SECTION 6-ENGINE

312 CUBIC INCH DISPLACEMENT ENGINE—MECHANICAL

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ENGINE DESCRIPTION – 312 CUBIC INCH DISPLACEMENT ENGINE

The Safety-Surge 255 horsepower engine is an eight cylinder valve-in-head 90° "V"-type which has a displacement of 312 cubic inches using a 3.80 inch bore and a 3.44 inch stroke. The compression ratio is 9.75 to 1. Consult figures 6A-1, 6A-2 and 6A-3 for views of complete engine assembly.

The cylinder block and upper crankcase are cast in one piece with cored passages for cooling the entire length of the cylinder barrels. This unit forms the major section of the engine as it is fitted with the crankshaft, camshaft, pistons, and various related parts.

The fully counterbalanced crankshaft is supported by five copper lead steel backed replaceable main bearing inserts with the center bearing, number 3, absorbing the end thrust. The crankshaft has six counterweights for precise balance and superior resistance to torsional vibration.

The camshaft, which is supported by five replaceable babbitt lined steel backed bearing inserts, is driven with a silent timing chain which requires no adjustment.

The centrifugal and vacuum operated distributor, mounted at the top right rear of the cylinder block assembly, is gear driven by the camshaft.

An eccentric cam, bolted to the front end of the camshaft, operates the fuel pump of the 312 cubic inch displacement engine.

The end thrust of the camshaft is controlled by a thrust plate and spacer located between the front camshaft journal and the camshaft sprocket.

Full skirt aluminum alloy pistons are used in the 312 cubic inch displacement engine. The pistons are of the auto-thermic design which provides for controlled piston expansion thus resulting in closer initial piston fits without binding or excessive friction, consequently eliminating cold engine piston slap and assuring longer piston life.

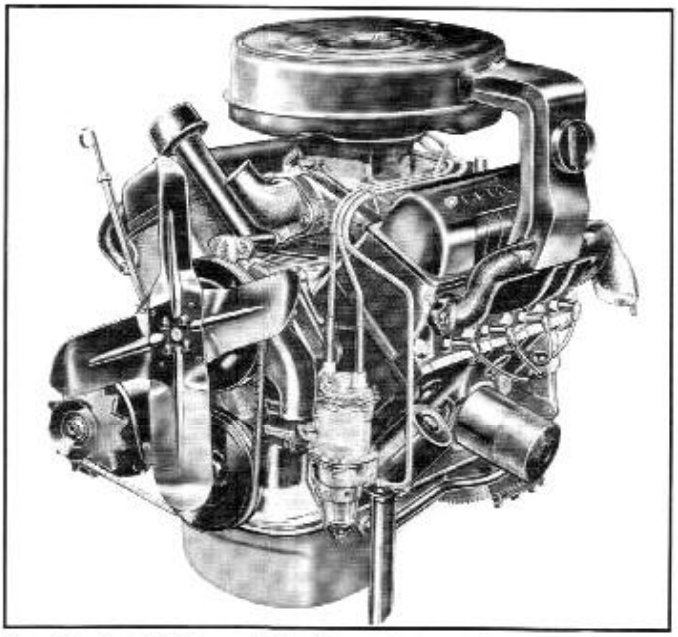


Fig. 6A-1—Left Front 3/4 View—312 Cubic Inch Engine

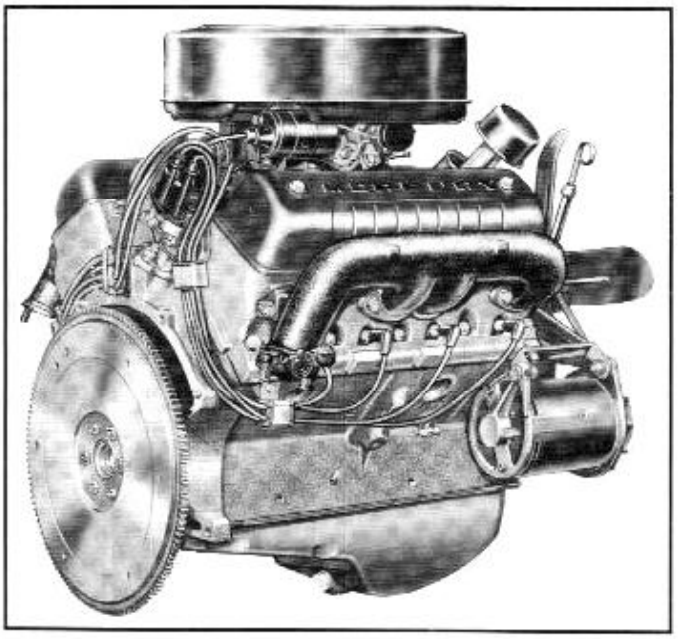


Fig. 6A-2—Right Rear 3/4 View—312 Cubic Inch Engine

The selective fit piston pin in each piston is prevented from moving axially by two steel retaining rings in the piston pin bore of the piston.

The forged steel, "I" beam section, connecting rods contain a bronze bushing at the upper end for installation on the piston pin, while the lower end and bearing cap contain the locking type selective fit bearing inserts. Each respective connecting rod bearing cap is attached to the connecting rod with two heat treated steel bolts.

Solid steel mushroom-type tappets are used in the 312 cubic inch displacement engine. They are housed in the cylinder block tappet chamber. The tappets operate directly on the camshaft lobes thereby transmitting the thrust of the camshaft lobes, by mechanical pressure, to the push rods that actuate the valve train. A specified valve lash clearance must be maintained for efficient valve train operation.

In addition to the parts that are housed in the cylinder block, are many that are attached externally to complete the engine assembly. These are, the intake manifold, exhaust manifolds, cylinder head assemblies, water pump, oil pump, generator, distributor, fuel pump, starter, carburetor, oil pan, and other related parts.

The cylinder head assemblies feature combustion characteristics that produce very high volumetric and thermal efficiencies.

Both cylinder heads contain intake and exhaust valve assemblies. Valve rocker arm assemblies mounted on the respective cylinder heads complete the valve train.

The rotatable intake and exhaust type valves in each cylinder head are inclined toward the manifold ports, making the breathing of the engine easier. Valve rotation, while the engine is running, permits self cleaning and better seating, minimizes valve warpage, wear and sticking. An umbrella-type valve stem seal fits over the top of the valve stem and extends over the valve guide opening. The seal controls lubrication of the valve stem. Calibrated valve springs provide positive valve action at high engine speeds. Self locking adjusting screws in the rocker arm allow easy maintenance of valve clearance.

The intake manifold, which is mounted to the cylinder heads, supplies both cylinder banks with vaporized fuel from the carburetor.

A thermostatic choke control heat tube is located in the intake manifold bore, directly below the carburetor. The heat tube is heated by exhaust gases in the intake manifold riser passage. Carburetor vacuum draws fresh air into the heat tube and the air is thus warmed before it reaches the thermostatic choke control located on the carburetor. Refer to the "Fuel" section of this manual for the description and operation of the thermostatic choke.

Two exhaust manifolds, one on the right bank and one on the left bank, are mounted to the respective cylinder heads. Compression pressure in the cylinder heads forces engine exhaust through the exhaust manifolds into the exhaust system.

The right exhaust manifold outlet is connected to a thermostatically controlled exhaust valve which governs the flow of hot exhaust gases. When the engine is cold or idling at normal operating temperature, the exhaust valve is closed (heat on position). A portion of the exhaust gases, thus restricted, are directed through the right cylinder head into the intake manifold heat riser passage. The exhaust gases then pass through the intake manifold into the left cylinder head exhaust passage. From this point, the gases flow through cylinder head into the left exhaust manifold and out through the left muffler inlet pipe. This diversion of hot exhaust gases allows a faster engine warm up.

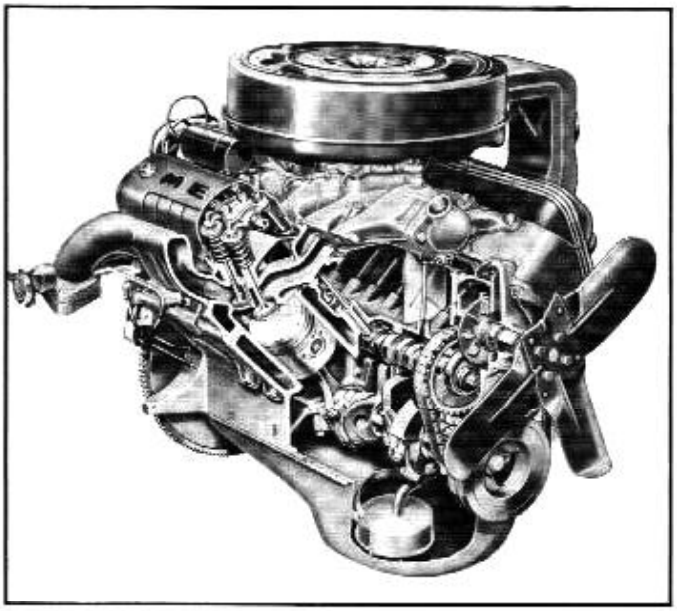


Fig. 6A-3—Right Front 3/4 Section—312 Cubic Inch Engine

As the engine warms up, the thermostatically controlled exhaust valve gradually opens to the fully open position (heat off position) allowing the exhaust gases to flow through the exhaust system in a normal manner.

A "V"-type fan belt, driven by a single sheave damper on the crankshaft, drives the water pump-fan-combination and generator of the 312 cubic inch engine.

The water pump is mounted integral with the front cover and supplies both cylinder banks with adequate cooling.

The generator is mounted on the lower right side of the engine with an adjustable arm to permit proper belt tension adjustment.

On vehicles equipped with conventional or overdrive transmissions, the rear face of the flywheel assembly is used as a friction surface, which is engaged by the clutch disc. The flywheel assembly is mounted on, and secured to, the rear shoulder of the crankshaft.

A flex-type flywheel which is mounted on, and is secured to the rear shoulder of the crankshaft, drives the Merc-O-Matic transmission converter assembly.

Cylinder Numbering 312 Cubic Inch Engine

When viewing the engine from the rear, the right bank of cylinders are numbered 1, 2, 3 and 4. Number 1 being at the front. Similarly, the left bank of cylinders are numbered 5, 6, 7 and 8. Number 5 being at the front.

The engine firing order is 1-5-4-8-6-3-7-2.

Engine Lubricating System — 312 Cubic Inch Engine

A pressure lubricating system employing a full flow disposable type oil filter is incorporated in the 312 cubic inch engines. See figure 6A-4.

The rotor type oil pump, mounted externally at the lower left rear of the cylinder block is driven by the distributor through an intermediate shaft. Thus the oil pump and distributor are driven at camshaft speed.

The oil supplied to the oil pump passes from the intake screen assembly of the oil pan into the oil pump

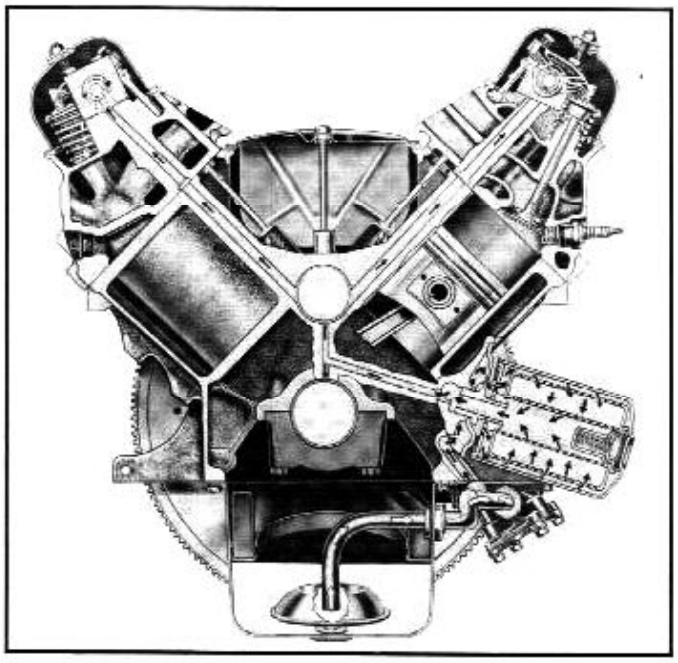


Fig. 6A-4—Lubrication System—312 Cubic Inch Engine

inlet tube which is mounted on the left side of the oil pan. A spring loaded relief valve in the oil pump controls the pressure of the system. The oil relieved by the relief valve is directed back to the intake side of the pump.

The oil leaves the pump directly through a passage in the block which directs the oil to the filter assembly. This means that all the oil delivered by the oil pump is directed immediately into the filter where it is filtered before entering the main oil passage for circulation throughout the engine. See figure 6A-4.

A by-pass valve, located in the filter is provided to operate only when the oil flow is restricted because of dirt or other foreign materials. Figure 6A-5 is presented to illustrate the operation of this by-pass valve. First, the solid arrows denote the path the oil flows through the filter when the element is relatively clean, thus, very little resistance is present to restrict the flow of oil. Under this condition, the pressures of the oil at points "A" and "B" are almost equal, therefore, the by-pass valve remains closed and filtered oil is supplied to the main oil passage.

As dirt or foreign materials accumulate in the filter, resistance to normal oil flow is increased. This means that the pressure of the oil at point "A" will be lowered. As soon as the pressure of the oil at point "A" drops to a value less than the value of the pressure point "B" the by-pass valve will open. The path the oil flows is then illustrated by the dotted arrows. It should be noted that when the by-pass valve is open, that portion of the oil flowing through the by-pass valve does not travel through the filter but is supplied directly to the main oil passage.

Lubrication Circuit — 312 Cubic Inch Displacement Engine

The main oil passage, which receives the oil from the filter assembly, extends the full length of the left side of the cylinder block. This passage supplies oil to all camshaft bearings and main bearings through a drilled passage in each main bearing supporting web which connects with the main oil supply line as shown in figure 6A-4.

The rocker arm assembly of the right bank receives oil through a drilled passage in the cylinder block at the No. 3 cam bearing which lines up with a hole in the cylinder head that directs the oil through the No. 2 rocker arm shaft support. The left bank rocker arm assembly is supplied oil by No. 3 rocker arm shaft support from the No. 3 cam bearing.

The oil from the rocker arm shaft support flows into the rocker arm shaft where it is directed through small holes to lubricate each rocker arm bushing and the valve and ball joint ends. The excess oil at this point spirals down the rotating push rod and assists in lubricating the tappet and push rod seat. Each rocker arm shaft has an overflow pipe which exhausts excess oil into the push rod chamber. The overflow pipes are located at the front of the right bank and at the rear of the left bank rocker arm assemblies. The oil from each rocker arm drains into the push rod chamber through holes provided in the cylinder heads.

The oil in the push rod chamber, collecting from the left bank rocker arm overflow pipe, tappets, etc. drains back into the pan through a large opening at the rear of the block. This oil lubricates the distributor drive gear.

The oil from the right bank rocker arm overflow

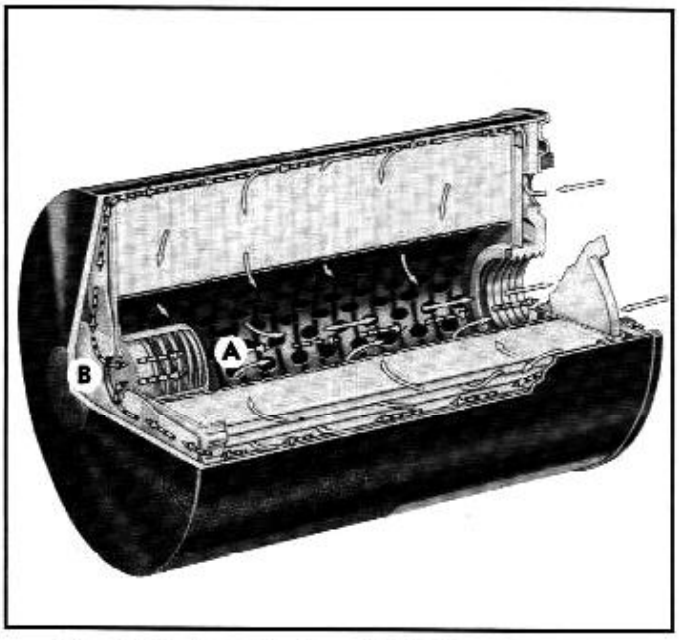


Fig. 6A-5—Cross Section of Oil Filter Assembly

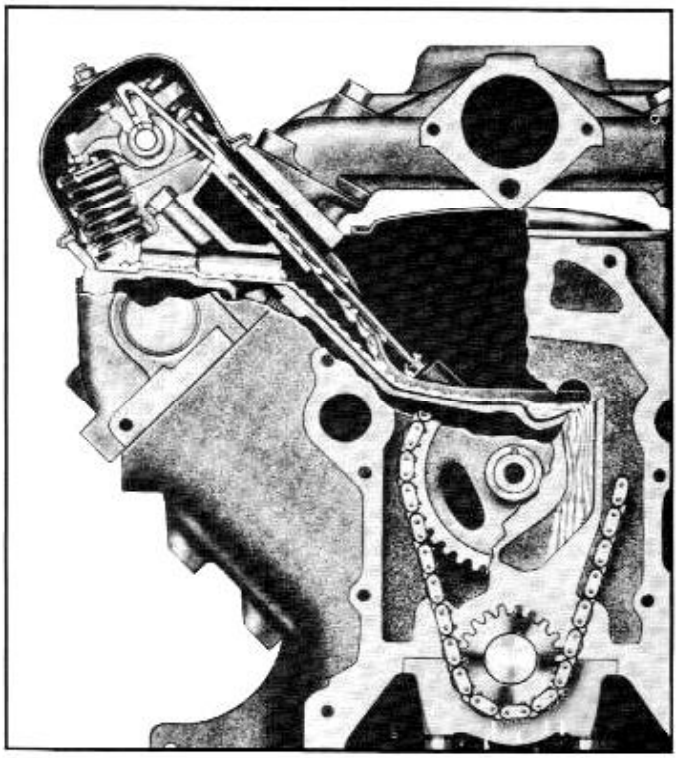


Fig. 6A-6—Timing Chain Lubrication

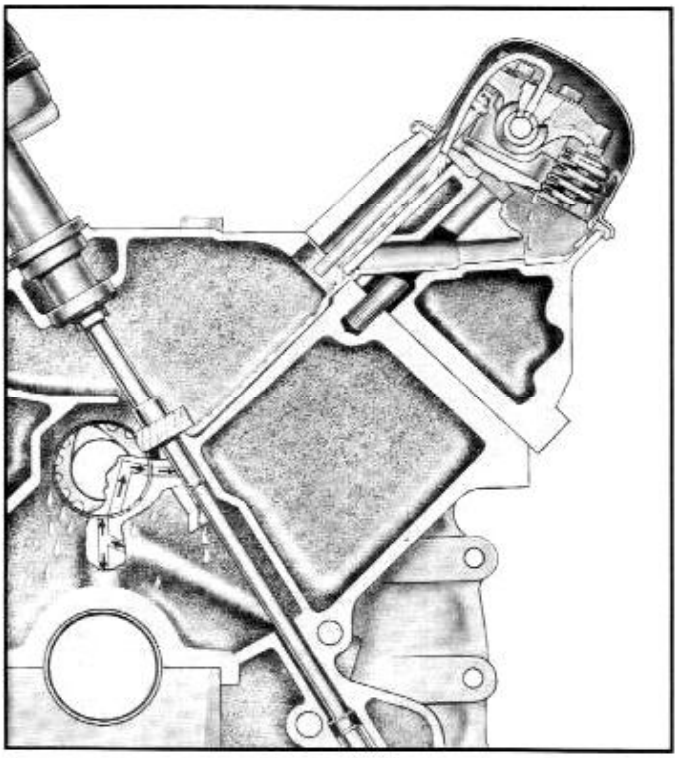


Fig. 6A-7—Distributor Lubrication

pipes is channeled in the push rod chamber by a trough which directs it to the front of the engine through a hole in the front cylinder block wall. This oil flows down the front of the block, lubricating the timing chain and sprockets. See figure 6A-6. The distributor, intermediate shaft and bushing are lubricated by oil supplied through a drilled passage from No. 5 camshaft bearing. See figure 6A-7.

The connecting rod bearings receive their lubrication through passages drilled from the main crankshaft journals to the crankpins. The cylinder walls are lubricated by oil sprayed from a hole drilled in the connecting rod whenever the hole in the rod lines up with the hole in the crankpin. See figure 6A-8.

Engine Cooling System — 312 Cubic Inch Displacement Engine

The coolant is drawn from the lower tank of the radiator by the centrally mounted water pump which delivers the coolant to an equalizing chamber in the front cover. The equalizing chamber distributes the coolant to both cylinder banks. See figure 6A-9.

As the coolant enters the cylinder block, it travels through cored passages to cool the entire length each cylinder wall. Upon reaching the rear of the cylinder block, the coolant is redirected up into the cylinder heads where it cools the combustion chambers, valves, valve seats, etc., on its return to the front of the engine.

At this point, the coolant from each cylinder head flows through the intake manifold into the water outlet connection, past the thermostat, if it is open, into the upper tank of the radiator. When the thermostat is closed, coolant is by-passed through a pipe which returns the coolant directly to the water pump for recirculation throughout the engine. The function of the by-pass system is to assure uniform engine warm up, and reduce cooling system pressure. When the thermostat is open the flow through the by-pass system is reduced due to reduced coolant pressure.

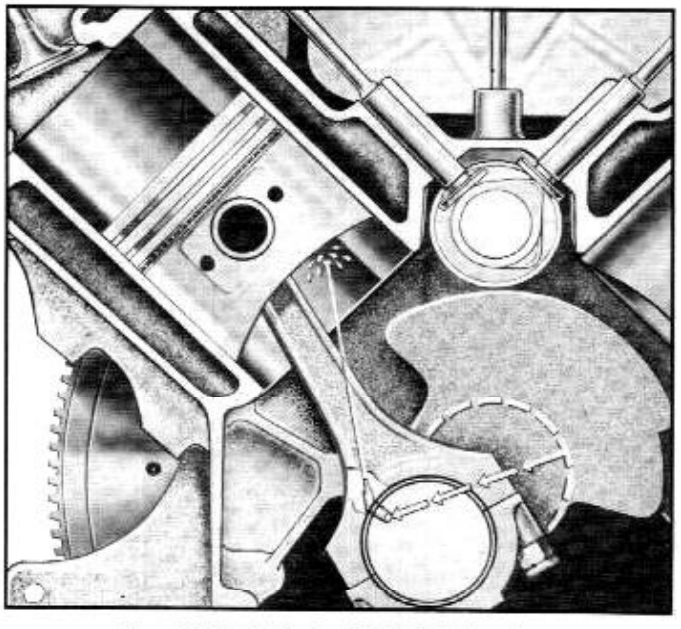


Fig. 6A-8—Cylinder Wall Lubrication

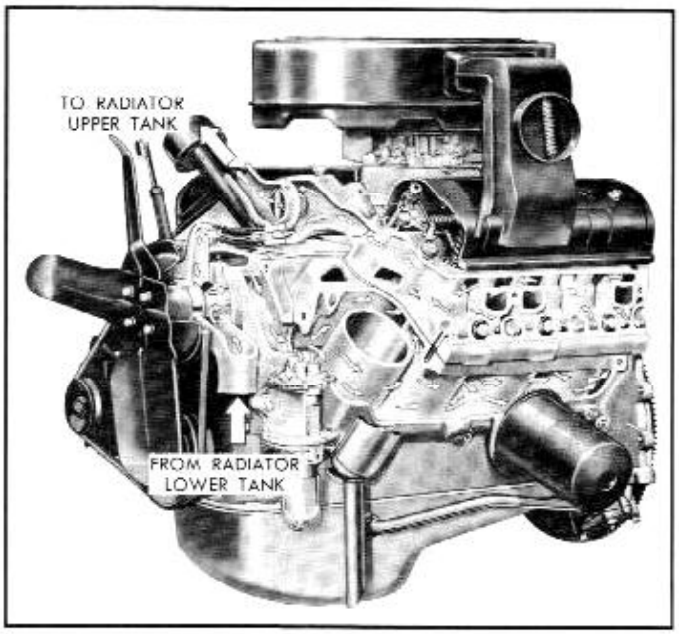


Fig. 6A-9—Cooling System—312 Cubic Inch Engine

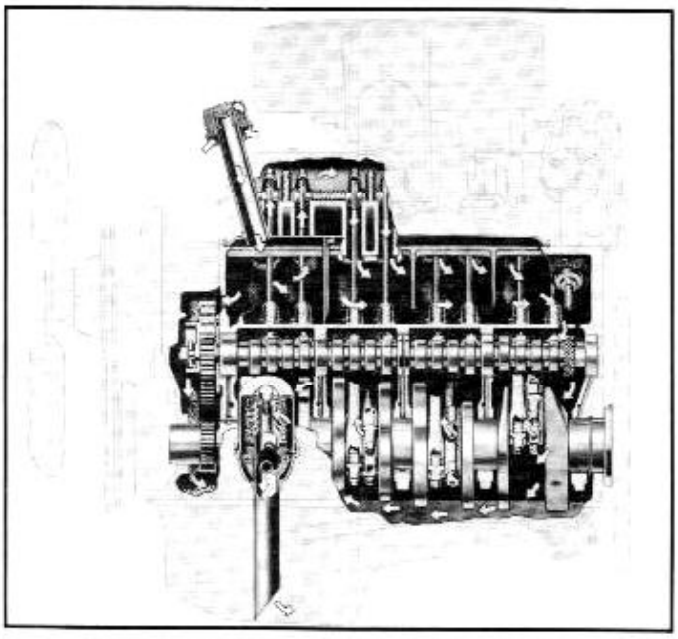


Fig. 6A-10—Crankcase Ventilation System—312 Cubic Inch Engine

The entire system is under a positive pressure of 12 to 15 P.S.I. by the use of a pressure type radiator cap. The complete cooling system is more fully described in the "Cooling System" section of this manual.

After overhauling an engine and at intervals throughout the service life of the vehicle, the entire cooling system should be thoroughly cleaned and a rust inhibitor added to the coolant, or if anti-freeze is required, use one that contains a rust inhibitor. A rust colored coolant is a warning that the system should be cleaned. Flushing of the radiator and also the cylinder block will generally bring the system back to top efficiency.

Crankcase Ventilating System — 312 Cubic Inch Displacement Engine

The crankcase ventilating system incorporated in the Mercury engine is designed to provide positive circulation of ventilating air. See figure 6A-10.

Air entering the engine through the oil filler tube passes through a filtering material located in the filler tube cap. From the filler tube, the filtered air flows into the front section of the valve push rod chamber where it is directed by a baffle, located on the chamber cover, upward into the front area of both rocker arm chambers. From this point the ventilating air is forced to the rear of the rocker arm chambers. The ventilating air moves down into the rear section of the valve push rod chamber and downward through an opening in the block to the engine crankcase. Air is also diverted from the front section of the valve push rod chamber through holes in the front cylinder block wall to ventilate the camshaft sprocket chamber.

In addition to providing positive ventilation, the ventilating air is permitted to normalize its temperature before contacting contaminating vapors originating in the crankcase. This warm ventilating air minimizes formation of crankcase sludge.

As shown in figure 6A-10, the air from the crankcase is then directed through a filter into the road draft outlet tube by the forward motion of the vehicle creating a partial vacuum at the road draft tube outlet.

In order for the system to function properly and provide adequate ventilation, it is necessary that the filtering material located in the oil filter tube cap and the road draft outlet tube be periodically cleaned by rinsing the elements in a suitable solvent and saturating with engine oil.

PERIODIC MAINTENANCE

To maintain maximum engine performance, it is recommended that the following service items be periodically performed at each of the mileage intervals indicated:

2,000 Miles

1. Inspect and adjust tension of drive belts.
2. Clean crankcase inlet breather cap and ventilation screen.
3. Change oil in crankcase every 2,000 miles or every three months, whichever occurs first.
4. Lubricate exhaust thermostat valve shaft.

4,000 Miles

1. Replace oil filter.

6,000 Miles

1. ENGINE DIAGNOSIS. Check starter system, distributor spark advance, coil, generator, generator regulator, carburetor and choke adjustments. Adjust Merc-O-Matic transmission linkage and check shift points.

10,000 Miles

1. Install new spark plugs.

Seasonal Services

1. Flush radiator, Spring and Fall.
2. Inspect all hoses and replace if necessary.
3. Add rust inhibitor to coolant each Spring.

VALVE LASH ADJUSTMENT

Valve lash is adjusted by means of self locking adjusting screws located on the push rod ends of the rocker arms. The adjusting screws have an integral hex head and special threads which provide an interference fit in the rocker arm. The first three threads are lead threads. Interference is not reached until center portion of screw threads are in full contact with the threads in rocker arms. When point of interference is reached, it should take a minimum of 3 lbs. ft. torque to turn the screw further. If the torque required to turn the screw is less than 3 lbs. ft., (wear limit) replace the rocker arm and adjusting screw.

Valve lash should be held as close as possible to specifications. If lash is set too close, the valve will open too early and close too late, thereby resulting in rough engine idle. Burning and warping of the valves will also occur because the valves cannot make contact with the seats long enough to cool properly. If the valve lash is excessive, it will cause the valve to open too late and close too early causing valve bounce. In addition, damage to the cam lobes is likely because the tappet feet will not follow the pattern of the cam lobe, thereby causing shock contact between these two parts.

If a cylinder head or rocker arm shaft mechanism has been removed and installed, it will be necessary to make a preliminary (cold) valve lash adjustment before starting the engine.

If valve lash adjustment is made for an engine tune-up follow the final (hot) adjustment procedure.

The cylinders are numbered from front to rear—right bank, 1-2-3-4; left bank, 5-6-7-8. The valves are arranged from front to rear on both banks, E-I-I-E-E-I-I-E.

Preliminary Valve Lash Adjustment

The preliminary valve lash adjustment specification for both intake and exhaust valves is 0.020 inch. Using a feeler gauge, perform preliminary valve lash adjustment as follows:

1. Check rocker arm adjusting screw torque by turning all the adjusting screws until interference is noted, then check the torque required to turn the screw further.
2. If the torque required to turn the screw is less than 3-foot pounds (36 inch pounds), replace the rocker arm and adjusting screw.
3. Make three chalk marks on the crankshaft damper. Space the marks approximately 90° apart so that with the timing mark, the damper is divided into four equal parts (90° represents 1/4 of the distance around the damper circumference). See figure 6A-11.
4. Rotate the crankshaft until No. 1 piston is near T.D.C. at the end of the compression stroke, then adjust the following valves, using a feeler gauge (See figure 6A-12):

No. 1 – Exhaust	No. 1 – Intake
No. 4 – Exhaust	No. 2 – Intake
No. 5 – Exhaust	No. 7 – Intake

Rotate the crankshaft 180° or 1/2 turn (this puts

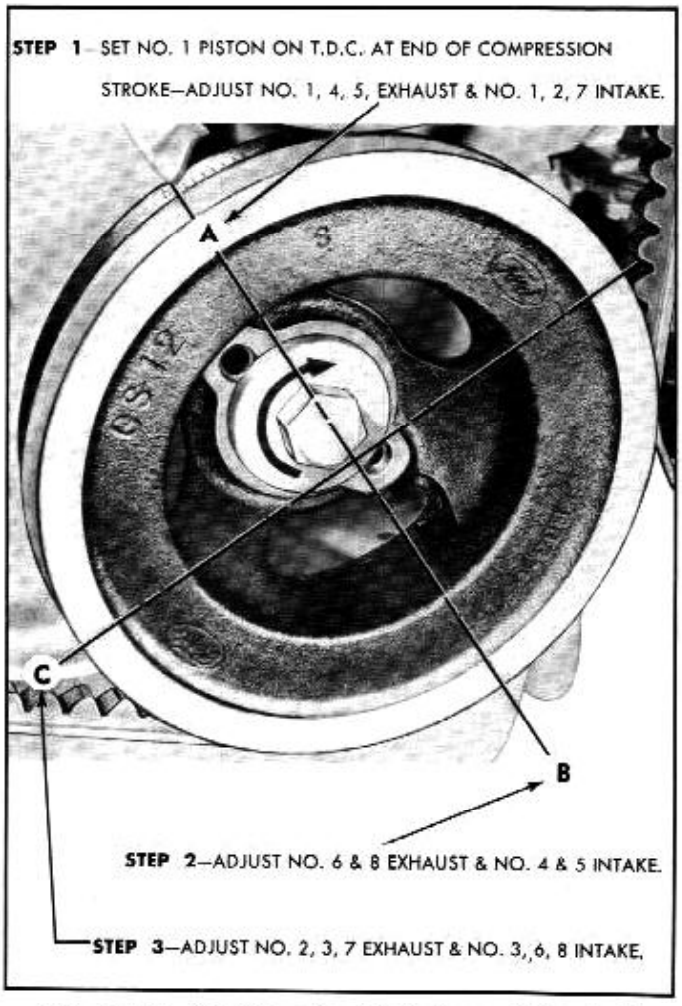


Fig. 6A-11—Quadrant for Preliminary Valve Lash Adjustment

No. 4 piston on T.D.C.), then adjust the following valves:

No. 6 – Exhaust	No. 4 – Intake
No. 8 – Exhaust	No. 5 – Intake

Rotate the crankshaft 270° or 3/4 turn from 180° (this puts No. 3 piston on T.D.C.), then adjust the following valves:

No. 2 – Exhaust	No. 3 – Intake
No. 3 – Exhaust	No. 6 – Intake
No. 7 – Exhaust	No. 8 – Intake

Final Valve Lash Adjustment

The final valve lash adjustment for both intake and exhaust valves is 0.019". Perform final (hot) valve lash adjustment as follows:

1. Run engine for 30 minutes at approximately 1200 R.P.M. to stabilize engine temperatures.
2. Turn ignition key "Off", then remove valve rocker arm covers from cylinder heads.
3. Start engine. With engine idling, check the valve lash with a feeler gauge. Adjust valve lash if necessary. See figure 6A-12.
4. Remove old rocker arm cover gaskets. Clean gasket mounting surfaces of rocker arm covers and cylinder head. Install new gaskets on rocker arm covers.
5. Install rocker arm covers, seals and/or washers (install new seals if necessary) and retaining nuts. Tighten nuts to 2-2.5 lbs. ft. torque.

CHECKING CAMSHAFT LOBE LIFT – ENGINE IN VEHICLE

This procedure is similar to the procedure for checking valve timing. Check the lobe lift in consecutive order and note the readings.

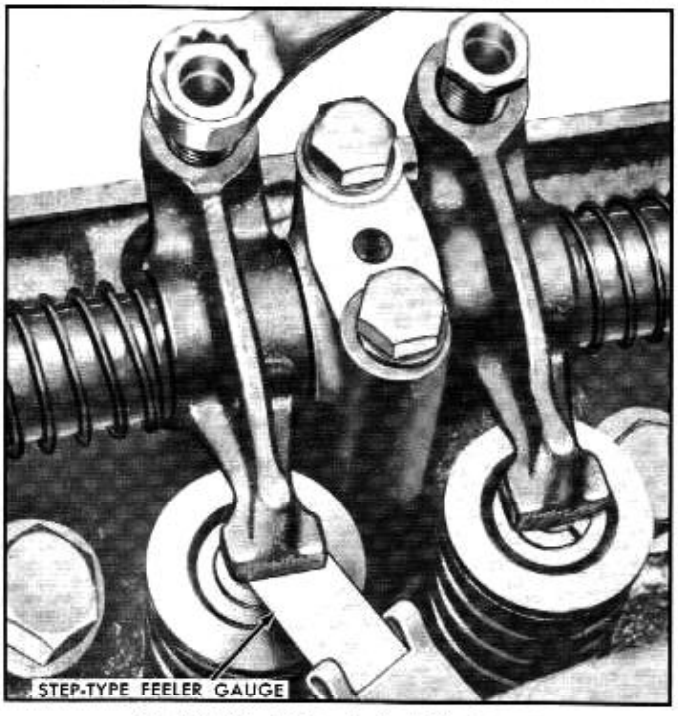


Fig. 6A-12—Valve Lash Adjustment

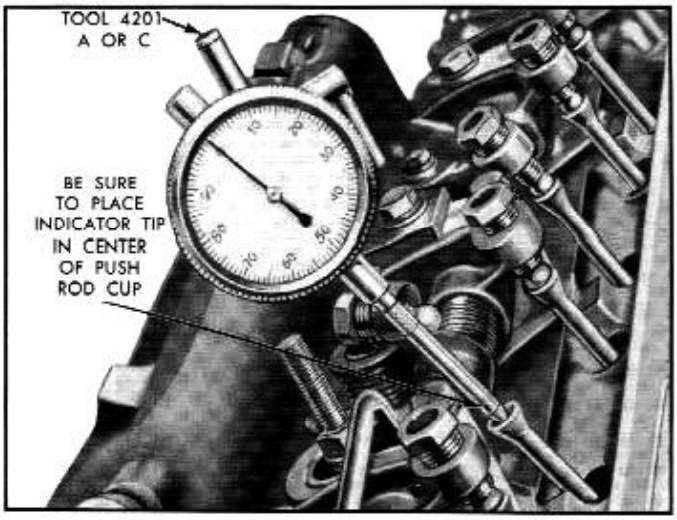


Fig. 6A-13—Checking Cam Lobe Lift—Typical

1. Remove nuts securing valve rocker arm cover to cylinder head. Remove seals and rocker arm cover.
2. Disconnect high tension coil lead wire at coil. Disconnect wire at "S" terminal of starter relay switch. Connect an auxiliary starter cable to the positive terminal of battery and "S" terminal of starter relay switch.
3. Loosen the valve rocker arm adjusting screw, then slide the rocker arm assembly to one side and secure it in this position.
4. Make sure the push rod is in the tappet socket, then install a dial indicator, using Tool 4201-A or C, in such a manner as to have the actuating point of the indicator in the push rod socket and in the same plane as push rod movement. See figure 6A-13.
5. Using the auxiliary starter cable switch, "bump" the engine over until the tappet rests on the heel of the camshaft lobe. At this point the push rod is in its lowest position.

   Set the dial indicator on zero, then "bump" the engine over until the push rod is in its fully raised position, and note the total lift recorded on the indicator. Using the starter cable switch, continue to rotate the camshaft until the indicator reads zero. This is a check on the accuracy of the original indicator reading. If the camshaft reading on any of the intake valve lobes is below the specification wear limits of 0.267", replace camshaft. If the camshaft reading on any of the exhaust valve lobes is below the wear limit of 0.280" the camshaft and/or tappets must be replaced. To replace a camshaft, refer to "Removal and Installation of Camshaft–Engine in Vehicle" in this section of manual.

6. If the camshaft readings for all lobes are within specifications, remove Tool 4201-A or C and perform preliminary valve lash adjustments. Refer to "Valve Lash Adjustment" in this section of manual.
7. Connect high tension coil lead wire to coil. Disconnect auxiliary starter cable from "S" terminal of starter relay switch and battery terminal. Connect the previously removed wire to "S" terminal.
8. Perform final valve lash adjustments. Refer to "Valve lash Adjustment" in this section of manual.
9. Install rocker arm cover, seals and retaining nuts. Tighten nuts to 2-2.5 lbs. ft. torque.

CHECKING VALVE TIMING – ENGINE IN VEHICLE

The valve timing should be checked when poor engine performance is noted and other checks such as valve lash, carburetion, ignition, compression, lobe lift, etc., fail to locate the cause of the trouble.

To check the valve timing with the engine in vehicle proceed as follows:

1. Remove nuts securing right hand valve rocker arm cover to cylinder head. Remove seals and cover.
2. Disconnect high tension coil lead wire at coil. Disconnect wire at "S" terminal of starter relay switch. Connect an auxiliary starter cable to the positive terminal of battery and "S" terminal of starter relay switch.
3. Loosen the number 2 intake valve rocker arm adjusting screw, then slide rocker arm toward rear and secure it in this position.
4. Make sure the push rod is in the tappet socket, then install a dial indicator in such a manner as to have the actuating point of the indicator in the push rod socket and in the same plane as push rod movement. See figure 6A-13.
5. Install a quadrant on the crankshaft damper.
   NOTE: Before checking valve timing, check for a bent timing pointer. Replace pointer if it is damaged.
6. Using auxiliary starter cable, "bump" the engine over until the tappet rests on the heel of the camshaft lobe. At this point the push rod is in its lowest position. Set the dial indicator on zero, then "bump" the camshaft over until the dial indicator registers the specified cam lobe lift as indicated in the table of valve timing specifications which is provided in the adjacent column.

INTAKE VALVE			
Opens		Closes	
Crankshaft Degrees	Cam Lift	Crankshaft Degrees	Cam Lift
18° B.T.D.C.	.015	18° A.B.D.C.	.100
EXHAUST VALVE			
Opens		Closes	
Crankshaft Degrees	Cam Lift	Crankshaft Degrees	Cam Lift
66° B.B.D.C.	.013	10° A.T.D.C.	.016

7. Compare the crankshaft degrees indicated on the quadrant with specifications in the above table. Continue to rotate the engine to check the valve closing.
8. If the valve timing is not within specifications, check the timing chain, camshaft sprocket, camshaft and tappets, and crankshaft in their order of accessibility.

REMOVAL AND INSTALLATION OF REAR ENGINE SUPPORT INSULATOR AND RETAINER – ENGINE IN VEHICLE

Removal

1. Remove support retainer to extension housing attaching screws and washers.
2. "Jack up" extension housing slightly to relieve the pressure on the support assembly.
3. Remove the retainer and insulator assembly.

Installation

1. "Jack up" the extension housing just enough to position the support assembly and retainer.
2. Install insulator in retainer. Place insulator and retainer assembly in position on frame crossmember. Install retainer to frame crossmember attaching washer and screws.
3. Remove the jack from housing and tighten attaching screws to 34-42 lbs. ft. torque.

REMOVAL AND INSTALLATION OF FRONT ENGINE SUPPORT INSULATORS – ENGINE IN VEHICLE

Removal

1. Remove screws securing right and left engine splash shield upper arms to frame side rails.
2. Raise front of vehicle with a floor jack. Remove

screws securing engine splash shield to front crossmember, then remove shield.
3. Loosen, but do not remove, the screws securing rear engine mount retainer and insulator to frame crossmember.
4. Remove nuts securing the front engine support insulators to frame side member engine supports.
5. Place a block of wood on an engine floor stand, then place stand under front end of oil pan.
6. Lower vehicle with floor jack until floor stand raises engine enough to allow clearance for removal of support insulators.

Installation

1. Remove retaining screws securing each respective insulator to engine block. Replace insulator and tighten retaining screws.
   NOTE: Replace support insulator on one respective side before proceeding to the next.
2. Raise front end of vehicle and guide engine as necessary to make certain insulator studs enter holes in frame side member supports. When engine support insulator is properly seated secure engine support insulators to frame side member. Tighten nuts to 30-40 lbs. ft. torque.
3. Tighten bolts securing rear engine mount insulator and retainer to frame crossmember.
4. Install and secure engine splash shield to front frame crossmember.
5. Lower vehicle and secure upper engine splash shield arms to frame and side rails.

REMOVAL AND INSTALLATION OF OIL PAN – ENGINE IN VEHICLE

Removal

1. Remove the number 6 cylinder spark plug. Position number 6 piston on T.D.C. to allow clearance between oil pan and crankshaft.
2. Remove screws securing engine splash shield to right and left frame side member.
3. Raise vehicle. Drain the oil from crankcase.
4. Remove retaining screws securing engine splash shield to frame crossmember. Remove splash shield.
5. Disconnect stablizer bar at right and left lower suspension arms. Remove retaining screws securing stabilizer to front frame crossmember. Pull stabilizer forward to allow clearance for oil pan removal.
6. Disconnect the nut securing oil pump inlet tube to the oil pump. Loosen the nut securing the inlet tube to oil pan.
7. Remove oil pan retaining screws, then remove oil pan, screen cover and inlet tube assembly as a unit.

Cleaning and Inspection

Remove gasket material from surfaces of oil pan and cylinder block. Clean oil pan, screen cover and inlet tube assembly in a suitable solvent.

Inspect oil pan and screen cover assembly for damage and replace if necessary. Make sure the gasket surfaces of the cylinder block and oil pan are free of burrs.

Installation

1. Insert inlet tube of screen cover assembly through hole in oil pan from inside oil pan. Coat the threads of inlet tube to oil pan nut with oil resistant sealer. Install a new washer then loosely install the nut.
2. Install nut and a new seal on the pump end of inlet tube.
3. Coat the cylinder block gasket surface with oil resistant sealer. Position a new gasket on oil pan, making sure all holes are aligned.
4. Install inlet tube and seal in oil pump while carefully positioning oil pan against the cylinder block. Install two of the retaining screws in each side of pan. Install the remaining screws and nuts, then tighten screws in sequence from the center outward. Tighten screws to 12-15 lbs. ft. torque.
5. Tighten jam nut at oil pan to 28-32 lbs. ft. torque. Tighten nut at oil pan to 10-12 lbs. ft. torque.
   NOTE: Do not overtighten the inlet tube nuts.
6. Install stabilizer bar. Install engine splash shield on frame crossmember. Lower vehicle. Install engine splash shield arms on frame side members.
7. Fill crankcase with the proper amount and grade of lubricant. Start engine; check for leaks.

REMOVAL AND INSTALLATION OF OIL PUMP – ENGINE IN VEHICLE

Removal

1. Raise vehicle. Loosen oil inlet tube jam nut at oil pan. Disconnect oil inlet jam nut at oil pump. Remove oil pump to cylinder block retaining screws.
2. Pull oil pump inlet tube out of oil pump. Remove oil pump, intermediate shaft and gasket. Remove seal from inlet tube.

Disassembly

Refer to figure 6A-14.

1. Remove retaining screws securing cover to body assembly. Remove cover and gasket.

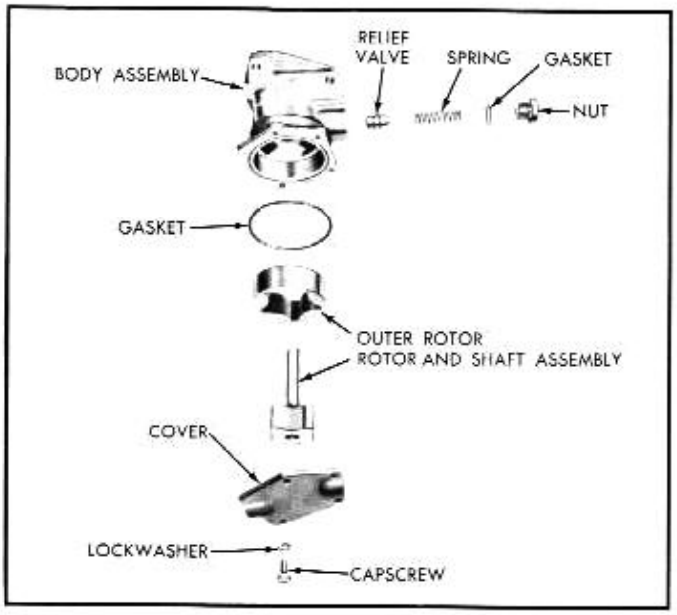


Fig. 6A-14—Disassembled Oil Pump

2. Remove rotor and shaft assembly. Remove relief valve nut, gasket, spring, and relief valve.

Cleaning and Inspection

1. Clean cylinder block and oil pump mounting surfaces. Clean all parts in a suitable solvent. Be sure all dirt and foreign material is removed.
2. Check pump housing, outer race, and rotor shaft for damage or excessive wear. Check mating surfaces of pump cover for wear. If plate is worn, scored or grooved, replace plate.
3. Inspect relief valve spring for a collapsed or worn condition. Check relief valve spring tension. The spring should exert a pressure of 9.8 pounds at 0.800 inch. If spring tension is not within specifications or it is defective, replace spring.
4. Check the relief valve piston for scores and free operation in the bore. The specified piston clearance is 0.002 to 0.004 inch.
5. Check rotor-shaft to housing bearing clearance by measuring O.D. of shaft and I.D. of housing bearing. Clearance limits are .0015 to .0029 inch.
6. Measure the outer rotor race to body clearance as shown in figure 6A-15. The clearance should be .006 to .009 inch.
7. With the rotor and shaft assembly installed in the housing, place a straight edge over the rotor assembly and pump body. Measure the clearance between the pump and straight edge at the rotor. The clearance should be .0010 to .0029 inch. See figure 6A-16.

   NOTE: The outer rotor, and shaft and rotor assembly are replaceable only as an assembly.

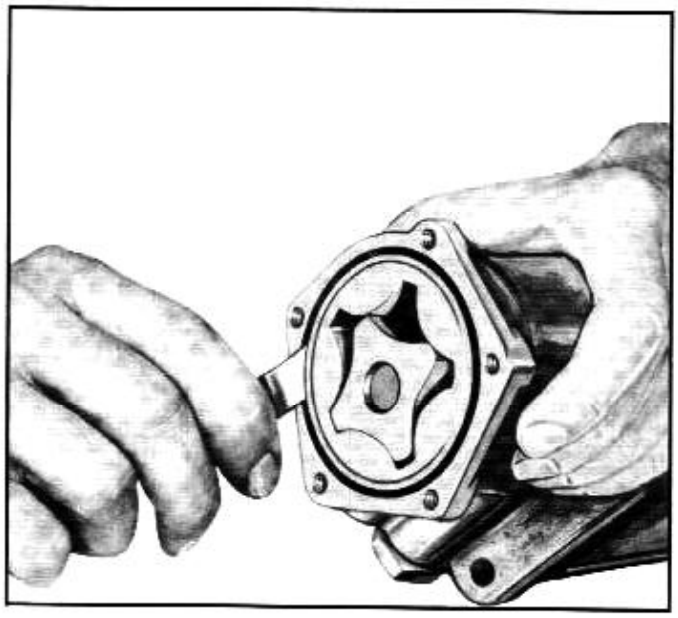


Fig. 6A-15—Checking Outer Rotor to Pump Body Clearance

Assembly

1. Oil all parts thoroughly. Install oil pressure relief valve, spring, new gasket and nut.
2. Install outer race and the inner rotor and shaft assembly. Install gasket in groove on pump body assembly. Install cover and retaining screws. Torque screws 12 to 15 lbs. ft.

Installation

1. Install new seal on pump end of inlet tube. Install tube and seal in oil pump. Do not tighten jam nut at this time.
2. Insert intermediate shaft into oil pump drive shaft. Position a new gasket on pump housing. Install pump and shaft on cylinder block as an assembly. NOTE: Do not force pump assembly into position if it will not seat readily, for the intermediate shaft hex and distributor shaft may be misaligned. Rotate intermediate shaft into a new position to align.

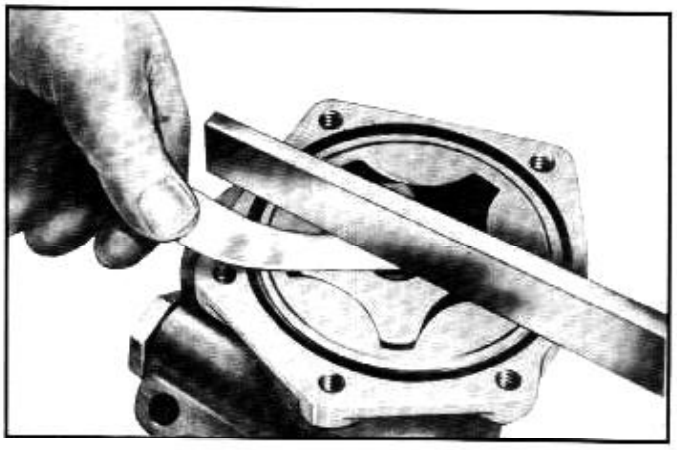


Fig. 6A-16—Checking Rotor End Play Clearance

3. Tighten oil pump to cylinder block retaining screws to 12-15 lbs. ft. torque.
4. Tighten oil pump jam nut to 10-12 lbs. ft. torque. Tighten jam nut at oil pan to 28-32 lbs. ft. torque. DO NOT OVERTIGHTEN NUTS.
5. Lower vehicle. Start engine, observe the oil pressure indicator performance. Check oil system for leaks.

REMOVAL AND INSTALLATION OF OIL FILTER (DISPOSABLE TYPE) — ENGINE IN VEHICLE

Figure 6A-17 shows a disassembled view of the oil filter assembly and component parts. The gasket, adaptor and connector are not removed or replaced during an oil filter replacement unless leakage or damage is evident. Disregard steps three (3) and four (4) of the following procedure if it is not necessary to replace these parts.

Removal and Replacement

1. Raise vehicle. Place a drip pan under filter assembly.
2. Turn filter assembly counterclockwise and remove from cylinder block. Discard filter if its condition warrants replacement.
3. If it is necessary to remove connector, adaptor, and gasket, turn insert counterclockwise to remove.
4. Clean cylinder block recess. Install a new gasket in recess, making sure it is properly seated around the outside edge. Install adaptor with the word "TOP" in the uppermost position. See figure 6A-18. Install the connector and tighten it to 50-70 lbs. ft. torque.
   NOTE: Be sure adaptor does not rotate.

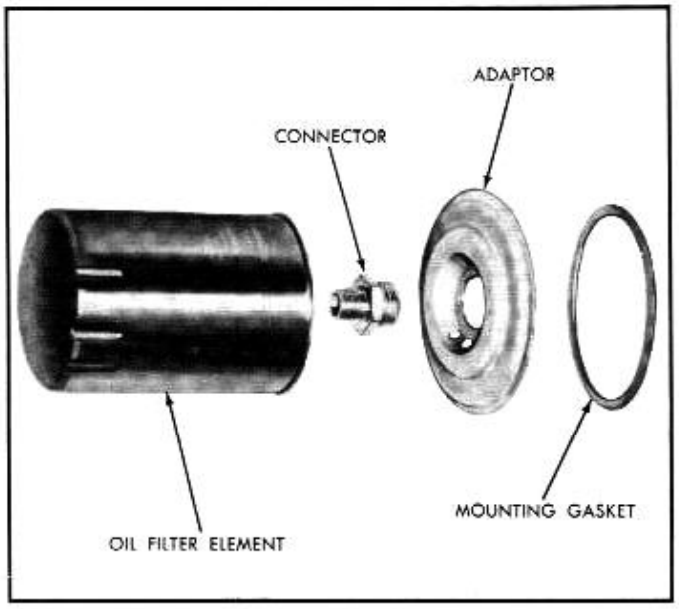


Fig. 6A-17—Disassembled View of Disposable-Type Oil Filter Assembly

Fig. 6A-18—Oil Filter Replacement

5. Coat the filter gasket face with engine oil. Check to see if the adaptor is properly positioned with the word "TOP" in the uppermost position. Install filter on connector; hand tighten until filter gasket contacts adaptor face, then advance filter one-half (1/2) turn. DO NOT OVERTIGHTEN.
6. Lower vehicle. Refill crankcase with proper amount and grade of lubricant if necessary. Start the engine; operate it at fast idle and check for oil leaks. If leakage is indicated perform necessary repairs to correct the condition.

REMOVAL AND INSTALLATION OF OIL FILTER (CARTRIDGE TYPE) — ENGINE IN VEHICLE

Removal

1. Raise vehicle. Place a drip pan under the filter assembly.
2. Unscrew the filter bolt and valve assembly from the insert, then remove the filter assembly.

Disassembly

1. Remove gasket, filter element, neoprene gasket, retainer and spring. Remove center bolt from the cover and remove fibre gasket from bolt. Discard filter element and all gaskets.
2. Wash all parts in a suitable solvent. Make sure all openings in the bolt and valve assembly are clean.

Assembly

1. Install a new fibre gasket on the bolt. Place the

bolt through the filter cover. Install spring, retainer, and gasket on the bolt, making sure the retainer tang is engaged in the spring. Install a new filter element over the bolt.

Installation

1. Check to see if the two elongated holes in the oil filter anti-drain back diaphragm are in the uppermost "TOP" position. Clean the filter recess and install a new oil filter mounting gasket.
2. Place the filter assembly in position. Insert the bolt into the insert. Then turn bolt until it is finger tight, then rotate filter assembly slightly, in each direction, to seat the gasket evenly. Tighten center bolt to 20-25 lbs. ft. torque. DO NOT OVER-TIGHTEN.
3. Lower vehicle. Refill crankcase with proper amount and grade of lubricant, if necessary. Start engine and operate it at fast idle. Check for oil leaks. If leakage is indicated, perform necessary repairs to correct the condition.

REMOVAL AND INSTALLATION OF FLYWHEEL, REAR OIL PASSAGE PLUGS AND CAMSHAFT BEARING PLUG (STANDARD OR OVERDRIVE TRANSMISSION) — ENGINE IN VEHICLE

Removal

1. Remove transmission assembly. Refer to "Transmission" section of this manual.
2. Disengage clutch pedal retracting spring from clutch release lever.
3. Remove two cap screws and lockwashers retaining equalizer bracket assembly to cylinder block.
4. Mark position of flywheel and pressure plate assembly so parts may be installed in original position if inspection reveals a satisfactory condition. Compress the pressure plate assembly with Tool 7563. Remove cap screws and remove pressure plate and disc.
   NOTE: If tool is not available, install three wedges between clutch fingers and pressure plate housing.
   Disconnect starter cable. Remove spark plug wiring loom grommet.
5. Remove starter assembly.
6. Remove screws securing flywheel to crankshaft flange. Remove flywheel.
7. REMOVAL AND REPLACEMENT OF REAR PASSAGE PLUG
   a. If oil leakage is indicated at rear oil passage plugs, inspect bore for stripped or improperly machined threads. If threads are stripped, tap new threads further into the bore. This will allow the plug to seat further into the cylinder block.
   b. Coat a new plug with a suitable oil resistant sealing compound and install plug.
   CAUTION: *Do not restrict the oil passage by screwing the plug too far into the tapped hole.*
8. REMOVAL AND REPLACEMENT OF CAMSHAFT BEARING PLUG

If oil leakage is indicated at camshaft bearing plug, replace plug as follows:

   a. Remove screws securing flywheel housing to cylinder block. Remove flywheel housing from cylinder block.
   b. Drill a ½ inch hole in center of camshaft bearing plug, then remove plug with Clutch Pilot Bearing Removing Tool 7600-E.
   c. Clean the camshaft bearing bore to remove scale, rust and old sealing compound. Check the bore for cracks or sand holes.
   d. Coat edges of new camshaft bearing plug with a suitable oil resistant sealing compound. Install the plug, with the flange side facing out, using Tool 6266-B.
   e. Install flywheel housing on cylinder block. Tighten screws to 40-50 lbs. ft. torque.

Inspection

1. Inspect the flywheel for cracks, heat check, scores or other damage that would make it unfit for further service.
2. Inspect the ring gear for worn, chipped or cracked teeth. If the teeth are damaged, replace the flywheel ring gear. See "Ring Gear Replacement".
3. With the flywheel installed on the crankshaft, figure 6A-19, check the flywheel face run-out.

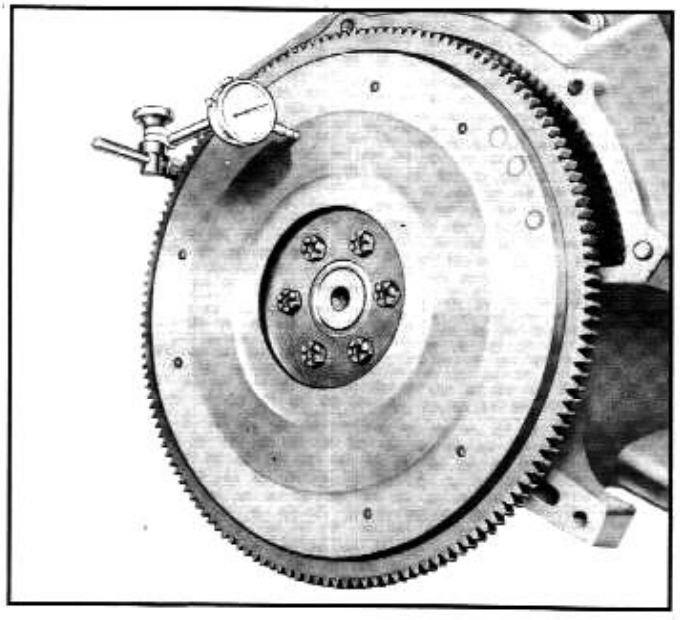


Fig. 6A-19—Checking Flywheel Run-out—Typical

Install a dial indicator so that the indicator point bears against the flywheel face. Turn the flywheel, making sure it is full forward or rearward so that crankshaft end-play will not be indicated as flywheel run-out.

If the run-out exceeds .010 inch, remove the flywheel and check the flywheel contact face of the crankshaft. If no burrs exist, check the run-out of the crankshaft mounting flange. Replace the flywheel assembly if flange run-out does not exceed .002 inch T.I.R. Replace the crankshaft if flange run-out exceeds .002 inch T.I.R. Inspect clutch disc and clutch assembly for damage. Replace damaged parts.

RING GEAR REPLACEMENT

The flywheel and ring gear are a shrink fit and are replaceable as separate parts. Replace ring gear as follows:

1. With flywheel removed from vehicle, heat the defective ring gear evenly with a torch on the engine side of the gear, then knock it off flywheel.
   NOTE: Do not hit the flywheel when removing the ring gear.
2. Heat the new ring gear evenly until the gear expands enough to slip it onto flywheel. Make sure the gear is seated properly against the shoulder.
   NOTE: Do not heat any portion of the gear to a temperature of more than 500° F. If this limit is exceeded, the temper will be removed from the ring gear teeth.
3. Install flywheel assembly on crankshaft. Check gear face run-out. Run-out should not exceed .005" T.I.R.

Installation

1. Install flywheel. Tighten retaining screws to 75-85 lbs. ft. torque. Check flywheel clutch face run-out. Run-out must not exceed .010 inch T.I.R. See figure 6A-19. Check flywheel housing alignment.
2. Compress clutch pressure plate assembly using Tool 7563 or three wedges.
3. Position clutch disc on flywheel and hold in place by installing Pilot Tool 7563-A through disc into the flywheel.
4. With clutch pressure plate still compressed, install plate on flywheel using six retaining screws. Tighten screws to 22-28 lbs. ft. torque.
   NOTE: If original clutch assembly is to be used, position unit according to marks made during disassembly.
5. Remove compressor tool or wedges and remove clutch disc pilot tool.
6. Install equalizer bracket assembly on cylinder block.
7. Install clutch pedal retracting spring and clutch release lever.
8. Install transmission assembly. Refer to "Transmission" section of this manual.
9. Check total travel and free travel of clutch pedal and make necessary adjustment. Refer to "Clutch Pedal Adjustment" in the transmission section of this manual.

REMOVAL AND INSTALLATION OF FLYWHEEL, REAR OIL PASSAGE PLUGS AND CAMSHAFT REAR BEARING PLUG (MERC-O-MATIC EQUIPPED CARS) — ENGINE IN VEHICLE

Removal

1. Remove converter housing to cylinder block upper attaching screws.
2. Raise vehicle. Remove converter lower access plate and converter front access plate.
3. Remove transmission filler pipe and bracket, then drain transmission.
4. Disconnect rear universal at rear axle and remove drive shaft.
5. Remove clip and pin retaining parking brake equalizer to equalizer bracket. Remove nut retaining the equalizer to parking brake cable. Allow cable to hang loosely below car.
6. Remove transmission control linkage shield. Disconnect throttle linkage arm at throttle lever. Remove manual cable access cover plug to disconnect manual cable. Remove manual cable clamp screw. Disengage manual cable spring clip through access plug hole in transmission and lift cable up to remove. Disengage park release cable from arm.
7. Remove clip securing parking brake cable to rear engine support crossmember. Remove parking brake cable.
8. Disconnect wire at reverse lockout assembly. Disconnect speedometer cable from transmission.
9. Disconnect transmission oil transfer lines at transmission. Disconnect starter cable at starter. Remove spark plug wiring loom grommet. Remove starter assembly.
10. SINGLE EXHAUST SYSTEM EQUIPPED CARS
    Remove nuts that secure muffler exhaust inlet pipe to right and left exhaust manifolds. Remove muffler exhaust outlet pipe from mounting bracket and insulator assembly at rear of muffler. Move exhaust system away from working area.
11. DUAL EXHAUST SYSTEM EQUIPPED CARS
    Remove nuts securing the left muffler exhaust

inlet pipe to the exhaust manifold. Remove left muffler outlet pipe from support bracket and insulator assembly at rear of muffler. Move exhaust system away from area of frame crossmember.

12. Remove two screws securing the transmission rear engine support to the transmission. Install a transmission support stand under transmission. Remove bolts securing engine support crossmember to frame side rails. Remove support crossmember.
13. Remove screws retaining flywheel to converter cover. (Early production flywheels are attached to converter with six cap screws. The new type flywheels are secured with four capscrews.)
    NOTE: To prevent damage to converter assembly, when transmission is removed, make sure the converter is retained within the converter housing (fabricate a clip for this purpose). Remove remaining screws securing converter housing to cylinder block, then move the transmission back far enough to clear the flywheel.
14. Remove the flywheel to crankshaft retaining screws and remove flywheel (Flex-Type).
15. To remove and replace the converter cover assembly, refer to the "Lincoln and Mercury Automatic Transmission Repair and Adjustment Manual" Form LM-4613—Nov., 1954.
16. REAR OIL PASSAGE PLUG REPLACEMENT
    a. Remove screws securing flywheel to crankshaft. Remove flywheel.
    b. If oil leakage is indicated at rear oil passage plugs, remove plug. Inspect bore for stripped or improperly machined threads.
    c. If threads are stripped, thread the hole a little deeper into the bore. This will allow the plug to seat further in the cylinder block.
    d. Coat a new plug with an oil resistant sealer and install plug.
17. CAMSHAFT REAR BEARING PLUG REPLACEMENT
    If oil leakage is indicated at camshaft bearing plug, replace plug as follows:
    a. Drill a ½" hole in center of camshaft bearing plug, then remove plug with Clutch Pilot Bearing Removing Tool 7600-E.
    b. Clean the camshaft bearing bore to remove scale, rust and old sealing compound. Check the bore for cracks or sand holes.
    c. Coat edges of new camshaft bearing plug with a suitable oil resistant sealing compound. Install the plug, with flange side facing out, using Tool 6266-B.

Installation

1. Install flywheel on crankshaft. Tighten attaching screws 75-85 lbs. ft. torque.
2. Install dowels in two upper cylinder block to converter housing mounting holes. Align converter housing mounting holes with the dowels in cylinder block. Align converter drain plugs with access slots in the flywheel. Install two lower cylinder blocks to converter mounting bolts. Tighten bolts 40-50 lbs. ft. torque.
3. Remove retainer securing converter assembly in the housing. Install flywheel to converter attaching bolts. Tighten bolts to 25-28 lbs. ft. torque.
4. Install rear engine support crossmember on frame side rails. Secure transmission to rear engine support insulator and crossmember and tighten screws to 22-28 lbs. ft. torque.
   CAUTION: *Make sure mounting clamp does not contact crossmember.*
5. SINGLE EXHAUST SYSTEM EQUIPPED VEHICLES
   Clean gasket surfaces of the muffler exhaust inlet pipes, exhaust manifolds and exhaust thermostat valve. Using new gaskets, install exhaust inlet pipes and transmission oil filler tube bracket. Tighten all nuts to 34-42 lbs. ft. torque. Install muffler exhaust outlet pipe and support bracket on frame side rail.
6. DUAL EXHAUST SYSTEM EQUIPPED CARS
   Clean gasket surfaces of muffler inlet pipe and exhaust manifold. Using a new gasket, secure the exhaust exhaust inlet pipe to exhaust manifold. Tighten nuts to 34-42 lbs. ft. torque.
7. Connect reverse lockout switch wire to reverse lockout switch. Install speedometer cable.
8. Route manual brake cable through frame crossmember and secure to crossmember with retaining clip. Connect parking brake cable to equalizer lever. Secure lever to crossmember with a clevis pin. Install spring and adjust cable.
9. Install drive shaft in transmission. Install drive shaft on rear universal joint. Tighten retaining nuts to 15-18 lbs. ft. torque.
10. Install dust seal and starter. Install spark plug wiring loom grommet. Install starter cable.
11. Connect oil filler tube to transmission. Tighten jam nut to 40-50 lbs. ft. torque. Install oil filler tube bracket on muffler inlet pipe. Connect transmission oil transfer lines to transmission fittings. Tighten jam nut to 15-20 lbs. ft. torque.
12. Install transmission front cover and lower access cover.
13. Install transmission manual cable, park release cable and throttle linkage. Refer to "Merc-O-Matic Transmission" section of manual for adjustment procedures. Make complete linkage and cable adjustments. Install transmission linkage splash shield.

14. Lower vehicle. Remove dowel pins from cylinder block, then install two upper transmission to cylinder block mounting screws. Tighten screws to 40-50 lbs. ft. torque.
15. Fill transmission to required level on dipstick with type "A" transmission fluid. Start engine to fill torque converter. Add fluid to bring the fluid level to the correct height on dipstick.
16. Operate engine at fast idle and check for leaks. Shift transmission through all ranges including "Park." Check and adjust transmission linkage, throttle linkage, engine idle speed and carburetor dashpot.

REMOVAL AND INSTALLATION OF INTAKE MANIFOLD — ENGINE IN VEHICLE

Removal

1. Open petcocks and drain cooling system at radiator and cylinder block. Remove air cleaner and heat duct as an assembly. Remove battery ground cable.
2. Disconnect high tension lead, secondary, and primary ignition wires at coil and resistor. Disconnect distributor vacuum line.
3. Remove heater inlet hose at heater inlet fitting on manifold. Disconnect upper radiator hose from water outlet connection. Disconnect water by-pass hose from water pump.
4. Disconnect windshield wiper hose at vacuum booster line. Disconnect vacuum line from automatic starter cut-out switch, and intake manifold vacuum fitting.
5. Disconnect fuel inlet line at carburetor. Disconnect carburetor to control shaft rod at carburetor. Remove accelerator retract springs.
6. Remove retaining screws securing automatic starter cut-out switch, control shaft assembly, and accelerator shaft bracket to engine. Wire control shaft assembly, and accelerator shaft bracket to dash panel.
7. Disconnect vacuum booster line at manifold fitting. NOTE: If vehicle is equipped with a power brake unit, disconnect power brake vacuum hose at manifold fitting.
8. Remove retaining screws, nuts and washers securing intake manifold to the cylinder heads. Remove intake manifold and gaskets.

Disassembly and Assembly

If replacement of the intake manifold is necessary or inspection in greater detail is required, the following bench operations are required before installation of a new assembly:

1. Remove water outlet connection housing. Remove thermostat and heater fitting.
2. Remove carburetor, gaskets and spacer. Remove four carburetor mounting studs from manifold.
3. Remove ignition coil and resistor. Remove automatic choke inlet tube, and the vacuum fitting at rear of manifold.
4. Clean old gasket material from cylinder heads and intake manifold. Inspect for cracks, leaks, or blocked passages. Replace manifold if it is damaged.
5. Clean the new intake manifold and inspect all the passages for leaks and cracks.
6. Install vacuum fitting in rear of intake manifold (use sealer). Install automatic choke inlet tube. Install ignition coil and resistor.
7. Install four carburetor mounting studs in manifold riser. Then, install a new carburetor lower gasket, spacer, and a new upper gasket. Install carburetor and automatic choke inlet tube.
   NOTE: When tightening carburetor retaining nuts, first snug down all nuts, then tighten alternately in a criss cross pattern to an equivalent torque of 12 to 15 lbs. ft.
8. Install heater fitting, using sealer on threads to prevent leakage. Install thermostat in its proper position. Install water outlet connection housing. Tighten retaining screws to 12-15 lbs. ft. torque.

Installation

1. Install new intake manifold gaskets and intake manifold.
   NOTE: When installing manifold and gaskets, make up pilot studs to hold gaskets in position (use 3/8"-16 screws to make pilot studs). Position the manifold clamps and washers; install manifold retaining screws and nuts; tighten them to 23-28 lbs. ft. torque, working on each side alternately from the center towards the ends.
2. Install control shaft assembly, accelerator shaft bracket and automatic starter cut-out switch, on intake manifold. Install carburetor to control shaft rod on carburetor. Install accelerator shaft retracting springs.
3. Connect vacuum line to automatic starter cut-out switch and manifold vacuum fitting. Connect windshield wiper hose to vacuum booster line.
4. If vehicle is equipped with a power brake unit, connect power brake hose to manifold fitting. Connect vacuum booster line to manifold fitting.
5. Connect water by-pass hose to water pump. Connect heater inlet hose to heater fitting. Connect upper radiator hose to water outlet connector. Close petcocks at radiator and cylinder block.
6. Connect distributor vacuum line. Connect high tension lead, secondary, and primary ignition wires to coil and resistor.

7. Install battery ground cable. Fill cooling system with coolant. Start engine, and run it at 1200 R.P.M. until it is thoroughly warm (approximately 30 minutes). While engine is running check for leaks.
8. With engine running, check timing and timing advance. Make necessary carburetor adjustments, then adjust transmission linkage.
9. Install air cleaner and air duct assembly.

REMOVAL AND INSTALLATION OF AUTOMATIC CHOKE CONTROL HEAT TUBE—ENGINE IN VEHICLE

If the automatic choke control fresh air heat tube in the intake manifold is cracked or broken, the automatic choke will not function properly.

To check for a broken or cracked heat tube; remove carburetor air cleaner; remove choke cover and inspect choke assembly. If parts appear burned or covered with carbon, the heat tube should be replaced. In some cases dust will be found in the choke cover. This is normal and does not mean the choke is defective or the heat tube is leaking.

Removal

1. Perform steps 1 through 8 of "Intake Manifold Removal" procedures in this section of manual.
2. Disconnect fuel, and vacuum lines from carburetor. Remove carburetor and choke assembly from manifold. Remove fittings at each end of heat tube (pry or twist out).

   NOTE: Refer to "Fuel Section" of this manual for instructions regarding the cleaning and repair of automatic choke and carburetor.
3. Drive the small end of the heat tube, located on the right hand side of manifold, back into the manifold with a flat end pin punch.

   NOTE: If the large end of the tube does not come out the opposite side of manifold, the tube is probably bent or broken off. In this case, the large end should also be driven into the manifold. Remove the tube, or pieces, out through the manifold heat riser chamber. This can usually be accomplished by shaking the manifold. If it does not fall out, make a hook out of wire and remove pieces.

Installation

NOTE: Before installing the new heat tube, check manifold right hand bore to see if small end of the new tube fits easily. If the hole is too small, it should be reamed to provide a slip fit. A 5/16 inch expansion reamer, with the adjusting screw removed, can be used for the operation. It is important not to ream the hole too large or there will be an exhaust leak.

1. Insert the small end of the heat tube through the large bore in the left side of manifold. Line the tube up using a 1/4 inch pin punch in the small bore in the right side. Drive the tube in place.
   NOTE: The tube ends should stick out approximately 1/16 inch on each side of manifold.
2. To check installation, adjust a vacuum pump to three inches of vacuum. Block off one opening of heat tube with a moistened finger, then connect the vacuum hose to the other opening. If the pump does not maintain a steady reading there is a leak in the tube and the tube should be replaced.
3. Install fittings on each side of heat tube. Do not dislodge the heat tube when these fittings are installed.
4. Using new gaskets, install spacer, carburetor and automatic choke assembly. Alternately torque retaining nuts in a criss-cross pattern to 12-15 lbs. ft. Connect carburetor fuel and vacuum lines.
5. Perform steps 1 through 8 of "Intake Manifold Installation" procedures in this section of manual.

REMOVAL AND INSTALLATION OF VALVE PUSH ROD CHAMBER COVER – ENGINE IN VEHICLE

Removal

1. Remove intake manifold assembly. Refer to "Removal of Intake Manifold – Engine in Vehicle" in this section of manual.
2. Clean top of valve push rod chamber cover to prevent foreign material from falling into push rod chamber. Remove cover and gasket.

Inspection

1. If oil leakage is indicated, inspect valve push rod chamber cover for a warped or bent condition. Replace cover if damaged.
2. Clean crankcase inlet breather cap and ventilation screen.
3. Remove old gasket material from chamber cover and cylinder block mounting surface.

Installation

1. Install a new valve push rod chamber cover gasket on cylinder block. Install push rod chamber cover and new seals. Tighten retaining screws to 2.0-2.5 lbs. ft. torque.
2. Install intake manifold. Refer to "Installation of Intake Manifold" in this section of manual.

REMOVAL AND INSTALLATION OF RIGHT EXHAUST MANIFOLD – ENGINE IN VEHICLE

Removal

1. Disconnect the muffler inlet pipe from exhaust manifold. Remove exhaust manifold to cylinder head retaining screws, washers, and heat shields.
2. Remove exhaust manifold, exhaust control valve assembly and gaskets.
3. Clean the exhaust manifold, cylinder head, exhaust control valve, and inlet pipe mating surfaces. Replace stripped or broken studs. Inspect manifold for sand holes, cracks, restricted passages, and improperly machined surfaces. If damaged condition cannot be corrected, replace manifold.

Installation

1. Clean and inspect new manifold. Coat mating surfaces of the manifold with a light film of graphite grease. Start the rear retaining screw and lockwasher into the cylinder head. Install the manifold on the rear retaining screw, then install the remaining screws, washers and heat shields.
2. Tighten the retaining screws, working alternately from the center to the ends, to 23-28 lbs. ft torque.
3. Using new gaskets on both sides, install exhaust control valve. Connect the muffler inlet pipe and Merc-O-Matic transmission filler pipe bracket. Tighten nuts to 34-42 lbs. ft. torque. Start engine; check for leaks.

REMOVAL AND INSTALLATION OF LEFT EXHAUST MANIFOLD – ENGINE IN VEHICLE

Removal

1. Remove screws securing fresh air heat duct connector to fender apron. Loosen nut securing heat duct to bracket on exhaust manifold. Loosen wing nut securing heat duct to air cleaner. Remove duct.
2. Disconnect muffler inlet pipe from exhaust manifold.
3. Remove exhaust manifold to cylinder head retaining screws, lockwashers, spark plug heat shields and heat duct mounting bracket. Remove exhaust manifold.
4. Clean the exhaust manifold, cylinder head and inlet pipe mating surfaces. Replace broken or stripped studs. Inspect manifold for sand holes, cracks, restricted passages, and improperly machined surfaces. If damaged condition cannot be corrected replace manifold.

Installation

1. Clean and inspect new manifold. Coat mating surfaces of manifold with a light film of graphite grease. Start the rear retaining screw and lockwasher into the cylinder head. Install the manifold on rear retaining screw, then install the remaining screws, washers, heat shields, and heat duct mounting bracket.
2. Tighten the retaining screws, working alternately from the center to the ends, to 23-28 lbs. ft. torque.
3. Using a new gasket between manifold and muffler inlet pipe, connect inlet pipe and tighten nuts to 34-42 lbs. ft. torque.
4. Install air cleaner and duct. Install connector on fender apron and connect it to duct assembly.
5. Start engine. Check system for leaks.

REMOVAL OF CYLINDER FRONT COVER, TIMING CHAIN, CAMSHAFT AND CRANKSHAFT SPROCKETS – ENGINE IN VEHICLE

Removal

1. Raise vehicle, drain oil and remove oil pan. Refer to "Removal of Oil Pan – Engine in Vehicle" in this section of manual.
2. Lower vehicle. Open radiator and cylinder block petcocks and drain cooling system.
3. POWER STEERING EQUIPPED VEHICLES
   a. Without disconnecting hoses, remove power steering pump assembly from mounting bracket. Remove belt and position power steering unit against lower fender apron in a manner that will prevent fluid from draining out of reservoir.
4. Disconnect lower radiator hose from water pump. Disconnect upper radiator hose from connector, then disconnect water by-pass tube from water pump.
5. MERC-O-MATIC EQUIPPED VEHICLES
   a. Disconnect transmission inlet and outlet oil coolant lines from lower radiator tank.
6. Place a piece of heavy cardboard or fibreboard over radiator core to prevent damage when removing radiator. Remove attaching screws and remove radiator assembly.
7. POWER SURGE FAN EQUIPPED VEHICLES
   a. Remove screws securing power surge clutch and fan assembly and the water pump pulley to the water pump pulley hub. Remove power surge fan.
8. Remove screws securing fan assembly, spacer and pulley to water pump hub. Remove component parts as a unit. Remove drive belt.

9. Remove water pump and timing indicator.
10. If vehicle is equipped with power steering remove power steering pulley from crankshaft damper.
11. Using Tool 6316-FF remove crankshaft damper. Remove oil slinger and Woodruff key from crankshaft.
12. Disconnect the vacuum lines, gas line, and flexible fuel line from fuel pump, then remove fuel pump from front cover assembly.
13. Remove cylinder block front cover and gasket. NOTE: When removing front cover, use care to prevent damage to crankshaft seal in cover.
14. Remove screw, flat washer, spacer, fuel pump eccentric cam and counterweight from camshaft.
15. Align timing mark on camshaft sprocket with that of the timing chain. Remove camshaft sprocket, crankshaft sprocket, and timing chain as a unit.

Inspection

1. Inspect camshaft sprocket, crankshaft sprocket and timing chain for signs of wear, chipped teeth or other damage.
   NOTE: It is recommended that all parts be replaced when either of the sprockets or the chain require replacement.
2. Inspect cylinder front cover for cracks, sand holes, nicks or burrs. Replace front cover if it is dammaged beyond repair.
3. If front cover leaked at seal, install new crankshaft front oil seal using Tool 6700-B. See figure 6A-20. Coat seal with lubricant to facilitate installation.
4. If water leakage at front cover is indicated, it will be necessary to replace the oil previously drained from crankcase. Clean oil pan, clean gasket mating surface of cylinder block and oil pan.

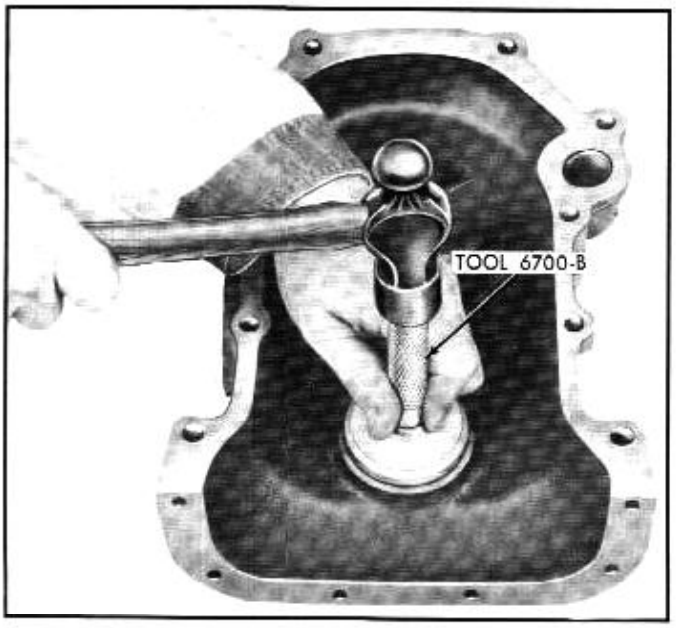


Fig. 6A-20—Installing Front Cover Seal

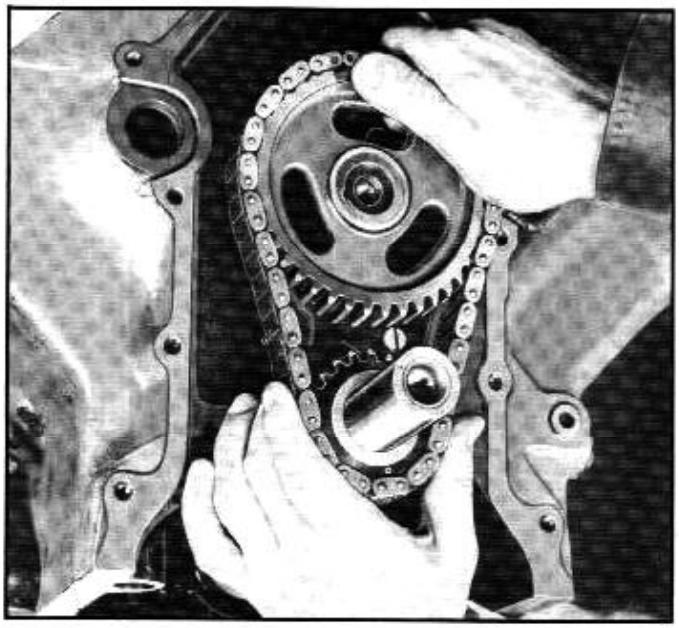


Fig. 6A-21—Installing Timing Chain and Sprockets

Installation

1. Install camshaft sprocket, crankshaft sprocket and timing chain simultaneously as a unit. See figure 6A-21. The timing marks on the camshaft sprocket, crankshaft sprocket and timing chain should be installed towards the left bank. See figure 6A-22.
2. Check alignment of timing marks. Check timing chain outward deflection. Rotate crankshaft to take up slack in driving side of chain and establish the straight position. Rotate crankshaft in

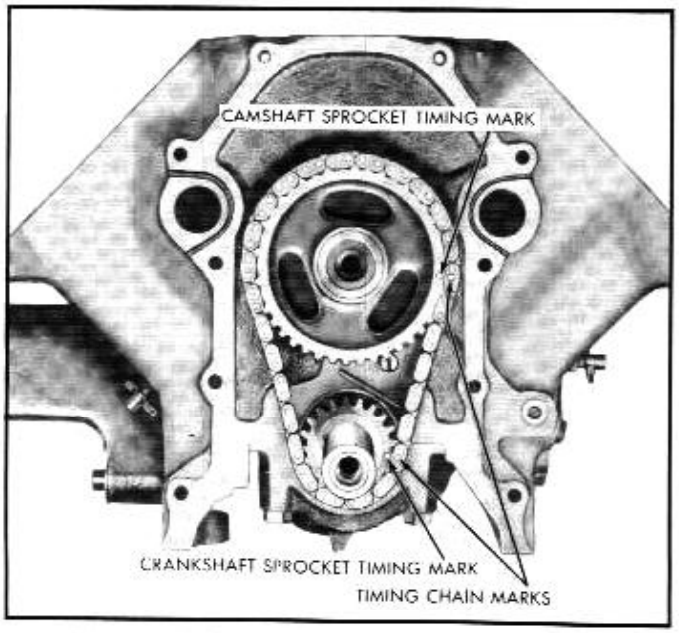


Fig. 6A-22—Timing Marks Aligned for Initial Timing

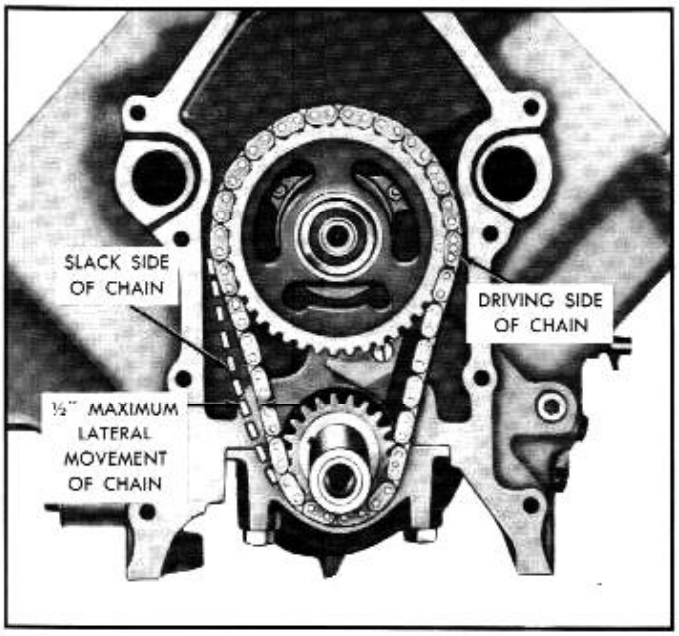


Fig. 6A-23—Timing Chain Deflection

opposite direction to take up slack in opposite side of chain. Pull chain outward with fingers. Measure outward deflection of chain. There should not be more than ½" difference between the chain straight position and the position of the chain deflected outward. See figure 6A-23.
NOTE: It is recommended that when either of the sprockets or the chain require replacement that all parts be replaced.

3. Install camshaft eccentric and counterweight. Place spacer in position and secure in place with flat washer, lockwasher and retaining screws.
4. Install Woodruff key in crankshaft.
5. Clean front cover and cylinder block gasket surfaces. Install crankshaft oil slinger. Install new cover gasket, using sealer on gasket. Install front cover assembly. Do not tighten retaining screws. Position Tool 6059-A over crankshaft and align front cover to tool. See figure 6A-24. Hold tool inward and tighten 3/8" screws to 23-28 lbs. ft. torque and tighten 5/16" screws 12-15 lbs. ft. torque.
6. Install oil pan. Refer to "Installation of Oil Pan—Engine in Vehicle" in this section of manual.
7. Install generator brackets and generator.
8. Using Tool 6306-AC install crankshaft damper. See figure 6A-25. Tighten screw to 130-145 lbs. ft. torque.
   NOTE: If vehicle is equipped with power steering, install power steering pulley at this time.
9. Position new water pump gasket and install water pump and timing pointer.
   NOTE: Coat gasket with gasket sealer. Tighten retaining screws to 12-15 lbs. ft. torque.

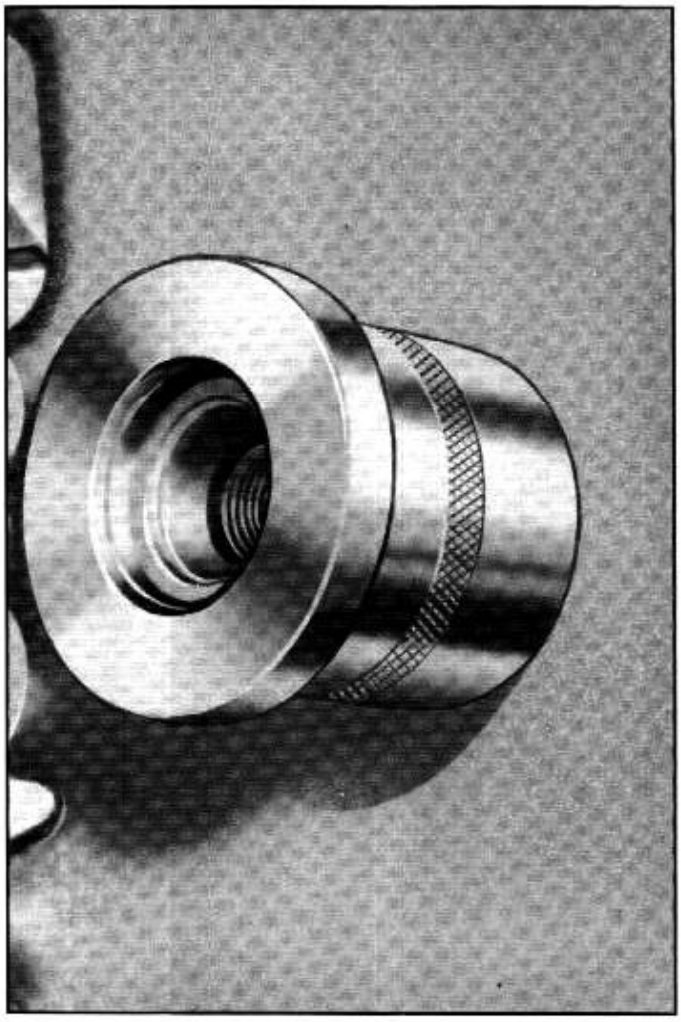


Fig. 6A-24—Aligning Front Cover

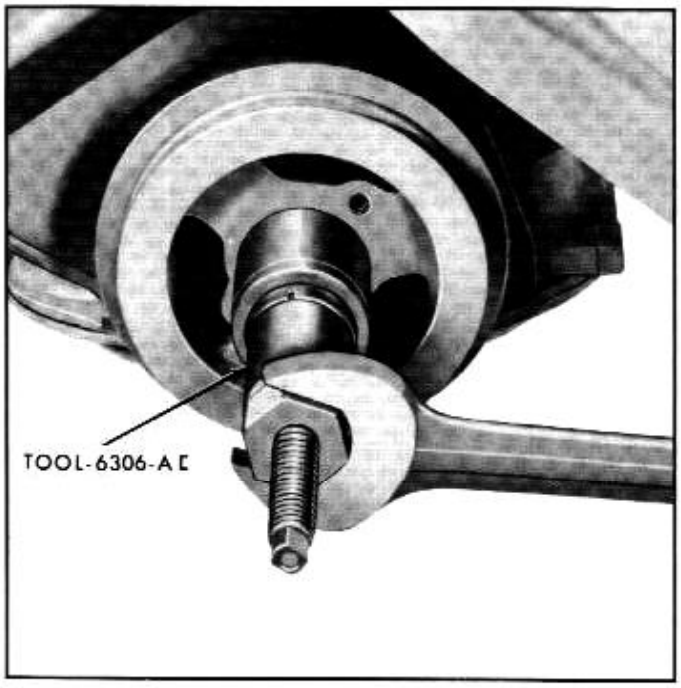


Fig. 6A-25—Installing Crankshaft Damper—Typical

10. Using new gasket, install fuel pump and tighten retaining screws to 23-28 lbs. ft. torque.
    NOTE: When installing, make sure fuel pump arm is in proper position on top of camshaft eccentric.
11. Connect flexible fuel line to fuel pump. Connect vacuum lines and fuel line to fuel pump.
12. Install water pump pulley, spacer and fan assembly. Tighten retaining screws to 10-13 lbs. ft. torque.
13. POWER SURGE FAN EQUIPPED VEHICLES
    a. Install water pump pulley, power surge clutch and fan assembly on water pump pulley hub.
14. Place fan-generator belt in position and make necessary adjustment to obtain 1/2" belt deflection.
15. POWER STEERING EQUIPPED VEHICLES
    a. Place power steering pump and reservoir assembly in position and secure to mounting bracket.
    b. Install power steering belt and adjust belt tension to allow 1/2" deflection.
16. Place a piece of fibre board or heavy cardboard in position over radiator core to protect it from damage, then install radiator assembly. Tighten retaining screws to 10-13 lbs. ft. torque.
17. Connect lower radiator hose to water pump.
18. MERC-O-MATIC EQUIPPED VEHICLES
    a. Connect oil transfer coolant lines to lower radiator tank.
19. Connect water by-pass hose to water pump. Connect upper radiator hose to water outlet connector.
20. Close petcocks at radiator and cylinder block.
21. Fill cooling system with coolant. Fill crankcase with oil to required level.
22. Start engine and bring it up to normal operating temperature by operating at 1200 R.P.M. for approximately 30 minutes. Check all connections for leaks. Check and adjust timing.

REMOVAL AND INSTALLATION OF CAMSHAFT AND TAPPETS – ENGINE IN VEHICLE

Removal

1. Remove hood assembly.
2. Remove right and left parking lamp assemblies. Do not disconnect wires. Remove right and left radiator grille upper mouldings. Remove radiator center grille moulding.
3. Drain cooling system at radiator and cylinder block.
4. Remove intake manifold. Refer to "Removal and Installation of Intake Manifold" in this section of manual.
5. Remove right and left rocker arm cover and the valve push rod chamber cover.
6. Remove the right and left rocker arm assembly as follows:
    a. Loosen rocker arm adjustment screws to remove tension on push rods.
    b. Remove oil overflow pipe from assembly. Remove six screws and two nuts securing rocker arm and shaft assembly to cylinder head.
    c. Lift up the rocker arm assembly to remove it from cylinder head.
    d. Remove push rods from cylinder head. Index the push rods to their respective bores for inspection and installation purposes.
7. POWER STEERING EQUIPPED VEHICLES
    Remove bolts securing power steering pump and reservoir to mounting bracket. Remove screw securing bracket to exhaust manifold. Remove drive belt, then without disconnecting hoses, remove pump and reservoir assembly, and place out of way against the lower fender apron.
8. Disconnect lower radiator hose at water pump.
9. MERC-O-MATIC TRANSMISSION EQUIPPED VEHICLES
    Disconnect oil coolant transfer lines at lower radiator tank.
10. Remove four (4) bolts securing radiator to radiator support and remove radiator assembly
    NOTE: To prevent damage to radiator core, place a piece of fibre board or heavy cardboard between fan blades and the radiator core while removing or installing radiator assembly.
11. POWER SURGE FAN EQUIPPED VEHICLES
    Remove four (4) screws securing power surge clutch and fan assembly, and water pump pulley to water pump. Remove power surge unit, pulley, fan-generator belt, and clutch plunger from water pump.
12. Remove screws securing fan assembly spacer, water pump pulley, and generator-water pump drive belt to water pump.
13. Remove water pump and timing indicator.
14. Remove crankshaft damper with Tool 6316-FF.
    NOTE: If vehicle is equipped with power steering, the power steering pulley must be removed from damper before removing damper assembly.
15. Disconnect the vacuum lines, gas line, and flexible fuel line from fuel pump. Remove fuel pump from front cover.
16. Raise vehicle and remove oil pan. Refer to "Removal of Oil Pan – Engine in Vehicle" located in this section of manual.
17. Lower vehicle. Remove cylinder block front cover and gasket.

NOTE: When removing front cover, use care to prevent damage to crankshaft seal in cover.

18. Remove oil slinger and Woodruff key from crankshaft.
19. Remove wire from "S" terminal of starter relay switch. Install auxiliary starter cable wire to "S" terminal of starter relay switch and positive terminal of battery.
20. Using auxiliary starter cable, "bump" engine over until timing marks on camshaft sprocket and chain are lined up.
21. Remove the distributor cap. Scribe a line on the distributor housing to mark the relative position of the rotor to the distributor housing. (This will aid when reinstalling the distributor unit.)
22. Remove distributor retaining screw and clamp, then remove the distributor.
    NOTE: Observe the amount and direction of rotor movement when removing distributor. This will aid when reinstalling the distributor unit.
23. Remove screw, flat washer, spacer, fuel pump eccentric, and counterweight from camshaft.
24. Remove camshaft sprocket, crankshaft sprocket, and timing chain as a unit.
    NOTE: Do not remove the sprockets from timing chain or change their relative positions on the teeth of chain.
25. Lift the respective valve tappets with a magnet and support each in its "up" position with a spring-type clothes pin. See figure 6A-26.
    NOTE: Before using spring-type clothes pins, grind the ends of pins as shown in figure 6A-27. This will give greater accessibility when installing the camshaft.
26. Remove camshaft thrust plate, Woodruff key, spacer and camshaft.
    NOTE: When removing camshaft, use extreme care to prevent the camshaft lobes from damaging the camshaft bearings.

Inspection

Clean the camshaft in solvent and wipe dry. Check the camshaft journal to bearing clearances by measuring the diameter of the journals and the I.D. of the bearings. The camshaft journal diameter specification is 1.9255"-1.9265". The inside diameter specification is 1.9275"-1.9285". The recommended clearance wear

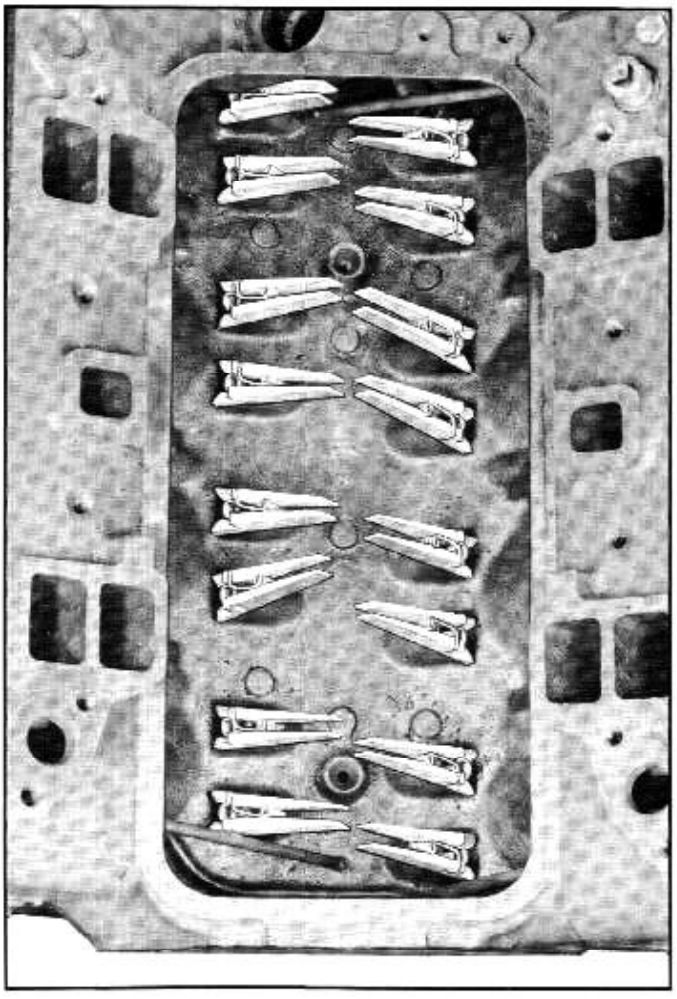


Fig. 6A-26—Retaining Valve Tappets with Clothes Pins

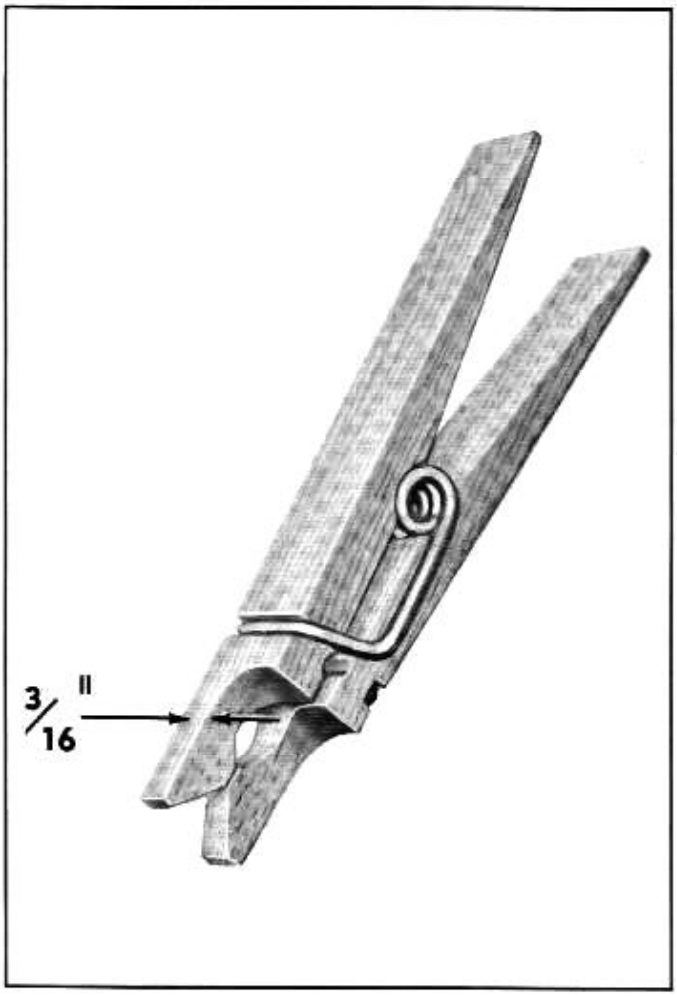


Fig. 6A-27—Reworked Clothes Pin

limit is .006 inch. If the clearance approaches the wear limit, the camshaft journals should be ground for undersize bearings, or the camshaft must be replaced. Standard and .015 inch undersize bearings are available for service.

NOTE: It will be necessary to remove the engine from the vehicle to replace the camshaft bearings. Check camshaft for out-of-round condition. If out-of-round exceeds .001″ the journal must be reground or camshaft replaced. Check camshaft runout; if runout exceeds .005 (total indicator reading) the camshaft should be replaced. Check the distributor driven gear for broken or chipped teeth. Replace camshaft if drive gear teeth are damaged.

NOTE: If the mating teeth on the distributor driven gear are damaged, this gear will have to be replaced. Refer to "Engine Electrical" for proper replacement procedures.

Inspect the cam lobes for pitting, scoring, and signs of wear. Lobe wear characteristics may result in pitting in the general area of the nose portion of the lobe. This pitting is not detrimental to the operation of the cam, therefore, the camshaft should not be replaced if this condition exists.

If a cam lobe is scored or worn below specifications, the camshaft must be replaced. The lift of all cam lobes should be checked for wear by measuring over the top of the lobe with a micrometer and subtracting the measurement of the base circle diameter. See figure 6A-28. The camshaft lobe lift wear limit for the intake valve lobes is .267″. The camshaft lobe limit for the exhaust valve lobes is .280″. If the camshaft lobe lift is less than this specification or closely approaches the wear limit, the camshaft should be replaced. If camshaft replacement is warranted, replace only the tappets that have been operating on cam lobes worn to a degree exceeding wear specifications.

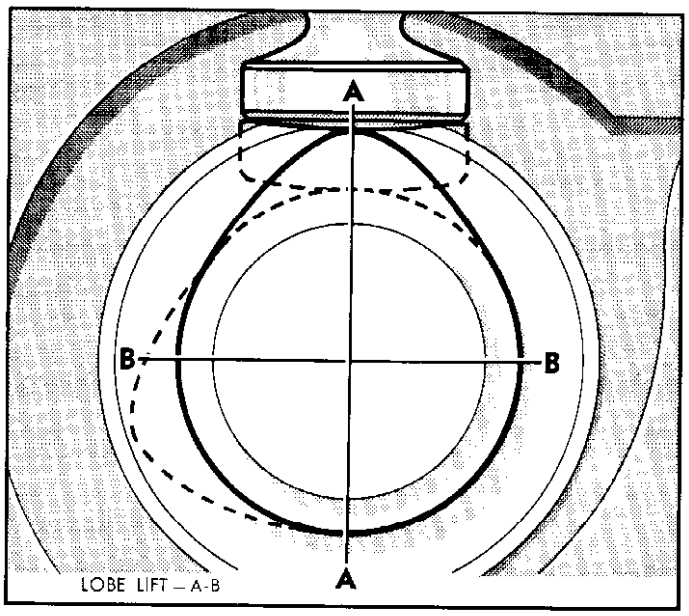


Fig. 6A-28—Measuring Camshaft Lobe Lift

Inspect the remaining tappets in the cylinder block. Any tappets showing evidence of pitting, scoring, galling or evidence of non-rotation and/or irregular rotation, must be replaced.

NOTE: Following a camshaft replacement, the oil pan should be thoroughly cleaned as small particles of metal may be found due to the wearing action. The oil filter and oil must be replaced.

Inspect ball and socket ends of push rod for signs of wear. Replace all push rods that are worn.

NOTE: If the ends are worn, the push rod may not rotate and thus cause noise.

Check push rods for a bent condition. If the push rod runout exceeds .020″ maximum T.I.R., replace push rod.

NOTE: Do not attempt to straighten a push rod.

Inspect thrust plate for wear, scores or gall marks. Replace plate if damaged.

Remove light scuffs, scores or nicks from camshaft machined surfaces with a smooth oilstone.

Installation

Figure 6A-29 is presented for your reference during assembly procedures.

1. Install replacement valve tappets into their respective bores and secure each in the up position with a spring-type clothes pin.
2. Oil the camshaft journals, then install camshaft in cylinder block. While making the installation, be extremely careful that camshaft journals and lobes do not damage bearings.
3. Install spacer and thrust plate. Tighten thrust plate retaining screws to 12-15 lbs. ft. torque.
   NOTE: Install spacer with large inside chamfer toward the No. 1 camshaft journal.
4. Install Woodruff key in camshaft. Check to make certain the key in crankshaft is properly seated.
5. Check camshaft end play using a dial indicator. To check camshaft end play, it is necessary to place the camshaft sprocket in position on the camshaft, and also that the cam eccentric and counterweight be secured with the spacer, flat washer, lock washer and cap screw. End play limits are .003″ to .012″. Replace camshaft if end play exceeds specifications.
6. Remove camshaft sprocket prior to installing chain.
7. Position camshaft sprocket on timing chain with timing marks aligned.
8. Install camshaft sprocket, crankshaft sprocket, and timing chain simultaneously as a unit. The timing marks on the camshaft sprocket, crankshaft sprocket, and timing chain should be in-

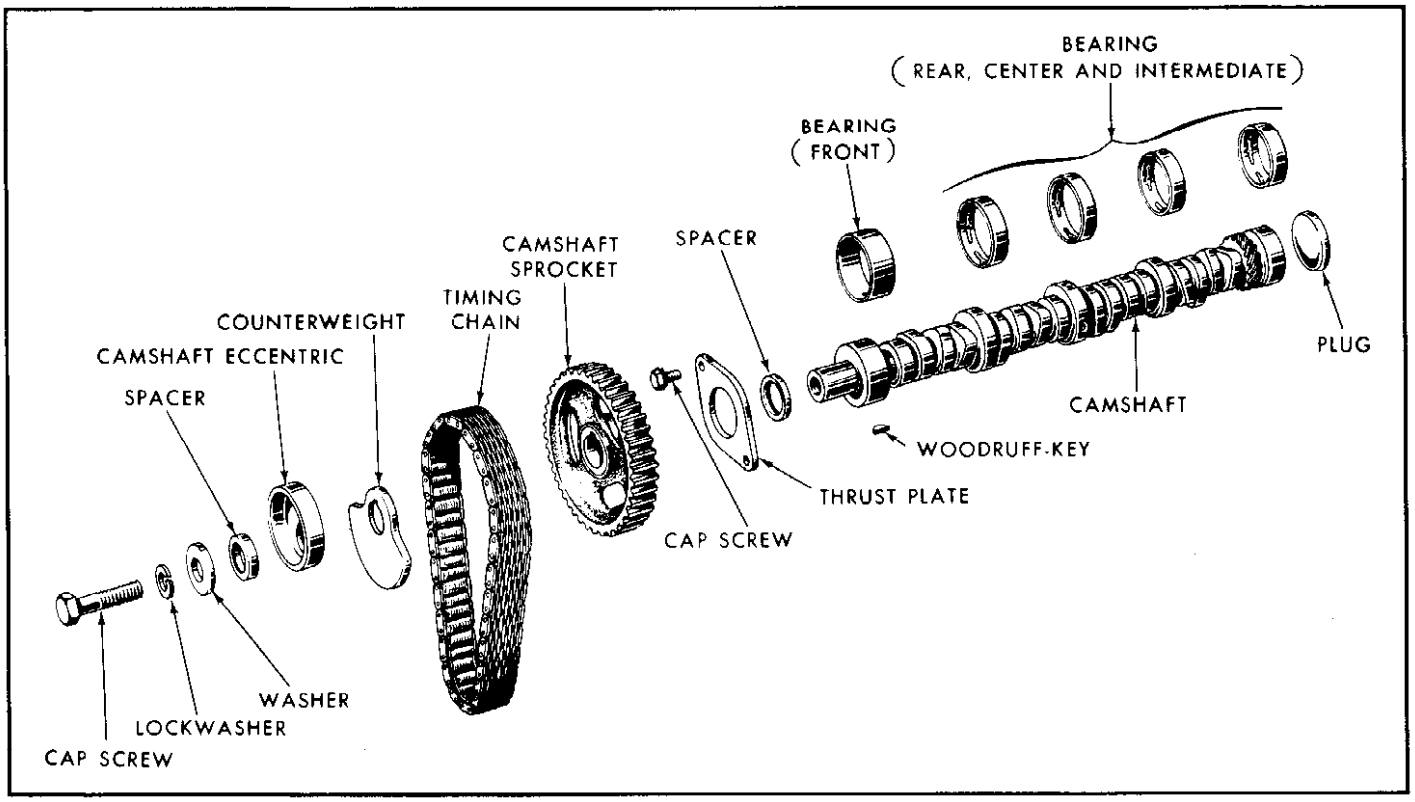


Fig. 6A-29—Camshaft and Related Parts

stalled towards the left bank.

9. Check alignment of timing marks. Refer to figure 6A-22. Check timing chain outward deflection. Rotate crankshaft to take up slack in driving side of chain and establish the straight position. Rotate crankshaft in opposite direction to take up slack in opposite side of chain. Pull chain outward with fingers. Measure outward deflection of chain. There should not be more than 1/2 inch difference between the chain straight position and the position of the chain deflected outward. Refer to figure 6A-23.

   NOTE: It is recommended that when either of the sprockets or the chain require replacement that all parts be replaced.

10. Install camshaft eccentric and counterweight. Place spacer in position and secure in place with flat washer lockwasher, and retaining screws. Tighten screws to 35 to 45 lbs. ft. torque.
11. Install oil slinger and insert Woodruff key in crankshaft.
12. Clean front cover and cylinder block gasket surfaces.
13. Install new crankshaft front oil seal in front cover if required, using Tool 6700-B. Install crankshaft oil slinger.
14. Install new front cover gasket. Use sealer on gasket. Install front cover assembly. Do not tighten cap screws. Position Tool 6059-A over crankshaft and align front cover to tool. Refer to figure 6A-24. Hold tool inward and tighten 3/8" screws 23 to 28 lbs. ft. torque, and tighten 5/16" screws 12 to 15 lbs. ft. torque.
15. Install oil pan. Refer to "Removal and Installation of Oil Pan – Engine in Vehicle".
16. Install generator brackets and generator.
17. Using Tool 6306-AC install crankshaft damper. Torque cap screws 130 to 145 lbs. ft.
    NOTE: If vehicle is equipped with power steering, install power steering pulley at this time.
18. Position new water pump gasket and install water pump and timing pointer.
    NOTE: Coat gasket with gasket sealer.
19. Install distributor. Before installing distributor crank engine until No. 1 piston is coming up on T.D.C. on the compression stroke. Stop the engine when timing marker on front of engine is in line with timing mark on crankshaft pulley. Install distributor with points just breaking and the rotor in position to fire No. 1 cylinder spark plug.
20. Install fuel pump. (When installing, make sure fuel pump is in proper position on top of camshaft eccentric.) Use new gasket and tighten securely. Install flexible fuel line, vacuum lines, and fuel line.
21. Install water pump pulley, spacer and fan assembly.
22. Place fan-generator belt in position and make

necessary adjustment to obtain 1/2" belt deflection. Place power steering pump and reservoir assembly in position and secure to mounting bracket.

23. Install and adjust power steering belt.
24. Place a piece of fibre board or heavy cardboard in position over radiator core to protect it from damage, then install radiator assembly and connect lower hose. If vehicle is equipped with Merc-O-Matic transmission, connect transmission oil transfer coolant lines to lower radiator tank.
25. Remove all clothes pin retainers from tappets. Then install all push rods in their proper sequence making sure the lower ends of the rods are positioned in the tappet sockets.
26. Install rocker arm assembly over studs and push assembly down into place, engaging rocker arm adjusting screws in the push rod sockets.
27. Install oil overflow pipes and retainers on front right bank rocker arm support and rear left bank rocker arm support. Tighten retaining screws and nuts to 12-15 lbs. ft. torque.

    NOTE: Make sure oil overflow pipes enter hole in rocker arm shaft prior to torquing rocker shaft support retaining screws and nuts.
28. Perform a preliminary lash adjustment (.020 inch cold – intake and exhaust valve). Refer to "Valve Lash Adjustment" in this section of manual.
29. Clean gasket surfaces and install new gaskets on push rod chamber covers. Install covers and tighten screws to 2-2½ lbs. ft. torque.
30. Clean cylinder head and intake manifold gasket surfaces, then install new gaskets and intake manifold. Torque screws 23 to 28 lbs. ft. working from the center to the ends.
31. Install control shaft assembly, accelerator shaft bracket and automatic starter cutout switch on intake manifold. Install carburetor to control shaft rod on carburetor. Install accelerator shaft retracting springs.
32. Connect vacuum line to automatic starter cutout switch and manifold vacuum fitting. Connect windshield wiper hose to vacuum booster line.
33. If vehicle is equipped with a power brake unit, connect power brake hose to manifold fitting. Connect vacuum booster line to manifold fitting.
34. Connect water by-pass hose to water pump. Connect heater inlet hose to heater fitting. Connect upper radiator hose to water outlet connector. Close petcocks at radiator and cylinder block.
35. Connect distributor vacuum line to distributor. Connect high tension lead, secondary and primary ignition wires to coil and resistor. Remove auxiliary starter cable from "S" terminal of starter relay and positive terminal of battery. Connect wire to starter relay "S" terminal.
36. Install battery ground cable.
37. Install radiator center grille, upper grille mouldings, and parking lamps.
38. Install hood assembly on hood hinge. Align hinge with index mark on hood and tighten retaining screws.
39. Fill cooling system with coolant. Check oil level with dipstick to make certain crankcase is filled to the required level.
40. Start engine and bring it up to normal operating temperature by operating at 1200 R.P.M. for approximately 30 minutes.
41. While engine is running during warm-up period, check for oil, fuel and water leaks.
42. Check the distributor timing, then check advance timing. For proper procedure, refer to "Engine Ignition System" section of this manual.
43. Perform final valve tappet adjustment (hot). The final intake and exhaust valve lash setting is .019 inch. Refer to "Valve Lash Adjustment" in this section of manual.

    NOTE: This operation should be performed while the engine is idling.
44. Check and set carburetor linkage. Adjust engine idle and carburetor air fuel mixture.
45. Install new rocker cover gasket. Install rocker covers, seals and retaining nuts. Tighten nuts to 2-2½ lbs. ft. torque.
46. Install air cleaner and duct assembly. Make a final check of all connections.

REMOVAL AND INSTALLATION OF CYLINDER HEADS – ENGINE IN VEHICLE

Removal

1. Remove intake manifold. Refer to "Removal and Installation of Intake Manifold – Engine in Vehicle" in this section of manual.
2. RIGHT BANK CYLINDER HEAD:
   a. Remove screw securing spark plug wiring loom grommet to cylinder head.
   b. Remove distributor cap and move it away from working area.
   c. If vehicle is equipped with power surge fan, disconnect wire from sending unit.
   d. Remove screw securing generator bracket to cylinder head. Remove screw securing oil dipstick tube and battery ground cable to cylinder head.
   e. Remove exhaust manifold. Refer to "Removal and Installation of Exhaust Manifolds—Engine in Vehicle" in this section of manual.
   f. Remove ignition wires from spark plugs. Remove spark plugs.

g. Remove rocker arm cover and gasket.
h. Loosen rocker arm adjustment screws to remove tension on push rods.
NOTE: It is necessary to remove the tension to prevent the possibility of bending the push rods or damaging the rocker arm shaft when removing the rocker arm and shaft assembly support cap screws and nuts.
i. Remove six screws and two nuts securing rocker arm and shaft assembly to cylinder head. Remove oil overflow pipe from the assembly.
j. Lift up the rocker arm assembly to remove it from cylinder head.
k. Remove push rods from cylinder head. Index the push rods to their respective bores for inspection and replacement purposes. See figure 6A-30.
l. Install Cylinder Head Holding Fixture, Tool 6085-G to cylinder head using four 3/8" x 1½" N.C. screws and flat washers. See figure 6A-31.
NOTE: Cylinder head holding fixture tool must be attached securely to cylinder head.
m. Remove cylinder head cap screws, then lift cylinder head off the two locating dowels on cylinder block.
CAUTION: *Use extreme care when handling to prevent damage to gasket surfaces. Never pry between cylinder head and cylinder block as they both have a finished surface and must not be damaged.*

3. LEFT BANK CYLINDER HEAD:
a. Disconnect wire from temperature gauge sending unit.
b. Remove cap screw and lockwasher securing engine ground strap and wiring loom clip to cylinder head.
c. Remove exhaust manifold. Refer to "Removal and Installation of Exhaust Manifolds - Engine in Vehicle" in this section of manual.
d. Remove ignition wires from spark plugs. Remove spark plugs.
e. Remove rocker arm cover and gasket.
f. Loosen rocker arm adjustment screws to remove tension on push rods.
NOTE: It is necessary to remove the tension to prevent the possibility of bending the push rods or damaging the rocker arm shaft, when removing the rocker arm and shaft assembly support cap screws and nuts.
g. Remove six screws and two nuts securing rocker arm and shaft assembly to cylinder head. Remove oil overflow pipe from assembly.
h. Lift up the rocker arm assembly to remove it from cylinder head.
i. Remove push rods from cylinder head. Index the push rods to their respective bores for inspection and replacement purposes. See figure 6A-30.
j. Install Cylinder Head Holding Fixture, Tool 6085-G to cylinder head using four 3/8" x 1½" N.C. screws and flat washers. See figure 6A-31.
NOTE: Cylinder head holding fixture must be attached securely to cylinder head.
k. Remove cylinder head cap screws, then lift head off the two locating dowels on cylinder block.
CAUTION: *Use extreme care when handling to prevent damage to gasket surfaces. Never pry between cylinder head and cylinder block as they both have a finished surface and must not be damaged.*

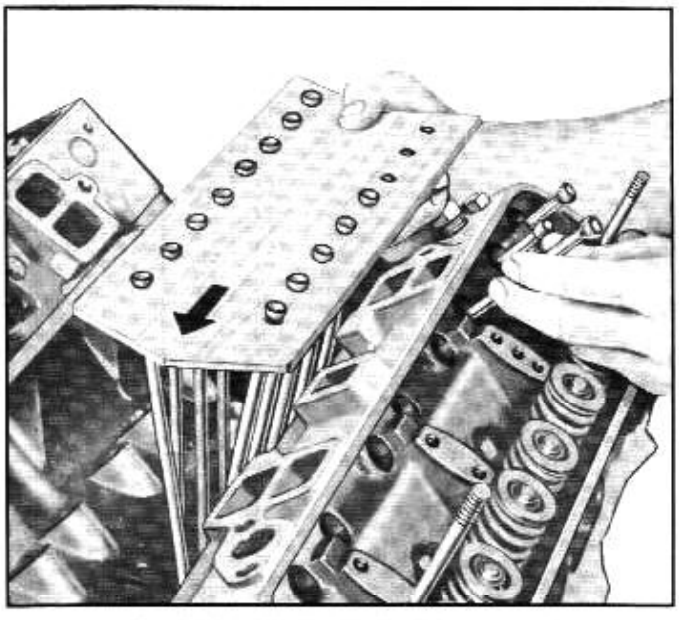


Fig. 6A-30—Valve Push Rod Removal

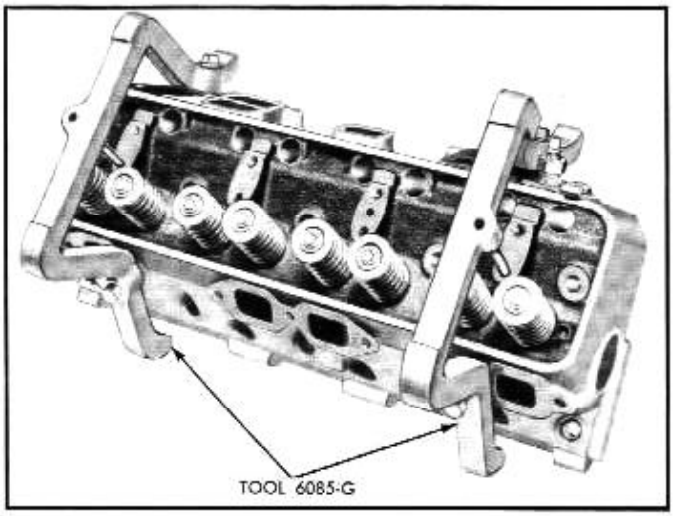


Fig. 6A-31—Cylinder Head Holding Fixtures

Disassembly Reconditioning and Assembly of Cylinder Heads, Valves, Push Rods, and Rocker Arm Assemblies

CYLINDER HEADS

The cylinder head, as removed from the engine, contains the valve assemblies and holding fixture, Tool 6085-G. The rocker arm assembly was removed prior to installation of the holding fixture so that fixture would never have to be removed while the heads are off the engine. Thus, the machined surfaces of the cylinder heads are protected at all times while work operations are being performed.

Clean, inspect, and recondition the cylinder head assemblies as follows:

With the valves installed in the cylinder head to protect the valve seats, clean carbon deposits from combustion chambers and valve heads with a wire brush and scraper. See figure 6A-32. Wash the cylinder head in cleaning solvent to remove grease and dirt from surfaces and dry thoroughly.

Disassemble and remove valve assemblies from cylinder head as follows:

1. Turn cylinder head, with Tool 6085-G attached, so it rests on its side and compress valve spring with Tool 6513-EE. See figure 6A-33.
2. Tap retainer gently with a soft hammer, then remove valve keys. Refer to figure 6A-34.
3. Remove valve compressor Tool 6513-EE, then remove valve spring retainer, inner sleeve, valve spring, valve stem seal, and valve.
4. Repeat steps "a" through "c" for remaining valves. NOTE: Keep each valve and its related parts together so they may be reinstalled in their respective positions.

Clean valve guide bores using a valve guide cleaning tool. Check all water passages to make sure they are open.

Examine the cylinder heads for water leaks or cracks

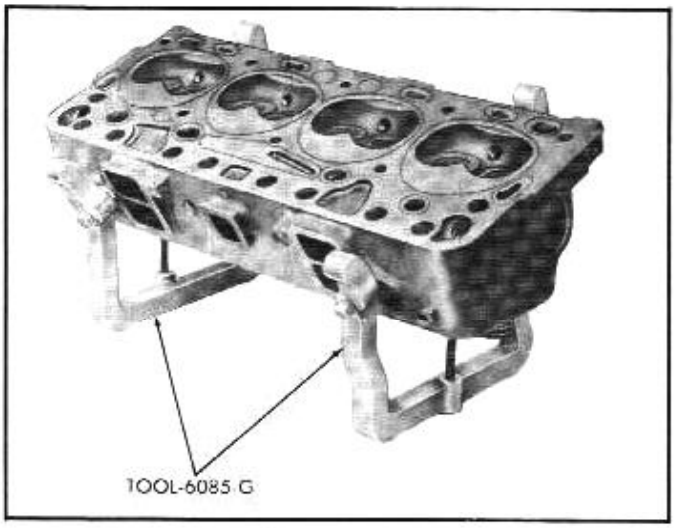


Fig. 6A-32—Cylinder Head Positioned for Carbon Removal

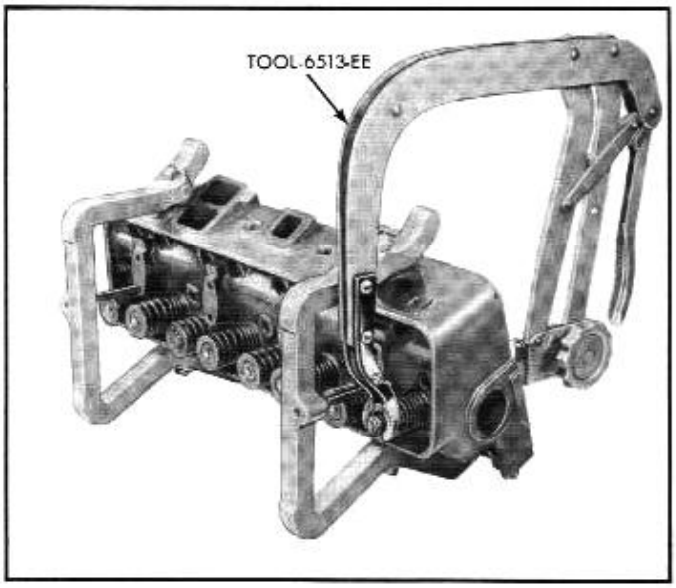


Fig. 6A-33—Compressing Valve Spring

in the combustion chambers, exhaust ports, or around the valve seats. Inspect the gasket surfaces for scratches or mars of any type. This is very important as any damage to this surface may cause a leak when installed with the thin steel gasket.

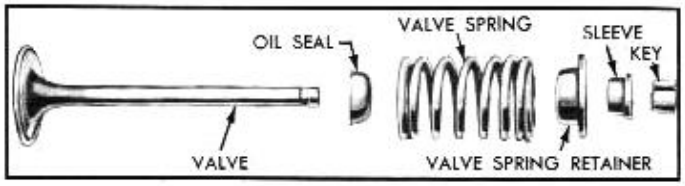


Fig. 6A-34—Valve Assembly

The cylinder head assemblies are completely interchangeable from one cylinder bank to another providing the water outlet coincides with the water opening in the front section of the intake manifold. It may be necessary to remove the water outlet plug on one

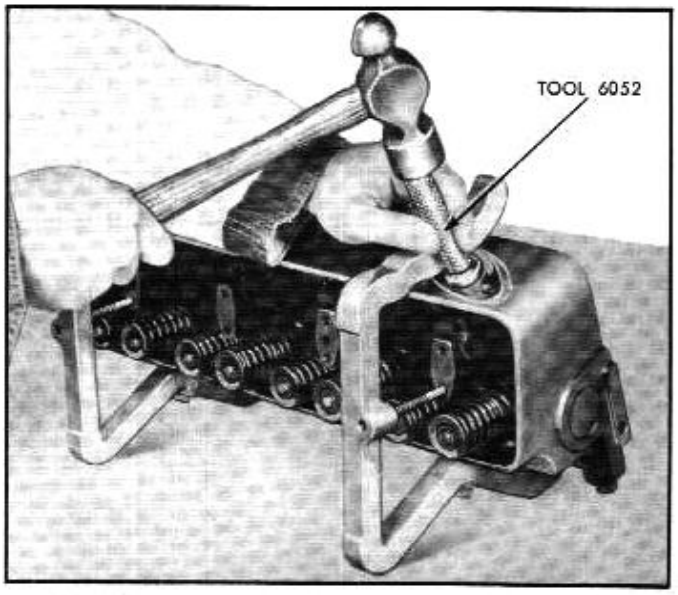


Fig. 6A-35—Installing Cylinder Head Water Plug

section of the cylinder head and install a new plug in the rear section. When installing a new plug, coat edges with a light coat of water resistant sealer and use Tool 6052 as shown in figure 35. This applies to the right cylinder head (unless the cylinder head is equipped with a power surge sending unit).

The left cylinder head has an adaptor for the coolant temperature sending unit. The right cylinder head has an adaptor for the power surge fan sending unit, if the vehicle is so equipped. Coat adaptors with a light film of water resistant sealer and tap in place with a mallet until seated.

NOTE: Install adaptors with undercut toward the inside of the cylinder head.

The removal of the water temperature sending unit adaptor plug can be accomplished by using Tools 6387-AA and 6387-F. See figure 6A-36.

NOTE: Tool 6387-AA has an adaptor made out of a 3/8"-18 plug and a 3/8"-20 cap screw.

VALVE, VALVE SEATS AND VALVE SPRINGS

Remove all carbon from valve stems and heads using a fine wire brush or buffing wheel. Inspect each valve, discarding any that show evidence of burned, warped, bent or cracked condition.

Check valve stem clearance of each valve in its respective valve guide using Tool 6505-E. See figure 6A-37. To properly use tool, install on valve stem until fully seated and tighten knurled set screw firmly, then permit valve to drop away from its seat until tool contacts the upper surface of the valve guide.

Position dial indicator with flat tip against the center portion of tool spherical section at approximately 90° to the valve stem. In order to ascertain actual valve stem clearance, tool should be moved back and forth on an axis at a right angle to the rocker shaft. Take a

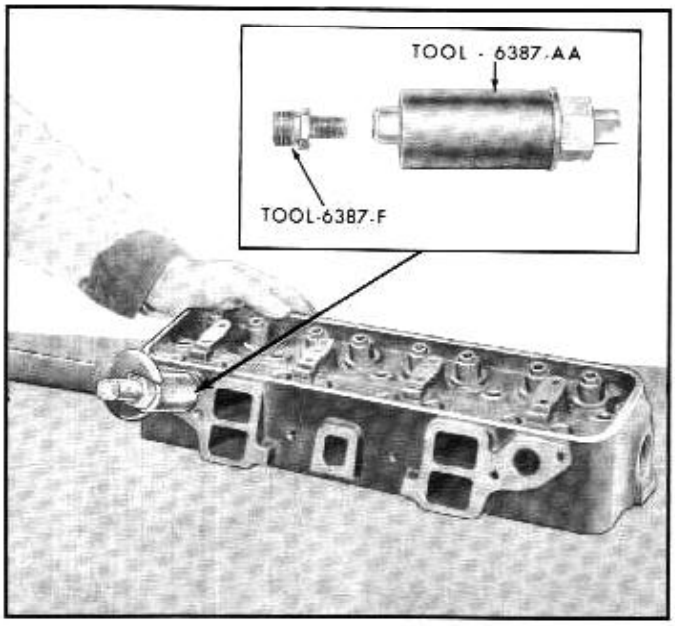


Fig. 6A-36—Removing Temperature Gauge Sending Unit Adaptor

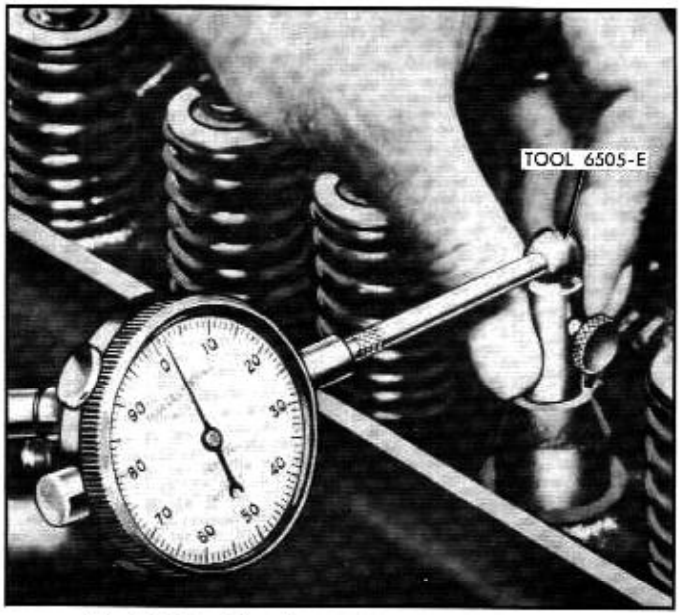


Fig. 6A-37—Checking Valve Stem Clearance

reading on dial indicator without removing the tool from valve guide upper surface, then divide reading by two, the division factor of the tool.

If the clearance exceeds the service limits of .004" on the intake or .006" on the exhaust, it is recommended to ream the valve guides with Tool Kit 6085 to the next oversize diameter as shown in figure 6A-38. Tool Kit 6085 is made up of three reamer (cutter) pilot combinations, which are as follows:

1. Tool 6085-1—Std. Diameter Pilot Plus .003" O.S. Reamer.
2. Tool 6085-2—.003" O.S. Pilot Plus .015" O.S. Reamer.
3. Tool 6085-3—.015" O.S. Pilot Plus .030" O.S. Reamer.

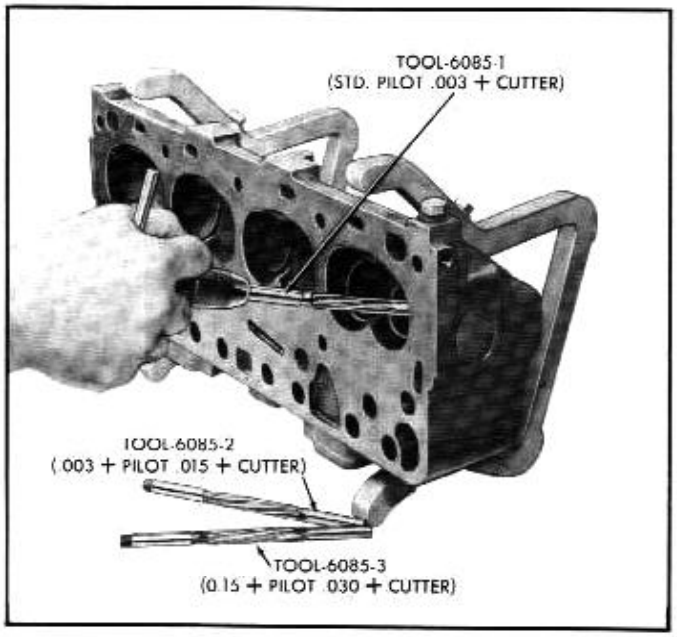


Fig. 6A-38—Reaming Valve Guides

IMPORTANT: Always use the reamers in sequence when reaming from standard to oversize diameter (to accommodate oversize valve stems). Valves having oversize stems are available for service. The valve seats must be reground whenever the valve guides are reamed.

Refacing the valves and valve seats must be done with precision equipment to insure a good compression tight fit between parts. The grinding wheels of the refacers should be carefully dressed to the proper angles. The valve face should be ground to a 45° angle (both intake and exhaust) with a minimum thickness of 1/32″ on the outer edge of valve head. If thickness is less than 1/32″, replace valve. Valve face run-out must not exceed .002″. See figure 6A-39. The end of the valve stem may be ground if grooved. Do not remove more than .010″ stock.

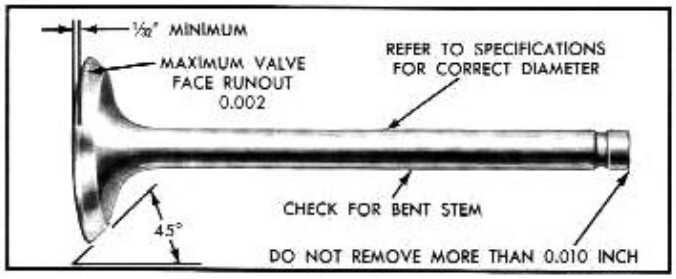


Fig. 6A-39—Valve Tolerances

The valve seats in the cylinder head should also be ground to a true 45° angle maintaining a seat width of between .060-.080 inch – intake valve and .070-.090—exhaust valve. Only remove enough stock to clean up pits or grooves. If seat is wider than specified, it will be necessary to grind either the bottom of valve seat with a 30° angle grinder or the top of the seat with a 60° angle grinder until proper seat width is obtained and the seat contact with the valve is centrally located. See figure 6A-40.

It is important to have the finished seat face contact the approximate center of the valve face. This can be checked by placing prussian blue on the valve seat and installing the valve. If contact is indicated near the top edge of the valve face, lower the seat by using the

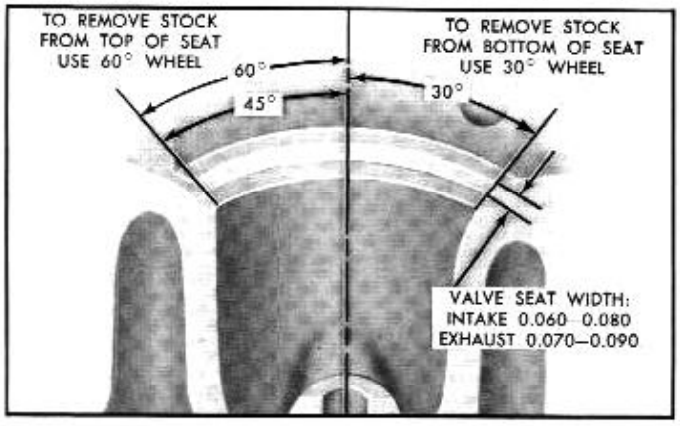


Fig. 6A-40—Valve Seat Refacing

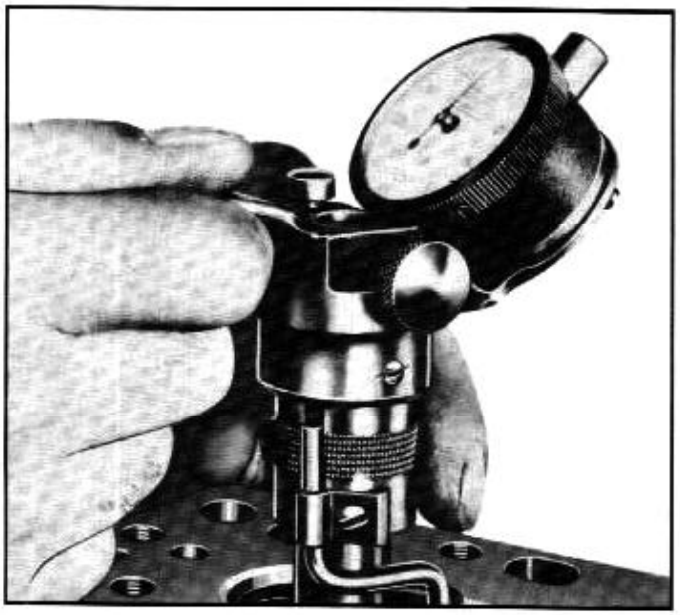


Fig. 6A-41—Checking Valve Seat Run-out

60° angle grinder. If the contact is lower than the center of the valve face, raise the seat by using the 30° angle grinder. Make sure all metal particles are thoroughly cleaned from the cylinder head. A light lapping operation is recommended after refacing valves and seats using a fine grit lapping compound.

Check the valve seat run-out with an accurate gauge. Run-out should not exceed .002″ total indicator reading (wear limit .0025″). See figure 6A-41.

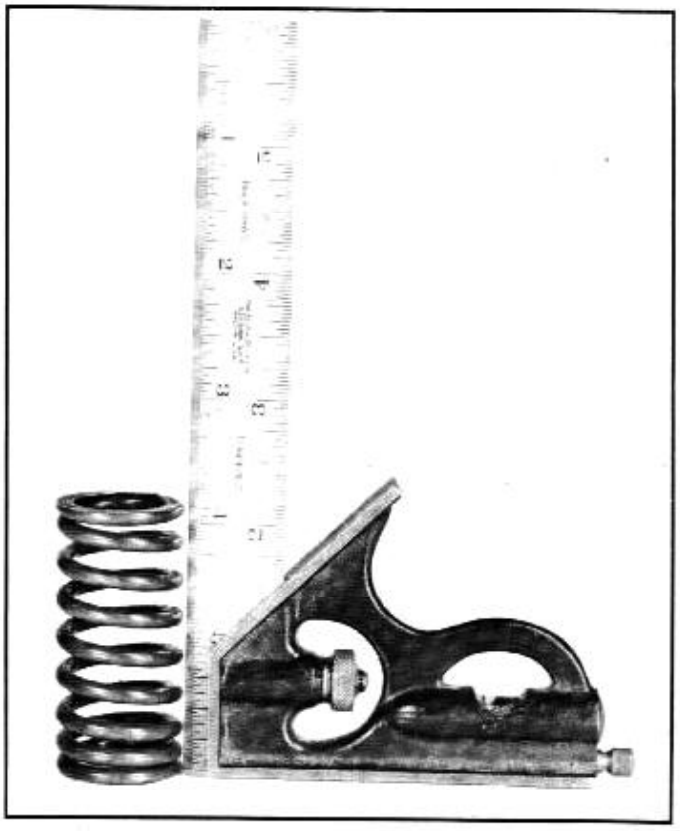


Fig. 6A-42—Testing Spring for Squareness

Examine the valve springs, discarding any that show signs of rust or pit marks. Check springs for squareness with a square and surface plate (a piece of plate glass may also be used). See figure 6A-42. Discard any springs that are out of square more than 1/16". Check pressure of each spring with Tool LM-106 as shown in figure 6A-43. The springs should exert a minimum pressure of 64 lbs. when compressed to a height of 1.780 inches or 145 lbs. when compressed to a height of 1.390 inches. If Tool LM-106 is used, set knob on calibrated screw to compressed length of valve spring and pull torque wrench until click is heard. Multiplying reading on torque wrench by two gives pressure exerted by spring. If spring is not within specified limits it is recommended that spring be replaced.

Install the exhaust and intake valve assemblies in the cylinder head as follows:

1. Install valves in their respective guides and install valve stem seal. Install valve springs (closed end of spring must be toward the cylinder head) and valve spring retainer.
   NOTE: Coat stems with engine oil to furnish initial lubrication.
2. Position Compressor Tool 6513-EE over valve spring retainer and valve head.
3. Compress valve spring and install spring retainer sleeve and position valve keys on valve stem. Release Tool 6513-EE slowly and check position of valve keys.
4. Install all the respective valves in same manner.
5. Correct valve spring load is necessary for efficient high speed engine operation. Due to variance in the valve seats, the assembled height of the spring installed on the cylinder head should be measured as follows:
   a. Use dividers to measure the assembled height from the surface of the cylinder head spring pad to underside of the spring retainer. See figure 6A-44.
   b. Check the dividers against a scale. If the valve closed assembled height is 1.780 inches or greater, install the necessary spacer or spacers between the cylinder head spring pad and the valve spring to bring the assembled height to the recommended dimension of 1.780 inches. NOTE: The spacers available for service are .030 inch thick. Never use more than two spacers to bring the assembled height to specifications. Replace the spring if more than two are required. Do not use spacers unless necessary. Use of spacers in excess of recommendations will result in overstressing the valve springs which will lead to excessive load loss and spring breakage.

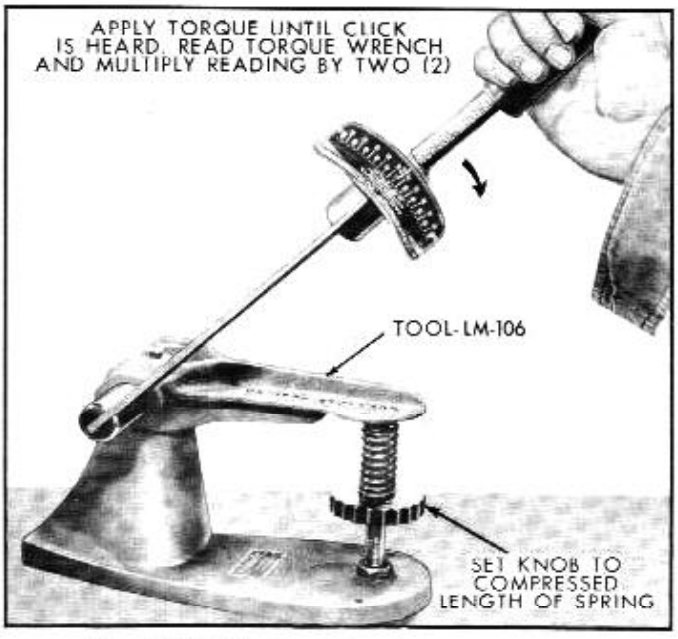


Fig. 6A-43—Testing Valve Spring Tension

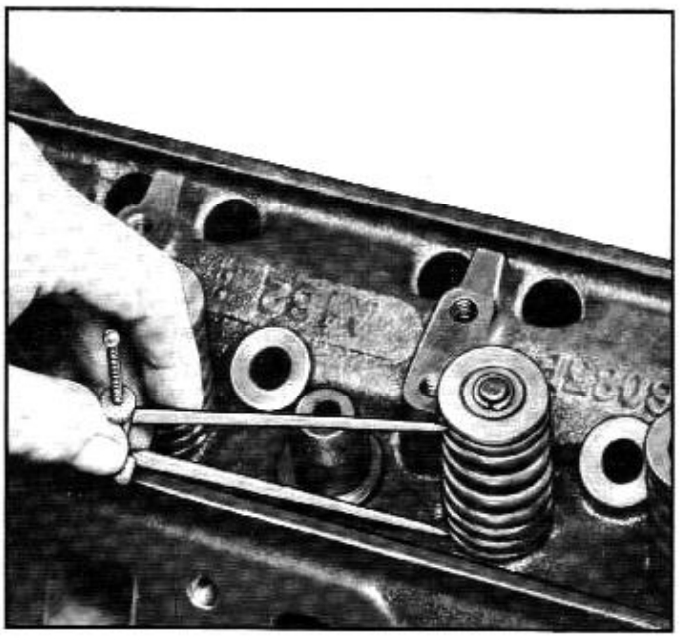


Fig. 6A-44—Measuring Valve Spring Assembled Height

ROCKER ARM ASSEMBLIES AND PUSH RODS

Since the rocker arm assemblies are removed from the engine as a unit, the disassembly and assembly procedures are presented as follows (Figure 6A-45 shows a disassembled view of the complete assembly):

1. Remove cotter keys, flat and "wave" washers from ends of shaft.
2. Remove rocker arms, springs and supports from shaft. Keep parts in order so that they may be replaced in original position if in satisfactory condition.
3. Remove plugs from end of shaft as follows:
   a. Drill a hole in plug at one end of shaft.

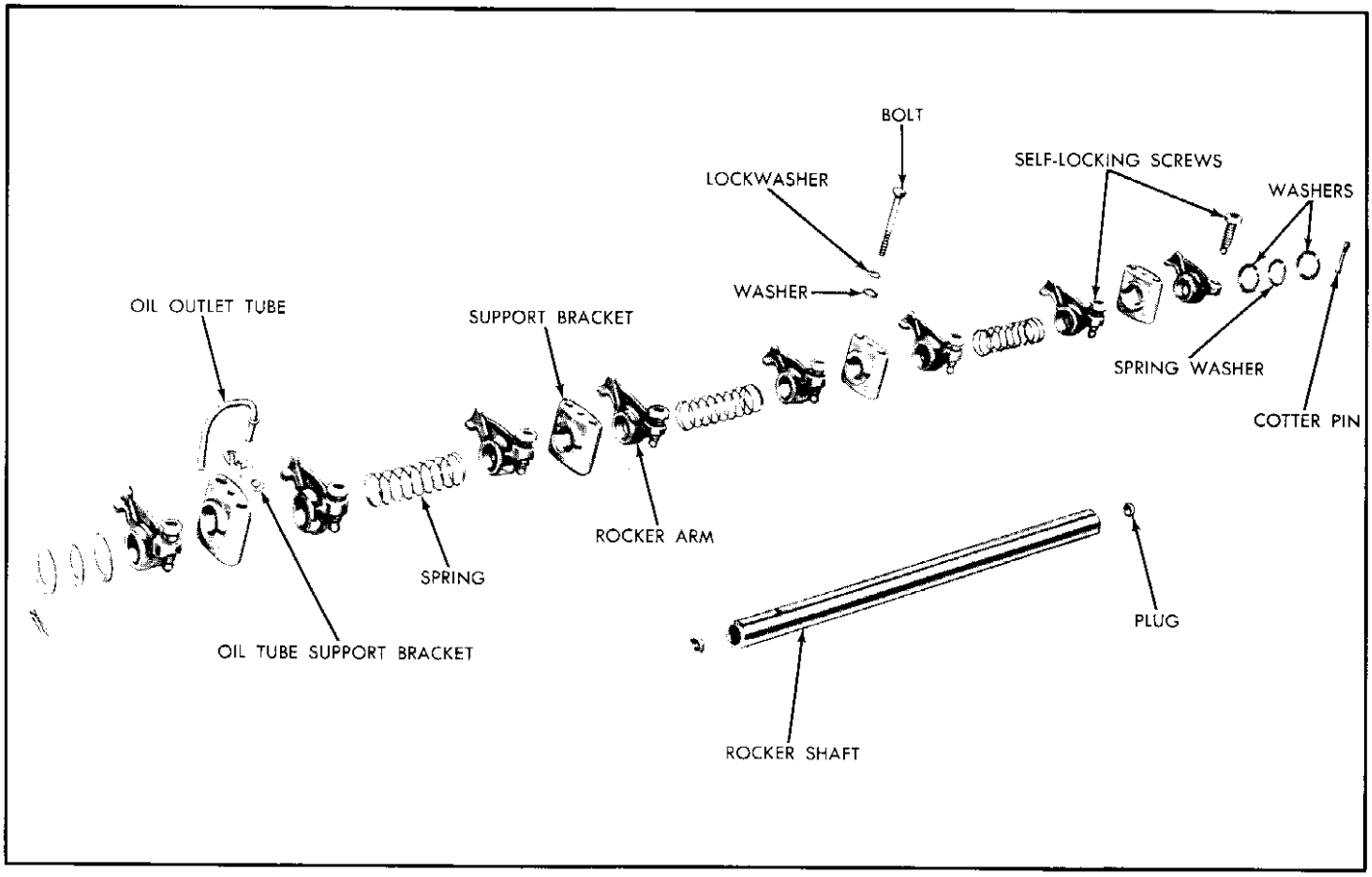


Fig. 6A-45—Rocker Arm Mechanism

b. Insert metal rod through hole and knock out plug at other end of shaft.
c. Knock out remaining plug in opposite end of shaft.

4. When rocker arm assemblies are completely disassembled, clean all parts thoroughly making sure all oil passages are open.
5. Inspect shaft for sign of wear. Check rocker arm to shaft clearance. Replace any parts showing excessive wear. If rocker arm pad radius is grooved excessively at valve end, replace part. Do not true this surface by grinding. A slight dressing of the rocker arm pad is permissible to clear up minor imperfections; however, contour of rocker arm pad must be maintained.
6. Check each push rod for bent or damaged condition. Replace with new parts if bent more than .020″ total indicator reading.
   NOTE: Do not attempt straightening push rod.
7. To assemble rocker arm assemblies, reverse the removal procedure. Reverse the disassembly procedure using new plugs in the rocker arm shaft. NOTE: Make sure rocker arms are correctly positioned to actuate valves. The oil overflow pipe hole in shaft should be seen through the center hole of front support on right bank and rear support on left bank. If hole cannot be seen, turn shaft until holes line up.

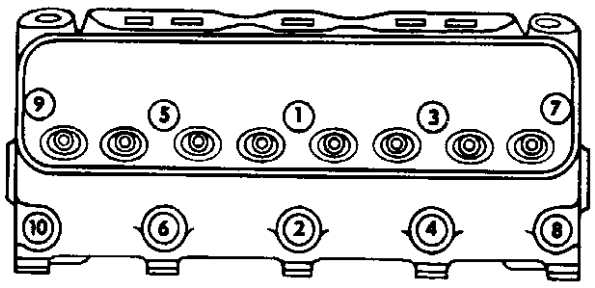
Installation of Cylinder Heads — Engine in Vehicle

It is advantageous to use pilot studs when installing cylinder head assemblies. Pilots can be made from two long cylinder head retaining screws. This may be done by cutting the head from the screw, then round edges with a file and cut a slot for screwdriver.

1. Coat both sides of cylinder head gasket with gasket sealer and install on cylinder block.
   NOTE: Cylinder head gaskets are interchangeable on either bank. Gaskets are properly installed when the word "FRONT" is at the forward end with water passage holes lined up.
2. INSTALL RIGHT BANK CYLINDER HEAD AS FOLLOWS:
   a. Install right bank cylinder head assembly in position on cylinder block with plugged water passage or power surge fan sending unit adaptor (if vehicle is so equipped) to rear of block. Remove Cylinder Head Holding Fixture Tool 6085-G and pilot studs.

b. Install cylinder head retaining screws and make three torque applications, two cold and one hot (The final "hot" application will be made after the engine is assembled.) following procedure outlined in figure 6A-46. When torquing screws it is recommended that Snap-On Tool S-8663-A and P-8675 be used with the torque wrench.
c. Install generator bracket and spark plug wiring harness grommet on cylinder head. Install oil dipstick tube and battery ground cable on cylinder head.
d. Install exhaust manifold and spark plug heat shields. Torque cap screws 23 to 28 lbs. ft.

3. INSTALL LEFT BANK CYLINDER HEAD AS FOLLOWS:
a. Install left bank cylinder head assembly in position on cylinder block with coolant temperature sending unit adaptor water passage to the rear. Remove Cylinder Head Holding Fixture Tool 6085-G and pilot studs.
b. Install cylinder head cap screws and make three torque applications, two cold and one hot (The final "hot" application will be made after the engine is assembled.) following procedure outlined in figure 6A-46. When torquing cap screws it is recommended that Snap-On Tool S-8663-A and P-8675 be used with the torque wrench.
c. Install engine ground strap and wiring loom clip on cylinder head. Install coolant sending unit. Connect coolant temperature gauge wire at sending unit.
d. Install exhaust manifold and spark plug heat shields. Torque cap screws 23 to 28 lbs. ft.



TORQUING OF ALL CYLINDER HEAD BOLTS, IN THE ABOVE SEQUENCE, TO BE PROGRESSIVELY INCREASED IN THREE STEPS:

1ST STEP	ENGINE COLD—TORQUE TO 45-55 LBS. FT.
2ND STEP	ENGINE COLD—TORQUE TO 55-65 LBS. FT.
3RD STEP	ENGINE HOT—STABILIZED AT 160°—180° F. TORQUE TO 65-75 LBS. FT.

Fig. 6A-46—Torque Sequence and Values

4. Install push rods in cylinder block being sure they are properly seated in the tappets.
5. Install rocker arm and shaft assembly. When installing oil overflow pipes, right bank pipe goes to the front and left bank pipe goes to rear rocker arm support.
CAUTION: *Make sure pipe enters hole in rocker arm support and shaft.*
6. Using a feeler gauge, perform preliminary valve lash adjustment as follows:
NOTE: The cylinders are numbered from front to rear — right bank, 1-2-3-4; left bank, 5-6-7-8. The valves are arranged from front to rear on both banks, E-I-I-E-E-I-I-E. Preliminary valve lash for both intake and exhaust valves is 0.020 inch (cold).
a. Check rocker arm adjusting screw torque by turning all the adjusting screws until interference is noted, then check the torque required to turn the screw further.
b. If the torque required to turn the screw is less than 3 lbs. ft. wear limit (36 inch pounds) replace the rocker arm and adjusting screw.
c. Make three chalk marks on the crankshaft damper. Space the marks approximately 90° apart so that with the timing mark, the damper is divided into four equal parts (90° represents 1/4 of the distance around the damper circumference). See figure 6A-47.
d. Rotate the crankshaft until No. 1 piston is near T.D.C. at the end of the compression stroke, then adjust the following valves:

No. 1 — Exhaust	No. 1 — Intake
No. 4 — Exhaust	No. 2 — Intake
No. 5 — Exhaust	No. 7 — Intake

Rotate the crankshaft 180° or 1/2 turn (this puts No. 4 piston on T.D.C.), then adjust the following valves:

No. 6 — Exhaust	No. 4 — Intake
No. 8 — Exhaust	No. 5 — Intake

Rotate the crankshaft 270°, or 3/4 turn from 180° (this puts No. 3 piston on T.D.C.), then adjust the following valves:

No. 2 — Exhaust	No. 3 — Intake
No. 3 — Exhaust	No. 6 — Intake
No. 7 — Exhaust	No. 8 — Intake

7. Clean, check and install spark plugs. Tighten plugs to 15 to 20 lbs. ft. torque.
8. Install new intake manifold gaskets and intake manifold.
NOTE: When installing manifold and gaskets, make up pilot studs to hold gaskets in position use 3/8"-16 screws to make pilot studs. Position the manifold clamps and washers; install manifold retaining screws and nuts; tighten them

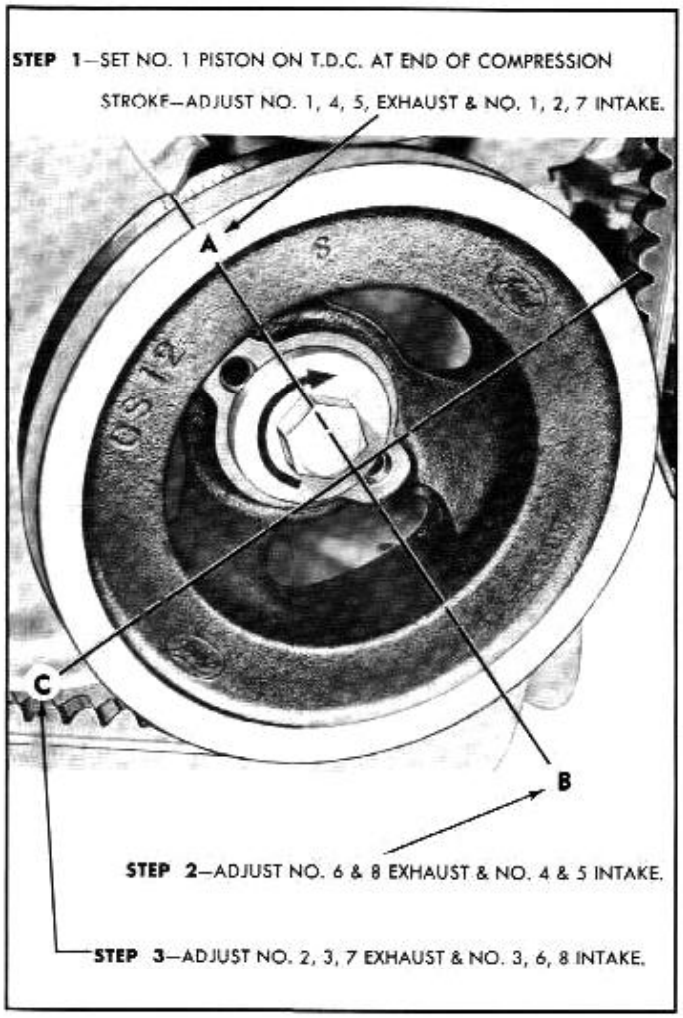


Fig. 6A-47–Quadrant for Preliminary Valve Adjustment

to 23-28 lbs. ft. torque, working on each side alternately from the center toward the ends.

9. Install, control shaft assembly, accelerator shaft bracket and automatic starter cut-out switch, on intake manifold. Install carburetor to control shaft rod on carburetor. Install accelerator shaft retracting springs.
10. Connect vacuum line to automatic starter cut-out switch and manifold vacuum fitting. Connect windshield wiper hose to vacuum booster line.
11. If vehicle is equipped with a power brake unit, connect power brake hose to manifold fitting. Connect vacuum booster line to manifold fitting.
12. Connect water by-pass hose to water pump. Connect heater inlet hose to fitting on intake manifold. Connect upper radiator hose to water outlet connector. Close petcocks at radiator and cylinder block.
13. Connect distributor vacuum line. Connect high tension lead, secondary, and primary ignition wires to coil and resistor.
14. Install battery ground cable. Fill cooling system with coolant. Start engine, and run it at 1200 R.P.M. until it is thoroughly warm (approximately 30 minutes). While engine is running check for leaks.
15. With engine running, check and adjust timing and connect primary spark control vacuum line to distributor and check advance timing.
16. Turn engine off, then while engine is still hot, final (hot) torque cylinder head cap screws. Torque cap screws in proper sequence to 65-75 lbs. ft. See figure 6A-46.
17. Perform final (hot) tappet adjustment. (Intake and exhaust valve lash setting is .019.) This final adjustment should be performed with the engine running and temperature stabilized by operating engine for 30 minutes at 1200 R.P.M.
18. Install rocker arm cover and new gasket. Torque nut 2 to 2½ lbs. ft.
19. Final check for leaks at all connections and gaskets.
20. Adjust carburetor and throttle linkage.
21. Install Air Cleaner and air duct.

REMOVAL AND INSTALLATION OF PISTONS, PISTON PINS, PISTON RINGS AND CONNECTING RODS – ENGINE IN VEHICLE

Removal

1. Raise vehicle and remove oil pan. Refer to "Removal of Oil Pan – Engine in Vehicle" in this section of manual.
2. Lower vehicle and remove cylinder head. To remove cylinder head, refer to "Removal of Cylinder Heads – Engine in Vehicle" in this section of manual.
3. Disconnect high tension lead wire at coil. Disconnect wire at "S" terminal of starter relay switch. Connect an auxiliary starter cable to the positive terminal of battery and the "S" terminal of starter relay switch.
4. Remove cylinder ridge from cylinder bores as follows:
   a. Using the auxiliary starting cable switch, "bump" engine over until the respective piston to be removed is at approximately B.D.C.
   b. Remove cylinder ridge using Tool 6011-A. See figure 6A-48.
   NOTE: Insert a clean cloth into cylinder bore to prevent chips and carbon from falling on piston and rings. Remove cloth and wipe bore clean after removing the ridge.
5. Raise vehicle.
6. Using auxiliary starter switch, rotate crankshaft to position the respective journals at approximately B.D.C. for removal of connecting rod and piston assembly.

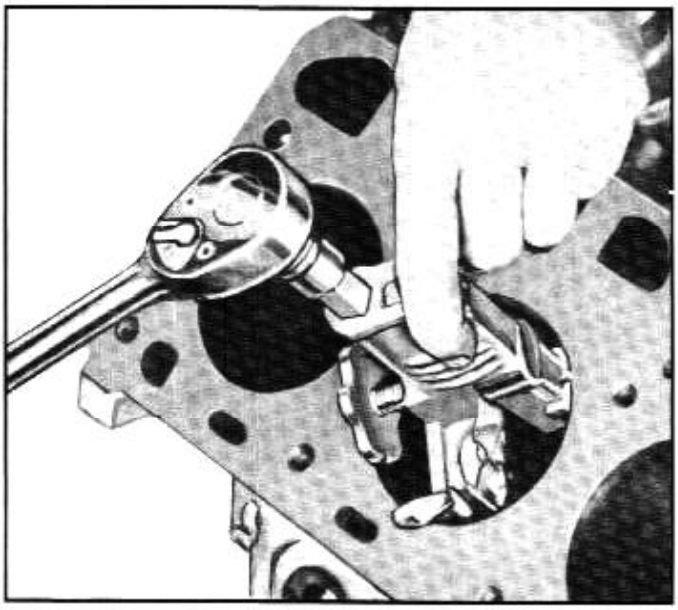


Fig. 6A-48—Removing Cylinder Ridge—Typical

7. Remove connecting bearing cap and bearing inserts. Using a wood hammer handle, push connecting rod and piston assembly out of cylinder bore.
   CAUTION: *Use care to prevent connecting rod from striking cylinder bore. If cylinder bore is scored or nicked while removing the assembly, the cylinder bore will have to be honed or bored to repair the damage.*
8. Replace bearing inserts and cap on connecting rod so that the numbered sides match.
   NOTE: Each assembly is numbered so that it can be reinstalled in its respective cylinder bore.
9. If more than one piston and connecting rod assembly is to be removed, repeat Steps 6 through 8 for each respective assembly.

Cleaning, Inspection and Reconditioning — Pistons, Piston Pins, Piston Rings and Connecting Rods

CYLINDER BLOCK

One of the most important phases of reconditioning is the thorough cleaning and inspection of the cylinder block.

Each machined surface of the cylinder block should be cleaned of all old gasket material.

Inspection of the cylinder block should be done carefully to detect any scoring of the cylinder bores, cracks or water leaks. Minute cracks may be found by coating suspected areas with a mixture of 75% light motor oil and 25% kerosene. After wiping area clean and dry, immediately apply a coating of zinc oxide dissolved in wood alcohol. If any cracks are present, the white coating of the zinc oxide-wood alcohol mixture will discolor at the defective area.

Each cylinder bore should be checked for taper and out-of-round conditions. Use an accurate gauge following the manufacturer's directions. Measure the diameter of the cylinder bore at the top of the piston ring travel at right angles to the centerline of the crankshaft (A) see figure 6A-49. Record readings. Next, measure each bore so gauge reading coincides with centerline of crankshaft (B). The difference between the readings is the out-of-round condition at the top of the cylinder bore. Repeat this same procedure at the bottom of the ring travel to check for out-of-round. The difference between the diameters measured at the top (A) and bottom (B) of the bore (at right angles to the centerline of the crankshaft) is the taper of the bore. See figure 6A-50.

If the cylinder bore wear does not exceed the limits of .0005″ out-of-round (wear limit .005″) and .001″ taper (wear limit .008″), new service piston rings will give satisfactory performance provided the piston clearance is not excessive.

However, if the wear exceeds the limits it will be necessary to rebore the cylinder or cylinders to within .0015″ of the required oversize diameter. This will allow enough stock for the final step of honing the bores so the exact clearance and surface finish may be obtained for the selected oversize pistons.

NOTE: After the honing operation is completed, cylinder bores and block should be thoroughly cleaned.

Each piston thus fitted should immediately be marked with the respective cylinder number it was fitted to. It is recommended that the clearance between the fitted piston and the cylinder wall be held to the mean limit.

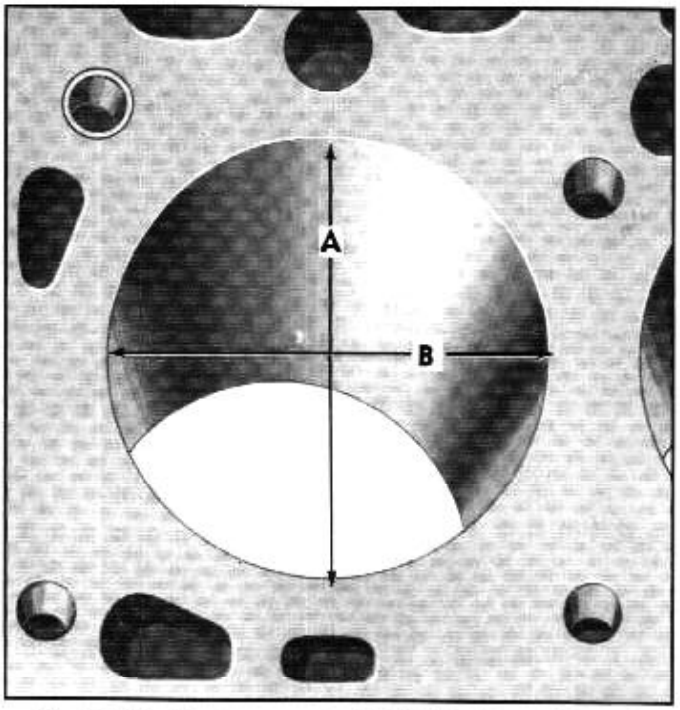


Fig. 6A-49—Measurement of Cylinder Out-of-Round

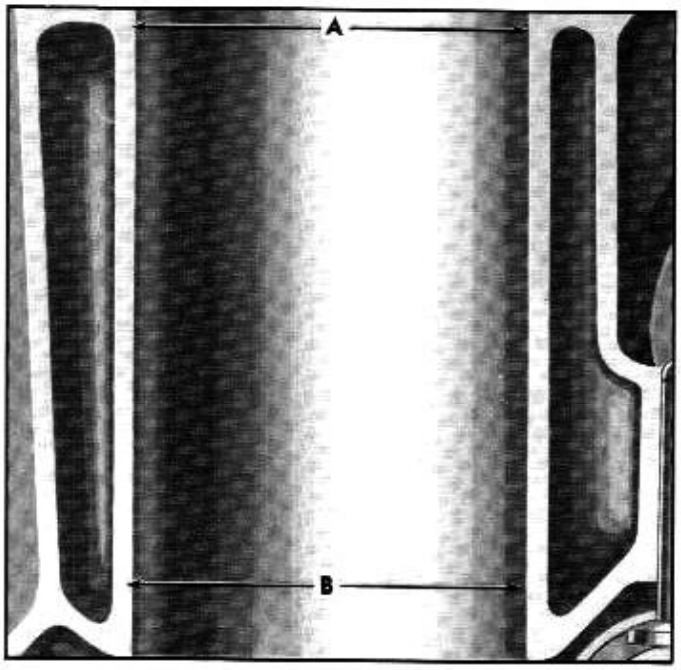


Fig. 6A-50—Measurement of Cylinder Taper

Piston fit should be checked by positioning a length of 1/2" wide feeler stock, of the recommended thickness for the existing condition, between the inverted piston and the cylinder wall. The feeler should extend the entire length of the piston at 90° from the piston pin holes. Hold the piston in the cylinder bore so the end is about 1½" below the top of the block and the piston pin bore is parallel to the crankshaft. Then pull feeler stock from cylinder while noting reading on pull scale Tool FLM-6110-A as shown in figure 6A-51.

If reading on scale conforms to limits presented in the following chart for the existing condition, the piston clearance is satisfactory.

Fit New Piston in New Bore		Fit New Piston in Used Bore		Fit Used Piston in Used or New Bore	
Feeler Thickness (Inches)	Pull (lbs.)	Feeler Thickness (Inches)	Pull (lbs.)	Feeler Thickness (Inches)	Pull (lbs.)
.002	5-10	.0025	5-10	.003	5-10

If reading on scale is greater than maximum pull limit, check piston for any damage that may effect the pull reading. If no damage is evident then try another piston. Recheck fit of new piston.

Prior to installing a piston with new rings in a used cylinder bore, it is necessary to remove the high glaze from the wall to aid seating of the rings.

PISTONS AND PISTON PINS

From the inspection and measurements of the cylinder bores, it has been determined that the pistons to be installed are either new pistons or that the original pistons are to be reused with new piston rings.

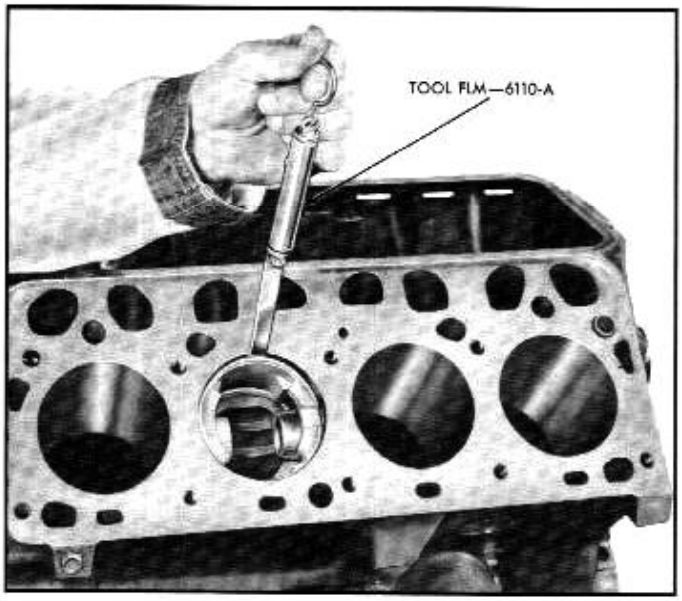


Fig. 6A-51—Checking Piston Clearance

If the original pistons are to be used with new rings, the pistons must be thoroughly cleaned of all carbon. Tool LM-6110-A is provided for cleaning the piston ring grooves. Soaking the pistons in cleaning solvent will loosen the carbon for removal. NEVER USE A WIRE BRUSH ON A PISTON, this will round off the ring lands. Clean oil holes or slots being careful not to remove any metal.

Inspect the pistons for scuffed or scored skirts, worn or cracked ring lands, discarding any showing such conditions. When the condition is in doubt, replace the piston.

There are actually two different sizes of pistons which can be fitted to a STANDARD size cylinder bore. By this, we mean that a standard size cylinder bore has a production tolerance between the limits of 3.8000" to 3.8024", as determined by the point at which the proper cylinder bore finish is reached. Pistons used in a standard size cylinder bore are marked No. 2 and No. 6 and are assigned different part numbers for service. The numbers correspond to the following sizes (See figure 6A-52):

Piston Number On Dome	Dimension "Z" (See figure 6A-52)
2	3.7987 to 3.7990
6	3.7999 to 3.8002

From the above it can be seen that a standard size cylinder bore may measure up to a diameter of 3.8024". However, it is still considered standard and

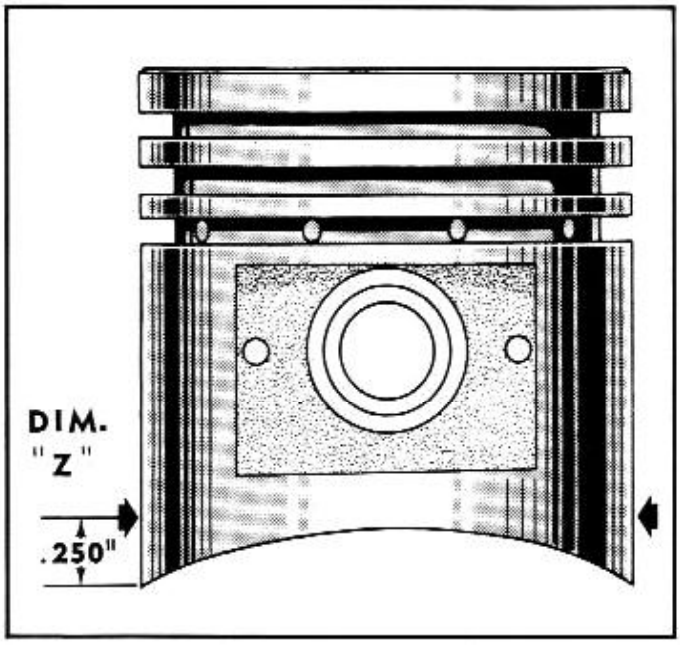


Fig. 6A-52—Measuring Piston Diameter

it is not necessary to use an oversize piston. If one of the standard size pistons will not fit with the proper clearance (ribbon pull) then it will be necessary to rebore the cylinder as required and use an oversize piston.

Use Tool 6135-B or equivalent to ream the pistons if oversize piston pins are to be used. Use Tool 6135-C to remove old pin from piston and connecting rod. The specified clearance between piston and pin, and piston pin and connecting rod bushing is 0.0001"-0.0003" (wear limit – loose – 0.0008"). The piston pin should be a light thumb press fit and should be installed in the piston and rod when the piston is at a normal room temperature (70° F.). Two retainers are used to hold the pin place; one at each end of pin. When installing the retainer rings make sure they are properly seated in grooves provided in piston pin boss. Always use a new pin retainer.

NOTE: Always assemble rod to piston so the indentation embossed on piston head will face the front of the engine, while the numbered side of the rods on the right bank will face right side of engine and rods for the left bank will face the left side of the engine, when viewed from the rear.

CONNECTING RODS

Each connecting rod should be thoroughly cleaned and visually inspected for defects. If condition is satisfactory, the rod should be assembled to the piston for installation in the cylinder from which it was removed. See figure 6A-53.

The connecting rod should be checked for proper clearance with piston pins. The specified clearance is .0001"-.0003" (wear limit – loose – .0008"). The pin should be able to move through the bushing with light thumb pressure. If loose, oversize piston pins of .001" and .002" are available.

After the rods are assembled to the pistons, the complete assembly should be checked with suitable aligning equipment. Since many makes are in use, it is recommended that the manufacturer's instructions be followed to assure that the rod is not bent or twisted. Bending the connecting rod to obtain correct alignment is permissible. The following specifications apply when checking connecting rod alignment:

Twist Total Difference – Maximum* . . . 0.012"
Bend Total Difference – Maximum* . . . 0.004"
*Finished piston pin bushing and crankshaft bearing bore must be parallel and in same vertical plane within the specified total difference at ends of eight (8) inch long bar measured four (4) inches of each side of rod.

An oil squirt hole is provided in each connecting rod to direct a stream of oil on the cylinder wall as the piston approaches top center. The oil is supplied through a hole drilled in the crankpin end of the rod which intermittently lines up with the hole in the crankpin. Thus, it may be seen that the squirt of oil is of short duration and occurs only once at each cylinder for each revolution of the crankshaft at low engine speeds only. Make sure these oil squirt holes are open. Also, make sure the rod bearings are provided with a hole that is clear of obstructions to allow the oil from the crankpin to flow through the bearing to the squirt hole.

PISTON RINGS

Each piston has three piston rings located above the piston pin. See figure 6A-53. The compression rings are located in the two top grooves while the lower groove accommodates the expander type oil control ring. Select the proper rings for the size of the pistons to be used.

Prior to installing the rings on the piston, each ring must be checked for the proper ring gap. Push the ring down into the cylinder bore about two inches using the head of a piston so that the ring is square with the cylinder wall. Extreme caution should be used during this operation. Check the space or gap between the ends of the ring with a feeler gauge. See figure 6A-54. The gap should be within the limits of 0.012" to 0.022" for both compression rings and 0.015" to 0.062" for the oil control ring.

If gap is less than limit, try another ring for fit. Each ring should be fitted and checked in the cylinder in which it is going to be used and marked accordingly.

Piston rings should also be checked for side clearance in the groove of the piston on which they are to

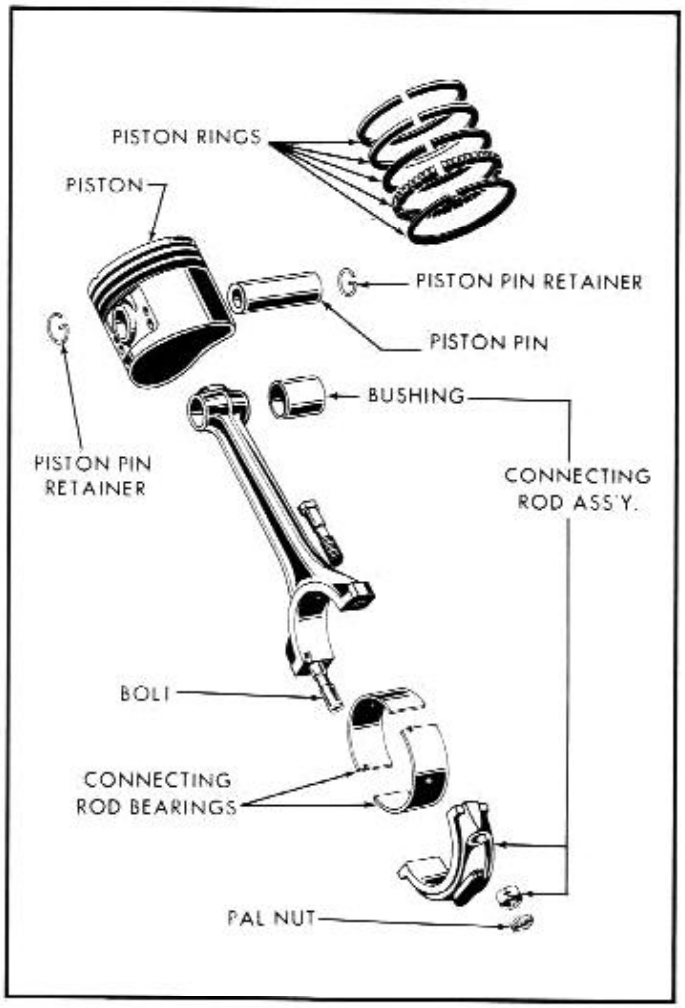


Fig. 6A-53—Piston and Connecting Rod Assembly

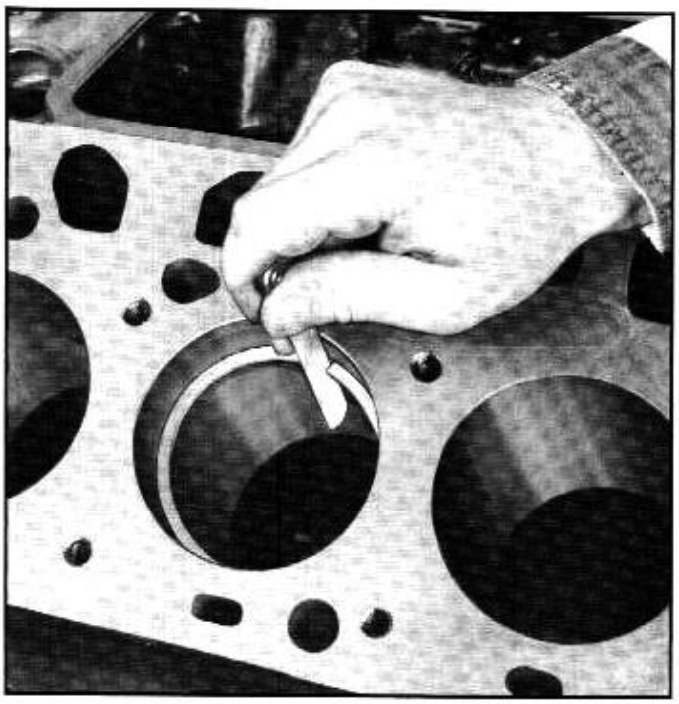


Fig. 6A-54—Checking Piston Ring Gap

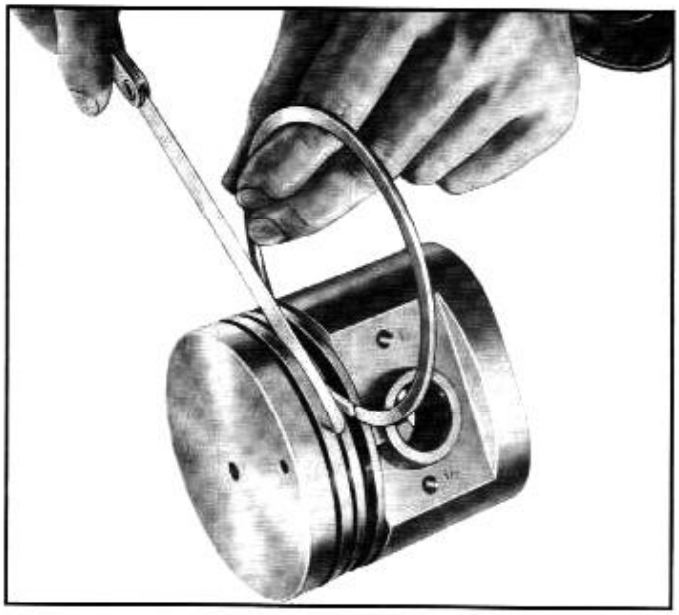


Fig. 6A-55—Checking Piston Ring Side Clearance

be installed. This is done by placing the outer edge of the ring in the piston groove and rolling the ring entirely around the piston to make sure that there is no binding and the ring is free in groove. With a thickness gauge, check the side clearance of each ring in its respective groove. See figure 6A-55. The side clearance of upper compression ring is .0020″ to .0035″. The side clearance of lower compression ring is .001″ to .003″. The wear limit for both upper and lower rings is .006″.

Assemble rings on pistons to which they were fitted by using a piston ring expander Tool 6149-6. This type tool is recommended to avoid over-expanding and to expand the ring to a true circle to avoid

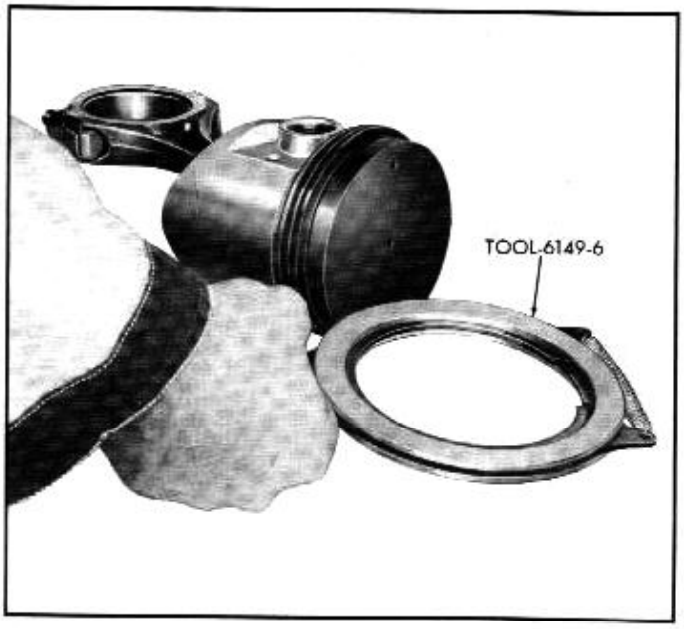


Fig. 6A-56—Piston Ring Expander Tool

distortion. See figure 6A-56. Space ring gaps 120° apart and coat with engine oil prior to installing. When spacing oil ring on piston, the ring gap should be positioned so that it will be on the inside of the "V" (high side of cylinder bore) when piston is installed in cylinder bore.

Installation

1. Turn crankshaft so crankpin for No. 1 and No. 5 cylinders is at approximately B.D.C.
2. Coat cylinder bores, crankshaft journals, pistons, piston pins, and piston rings with engine oil. (Check ring gap spacing. Oil ring gap should be positioned to the inside of the "V" of engine and the remaining ring gaps spaced 120° apart.) Insert piston into Ring Compressor Tool FLM-6149 and install piston assembly into respective cylinder bore, as shown in figure 6A-57. Install connecting rod bearings and caps, coating each with engine oil. The numbered side of the cap must match and be on the numbered side of the rod. Secure with hex nuts and pal nut. Torque hex nuts 45-50 lbs. ft. Install pal nuts and torque 3 to 3½ lbs. ft. or finger tight plus 1/3 turn. Repeat above operation for remaining cylinders, turning crankshaft so crankpin for each set of cylinders is at approximately B.D.C. for installation of remaining piston assemblies.

   NOTE: The numbered side of the rods must face towards the outside of the block and dimple embossed or slot cut on the top of the piston, must face the front of the engine. See figures 6A-58 and 6A-59.

   CAUTION: *When installing piston assemblies, be extremely careful that the connecting rod bolts do not strike the crankshaft journals. If this should happen, remove burr using fine oilstone. DO NOT HAMMER ON TOP OF PISTON when installing assembly in cylinder bore. Apply even pressure to wood hammer handle. See figure 6A-57. By applying a continuous pressure to the piston, any obstruction will be immediately indicated. The piston assembly can then be removed and rings checked and reinstalled correctly or if obstruction is present, correct defect.*
3. Check connecting rod side clearance using feeler gauge. See figure 6A-60. Limits are .006" to .016" (wear limit .019"). Replace bearings if end play exceeds this limit.
4. Install oil pan. Refer to "Installation of Oil Pan — Engine in Vehicle" in this section of manual.

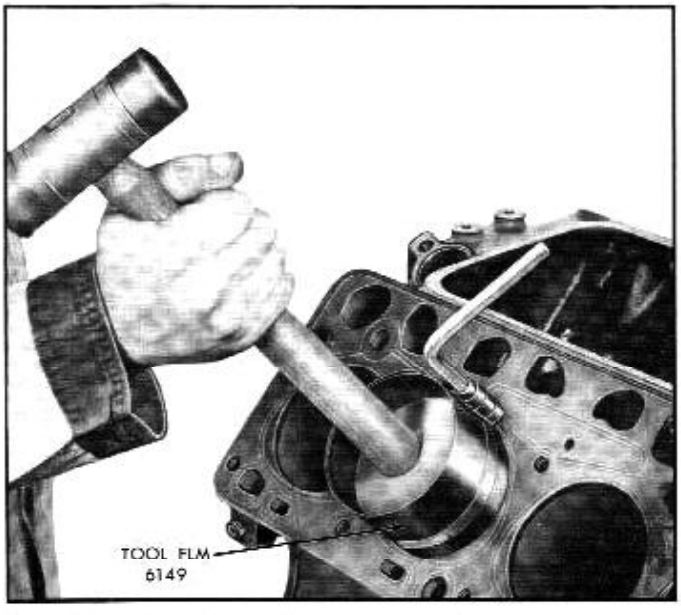


Fig. 6A-57—Installing Piston Assembly in Cylinder Block

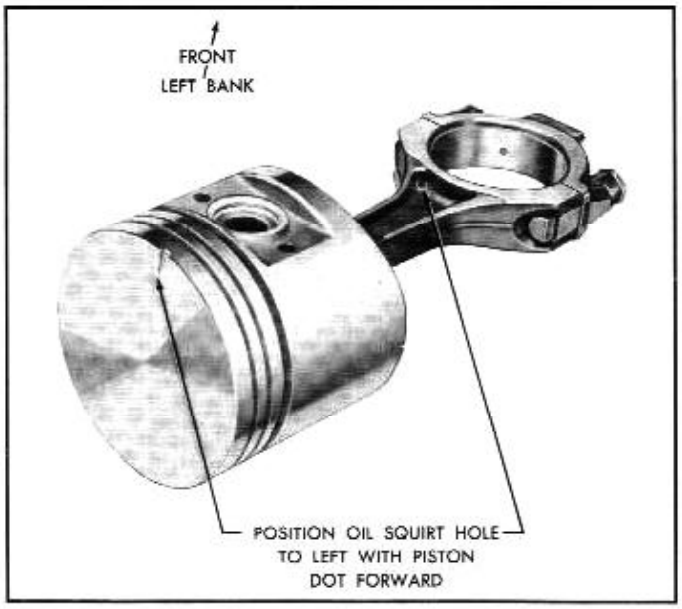


Fig. 6A-58—Position of Piston and Connecting Rod Squirt Hole—Left Bank

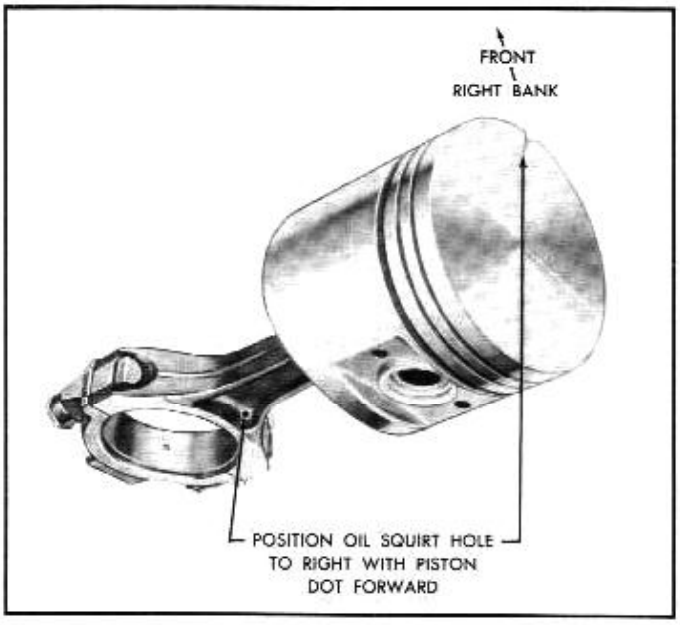


Fig. 6A-59—Position of Piston and Connecting Rod Squirt Hole—Right Bank

5. Install cylinder head. Refer to "Installation of Cylinder Head – Engine in Vehicle" in this section of manual.
6. Perform engine compression test.

REMOVAL AND INSTALLATION OF MAIN AND CONNECTING ROD BEARINGS – ENGINE IN VEHICLE

Removal

1. Remove spark plug wires and spark plugs.
2. Disconnect high tension coil lead wire at coil. Disconnect wire at "S" terminal of starter relay switch. Connect an auxiliary starter cable to the positive terminal of battery and "S" terminal of starter relay switch.
3. Remove oil pan. Refer to "Removal of Oil Pan – Engine in Vehicle" in this section of manual.

Inspection

It is necessary to ascertain the condition of all main crankshaft journals and connecting rod journals before proceeding with the bearing replacement procedures. If a crankshaft has journals that are badly nicked or scored, or the journals are grooved, out-of-round or tapered beyond specification limits, the engine must be removed from the vehicle. The crankshaft will then have to be removed for grinding or replacement purposes.

1. Check the condition of each main bearing one at a time, leaving the other bearings securely fastened.

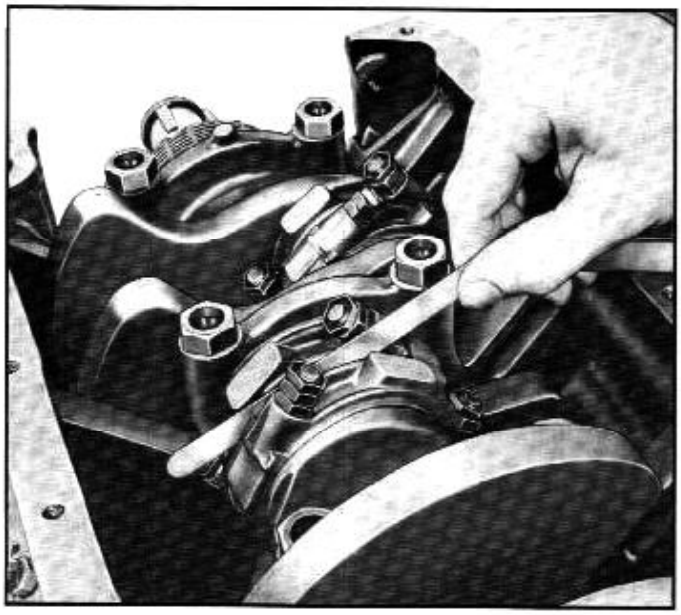


Fig. 6A-60—Checking Connecting Rod Side Clearance

Remove bearing cap and insert. Clean and inspect each bearing carefully. Bearings that have a scored, chipped or worn surface will have to be replaced. Typical examples of bearing failures and their causes are shown in figure 6A-61.

2. Clean and inspect main bearing journals for cracks, scratches, grooves or scores. Dress minor imperfections with an oilstone. Replace or regrind badly damaged crankshafts.

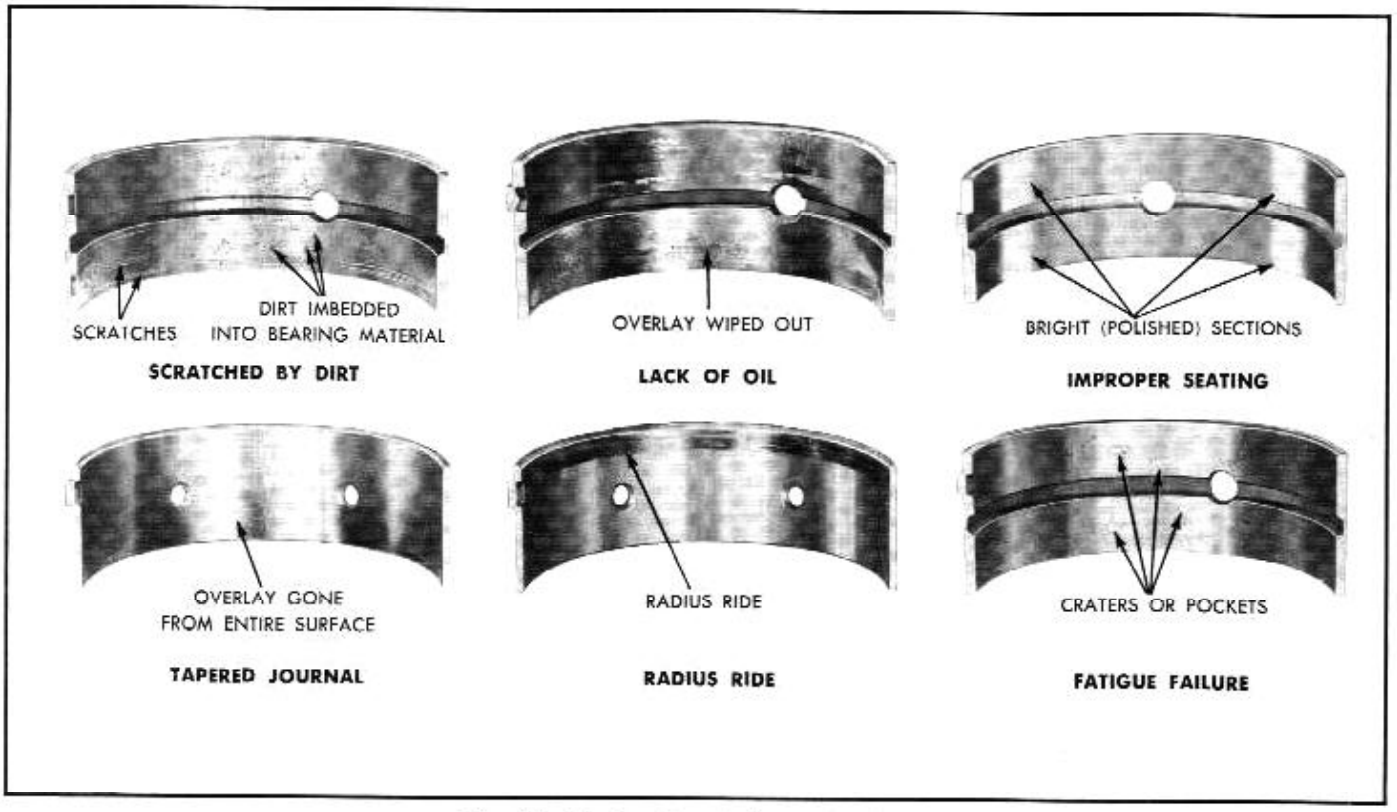


Fig. 6A-61—Bearing Failures—Typical

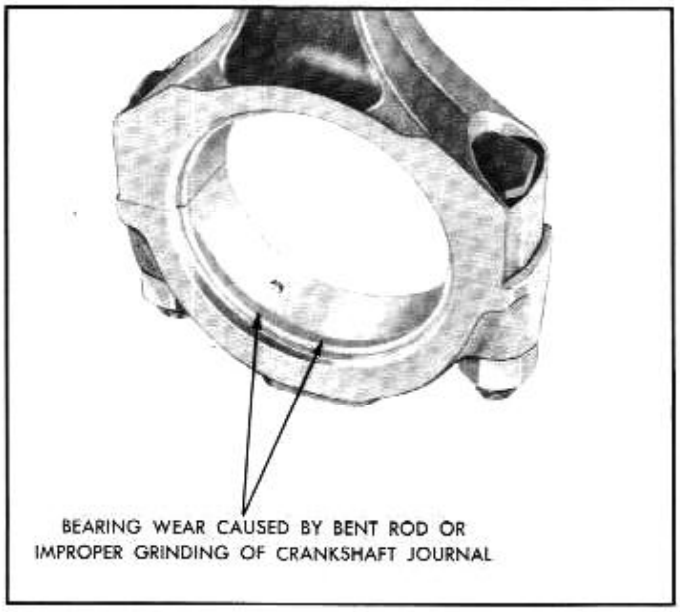


Fig. 6A-62—Wear Pattern On Connecting Rod Bearing

3. Using the auxiliary starter switch, rotate crankshaft to position the respective connecting rod journals at B.D.C. for removal of connecting rod bearing caps and inserts. Remove palnuts and nuts securing bearing cap to connecting rod. Remove cap and bearing insert. Refer to figures 6A-61 and 6A-62 for typical examples of bearing failures. Bearings that have a scored, chipped or worn surface will have to be replaced.
   NOTE: If wear pattern on connecting rod bearing insert indicates a bent rod, or improperly ground crankshaft connecting rod journal, remove the crankshaft for replacement or regrinding if it is the cause of failure. If crankshaft is not the cause of failure, replace connecting rod. Refer to "Removal and Reconditioning of Pistons, Piston Pins, Piston Rings, Connecting Rods and Bearings".
4. Clean and inspect connecting rod journals of crankshaft for cracks, scratches, grooves or scores. Dress minor imperfections with an oilstone. Replace or regrind badly damaged crankshafts.
   NOTE: It will be necessary to remove the engine from vehicle to remove crankshaft for replacement or grinding purposes.
5. Measure the diameter of each journal in at least four (4) places to determine out-of-round, taper or undersize condition. The connecting rod journal diameter specification is 2.1880" to 2.1888". See figure 6A-63. The out-of-round and taper limits for the connecting rod journals are .00025 inch out-of-round (wear limit .0005 inch), and .0005 inch taper (wear limit .001 inch). If the journals approach the taper or out-of-round wear limits, they should be reground to size for the next undersize bearing. If the journal diameters are less than specified the crankshaft must be reground for the next undersize bearing.

Fitting Main Bearings

To obtain an accurate reading of main bearing to crankshaft clearance, using the Plastigage method of checking, all bearing caps must be in place and torqued to 95 to 105 lbs. ft. Then follow procedure outlined below:

1. It will be necessary to support the weight of the crankshaft. This can be done with a small jack positioned to bear against the crankshaft counterweight adjoining the bearing which is being checked for clearance.
   NOTE: Crankshaft support is necessary when checking main bearing clearances in order to prevent the crankshaft weight from compressing the Plastigage, which would provide an erroneous reading.
2. Remove one bearing cap and bearing insert at a time. Remaining caps are left tight while checking the bearing clearance.
3. The upper half of the bearing can be removed from the cylinder block by using Tool 6331 inserted into the crankshaft oil hole and rotating the crankshaft opposite to engine rotation. This tool will push the bearing insert out.
   CAUTION: *Use Tool 6331 with care to avoid the possibility of damaging bearing.*
4. Wipe the oil from all contacting surfaces of the crankshaft and bearing inserts, bearing cap, etc.
5. Install upper half of bearing insert. Place plain end of insert over the locking tang side of crankshaft and rotate the insert into position as far as

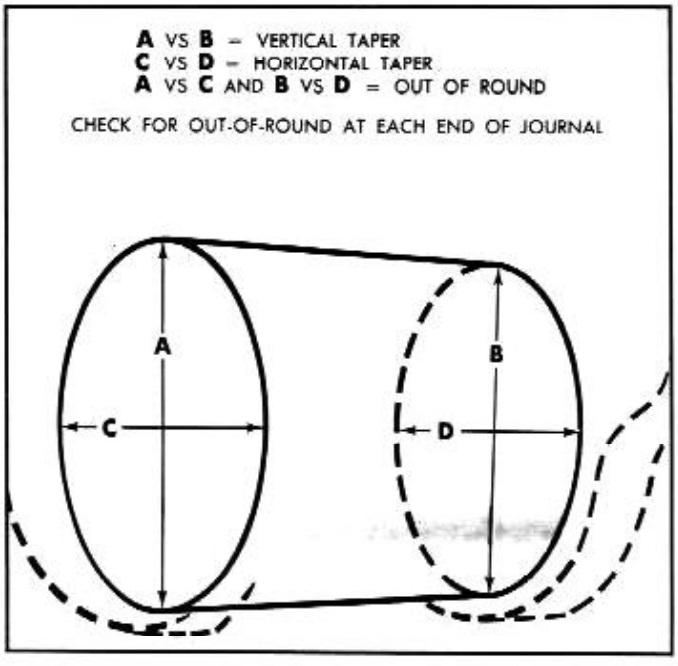


Fig. 6A-63—Crankshaft Journal Measurement

possible, then use Tool 6331 to further seat the insert.

6. Place a piece of Plastigage, the full width of the bearing surface, on the crankshaft journal about 1/4" off center. Install bearing insert and cap. Tighten retaining screws to 95-105 lbs. ft. torque. CAUTION: *Do not rotate crankshaft while making checks with Plastigage.*
7. Remove bearing cap and insert, but do not disturb Plastigage.
8. Compare the width of the flattened Plastigage at its widest point with the scale printed on the Plastigage envelope. See figure 6A-64. This reading indicates the bearing clearance in thousandths of an inch. Clearance should be from .0008" to .0026" (.0036" wear limit).
9. If the clearance is less than .0008" or more than .0026", try another bearing insert to bring the clearance within the desired specification.
   NOTE: Standard size bearing inserts are divided into two sizes carrying different suffixes to the part number. They can be identified by a daub of either red or blue color dye. Red bearing inserts will increase the clearance, blue bearing inserts will decrease the clearance.

Any combination of red and/or blue bearing inserts may be used to bring the desired results.

If the various selective fit bearings do not bring the clearance within the desired limits it will be necessary to regrind the crankshaft journals and install undersize bearing inserts.

Fitting Connecting Rod Bearings

1. Using the auxiliary starter switch, rotate crankshaft to position the No. 1 connecting rod journal at B.D.C. Remove connecting rods secured to the respective journal.
   NOTE: Fit the connecting rod bearings to one journal at a time before proceeding to the next.
2. Remove bearing cap and separate bearing from cap and rod.
3. Clean oil from connecting rod journal, connecting rod bearing cap bores, and bearing contact surfaces.
4. Install upper bearing insert into the rod and pull rod assembly into firm contact with the crankshaft journal.
5. Install lower bearing into connecting rod cap. Place a piece of Plastigage on the bearing surface the full width of bearing about 1/4" off center.
6. Install cap and tighten to 45 to 50 lbs. ft. torque. CAUTION: *Do not turn crankshaft while Plastigage is in place.*
7. Remove bearing cap and compare the width of the flattened Plastigage at its widest point with the scale printed on the Plastigage envelope. See figure 6A-64. If clearance is less than .0008" or more than .0027" (wear limit .0037"), try another selective fit bearing to bring the clearance within the desired limits.
8. Check connecting rod side clearance using a feeler gauge. See figure 6A-60. The specified limits are .006" to .016" (wear limit .019"). Replace bearing inserts if side clearance is greater than specified.

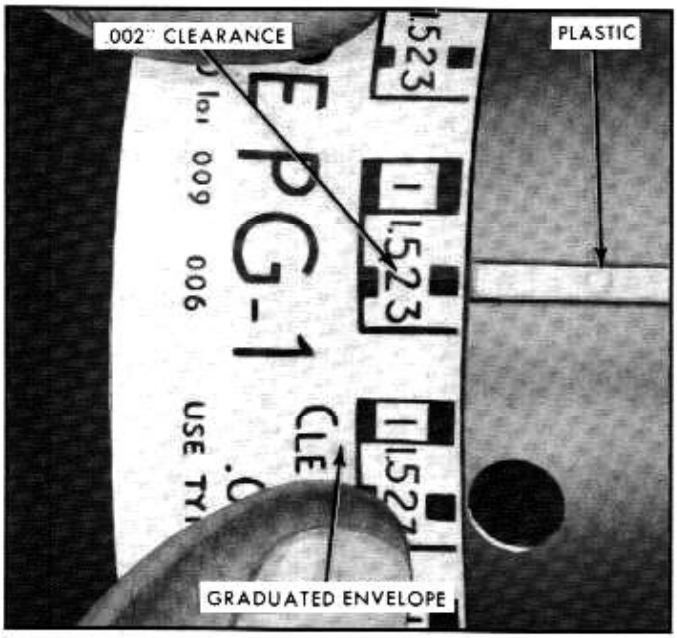


Fig. 6A-64—Checking Bearing Clearance

Installation

1. Install oil pan. Refer to "Installation of Oil Pan—Engine in Vehicle" in this section of manual.
2. Lower vehicle. Disconnect auxiliary starter cable from starter relay switch and battery. Connect the previously removed wire to "S" terminal of starter relay switch.
3. Connect high tension coil lead wire to coil.
4. Install spark plugs and tighten them to 15-20 lbs. ft. torque.
5. Start engine and check for oil leaks.

REMOVAL OF ENGINE ASSEMBLY (LESS TRANSMISSION)

1. Mask edge of hood, fenders, and cowl to protect paint. Place fender covers on fenders.
2. Drain cooling system. The two engine drain cocks are located on each side and to the front of the cylinder block. The radiator drain cock is located on the lower radiator tank.
3. Remove screws securing hood to hinge assemblies. NOTE: If hood is properly aligned, index the hood hinge to the hood for installation purposes.

4. Remove carburetor air cleaner and fresh air duct as an assembly.
5. Disconnect battery cables and remove battery.
6. Disconnect heater inlet hose at fitting on manifold. Disconnect heater outlet hose at water pump.
7. Disconnect the generator armature field and ground wires at generator.
8. Disconnect starter cable from starter.
9. Disconnect primary and secondary wires from coil and resistor. Disconnect wire from power surge fan sending unit, if vehicle is so equipped.
10. Remove two accelerator shaft retract springs. Disconnect carburetor to control shaft rod at carburetor.
11. Disconnect accelerator shaft assembly from transmission control shaft. Remove two cap screws securing control shaft assembly and accelerator shaft bracket to engine. Wire control shaft assembly to dash panel.
12. Remove screw retaining engine ground strap to engine.
13. Disconnect coolant temperature sending unit wire, oil pressure gauge sending unit wire, and starter cutout switch wires.
14. Disconnect windshield wiper vacuum hose from vacuum booster line.
15. POWER BRAKE EQUIPPED VEHICLES:
    a. Remove power brake vacuum booster hose from connector on manifold.
16. MERC-O-MATIC EQUIPPED VEHICLES:
    a. Disconnect transmission oil coolant transfer lines at radiator lower tank.
17. POWER STEERING EQUIPPED VEHICLES:
    a. Loosen power steering drive belt.
    b. Remove screw securing power steering hose bracket to cylinder block.
    c. Remove power steering pump.
    d. With hoses connected, position power steering pump assembly against lower fender apron in a manner that will prevent the oil from draining out of reservoir filler cap.
18. Disconnect lower radiator hose at water pump. Disconnect upper radiator hose at the connector. Remove bolts securing radiator assembly to radiator support and remove radiator.
    NOTE: Before removing radiator, position a piece of fibre board or heavy cardboard between radiator and fan blade to prevent damage to radiator core upon removal.
19. POWER SURGE FAN EQUIPPED VEHICLES:
    a. Remove screws securing power surge clutch and fan assembly, and the water pump pulley to the water pump pulley hub. Remove the power surge fan assembly and pulley from vehicle.
20. Loosen screws securing fan assembly, spacer and pulley to water pump pulley hub and remove the component parts as a unit.
21. Disconnect the water and vacuum hoses from windshield washer container. Remove container from mounting bracket.
22. Disconnect flexible fuel line at fuel pump.
23. Disconnect two screws securing upper engine splash shield arms to frame side member.
24. Raise vehicle.
25. Remove screws securing engine splash shield to front frame crossmember.
26. Remove starter assembly and dust seal.
27. Disconnect both right and left muffler inlet pipes from exhaust manifold.
28. Disconnect the clutch release lever retracting spring. Disconnect the clutch release lever rod from clutch release lever assembly. Remove flywheel housing cover.
29. Remove the retaining screws that secure the clutch release (engine) bracket to the engine. Slide the bracket and two-piece sockets out of the clutch release equalizer bar assembly.
30. MERC-O-MATIC TRANSMISSION EQUIPPED VEHICLES:
    a. Disconnect oil transfer line mounting bracket from engine.
    b. Remove transmission linkage splash shield.
    c. Remove converter housing cover and lower access cover. Remove bolts securing converter cover to flywheel.
    d. Remove lower converter housing to cylinder block retaining screws.
31. Remove screws securing the front engine support insulator assemblies to the cylinder block.
32. Remove oil filter.
33. Lower vehicle and support transmission with a support jack. Remove lower flywheel housing to cylinder block retaining screws.
34. MERC-O-MATIC EQUIPPED VEHICLES:
    a. Remove upper converter housing to cylinder block retaining screws.
35. Install Engine Hoisting Sling Tools 6000-B-A and 6000-C. Position sling to remove engine, less transmission.
36. Lift engine slightly. Have another mechanic push engine forward to clear dash panel. Continue to lift engine while mechanic guides engine to prevent damage.
37. Remove spark plugs before installing engine on repair stand.

DISASSEMBLY OF ENGINE (REMOVED FROM VEHICLE)

For the purpose of this manual, the engine has been removed (less transmission and flywheel housing) from the vehicle and installed on an engine repair stand for complete teardown procedures. From the procedures outlined, the mechanic can obtain the information necessary to perform a specific operation.

1. Install engine on repair stand with repair stand adaptor Tool 6005-CF or 6005-CFS.
2. Make sure all oil and water has been drained from cylinder block.
3. Disconnect fuel lines from fuel pump and carburetor. Disconnect vacuum lines from vacuum booster pump, intake manifold, and distributor.
4. Disconnect high tension lead and primary ignition wires from coil and remove coil from intake manifold.
5. Remove distributor cap and four wiring harness brackets. Wires, cap, and brackets may be removed as a unit.
6. Remove distributor by lifting assembly from block recess, after removing retaining screw and bracket.
7. Disconnect automatic choke heat tube from choke.
8. Remove carburetor and gasket.
9. Remove spark plug heat baffles.
10. Remove both right and left hand exhaust manifolds.
11. Disconnect generator brackets from front cover and cylinder block, and remove generator and brackets as a unit.
12. Remove screw and flat washer from front of crankshaft damper. Remove damper with Tool 6316-FF.
    NOTE: On those units equipped with power steering, remove pulley before removing damper.
13. Disconnect water by-pass tube from water pump and remove water pump and timing pointer.
14. Remove oil filler cap, oil dipstick and tube assembly. Tube is a press fit into cylinder block. If tight, tap lightly on welded bracket with mallet.
15. Remove fuel pump from cylinder block front cover.
16. Remove road draft tube and filter assembly. To remove tube, loosen the two screws from inside after cover and filter are removed.
17. Remove oil filter adaptor and diaphragm so that area behind diaphragm may be cleaned.
18. Remove oil pressure gauge sender unit.
19. Remove oil pump and oil pump pickup tube. (The oil pump is secured in place with two screws on the bottom and one above.) Remove oil pump intermediate drive shaft from block if it did not come out with oil pump.
20. Remove water outlet connection and thermostat from intake manifold.
21. Remove engine temperature sending unit from the left cylinder head.
22. Remove power surge fan sending unit if vehicle is so equipped.
23. Remove intake manifold and gaskets.
24. Clean top of valve push rod chamber cover so foreign material will not fall into push rod chamber, then remove cover and gasket.
    NOTE: This is particularly important when this operation is performed with the engine in the vehicle.
25. Remove rocker arm covers and gaskets.
26. REMOVE CYLINDER HEADS AS FOLLOWS:
    a. Loosen rocker arm adjustment screws to remove tension on push rods.
       CAUTION: *It is necessary that the tension be removed to prevent the possibility of bending the push rods or damaging the rocker arm shaft when removing rocker arm and shaft assembly support screws and nuts.*
    b. Remove six screws and two nuts securing rocker arm and shaft assembly to the cylinder head. Remove oil overflow pipes from each assembly.
    c. Remove rocker arm and shaft assembly by lifting up. Identify assembly for reinstallation.
    d. Remove push rods from each cylinder bank.
    e. Install Cylinder Head Holding Fixture Tool 6085-G to cylinder head, using 3/8" x 1⅜" screws with flat washers. See figure 6A-65.

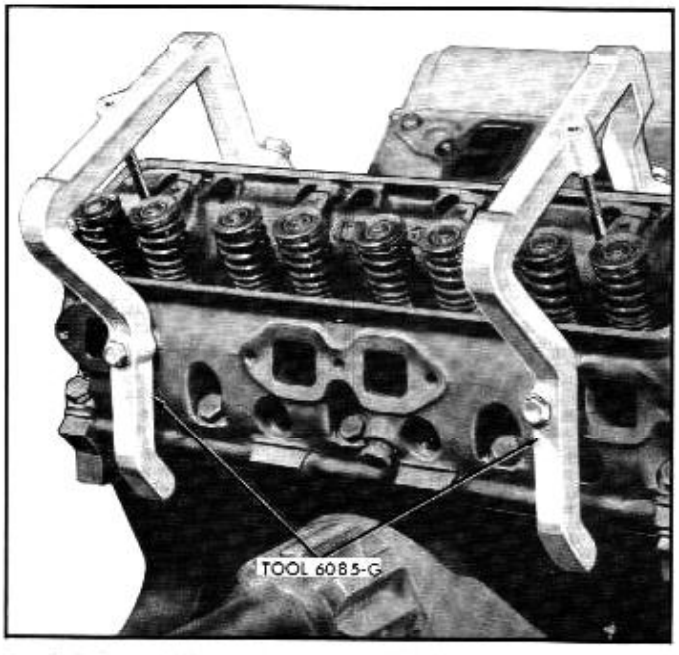


Fig. 6A-65—Holding Fixture Installed on Cylinder Head

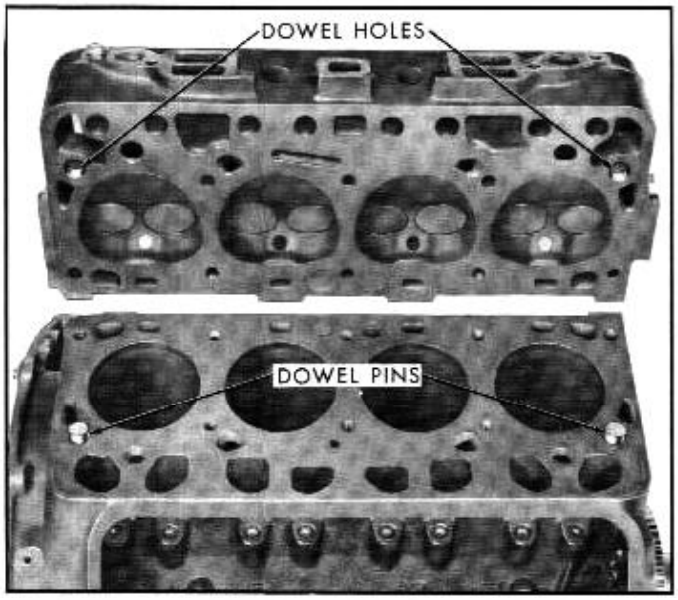


Fig. 6A-66—Cylinder Head Dowel Pin Location

NOTE: Cylinder Head Holding Fixture Tool 6085-G must be attached securely to cylinder heads. This is essential for the purpose of protecting the head gasket surfaces whenever the cylinder heads are removed.

f. Remove cylinder head retaining screws and lift head off two locating dowels. See figure 6A-66. Remove steel cylinder head gasket.
CAUTION: *Use extreme care when handling to prevent damage to gasket surfaces. Never pry between cylinder heads and block as they have a finished surface and must not be damaged.*

27. Index clutch plate to flywheel so that it can be reinstalled in its same relative position. Remove clutch pressure plate and clutch disc assembly. Clutch plate should be compressed prior to removing retaining screws otherwise it is possible to distort the assembly (except Merc-O-Matic).
CAUTION: *Do not permit clutch disc to drop. Do not let any oil or grease contact the clutch surfaces.*
28. Remove the flywheel assembly.
29. Remove oil pan and gasket.
30. Remove crankshaft damper Woodruff key.
31. Remove the cylinder block front cover and gasket. Remove crankshaft oil slinger.
NOTE: When removing front cover use care to prevent damage to crankshaft seal in cover.
32. Remove screw, lockwasher, and large flat washer retaining fuel pump eccentric and counterweight to camshaft and remove these parts.
33. Remove camshaft sprocket, crankshaft sprocket, and timing chain as one unit. See figure 6A-67.
34. Remove Woodruff key from camshaft.
35. Turn engine assembly to vertical position on engine stand with front end upward.

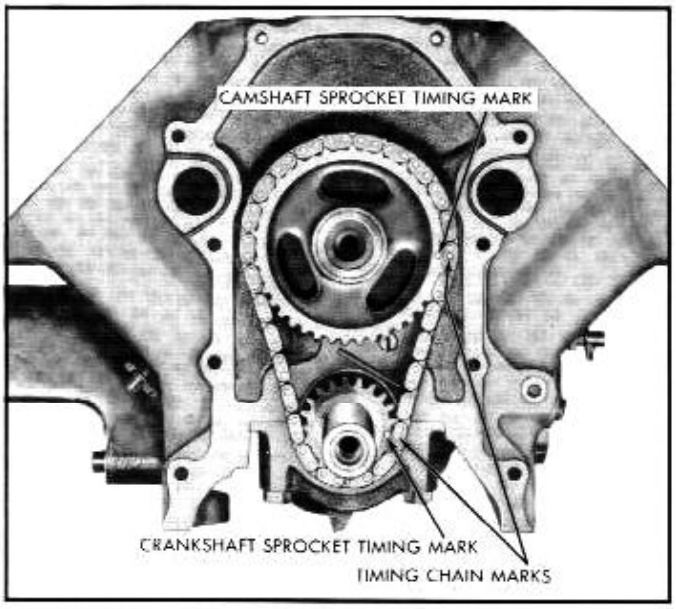


Fig. 6A-67—Removing Timing Chain and Sprocket

36. Remove the cylinder ridge with Tool 6011-A, as shown in figure 6A-68, or equivalent. Follow the instructions furnished by the manufacturer of the ridge cutter being used.
CAUTION: *Never cut into ring travel area in excess of 1/32 inch when removing ridge.*
37. Rotate crankshaft to position journals for removal of connecting rod assemblies. Remove connecting rod caps and push connecting rod and piston assembly from cylinder bore. Replace caps and bearing inserts on rods so numbered sides match. The assemblies are numbered so they can be reinstalled in their respective cylinders.
38. Turn engine assembly to an upside down horizontal position.

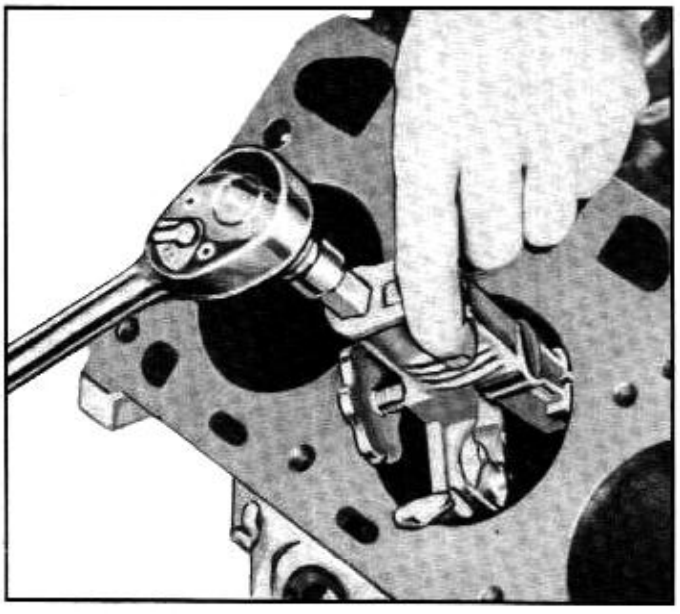


Fig. 6A-68—Removing Cylinder Ridge—Typical

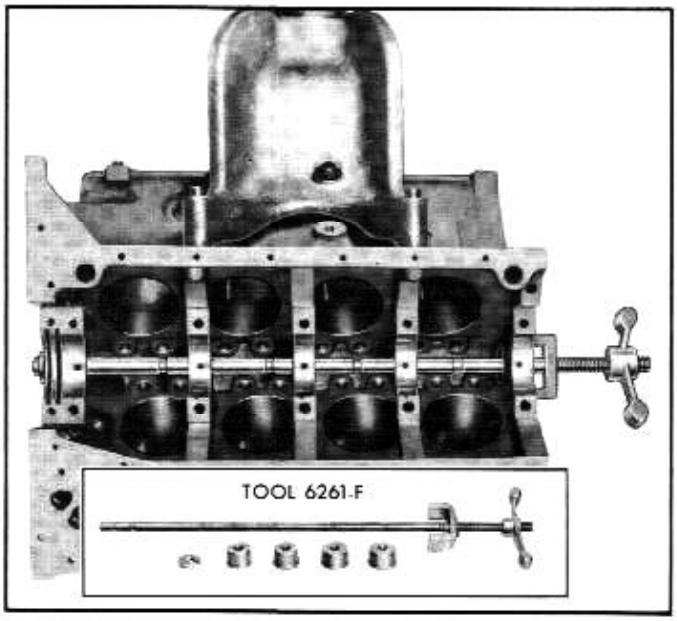


Fig. 6A-69—Removing Camshaft Bearings

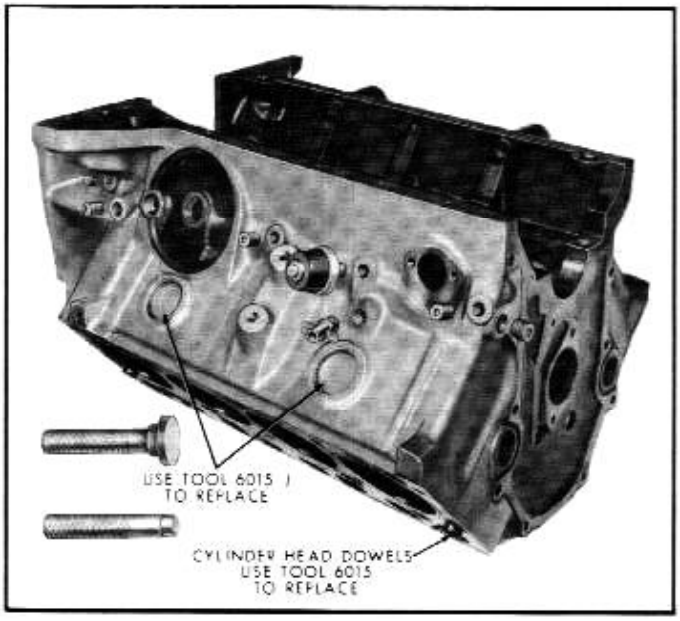


Fig. 6A-70—Tools for Cylinder Block Plugs and Fittings

39. Remove rear crankshaft oil seal retainer, and retainer to cylinder block seals.
40. Remove five main bearing caps. Keep all bearings and caps in their order of removal for reinstallation. Mark caps for identification of location before removal.
41. Lift the crankshaft from the cylinder block assembly, and then remove upper bearings. Keep all bearings in their order of removal.
42. Remove the camshaft thrust plate and spacer.
43. Turn the engine to a vertical position (front end up). Push all tappets in to allow clearance for removal of camshaft.
44. Remove camshaft from block assembly, being careful not to damage camshaft bearings.
45. Remove camshaft bearing plug from rear of cylinder block, only, if it is found necessary to replace camshaft bearings, or if plug leaks.
46. Remove all tappets from cylinder block assembly. NOTE: Keep tappets in order of removal so they may be reinstalled in their original bores.
47. Turn engine assembly to an upside down horizontal position.
48. Using Tool 6261-C and adaptor pilots, remove camshaft bearings. See figure 6A-69.
49. Remove two drain cocks from cylinder block assembly.

CLEANING, INSPECTION AND RECONDITIONING OF ENGINE ASSEMBLY

Cylinder Block

One of the most important phases of engine reconditioning is the thorough cleaning and inspection of the cylinder block.

Each machined surface of the cylinder block should be cleaned of all old gasket material. The pipe plugs which seal the oil passages should be removed and all passages thoroughly cleaned. The location of the various plugs and fittings used in the cylinder block are presented in figures 6A-70 and 6A-71.

If it becomes necessary to remove an expansion type plug due to water or oil leaks, drill 1/2″ hole in the center of plug and remove by using Clutch Pilot Bearing Removing Tool 7600-E. The tools used to drive in new plugs are listed in figures 6A-70 and 6A-71 at their respective plug locations. Install the plugs with the flange side facing out and drive the plugs with the flange flush or slightly below the casting surface.

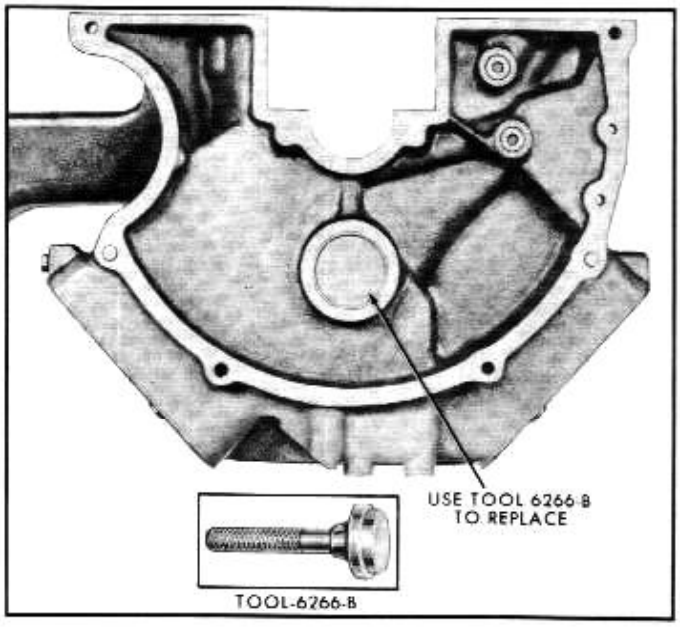


Fig. 6A-71—Tool for Installation of Camshaft Bearing Plug

NOTE: Coat edges of plugs with suitable sealing compound prior to installation.

Inspection of the cylinder block should be done carefully to detect any scoring of the cylinder bores, cracks or water leaks. Minute cracks may be found by coating suspected areas with a mixture of 75% light motor oil and 25% kerosene. After wiping area dry, immediately apply a coating of zinc oxide dissolved in wood alcohol. If any cracks are present, the white coating of the zinc oxide-wood alcohol mixture will discolor at the defective area.

Each cylinder bore should be checked for taper and out-of-round conditions. Use an accurate gauge following the manufacturer's directions. Measure the diameter of the cylinder bore at the top of the piston ring travel at right angles to the centerline of the crankshaft (A). See figure 6A-72. Record readings. Next, measure each bore so gauge reading coincides with centerline of crankshaft (B). The difference between the readings is the out-of-round condition at the top of the cylinder bore. Repeat this same procedure at the bottom of the ring travel to check for out-of-round. The difference between the diameters measured at the top (A) and bottom (B) of the bore (at right angles to the centerline of the crankshaft) is the taper of the bore. See figure 6A-73.

If the cylinder bore wear does not exceed the limits of .0005" out-of-round (wear limit .005 inch) and .001" taper (wear limit .008 inch), new service piston rings will give satisfactory performance provided the piston clearance is not excessive.

However, if the wear exceeds the limits it will be necessary to rebore the cylinder or cylinders to within

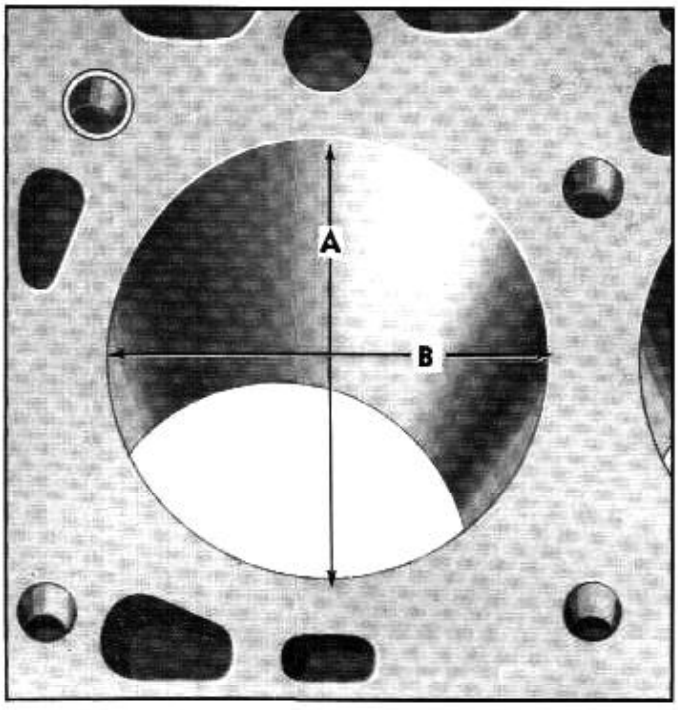


Fig. 6A-72—Measurement of Cylinder Out-of-Round

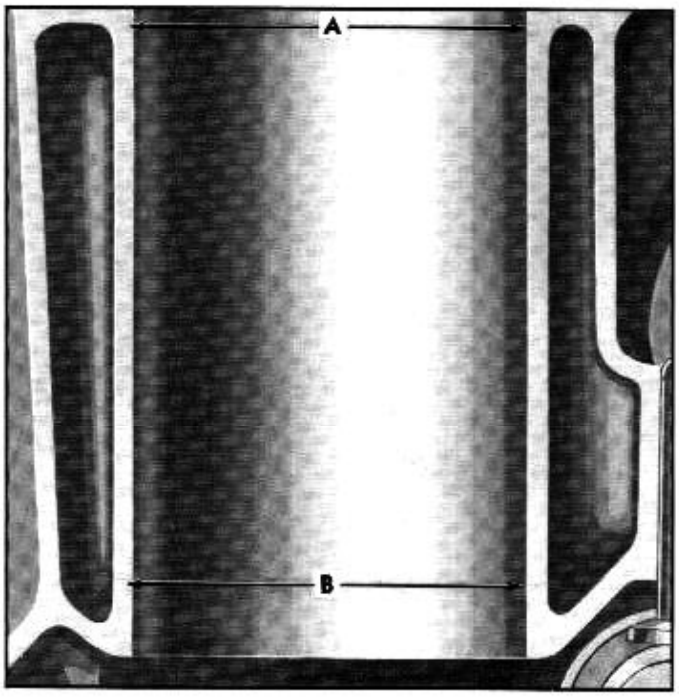


Fig. 6A-73—Measurement of Cylinder Taper

.0015" of the required oversize diameter. This will allow enough stock for the final step of honing the bores so the exact clearance and surface finish may be obtained for the selected oversize pistons.

NOTE: After the honing operation is completed, cylinder bores and block should be thoroughly cleaned.

Each piston thus fitted should immediately be marked with the respective cylinder number it was fitted to. It is recommended that the clearance between the fitted piston and the cylinder wall be held to the mean limit.

Piston fit should be checked by positioning a length of 1/2" wide feeler stock, of the recommended thickness for the existing condition, between the inverted piston and the cylinder wall. The feeler should extend the entire length of the piston at 90° from the piston pin holes. Hold the piston in the cylinder bore so the end is about 1½" below the top of the block and the piston pin bore is parallel to the crankshaft. Then, pull feeler stock from cylinder while noting reading on Piston Pull Scale, Tool FLM-6110-A, as shown in figure 6A-74.

If reading on scale conforms to limits presented in the following chart for the existing condition, the piston clearance is satisfactory.

Fit New Piston in New Bore		Fit New Piston in Used Bore		Fit Used Piston in Used or New Bore	
Feeler Thickness (Inches)	Pull (lbs.)	Feeler Thickness (Inches)	Pull (lbs.)	Feeler Thickness (Inches)	Pull (lbs.)
.002	5-10	.0025	5-10	.003	5-10

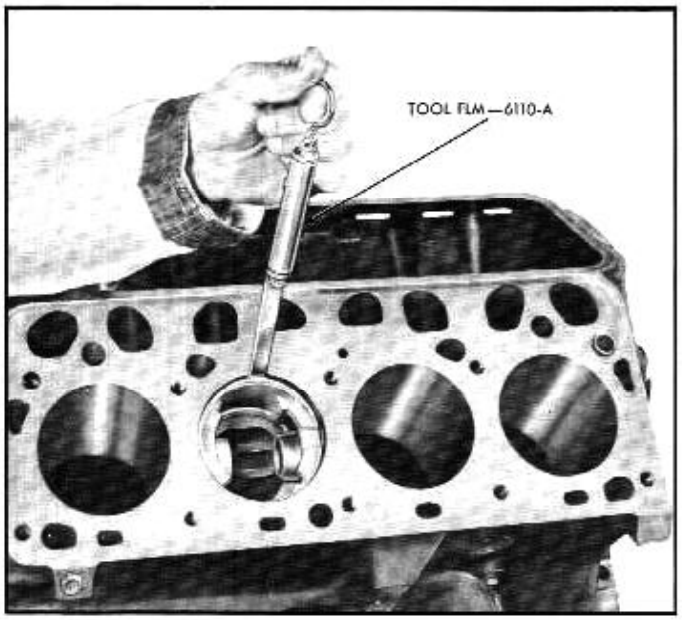


Fig. 6A-74—Checking Piston Clearance

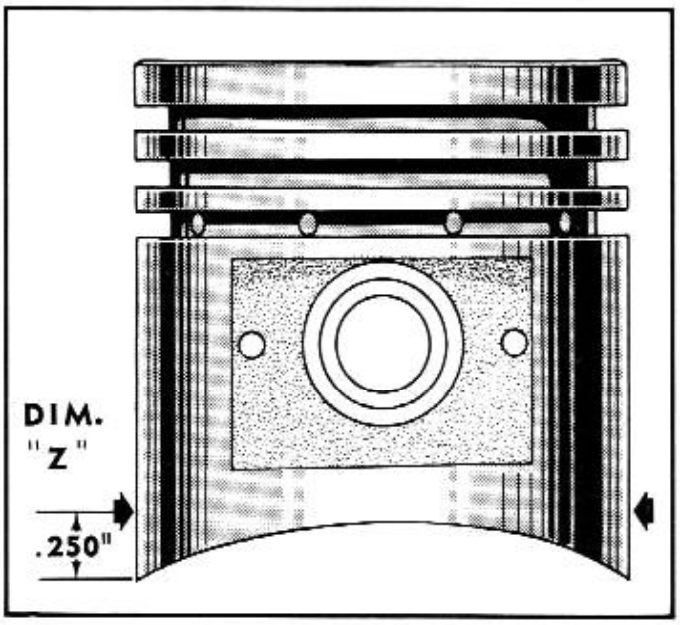


Fig. 6A-75—Measuring Piston Diameter

If reading on scale is greater than maximum pull limit, check piston for any damage that may affect the pull reading. If no damage is evident then try another piston. Recheck fit of new piston.

Prior to installing a piston with new rings in a used cylinder bore, it is necessary to remove the high glaze from the wall to aid seating of the rings.

Pistons and Piston Pins

From the inspection and measurements of the cylinder bores, it has been determined that the pistons to be installed are either new pistons or that the original pistons are to be reused with new piston rings.

If the original pistons are to be used with new rings, the pistons must be thoroughly cleaned of all carbon. Tool LM-6110-A is provided for cleaning the piston ring grooves. Soaking the pistons in cleaning solvent will loosen the carbon for removal. NEVER USE A WIRE BRUSH ON A PISTON, this will round off the ring lands. Clean oil holes or slots being careful not to remove any metal.

Inspect the pistons for scuffed or scored skirts, worn or cracked ring lands, discarding any showing such conditions. When the condition is in doubt, replace the piston.

There are actually two different sizes of pistons which can be fitted to a STANDARD size cylinder bore. By this, we mean that a standard size cylinder bore has a production tolerance between the limits of 3.8000" to 3.8024", as determined by the point at which the proper cylinder bore finish is reached. Pistons used for service in a standard size cylinder bore are marked No. 2 and No. 6 and are assigned different part numbers for service. The numbers correspond to the following sizes (See figure 6A-75):

Piston Number on Dome	Dimension "Z" (See figure 6A-75)
2	3.7987" to 3.7990"
6	3.7999" to 3.8002"

From the above it can be seen that a standard size cylinder bore may measure up to a diameter of 3.8024". However, it is still considered standard and it is not necessary to use oversize piston. If one of the standard size pistons will not fit with the proper clearance (ribbon pull) then it will be necessary to rebore the cylinder as required and use an oversize piston.

Use Tool 6135-B or equivalent to ream the pistons if oversize piston pins are to be used. Use Tool 6135-C to remove old pin from piston and connecting rod. The specified clearance between piston and pin, and piston pin and connecting rod bushing is .0001"-.0003" (wear limit—loose—.0008"). The piston pin should be a light thumb press fit and should be installed in the piston and rod when the piston is at a normal room temperature (70° F.). Two retainers are used to hold the pin in place (one at each end of pin.)

When installing the retainer rings make sure they are properly seated in grooves provided in piston pin boss. Always use new pin retainer after removal from piston.

Connecting Rods

Each connecting rod should be thoroughly cleaned and visually inspected for defects. If condition is satisfactory, the rod should be assembled to the piston

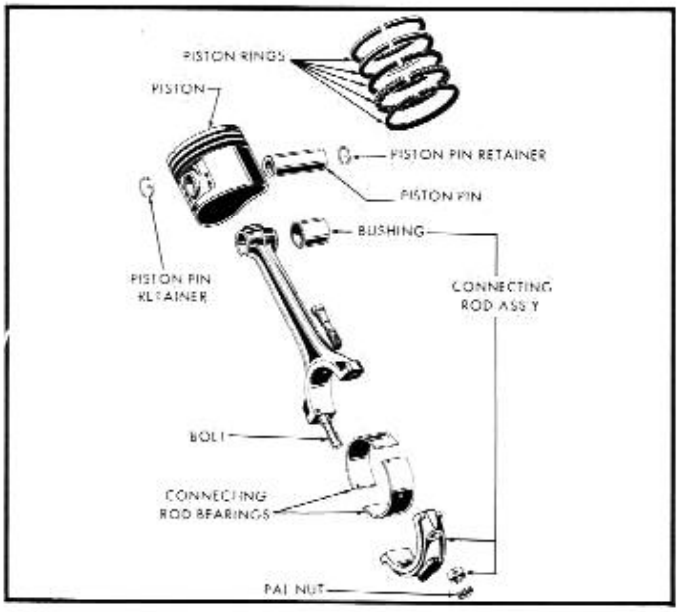


Fig. 6A-76—Piston and Connecting Rod Assembly

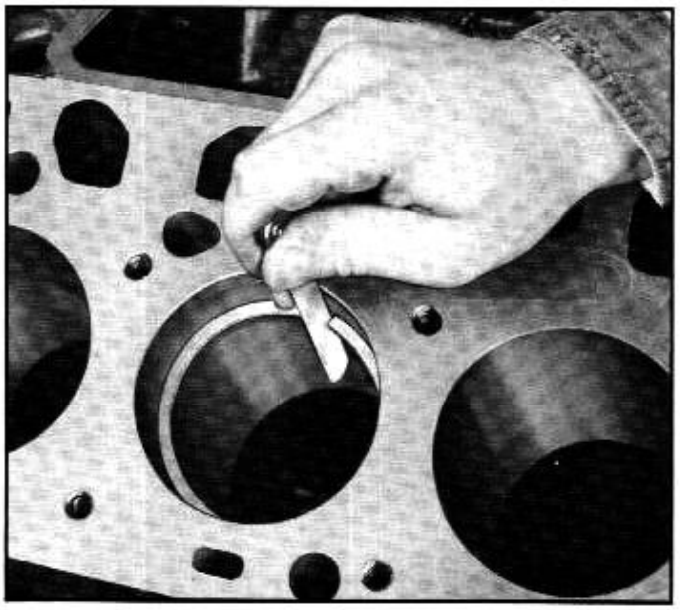


Fig. 6A-77—Checking Piston Ring Gap

for installation in the cylinder from which it was removed. See figure 6A-76.

The connecting rod bushings should be checked for proper clearance with piston pins. Piston pin to connecting rod bushing clearance specification is .0001"-.0003" (wear limit—loose—.0008"). The pin should be able to move through the bushing with a light thumb pressure. If loose, oversize piston pins of .001" and .002" are available.

Assemble rod to piston so the indentation embossed on piston head will face the front of the engine, while the numbered side of the rods on the right bank will face the right side of engine, and the rods for the left bank will face the left side of the engine, when viewed from the rear.

After rods are assembled to the pistons, the complete assembly should be checked with suitable aligning equipment. Since many makes are in use, it is recommended that the manufacturer's instructions be followed to assure that the rod is not bent or twisted. Bending the connecting rod to obtain correct alignment is permissible.

The correct alignment specification is as follows:

Twist Total Difference—Maximum* . . . . 0.012"
Bend Total Difference—Maximum* . . . . 0.004"
*Finished piston pin bushing and crankshaft bearing bore must be parallel and in same vertical plane within the specified total difference at ends of eight (8) inch long bar measured four (4) inches of each side of rod.

An oil squirt hole is provided in each connecting rod to direct a stream of oil on the cylinder wall as the piston approaches top center. The oil is supplied through a hole drilled in the crankpin end of the rod which intermittently lines up with the hole in the crankpin. Thus, it may be seen that the squirt of oil is of short duration and occurs only once at each cylinder for each revolution of the crankshaft at low engine speeds only. Make sure these oil squirt holes are open. Also, make sure the rod bearings are provided with a hole that is clear of obstructions to allow the oil from the crankpin to flow through the bearing to the squirt hole.

Piston Rings

Each piston has three piston rings located above the piston pin. See figure 6A-76. The compression rings are located in the two top grooves while the lower groove accommodates the expander type oil control ring. Select the proper rings for the size of the pistons to be used.

Prior to installing the rings on the piston, each ring must be checked for the proper ring gap. Push the ring down into the cylinder bore about two inches using the head of a piston so that the ring is square with the cylinder wall. Extreme caution should be used during this operation. Check the space or gap between the ends of the ring with a feeler gauge. See figure 6A-77. The gap should be within the limits of 0.012" to 0.022" for both compression rings and 0.015" to 0.062" for the oil control ring.

If gap is less than limit, try another ring for fit. Each ring should be fitted and checked in the cylinder in which it is going to be used, and marked accordingly.

Piston rings should also be checked for side clearance in the groove of the piston on which they are to be installed. This is done by placing the outer edge

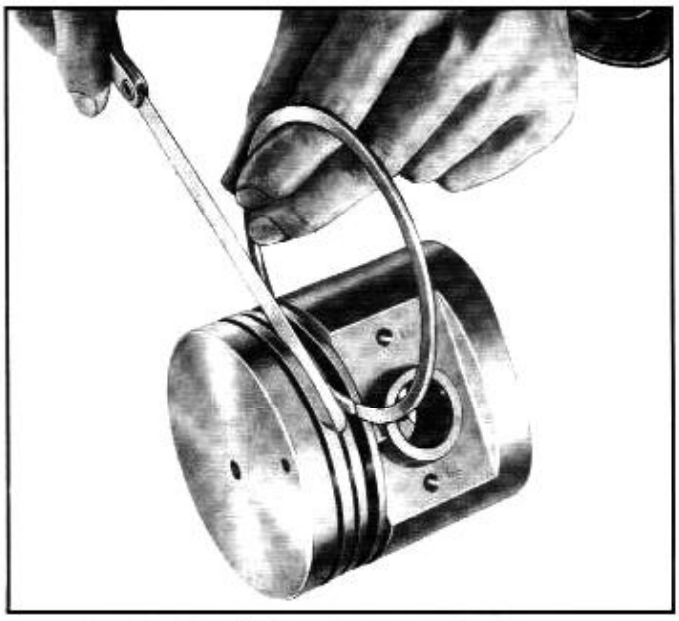


Fig. 6A-78—Checking Piston Side Clearance

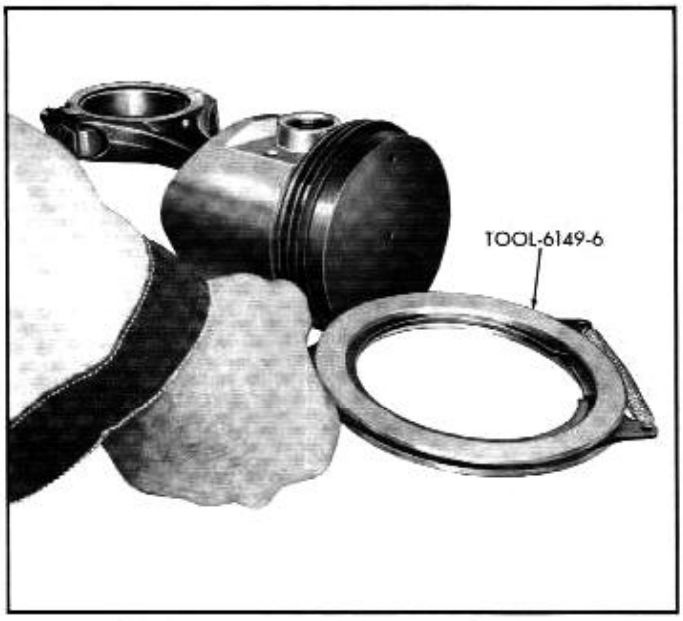


Fig. 6A-79—Piston Ring Expander Tool

of the ring in the piston groove and rolling the ring entirely around the piston to make sure that there is no binding and the ring is free in the groove. With a thickness gauge, check the side clearance of each ring in its respective groove. See figure 6A-78. The side clearance for the upper compression ring is 0.0020″ to 0.0035″. The side clearance for the lower compression ring is 0.001″ to 0.003″. The wear limit for both upper and lower rings is 0.006″.

Assemble rings on pistons to which they were fitted by using Piston Ring Expander Tool 6149-6. This type of tool is recommended to avoid over-expanding and to expand the ring to a true circle to avoid distortion. See figure 6A-79. Space ring gaps 120° apart and coat with engine oil prior to installing. When spacing oil ring on piston, the ring gap should be positioned so that it will be on the inside of the "V" (high side of cylinder bore) when piston is installed in cylinder bore.

Cylinder Head

The cylinder head as removed from the engine contains the valves and holding fixture Tool 6085-G as shown in figure 6A-80. The rocker arm assembly was removed prior to installation of holding fixtures so the fixture would never have to be removed while the heads are off the engine, thus, the machined surfaces of the cylinder heads are protected at all times as all work operations can be performed with the fixtures installed.

With the valves installed to protect the valve seats, clean carbon deposits from combustion chambers and valve heads with a wire brush and scraper. Wash heads in cleaning solvent to remove dirt and grease from surfaces and dry thoroughly.

DISASSEMBLE VALVES AS FOLLOWS:

1. Turn cylinder head, with Tool 6085-G attached, so it rests on side and compress valve spring with Tool 6513-EE. See figure 6A-81.
2. Tap retainer gently with soft hammer, then remove valve keys.
3. Remove valve compressor Tool 6513-EE, then remove valve spring retainer, inner sleeve, valve spring, valve stem seal, and valve. See figure 6A-82.
4. Repeat steps "1 to 3" for remaining valves.
   NOTE: Keep valves and their related parts together so they may be reinstalled in their respective positions.

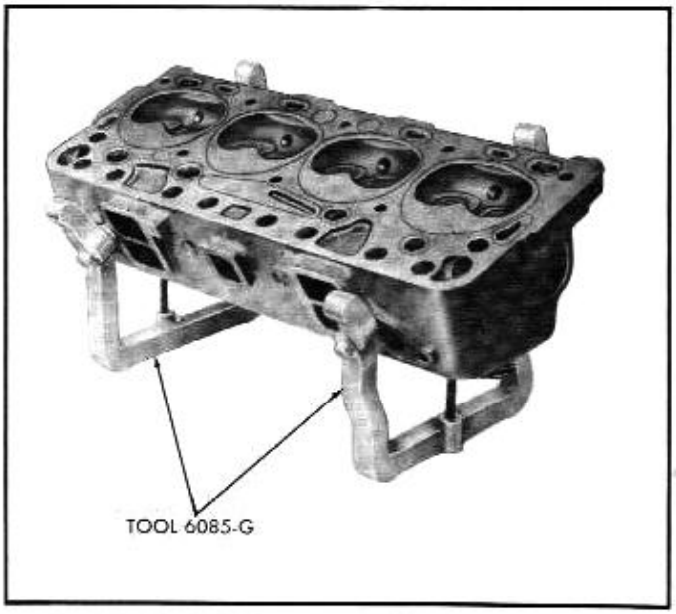


Fig. 6A-80—Cylinder Head with Fixture Installed

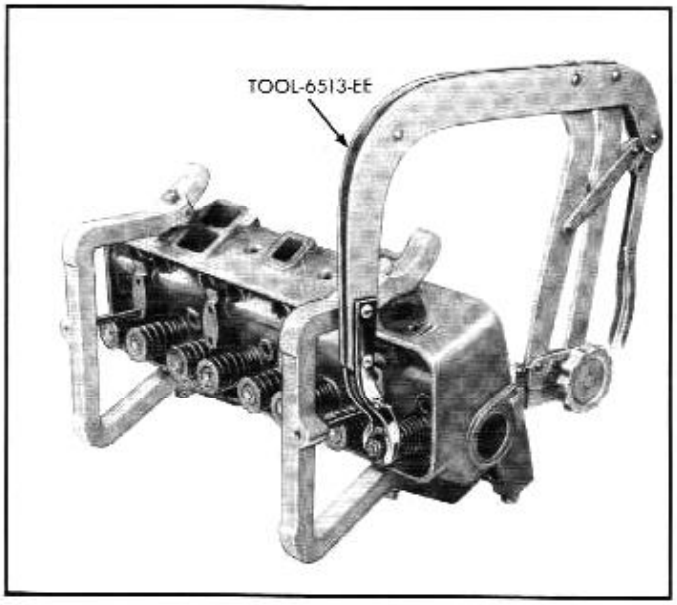


Fig. 6A-81—Compressing Valve Spring

Clean valve guide bores using a valve guide cleaning tool. Check all water passages to make sure they are open.

Examine the cylinder heads for water leaks or cracks in the combustion chambers, exhaust ports, or around the valve seats. Inspect the gasket surfaces for scratches or mars of any type. This is very important as any damage to this surface may cause a leak when installed with the thin steel gasket.

NOTE: The chances of scratching or marring the gasket surfaces of the head are greatly reduced when holding fixture tools are used.

The cylinder head assemblies are completely interchangeable from one cylinder bank to another providing the water outlet coincides with the water opening in the front section of the intake manifold. If the vehicle is not equipped with a power surge fan, it may be necessary to remove the water outlet plug on one section of the cylinder head and install a new plug. Coat edges with a light coat of water resistant sealer and use Tool 6052 as shown in figure 6A-83. (This applies to the right cylinder head only.)

The left cylinder head has an adaptor for the coolant temperature sending unit. The right cylinder head has and adaptor for the power surge fan sending unit (if the vehicle is so equipped). Coat adaptors with a light film of water resistant sealer and tap in place with a mallet until seated.

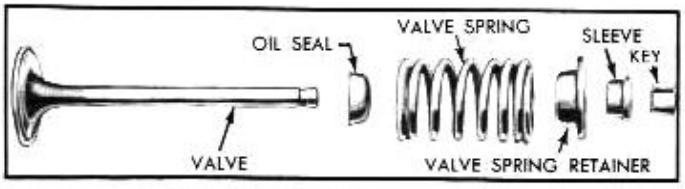


Fig. 6A-82—Valve Assembly

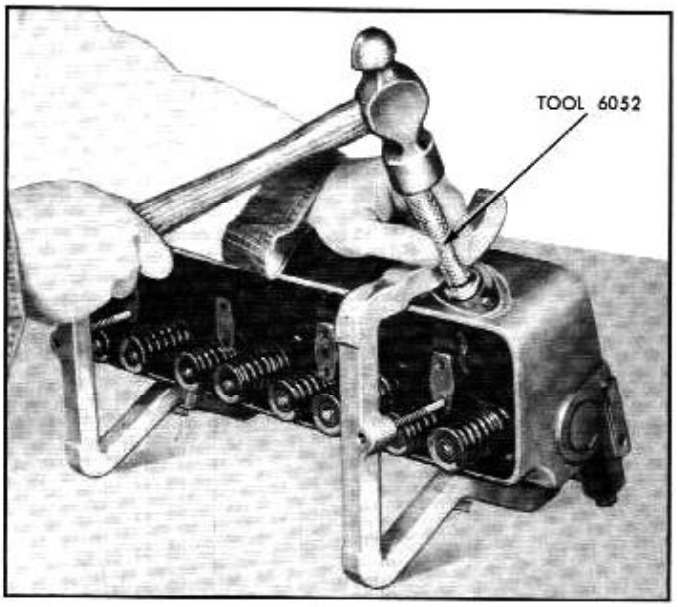


Fig. 6A-83—Installing Cylinder Head Water Plug

NOTE: Install adaptor with undercut toward the inside of the cylinder head.

The removal of the water temperature sending unit adaptor plug can be accomplished by using Tool 6387-AA and 6387-F. See figure 6A-84.

The steel cylinder head gaskets are also interchangeable and should be installed so the word "FRONT" is at the forward edge of the block. Whenever a cylinder head is removed, clean the surface thoroughly.

Valve, Valve Seats and Valve Springs

Remove all carbon from valve stems and heads using a fine wire brush or buffing wheel. Inspect each valve discarding any that show evidence of burned,

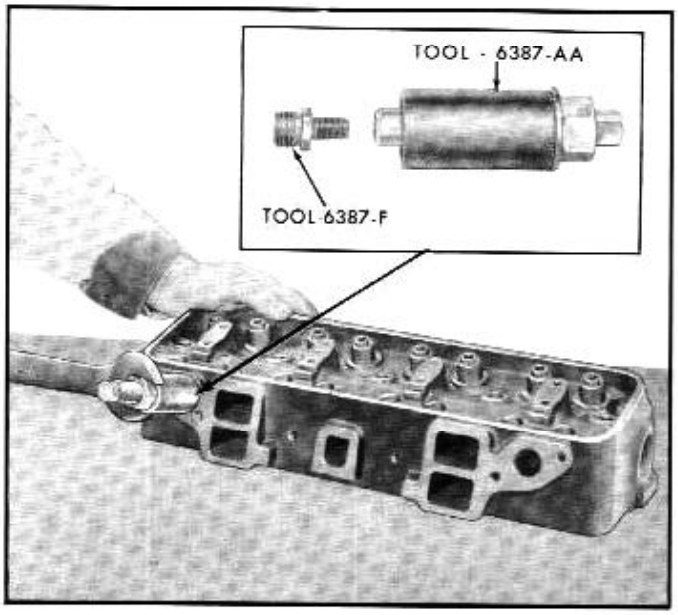


Fig. 6A-84—Removing Temperature Gauge Sending Unit Adaptor

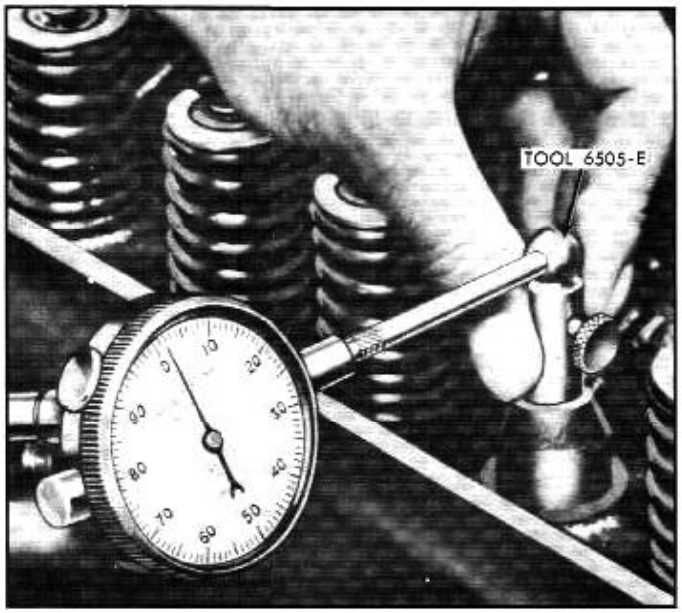


Fig. 6A-85—Checking Valve Stem Clearance

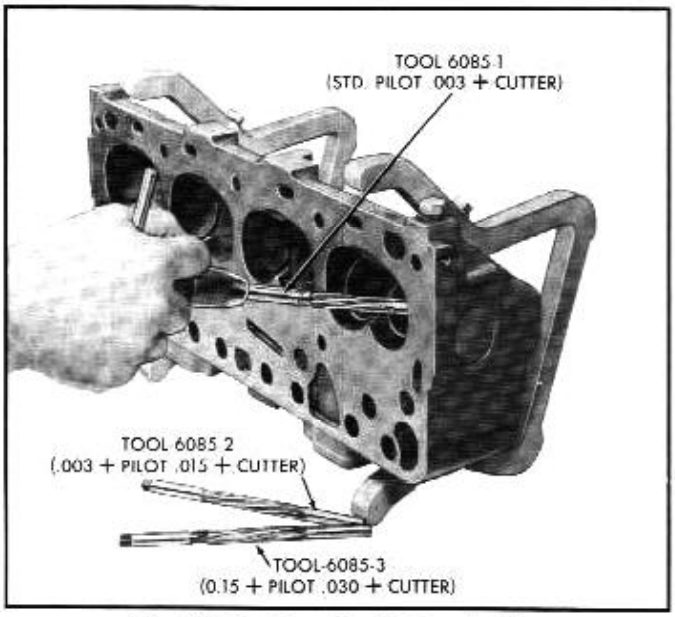


Fig. 6A-86—Reaming Valve Guides

warped, bent or cracked condition.

Check valve stem clearance of each valve in its respective valve guide using Tool 6505-E. See figure 6A-85. To properly use tool, install it on valve stem until fully seated and tighten knurled set screw firmly, then permit valve to drop away from its seat until tool contacts the upper surface of the valve guide.

Position dial indicator with flat tip against the center portion of tool spherical section at approximately 90° to the valve stem. In order to ascertain actual valve stem clearance, tool should be moved back and forth on an axis at a right angle to the rocker shaft. Take a reading on dial indicator without removing the tool from valve guide upper surface, then divide reading by two, the division factor of the tool.

If the clearance exceeds the service wear limits of .004″ on the intake valve or .006″ on the exhaust valve, it is recommended to ream the valve guides with Tool Kit 6085 to the next oversize diameter as shown in figure 6A-86. Tool Kit 6085 is made up of three reamer (cutter) pilot combinations which are as follows:

1. Tool 6085-1 — Std. Diameter Pilot plus .003″ O.S. Reamer.
2. Tool 6085-2 — .003″ O.S. Pilot plus .015″ O.S. Reamer.
3. Tool 6085-3 — .015″ O.S. Pilot plus .030″ O.S. Reamer.

IMPORTANT: Always use the reamers in sequence when reaming from standard to O.S. (oversize) diameter to accommodate oversize valve stems. Valves having oversize stems are available for service. The valve seats must be reground whenever the valve guides are reamed.

Refacing the valves and valve seats must be done with precision equipment to insure a good compression tight fit between parts. The grinding wheels of the refacers should be carefully dressed to the proper angles. The valve face should be ground at a 45° angle (both intake and exhaust) with a minimum thickness of 1/32″ on the outer edge of valve head. If thickness is less than 1/32″, replace valve. See figure 6A-87. Valve face run-out must not exceed .002″ wear limit. The end of the valve stem may be ground if grooved. Do not remove more than .010″ stock.

The valve seats in the cylinder head should also be ground to a true 45° angle maintaining a seat width of between .060″-.080″ intake valve, and .070″-.090″ exhaust valve. Only remove enough stock to clean up pits or grooves. If seat is wider than specified it will be necessary to grind either the bottom of valve seat with a 30° angle grinder or the top of the seat with a 60° angle grinder until proper seat width is obtained and the seat contact with the valve is centrally located. See figure 6A-88.

It is important to have the finished seat face contact the approximate center of the valve face. This can be checked by placing prussian blue on the valve seat and installing the valve. If contact is indicated near the top edge of the valve face, lower the seat by using

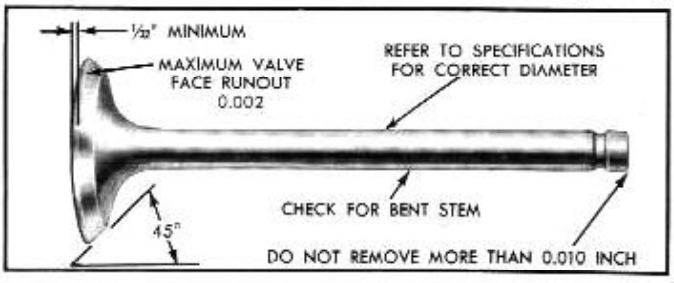


Fig. 6A-87—Valve Tolerances

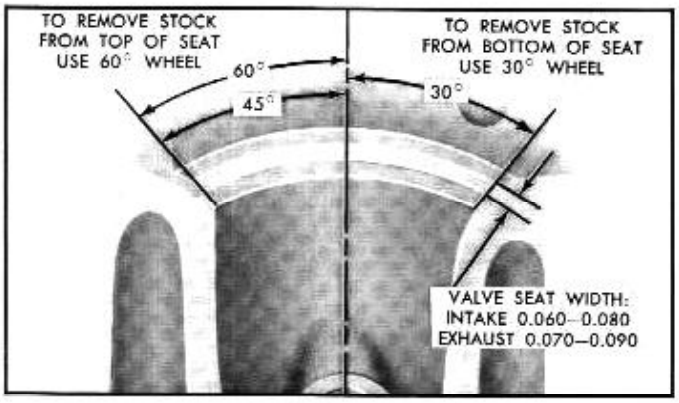


Fig. 6A-88—Valve Seat Refacing

the 60° angle grinder. If the contact is lower than the center of the valve face, raise the seat by using the 30° angle grinder. Make sure all metal particles are thoroughly cleaned from the cylinder head. A light lapping operation is recommended after refacing valves and seats using a fine grit lapping compound.

Check the valve seat run-out with an accurate gauge. Run-out should not exceed .002" total indicator reading (wear limit .0025"). See figure 6A-89.

Examine the valve springs discarding any that show signs of rust or pit marks. Check springs for squareness with a square and surface plate (a piece of plate glass may also be used). See figure 6A-90. Discard any springs that are out of square more than 1/16". Check pressure of each spring with Tool LM-106 as shown in figure 6A-91. The spring should exert a minimum pressure of 64 lbs. when compressed to a height of 1.780 inches or 145 lbs. when compressed to a height of 1.390 inches. If Tool LM-106 is used, set knob on calibrated screw to compressed length of valve spring and pull torque wrench until click is

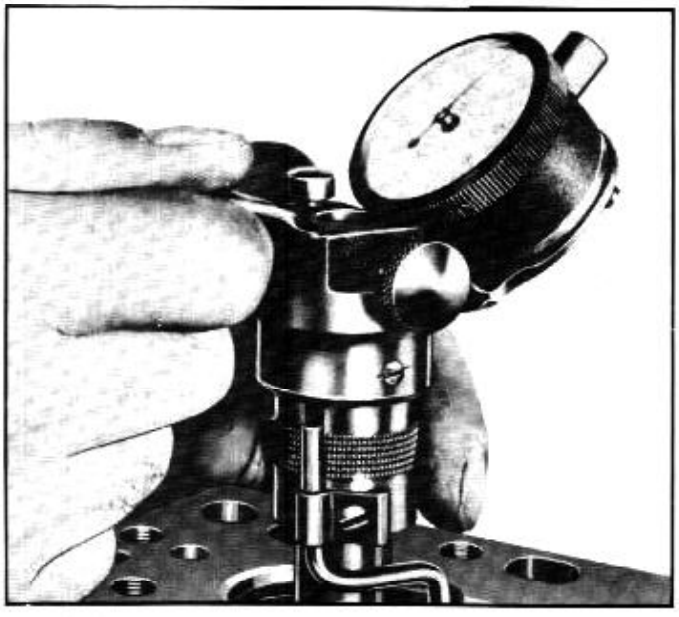


Fig. 6A-89—Checking Valve Seat Run-out—Typical

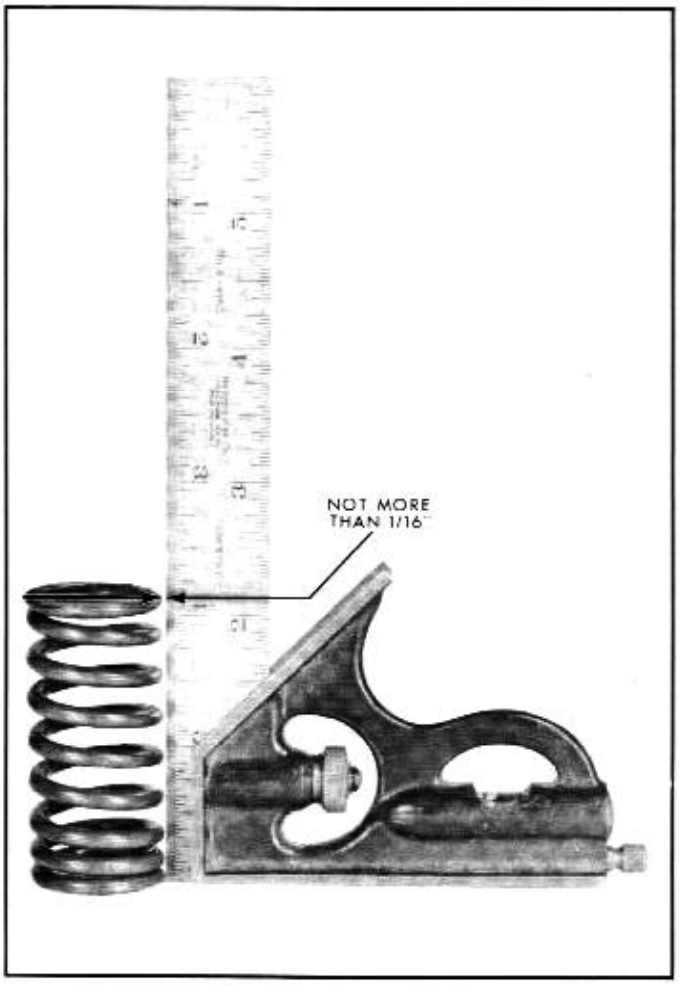


Fig. 6A-90—Checking Spring for Squareness

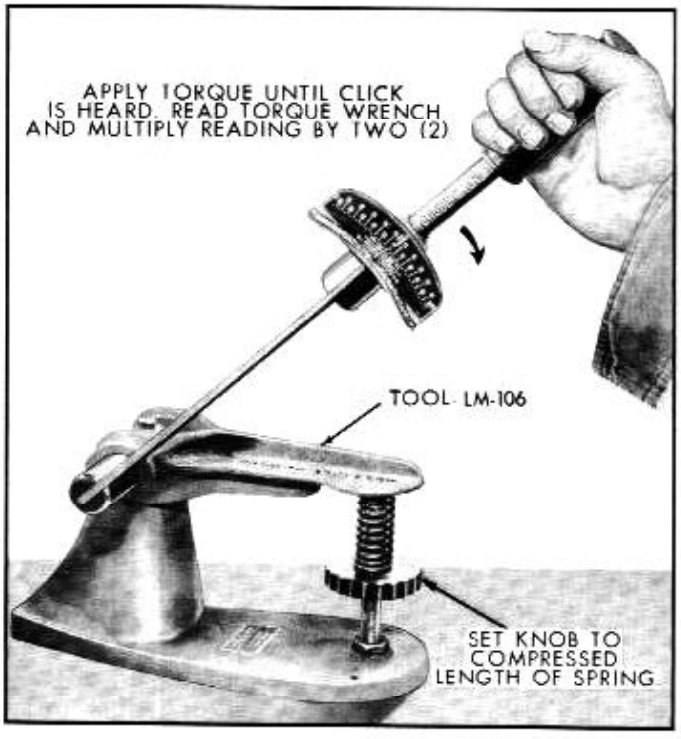


Fig. 6A-91—Testing Valve Spring Tension

heard. Multiplying reading on torque wrench by two, gives pressure exerted by spring. If spring is not within specified limits, it is recommended that spring be replaced.

Rocker Arm Assemblies and Push Rods

Since the rocker arm assemblies are removed from the engine as a unit, the disassembly and assembly procedures are presented herein. Figure 6A-92 shows a disassembled view of the complete assembly.

1. Remove cotter keys, flat and wave washers from ends of shaft.
2. Remove rocker arms, springs and supports from shaft. Keep parts in order so that they may be replaced in original position if in satisfactory condition.
3. Remove plugs from end of shaft as follows:
   a. Drill a hole in plug at one end of shaft.
   b. Insert metal rod through hole and knock out plug at other end of shaft.
   c. Knock out remaining plug from other end of shaft.
4. To assemble, reverse disassembly procedure.

   NOTE: Make sure rocker arms are correctly positioned to actuate valves. The oil overflow pipe hole in shaft should be seen through the center hole of front support on right bank and rear support on left bank. If hole cannot be seen, turn shaft until holes line up. When rocker arm assemblies are completely disassembled, clean all parts thoroughly making sure all oil passages are open.

Inspect shaft for signs of wear. Check rocker arm to shaft clearance. Replace any parts showing excessive wear. If rocker arm pad radius is grooved excessively at valve end, replace rocker arm. Do not attempt to true this surface by grinding. A slight dressing of the rocker arm pad is permissible to clear up minor imperfections, however, contour of rocker arm pad must be maintained.

Check each push rod for bent or damaged condition. DO NOT ATTEMPT STRAIGHTENING PUSH ROD. Replace with new parts if bent more than .020" total indicator reading.

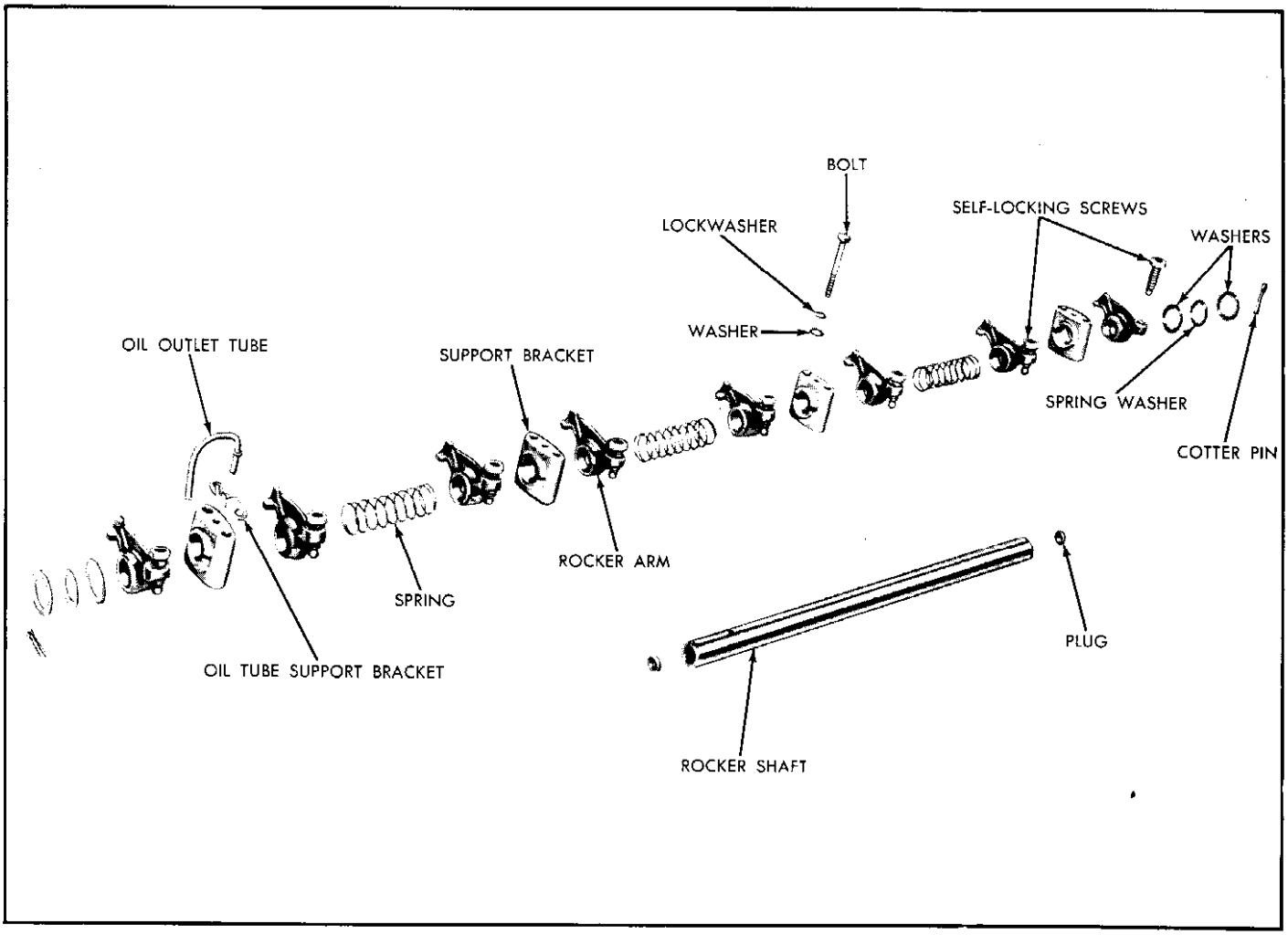


Fig. 6A-92—Rocker Arm Mechanism

Crankshaft

Wash the crankshaft with suitable cleaning solvent to thoroughly clean all journals and oil passages.

Inspect the crankshaft for cracks, scored or grooved journal surfaces. Light scratches may be removed by using a smooth oilstone, otherwise the journal should be reground.

The run-out of the crankshaft should be checked with suitable equipment. Since many makes are in use it is recommended that the manufacturer's instructions be followed to assure that crankshaft is not bent or twisted. If main bearing journal run-out exceeds the maximum wear limit specification of .003" the crankshaft should be replaced.

Measure diameter of each main and connecting rod journal in at least four places to determine out-of-round, taper, or undersize condition. See figure 6A-93. The main bearing journal diameter specification is 2.6235"-2.6243"; out-of-round specification .0025" (wear limit .0005"); taper specification .0005" (wear limit .001"). The connecting rod journal diameter specification is 2.1880"-2.1888"; out-of-round specification .00025" (wear limit .0005"); taper specification .0005" (wear limit .001"). If the journals approach the taper or out-of-round wear limits, they should be reground for the next undersize bearing. If the journal diameter is less than specified, the journals must be reground for the next undersize bearing.

Camshaft

After cleaning the camshaft, inspect all journal and cam lobes for scores, roughness or wear.

Each journal should be measured, and reground or camshaft replaced if out-of-round exceeds .001" or

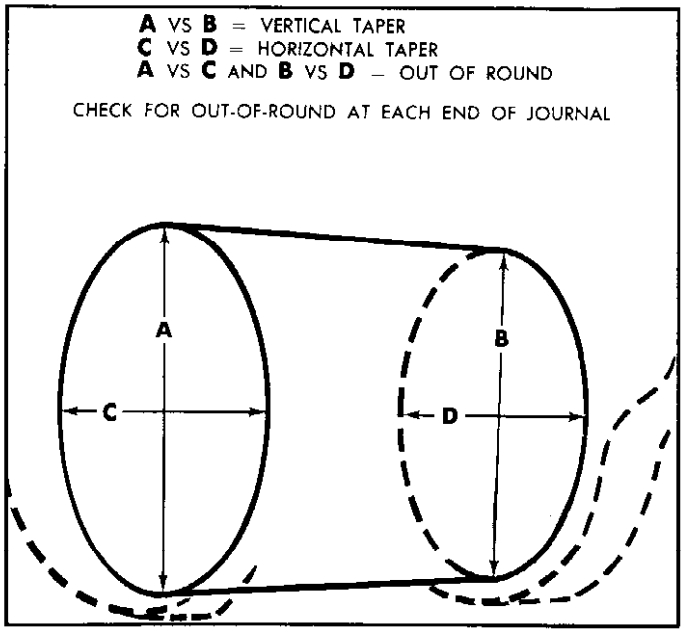


Fig. 6A-93—Crankshaft Journal Measurement

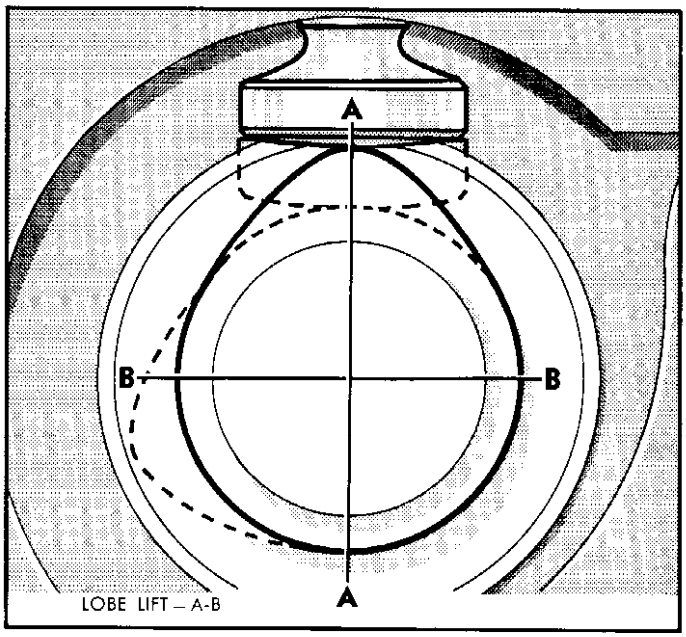


Fig. 6A-94—Measuring Camshaft Lobe Lift

if bearing clearance wear limit exceeds .006". Standard and oversize bearings are available for service.

The run-out should be checked following procedures used to check the crankshaft run-out. If run-out exceeds .005" total indicator reading the camshaft should be replaced.

Lobe wear characteristics may result in pitting in the general area of the nose portion of the lobe. This pitting is not detrimental to the operation of the cam, therefore, the camshaft should not be replaced solely because this condition exists.

If camshaft lobes indicate possible wear, check lobe lift by measuring over the top of the lobe with a micrometer and subtracting the measurement of the base circle diameter. See figure 6A-94. Minimum camshaft lobe lift wear limit on intake lobes is .267". The exhaust lobe wear limit is .280". Replace camshaft if lobes are below or approach minimum specifications.

If camshaft replacement is warranted replace the tappets that have been operating on cam lobes worn to a degree exceeding wear specifications. Inspect the remaining tappets. Any tappets showing evidence of pitting, scoring, galling or evidence of non-rotation and/or irregular rotation, must be replaced.

Check the camshaft gear for broken or chipped teeth. Replace camshaft if teeth are damaged.

NOTE: If the mating teeth on the distributor driven gear are damaged, this gear will have to be replaced. Refer to "Engine Electrical" section of this manual for proper replacement procedures.

Bearings (Mains and Rods)

The bearing inserts used throughout this engine are selective fit and require no line reaming on installation.

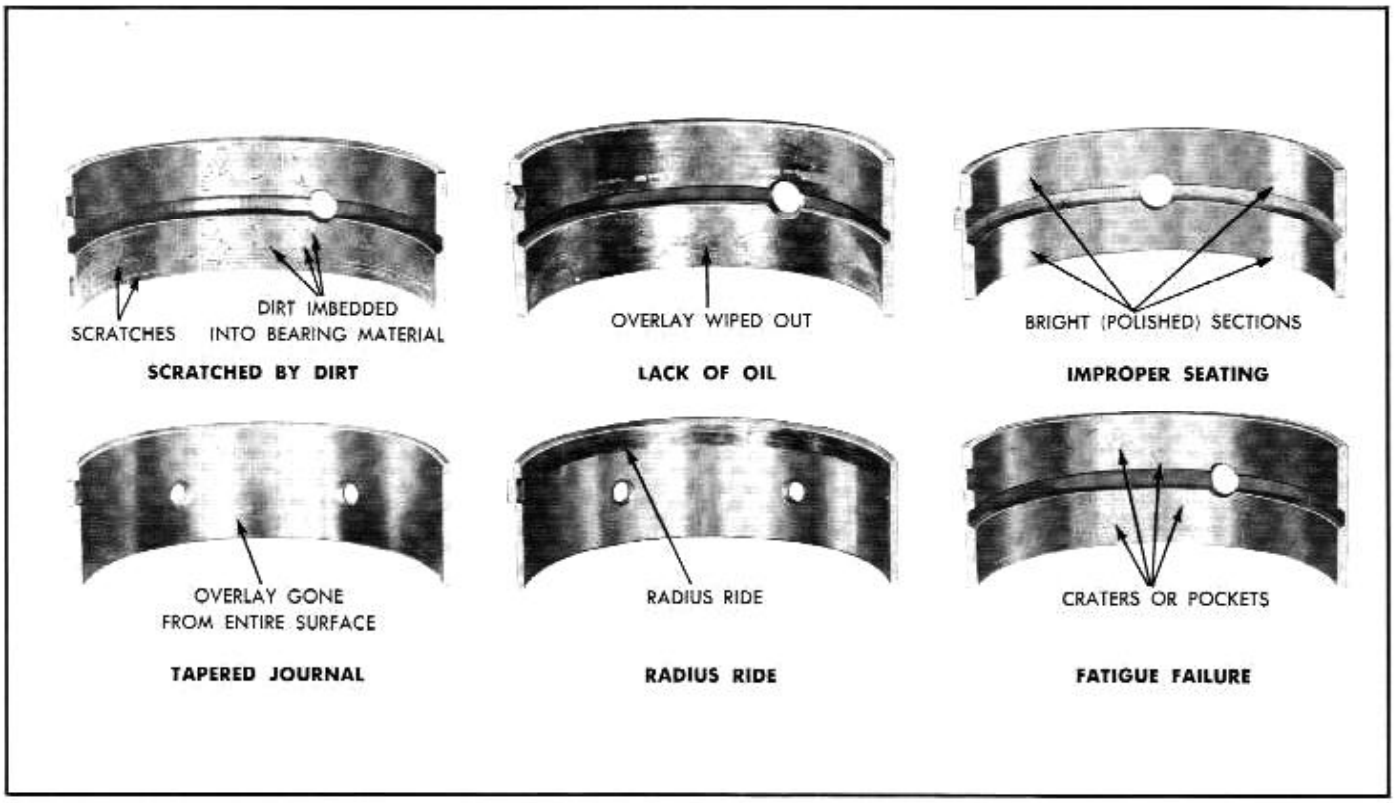


Fig. 6A-95—Bearing Failures—Typical

The bearings are available for service in standard and undersizes for use on journals that have been reground.

If inspection reveals badly worn or scored bearings, replace bearing during reassembly of engine. See figure 6A-95. The installation of new bearings must be closely checked to maintain the proper clearance between the journal and bearing surface. A convenient and accurate method for checking this bearing clearance is with the use of Plastigage (manufactured by the Perfect Circle Corporation).

Camshaft Bearings

Check the camshaft journal to camshaft bearing clearances by measuring the diameter of the journals and the inside diameter of the bearings. The recommended clearance limits are .0010"-.0025" (wear limit is .006"). If the clearance approaches the wear limit, the camshaft journals should be ground for undersize bearings or the camshaft replaced (and/or the bearings replaced). The bearings are available prefinished to size for standard and .015 inch undersize journal diameters.

If camshaft bearings have to be replaced, it will be necessary to remove the camshaft bearing bore plug at rear of cylinder block. Remove plug by driving it out with a long rod.

NOTE: The bearing bore plug can also be removed by drilling a 1/2" hole in center of plug. Remove plug using Clutch Pilot Bearing Removing Tool 7600-E. Insert tool in hole and pull out plug.

Clean camshaft bearing bore to remove scale, rust and old sealing compound. Check bore for cracks or sand holes.

Remove the camshaft bearings using Tool 6261-F and adaptors. See figure 6A-96.

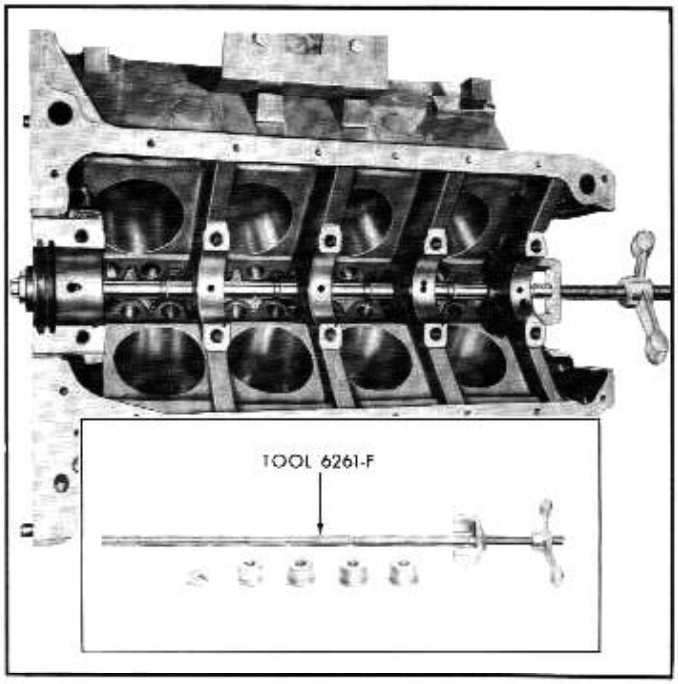


Fig. 6A-96—Removing Camshaft Bearings

Manifolds

The intake manifold is cast in one piece and supplies both cylinder banks with vaporized fuel. Each cylinder bank has a separate exhaust manifold. Located at the end of the right exhaust manifold where it connects to the muffler inlet pipe, is the exhaust control valve. This bi-metal spring "Counterweight" type thermostat is completely automatic in its operation, and does not need any adjustment, but should operate freely.

The manifolds should be thoroughly cleaned and examined for cracks or leaks. If cracks or leaks exist replace manifold. The center exhaust passage of the intake manifold below the carburetor should be cleaned of all carbon deposits. The passage of the automatic choke control heat tube should be cleaned so that it is completely open, otherwise the operation of the choke will be impaired.

If the automatic choke control heat tube in the manifold is cracked or broken, the automatic choke will not function properly.

To check for leaks adjust a vacuum pump to three inches of mercury. Block off one end with a moistened finger then connect the vacuum hose to the other opening. If the pump does not maintain a steady reading there is a leak in the tube and it must be replaced as follows:

REMOVAL

1. Drive the small end of the heat tube, located on the right hand side of manifold, back into the manifold with a flat end pin punch.
   NOTE: If the large end of the tube does not come out the other side of manifold, the tube is probably bent or broken off. In this case the large end should also be driven into the manifold. Remove the tube, or pieces, out through the manifold heat riser chamber. This can usually be accomplished by shaking the manifold. If it does not fall out, make a hook out of wire and remove pieces.

INSTALLATION

NOTE: Before installing the new heat tube, check manifold right hand bore to see if small end of the new tube fits easily. If the hole is too small, it should be reamed to provide a slip fit. A 5/16 inch expansion reamer, with the adjusting screw removed, can be used for the operation. It is important not to ream the hole too large or there will be an exhaust leak.

1. Insert the small end of the heat tube through the large bore in the left side of manifold. Line the tube up using a 1/4 inch pin punch in the small bore in the right side. Drive the tube in place. The tube ends should stick out about 1/16 inch on each side of manifold.
2. To check installation, adjust a vacuum pump to three inches of vacuum. Block off one opening of heat tube with a moistened finger, then connect the vacuum hose to the other opening. If the pump does not maintain a steady reading there is a leak in the tube and the tube should be replaced.

Oil Pan

The pan should be thoroughly cleaned in cleaning solvent to remove any foreign material from below the baffle plate which is spot welded in place. Examine the gasket surfaces of the pan for gasket material or dents.

Disassembly, Inspection and Assembly of Oil Pump

1. Remove four cap screws securing cover to body assembly. Remove cover and gasket. See figure 6A-97.
2. Remove rotor and shaft assembly.
3. Remove relief valve nut-spring and relief valve.
4. Clean all parts in a suitable solvent.
5. Check pump housing and rotors for damage or excessive wear.
6. Check compression of the relief valve spring. The relief valve spring tension should be 9.8 lbs. at a specified length of .800 inch. Check relief valve clearance in body assembly. The specified clearance is .002 to .004 inch.
7. Measure the outer rotor race to body clearance as shown in figure 6A-98. The clearance should be .006" to .009".

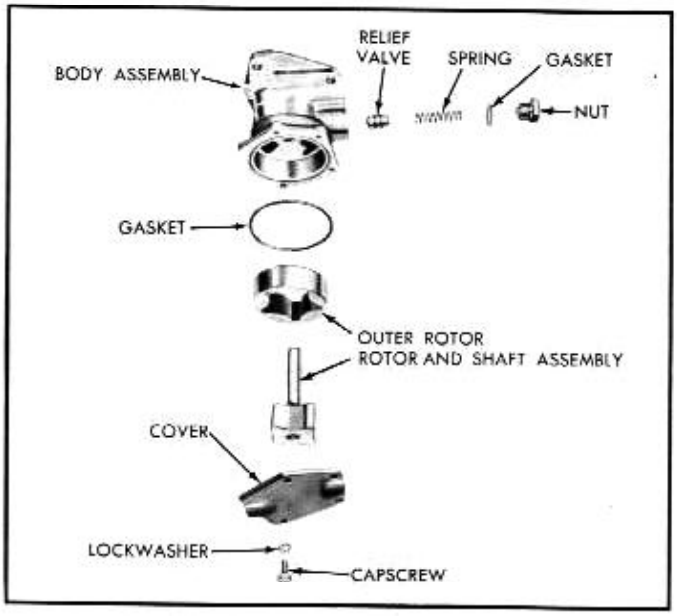


Fig. 6A-97—Disassembled Oil Pump

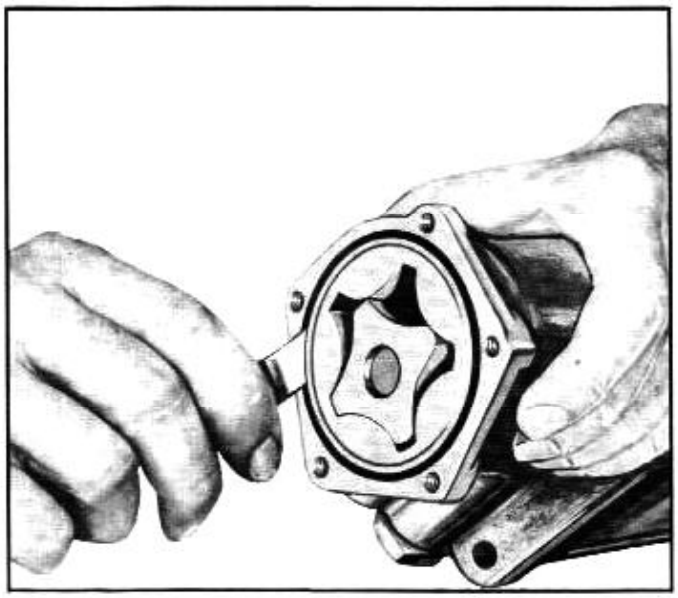


Fig. 6A-98—Checking Outer Rotor to Pump Body Clearance

8. With the rotor and shaft assembly installed in the housing, place a straight edge over the rotor assembly and pump body. Measure the clearance between the pump and the straight edge at the rotor. The clearance should be .0010″ to .0029″. See figure 6A-99.
9. Check the cover for wear, if it is scored or grooved replace it.
   NOTE: The outer rotor, and shaft and rotor assembly are replaced as an assembly.
10. To assemble pump, reverse disassembly procedure.
    IMPORTANT: Remove all old gasket material from cylinder block and pump body.

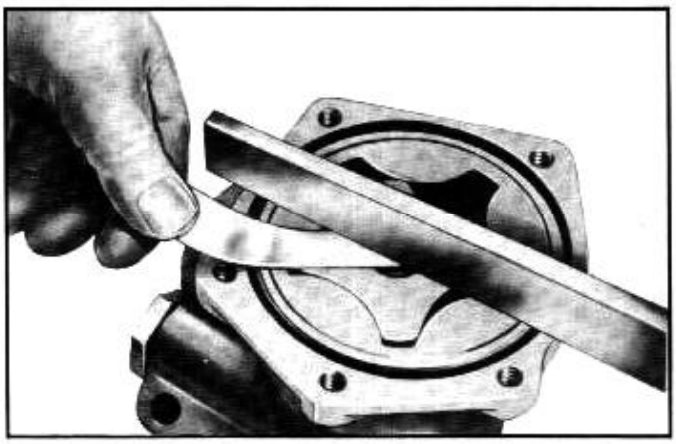


Fig. 6A-99—Checking Rotor End Play Clearance

ASSEMBLY OF ENGINE (REMOVED FROM VEHICLE)

For your reference, figures 6A-100 through and including 6A-103, are presented to assist during assembly procedures and for parts identification.

1. With cylinder block attached to engine repair stand turn block on stand so bottom faces upward. Install the two drain cocks in the cylinder

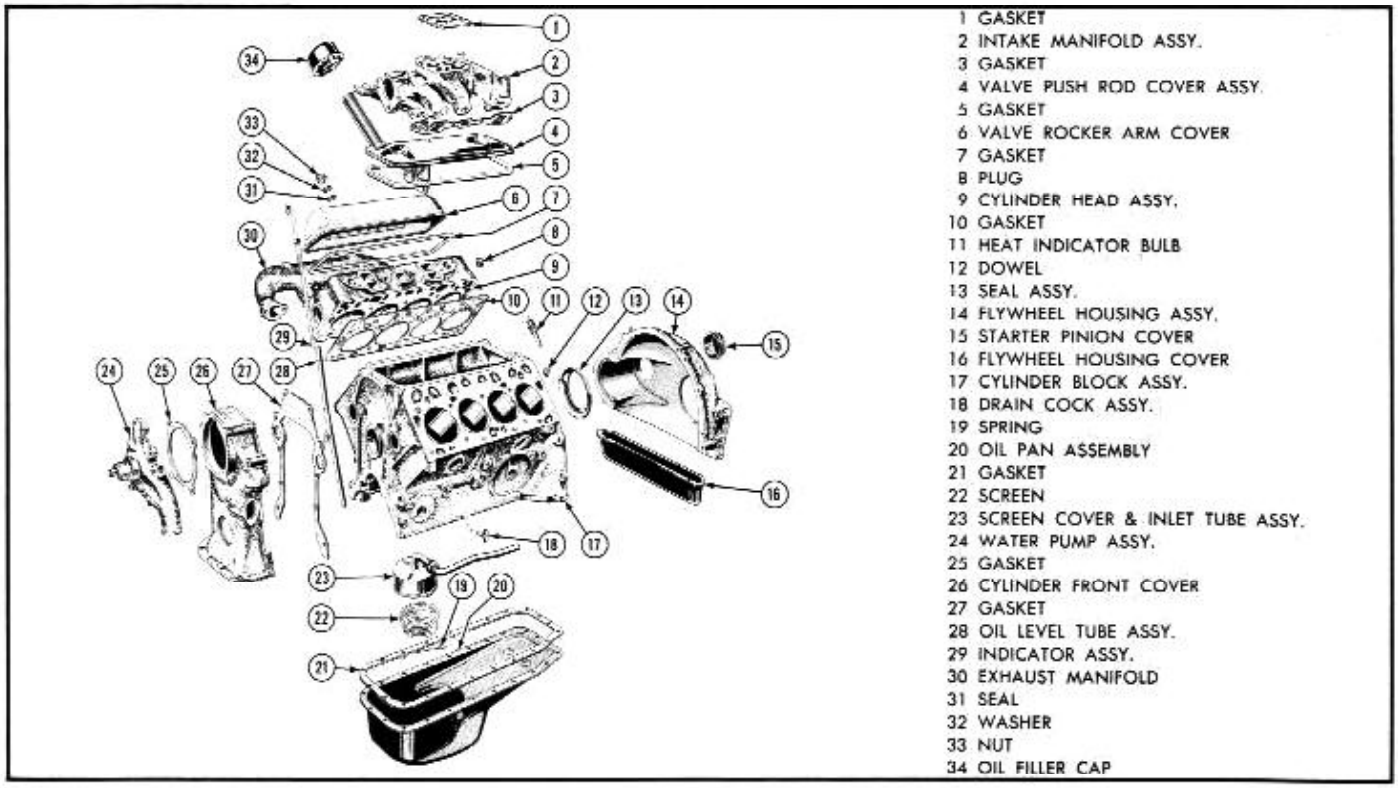


Fig. 6A-100—Cylinder Block and Related Parts

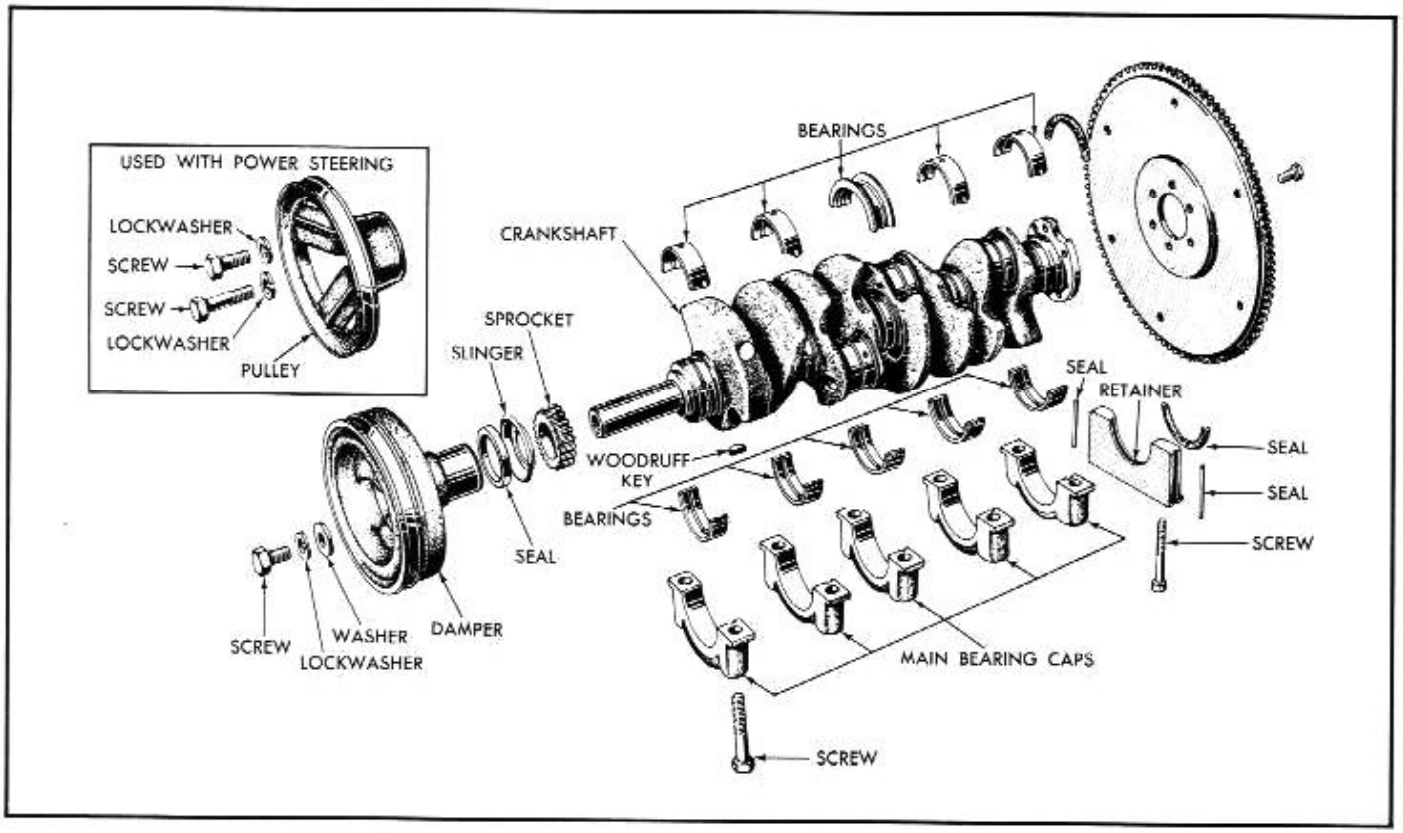


Fig. 6A-101—Crankshaft, Flywheel and Related Parts

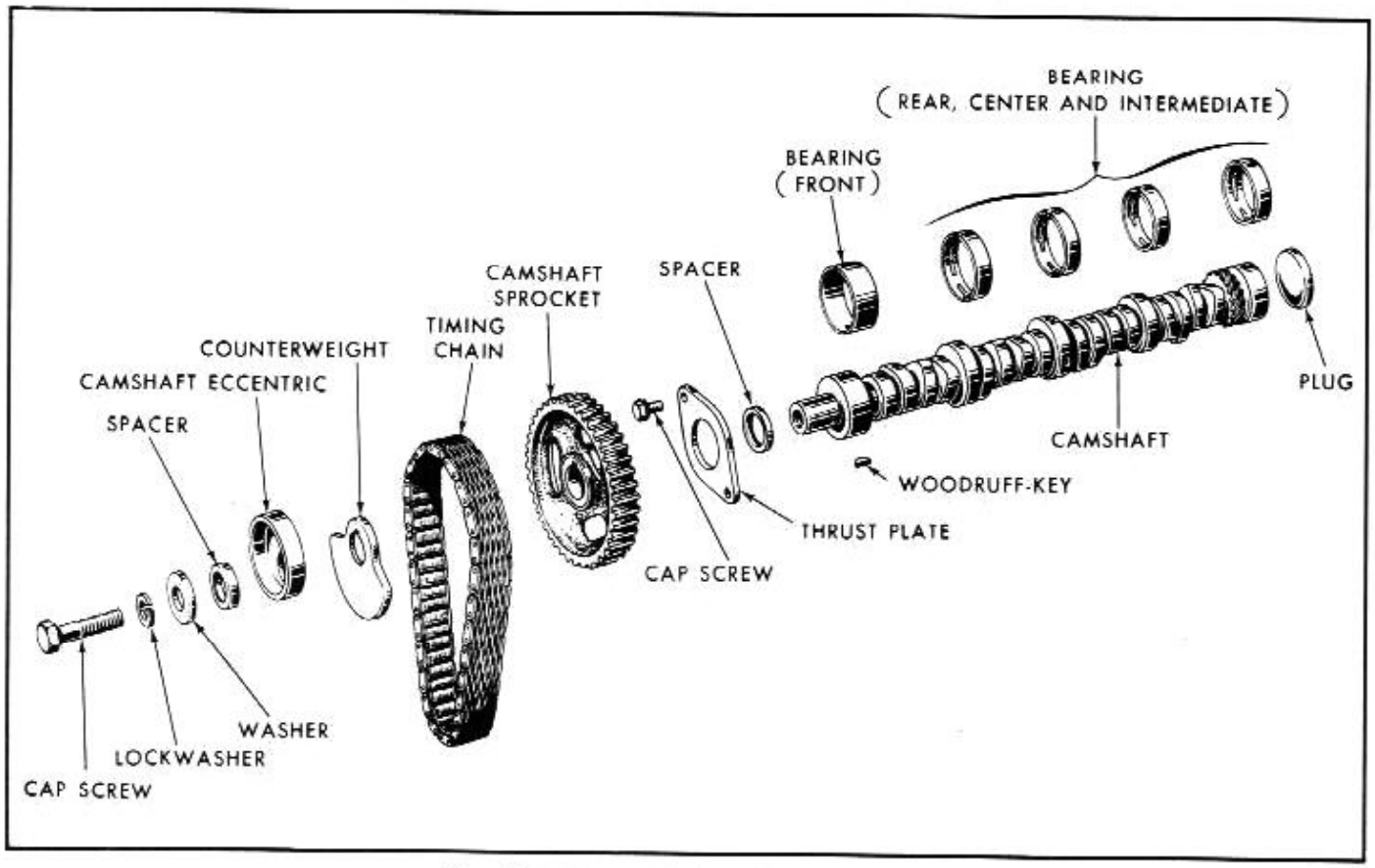


Fig. 6A-102—Camshaft and Related Parts

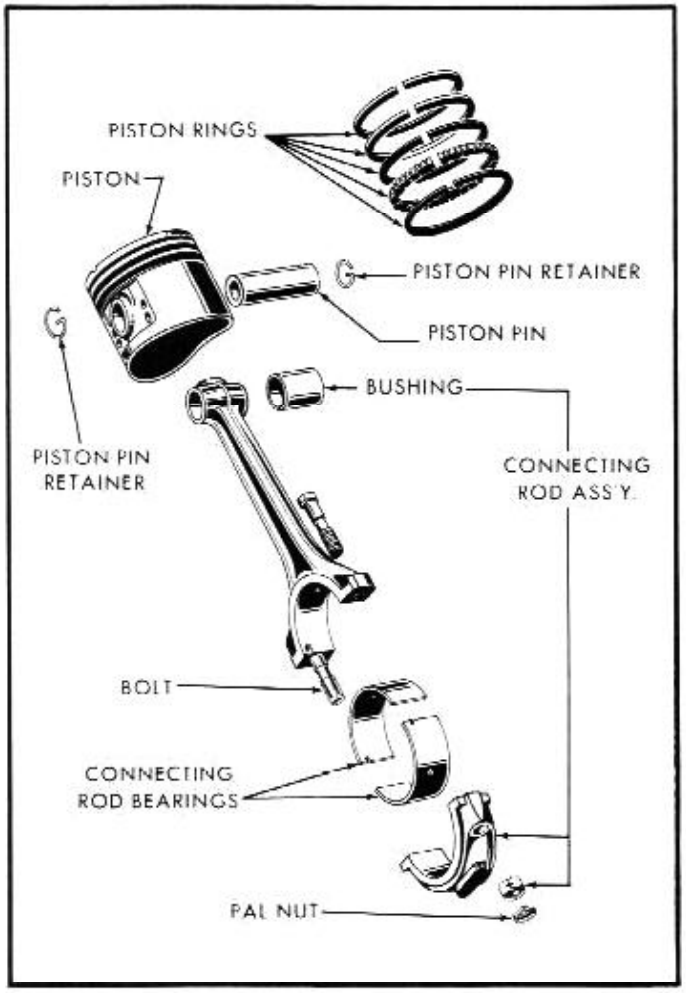


Fig. 6A-103—Piston and Connecting Rod Assembly

block outlet holes. Use sealer on threads.

2. Install new camshaft bearings, if original bearings were removed because of wear or damage. To install bearings, use Tool 6261-F and adaptors. See figure 6A-104.
   CAUTION: *Install bearings so oil holes in each bearing are in line with holes in cylinder block web. The notch on edge of bearing should face the front of the engine at the bottom of the bore.*
   NOTE: Number 1 camshaft bearing must be at least .005″ and not more than .020″ below front face of cylinder block bearing bore.
3. Coat edges of new camshaft bearing plug with a suitable oil resistant sealing compound. Install the plug, with the flange side facing out, using Tool 6266-B.
4. Install valve tappets in their original bores. Before installation, coat each tappet with liberal amount of engine oil.
   NOTE: Be sure all tappets are seated properly before installing camshaft. Inspect all tappets for wear, chips or nicks and replace if damaged.
5. Install camshaft. Before installation, coat all journals and bearings with liberal quantity of engine oil. Install camshaft spacer and thrust plate. Torque cap screws to 12-15 lbs. ft.
   CAUTION. *When installing camshaft use extreme care not to damage bearings or journal surfaces. When installing camshaft spacer onto camshaft be sure the end with large inside chamfer is placed toward the camshaft journal.*
6. Check camshaft end play using dial indicator. To check end play it will be necessary to temporarily install all the related component parts, then torque cam sprocket retaining screw to 35 to 45 lbs. ft. End play limits are .003″ to .012″.
7. Install new rear crankshaft journal oil seal in cylinder block using Tool 6701-A. See figure 6A-105.

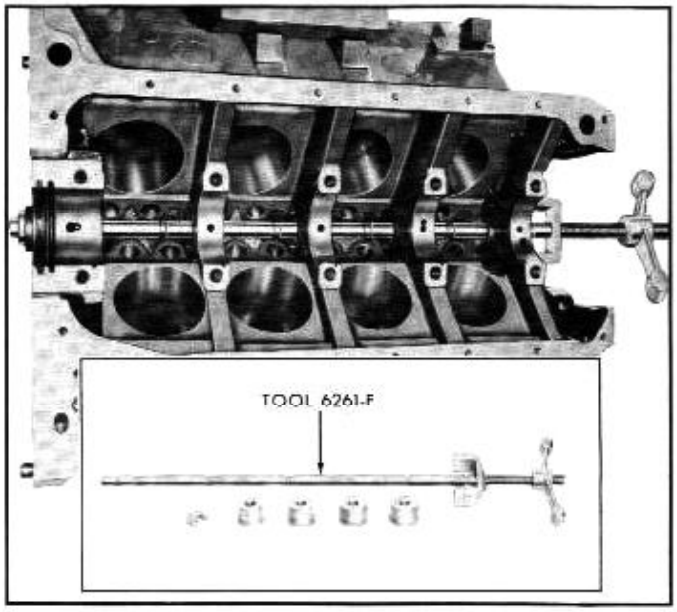


Fig. 6A-104—Installing Camshaft Bearings

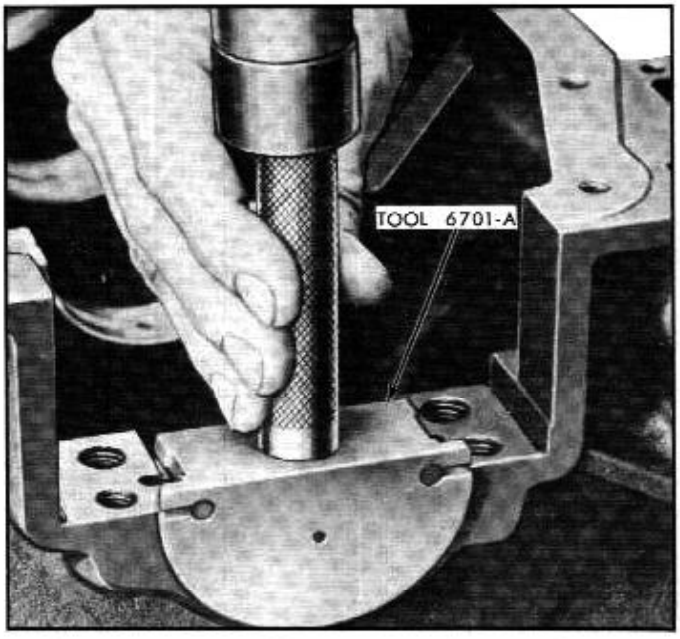


Fig. 6A-105—Installing Rear Crankshaft Oil Seal

8. Place upper main bearing inserts in position in bore with tank of bearing in slot provided. Lubricate bearings with engine oil. If main journals have been reground to a definite undersize, install correct undersize bearing inserts.
9. Install crankshaft and position lower main bearing inserts and caps over crankshaft in their original position. Torque cap screws 95 to 105 lbs. ft. To determine if bearing clearance is within limits, use Plastigage method as follows:
   a. Remove one bearing cap and bearing insert at a time. Remaining caps are left tight while checking the bearing clearance.
   b. Place a piece of Plastigage, the full width of the bearing surface, on the crankshaft journal about 1/4" off center. Install bearing insert and cap. Tighten cap screws to recommended torque.
      CAUTION: *Do not rotate crankshaft while making checks with Plastigage.*
   c. Remove bearing cap and insert, but do not disturb Plastigage.
   d. Compare the width of the flattened Plastigage at its widest point with the scale printed on the Plastigage envelope. See figure 6A-106. This reading indicates the minimum bearing clearance in thousandths of an inch. Clearance should be from .0008" to .0026" (.0036" wear limit).
   e. If the clearance is less than .008" or more than .0036", try another bearing insert to bring the clearance within the desired specification.
      NOTE: Standard size bearing inserts are divided into two sizes carrying different suffixes to the part number. They can be identified by a daub of either red or blue color dye. Red bearing inserts will increase the clearance, blue bearing inserts will decrease the clearance. Any combination of red and/or blue bearing inserts may be used to bring the desired results. If the various selective fit bearings do not bring the clearance within the desired limits it will be necessary to regrind the crankshaft journals and install undersize bearing inserts.
   f. Lubricate the bearings with engine oil.
   g. Install bearings. Align thrust bearing.
      NOTE: When aligning thrust bearing, install the main bearing caps and inserts except the thrust bearing cap, and tighten to proper torque. Install the thrust bearing cap and insert. Install the retaining screws, snug tight, then pry the crankshaft toward the rear of the engine. Reverse this action by prying the crankshaft forward (toward the front of the engine). This will align the thrust surfaces of both halves of the thrust bearing. Retain this forward pressure on the crankshaft, and tighten main bearing retaining screws to 95 to 105 lbs. ft. torque.
10. Check crankshaft end play. See figure 6A-107. Force crankshaft forward as far as possible and release. Connect dial indicator so contact point rests against crankshaft flange. Set indicator at zero and then force crankshaft to rear and release. Note end play reading. Limits are .002" to .010".

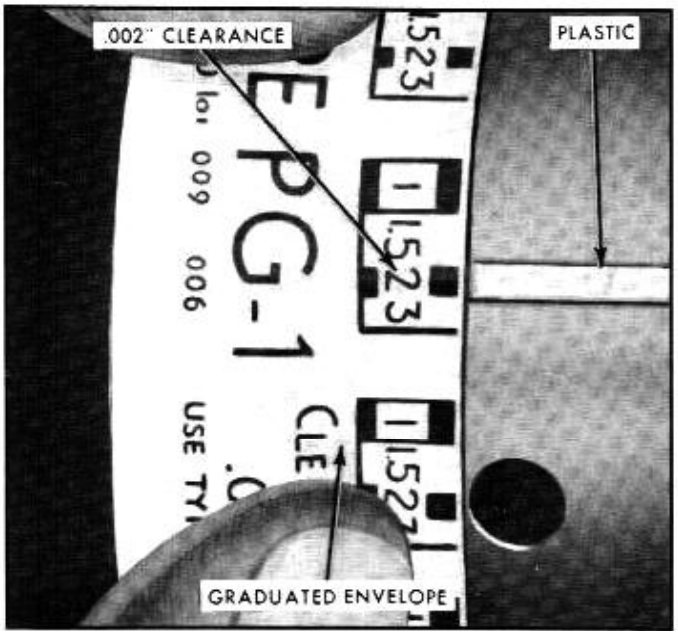


Fig. 6A-106—Checking Bearing Clearance

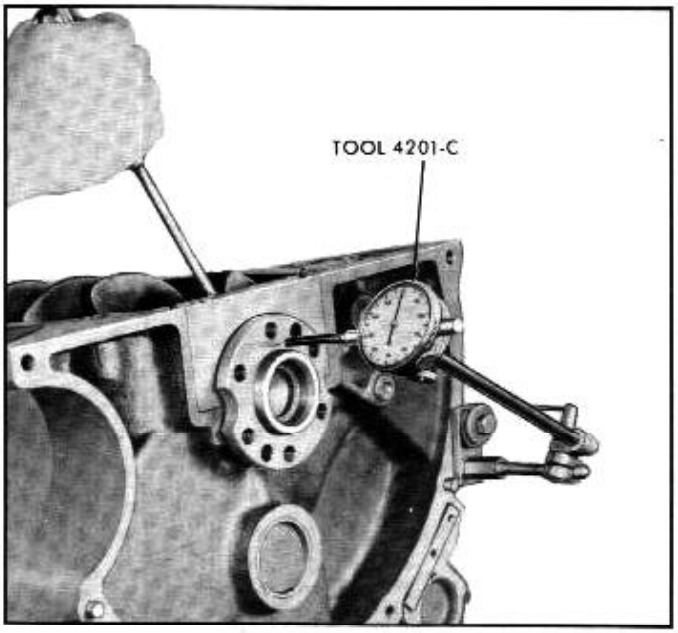


Fig. 6A-107—Checking Crankshaft End Play

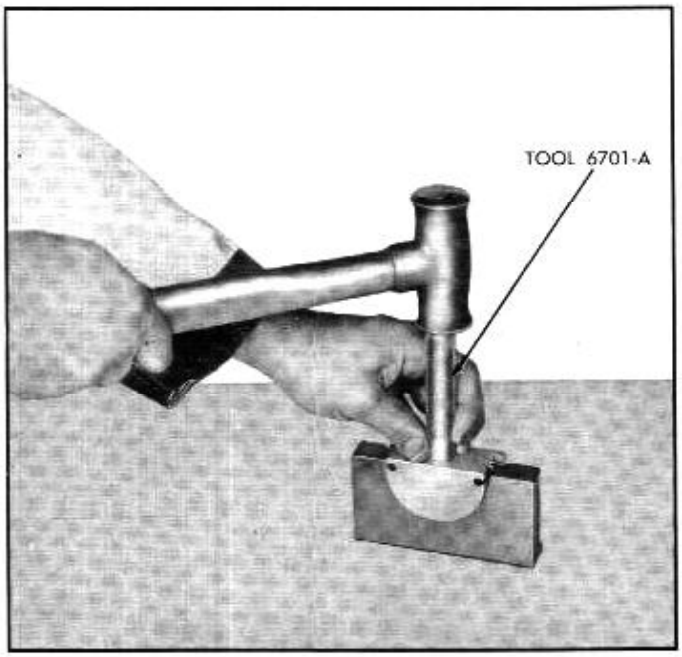


Fig. 6A-108—Installing Rear Crankshaft Oil Seal in Bearing Cap

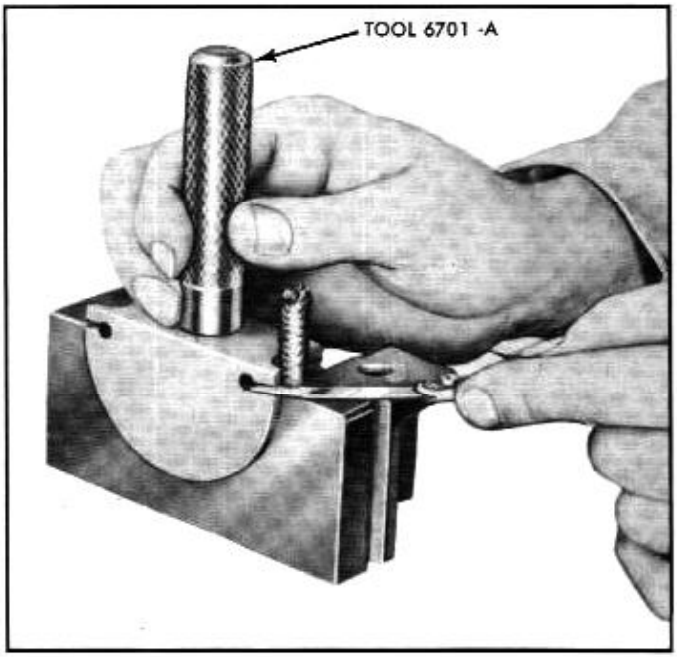


Fig. 6A-109—Cutting Oil Seal

11. Install number 5 main bearing cap and seal retainer as follows:
    a. Remove main bearing cap and install new crankshaft packing in the retainer using Tool 6701-A. Cut packing flush without frayed edges. See figures 6A-108 and 6A-109.
    b. Coat the retainer to cylinder block parting line (lightly) with oil resisting sealing compound.
    c. Install bearing cap assembly and torque bolts to 95 to 105 lbs. ft.
    d. Lubricate the seals with engine oil and insert into their respective side grooves. When the seals are in place, they will project below the oil pan gasket surface. DO NOT cut off the excess material.

       NOTE: The seals may be lightly tapped in place with a mallet.
    e. Test assembly with compressed air for leaks as shown in figure 6A-110.
12. Turn cylinder block to vertical position so front end faces upward.
13. Turn crankshaft so crankpin for No. 1 and No. 5 cylinders is at approximately B.D.C.
14. Coat cylinder bores, crankshaft journals, pistons, piston pins, and piston rings with engine oil. (Check ring gap spacing. Oil ring gap should be positioned to the inside of the "V" of engine and the remaining ring gaps spaced 120° apart.) Insert the previously assembled piston assembly into Piston ring Compressor Tool 6150 and install piston assembly into respective cylinder bore, as shown in figure 6A-111.

CAUTION: *When installing piston assemblies, be extremely careful that the connecting rod bolts do not strike the crankshaft journals. If this should happen, remove burr using fine oilstone. Damage which cannot be corrected through the use of an oilstone will necessitate reboring the cylinder walls to obtain the required surface finish. The cylinder bore will then require oversize pistons.*

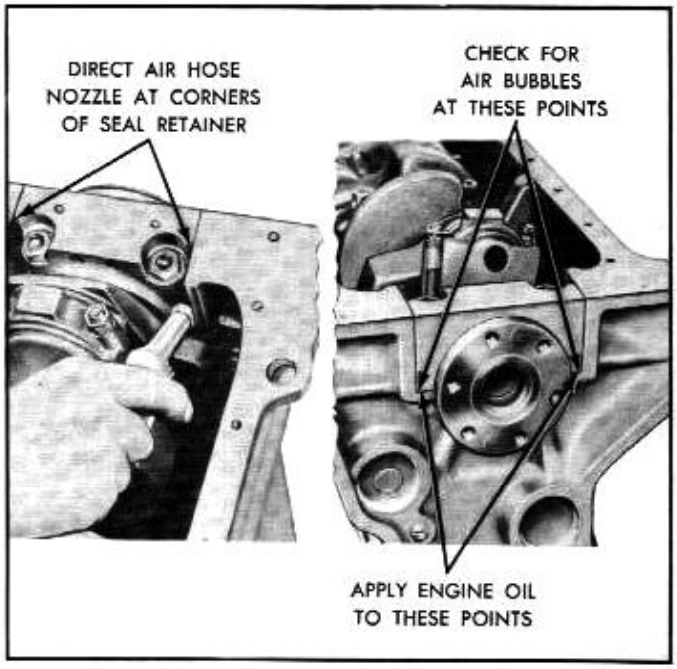


Fig. 6A-110—Checking Rear Oil Seals with Compressed Air—Typical

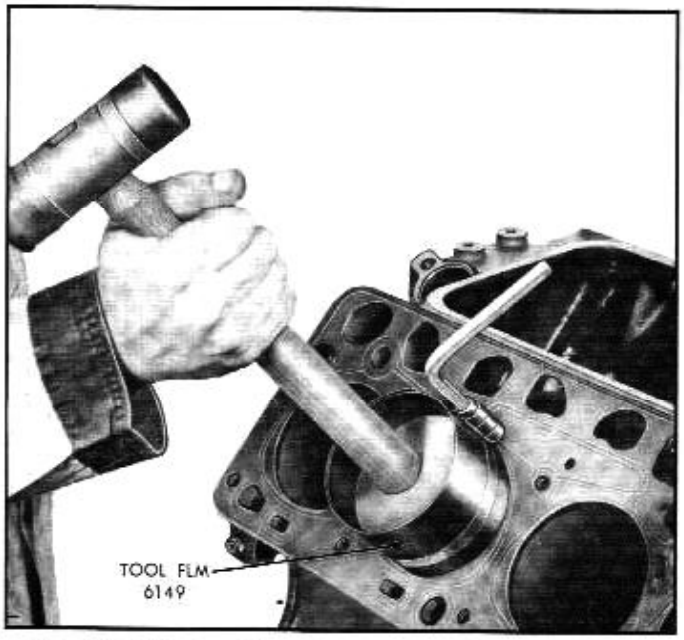


Fig. 6A-111—Installing Piston Assembly in Cylinder Block—Typical

DO NOT HAMMER ON TOP OF PISTON when installing assembly in cylinder bore. Apply even pressure to wood hammer handle. See figure 6A-111. By applying a continuous pressure to the piston, any obstruction will be immediately indicated. The piston assembly can then be removed and rings checked and reinstalled correctly, if obstruction is present.

Install connecting rod bearings and caps. The numbered side of the cap must match and be on the numbered side of the rod. Secure with hex nuts and pal nut. Torque hex nuts 45-50 lbs. ft. Install pal nuts and torque 3 to 3½ lbs. ft. or finger tight plus 1/3 turn. Repeat above operation for remaining cylinders, turning crankshaft so crankshaft journal for each set of cylinders is at approximately B.D.C. for installation of remaining piston assemblies.

NOTE: The numbered side of the rods must face toward the outside of the block and dimple embossed or slot cut on the top of the piston, must face the front of the engine. See figures 6A-112 and 6A-113.

15. Install connecting rod bearings as follows:
    a. Clean oil from crankshaft journal, rod and cap bearing bores and bearing contact surfaces.
    b. Install upper bearing into the rod and pull rod assembly into firm contact with the crankshaft journal.
    c. Install lower bearing into rod cap. Place a piece of Plastigage on the bearing surface the full width of bearing about 1/4" off center.
    d. Install cap and tighten to 45-50 lbs. ft. torque. CAUTION: *Do not turn crankshaft while Plastigage is in place.*
    e. Remove bearing cap and compare the width of the flattened Plastigage at its widest point with the scale printed on the Plastigage envelope. If clearance is less than .0008" or more than .0027" (.0037" wear limit), try another selective fit bearing to bring the clearance within the desired limits. Coat bearings and journal with engine oil after bearing

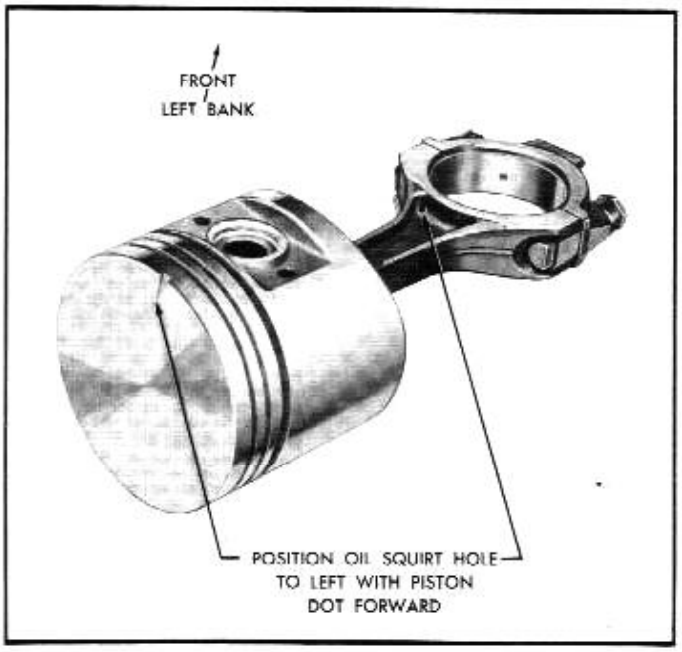


Fig. 6A-112—Position of Piston Assembly and Connecting Rod—Left Bank

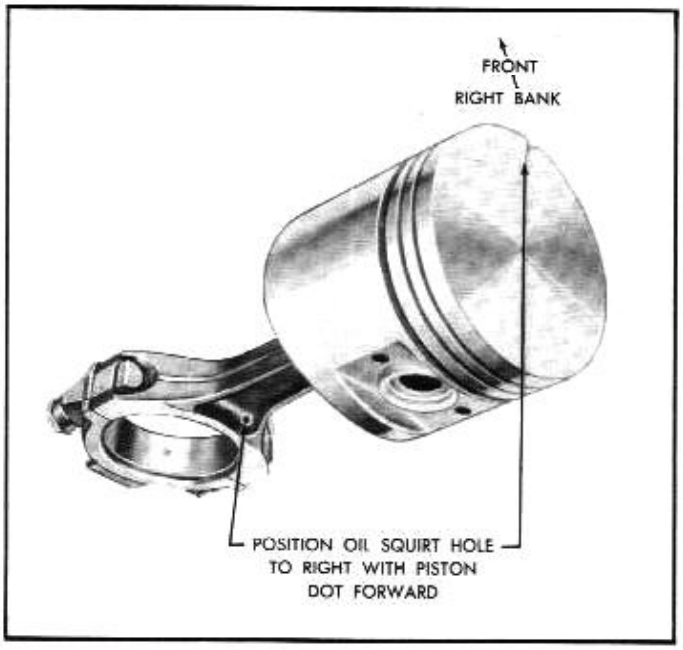


Fig. 6A-113—Position of Piston Assembly and Connecting Rod—Right Bank

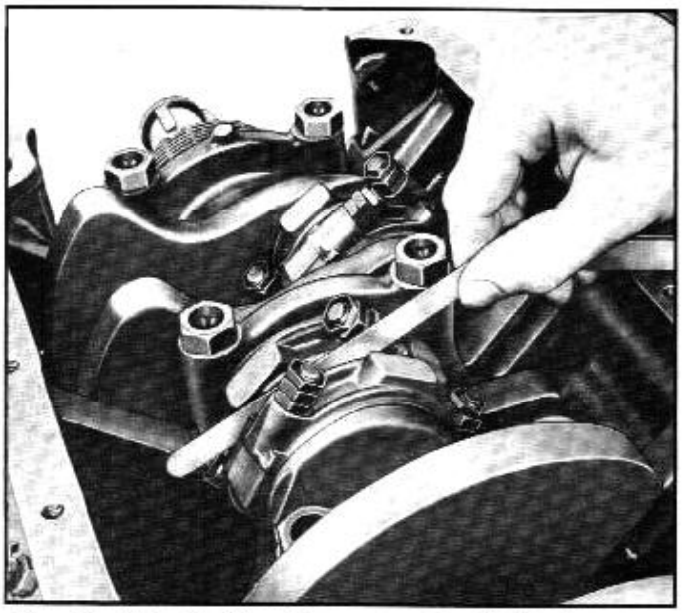


Fig. 6A-114—Checking Connecting Rod Side Clearance

has been fitted.

16. Check connecting rod side clearance using feeler gauge. See figure 6A-114. Limits are .006" to .016" (wear limit .019").
17. Insert Woodruff keys in crankshaft and camshaft.
18. Place timing chain over camshaft and crankshaft sprockets, making sure timing marks are lined up, adjacent to marks on timing chain. See figure 6A-115.
19. Align camshaft key and crankshaft key so both timing chain sprockets and timing chain can be installed simultaneously.
    NOTE: The timing marks on the camshaft, crankshaft sprocket, and timing chain should be in-

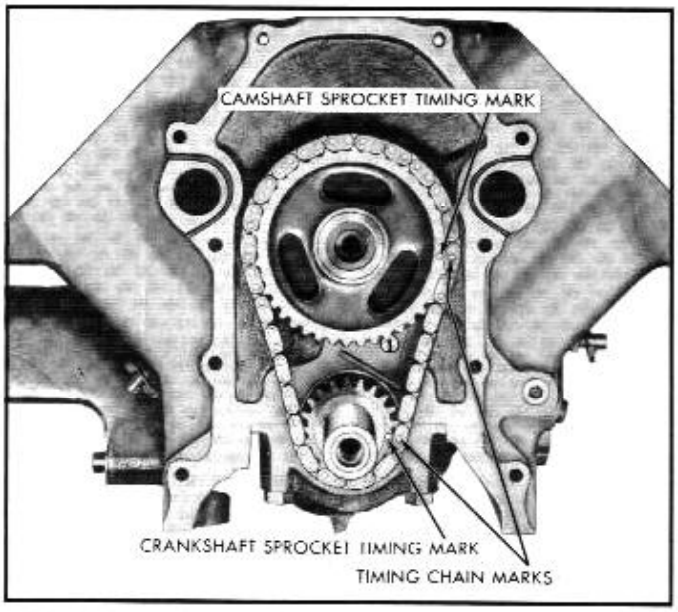


Fig. 6A-115—Timing Marks Aligned for Initial Timing

stalled toward the left cylinder bank. The left side of the engine is as viewed from the driver's seat.

20. Holding camshaft and crankshaft sprocket with timing chain in place, install on camshaft and crankshaft simultaneously as shown in Figure 6A-116.
21. Check timing chain outward deflection. Rotate crankshaft to take up slack on driving side of chain and establish straight position. Rotate crankshaft in opposite direction to take up slack on opposite side of chain. Pull chain outward with fingers. Measure outward deflection of chain. See figure 6A-117. There should not be more than 1/2" difference between the chain straight

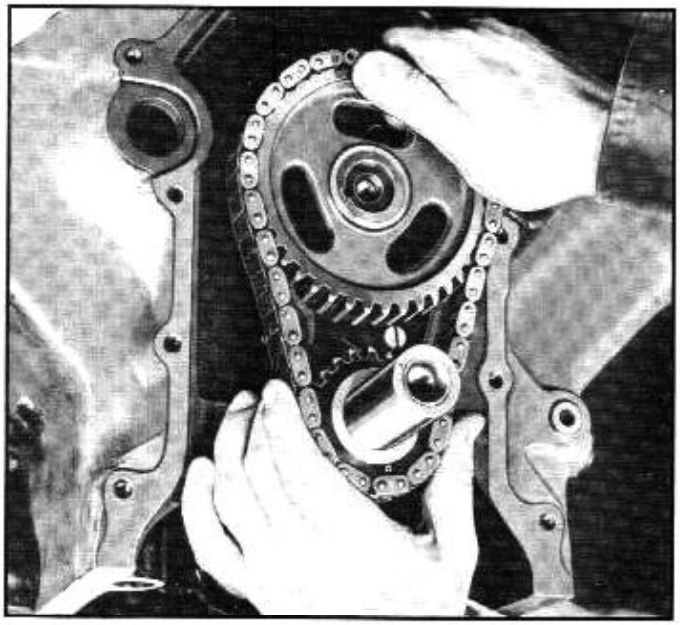


Fig. 6A-116—Installing Timing Chain and Sprockets

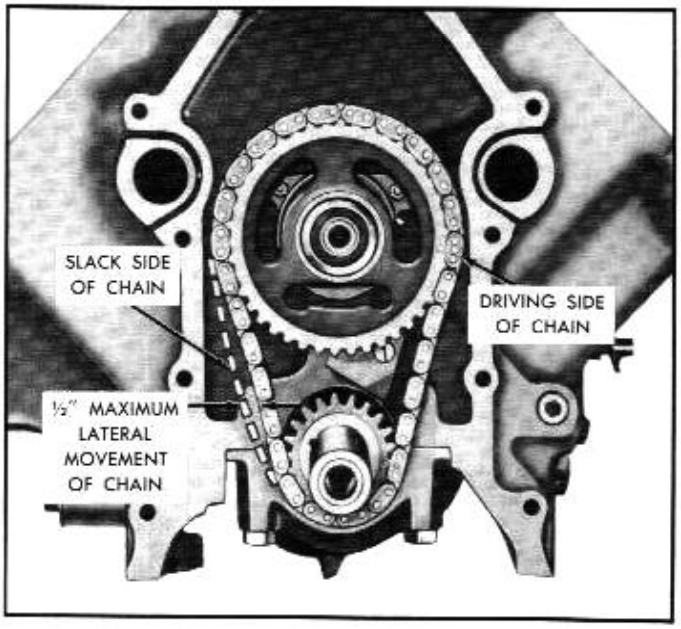


Fig. 6A-117—Timing Chain Deflection

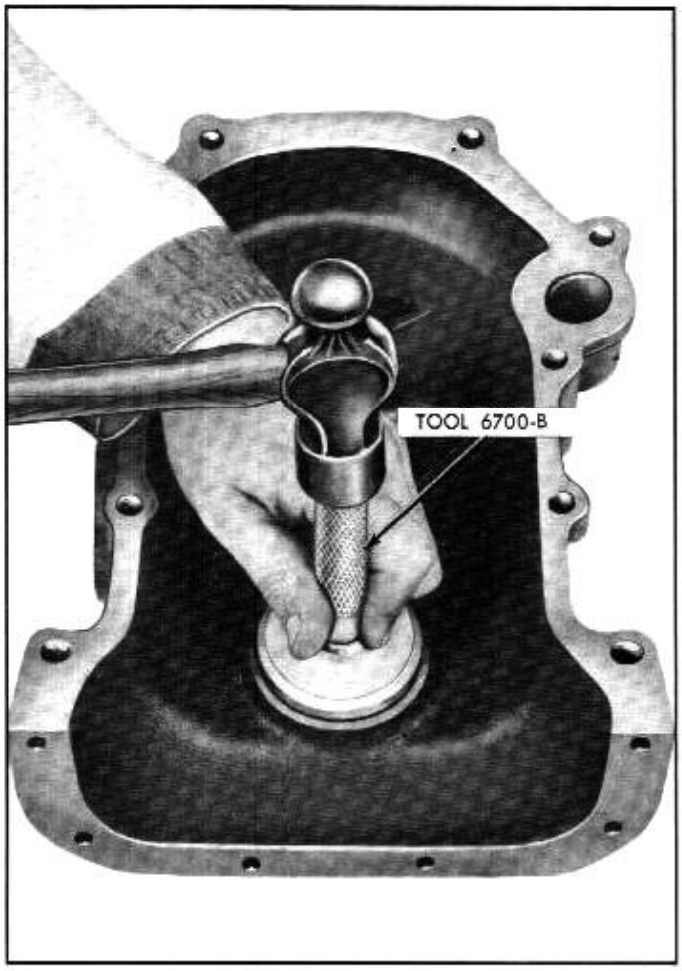


Fig. 6A-118—Installing Front Cover Seal

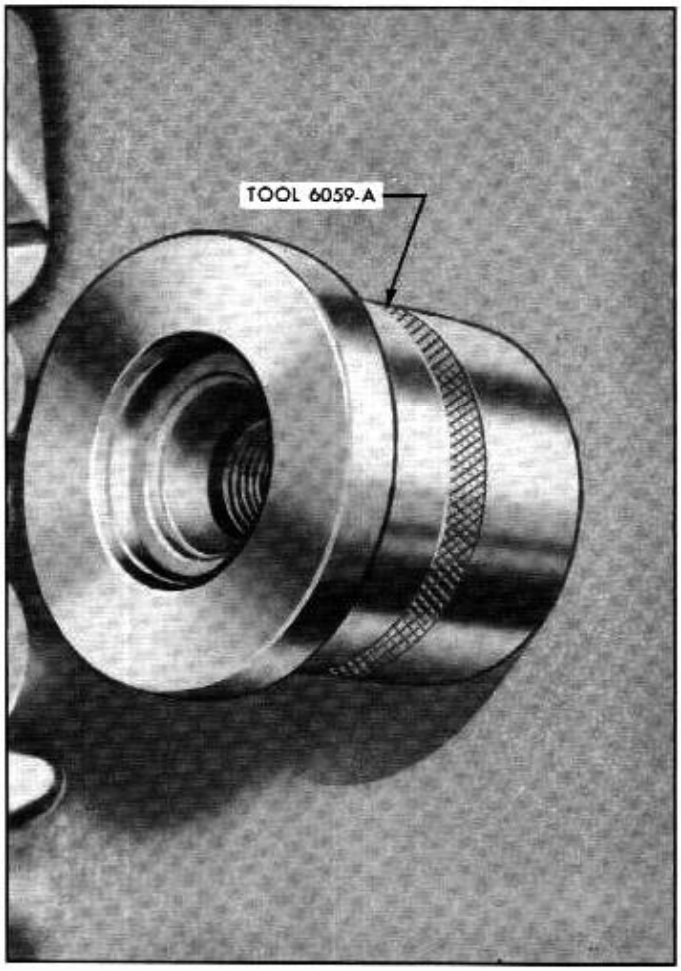


Fig. 6A-119—Aligning Front Cover

position and the position of chain when deflected outward.

22. Install camshaft eccentric and counterweight as an assembly. Align keyway of eccentric and counterweight with Woodruff key on camshaft. Place spacer in position and secure with plain washer, lockwasher, and screw. Torque 35 to 45 lbs. ft.
23. Install new crankshaft front oil seal in front cover using Tool 6700-B. See figure 6A-118. Coat seal with cup grease to facilitate installation. Install crankshaft oil slinger.
24. Install new front cover gasket. Use sealer on gasket. Install front cover assembly; do not tighten cap screws. Position Tool 6059-A over crankshaft as shown in figure 6A-119, and align front cover to tool. Hold tool inward and tighten 3/8" screws to 23 to 28 lbs. ft. torque. Tighten 5/16" screws to 12 to 15 lbs. ft. torque.
25. Install Woodruff key in crankshaft for damper assembly. Clean gasket surface on cylinder cover and cylinder assembly.
26. Install engine oil pan, with new gasket, in position and then secure with 21 hex head screws.

NOTE: When tightening, start from the center and work toward the front and rear alternately on both sides.

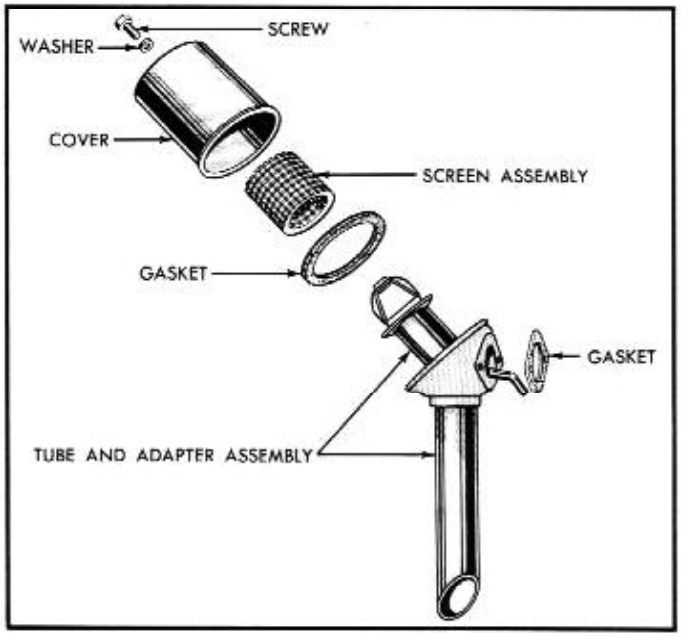


Fig. 6A-120—Crankcase Ventilation Assembly

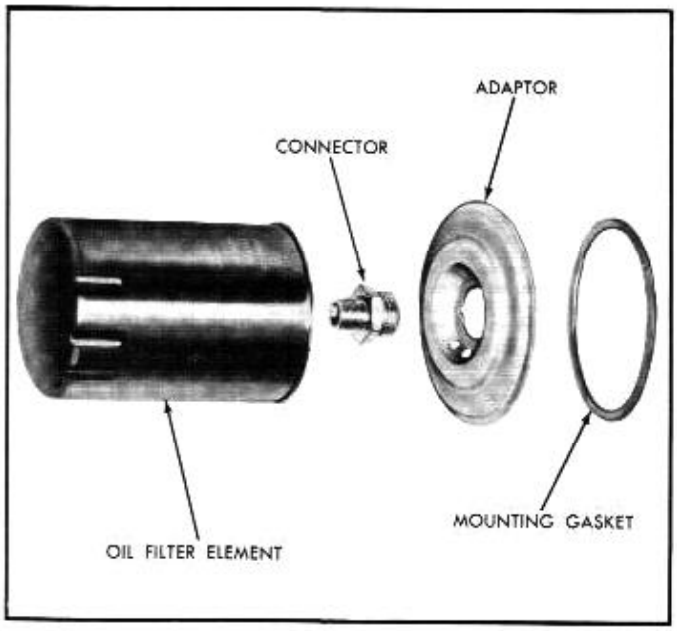


Fig. 6A-121—Oil Filter Assembly

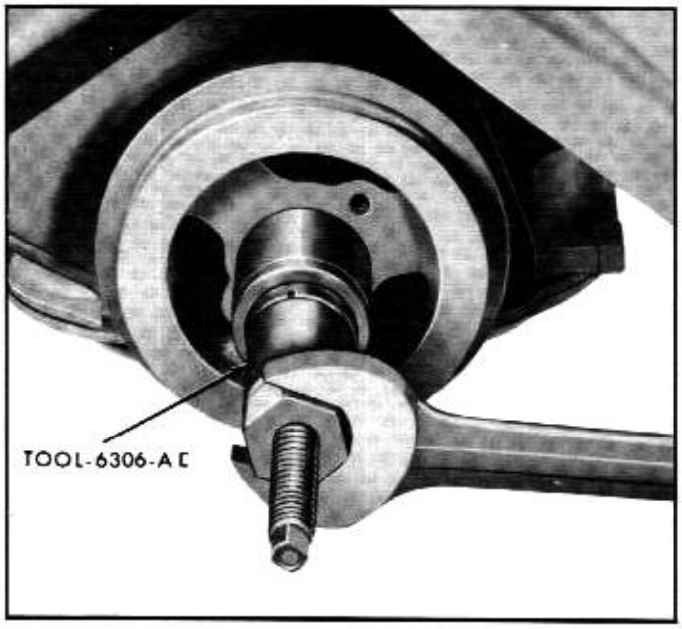


Fig. 6A-122—Installing Crankshaft Damper—Typical

27. Install oil pressure sending unit.
28. Install crankcase ventilation tube to side of block with new gasket and cleaned filter element. Install cover using new gasket. See figure 6A-120.
29. Install oil filter gasket, adaptor and connecter. See figure 6A-121.
    NOTE: The filter adaptor must be installed with the word "TOP" in the uppermost position.
30. Install oil filter assembly. Apply a film of oil to the canister mounting gasket, turn the canister clockwise until it contacts the block, then hand twist 1/2 turn or 180°.
    CAUTION: *Do not overtighten.*
31. Using Tool 6306-AC install crankshaft damper. Secure with flat washer and retaining screw. Torque 130 to 145 lbs. ft. See figure 6A-122.
32. Position new water pump gasket on water pump (use sealer on gasket). Install water pump and timing pointer.
33. ASSEMBLE CYLINDER HEADS AS FOLLOWS:
    a. Install valves in their respective guides and install valve stem seal. Install valve spring (closed end of spring must be toward the cylinder head), valve spring retainer and inner sleeve.
       NOTE: Coat stems with engine oil to furnish initial lubrication.
    b. Position Compressor Tool 6513-EE over valve spring retainer and valve head.
    c. Compress valve spring and install valve keys on valve stem. Release Tool 6513-EE slowly and check position of valve keys.
    d. Install remaining valves in same manner.
    e. Use dividers to measure the assembled height from the surface of the cylinder head spring pad to underside of the spring retainer. See figure 6A-123.
    f. Check the dividers against a scale. If the valve closed assembled height is 1.780" or greater, install the necessary spacer or spacers between the cylinder head spring pad and the valve spring to bring the assembled height to the recommended dimension of 1.780 inches.
       NOTE: The spacers available for service are .030 inch thick. Never use more than two spacers to bring the assembled height to specifications. Do not use spacers unless necessary. Use of spacers in excess of recommendations will result in overstressing the

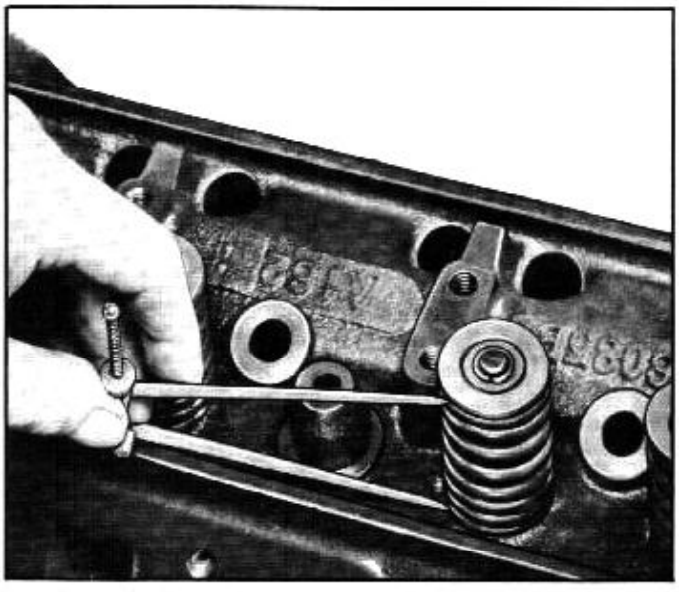


Fig. 6A-123—Measuring Valve Spring Assembled Length

valve springs which will lead to excessive load loss and spring breakage.

34. Coat cylinder head gasket with gasket sealer and install in position over dowels on cylinder block.
NOTE: These gaskets are interchangeable for use on either cylinder bank. Make sure gaskets are installed properly by checking water passage holes and forward end for word "FRONT" stamped on gasket.
NOTE: It is advantageous to use pilot studs when installing cylinder head assemblies. It is suggested that pilots be made from two long cylinder attaching screws. This may be done by cutting the head from the screw, round edges with a file and cut slot for screw driver.
35. Install cylinder head assemblies over dowels so plugged water jacket is to the rear of the block.
36. Install cylinder head screws and make three torque applications using recommended sequence, (see figure 6A-124) in the following manner:
Cold torque . . . . . Initial . . . . 45-55 lbs. ft.
Cold torque . . . . . 2nd . . . . . 55-65 lbs. ft.

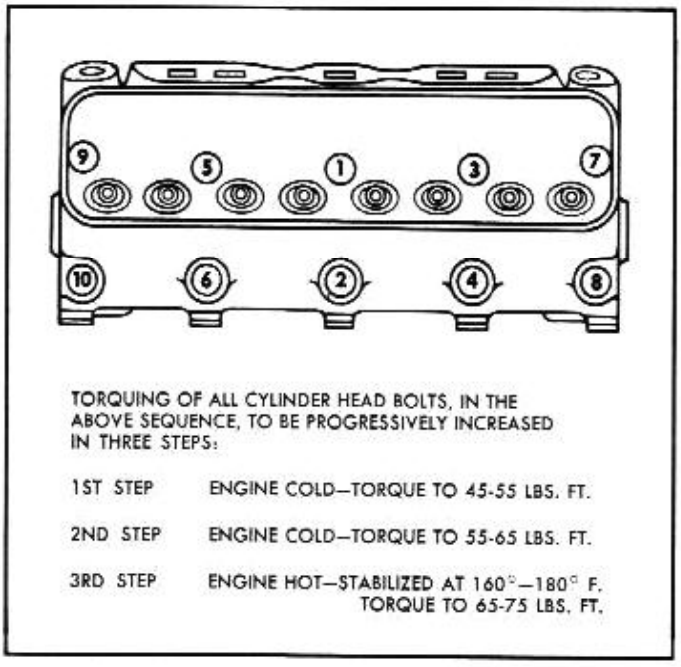


Fig. 6A-124—Torque Sequence and Valves

After the engine is completely assembled and in the vehicle, run the engine a minimum of 30 minutes at 1200 R.P.M., then
Hot torque . . . . . Final . . . . . 65-75 lbs. ft.
Tool 8663-A can be used on all screws on right bank and lower screws on left bank. Tool P-8675 can be used on all screws under rocker arm on left bank.

37. Remove Cylinder Head Holding Fixtures, Tool 6085-G, and install 8 push rods (each side) making sure they are properly seated in the tappets.
38. Position rocker arm assembly over studs and push down into place engaging rocker arm adjusting screws in push rod sockets.
39. Install oil overflow pipes and retainers on front right bank rocker arm support and rear left bank rocker arm support. Torque retaining screws and nuts to 12 to 15 lbs. ft.
CAUTION: *Make sure oil overflow pipes enter holes in rocker arm shaft, prior to torquing rocker shaft support retaining screws and nuts.*
40. Make three chalk marks on the crankshaft damper. Space the marks approximately 90° apart so that with the timing mark, the damper is divided into four equal parts (90° represents 1/4 of the distance around the damper circumference). See figure 6A-125. Perform preliminary tappet adjustments with a feeler gauge, as follows:
NOTE: To adjust valve tappet clearances, turn adjusting screws until proper clearances are obtained. Tappet adjusting screw torque specifications are 7-15 lbs. ft. (Torque will decrease after each valve adjustment.) If adjusting screw

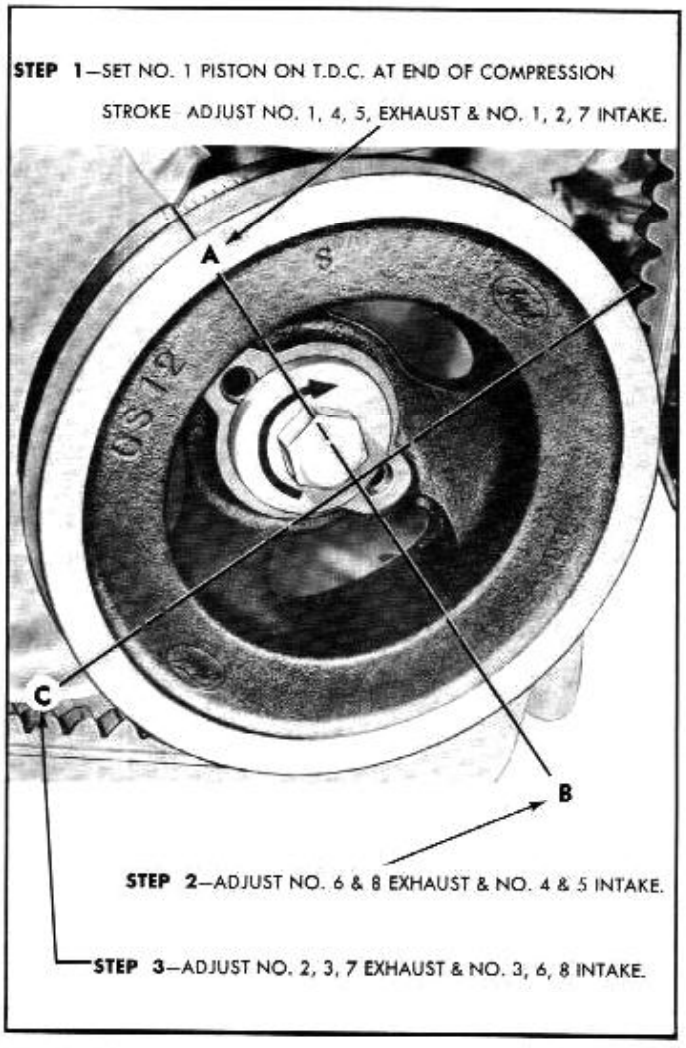


Fig. 6A-125—Quadrant for Preliminary Valve Adjustment

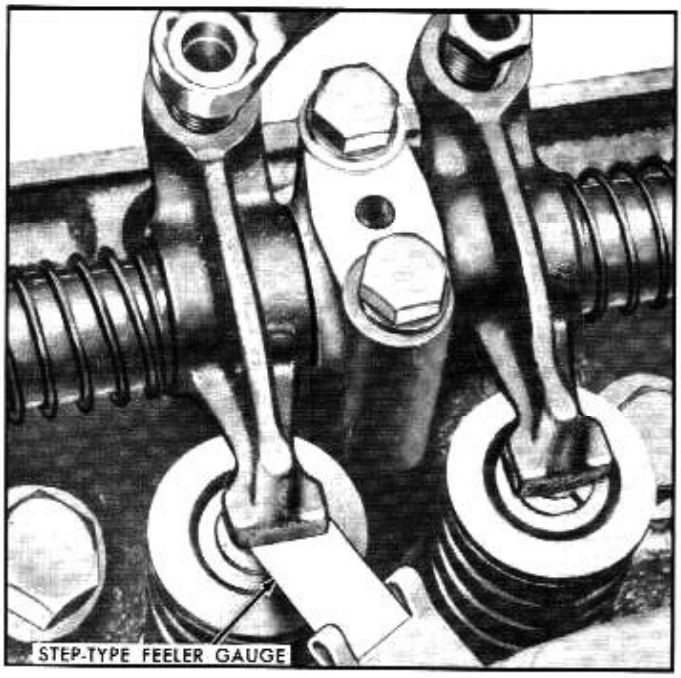


Fig. 6A-126—Valve Lash Adjustment

torque reaches a minimum of 3 lbs. ft. torque replace rocker arm and adjusting screw.

a. Rotate crankshaft until No. 1 piston is at approximately T.D.C. (Top Dead Center) on the compression stroke. Timing mark on crankshaft damper should be in line with timing pointer. Preliminary valve lash for both intake and exhaust valves is .020" (cold).

b. Adjust the valve lash on the following valves (see figure 6A-126):

No. 1 Exhaust	No. 1 Intake
No. 4 Exhaust	No. 2 Intake
No. 5 Exhaust	No. 7 Intake

c. Rotate crankshaft 180° this will put No. 4 piston on T.D.C. Adjust the following valves:

No. 6 Exhaust	No. 4 Intake
No. 8 Exhaust	No. 5 Intake

d. Rotate crankshaft additional 270° from step c. This will put No. 3 piston on T.D.C. Adjust remaining valves.

No. 2 Exhaust	No. 3 Intake
No. 3 Exhaust	No. 6 Intake
No. 7 Exhaust	No. 8 Intake

e. Final tappet adjustment is made after engine assembly is completed and the engine has been run until normal operating temperature is reached (approximately 30 minutes at 1200 R.P.M.). The final setting is .019" (hot) for both intake and exhaust valves and is made while the engine is idling.

41. Install rocker arm covers using new gaskets and new seals under the two nuts. Torque nuts 2 to 2½ lbs. ft.

42. Install valve push rod chamber cover using new gasket and bolt seals. Torque screws 2 to 2½ lbs. ft.

43. Install new gaskets and intake manifold securing with 10 cap screws and lockwashers. Torque 23 to 28 lbs. ft. working from center to ends of manifold.

    NOTE: When installing new gasket and manifold make up pilot studs to hold gasket in place. Pilot studs can be made out of 3/8"-16 screws or studs.

44. Install exhaust manifold on right bank cylinder head. Before installing, coat mating surfaces with graphite grease. Secure in position with two end screws. Tighten finger tight. Place spark plug wire heat shields in position and secure with retaining screws. Tighten all screws to 23 to 28 lbs. ft. torque, working from center toward ends of manifold. Repeat the above operation for the left bank manifold installation making sure air cleaner duct bracket is installed in its proper position.

45. Install oil dipstick tube in block. (Coat end of tube with sealer). Install dipstick and filler cap. Secure oil dipstick tube to cylinder head.

46. Install thermostat and water outlet connection to intake manifold using new gasket (use sealer on gasket). Connect water by-pass tube to water pump.

47. Install distributor as follows:
    a. Hold thumb over No. 1 spark plug hole and turn crankshaft until compression is felt on thumb.
    b. Find No. 1 spark plug socket in distributor cap and fit distributor cap to distributor housing.
    c. Mark distributor housing to indicate No. 1 spark plug wire position.
    d. Position rotor approximately 20 degrees counterclockwise from mark made on distributor housing. Engage distributor drive gear and install distributor in engine.
    e. Check to be sure distributor is seated. Install distributor clamp and screw finger tight, then turn distributor slightly so that the point contacts are just ready to open.
    f. Tighten distributor hold-down screw. Final timing of the distributor must be made after the engine is operating. See "Engine Electrical" section of this manual.

48. Place distributor cap in position, install wiring harness brackets and wires.

49. Insert oil pump drive intermediate shaft in the oil pump drive shaft. Install new gasket on oil pump (use sealer on gasket).

50. Install intermediate shaft and pump as an assembly, into position in block. Turn oil pump assembly back and forth until engagement of intermediate shaft with distributor shaft hex is felt. At this point, oil pump may be raised into position so it is flush with the bottom of the block assembly. Install retaining screws. Alternately tighten screws to 12 to 15 lbs. ft. torque.
51. Install new "O" ring seal on oil inlet pipe. Install oil inlet pipe in oil pump. Tighten nut at oil pump 10 to 12 lbs. ft. torque. Tighten nut at oil pan to 28 to 32 lbs. ft. torque.
52. Install fuel pump using a new gasket and sealer. Alternately tighten screws to 23 to 28 lbs. ft. torque.
53. Install carburetor mounting pad lower gasket, spacer, and upper gasket.
54. Install carburetor on intake manifold. Retain carburetor on manifold with four lockwashers and hex nuts. Do not tighten at this time.
55. Connect vacuum lines from carburetor to distributor. Install fuel and vacuum lines to fuel pump.
56. Install coolant temperature sending unit.
57. Install automatic choke inlet tube and fittings. Secure heat tube to choke with hex nut. Tighten four nuts at carburetor base securing carburetor to intake manifold. Tighten nuts alternately and in a criss cross pattern. Torque to the equivalent of 12 to 15 lbs. ft.
58. Install coil and connect high tension and primary ignition wires.
59. Install generator support bracket. Install generator adjusting strap and generator assembly.
60. Install fan assembly, and generator fan belt.
61. Place flywheel in position on crankshaft. Install 6 screws. Alternately torque 75 to 85 lbs. ft.
62. Install clutch disc and pressure plate to flywheel using Tool 7563-A to align clutch disc. Turn six screws down evenly, then alternately torque 22 to 26 lbs. ft. (standard and overdrive transmissions only). Remove tool.

INSTALLATION OF ENGINE ASSEMBLY (LESS TRANSMISSION)

NOTE: On vehicles equipped with a standard or overdrive transmission, alignment of clutch disc with the use of Tool 7563-A is necessary, before installing engine.

1. Lower engine into the engine compartment. Align exhaust manifolds and muffler inlet pipes. Be sure exhaust thermostat valve and new gaskets are in position.
   NOTE: On vehicles equipped with Merc-O-Matic transmission, index two large slots in edge of flywheel with the converter cover drain plugs.
2. Align locating dowels in engine with holes in flywheel housing. Use care to prevent damage to transmission input shaft.
3. Remove dowels and secure engine in position with two upper flywheel housing or converter to cylinder block attaching screws. Tighten screws to 40-50 lbs. ft. torque.
4. Install two attaching screws in each engine front support insulator. Remove engine hoisting sling.
   NOTE: It may be necessary to lift engine slightly to start screws.
5. Raise vehicle. Install flywheel housing cover.
6. Place equalizer shaft washer and two piece ball sockets on clutch release equalizer (engine) bracket pivot ball and retain them with heavy grease.
7. Insert pivot ball and ball sockets into clutch release equalizer bar assembly. Install clutch release (engine) bracket on engine and tighten retaining screws.
8. Connect the clutch lever release rod assembly to the clutch release lever assembly. Install clutch release retracting spring.
9. Install two lower flywheel or converter to cylinder block attaching screws. Tighten screws to 40-50 lbs. ft. torque.
10. MERC-O-MATIC TRANSMISSION EQUIPPED VEHICLES:
    a. Remove retainer securing converter in converter cover.
    b. Check to be sure converter can be rotated by hand and is not binding.
    c. With drain plugs lined up with access slots, secure converter cover to flywheel and tighten nuts to 25-28 lbs. ft. torque.
    d. Install front converter cover and lower access cover.
11. Make certain exhaust thermostat valve and gaskets are installed properly, then secure right muffler inlet pipe and Merc-O-Matic transmission oil filler pipe (if vehicle is so equipped) to exhaust manifold. Tighten nuts to 34-42 lbs. ft. torque.
12. Install left muffler inlet pipe on exhaust manifold and tighten retaining nuts to 34-42 lbs. ft. torque.
13. Install oil pan drain plug.
14. Install starter and dust shield. Connect starter cable to starter.
15. MERC-O-MATIC TRANSMISSION EQUIPPED VEHICLES:
    a. Install transmission linkage splash shield.
    b. Connect transmission oil transfer inlet and outlet lines to transmission. Secure oil transfer line mounting bracket to cylinder block.
16. Connect armature, field and ground wires to generator.

17. Install spark plug wiring loom grommet on cylinder block.
18. Install engine splash shield on frame front crossmember.
19. Lower vehicle, secure upper engine splash shield arms to frame side members.
20. Connect flexible fuel line to fuel pump.
21. POWER SURGE FAN EQUIPPED VEHICLES:
    a. Install water pump pulley and power surge clutch and fan assembly on the water pump hub.
22. If vehicle is equipped with power steering position power steering drive belt on rear crankshaft damper sheave.
23. Install fan-generator belt and adjust belt tension to 1/2" deflection.
24. Place a piece of heavy cardboard or fibre board over radiator core to protect it from damage during installation. Install radiator. Tighten retaining screws to 10-13 lbs. ft. torque. Connect lower hose to water pump.
25. MERC-O-MATIC TRANSMISSION EQUIPPED VEHICLES:
    a. Connect transmission inlet and outlet lines to lower radiator tank.
26. Connect upper radiator hose to water pump. Connect heater outlet hose to water pump. Connect heater inlet hose to fitting on intake manifold.
27. POWER STEERING EQUIPPED VEHICLES:
    a. Install power steering pump on mounting bracket.
    b. Install power steering drive belt. Adjust belt tension to 1/2" deflection.
28. Install engine ground strap on cylinder block. Connect coolant temperature sending unit wire and oil pressure gauge sending unit wire.
29. POWER SURGE FAN EQUIPPED VEHICLES:
    a. Connect power surge fan sending unit wire to sending unit.
30. Install control shaft assembly and accelerator shaft bracket on engine. Connect carburetor control shaft rod to carburetor. Install retract springs.
31. MERC-O-MATIC TRANSMISSION EQUIPPED VEHICLES:
    a. Install automatic starter cut out switch and connect wires to switch.
    b. Connect vacuum line to intake manifold connecter and automatic starter cut out switch.
32. Connect windshield wiper hose to vacuum booster line.
33. POWER BRAKE EQUIPPED VEHICLES:
    a. Connect vacuum brake booster hose to intake manifold connecter.
34. Install windshield washer container in mounting bracket and connect all vacuum and water hoses.
35. Connect primary and secondary wires to coil and resistor.
36. Install battery and connect cables to positive and negative terminals.
37. Install spark plugs. Tighten to 15-20 lbs. ft. torque. Connect spark plug wires to spark plugs.
38. Fill crankcase with engine oil (6 qts.). Close all drain cocks and fill cooling system with coolant. Check all hose connections for leaks.
39. MERC-O-MATIC TRANSMISSION EQUIPPED VEHICLES:
    a. Check automatic transmission fluid and fill to required level on dipstick.
40. Start engine and bring it up to normal operating temperature by operating at 1200 R.P.M. for approximately 30 minutes.
41. While engine is running during warm-up period, check for oil, fuel and water leaks.
42. Check the distributor timing, then check advance timing. For proper testing procedures refer to "Engine Electrical" section of this manual.
43. Perform final valve tappet adjustment (hot). The final valve lash setting is .019 inch. Refer to "Valve Tappet Adjustment" in this section of manual.
    NOTE: This operation is to be performed while engine is idling.
44. Check and set carburetor linkage. Adjust engine idle and carburetor air-fuel mixture.
45. Install rocker covers, seals and retaining nuts. Tighten nuts to 2-2½ lbs. ft. torque.
46. Install air cleaner and duct assembly.
47. Install hood assembly. Check hood alignment.
48. Adjust clutch pedal total travel and free travel.

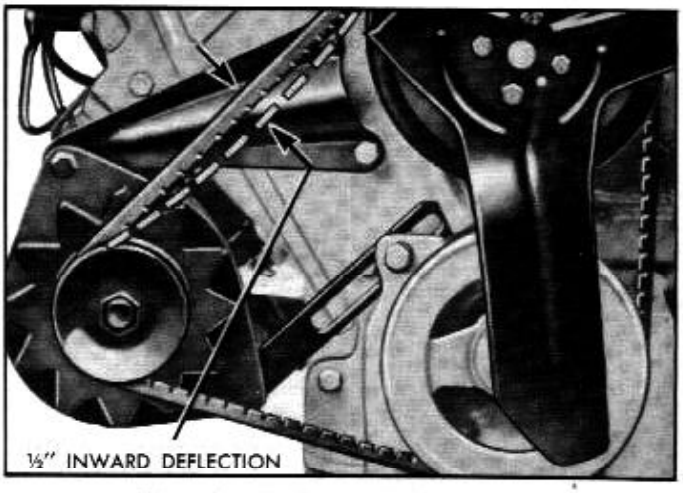


Fig. 6A-127—Fan Belt Deflection