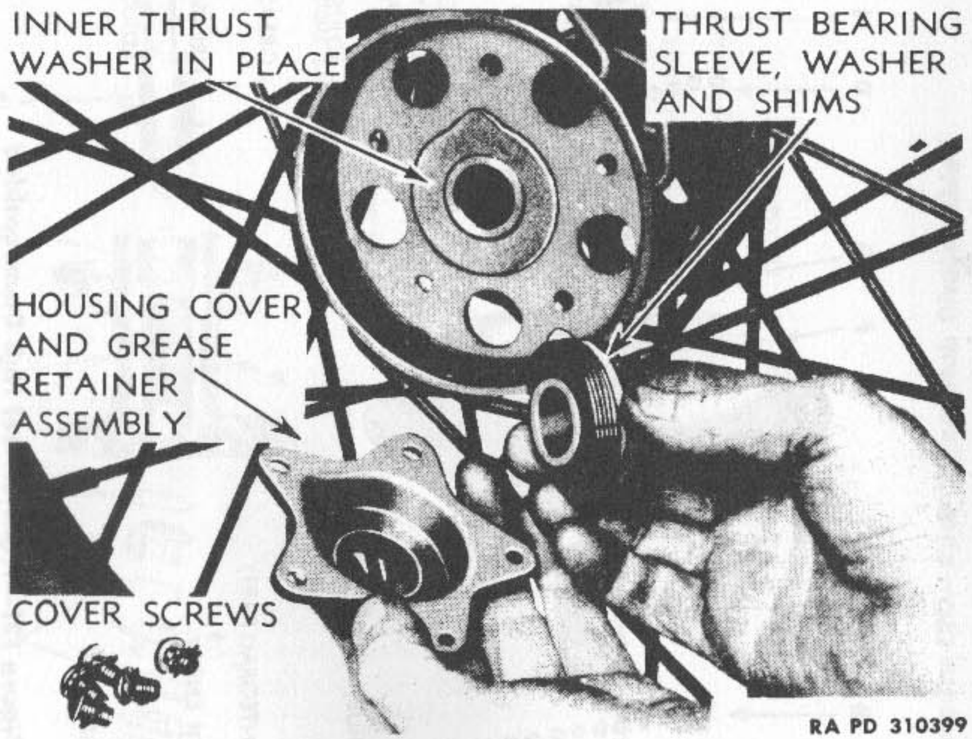


Figure 122—Parts Removed for Adjusting Rear Hub End Play

111. REAR HUB ASSEMBLY AND ADJUSTMENT.

a. Assembly (fig. 120). Select rollers to give 0.0005 to 0.00075 inch clearance on the inner sleeve. When trying for roller bearing clearance, bearings must be free from grease or oil. After correct size rollers have been selected proceed to assemble hub as follows:

(1) Apply general purpose grease to rollers and races and install right end bearing in hub, open end of retainer out. Install the roller bearing washer and the retaining lock ring.

(2) Install hub inner sleeve, cork grease retainer, cork retaining washer, and outside retaining lock ring.

(3) Install left side roller retainer washer in hub and roller bearing assembly with open end of retainer out.

(4) Install one of the thick thrust washers: then the thrust bearing sleeve; then the remaining thick thrust washer.

(5) Install the thin adjusting shims.

(6) Install paper gasket, thrust bearing housing, cork grease retainer, and bearing outer cover. Draw up the five cover screws tight.

(7) Hub is now ready to check end play adjustment.

b. End Play Adjustment (fig. 122). End play adjustment is made by adding or removing thin steel shim washers (0.002 in. thick) in the left end of the hub. The correct hub end play on the thrust bearing sleeve is 0.003 to 0.005 inch. The cork grease retaining washers may cause some drag on the thrust bearing sleeve, making it difficult to determine whether the thrust sleeve is free (0.003 to 0.005-in. end play). The hub must have the required end play and be free on the roller bearings to ensure most satisfactory service life. Remove or add shims as necessary to obtain correct end play, reassembling left end parts each time to make the end play check.

(1) HUB LUBRICATION. After final assembly, inject 1¼ ounces of general purpose grease with aid of grease gun.

112. FRONT HUB DISASSEMBLY.

a. Remove nut from right end of hub and remove felt seal retainer, cone lock, and cone from axle sleeve. Felt seal will come out with the cone. The balls are free to fall out, no retainer being used.

b. Pry the grease deflector from the left end (brake side) of the hub and withdraw axle sleeve and cone assembly.

c. Grease distributing sleeve furnished on late models can be withdrawn from hub shell.

113. FRONT HUB CLEANING, INSPECTION, AND REPAIR.

a. Cleaning. Clean all parts in dry-cleaning solvent and wipe or air dry.

b. Inspection. Inspect all parts for good condition, paying attention to ball races in hub shell and on cones. Pitted or worn ball races makes part replacement necessary. Inspect brake shell for deep grooves and worn condition and see that spoke flanges are true and not damaged. If steel balls show signs of wear and are pitted, replace them.

c. Repair. The only repair to the front hub is replacement of worn or damaged parts and cone adjustment.

114. FRONT HUB ASSEMBLY AND ADJUSTMENT.

a. Assembly. Retain balls in hub shell races with grease. Install the grease distributing sleeve; fill inside of grease distributing sleeve with grease before assembling on axle sleeve. Install the grease distributing sleeve on the axle sleeve and cone assembly, and assemble to hub from the left (brake) end. Press grease deflector ring on hub.

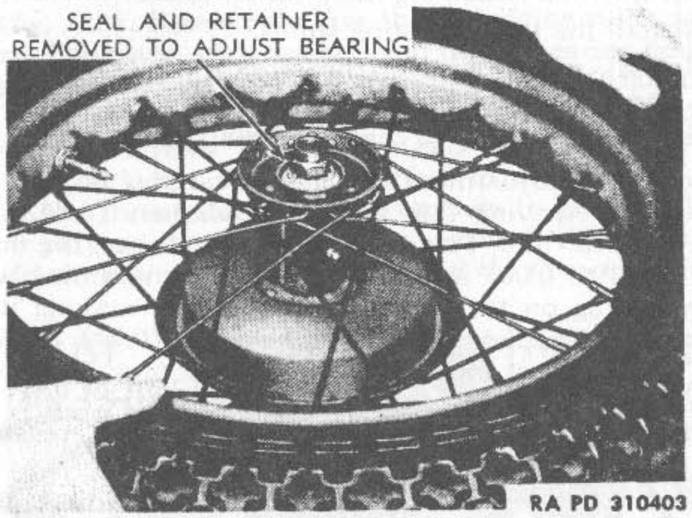


Figure 123—Cone, Lock and Nut in Position to Adjust Front Wheel Bearing Play

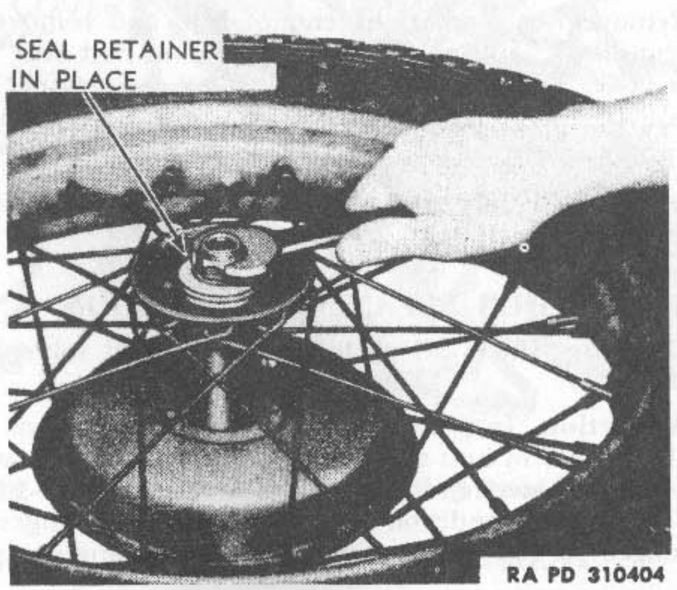


Figure 124—Tightening Bearing Cone Lock Nut After Adjustment

Turn on the right end cone; install cone lock and nut. Leave out felt grease seal and seal retainer until thrust adjustment has been made (fig. 123).

b. Adjustment. Adjust cone so that wheel rim has slight side shake when axle sleeve nut is tight; then remove nut and apply a slight amount of grease or oil to felt seal for initial lubrication and press firmly in place; then install felt seal retaining washer. Nut can now be turned on sleeve and tightened for final assembly (fig. 124).

After final assembly, make a bearing check to be sure cones are not too tight.

(1) HUB LUBRICATION. After final assembly, inject one ounce of general purpose grease.

c. Exceptions. Front wheel hubs on earlier models did not have grease distributing sleeve nor felt grease seal. When the felt grease seal was first assembled on model WLA front wheel hub, the cone, cone lock and nut differed from design illustrated in figures 121, 123 and 124 of this manual. For description of this assembly, refer to TM 9-879.

(1) Grease deflector sleeve can be installed in any WLA model front wheel hubs to direct grease to balls and races.

(2) Felt grease seal can be installed in any earlier WLA model front wheel hubs by replacing original parts with items H, J, K, L and M, figure 121.

CHAPTER 11

CHAINS, SPROCKETS, WHEELS, AND HUBS (Cont'd)

Section III

CHAINS AND SPROCKETS

115. DESCRIPTION.

a. Sprockets.

(1) ENGINE SPROCKET. Standard sprocket on WLA model has 31 teeth. Sprocket is ½-inch pitch for double-row roller chain and is taper fit on flywheel shaft with Woodruff key.

(2) CLUTCH SPROCKET. The clutch sprocket is an integral part of the clutch shell assembly and also serves as outer race for clutch hub ball bearing. When worn or damaged, the sprocket and hub shell assembly must be replaced.

(3) TRANSMISSION COUNTERSHAFT SPROCKET. Standard sprocket on WLA model has 17 teeth, sprocket is ⅝-inch pitch for single-row roller chain and is taper fit on transmission mainshaft with two Woodruff keys.

(4) REAR WHEEL SPROCKET. The 41-tooth, ⅝-inch pitch sprocket is secured to brake drum with eighteen $\frac{5}{32}$-inch rivets and six $\frac{3}{16}$-inch dowel pins. Refer to paragraph 116 for replacement instructions.

b. Chains.

(1) FRONT CHAIN. The front roller chain is endless, of double-row type, having 100 links of ½-inch pitch. Chain is lubricated from engine lubricating system and provided with separate adjustment. Front chain is adjusted by shifting transmission backward or forward in frame mounting.

(2) REAR CHAIN. The rear roller chain is single-row, ⅝-inch pitch and is 58¾ inches long when new. Rear chain is secured on sprockets with a connector (master) link. Rear chain is lubricated by engine lubricating system and provided with separate adjustment. Supplementary lubrication provided by external application or by soaking chain in lubricating bath. Rear chain is adjusted by shifting rear wheel axle backward or forward in frame stay clips.

116. REAR WHEEL SPROCKET.

a. On later WLA models the rear wheel sprocket is assembled on the brake drum with eighteen $\frac{5}{32}$-inch rivets and six $\frac{3}{16}$-inch dowel pins. Sprocket rivets only on earlier models may work loose and elongate the rivet holes, making sprocket replacement necessary. The rear wheel sprocket only is furnished with twenty-four $\frac{5}{32}$-inch holes and the six $\frac{3}{16}$-inch dowel holes must be drilled after eighteen rivets have been installed. If inspection shows rear sprocket is in worn condition and rivets are loose, service as follows in **b**, **c**, and **d**, of this paragraph.

b. To Tighten Slightly Loose Sprocket.

(1) If sprocket is only very slightly loose and rivet holes are not elongated, remove 6 of the rivets (every fourth rivet as in fig. 125) by chiseling off heads (hub side) and punching out rivets. Reset remaining 18 rivets, using special riveting jig (No. 41-J-373) and concave punch. Lock jig securely in vise, set drum and sprocket assembly in jig, with sprocket up. Place slotted washer between spring on jig and speedometer drive gear on drum, and turn knurled spring tension adjusting nut down lightly against spring. Spring tension holds rivet head firmly in anvil socket to ensure a good, tight, riveting job on each rivet and dowel pin. With spring tension properly adjusted, drum assembly can be lifted far enough to permit turning sprocket so any (fig. 126). If old style jig (without spring and washer assembly attached) is used, care must be taken to see that rivet head seats well into anvil socket, when heading rivet. Or a long bolt with nut, 2 large flat washers, and a spring can be used (through center of jig) to make it similar to late style jig.

(2) After rivets have been reset, redrill the 6 holes from which rivets were removed, using a $\frac{3}{16}$-inch drill. Drill from hub side, holding drill as steady as possible and at right angles to sprocket face so holes will be straight and to size. Insert dowel pins, with heads on inside (hub side) of sprocket (fig. 126). After inserting dowel pins, place sprocket and drum assembly on riveting jig and fully seat dowel pins, using hollow punch. Head the hollow (outer) end of dowel pins

pounch not only forms a head but
s: o they completely fill their holes.

oose Sprocket, with Rivet Holes

u: : rivet holes do not appear to be
er it and sprocket is otherwise in
off heads of all rivets and punch
ea.ds on hub side), skipping every
ash ring is damaged or its holes

assembly on riveting jig and fully
(hub side) of sprocket and at the

mably tight together, using hollow
r (outer) end of rivets, using con-
rivets as the first one, then head the
next, head the two rivets midway
d the remaining 14 rivets. As each
to y to heading, again use hollow
ead and parts of assembly are tight
.

ded securely, redrill the six open
t dowel pins as explained in **b** (2)

d. Fitting New Sprocket to Used Brake Drum.

(1) When necessary to replace rear sprocket with a new sprocket due to worn teeth or badly elongated rivet holes, or both, chisel off heads of all rivets and punch out rivets. If the assembly is one with dowel pins, mark the dowel pin holes in drum before punching out dowel pins and rivets. Sprocket can then be removed and discarded.

(2) Carefully inspect brake drum. If original holes are badly worn and elongated and outside diameter of drum flange is worn so it is a loose fit in counterbore of new sprocket, drum also should be discarded and a new, complete sprocket and drum assembly installed. If holes are found elongated to some extent, but drum flange is still a fairly close fit in counterbore of new sprocket, and drum is in good condition otherwise, a new set of holes can be drilled in drum flange, midway between original holes. When redrilling, use new sprocket as

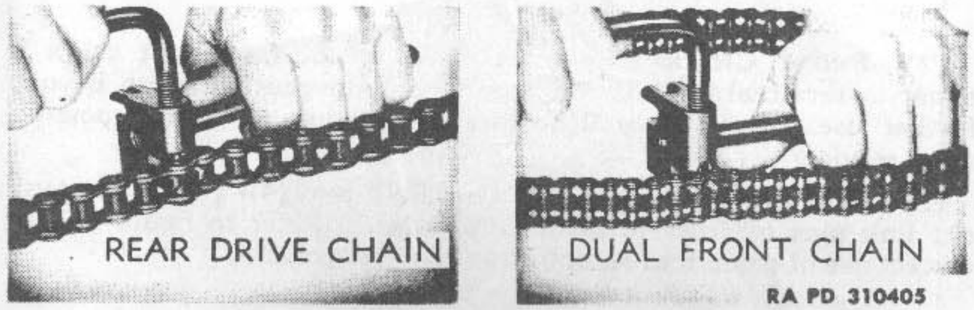


Figure 127—Replacing Front and Rear Chain Links with Tool (41-T-3320)

a template for locating holes. Sprocket must be installed in same manner as it is installed in final assembly and with flange on brake drum registered in counterbore of sprocket. When repairing in this manner, block up sprocket and drum so they rest on blocks rather than on speedometer drive gear on drum hub. Use thin boards or other available material of required thickness. Drill one $^{5}/_{32}$-inch hole and insert rivet. Next, drill hole directly opposite first hole and insert rivet. These rivets will hold sprocket and drum in exact relation while drilling remaining holes. Now drill remaining 22 holes with $^{5}/_{32}$-inch drill. Remove the two rivets and sprocket from drum and completely remove burs from newly drilled holes with a file. Replace sprocket on drum, install splash ring and insert 18 rivets (with heads on hub side), leaving every fourth hole open for dowel pin, and head all rivets securely. Follow procedure given in **c** (2) of this paragraph, when heading rivets.

(3) After rivets have been headed securely, redrill the six open holes and fit dowel pins as explained in **b** (2) of this paragraph.

Bear in mind when new sprocket is being installed on used drum and original drum holes are being used again, that if drum has already been drilled for dowel pins, care must be taken to see that dowel pins are again fitted in same holes.

117. CHAINS.

a. Except in case of emergency, repair to drive chains is not good practice because chains are generally worn excessively at time of breakage and should be replaced. Both the front and rear chains can can be repaired by removing the broken link and installing repair links. Inspect both chains for broken or lost rollers, loose pins, and cracked side plates.

b. Chain Wear. Determine chain wear with regard to replacement as follows:

(1)

(2) FRONT CHAIN. The front chain is endless. Front chain is either in serviceable condition or rusted, damaged and worn beyond further use. Inspection will reveal condition as to further possible good service.

c. Chain Link Replacement. Use chain tool (41-T-3320) to push out link pins in order to install repair links. Refer to figure 127 for correct use of chain tool on both front and rear chains.

CHAPTER 12
STEERING SYSTEM

Section I
FORK

118. DESCRIPTION.

a. The WLA model fork is composed of two members; namely, the spring fork and the rigid fork. The spring fork consists of two spring fork side assemblies to absorb shock and recoil during service action. The rigid fork stem passes through the frame head and, with the two side assemblies, attaches to the handlebars for steering. The rigid fork bearing in the frame head is provided by thirty $\frac{5}{16}$-inch

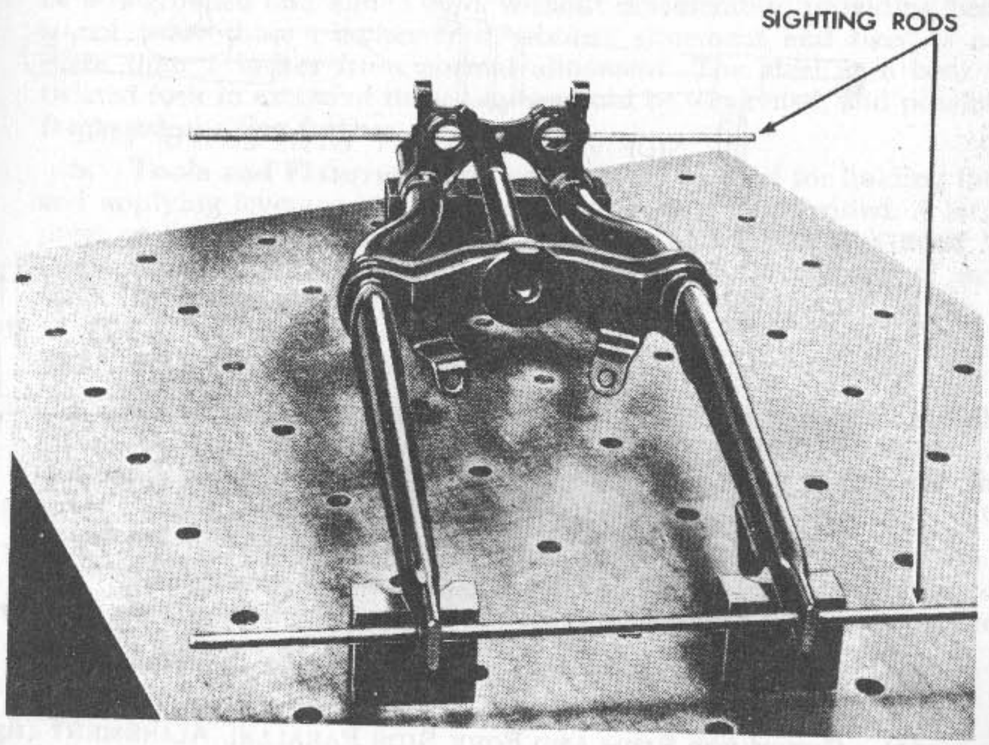


Figure 128—Visual Check of Fork Side Alinement

balls, cones and frame head cups. Lower ends of the spring and rigid forks are attached to rocker plates which provide the mounting and rocker action for the front wheel. Forks are heat treated and bent forks can be straightened and alined without preheating.

119. INSPECTION.

a. General. Forks and components must be cleaned with dry-cleaning solvent or by steam so that cracks will show up in inspection. Broken or badly bent spring forks and rigid forks must be replaced. Forks not badly bent or in need of alinement can be straightened.

b. Spring Fork. Inspect the spring rods for straightness, alinement, wear at bushing contact point and for good thread condition. Inspect fork sides for cracks. Use two straightedges to check fork sides for alinement. Broken or badly bent and twisted spring fork must be replaced.

c. Rigid Fork. Inspect for cracks and breaks, condition of stem threads and ends which engage handlebar bracket. Broken and badly bent and twisted forks must be replaced.

(1) CHECK FOR TWIST. Use the visual check of fork side relative alinement as shown in figure 128. Use two $5/16$ inch diameter bars, at least 18 inches long. Pass one bar through stud holes and lay the other bar across the stem ends of the fork sides. Sight along the two bars to determine twist.

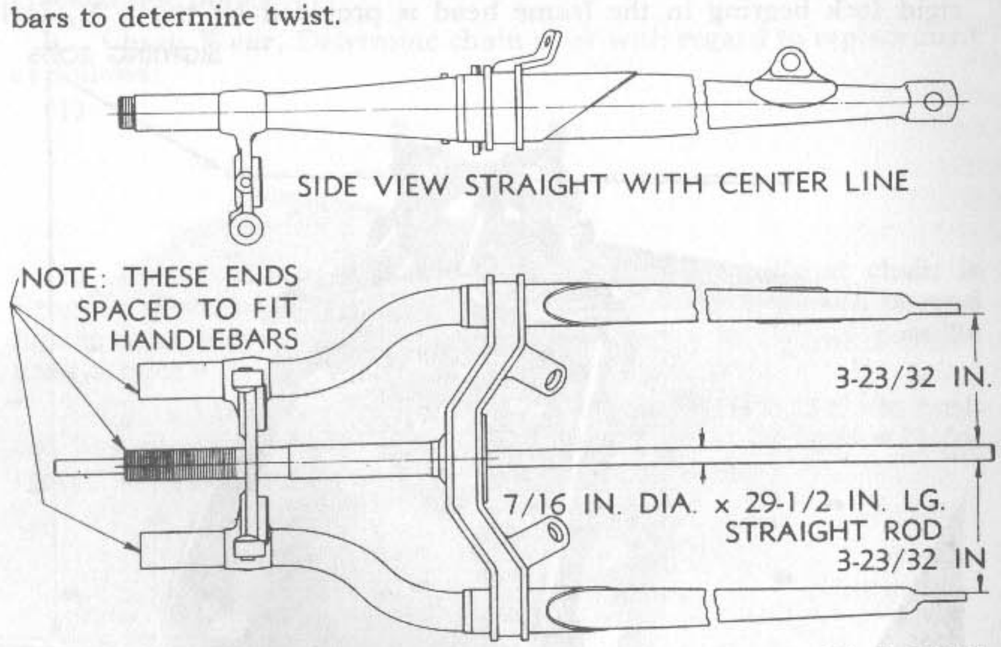


Figure 129—Dimensions for Fork Side and Fork Stem Alinement

(2) CHECK FOR STEM AND FORK SIDE PARALLEL ALINEMENT (fig. 129). This is a rough check. Pass a $7/16$ inch diameter bar, 30 inches long, through the fork center stem. Measure distance between fork tips and test bar. When fork sides are parallel to center stem, distance will be $3\frac{23}{32}$ inches. See that fork upper ends are alined to fit the handlebar bracket mounting holes.

d. Springs and Bushings.

(1) RECOIL SPRING. Free length, approximately $5\frac{3}{4}$ inches. Replace when broken or shrunk $1/8$ inch.

(2) BUFFER SPRING. Free length approximately $3\frac{1}{8}$ inches. Replace when broken or shrunk $1/8$ inch.

(3) CUSHION SPRING. Free length $6\frac{7}{16}$ inches. Replace when broken or shrunk $1/8$ inch.

(4) CUSHION BUFFER SPRING. Free length $3\frac{5}{16}$ inches. Replace when broken or shrunk $1/8$ inch.

(5) SPRING ROD BUSHINGS. Hole diameter 0.505 inch. Clearance on fork spring rods 0.005 inch.

e. Rocker Plates and Studs. The rocker plates are steel bushed and have 0.004 to 0.005 inch clearance on the fork tip studs. Replace bushings and/or studs when clearance is excessive.

(1) Bushing hole diameter is 0.751 inch.

(2) Stud diameter is 0.747 inch.

120. STRAIGHTENING FORKS.

a. Both the spring and rigid forks are heat treated steel and can be straightened and alined cold, without disassembly, providing bend is not more than 4 inches from normal alinement and twist is not more than 2 inches from normal alinement. The steel in a bent or twisted fork in excess of these limits would be weakened, and possibly fractured, making further use unsafe.

b. Tools and Fixtures. Some satisfactory method for holding fork and applying leverage at the correct points must be provided. A large press or surface plate provided with hooks and pry blocks must be used. Alinement of forks must also conform to alinement of new forks (by comparison) after straightening.

121. FRAME HEAD BEARINGS.

a. Description. Ball cups are pressed into the frame head to hold fifteen $5/16$-inch steel balls (without retainer), upper and lower. A stationary cone is pressed onto the rigid fork center stem for the lower bearing race to float on, and an adjustable cone screws onto upper end of fork stem for upper bearing race to float on.

b. Inspection. Inspect head cups and cones for pits, cracks, or worn condition. Inspect steel balls for pits. Replace damaged, broken, or worn parts as compared with new parts.

122. STEERING DAMPER.

a. The steering damper is an accessory, manually adjusted to apply friction to the front fork and prevent vehicle wobble in rough terrain or at high speeds. Repair to steering damper is made by parts replacement.

CHAPTER 12

STEERING SYSTEM (Cont'd)

Section II

HANDLEBARS AND CONTROLS

123. DESCRIPTION.

a. Handlebars are of welded construction and are heat-treated for strength. Do not weld handlebars. The only repair that should be attempted is straightening of handlebars. The handlebar bracket attaches to the rigid fork side bar and outer stem ends. Control wire

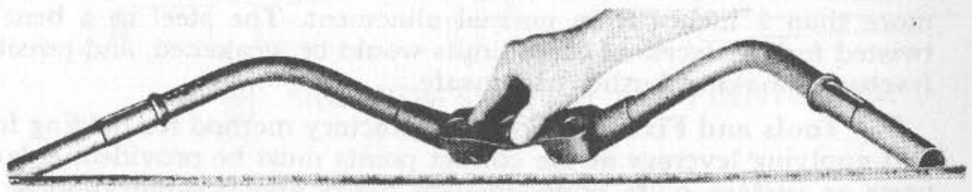


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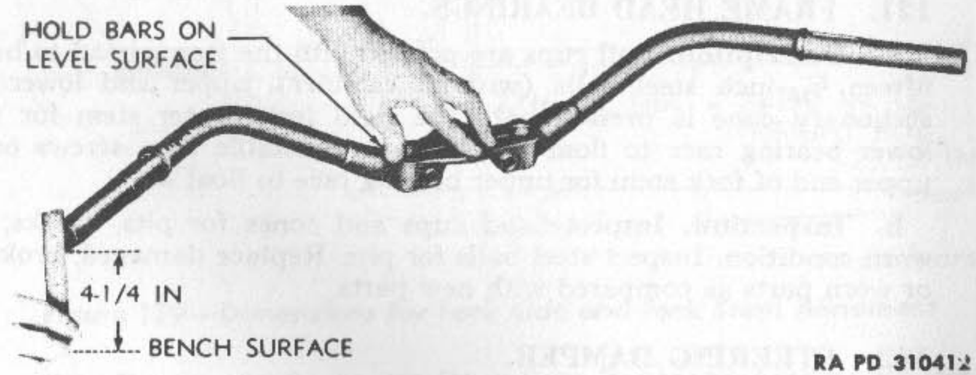
Figure 130—Inspecting Handlebars for Width



RA PD 310412

Figure 131—Inspecting Handlebars for Height

plungers (spark and throttle) are actuated by spirals in the grip sleeves. The grip sleeves are retained on the handlebars by means of end screws. Badly bent or broken handlebars must be replaced and damaged or worn components must be replaced.

b. Replacing Controls. Refer to TM 9-879 for instructions covering handlebar control wire and housing replacement.

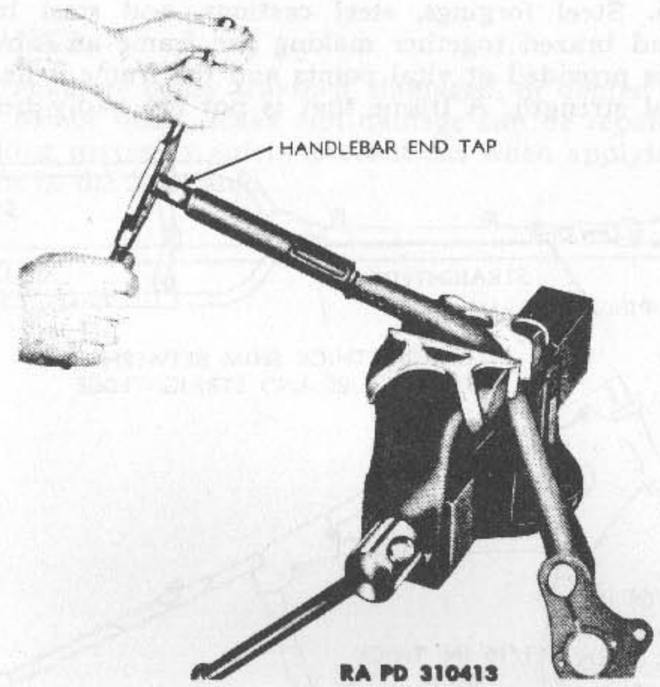
124. HANDLEBAR ALINEMENT.

a. If handlebars are not bent sufficiently to kink, fracture or weaken the tubing, they can be alined cold by mounting the bracket and bending the bars back in shape. A long pipe placed over the bar

will provide leverage, taking care not to kink or dent the tubing in the straightening process. Refer to figures 130 and 131 for alinement specifications.

125. REPAIR.

a. Badly bent or broken handlebars must be replaced to ensure highest safety factor in service. The control components can be replaced. Damaged threads in ends of handlebar can be cleaned up with tap as shown in figure 132.



RA PD 310413

Figure 132—Tapping Handlebar End with Tap (41-T-1026)

CHAPTER 13

CHASSIS PARTS AND EQUIPMENT

Section I

FRAME AND TANKS

126. DESCRIPTION.

a. Frame. Steel forgings, steel castings, and steel tubing are assembled and brazed together making the frame an integral part. Reinforcing is provided at vital points and the frame is heat treated for additional strength. A frame that is not too badly bent can be

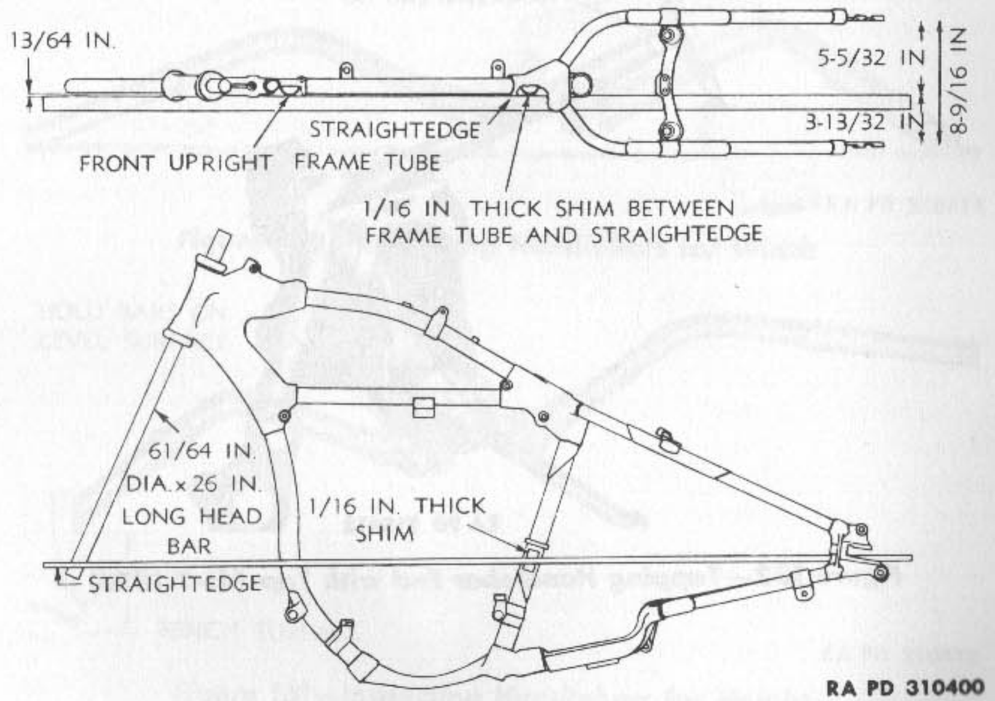


Figure 133—Checking Frame Alinement with Straightedge

straightened and alined cold, provided suitable fixtures and alining devices are at hand. A broken frame, or a frame bent to such extent the tubing or castings are weakened, must be replaced in the interest of safety in service.

b. Tanks. Tanks are of welded steel construction. All fittings are either welded or riveted in place. The right tank is used for engine oil. The left tank is used for fuel.

127. FRAME ALINEMENT.

a. Rough Check for Frame Alinement. A satisfactory method of rough checking a frame that is not visibly out of line, yet it is sus-

pected of misalinement, can be made with a straightedge and a bar (fig. 133). The $^{61}/_{64}$-inch bar is passed through the frame head (ball cups installed and with the straightedge placed along the side of the frame), measurement of rear fork stay clips and distance from head bar to straightedge determines alinement.

b. Straightening and Alining Frame. When rough check, or visible signs reveal frame misalinement, straightening and accurate measurement must be done on a surface plate provided with holding fixtures, leverage tools and accurate gages. Special instructions accompany such equipment.

128. TANKS.

a. If tanks are badly smashed, damaged, or dented they must be replaced. Minor dents, leaks and damage can be repaired by use of torch, taking necessary safety precautions when applying heat or an open flame to the fuel tank.

CHAPTER 13

CHASSIS PARTS AND EQUIPMENT (Cont'd)

Section II

MUDGUARDS, CHAIN GUARDS, STANDS, AND SKID PLATE

129. MUDGUARDS.

a. Front Mudguard. If front mudguard is badly bent or broken, repair is not worth while because future service will be limited. If stays or stay brackets only are bent or broken, they can be replaced.

b. Rear Mudguard. The rear end of the rear mudguard is hinged to the front section. Broken stays or stay brackets can be replaced. If mudguard is badly bent or broken, satisfactory repair cannot be made.

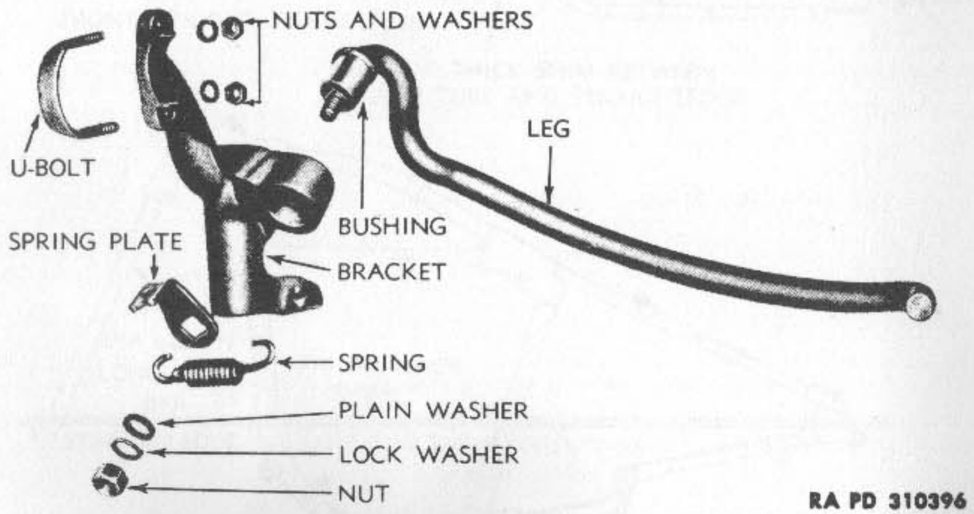


Figure 134—Jiffy Stand Disassembled

130. CHAIN GUARDS.

a. Front Chain Guard. The front chain guard is in two parts, the outer (cover) guard and the inner guard. When chain guard is not too badly bent or dented, it can be straightened and made serviceable.

b. Rear Chain Guard. The rear chain guard can be straightened when bent and a damaged mounting stud can be replaced.

131. STANDS.

a. Jiffy Stand. The jiffy (side) stand is used as a prop and can be folded up out of the way, before vehicle is put in motion. Repairs to the jiffy stand consist of parts replacement (fig. 134).

b. Rear Stand. Rear stand supports vehicle in an upright position. Stand is of welded construction. A badly bent, twisted, or broken stand must be replaced because insufficient strength remains in a damaged stand that has been straightened or welded.

132. SKID PLATE.

a. When the skid plate becomes so badly damaged it cannot be assembled to the vehicle without unnecessary work and time, it should be replaced. Owing to design of skid plate, it is difficult to aline, once twisted.

CHAPTER 13

CHASSIS PARTS AND EQUIPMENT (Cont'd)

Section III

BATTERY BOX, TOOL BOX, AND FOOTBOARDS

133. BATTERY BOX.

a. The battery box is of unit construction and other than taking out dents, replacing cover hold-down bolts and repainting, it cannot be repaired. The battery box is in a protected location and battery acid corrosion causes the most damage.

134. TOOL BOX.

a. Other than straightening a dented tool box and replacing a damaged cover, other repairs are not practical.

135. FOOTBOARDS.

a. Left Footboard Sidebar. The left footboard sidebar provides footboard and clutch pedal mounting. Badly bent or broken parts must be replaced. The footboard cover and the footboard hinges can be replaced. Both footboards are interchangeable.

b. Right Footboard Sidebar. The right footboard sidebar provides footboard and brake pedal mounting. Badly bent or broken parts must be replaced.

CHAPTER 13

CHASSIS PARTS AND EQUIPMENT (Cont'd)

Section IV

SADDLE AND SADDLE POST

136. SADDLE.

a. A badly bent, twisted, cut or worn saddle cannot be repaired with satisfactory results. Replace any saddle considered not safe and serviceable.

137. SADDLE POST (fig. 135).

a. Spring saddle post can be taken apart, and broken, or damaged springs, spring rod, and fittings can be replaced.

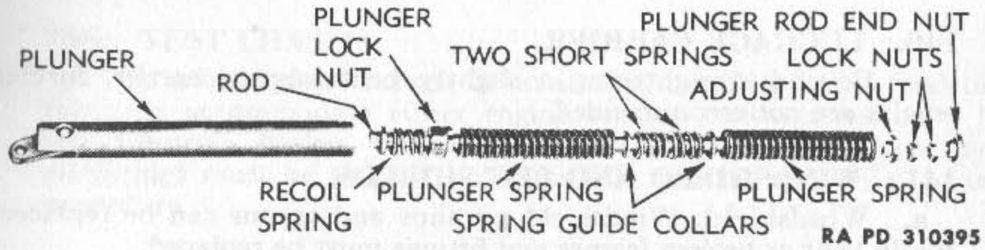


Figure 135—Saddle Spring Post, Disassembled

b. Saddle Post Adjustment. The spring saddle spring post is correctly adjusted for the average weight rider when the distance from end of plunger to adjusting nut is $11\frac{15}{16}$ inches (fig. 136). To increase spring compression, turn adjusting nut to the right. To reduce spring compression, turn adjusting nut to the left.

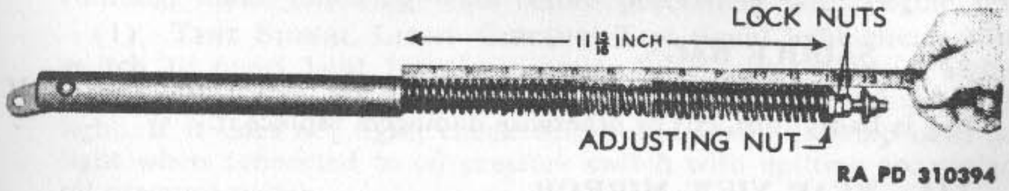


Figure 136—Saddle Spring Post Adjustment

CHAPTER 13

CHASSIS PARTS AND EQUIPMENT (Cont'd)

Section V

EQUIPMENT

138. AMMUNITION CARRIER.

a. Slightly bent or twisted ammunition carrier can be straightened. Badly bent or broken carriers must be replaced.

139. GUN SCABBARD CARRIER.

a. Slightly bent or twisted gun scabbard carrier can be straightened. Badly bent or broken carrier must be replaced.

140. LUGGAGE CARRIER.

a. Beyond straightening a slightly bent luggage carrier, further repairs are not recommended.

141. WINDSHIELD AND LEG SHIELDS.

a. Windshield. Windshield pyralins and aprons can be replaced. Badly bent or broken frames and fittings must be replaced.

b. Leg Shields. If leg shields and brackets are slightly bent, they can be straightened and made serviceable. If badly damaged or broken, replace.

142. SAFETY GUARDS.

a. Safety guards are made of high quality, heat treated steel and when bent, but not kinked, they can be straightened cold. Do not attempt safety guard repairs by welding or brazing methods.

143. SADDLE BAGS.

a. Saddle bags with ripped seams can be resewn and riveted. If bag is badly torn, cut or otherwise damaged, replace it.

144. REAR VIEW MIRROR.

a. Other than replacement of rear view mirror bracket, and bracket clamp, further repairs are not practical. Replace broken or badly damaged units.

CHAPTER 14

ROAD TEST OF ENGINE, TRANSMISSION, AND CLUTCH

Section I

ENGINE

145. INTRODUCTION.

a. After an engine has been overhauled, either top end or base, it must be adjusted, operated and tested before installing in vehicle for immediate service. The best method is to install engine in a test chassis and give it an actual road test. An engine fitted with new pistons and/or rings must be given run-in consideration the first 500 miles the same as a new vehicle. Refer to TM 9-879.

b. Duration of Test. To ensure normal operating temperatures and correct functioning of fuel system the overhauled engine must be road tested between 5 and 10 miles.

146. TEST CHASSIS.

a. A vehicle chassis must be available, complete in every detail, ready to accommodate either engine and/or transmission units for test. Controls, brakes, tires, signal lights, electrical equipment, and all fittings must be in good order for safe and satisfactory road test procedure.

147. LUBRICATION.

a. Newly overhauled engine will have one-half pint of engine oil poured over the timing gears before gear case cover is installed. Oil lines must be connected and oil must be present in tank and actually reach oil supply pump before operating newly overhauled engine.

b. Observe Action of Red Signal Light. After the ignition switch is turned on, the red signal light in the switch panel should go on. If red signal light fails to go on, or fails to go off after engine is running, make following tests before proceeding with engine test.

(1) TEST SIGNAL LIGHT CIRCUIT. Test signal light circuit from switch to panel light by disconnecting wire at oil pressure switch and grounding on engine; then turn ignition switch on. Lamp should light. If it does not light, check wiring and lamp. If lamp does not light when connected to oil pressure switch with ignition on, replace oil pressure switch.

(2) SIGNAL LIGHT CONTINUES TO BURN AFTER ENGINE IS OPERATED ABOVE IDLING SPEEDS.

(a) Check oil supply in tank. If red signal fails to go out after engine is warm, or after one minute of operation, further check must be made to locate trouble because indication points to faulty engine lubrication system, or fault in signal light circuit. Eliminate the signal light system first as in (1) above.

(b) With oil pressure switch and signal system wiring in good order, yet light fails to go out after engine is operating, indication is trouble in the oil supply pump. Replace pump.

c. Excessive Smoke Issues from Exhaust and Oil Spray Issues from Gear Case Breather Outlet. This is an indication that the scavenger pump is not draining engine crankcase and returning oil to tank. With engine running at idle speed, examine oil return in tank. Remove tank oil cap and with a small flashlight observe whether or not oil is dripping from ⅛-inch hole in oil return tube. Hole is on underside of tube and is located just back of oil gage rod tube. If observation is poor, place finger over hole and feel for pulsation of oil pressure. If oil does not return to tank, scavenger pump is faulty. Should the crankcase breather valve be incorrectly timed, smoke will issue from the exhaust but not as noticeably as when scavenger pump is not working. See d below for this condition.

d. Smoke Issues from Exhaust and Excessive Oil Condition Exists Around Cylinder Ports (Where Exhaust Pipes Enter Cylinders). Engine scavenger pump and crankcase breather valve are one unit, operated by worm gear located behind engine shaft pinion gear. Although scavenger pump is not timed, the breather valve sleeve which drives it must be timed to balance the engine lubricating system. If for any reason the scavenger pump unit is removed from engine base, the breather valve must be retimed (within the gear case) when pump assembly is replaced. Incorrectly timed breather valve will force oil past piston rings, causing some smoke besides forcing oil out through exhaust ports, causing excessive oily condition around exhaust pipes where they enter cylinder ports.

e. Adjustment of Oil Supply Pump. Adjustment of the oil feed pump is made by changing the tension of the oil pressure regulating valve spring. Remove the cap screw to expose the adjusting screw. Correct adjustment is obtained when head of adjusting screw is ⅜ inch below top surface of pump body. Turning screw clockwise increases the oil pressure; turning screw counterclockwise reduces the oil pressure. Refer to figure 50 for nomenclature of oil feed pump assembly.

148. CARBURETION.

a. Gasoline must be in tank and must reach carburetor bowl. Throttle control must operate correctly with fully open and closed positions of handlebar grip. With fuel valve open, observe for leaks in line connections and at carburetor bowl.

b. Carburetor Adjustment. A carburetor that is badly out of adjustment, or a new carburetor just installed, must be adjusted as follows:

(1) Turn the low speed needle valve all the way down (to right).

(2) Back needle valve out (to left) about three full turns. With needle valve in this position, engine will start, but mixture will probably be too rich.

(3) Start the engine. After choke lever has been moved to normal open running position and engine is normally hot, correct adjustment of needle valve by turning needle valve down (to right) one notch at a time until mixture becomes so lean that engine misses and is

inclined to stop; then back out needle valve 5 to 10 notches, or until engine fires regularly with retarded spark and throttle closed, or as nearly closed as it can be set and still have engine run at idling speed.

(4) ADJUST THROTTLE LEVER STOP SCREW. Adjust screw as may be necessary to make engine idle at proper speed with throttle in fully closed position. Turning stop screw to the right makes engine idle faster. Turning stop screw to the left makes engine idle slower. NOTE: *Do not idle engine at the slowest possible speed, because an extremely slow idling adjustment causes hard engine starting.* Changing idling speed with throttle stop screw is likely to change the low speed fuel mixture to some extent; therefore, it will be necessary to again check and correct the low speed needle valve adjustment **b** (3) of this paragraph. Engine starting and all-around carburetion will be better with low speed fuel adjustment slightly rich rather than extremely lean.

149. IGNITION.

a. Battery, Spark Advance, and Circuit Breaker. Battery in test vehicle must be at least one-half charged (1,200 sp gr) and wiring and ignition must be in good order. Spark advance lever must advance and retard fully with operation of handlebar grip. Circuit breaker points must be adjusted to have 0.022-inch gap when open.

b. Spark Plugs. Spark plugs of questionable condition should be replaced with new ones with No. 3 heat range. Gaps must be adjusted to between 0.025 and 0.030 inch.

c. Observe Engine Operation for Excessive Spark Advance. When making road test of engine, observe for knocking at lower speeds and upon acceleration, due to excessively advanced spark. Also observe engine operating temperature that might be above normal due to excessively advanced spark.

d. Observe Engine Operation for Retarded Spark. Accelerate engine and listen to exhaust reports to detect retarded spark. If spark is retarded excessively, engine overheating will also result.

150. NOISES.

a. Chassis Condition. It will be assumed that chassis will be in good condition and that drive chains will be correctly adjusted so that unusual noises from these sources will not be considered.

b. Noises Caused by Excessive Clearance. Piston slap, rod bearing noise and cam gear noise caused by excessive clearances or loose fit can be detected with engine idling or under load at low speeds. Noises of this type are generally metallic in sound. The engine should be allowed to become warm enough to reach normal operating temperature before passing on piston slap.

c. Thumping, Pounding Noise in Engine. Very close piston and ring fits, tight piston pins in rod bushings or twisted connecting rods will cause pounding and thumping noise. If tappet guides are not located in correct position, thumping noise in gear case will result.

d. Howling, Grinding Noise. If the timing gears are meshed too close, a howling, grinding noise will result. If cam gear bearings and flywheel mainshafts are not in alinement, a grinding noise results.

151. GENERAL PERFORMANCE.

a. Test engine for all-around general performance, starting, acceleration, smoothness of operation, and excessive overheating. Observe for abnormal vibration which might indicate looseness of bolts and nuts or flywheels out of true. Observe for sluggishness which might be caused by lack of correct bearing tolerances.

b. Vehicle Service. Engine unit must be in such mechanical condition after road test as to render dependable field service, the same as a new engine.

CHAPTER 14

ROAD TEST OF ENGINE, TRANSMISSION, AND CLUTCH (Cont'd)

Section II

TRANSMISSION AND CLUTCH

152. INTRODUCTION.

a. A newly overhauled transmission and clutch unit must be run-in or tested before installing in vehicle for immediate field service. Before testing transmission in test block or vehicle frame, make sure that the case contains ¾ pint of engine oil. Starter crank must be tried for full travel and disengagement of starter clutch at end of starter stroke.

b. Length of Test. Bench block test of transmission should run 15 to 20 minutes. Vehicle test of transmission should run up to 5 miles for thorough check.

153. TEST CHASSIS.

a. The vehicle chassis used for engine testing can be used for transmission test. All parts and units of test chassis must be in good working condition for safe and satisfactory road test procedure. Chain guards must be in place and chains must be correctly adjusted before operating test vehicle.

154. GEAR SHIFTING.

a. Clutch control and gear shifter lever linkage must be correctly adjusted (TM 9-879) before checking either the transmission or clutch. Test for ease of gear shifting, low, through neutral, to second and high. Gears must not clash in any selected position nor should gears jump out of mesh with vehicle under load. Transmission must be free from unusual noises.

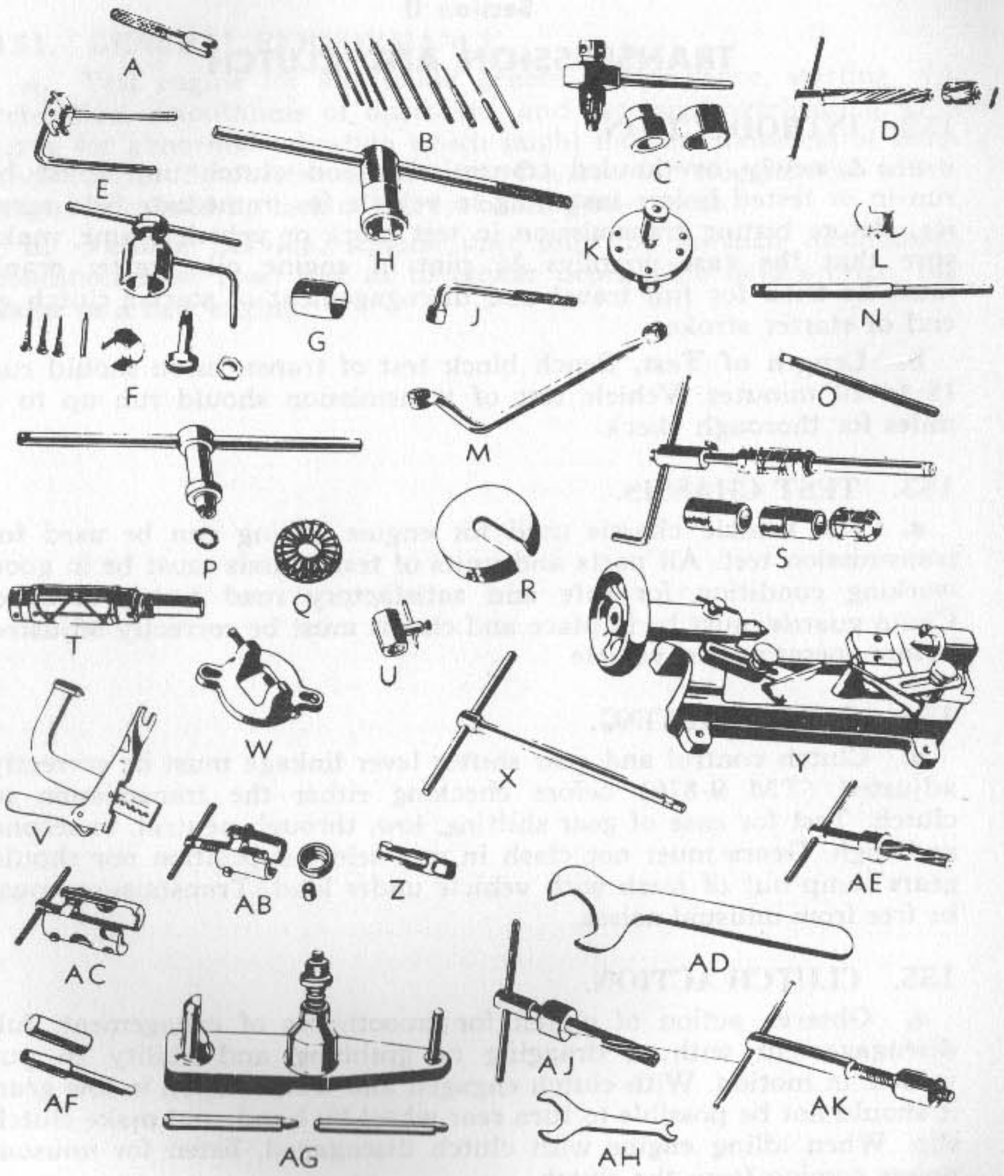
155. CLUTCH ACTION.

a. Observe action of clutch for smoothness of engagement, full disengagement without dragging or grabbing and ability to put vehicle in motion. With clutch engaged and transmission in low gear, it should not be possible to turn rear wheel by hand, and make clutch slip. When idling engine with clutch disengaged, listen for unusual noises coming from the clutch.

156. NOISES.

a. Transmission. Grinding noise in transmission indicates incorrect end play clearances, or improper assembly. Loose, rattling noise in transmission indicates incorrect assembly.

b. Clutch. Loose, rattling noise in disengaged idling clutch may be caused by ball retainer plate having too much end play on the studs. Retainer spring rings may be broken or not tight against retainer plate.



RA PD 310410

Figure 137—Special Tools

SPECIAL TOOLS

Special Tool	Federal Stock No.	Mfgrs. No.
A—WRENCH, SPOKE NIPPLE, FRONT WHEEL	41-W-3339	HRD 120032-X
B—TOOL, CARBURETOR CLEAN-UP, SET	41-T-3081-45	HRD 12012-38
C—REMOVER, CAM GEAR SHAFT BUSHING	41-R-2372-20	HRD 11952-26
D—REAMER, CAM GEAR SHAFT TIMER DRIVE SHAFT BUSHING	41-R-2265	HRD 12133-37
E—TOOL, REPAIR, DRIVE CHAIN	41-T-3320	HRD 12039-X
F—REMOVER AND REPLACER, TRANSMISSION OIL SEAL	41-T-2389-47	HRD 12735-42
G—GUIDE ASSEMBLY, CLUTCH GREASE, THROUGH OIL SEAL, 1941 MODEL	41-G-1255	HRD 12747-41
H—WRENCH, CLUTCH HUB NUT	41-W-866-10	HRD 12745-41
J—WRENCH, HEAD BOLT	41-W-1525	HRD 12047-30A
K—PULLER, CLUTCH HUB, MODEL 1941	41-P-2905-90	HRD 12022-41
L—WRENCH SPOKE NIPPLE, FRONT WHEEL	41-W-3339	HRD 12032-X
M—WRENCH, CYLINDER BASE NUT, TWIN	41-W-872-10	HRD 12650-29
N—PILOT, VALVE GUIDE, SMALL, 0.334 IN.	41-P-412	HRD 12621-26
O—REAMER, VALVE GUIDE STANDARD	41-R-2309-65	HRD 12623-26
P—HOLDER, CUTTER HANDLE AND NUT	41-H-2270	HRD 11898-X
Q—CUTTER, CLEARANCE, FOR 45 CU IN. TWINS	41-C-2822-30	HRD 11890-29
R—PLATE, PISTON SQUARING, FOR ALL SINGLES AND 45 CU IN. TWINS	41-P-1550-25	HRD 12655-26
S—LAP, BEARING, 1940 CRANKCASE	41-L-203	HRD 11954-40
T—ARBOR, CONNECTING ROD LAPPING FOR ALL 1-INCH CRANK PINS	41-A-337-10	HRD 11944-X
U—GAGE, FLYWHEEL END PLAY, ALSO CHECK END PLAY OF MAINSHAFT ON 45 CU IN. TRANSMISSION	41-G-198	HRD 11967-38
V—LIFTER, VALVE SPRING, HAND	41-L-1409	HRD 12053-30
W—TOOL, CONNECTING ROD CLAMPING	41-T-3091	HRD 12058-X
X—WRENCH, WHEEL LUG	41-W-3832	HRD 12025-35
Y—STAND, FLYWHEEL TRUING, UNIVERSAL TYPE	41-S-4970	HRD 11962-X
Z—TAP, HANDLEBAR END	41-T-1026	HRD 12043-36
AB—PULLER, TAPPET, GUIDE	41-P-2956	HRD 11960-38
AC—PULLER, BEARING AND GEAR	41-P-2903	HRD 11849-X
AD—WRENCH, MANIFOLD	41-W-1570-10	HRD 12003-X
AE—REAMER, OILER DRIVE SHAFT AND PIN SHAFT BUSHING, 74 CU IN. PIN SHAFT AND 45 CU IN. OILER SHAFT DRIVE	41-R-2303	HRD 12132-36
AF—TOOL, LOCK RING	41-T-3260	HRD 12052-32
AG—JIG, REAR SPROCKET RIVETING	41-J-373	HRD 12067-42
AH—WRENCH, TAPPET AND VALVE COVER	41-W-3617	HRD 11806-31
AJ—REAMER, PINION SHAFT BUSHING	41-R-2304	HRD 12135-37
AK—TOOL, PISTON PIN BUSHING	41-T-3305	HRD 12057-X

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Legend for Figure 137—Special Tools

CHAPTER 15
SPECIAL TOOLS

157. DESCRIPTION AND DATA.

a. The tools illustrated in this chapter are used in maintaining the vehicle. Refer to figure 137.

b. The list in figure 37 is for information only. It is not to be used as a basis for requisition.

REFERENCES

PUBLICATIONS INDEXES.

The following publications indexes should be consulted frequently for latest changes to or revisions of the publications given in this list of references and for new publications relating to materiel covered in this manual:

Introduction to Ordnance Catalog (explains SNL system)	ASF Cat. ORD-1 IOC
Ordnance publications for supply index (index to SNL's)	ASF Cat. ORD-2 OPSI
Index to ordnance publications (lists FM's, TM's, TC's and TB's of interest to Ordnance personnel, MWO's, OPSR's, BSD, S of SR's, OSSC's and OFSB's. Includes alphabetical listing of Ordnance major items with publications pertaining thereto)	OFSB 1-1
List of publications for training (lists MR's, MTP's, T/BA's, T/A's, and FM's, TM's, and TR's concerning training)	FM 21-6
List of training films, film strips and film bulletins (lists TF's, FS's, and FB's by serial number and subject)	FM 21-7
Military training aids (lists graphic training aids, models, devices, and displays)	FM 21-8

STANDARD NOMENCLATURE LISTS.

Motorcycle, chain drive (Harley-Davidson)	SNL G-523
Cleaning, preserving and lubricating materials, recoil fluids, special oils, and miscellaneous related items	SNL K-1
Soldering, brazing, and welding materials, gases, and related items	SNL K-2
Tools, maintenance, for the repair of automotive vehicles	SNL G-27
Tool sets—motor transport	SNL N-19
Tool sets for ordnance service command, automotive shops	SNL N-30

Current Standard Nomenclature Lists are listed above.

EXPLANATORY PUBLICATIONS.

Fundamental Principles.

Military motor vehicles	AR 850-15
Automotive electricity	TM 10-580
Electric fundamentals	TM 10-455
The motor vehicle	TM 10-510
Chassis, body, and trailer units	TM 10-550

Operation of Materiel.

Motorcycle, solo (Harley-Davidson Model WLA)	TM 9-879

Maintenance and Repair.

Automotive lubrication	TM 10-540
Motor transport inspections	TM 10-545
Tire repair and retread	TM 9-1868
Cleaning, preserving, lubricating and welding materials and similar items issued by the ordnance department	TM 9-850

Protection of Materiel.

Explosives and demolitions	FM 5-25
Defense against chemical attack	FM 21-40
Decontamination of armored force vehicles	FM 17-59
Chemical decontamination, materials and equipment	TM 3-220

Storage and Shipment.

Registration of motor vehicles	AR 850-10
Storage of motor vehicle equipment	AR 850-18
Ordnance storage and shipment chart, group G—Major Items	OSSC-G

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