1958

FORD CAR

SHOP MANUAL

RD DIVISION • FORD MOTOR COMPANY

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Shop Manual

SERVICE DEPARTMENT

FORD DIVISION

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INDEX

FOREWORD

This manual provides information for the proper servicing of 1958 Ford Cars, Station Wagons, Couriers, and Rancheros.

Service information on air suspension and air conditioning is covered in separate manuals.

The descriptions and specifications contained in this manual were in effect at the time the manual was approved for printing. The Ford Division of Ford Motor Company reserves the right to discontinue models at any time, or change specifications or design, without notice and without incurring obligation.

SERVICE DEPARTMENT
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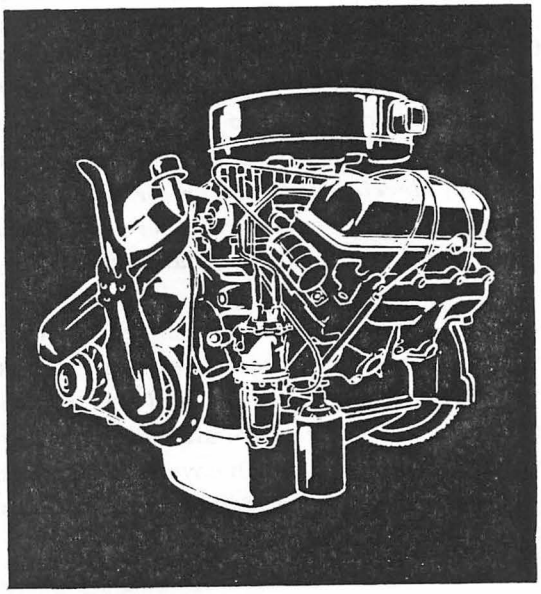
1958 Ford Car Shop Manual

GROUP 1

ENGINES



GROUP 1—ENGINES

Part 1

General Engine Service

The following service procedures apply to all engines. The cleaning, inspection, repair, and overhaul procedures of the component engine parts apply after the parts have been removed from the engine, or in the case of a complete engine overhaul, after the engine has been disassembled.

For removal, disassembly, assembly, and installation procedures, refer to Part 2, 3, or 4.

The specifications for all engines are listed in Part 5.

1. GENERAL ENGINE TROUBLE SHOOTING

Poor engine performance can be caused by the need of a general engine tune-up, by gradual wear of engine parts, or by a sudden parts failure. A good trouble diagnosis will indicate the need of a complete engine tune-up, individual adjustments, part(s) replacement or overhaul, or the need of a complete engine overhaul.

Engine performance complaints usually fall under one of the following basic headings: ***engine will not crank; engine cranks normally, but will not start; engine starts, but fails to keep running; engine runs, but misses; rough engine idle; poor acceleration; engine does not develop full power, or has poor high speed performance; excessive fuel consumption; engine overheats; or the engine fails to reach normal operation temperature.***

Table 1 is a general trouble shooting chart which lists troubles with procedures and checks to be ...e trouble in a ...ch check refers ... detail, checking made in the various systems. When a particular trouble can not be traced to a definite system by a simple check, the possible systems that could be at fault are listed in the order of their probable occurrence; therefore, in most cases, the checks should be made in the order listed. Some consideration, however, should be given to logical order. For example, if the spark plugs are removed for testing and they are not the cause of the trouble, and several checks later calls for a compression test, to save time, check the compression while the spark plugs are out.

Separate trouble shooting charts are included in the ignition, fuel, and cooling system sections of the manual. These charts list the basic troubles listed in Table 1, but cover only the items relating to the particular system under consideration. For example, in Table 1 under Poor Acceleration, the ignition system is listed as a probable cause of the trouble. In the Ignition System Trouble Shooting Chart under Poor Acceleration, all the ignition system items that affect acceleration are listed. These items should all be checked before proceeding to the next probable system listed in Table 1.

Table 1—General Engine Trouble Shooting

Engine Will Not Crank

The cause of this trouble is usually in the starting system (Group 8—Part 2).

If the starting system is not at fault, check for a hydrostatic lock or a seized engine. Remove the spark plugs, then attempt to crank the engine with the starter. If the engine cranks, it indicates that water is leaking into the cylinders. Remove the cylinder head(s) and inspect the gasket(s) and/or head(s) for cracks. Also examine the cylinder block for cracks.

Engine Cranks Normally, But Will Not Start

Check the fuel supply.

If there is sufficient fuel in the tank, the cause of the trouble probably lies in either the ignition or the fuel system.

To isolate the cause:

Remove the ignition wire from one spark plug, and insert a piece of proper sized metal rod in the insulator so that it protrudes from the insulator. With the ignition on and the starter cranking the engine, hold the end of the rod approximately $\frac{3}{16}$ inch from the cylinder block.

If there is no spark or a weak spark, the cause of the trouble is in the ignition system (Group 2—Part 1).

If the spark is good, check the spark plugs (Group 2—Part 1).

If the spark plugs are not at fault, check the fuel system (Group 2—Part 2).

If the fuel system is not at fault, check the valve timing (Group 1—Part 2, 3, or 4).

Engine Starts, But Fails to Keep Running

If the engine starts and runs for a few seconds, then stops, check the:

Fuel system (Group 2—Part 2).

Ignition system (Group 2—Part 1).

Engine Runs, But Misses

First, determine if the miss is steady or erratic and at what speed the miss occurs by operating the engine at various speeds under load.

MISSES STEADY AT ALL SPEEDS. Isolate the miss by operating the engine with one cylinder not firing. This is done by operating the engine with the ignition wire removed from one spark plug at a time, until all cylinders have been checked. Ground the spark plug wire removed.

If the engine speed changes when a particular cylinder is shorted out, that cylinder was delivering power before being shorted out. If no change in the engine operation is evident, the miss was caused by that cylinder not delivering power before being shorted out, check the:

Ignition system (Group 2—Part 1).

Engine compression to determine which mechanical component of the engine is at fault (page 1-7).

MISSES ERRATICALLY AT ALL SPEEDS. If the miss cannot be isolated in a particular cylinder, check the:

Exhaust gas control valve (page 1-9).

Ignition system (Group 2—Part 1).

Fuel system (Group 2—Part 2).

Engine compression to determine which mechanical component of the engine is at fault (page

ssive back pressure.

rnal leaks and/or for a condition that prevents the engine from reaching

ure (Group 2—Part 3).

Table 1—General Engine Trouble Shooting (cont'd)

MISSES AT IDLE ONLY. Check the:
- Fuel system (Group 2—Part 2).
- Ignition system (Group 2—Part 1).
- Vacuum booster pump, lines and fittings for leaks.
- Valve lash (Group 1—Part 2, 3, or 4).
- Engine compression for low compression (page 1-7).

MISSES AT HIGH SPEED ONLY. Check the:
- Ignition system (Group 2—Part 1).
- Fuel system (Group 2—Part 2).
- Cooling system for overheating or internal leakage (Group 2—Part 3).

Rough Engine Idle

Check the:
- Fuel system (Group 2—Part 2).
- Ignition system (Group 2—Part 1).
- Exhaust gas control valve (page 1-9).
- Valve lash (Group 1—Part 2, 3, or 4).
- Vacuum booster pump, lines and fittings for leaks.
- Power brake vacuum booster for leaks (Group 7—Part 2).
- Engine supports for looseness (Group 1—Part 2, 3, or 4).
- Improper cylinder head bolt torque (Group 1—Part 2, 3, or 4).

Poor Acceleration

Check the:
- Ignition system (Group 2—Part 1).
- Fuel system (Group 2—Part 2).
- Exhaust gas control valve (page 1-9).
- Valve lash (Group 2—Part 2, 3, or 4).
- Brakes for proper adjustment (Group 7).
- Clutch for slippage—Conventional Drive and Overdrive Transmission (Group 3—Part 1).
- Automatic transmission for proper adjustment.

Engine Does Not Develop Full Power, Or Has Poor High Speed Performance

Determine if the trouble exists when the engine is cold, at normal operating temperature, or at all engine temperatures.

ENGINE COLD. Check the:
- Exhaust gas control valve (page 1-9).
- Fuel system (Group 2—Part 2).
- Cooling system if the engine reaches operating temperature slowly (Group 2—Part 3).

ENGINE AT NORMAL OPERATING TEMPERATURE. Check the:
- Exhaust gas control valve (page 1-9).
- Fuel system (Group 2—Part 2).

ALL ENGINE TEMPERATURES. Check the:
- Engine compression (page 1-7).
- Ignition system (Group 2—Part 1).
- Fuel system (Group 2—Part 2).
- , or 4).
- .
- , 3, or 4).
- erheats (Group 2—Part 3).

Table 1—General Engine Trouble Shooting (cont'd)

Engine Does Not Develop Full Power, Or Has Poor High Speed Performance (cont'd) Exhaust system for excessive back pressure. Torque converter (Group 4—Part 3). Brake adjustment (Group 7). Tire pressure (Group 5—Part 3).
Excessive Fuel Consumption Determine the actual fuel consumption with test equipment installed in the car. If the test indicates that the fuel consumption is not excessive, demonstrate to the owner how improper driving habits will affect fuel consumption. If the test indicates that the fuel consumption is excessive, make a preliminary check of the items listed below before proceeding to the fuel and ignition systems. PRELIMINARY CHECKS Tires (Group 5—Part 3). Wheel alignment (Group 5—Part 1). Brakes (Group 7). Exhaust gas control valve (Group 1, Parts 2, 3, or 4). Odometer calibration (Group 9—Part 1). Ignition timing (Group 2—Part 1). Valve lash (Group 1—Part 2, 3, or 4). FUEL SYSTEM (Group 2—Part 2). IGNITION SYSTEM (Group 2—Part 1). ENGINE COMPRESSION (page 1-7). COOLING SYSTEM (Group 2—Part 3). TORQUE CONVERTER
Engine Overheats Temperature sending unit (Group 9—Part 1). Temperature gauge (Group 9—Part 1). Exhaust gas control valve (page 1-9). Cylinder head bolt torque (Group 1—Part 2, 3, or 4). Cooling system (Group 2—Part 3). Ignition timing (Group 2—Part 1). Valves (page 1-11). Exhaust system. Brakes (Group 7).
Engine Fails to Reach Normal Operating Temperature Temperature sending unit (Group 9—Part 1). Temperature gauge (Group 9—Part 1). Engine thermostat (Group 2—Part 3).

2. TUNE-UP

ıre for testing vari-
sary, bringing them
to restore engine efficiency and performance.

The Tune-Up Schedule (Table 2) is applicable for either a minor or major tune-up. A minor tune-up is

recommended each 6000 miles and a major tune-up is recommended each 12,000 miles. The reference after each operation refers to that part of the manual which describes, in detail, the procedure to be followed. Perform the operations in the sequence listed.

Table 2—Tune-Up Schedule

Operation	Perform on Minor	Perform on Major	Recommended Procedure
SPARK PLUGS Clean, adjust, and test.	X	X	Group 2 Part 1
ENGINE COMPRESSION Take compression reading of each cylinder.		X	Page 1-7
INTAKE MANIFOLD Check and adjust bolt torque.		X	Group 1 Part 2, 3, or 4
DRIVE BELTS Check and adjust the tension of all drive belts.	X	X	Group 2 Part 3
BATTERY Clean battery cables and terminals.		X	Group 8 Part 1
Tighten cable clamps.		X	
Grease battery terminals.		X	
Check battery state of charge.	X	X	
ELECTRICAL Oil generator rear bearing through oil cup—Ford 1-6 Engine.		X	Group 8 Part 1
Check generator output.		X	
Check starter motor current draw.		X	
Check coil output.		X	Group 2 Part 1
Perform a primary circuit resistance test.		X	
Perform a secondary circuit continuity test.		X	
DISTRIBUTOR Check the condition of the breaker	X		Group 2 Part 1

Operation	Perform on Minor	Perform on Major	Recommended Procedure
DISTRIBUTOR (Cont.) Lubricate the distributor cam. Oil the lubricating wick (Centrifugal Advance Distributor). Lubricate the distributor bushing through the oil cup.		X	Group 2 Part 1
Check and adjust point dwell.	X	X	
Check and adjust centrifugal advance (Centrifugal Advance Distributor).		X	
Check and adjust vacuum advance.		X	
Clean distributor cap and rotor.	X	X	
FUEL SYSTEM Clean fuel pump filter bowl.	X	X	Group 2 Part 2
Replace fuel pump filter bowl strainer.		X	
Check fuel pump pressure and capacity.		X	
Clean carburetor fuel bowl(s) and adjust float setting.		X	
ADJUSTMENTS Check and adjust ignition timing.	X	X	Group 2 Part 1
Check and adjust engine idle speed.	X	X	Group 2 Part 2
Adjust idle fuel mixture.	X	X	
Check and adjust valve lash.		X	Group 1 Part 2, 3, or 4
VACUUM Check manifold vacuum.	X	X	Page 1-7
EXHAUST Free the exhaust gas control valve.	X	X	Group 1 Part 1
COOLING SYSTEM Inspect the radiator, hoses, and engine for water leaks.		X	Group 2 Part 3
Add rust inhibitor to radiator.		X	

Manifold Vacuum Test

A manifold vacuum test aids in determining the condition of an engine and also in helping to locate the cause of poor engine performance. To test manifold vacuum:

1. Operate the engine for a minimum of ½-hour at 1200 rpm.
2. Install an accurate, sensitive vacuum gauge on the fuel pump end of the fuel pump vacuum line.
3. Operate the engine at recommended idle rpm.
4. Check the vacuum reading on the gauge.

TEST CONCLUSIONS. Manifold vacuum is affected by carburetor adjustment, valve timing, the condition of the valves, cylinder compression, and leakage of the manifold, carburetor, or cylinder head gaskets.

Because abnormal gauge readings may indicate that more than one of the above factors is at fault, exercise caution in analyzing an abnormal reading. For example, if the vacuum is low, the correction of one item may increase the vacuum enough so as to indicate that the trouble has been corrected. It is important, therefore, that each cause of an abnormal reading be investigated and further tests conducted where necessary in order to arrive at the correct diagnosis of the trouble.

Table 3 lists various types of readings and their possible causes. This table is merely a guide, however, and not a firm standard.

Allowance should be made for the affect of altitude on the gauge reading. The engine vacuum will decrease with an increase in altitude.

Engine Compression Test

1. Be sure the battery is good. Operate the engine for a minimum of ½ hour at 1200 rpm. Turn the ignition switch off, then remove all the spark plugs.
2. Set the throttle plates (primary throttle plates only on 4-barrel carburetors) and the choke plate in the wide open position.
3. Install a compression gauge in No. 1 cylinder.
4. Crank the engine until the gauge registers a maximum reading and record the reading. Note the number of compression strokes required to obtain the maximum reading.
5. Repeat the test on each cylinder, cranking the engine the same number of strokes for each cylinder as was required to obtain a maximum reading on No. 1 cylinder.

TEST CONCLUSIONS. A variation of ±10 pounds from specified pressure is satisfactory. However, the compression of all cylinders should be uniform within 10 pounds.

A reading of more than 10 pounds above normal indicates excessive deposits in the cylinder.

A reading of more than 10 pounds below normal indicates leakage at the head gasket, piston rings, or valves.

A low even compression in two adjacent cylinders indicates a head gasket leak. This should be checked before condemning the rings or valves.

To determine whether the rings or the valves are at fault, squirt the equivalent of a tablespoon of heavy oil in the combustion chamber, then crank the engine to

Table 3—Manifold Vacuum Gauge Readings

Gauge Reading	Engine Condition
18-19 inches (Ford I-6 Engine). 19-20 inches (Ford Y—V-8 and Interceptor V-8 Engines).	Normal.
Low and steady.	Loss of power in all cylinders caused possibly by late ignition or valve timing, or loss of compression due to leakage around the piston rings.
Very low.	Manifold, carburetor, or cylinder head gasket leak.
Needle fluctuates steadily as speed increases.	A partial or complete loss of power in one or more cylinders caused by a leaking valve, cylinder head or intake manifold gasket leak, a defect in the ignition system, or a weak valve spring.
Gradual drop in reading at engine idle.	Excessive back pressure in the exhaust system.
ittent fluctuation.	An occasional loss of power possibly caused by a defect in the ignition system or a sticking valve.
e.	Improper idle mixture adjustment, carburetor or intake manifold gasket leak, or possibly late valve timing.

distribute the oil and repeat the compression test. The oil will temporarily seal leakage past the rings. If approximately the same reading is obtained, the rings are satisfactory, but the valves are leaking. If the compression has increased 10 pounds or more over the original reading, there is leakage past the rings.

During a compression test, if the pressure fails to climb steadily and remains the same during the first two successive strokes, but climbs higher on the succeeding strokes, or fails to climb during the entire test, it indicates a sticking or stuck valve.

3. MANIFOLDS AND EXHAUST GAS CONTROL VALVE

Manifolds

Clean the manifolds in a suitable solvent, then dry them with compressed air. Scrape all carbon deposits from the center exhaust passage below the carburetor heat riser of the intake manifolds. This carbon acts as an insulator restricting the heating action of the hot exhaust gases.

Inspect the manifolds for cracks, leaks, or other defects that would make them unfit for further service. Replace all studs that are stripped or otherwise damaged. ***Remove all filings and foreign matter that may have entered the manifolds as a result of repairs.***

On the intake manifold for the Interceptor V-8 Engines, check the baffle plate on the underside of the manifold for looseness.

On the Ford Y—V-8 Engine, blow out the automatic choke passages of the intake manifold with compressed air. Make sure the passages are completely open, otherwise choke operation will be impaired. Check the automatic choke air heat tube that passes through the intake manifold for leaks, as follows:

Adjust a vacuum pump to obtain a steady reading of three inches of vacuum. Block off one opening of the tube with a moistened finger, then connect the vacuum pump 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.

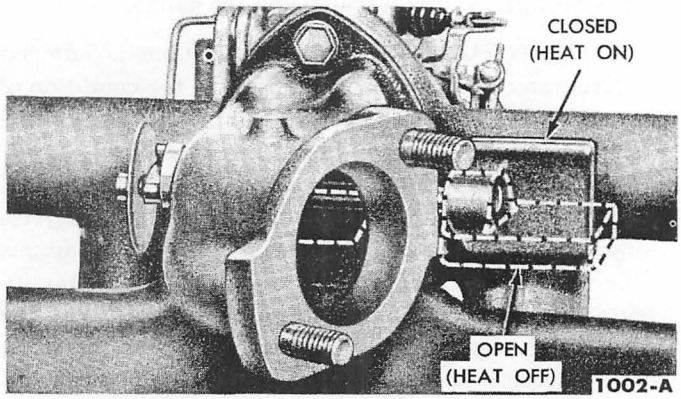


Fig. 2—Exhaust Gas Control Valve—Ford I-6 Engine

On the Interceptor V-8 Engines, clean out the automatic choke air heat chamber of the right exhaust manifold (Fig. 1). Make sure the air inlet and outlet holes are completely open. Blow out the automatic choke air heat tube with compressed air and check the tube for leaks as described for the Ford Y—V-8 Engine.

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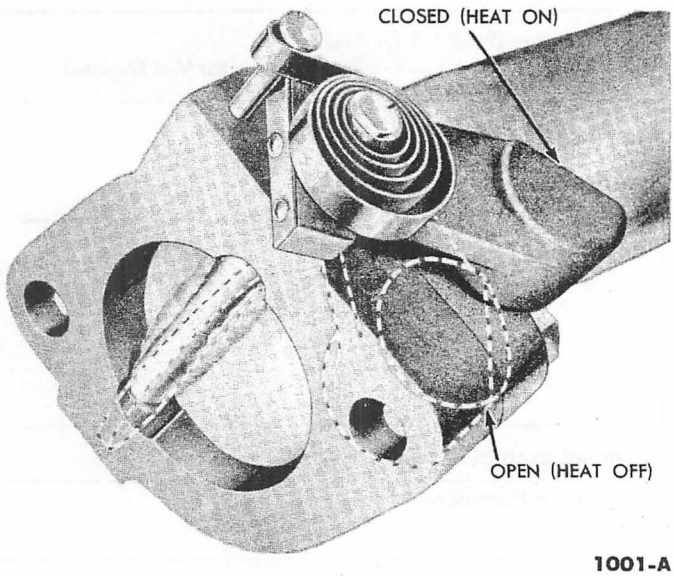


Fig. 3—Exhaust Gas Control Valve—Ford Y—V-8 and Interceptor V-8 Engines

Exhaust Gas Control Valve

Check the thermostatic spring to make sure it is hooked on the stop pin. The spring stop is at the top of the valve housing when the valve is properly installed. The action of the valve is illustrated in Fig. 2 or 3.

Check to make sure the spring holds the valve closed when the engine is cold. Actuate the counterweight by hand to make sure it moves freely through approximately 90° of rotation without binding.

The valve is closed when the engine is at normal operating temperature and running at idle speed. However, a properly operating valve will open when very light finger pressure is applied to the counterweight. Rapidly accelerate the engine to make sure the valve momentarily opens. The valve is designed to open when the engine is at normal operating temperature and is operated at high rpm. Free stuck valves with a penetrating oil and graphite mixture.

4. VALVE ROCKER ARM ASSEMBLY, PUSH RODS, AND CYLINDER HEADS

Valve Rocker Arm Assembly

Clean all the parts thoroughly. Make sure that all oil passages are open.

Check the clearance between each rocker arm and the shaft by checking the I.D. of the rocker arm bore and the O.D. of the shaft. If the clearance between any rocker arm and the shaft approaches the wear limit, replace the shaft and/or the rocker arm. Inspect the shaft and the rocker arm bore for nicks, scratches, scores, or scuffs. Dress up minor surface defects with a hone.

Inspect the pad at the valve end of the rocker arms for a grooved radius. If the pad is grooved, replace the rocker arm. ***Do not attempt to true this surface by grinding.***

Check the rocker arm adjusting screws and the push rod end of the rocker arms for stripped or broken threads, and the ball end of the adjusting screw for nicks, scratches, or excessive wear.

Check for broken locating springs. Inspect the oil tubes (Ford I-6 and Ford Y—V-8 Engines) for cracks or sharp bends.

Push Rods

Check the ball end and the socket end of the push rods for nicks, grooves, roughness, or excessive wear.

The push rods can be visually checked for straightness while they are installed in the engine by rotating them with the valve closed. They also can be checked between ball and cup centers with a dial indicator (Fig. 4). If the runout exceeds the maximum limit at any point, discard the rod. ***Do not attempt to straighten push rods.***

Typical

Cylinder Heads

To protect the machined surfaces of the cylinder head, do not remove the holding fixtures while the head is off the engine.

CLEANING AND INSPECTION. With the valves installed to protect the valve seats, remove carbon deposits from the combustion chambers and valve heads with a scraper and a wire brush. ***Be careful not to scratch the cylinder head gasket surface.*** After the valves are removed, clean the valve guide bores with a valve guide cleaning tool. Use cleaning solvent to remove old gasket sealer, dirt, and grease.

Check the cylinder head for cracks, and the gasket surface for burrs and nicks. Replace the head if it is cracked. ***Do not plane or grind more than 0.010 inch from the cylinder head gasket surface.*** Remove all burrs or scratches with an oil stone.

Cylinder Head Flatness. Check the flatness of the cylinder head gasket surface (Fig. 5). Specifications for flatness are 0.006 inch maximum overall, or 0.003 inch in any 6 inches.

Valve Seat Runout. Check the valve seat runout with

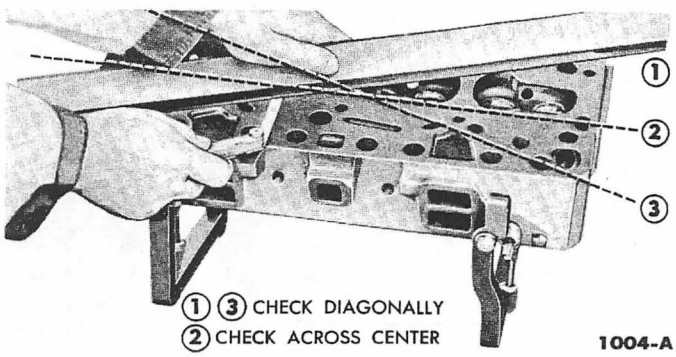


Fig. 5—Cylinder Head Flatness—Typical

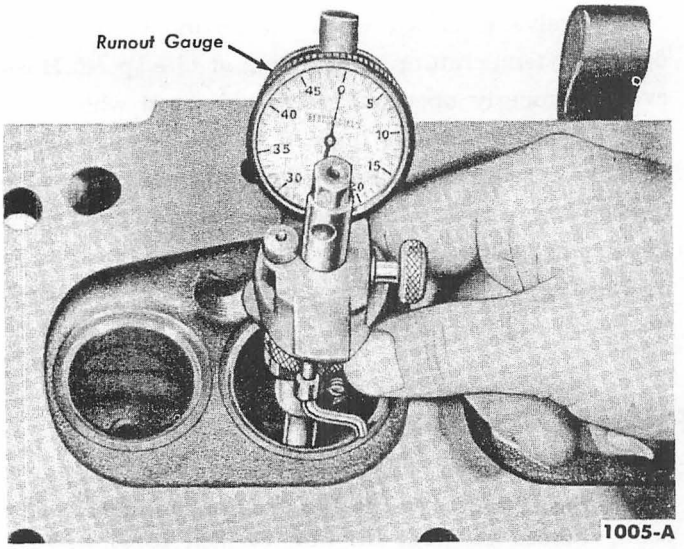


Fig. 6—Valve Seat Runout—Typical

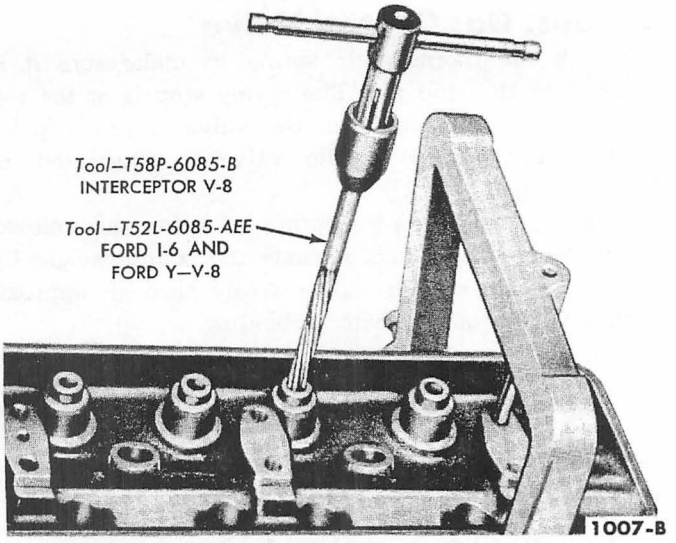


Fig. 8—Reaming Valve Guides—Typical

an accurate gauge (Fig. 6). Follow the instructions of the gauge manufacturer. The total runout should not exceed the wear limit.

Valve Seat Width. Measure the valve seat width (Fig. 7). The intake valve seat width limits are 0.060-0.080 inch and the exhaust valve seat width limits are 0.070-0.090 inch.

REAMING VALVE GUIDES. If it becomes necessary to ream a valve guide (Fig. 8) to install a valve with an oversize stem, a reaming kit is available which contains the following reamer and pilot combinations: a 0.003-inch O.S. reamer with a standard diameter pilot, a 0.015-inch O.S. reamer with a 0.003-inch O.S. pilot, and a 0.030-inch reamer with a 0.015-inch O.S. pilot.

When going from a standard size valve to an oversize valve, always use the reamers in sequence. ***Always reface the valve seat after the valve guide is reamed.***

REFACING VALVE SEATS. Refacing of the valve seats should be closely coordinated with the refacing of the valve face so the finished seat will match the valve face and be centered. This is important so that the valve and seat will have a good compression tight fit. Be sure that the refacer grinding wheels are properly dressed.

Grind the exhaust valve seat of all engines and the intake valve seat of the Ford I-6 and the Ford Y—V-8 Engines to a true 45° angle (Fig. 9). Grind the intake valve seat of the Interceptor V-8 Engines to a true 30° angle (Fig. 10). Remove only enough stock to clean up pits, grooves, or to correct the valve seat run-out. After the seat is ground, measure the seat width (Fig. 7). Narrow the seat, if necessary to bring it within limits.

If the valve seat width exceeds the maximum limits, remove enough stock from the top edge and/or bottom edge of the seat to reduce the width to specifications (Fig. 9 or 10).

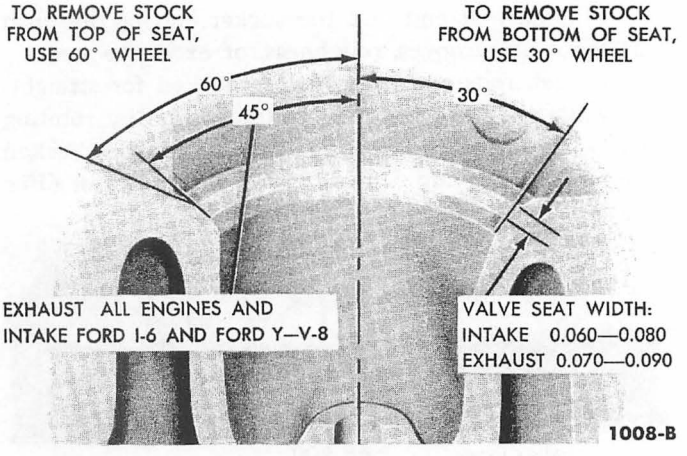


Fig. 9—Valve Seat Refacing—Exhaust All Engines and Intake Ford I-6 and Ford Y—V-8 Engines

On the exhaust valve seat of all engines and the intake valve seat of the Ford I-6 and the Ford Y—V-8 Engines, use a 30° angle grinding wheel to remove stock from the bottom of the seat (raise the seat) and use a 60° angle wheel to remove stock from the top of the seat (lower the seat).

On the intake valve seat of the Interceptor V-8 Engines, use a 15° angle grinding wheel to remove stock from the top of the seat (raise the seat).

The finished valve seat should contact the approximate center of the valve face. To determine where the valve seat contacts the face, coat the seat with Prussian blue, then set the valve in place. Rotate the valve with light pressure. If the blue is transferred to the center of the valve face, the contact is satisfactory. If the blue is transferred to the top edge of the valve face, lower the valve seat. If the blue is transferred to the bottom edge of the valve face, raise the valve seat.

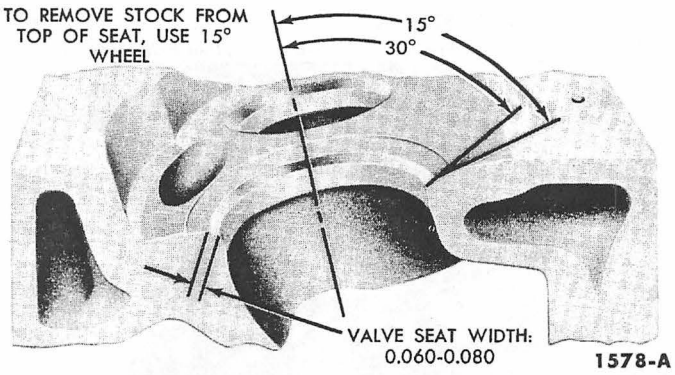


Fig. 10—Valve Seat Refacing—Intake Interceptor V-8 Engines

After refacing the valve seat, it is good practice to lightly lap in the valve with a medium grade lapping compound. Remove all the compound from the valve and seat after the lapping operation.

5. VALVE ASSEMBLY

Cleaning and Inspection

Remove all carbon and varnish from the valve with a fine wire brush or buffing wheel. The critical inspection points and tolerances of the valve are illustrated in Fig. 11.

Inspect the valve face and the edge of the valve head for pits, grooves, scores, or other defects. Inspect the stem for a bent condition and the end of the stem for grooves or scores. Check the valve head for signs of burning or erosion, warpage, and cracking. Defects, such as minor pits, grooves etc. may be removed. Discard valves that are severely damaged.

Inspect the valve springs (and valve damper springs on the Interceptor V-8 Engines), valve spring retainers, locks, and sleeves for defects. Discard any defective parts.

VALVE FACE RUNOUT. Check the valve face runout (Fig. 12). The wear limit is 0.002 inch total indicator reading.

VALVE STEM CLEARANCE. Check the valve stem to valve guide clearance of each valve in its respective valve guide with the tool shown in Fig. 13 or its equivalent.

Install the tool on the valve stem until fully seated and tighten the set screw, then permit the valve to drop away from its seal until the tool contacts the upper

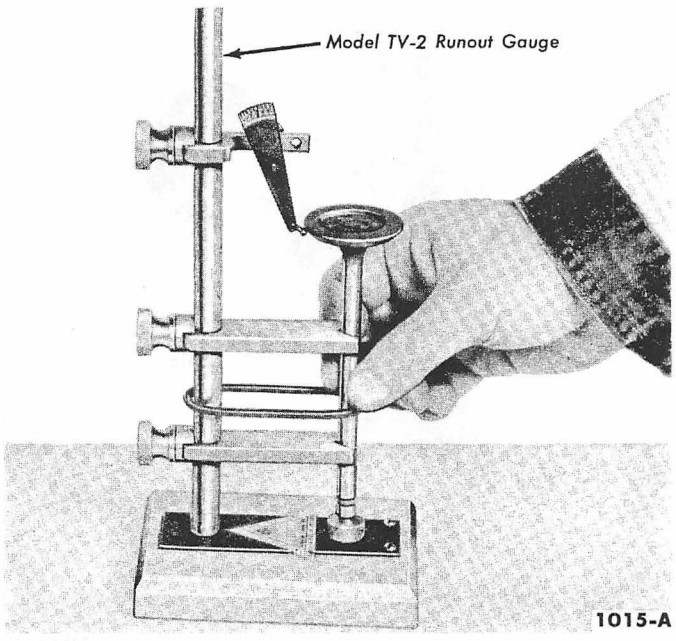


Fig. 12—Valve Face Runout

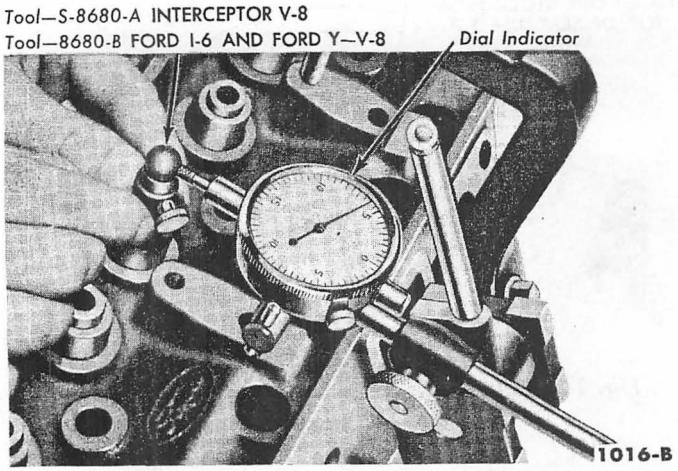


Fig. 13—Valve Stem Clearance—Typical

surface of the valve guide. Position a dial indicator with a flat tip against the center portion of the spherical section of the tool at approximately 90° to the valve stem. Move the tool back and forth on a plane that parallels normal rocker arm action and take the indicator reading without lifting the tool from the valve guide upper surface. Divide the indicator reading by 2 (division factor of the tool) to obtain the actual stem clearance. If the clearance approaches the wear limit, try a new valve.

VALVE SPRING PRESSURE. Check the valve spring for proper pressure (Fig. 14). ***Remove the damper spring from the valve spring of the Interceptor V-8 Engines before checking the pressure.*** Weak valve springs cause poor engine performance; therefore, if the

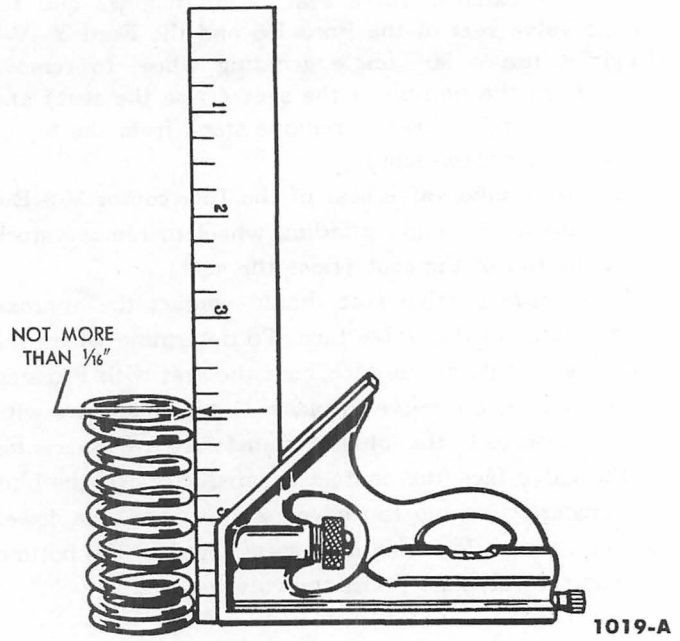


Fig. 15—Valve Spring Squareness

pressure of any spring approaches the wear limit, replace the spring.

VALVE SPRING SQUARENESS. Check each spring for squareness using a steel square and a surface plate (Fig. 15). Stand the spring and square on end on the surface plate. Slide the spring up to the square. Revolve the spring slowly and observe the space between the top coil of the spring and the square. If the spring is out of square more than $\frac{1}{16}$ inch, replace it.

Refacing Valves

The valve refacing operation should be closely coordinated with the valve seat refacing operation so that the finished angle of the valve face will match the valve seat. This is important so that the valve and seat will have a good compression tight fit. Be sure that the refacer grinding wheels are properly dressed.

If the valve face runout is excessive and/or to remove pits and grooves, reface the exhaust valves of all engines and the intake valves of the Ford I-6 and Ford Y—V-8 Engines to a true 45° angle. Reface the intake valves of the Interceptor V-8 Engines to a true 30° angle. Remove only enough stock to correct the runout or to clean up the pits and grooves. If the edge of the valve head is less than $\frac{1}{32}$ inch after grinding, replace the valve as the valve will run too hot in the engine.

Grind off all grooves or score marks from the end of the valve stem, then chamfer as necessary. Do not remove more than 0.010 inch from the stem.

After refacing the valves, it is good practice to lightly lap in the valves with a medium grade lapping compound to match the seats. Be sure to remove all the

compound from the valve and seat after the lapping operation.

Select Fitting Valves

If the valve stem to valve guide clearance approaches the wear limit, it is recommended that the valve guide be reamed for the next oversized valve stem (page 1-10). Valves with oversize stem diameters of 0.003, 0.015, and 0.030 inch are available for service. ***Always reface the valve seat when the valve guide is reamed.***

Valve Timing

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

Before the valve timing is checked, check for a bent timing pointer. Bring the No. 1 piston to T.D.C. on the compression stroke and see if the timing pointer is aligned with the T.D.C. mark on the damper.

If the valve timing is not within specifications, check the timing chain, camshaft sprocket, crankshaft sprocket, camshaft, and crankshaft in the order of accessibility.

To check the valve timing with the engine installed in the car, proceed as follows:

Install a quadrant on the crankshaft damper. Back off the No. 1 intake valve adjusting screw, then slide the rocker arm to one side and secure it in this position. 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 the push rod movement (Fig. 17). Turn the crankshaft damper slowly in the direction of rotation until the tappet is on the base circle of the camshaft lobe. At this point the push rod will be in its lowest position. Zero the dial indicator and continue turning the crankshaft slowly in the direction of rotation until the dial indicator registers the specified camshaft lobe lift (Table 4).

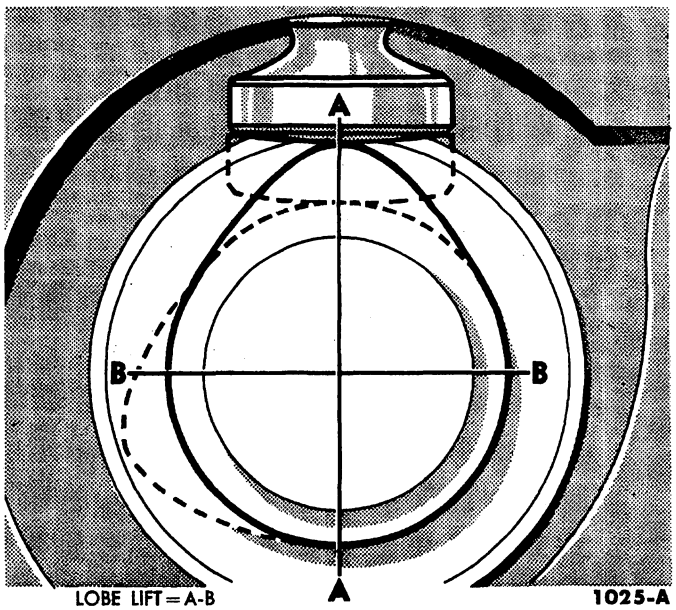


Fig. 16—Camshaft Lobe Lift Measurement

Compare the crankshaft degrees indicated on the quadrant with specifications (Table 4). After the valve opening is checked, continue to rotate the engine to check the valve closing.

Table 4—Valve Timing Specifications

Engine	Cubic Inch Displ.	Intake Valve				Exhaust Valve			
		Opens		Closes		Opens		Closes	
		Crankshaft Degrees	Camshaft Lobe Lift	Crankshaft Degrees	Camshaft Lobe Lift	Crankshaft Degrees	Camshaft Lobe Lift	Crankshaft Degrees	Camshaft Lobe Lift
Ford I-6	223	17° B.T.C.	0.016	53° A.B.C.	0.019	61° B.B.C.	0.016	9° A.T.C.	0.019
Ford Y—V-8	292	18° B.T.C.	0.015	58° A.B.C.	0.015	66° B.B.C.	0.013	10° A.T.C.	0.016
Interceptor V-8 and Interceptor V-8 "Special"	332	21° B.T.C.	0.017	51° A.B.C.	0.019	67° B.B.C.	0.017	9° A.T.C.	0.019
Interceptor V-8 "Thunderbird Special"	352	21° B.T.C.	0.017	51° A.B.C.	0.019	67° B.B.C.	0.017	9° A.T.C.	0.019

6. TIMING CHAIN, CAMSHAFT, AND BEARINGS

ing Chain

lean all parts in sol-
sed air. Inspect the
prockets for cracks,
mended that all the components be replaced if any one item needs replacement.

Camshaft and Bearings

CLEANING AND INSPECTION. Clean the camshaft in

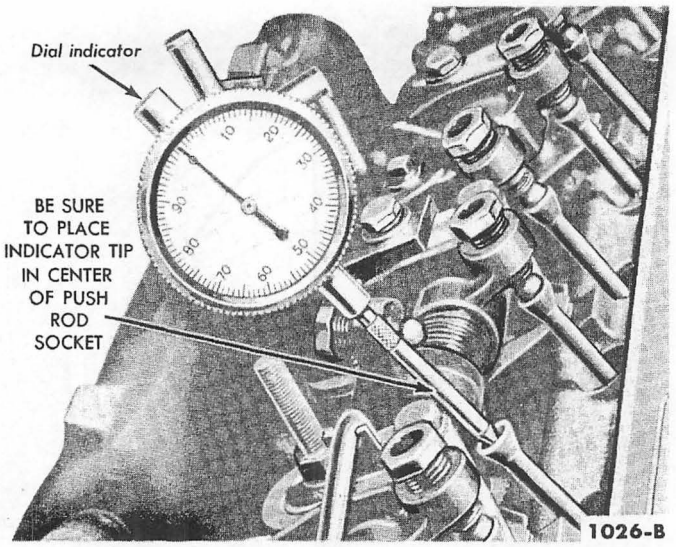


Fig. 17—Camshaft Lobe Lift—Typical

solvent and wipe dry. Inspect the camshaft lobes for pitting, scoring, and signs of abnormal 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 camshaft, therefore, the cam should not be replaced until the camshaft lobe lift loss has exceeded 0.005 inch. The lift of suspected worn lobes should be checked by measuring over the top of the lobe with a micrometer and subtracting the measurement of the base circle diameter (Fig. 16).

Check the camshaft journal to bearing clearances by measuring the diameter of the journals and the I.D. of the bearings. If the clearance approaches the wear limit, the camshaft journals should be ground for undersize bearings or the camshaft replaced, and/or the bearings should be replaced. Bearings are available prefinished to size for standard and 0.015-inch undersize journal diameters.

Check the distributor drive gear for broken or chipped teeth.

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

CAMSHAFT LOBE LIFT (CAMSHAFT INSTALLED). This procedure is similar to the procedure for checking valve timing. Loosen the valve rocker arm adjusting screw, then slide the rocker arm to one side and secure it in this position. 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 the push rod movement (Fig. 17). Turn the crankshaft damper slowly in the direction of rotation until the tappet is on the base circle of the camshaft lobe. At this point, the push rod will be in its lowest position. Set the dial indicator on zero, then continue to rotate the damper slowly until the push rod is in the fully raised position. Compare the total lift recorded on the indicator with specifications. Continue to rotate the engine until the indicator reads zero. This later step is a check on the accuracy of the original indicator reading.

7. CRANKSHAFT AND MAIN BEARINGS

Crankshaft

Handle the crankshaft with care to avoid possible fractures or damage to the finished surfaces.

CLEANING AND INSPECTION. Clean the crankshaft with solvent, then blow out all oil passages with compressed air.

Inspect main and connecting rod journals for cracks, scratches, grooves, or scores. Dress minor imperfections with an oilstone. Regrind severely marred journals.

Measure the diameter of each journal in at least four places to determine out-of-round, taper, or undersize condition (Fig. 18).

If the journals approach the wear limit, they should be reground to size for the next undersize bearing.

HING JOURNALS. Regrind the journal to undersize bear- give the proper cl bearing availa- b

Always reproduce the same journal shoulder radius that existed originally. Too small a radius will result in fatigue failure of the crankshaft. Too large a radius will

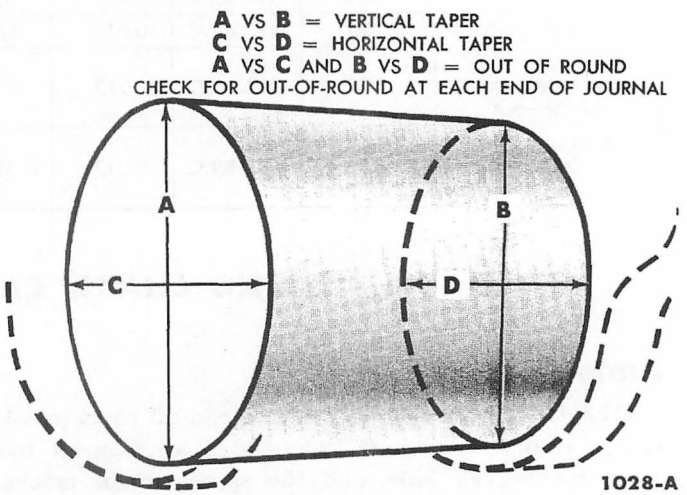


Fig. 18—Crankshaft Journal Measurements

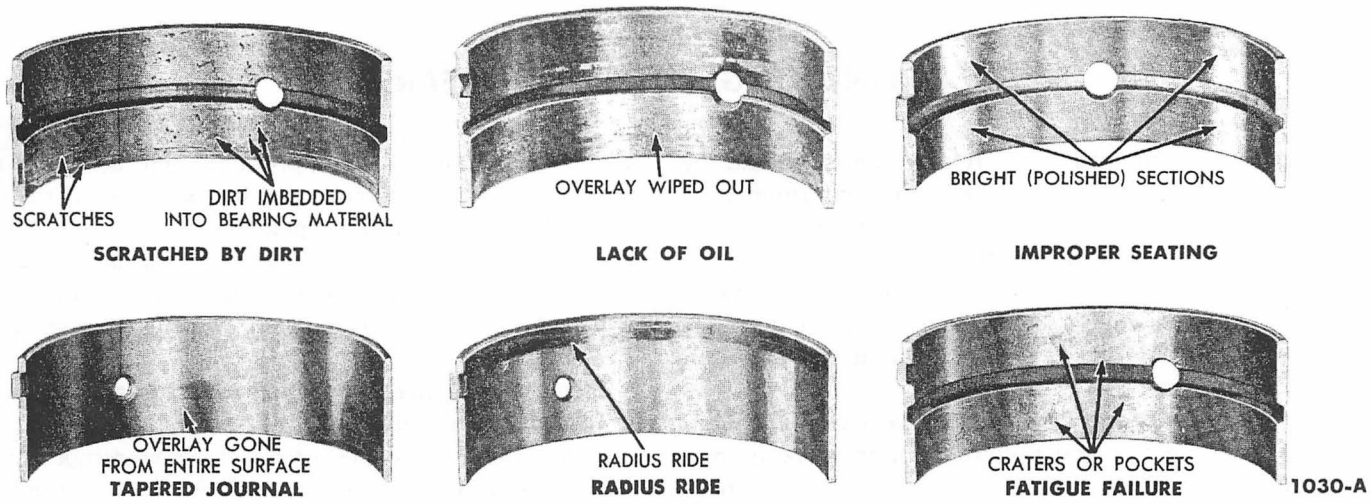


Fig. 19—Bearing Failures

result in bearing failure due to radius ride of the bearing.

After grinding, chamfer the oil holes, then polish the journal with a No. 320 grit polishing cloth and engine oil. Crocus cloth may be used also as a polishing agent.

Main Bearings

Clean the bearing inserts and cap thoroughly.

Inspect each bearing carefully. Bearings that have a scored, chipped, or worn surface should be replaced. Typical examples of bearing failures and their causes are shown in Fig. 19. Check the clearance of bearings that appear to be satisfactory with Plastigage. Fit new bearings following the recommended procedure (Part 2, 3, or 4).

8. FLYWHEEL

Conventional Flywheel

INSPECTION. Inspect the flywheel for cracks, heat check, or other defects that would make it unfit for further service. Machine the friction surface of the flywheel if it is scored or worn. If it is necessary to remove more than 0.045 inch of stock from the original thickness, replace the flywheel.

Inspect the ring gear for worn, chipped, or cracked teeth. If the teeth are damaged, replace the ring gear.

With the flywheel installed on the crankshaft, check the flywheel face runout.

FLYWHEEL FACE RUNOUT. Install a dial indicator so that the indicator point bears against the flywheel face (Fig. 20). Turn the flywheel making sure that it is full forward or rearward so that crankshaft end play will not be indicated as flywheel runout.

If the runout exceeds the maximum limit, remove the flywheel and check for burrs between the flywheel and the face of the crankshaft mounting flange. If no burrs check the runout of the crankshaft mounting chine the crankshaft runout is excessive.

verter drive plate

for cars with an automatic transmission is covered in Group 4.

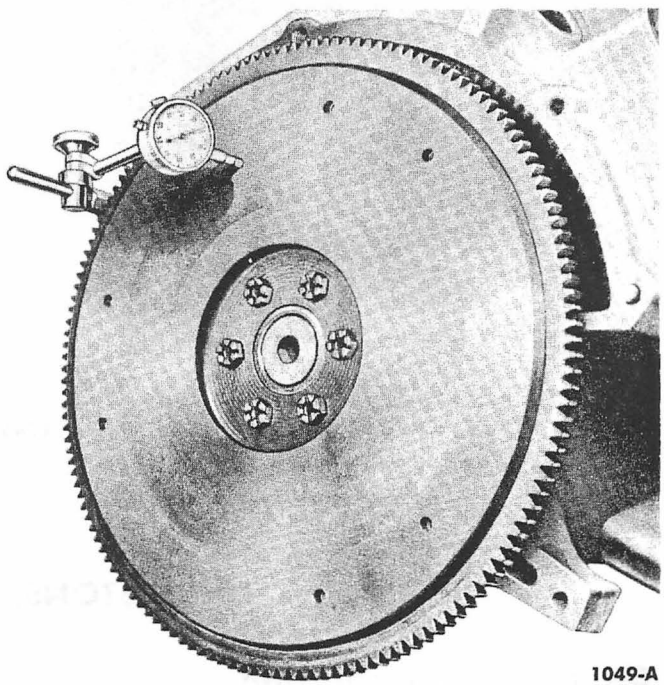


Fig. 20—Flywheel Face Runout—Typical

9. CONNECTING RODS AND BEARINGS

The connecting rods and related parts should be carefully inspected and checked for conformance to specifications. Various forms of engine wear caused by these parts can be readily identified.

A shiny surface on the pin boss side of the piston usually indicates that a connecting rod is bent or the piston pin hole is not in proper relation to the piston skirt and ring grooves (Fig. 21).

Abnormal connecting rod bearing wear can be caused by either a bent connecting rod, an improperly machined crankpin, or a tapered connecting rod bore (Fig. 22).

Twisted connecting rods will not create an easily identifiable wear pattern, but badly twisted rods will disturb the action of the entire piston, rings, and connecting rod assembly and may be the cause of excessive oil consumption.

Cleaning and Inspection

Clean the connecting rod in solvent, including the connecting rod bore and the back of the inserts ***Do not use a caustic cleaning solution.*** Blow out all passages with compressed air.

Inspect the connecting rods for signs of fractures and the bearing bores for out-of-round and taper. If the bore exceeds the recommended limits and/or if the rod is fractured, it should be replaced.

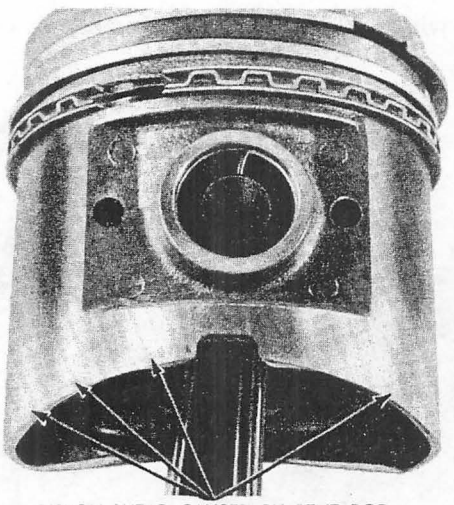
Check the piston pin to connecting rod bushing clearance. Replace the connecting rod if the bushing is so worn that it cannot be reamed or honed for an oversize pin.

Replace defective connecting rod nuts and bolts.

Inspect each connecting rod crankshaft journal for cracks, scratches, grooves, or scores. Dress minor imperfections with a smooth oilstone. Check each journal for out-of-round, taper, or undersize. If the journals exceed the maximum limits and/or if they are severely marred, they should be reground to size for the next undersize bearing.

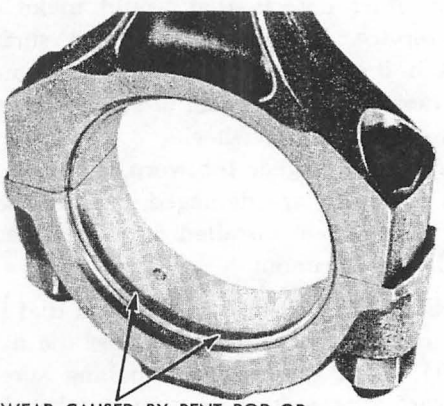
Inspect each bearing carefully. Replace bearings that have a scored, chipped, or worn surface. For the different types of bearing failures and their causes refer to Fig. 19. Check the clearance of bearings that appear to be satisfactory. Fit new bearings where necessary, following the recommended procedure (Group 1—Part 2, 3, or 4).

After the connecting rods are assembled to the piston, check them for bend or twist on a suitable alignment fixture. Follow the instructions of the fixture manufacturer. If the bend and/or twist is excessive, the connecting rod should be straightened or replaced.



PISTON WEAR CAUSED BY BENT ROD OR MISALIGNED PISTON PIN HOLE 1045-A

Fig. 21—Wear Pattern On Piston Pin Boss Surface—Typical



BEARING WEAR CAUSED BY BENT ROD OR IMPROPER GRINDING OF CRANKSHAFT JOURNAL 1046-A

Fig. 22—Wear Pattern On Connecting Rod Bearing—Typical

10. PISTONS, PINS, AND RINGS

n surfaces and from the underside of the piston head. Clean gum or varnish from the piston skirt, piston pins, and rings with

solvent. ***Do not use a caustic cleaning solution or a wire brush to clean pistons.*** Clean the ring grooves with a ring groove cleaner (Fig. 23). Make sure the oil ring slots (or holes) are clean.

Carefully inspect the pistons for fractures at the ring lands, skirt, and pin bosses, and for scuffed, rough, or scored skirts. If the lower inner portion of the ring grooves have high steps, replace the piston. The step will interfere with ring operation and cause excessive ring side clearance.

Spongy, eroded areas near the edge of the top of the piston are usually caused by detonation, or pre-ignition. A shiny surface on the thrust surface of the piston, offset from the centerline between the piston pin holes, can be caused by a bent connecting rod. The normal wear pattern of a piston is shown in Fig. 24. Replace pistons that show signs of excessive wear, wavy ring lands, fractures, and/or damage from detonation or pre-ignition.

Check the piston to cylinder bore clearance with a tension scale and ribbon and the ring side clearance following the recommended procedures.

Replace piston pins showing signs of fracture or etching and/or wear. Check the piston pin fit in the piston and rod bushing.

Replace all rings that are scored, chipped, or cracked. Check the end gap and side clearance. It is good practice to always install new rings when overhauling the engine. ***Rings should not be transferred from one piston to another regardless of mileage.***

Fitting Pistons

Pistons are available for service in standard sizes and oversizes for use in cylinders that have been rebored. Pistons of 0.020, 0.030, 0.040, and 0.060-inch oversize are available for most engines. Check the parts catalogue for sizes available.

The piston and cylinder block should be at room temperature (70°F) when the piston fit is checked. ***After any refinishing operation, allow the cylinder bore to cool before the piston fit is checked.***

Calculate the size piston to be used by taking a cylinder bore check (Fig. 27), then select the proper size piston to provide the desired clearance.

Make sure the piston and cylinder bore are clean and dry. Attach a tension scale to the end of a feeler gauge ribbon that is free of dents or burrs. The feeler ribbon should be ½-inch wide and of the recommended thickness for the existing condition.

sition the ribbon in the cylinder bore so that it ex- ton at 90° from the on and install it in is about 1½ inches and the piston pin

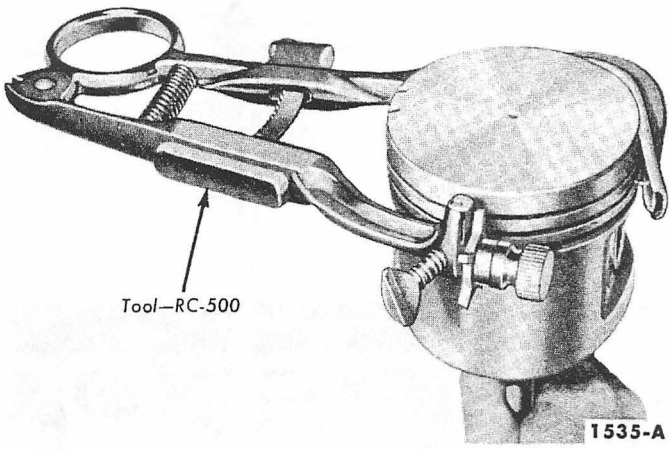


Fig. 23—Cleaning Ring Grooves—Typical

Hold the piston and slowly pull the scale in a straight line with the ribbon, noting the pull required to remove the feeler ribbon (Fig. 25).

If the pull is within limits for the existing condition, the piston fit is satisfactory.

If the scale reading is greater than the maximum allowable pull, recheck calculations to be sure that the proper size piston has been selected, check for a damaged piston, then try a new piston.

If the scale reading is less than the minimum allowable pull, recheck calculations before trying another piston. If none can be fitted, refinish the cylinder for the next size piston.

When a piston has been fitted, mark it for assembly in the cylinder to which it was fitted.

If the taper and out-of-round conditions of the cylinder bore are within limits, new piston rings will give satisfactory service provided the piston clearance in the cylinder bore is within limits. If the new rings are to be installed in a used cylinder that has not been refinished, remove the cylinder wall "glaze."

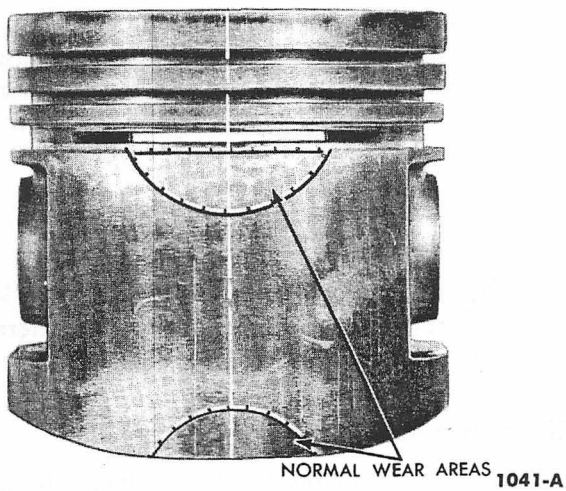


Fig. 24—Normal Piston Wear Pattern—Typical

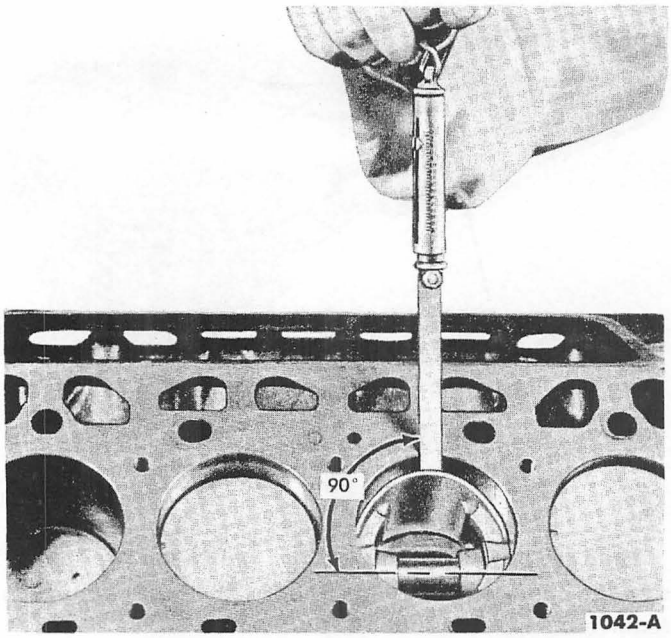


Fig. 25—Checking Piston Fit—Typical

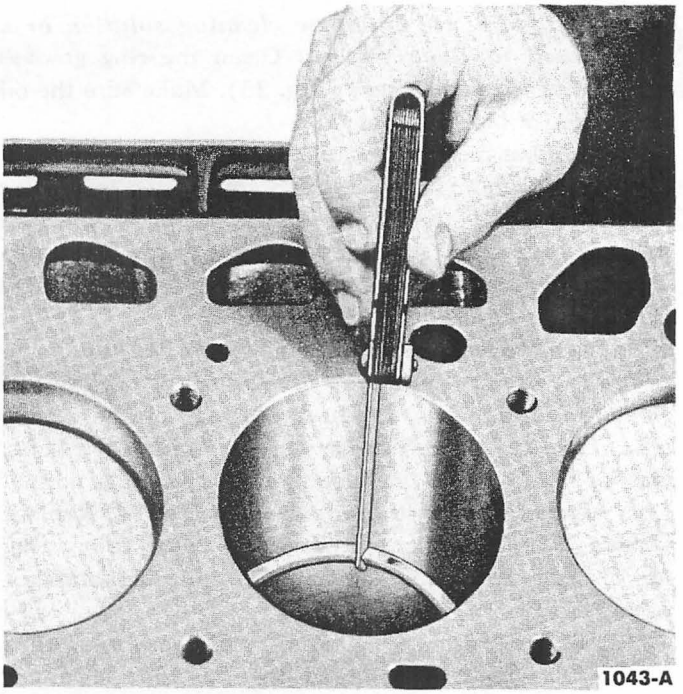


Fig. 26—Measuring Piston Ring Gap—Typical

Select the proper ring set for the size piston to be used. The rings must be checked for proper gap in the cylinder bore and for the proper side clearance in the piston grooves. First, check each ring for proper gap as follows:

Position the ring in the cylinder bore in which it is going to be used. Push the ring down into the cylinder bore area where normal ring wear is not encountered. Use the head of a piston to position the ring so that the ring is square with the cylinder wall. ***Use caution to avoid damage to the ring or cylinder bore.*** Measure the gap between the ends of the ring with a feeler gauge (Fig. 26).

If the gap is less than the recommended lower limit, try another ring set.

Fitting Piston Pins

The piston pin fit should be a light thumb press fit at normal temperature (70°F). Standard piston pins are color coded green. Pins of 0.001 inch oversize (color coded blue) and 0.002 inch oversize (color coded yellow) are available.

If the pin hole in the piston must be reamed, use an expansion-type, piloted reamer. Place the reamer in a vise and revolve the piston around the reamer. Set the reamer to the size of the pin bore, then expand the reamer slightly and trial ream the pin bore. Take a light cut. Use a pilot sleeve of the nearest size to maintain alignment of the bores.

Check the hole size, using the new piston pin. If the bore is small, expand the reamer slightly and make another cut. Repeat the procedure until the proper fit is obtained. Check the fitted piston pin for fit in the respective rod bushing. If necessary, ream or hone the bushing to fit the pin.

Install the piston pin in the piston and rod. Install a new retainer at each end of the pin to hold it in place. When the retainers are installed, make sure they are properly seated in the grooves provided in the piston pin bore.

11. CYLINDER BLOCK

During the disassembly of the cylinder block for engine overhaul, closely inspect the wear pattern on all pa[illegible]d diagnose the cause of wear.

[illegible] Remove old gas[illegible]. Remove all pipe plugs which seal oil passages, then clean out all the passages. Blow out all passages, bolt holes, etc. with compressed air. Make sure the threads in the head bolt holes are clean. Dirt in the threads may cause binding and result in a false torque reading. Use a tap to true-up threads and to remove any deposits.

After the block has been thoroughly cleaned, make a check for cracks. Minute cracks not visible to the naked

eye may be detected by coating the suspected area with a mixture of 25% kerosene and 75% light motor oil. Wipe the part dry and immediately apply a coating of zinc oxide dissolved in wood alcohol. If cracks are present, the coating will become discolored at the defective area. Replace the block if it is cracked.

Check all machined gasket surfaces for burrs, nicks, scratches, and scores. Remove minor imperfections with an oil stone. Check the flatness of the cylinder block gasket surface following the procedure and specifications recommended for the cylinder head (page 1-9).

Replace all expansion-type plugs that show evidence of leakage.

Inspect the cylinder walls for scoring, roughness, or other signs of wear. Check the cylinder bore for out-of-round and taper. Measure the bore with an accurate gauge following the instructions of the manufacturer. Measure the diameter of each cylinder bore at the top, middle, and bottom with the gauge placed at right angles and parallel to the centerlines of the engine (Fig. 27).

Rebore cylinders that are deeply scored and/or when out-of-round and/or taper approach the wear limits.

If the cylinder walls have minor surface imperfections, but the out-of-round and taper are within limits, it may be possible to remove the imperfections by honing the cylinder wall and installing new service piston rings providing the piston clearance is within limits. Use the finest grade of honing stone for this operation.

Refinishing Cylinder Walls

Honing is recommended for refinishing cylinder walls only when the walls have minor imperfections, such as light scuffs, scratches, etc. The grade of hone to be used is determined by the amount of metal to be removed. Follow the instructions of the hone manufacturer. If coarse stones are used to start the honing operation, leave enough material so that all hone marks can be removed with the finishing hone which is used to obtain the proper piston clearance.

Cylinder walls that are severely marred and/or worn beyond the specified limits should be rebored. Before any cylinder is rebored, all main bearing caps must be in place and tightened to the proper torque so that the crankshaft bearing bores will not become distorted from the boring operation.

Rebore only the cylinder or cylinders that require it.

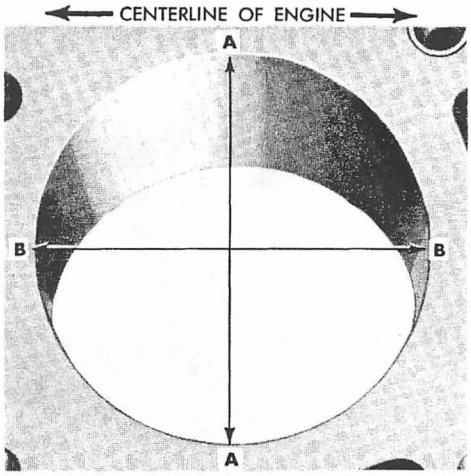


Fig. 27—Cylinder Bore Out-of-Round And Taper

All pistons are the same weight, both standard and oversize; therefore, various sized pistons can be intermixed without upsetting engine balance.

Rebore the cylinder with the most wear first to determine the maximum oversize. If the cylinder will not clean up when bored for the maximum oversize piston recommended, replace the block.

Rebore the cylinder to within approximately 0.0015 inch of the required oversize diameter. This will allow enough stock for the final step of honing so the correct surface finish and pattern are obtained. Use clean sharp hones of No. 220-280 grit for this operation.

For the proper use of the boring equipment follow the instructions of the manufacturer. Only experienced personnel should be allowed to perform this work.

After the final operation in either of the two refinishing methods described above and prior to checking the piston fit, thoroughly wash the cylinder walls with solvent to remove all abrasive particles, then thoroughly dry. Check the piston fit (page 1-17). Mark the pistons to correspond to the cylinders in which they are to be installed. When the refinishing of all cylinders that require it has been completed and all pistons fitted, thoroughly clean the entire block to remove all particles from the bearing bores, oil passages, cylinder head bolt holes, etc. Coat the cylinder walls with oil.

12. OIL PAN AND OIL PUMP

s from the inside of
ial from the gasket surface. Wash the pan in a solvent and dry it thoroughly. Be sure all foreign matter is removed from below the baffle plate.

Check the pan for cracks, holes, damaged drain plug

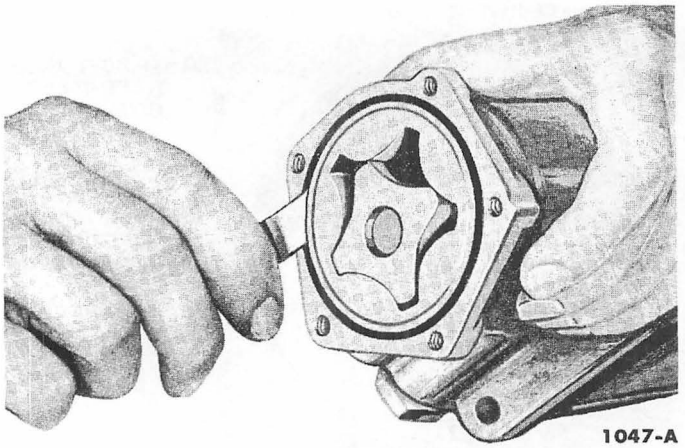


Fig. 28—Outer Race to Housing Clearance—Rotor Oil Pump

threads, a loose baffle, and a nicked or warped gasket surface.

Repair any damage, or replace the pan if repairs cannot be made.

Rotor-Type Oil Pump (Ford Y—V-8 and Interceptor V-8 Engines)

Wash all parts in a solvent and dry them thoroughly. Use a brush to clean the inside of the pump housing and the pressure relief valve chamber. Be sure all dirt and chips are removed.

Check the inside of the pump housing and the outer race and rotor for damage or excessive wear.

Check the mating surface of the pump cover for wear. If the cover mating surface is worn, scored, or grooved, replace the cover.

Measure the outer race to housing clearance (Fig. 28).

With the rotor assembly installed in the housing, place a straight edge over the rotor assembly and the housing. Measure the clearance between the straight edge and the rotor and outer race (Fig. 29).

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

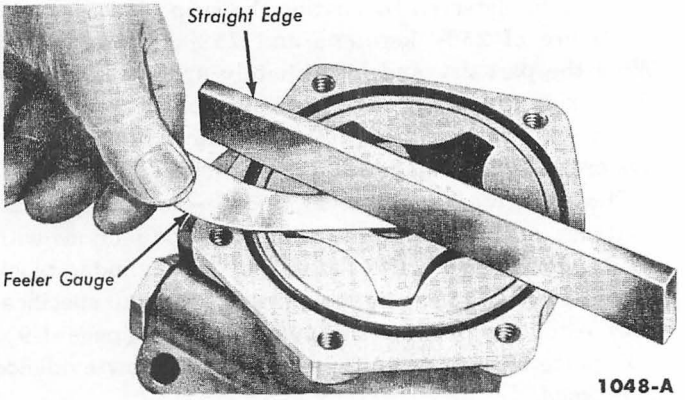


Fig. 29—Rotor End Play—Rotor Oil Pump

Check the drive shaft to housing bearing clearance by measuring the O.D. of the shaft and the I.D. of the housing bearing.

Inspect the relief valve spring for a collapsed or worn condition.

Check the relief valve spring tension. If the spring tension is not within specifications and/or the spring is defective, replace the spring.

Check the relief valve piston for scores and free operation in the bore.

Gear-Type Oil Pump (Ford I-6 Engine)

Wash all parts in a solvent and dry them thoroughly. Use a brush to clean the inside of the pump housing and the pressure relief valve chamber. Be sure all dirt and chips are removed. Remove old gasket material from the pump body and cover.

Inspect the pump body and the gear teeth for damage or wear. Check the gear end clearance with a dial indicator or Plastigage. The Plastigage method is as follows:

Position the gasket on the housing, then place Plastigage on the gears and install the cover. Remove the cover and check the Plastigage reading.

Check the gears for freedom of rotation. Check the compression of the oil pressure relief valve spring and check the clearance of the relief valve in the valve chamber.

13. EXHAUST SYSTEM

The exhaust system must be free of restrictions, leaks and excessive vibration. Leaks can usually be detected visually, or in some cases, a whistling noise may be heard at the pipe connections. All the parts of the system are replaceable.

Check the various sections of the exhaust system for [illegible] the slots in the [illegible] be blocked by [illegible]. However, the [illegible] ater than 1¾ inches. To correct leakage at the muffler connections, reposition the inlet and outlet pipes. Replace all sections that show signs of burning through.

Check for possible interference between the outlet pipe "kick-up" and the floor pan and the fuel tank. If the clearance is insufficient, reposition the outlet pipe in the muffler.

Exhaust system vibrations are usually caused by broken or improperly aligned clamps. Align or replace clamps as necessary.

GROUP 1—ENGINES

Part 2

Ford I-6 Engine

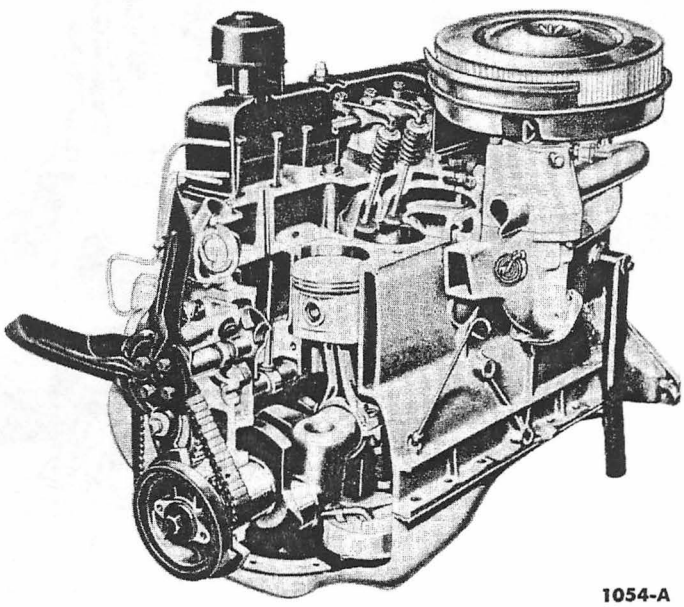
The service procedures given are for the engine installed in the chassis unless otherwise noted. Cleaning, inspection, repair, and overhaul procedures are covered in Part 1, "General Engine Service."

1. DESCRIPTION

The Ford I-6 Engine (Figs. 1 and 2) is a 6-cylinder engine with a piston displacement of 223 cubic inches and a compression ratio of 8.6:1. The engine may be identified by a decal on the valve rocker arm cover bearing the name of the engine. It can be identified also by the letter "A" at the beginning of the serial number on the patent plate. The Ford I-6 Engine is available in all car models except the Retractable Hardtop and the Conventional Convertible.

1053-B

Front View



1054-A

Fig. 2—Ford I-6 Engine—Left Front Sectional View

Manifolds

A chamber (heat riser) is cast into the intake manifold center section between the carburetor and exhaust manifold. A thermostatically controlled valve, located in the exhaust manifold, directs exhaust gases into this area to provide the heat necessary to assist in vaporizing the incoming fuel mixture.

Cylinder Head and Block

The cylinder head carries the valves, valve rocker arm assembly, manifold assembly, ignition coil, the water outlet and thermostat. Valve guides are cast integral in the head.

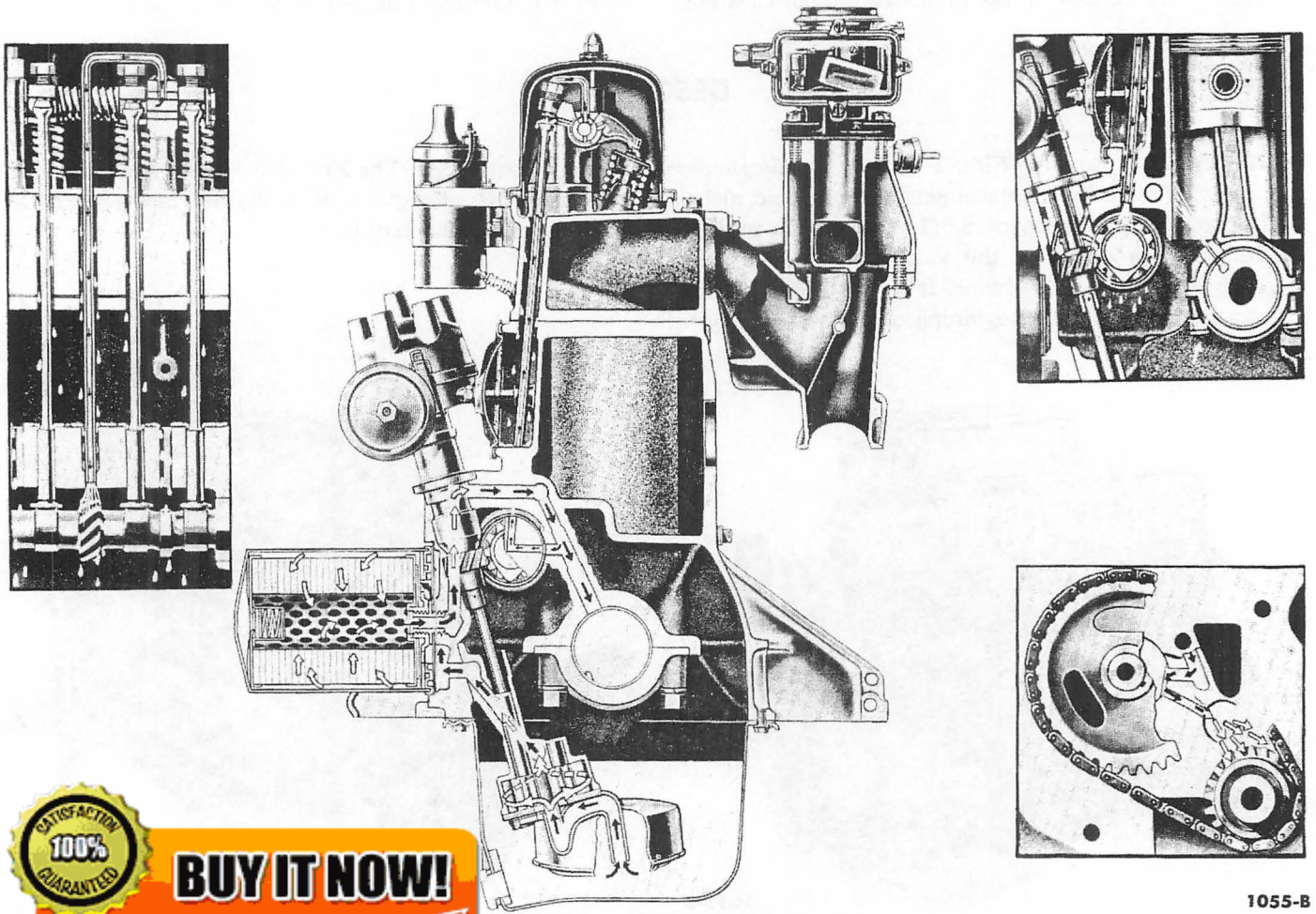
Both the intake and exhaust valve assemblies are the rotating-type which rotate each time the valve opens and closes. Lubrication of the valve stems is controlled by umbrella-type valve stem seals which fit over the top of the valve stems. The valve springs have equal coil spacing which provides more positive valve action at high engine speed. Easy maintenance of valve lash is afforded by self locking adjusting screws.

The camshaft is supported by four insert-type bearings pressed into the block. It is driven by a sprocket and timing chain in mesh with a sprocket on the crankshaft. Camshaft thrust is controlled by a thrust washer located between the camshaft sprocket and the front journal of the camshaft. An eccentric, made integral with the camshaft, operates the fuel pump. The tappets are the solid steel, mushroom-type. The push rods are one-piece tubular steel with oil cushioned sockets.

The crankshaft is supported by four insert-type main bearings. Crankshaft end thrust is controlled by the flanges of the No. 3 main bearing.

The forged steel, "I" section connecting rods contain a bronze piston pin bushing. The connecting rod bearings are the insert-type.

The aluminum alloy, three ring, flat head-type pistons are of the autothermic design. This design provides controlled piston expansion which allows closer initial piston fits without binding or excessive friction. The top compression ring is chrome-plated and the lower compression ring is phosphate-coated for extra protection against wear and scuffing. The oil control ring assembly consists of a serrated spring and two chrome-plated steel rails.



1055-B

Fig. 3—Lubrication System

Engine Lubricating System

Oil from the oil pan sump is forced through the pressure-feed lubricating system (Fig. 3) by a gear-type pump mounted inside the crankcase. The pump is driven by the distributor through an intermediate drive shaft. A spring loaded relief valve in the pump limits the maximum pressure of the system. The oil relieved by the valve is directed back to the intake side of the pump.

The engine is equipped with a full flow filter which filters the entire output of the pump before the oil enters the engine. The filter has an integral relief valve and mounting gasket. The relief valve permits oil to bypass the filter if it becomes clogged, thereby maintaining an emergency supply of oil to the engine at all times. An anti-drain back diaphragm prevents a reverse flow of oil when the engine is stopped.

The main oil gallery supplies oil to all the camshaft and main bearings through a drilled passage in each main bearing web.

The timing chain and sprockets are lubricated through a flat on the No. 1 camshaft bearing.

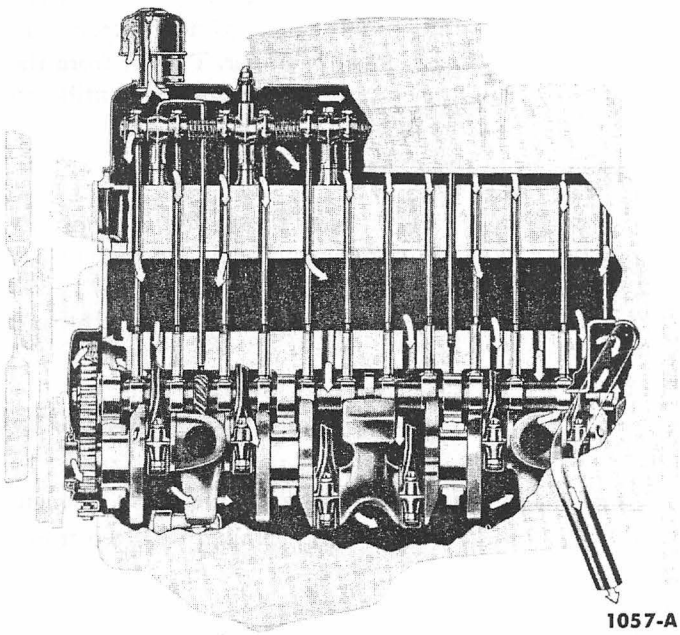
Oil slingers are provided to prevent leakage by directing oil away from the crankshaft front and rear oil seals. The front slinger is located between the crankshaft damper and the crankshaft sprocket and throws the oil onto the timing chain. The oil then drips into the oil pan. The rear slinger is part of the crankshaft and deflects oil into the slinger trough which empties the oil back into the oil pan.

Cylinder walls, pistons, and piston pins are lubricated through a drilled hole in each connecting rod which indexes with a drilled hole in the connecting rod journal of the crankshaft.

Oil under reduced pressure is fed to the valve rocker arm assembly through a drilled passage in the cylinder block at the No. 3 camshaft bearing which indexes with a hole in the cylinder head. An oil inlet tube directs the oil into the hollow rocker shaft through the No. 6 valve rocker arm support. The oil from the shaft flows through drilled holes in each rocker arm to lubricate the rocker arm bushing and the valve and ball end of the rocker arm. The excess oil spirals down the rotating push rod and assists in lubricating the tappet and push rod seat. An oil outlet tube exhausts excess oil from the rocker shaft to lubricate the distributor lower bushing and distributor drive gears. The oil outlet tube is located at the No. 1 rocker arm support. The oil from each rocker arm drains into the push rod chamber through provided in the cylinder head.

r drains back into e back of the block.

by the combina-

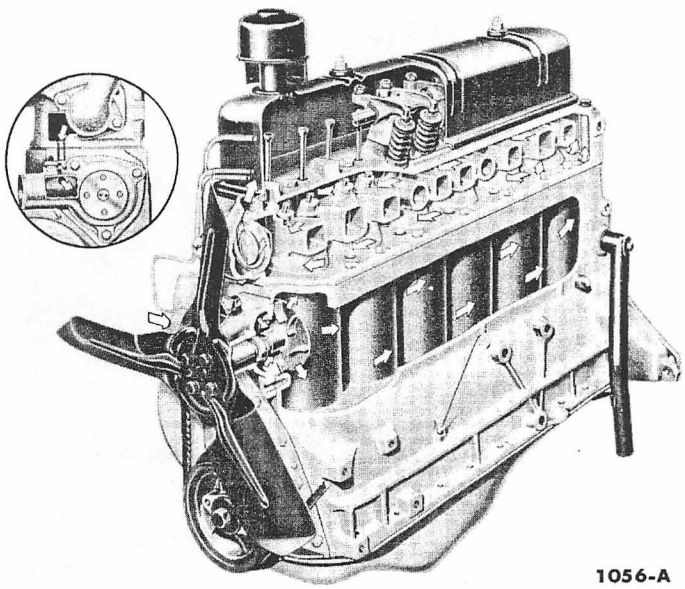


1057-A

Fig. 4—Crankcase Ventilation System

tion oil filler and breather cap located on the front of the valve rocker arm cover. The oil filler cap contains a maze filtering element.

From the filler cap, the filtered air flows into the front section of the valve rocker arm chamber. There are relatively few contaminating vapors at this point and the air has a chance to normalize its temperature before contacting contaminating vapors originating in the crankcase. This warm ventilating air minimizes the formation of crankcase sludge. The ventilating air



1056-A

Fig. 5—Cooling System

moves down past the push rods into the crankcase. Air is diverted from the front section of the crankcase through holes in the front of the cylinder block wall to ventilate the timing chain chamber. The air from the crankcase is then directed into the crankcase ventilation tube by the rotating action of the crankshaft.

Cooling System

The coolant is drawn from the lower tank of the radiator by the water pump which delivers the coolant to the cylinder block (Fig. 5).

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

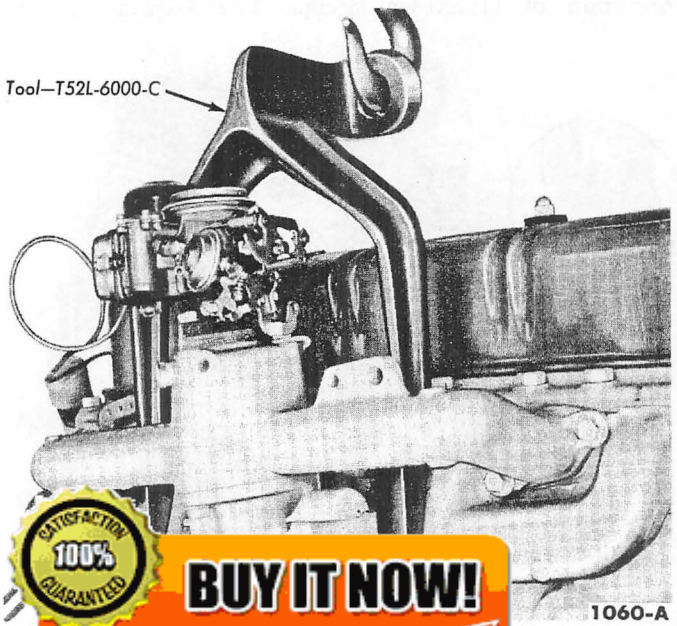
At this point, the coolant flows into the water outlet connection, past the water thermostat if it is open, into the upper tank of the radiator. If the thermostat is closed, a small portion of the coolant is bypassed through a pipe which returns the coolant to the water pump for recirculation. The entire system is pressurized to 13-15 psi with the use of a pressure-type radiator cap.

2. ENGINE REMOVAL AND INSTALLATION

Because of engine compartment tolerances, the engine should not be removed or installed with the transmission attached.

Removal

1. Drain the cooling system and the crankcase. Disconnect the battery ground cable at the battery, the heater hoses at the water pump and water outlet housing, and the vacuum hose and flexible fuel line at the fuel pump. Disconnect the primary wire at the coil, the oil pressure and temperature sending unit wires at the sending units, and the starter cable at the starter. Remove the starter (and the automatic transmission fluid filler tube bracket). Remove the engine rear plate upper right bolt.



2. Remove the radiator. Remove the air cleaner, then tape the air horn closed. Disconnect the accelerator retracting spring and the accelerator rod assembly at the carburetor.

On cars with an automatic transmission, remove the accelerator bracket from the intake manifold, then tie the bracket to the dash panel.

On conventional drive or overdrive units, disconnect the clutch release spring and rod.

3. Disconnect the choke control cable at the carburetor, the generator wires at the generator, and the engine ground strap at the converter housing or flywheel housing. Disconnect the exhaust manifold from the muffler inlet pipe.

On cars with an automatic transmission, remove the converter housing lower access cover and the converter housing cover assembly. Remove the flywheel to converter bolts, then secure the converter assembly in the housing.

On conventional drive or overdrive units, remove the flywheel housing inspection cover.

4. Remove the converter housing or flywheel housing

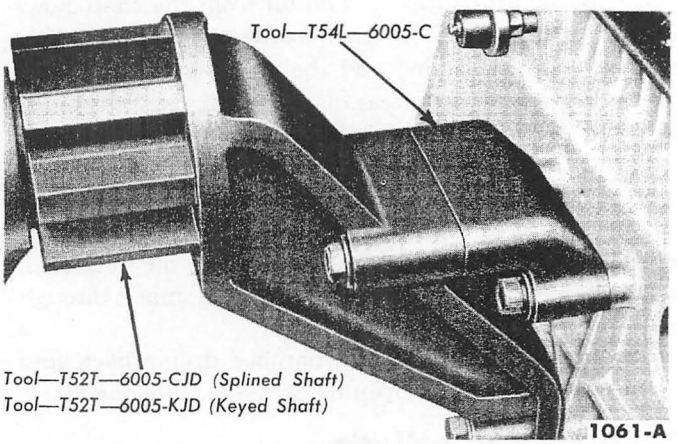


Fig. 7—Engine Mount

to engine bolts. Support the transmission with a jack. Remove the engine right and left support bracket to engine bolts.

5. Attach the engine lifting hook (Fig. 6). Raise the engine slightly, then carefully pull it from the transmission. Lift the engine out of the chassis, then install it on a work stand (Fig. 7).

Installation

1. Place a new gasket over the exhaust manifold to muffler inlet pipe studs. Lower the engine carefully into the chassis. Make sure the studs on the exhaust manifold are aligned with the holes in the muffler inlet pipe and the dowels in the block engage the holes in the flywheel or converter housing.

On cars with an automatic transmission, start the converter pilot into the crankshaft. Position the left rear splash shield and install the engine to converter housing bolts. Tighten the bolts to 45-50 foot-pounds torque. Remove the jack supporting the transmission. Remove the retainer securing the converter in the housing, then install the flywheel to converter bolts. Tighten the bolts to 25-28 foot-pounds torque. Install the converter housing lower access cover and the converter housing cover assembly.

On conventional drive or overdrive units, start the transmission main drive gear into the clutch disc. It may be necessary to adjust the position of the transmission with relation to the engine if the transmission input shaft will not enter the clutch disc. ***If the engine "hangs up" after the shaft enters, turn the crankshaft slowly (with the transmission in gear) until the shaft splines mesh with the clutch disc splines.*** Install the flywheel housing bolts and tighten them to 40-50 foot-pounds torque, then install the flywheel housing inspection cover. Remove the jack supporting the transmission.

2. Install the engine left and right support bracket to engine bolts, then tighten the bolts to 35-40 foot-pounds torque. Install the starter (and automatic transmission fluid filler tube bracket). Tighten the starter bolts to 15-20 foot-pounds torque.

3. Install the engine rear plate upper right retaining bolt. Connect the starter cable, the coil primary wire, the oil pressure and temperature sending unit wires, the vacuum hose and flexible fuel line, the heater hoses, and the battery ground cable.

4. Install the exhaust manifold to muffler inlet pipe lockwashers and nuts, then tighten the nuts to 23-28 foot-pounds torque. Connect the engine ground strap, the generator wires, and the choke control cable.

On cars with an automatic transmission, install the accelerator bracket on the intake manifold.

On conventional drive or overdrive units, connect the clutch release spring and rod. Adjust the clutch pedal free travel.

5. Connect the accelerator retracting spring and the accelerator rod assembly. Adjust the throttle linkage. Remove the tape from the carburetor air horn.

6. Install the radiator. Fill and bleed the cooling system. Fill the crankcase with the proper grade and quantity of engine oil. Operate the engine at fast idle and check all hose connections and gaskets for leaks. Install the air cleaner.

3. ENGINE SUPPORTS

The front supports are located on each side of the crankcase and the rear support is located at the transmission extension housing.

Engine Front Supports

The engine front support is shown in Fig. 8. The procedures given apply to either a right or left installation. If only one engine front support is to be removed, do not disturb the other front support.

REMOVAL

1. Remove the insulator to frame nuts, lockwashers, and spacer.

2. Remove the bracket to engine bolts and lock-
s.

then remove the

r assembly.

2. Install, but do not tighten, the bracket to engine lockwashers and bolts. If both supports have been removed, install the bolts on the opposite side before proceeding with step 3.

3. Lower the engine, then install, but do not tighten, the insulator to frame spacer, lockwashers, and nuts.

4. Tighten the bracket to engine bolts to 35-40 foot-pounds torque (the insulator to bracket bolts should be tightened to 50-60 foot-pounds torque). If both supports have been removed, install the bolts on the opposite side before proceeding with step 5.

5. Tighten the insulator to frame nuts to 40-45 foot-pounds torque.

Engine Rear Support

The engine rear support is shown in Fig. 9.

REMOVAL

1. Remove the support retainer to extension housing

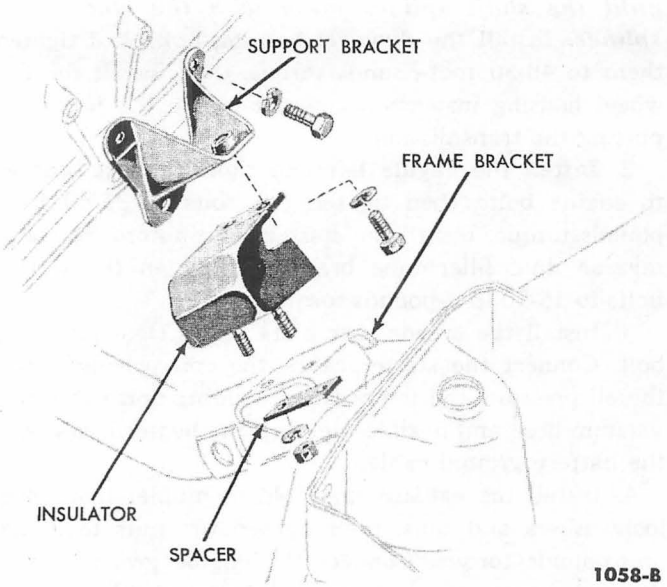


Fig. 8—Engine Front Support

bolts and washers, and remove the support assembly to frame nuts, lockwashers, and bolts.

2. Raise the extension housing slightly to relieve the pressure on the support assembly, then remove the retainer and support assembly.

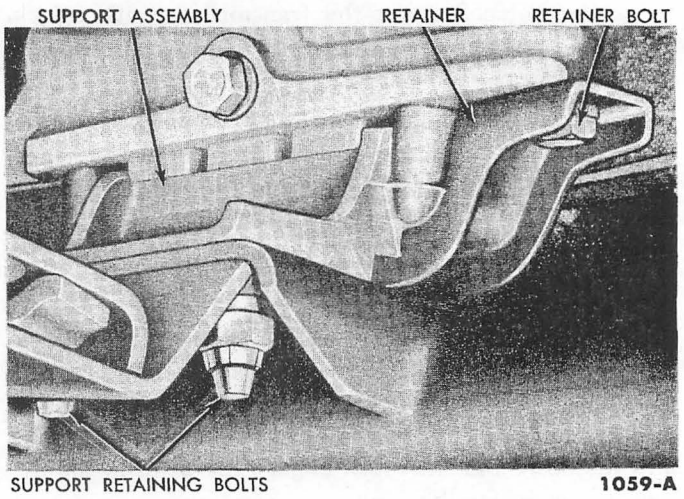


Fig. 9—Engine Rear Support

INSTALLATION

1. Raise the extension housing enough to position the support assembly and retainer. Install, but do not tighten, the support assembly to frame bolts, lockwashers, and nuts.

2. Remove the jack from the extension housing. Tighten the retainer bolts to 25-30 foot-pounds torque and tighten the support nuts to 40-45 foot-pounds torque.

4. MANIFOLDS AND EXHAUST GAS CONTROL VALVE

Manifolds

The manifold assembly is shown in Fig. 10.

REMOVAL

1. Remove the air cleaner, then tape the carburetor air horn closed.

On cars with an automatic transmission, disconnect the throttle control rod and the accelerating assembly connecting link at the accelerator bracket. Disconnect the accelerator retracting spring at the block mounted bracket, then remove the bracket.

On conventional drive and overdrive units, disconnect the accelerator retracting spring and the accelerator rod assembly at the bell crank.

2. Disconnect the vacuum line at the intake manifold. Disconnect the choke control cable, the fuel inlet line, and the distributor vacuum line at the carburetor, th[illegible]e the carburetor and gasket.

[illegible]m the exhaust [illegible]e manifold to t[illegible]rom the head. Re[illegible]

[illegible] intake and exhaust manifolds, then separate the manifolds.

INSTALLATION

1. Place the intake manifold over the studs on the exhaust manifold. Install the lockwashers, nuts and bolt, then tighten them finger tight.

2. Install new intake manifold gaskets using new sleeves, if necessary, in the ports of the cylinder head. Place a new exhaust manifold to muffler inlet pipe gasket over the studs on the exhaust manifold. Coat the mating surfaces lightly with graphite grease, then place the manifold assembly in position against the head. ***Make sure the port openings in the manifold assembly are aligned with the port openings in the cylinder head and that none of the gaskets have become dislodged.***

3. Install the attaching washers and bolts, then tighten the bolts to 23-28 foot-pounds torque, tightening from the center to the ends. Tighten the bolt and nuts joining the intake and exhaust manifolds to 23-28 foot-pounds torque. Install the exhaust manifold to muffler inlet pipe lockwashers and nuts, then tighten the nuts to 23-28 foot-pounds torque.

4. Position the carburetor gasket on the intake manifold, then install the carburetor. Tighten the carburetor retaining nuts to 12-15 foot-pounds torque. Connect the vacuum line to the intake manifold. Connect the choke control cable, the fuel inlet line, and the distributor vacuum line to the carburetor.

On cars with an automatic transmission, install the accelerating retracting spring bracket, then connect the spring. Connect the accelerating assembly connecting link and the throttle control rod.

On conventional drive and overdrive units, connect the accelerating retracting spring and the accelerator rod assembly.

5. Remove the tape from the carburetor air horn, then install the air cleaner.

Exhaust Gas Control Valve Replacement

The exhaust gas control valve is located in the outlet of the exhaust manifold. Normally, it does not require replacement unless it becomes inoperative due to excessive corrosion or damage.

1. Remove the manifold assembly and separate the intake and exhaust manifolds. Before removing the control valve assembly, note the position of the counterweight in relation to the valve plate. Remove the cotter pin, shield, stop spring, and thermostatic spring from the front end of the shaft.

2. Using an acetylene torch inside the manifold, cut the shaft on both sides of the valve plate. ***Use caution to avoid damage to the shaft bearing bores.*** Remove the valve and shaft pieces.

3. Clean the bushings of corrosion and repair any damage that may have occurred. Replace the bushings if necessary. When new bushings are installed, there should be a distance of 2 3/8 inches from the inside edge of one bushing to the inside edge of the other bushing. The bushings should be equally spaced within the counterbores. After installation, ream the bushings with a 5/16-inch reamer. Lubricate the new shaft and bushings with a penetrating oil and graphite mixture.

4. Insert the shaft through the bushings and valve Rotate the shaft in the valve plate until the (heat on) position aft, then move the a binding condi-

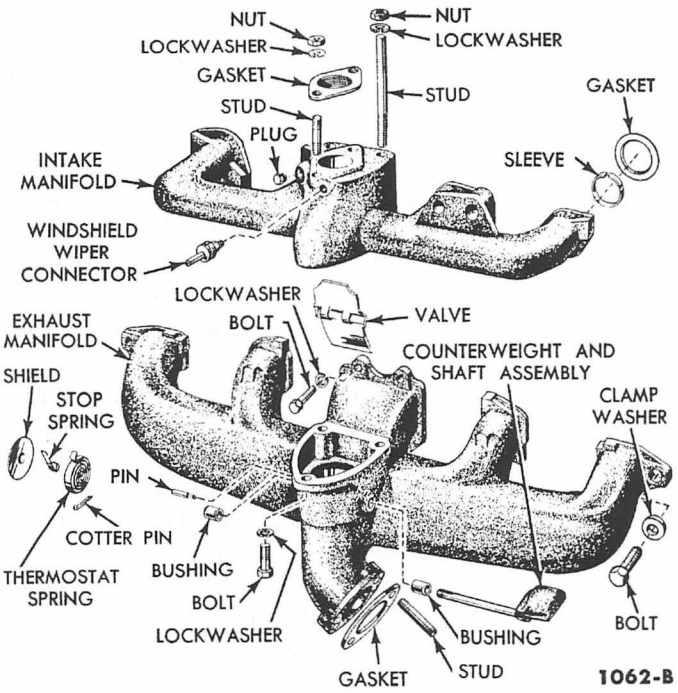


Fig. 10—Manifold Assembly

tion. If there is no binding, weld the valve to the shaft in the original manner. The shaft and valve are stainless steel to minimize corrosion and/or damage by excessive heat.

6. Install the thermostatic spring in the shaft slot. Wind the spring 3/4 turn and hook the open end of the spring over the stop pin. The thermostatic spring should hold the valve in the closed (heat on) position (i.e. in the proper position to direct the flow of gases into the heat riser).

7. Install the stop spring, shield, and cotter pin. Lubricate the shaft bushings while operating the valve manually to replace the original lubricant lost by the welding operation. Install the manifold assembly.

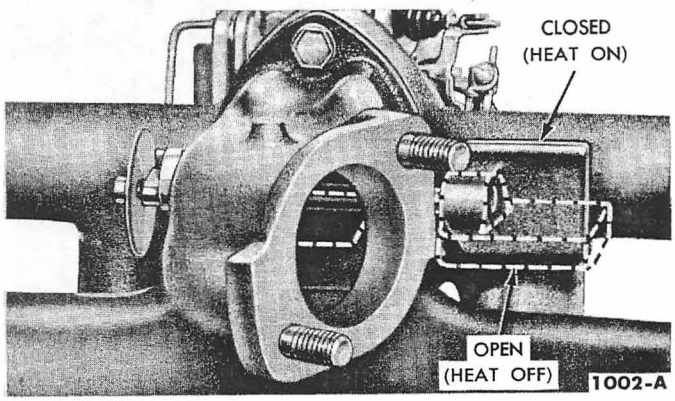


Fig. 11—Exhaust Gas Control Valve

5. CYLINDER HEAD AND VALVES

Cylinder Head Removal

1. Drain the cooling system. Remove the air cleaner, then tape the carburetor air horn closed. Disconnect the radiator upper hose at the radiator, the heater hose at the water outlet housing, the oil pressure and water temperature sending unit wires at the sending units, and the battery ground cable at the cylinder head. Disconnect the carburetor fuel inlet line and the vacuum line at the fuel pump, and the distributor vacuum line at the distributor. Disconnect the high tension lead at the coil, then remove the coil from the head and move it to one side. Remove the distributor cap. Disconnect the spark plug wires, then remove the spark plug.

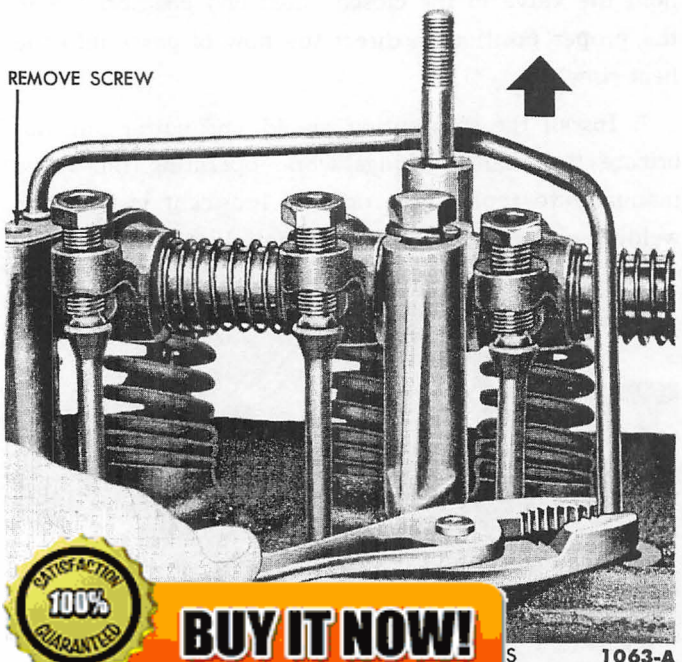
2. On cars with an automatic transmission, disconnect the throttle control rod and the accelerating assembly connecting link at the accelerator bracket. Disconnect the accelerator retracting spring at the block mounted bracket, then remove the bracket.

On conventional drive and overdrive units, disconnect the accelerator retracting spring and the accelerator rod assembly at the bell crank.

3. Disconnect the fuel inlet line and the distributor vacuum line at the carburetor, and the vacuum line at the intake manifold, then remove the three lines as an assembly. Disconnect the choke control cable at the carburetor.

4. Remove the valve rocker arm cover. Remove the cap screw and bracket from the No. 6 rocker arm support. Pull the oil inlet line out of the support, then pull it out of the block with pliers (Fig. 12). Be careful not to damage the line. Remove the cap screw from the No. 1 rocker arm support, then remove the oil outlet line and bracket. Loosen all rocker arm adjusting screws to remove the valve spring load from the rocker arms, then remove the valve rocker arm shaft assembly. Remove the valve push rods in sequence and identify them so they can be installed in their original positions (Fig. 13).

5. Remove the manifold to cylinder head bolts, and pull the manifold assembly away from the cylinder head. Brace the assembly so the oil inlet pipe will not be damaged. Install the cylinder head holding fixtures for convenience in lifting the head and to protect the gasket surfaces (Fig. 14). Remove all cylinder head bolts. Install the cylinder head guide studs (Fig. 15). Lift the cylinder head assembly off the engine. ***Do not pry between the head and block as the gasket surfaces may become damaged.***



Rocker Arm Shaft Disassembly

1. Remove the cotter pins from each end of the rocker arm shaft, and remove the flat washers and spring washers. Slide the rocker arms, springs, and supports off the shaft. Be sure to identify the parts.

2. If it is necessary to remove the plugs from each end of the shaft, drill or pierce the plug on one end, then use a steel rod to knock out the plug on the opposite end. Working from the open end, knock out the remaining plug.

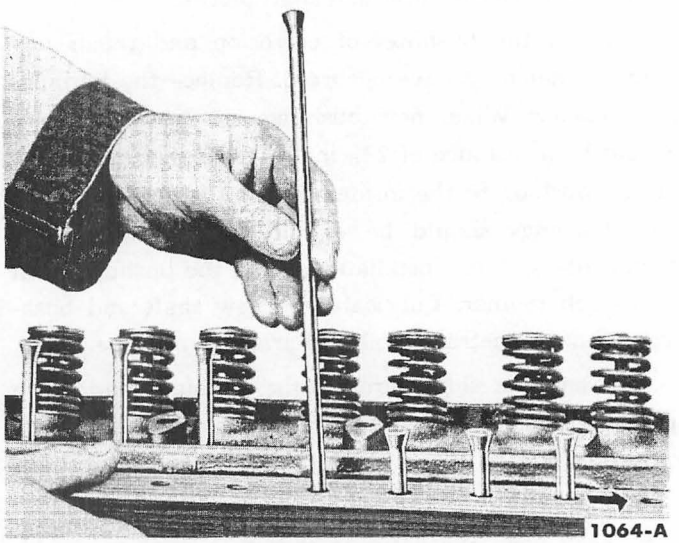


Fig. 13—Valve Push Rod Removal

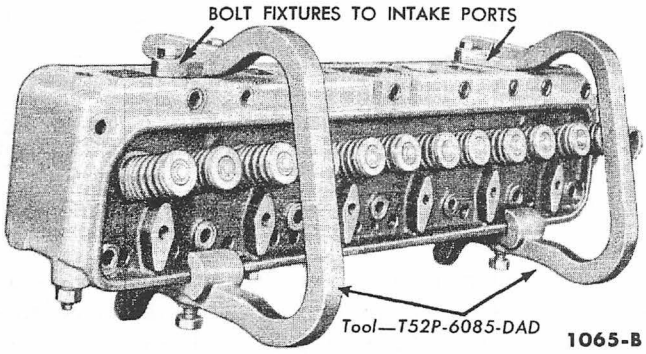


Fig. 14—Cylinder Head Holding Fixture

Rocker Arm Shaft Assembly

1. Oil all moving parts with engine oil.

2. If the plugs were removed from the end of the shaft, use a blunt tool or large diameter pin punch and install a plug, cup side out, in each end of the rocker arm shaft.

3. Install a flat washer, spring washer, another flat washer, and a cotter pin on one end of the shaft.

4. Install the rocker arms, supports, and springs (Fig. 16). Install the remaining flat washers with the spring washer between them, and install the cotter pin.

Cylinder Head Disassembly

1. Remove deposits from the combustion chambers and valve heads with a scraper and a wire brush before removing the valves. ***Be careful not to scratch the cylinder head gasket surface.***

2. Compress the valve spring (Fig. 17), then remove the valve retainer locks and release the spring. Remove the sleeve, spring retainer, spring, stem seal, and valve. Discard all valve stem seals. Identify all valve parts.

Cylinder Head Assembly

1. Install each valve in the port from which it was removed or to which it was fitted. Install a new stem seal on the valve.

2. Install the valve spring, then install the valve spring retainer, and sleeve. Compress the spring, and install the retainer locks (Fig. 17).

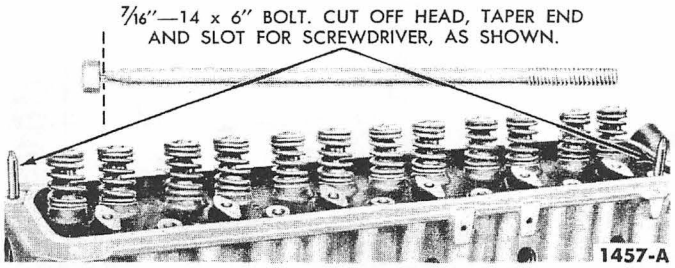


Fig. 15—Cylinder Head Guide Studs

3. Measure the assembled height of the valve springs from the surface of the cylinder head spring pad to the underside of the spring retainer with dividers (Fig. 18). Check the dividers against a scale. If the assembled height is $1\frac{13}{16}$ inches or greater, install the necessary 0.030-inch thick spacer(s) between the cylinder head spring pad and the valve spring to bring the assembled height to the recommended dimension of $1\frac{25}{32}$-$1\frac{13}{16}$ inches. ***Do not install 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.***

Cylinder Head Installation

1. Clean deposits and gasket sealer residue from the head and block gasket surfaces. Inspect the head for any damage and repair as necessary. Apply a coating of cylinder head gasket sealer to both sides of a new gasket. Use the brush furnished to spread the sealer evenly over the entire gasket surface. Position the gasket over the guide studs on the cylinder block.

2. Lift the cylinder head over the guides and slide the head down carefully. Before installing the cylinder head bolts, coat the threads of each bolt with a small amount of water resistant sealer. Install, but do not tighten, two bolts at opposite ends of the head to hold the head and gasket in position. Remove the guides, then install the remaining bolts. Remove the cylinder head holding fixtures.

3. The cylinder head bolt tightening procedure is performed in three progressive steps. Tighten the bolts to 55 foot-pounds torque in the proper sequence (Fig. 19), then tighten them to 65 foot-pounds torque in the

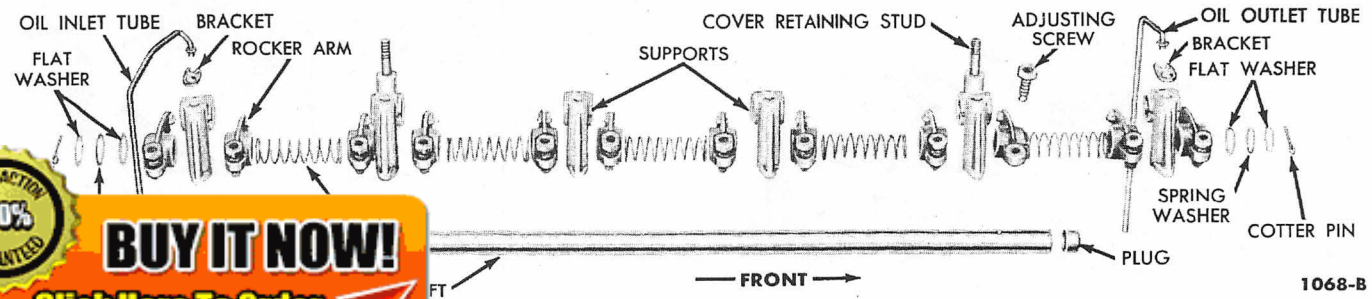


Fig. 16—Valve Rocker Arm Shaft Assembly

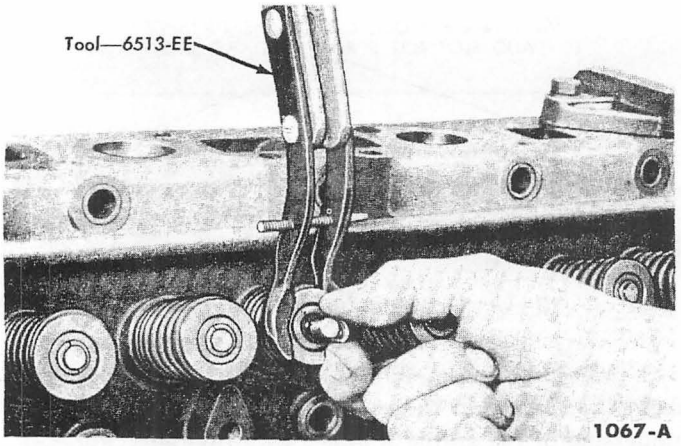


Fig. 17—Valve Stem Lock Removal or Installation

same sequence. Finally, tighten the bolts to 75 foot-pounds torque in the same sequence. ***After the cylinder head bolts have been tightened to specifications, the bolts should not be disturbed.***

4. Install the push rods in their proper sequence, positioning the lower end of the rods in the tappet sockets. Position the valve rocker arm shaft assembly on the head, then install the oil outlet line, bracket, and retaining screw on the No. 1 support. Make sure the oil line enters the shaft locating hole. Install a new "O" ring seal on the lower end of the oil inlet line, then position the line in the No. 6 support. Make sure the lower end of the oil line "O" ring seal is in the oil supply counterbore, then install the bracket and support bolt. Tighten all the retaining bolts to 45-55 foot-pounds torque. Perform a preliminary (cold) valve lash adjustment.

5. Install the manifold to cylinder head bolts and tighten them to 23-28 foot-pounds torque. Position the two vacuum lines and the carburetor fuel inlet line on the engine. Connect the distributor vacuum line and the carburetor fuel inlet line at the carburetor, and the manifold vacuum line at the manifold. Connect the choke control cable. Remove the tape from the carburetor air horn.

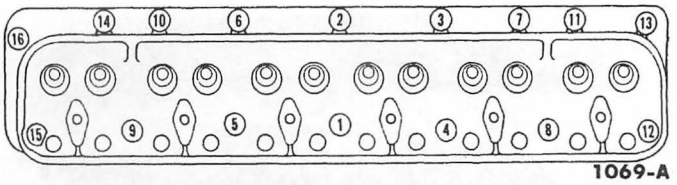


Fig. 19—Cylinder Head Bolt Tightening Sequence

On cars with an automatic transmission, install the accelerator retracting spring bracket on the block, then connect the spring. Connect the throttle control rod and the accelerating assembly connecting link.

On conventional drive and overdrive units, connect the accelerator rod assembly and the accelerator retracting spring.

6. Install the ignition coil, spark plugs, and the distributor cap. Connect the spark plug wires and the coil high tension lead. Connect the carburetor fuel inlet line and the vacuum line at the fuel pump, and the distributor vacuum line at the distributor. Connect the battery ground cable, the oil pressure and water temperature sending unit wires, the heater hose, and the radiator upper hose. Fill and bleed the cooling system.

7. Start the engine and operate it for a minimum of 30 minutes at approximately 1200 rpm to stabilize engine temperatures. Check the valve lash with the engine idling and adjust the lash if necessary.

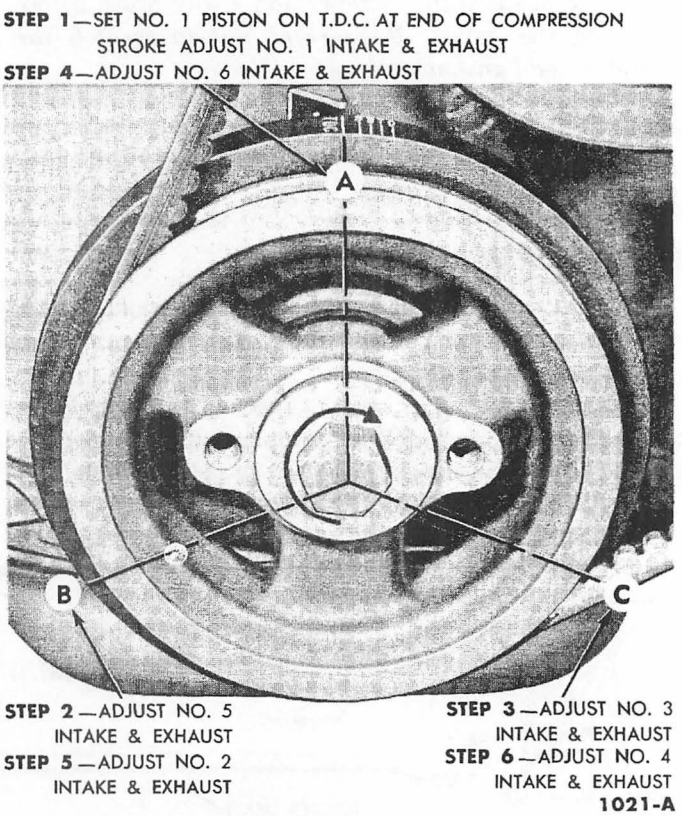


Fig. 20—Preliminary Valve Lash Adjustment

8. Coat one side of the valve rocker arm cover gasket with oil resistant sealer, and lay the cemented side of the gasket in place in the cover. Install the cover, making sure that the gasket seats evenly all around the head. Install the rubber seals on the studs making sure they are centered in the cover openings. Tighten the retaining nuts to 2.0-2.5 foot-pounds torque. Install the air cleaner.

Valve Lash Adjustment

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

If the cylinder head or the valve rocker arm assembly has been removed and installed, it will be necessary to make a preliminary (cold) valve lash adjustment before starting the engine. If the adjustment is made for an engine tune-up, follow the final adjustment procedure.

The cylinders are numbered from front to rear, 1-2-3-4-5-6. The valves are arranged from front to rear, E-I-I-E-I-E-E-I-E-I-I-E.

PRELIMINARY ADJUSTMENT

1. Turn all the valve adjusting screws until interference is noted, then check the torque required to turn the screw further. If the torque required to turn a screw is less than 3 foot-pounds (36 inch pounds), try a new self locking adjusting screw. If this is still unsatisfactory, replace the rocker arm and adjusting screw.

2. Make two chalk marks on the crankshaft damper (Fig. 20). Space the marks approximately 120° apart so that with the timing mark, the damper is divided into three equal parts (120° represents ⅓ of the distance around the damper circumference).

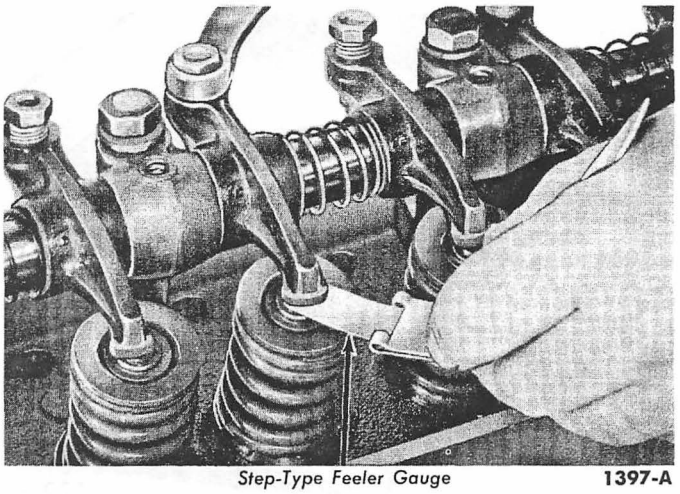


Fig. 21—Valve Lash Adjustment

3. Rotate the crankshaft until No. 1 piston is near T.D.C. at the end of the compression stroke. Number 1 piston is on T.D.C. at the end of the compression stroke when both valves are closed and the timing mark on the crankshaft damper is in line with the timing pointer.

4. Using a step-type feeler gauge ("go" and "no go"), adjust the intake and exhaust valve lash for No. 1 cylinder (Fig. 21). The preliminary (cold) intake and exhaust valve lash should be set at 0.019 inch.

5. Repeat this procedure for the remaining set of valves, turning the crankshaft ⅓ turn at a time, in the direction of rotation, while adjusting the valves in the firing order sequence (1-5-3-6-2-4).

FINAL ADJUSTMENT. Operate the engine for a minimum of 30 minutes at approximately 1200 rpm to stabilize engine temperatures. With the engine idling, check the valve lash. Adjust the lash if necessary (Fig. 21). The final (hot) intake and exhaust valve lash should be 0.019 inch.

6. CRANKSHAFT DAMPER AND CYLINDER FRONT COVER

Crankshaft Damper

REMOVAL

1. Drain the cooling system, then remove the radiator. Remove the fan, drive belt, and pulley.

cars equipped with power steering, remove the
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2. Remove the cap screw and washer from the end of the crankshaft, then remove the damper (Fig. 22).

INSTALLATION

1. Lubricate the crankshaft with an oil and white lead mixture and lubricate the oil seal rubbing surface with grease.

2. Align the damper keyway with the key on the crankshaft and start the damper on the shaft. Press the damper on the shaft (Fig. 23). Install the lockwasher

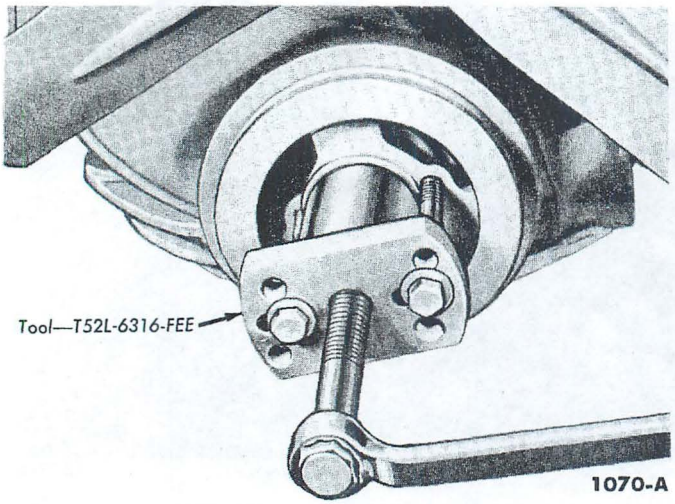


Fig. 22—Damper Removal

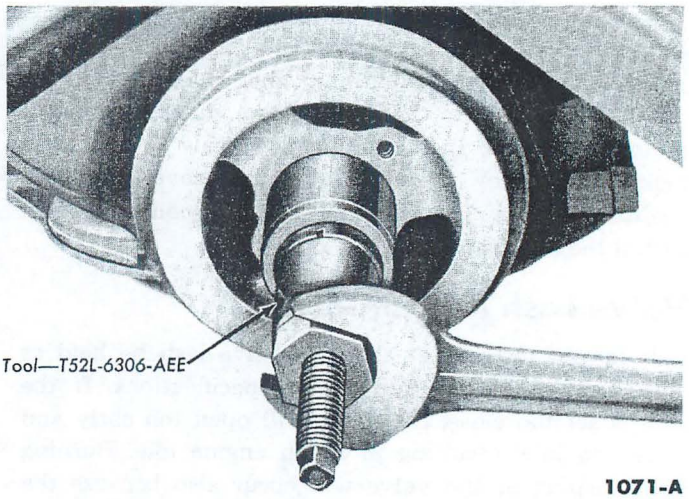


Fig. 23—Damper Installation

and cap screw, then tighten the cap screw to 85-95 foot-pounds torque. Install the pulley, drive belt, and fan. Adjust the drive belt.

On cars equipped with power steering, install the power steering pump pulley on the crankshaft damper. Tighten the retaining bolts to 23-28 foot-pounds torque. Install and adjust the power steering pump drive belt.

3. Install the radiator. Fill and bleed the cooling system.

Cylinder Front Cover and Oil Seal

CYLINDER FRONT COVER REMOVAL

1. Drain the cooling system and the crankcase. Remove the radiator, fan, drive belt, pulley and the crankshaft damper. Disconnect the heater hose and the generator adjusting arm from the water pump, then remove the water pump.

2. Remove the screws fastening the cylinder front cover to the block and oil pan, then remove the cover and gasket.

3. Remove the oil level dip stick, crankcase ventilation tube, stabilizer bar, flywheel housing inspection cover, and the oil pan.

OIL SEAL REPLACEMENT. It is good practice to replace the oil seal each time the cylinder front cover is removed.

1. Drive out the old seal with a pin punch, then clean out the recess in the cover.

2. Coat a new seal with grease, then install the seal (Fig. 24). Drive the seal in until it is fully seated in the recess. Check the seal after installation to be sure the spring is properly positioned in the seal.

CYLINDER FRONT COVER INSTALLATION

1. Install the oil pan, flywheel housing inspection cover, stabilizer bar, crankcase ventilation tube, and the oil level dip stick. Clean the cylinder front cover and the gasket surface of the cylinder block. Coat the gasket surface of the block and the cover with sealer, then position a new gasket on the block. Place the cover on the block and install the retaining screws. Tighten the screws to 6-9 foot-pounds torque.

2. Install the water pump, then connect the generator adjusting arm and heater hose. Install the crankshaft damper, pulley, drive belt, and fan. Adjust the drive belt.

On cars equipped with power steering, install the power steering pump pulley on the crankshaft damper. Install and adjust the power steering pump drive belt.

3. Install the radiator. Fill and bleed the cooling system. Fill the crankcase with the proper grade and quantity of engine oil. Operate the engine at fast idle and check all hose connections and gaskets for leaks.

7. TIMING CHAIN, CAMSHAFT, BEARINGS, AND TAPPETS

Sprockets and Timing Chain

rankcase. Remove the radiator, fan, drive belt, pulley, and the crankshaft damper. Disconnect the heater hose and the generator adjusting arm from the water pump, then remove the water pump. Remove the screws fastening the cylinder front cover to the block and oil pan, then remove the cover and gasket. Remove the oil level dip stick, crankcase ventilation tube, stabilizer bar, flywheel housing inspection cover, and the oil pan.

2. Remove the crankshaft front oil slinger. Crank the engine until the timing marks on the sprockets and chain are positioned as shown in Fig. 25. Remove the camshaft sprocket retaining bolt and washer. Slide both

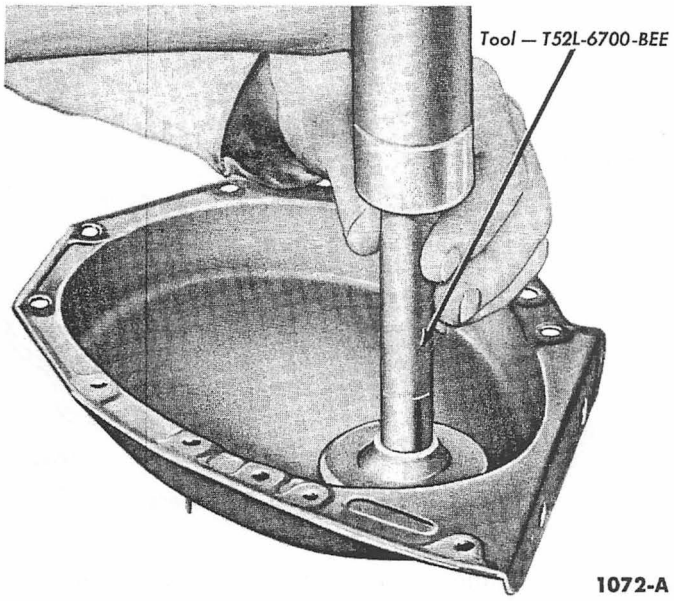


Fig. 24—Oil Seal Installation

sprockets and the timing chain forward and remove them as an assembly.

INSTALLATION

1. Place the keys in position in the slots on the crankshaft and camshaft.

2. Position the sprockets and timing chain on the camshaft and crankshaft. Be sure the timing marks on the sprockets and chain are positioned as shown in Fig. 25. There are 12 timing chain link pins between the timing marks on the sprockets.

3. Install the camshaft sprocket washer and retaining bolt. Tighten the bolt to 35-45 foot-pounds torque.

4. Rotate the crankshaft in a clockwise direction (as viewed from the front) to take up the slack on the left side of the chain. Establish a reference point on the block and measure from this point to the chain (Fig. 26). Rotate the crankshaft in the opposite direction to take up the slack on the right side of the chain, then force the left side of the chain out with the fingers and measure the distance between the reference point and the chain. The deflection is the difference between the two measurements. The deflection should not exceed ½ inch.

5. Install the crankshaft front oil slinger and the cylinder front cover. Install the oil pan, flywheel housing inspection cover, stabilizer bar, crankcase ventilation tube, and the oil level dip stick. Install the water pump, then connect the generator adjusting arm, heater hose, ttery ground wire. Install the crankshaft damper, e drive belt. teering, install the e belt, then adjust

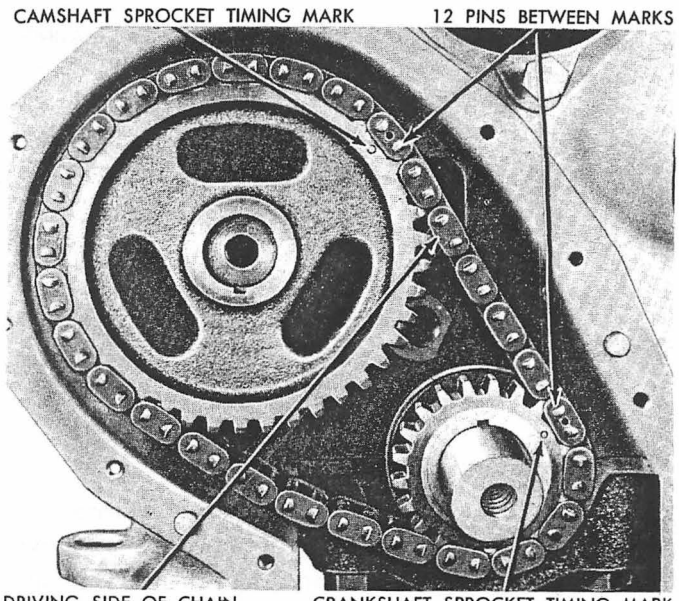


Fig. 25—Aligning Timing Marks

6. Install the radiator. Fill the cooling system and the crankcase. Start the engine and adjust the ignition timing. Operate the engine at fast idle and check all hose connections and gaskets for leaks.

Camshaft

The camshaft and related parts are shown in Fig. 27.

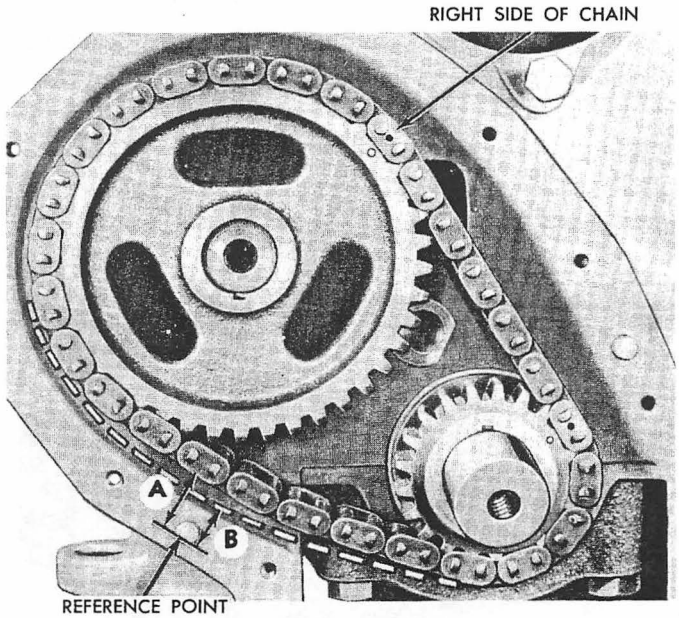


Fig. 26—Timing Chain Deflection

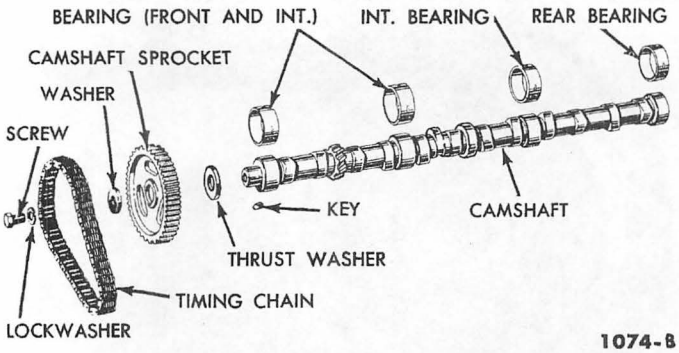


Fig. 27—Camshaft and Related Parts

REMOVAL

1. Drain the cooling system and the crankcase. Remove the radiator, and the grille. Remove the fan, drive belt(s), pulley, crankshaft damper, and the water pump. Remove the cylinder front cover. Remove the oil level dip stick, crankcase ventilation tube, stabilizer bar, flywheel housing inspection cover, and the oil pan.

2. Remove the air cleaner, then tape the carburetor air horn closed. Remove the valve rocker arm cover, the rocker arm shaft assembly, then remove the valve push rods in sequence.

3. Disconnect the primary wire and the high tension wire at the coil, the vacuum line and primary wire at the distributor, and the spark plug wires at the spark plugs. Remove the distributor cap. Disconnect the ignition wires from the clip on the valve push rod cover, then remove the cover. Remove the fuel pump.

4. Remove the crankshaft front oil slinger. Crank the engine until the timing marks on the sprockets and chain are positioned as shown in Fig. 25. Remove the camshaft sprocket retaining bolt and washer.

Tappets

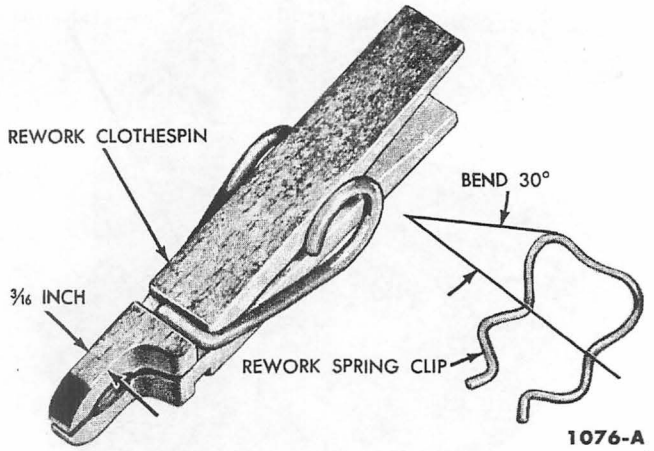


Fig. 29—Valve Tappet Retainers

5. Scribe a line on the distributor housing and cylinder block to mark the position of the rotor and distributor housing for installation, then remove the distributor.

6. Remove the sprockets and timing chain, the woodruff key, and camshaft thrust washer.

7. Turn the camshaft until the tappets can be lifted with either a magnet (Fig. 28), or the fingers. Raise the tappets clear of the camshaft lobes and secure them with spring-type clothes pins or window regulator spring clips (Figs. 28 and 29).

8. Carefully remove the camshaft by pulling it toward the front of the engine. ***Use caution to avoid damaging the camshaft bearings.***

INSTALLATION

1. Oil the camshaft and carefully slide it through the bearings. Install the thrust washer and woodruff key. ***Be sure the chamfer on the thrust washer is to the rear or faces the camshaft journal.***

2. Install the sprockets and timing chain, camshaft sprocket washer, lockwasher, and bolt. Tighten the bolt to 35-45 foot-pounds torque. Install the crankshaft front oil slinger and the cylinder front cover. Install the oil pan, flywheel housing inspection cover, stabilizer bar, crankcase ventilation tube, and the oil level dipstick. Install the water pump, then connect the generator adjusting arm, heater hose, and battery ground wire. Install the crankshaft damper, pulley, drive belt, and fan. Adjust the drive belt.

On cars equipped with power steering, install the power steering pump pulley and drive belt, then adjust the drive belt.

3. Install the grille and the radiator.

4. Release the tappets and install the push rods, then

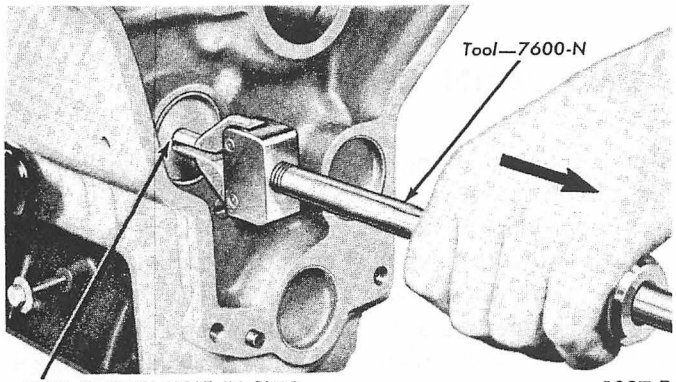


Fig. 30—Camshaft Rear Bearing Bore Plug Removal

install the valve rocker arm shaft assembly. Perform a preliminary valve lash adjustment.

5. Cement a new gasket to the valve push rod cover, then install the cover and the ignition wiring clip. Install the ignition wires in the clip. Install the fuel pump and connect the fuel lines and vacuum line.

6. If the crankshaft was not disturbed, install the distributor using the scribed lines as guides to properly position the rotor and housing. If the crankshaft was disturbed, crank the engine until the No. 1 piston is on T.D.C., then position the distributor in the block with the rotor at the No. 1 firing position. Install the distributor hold down clamp. Connect the distributor primary wire and the vacuum line. Install the distributor cap, and connect the spark plug wires and the coil high tension lead.

7. Fill and bleed the cooling system. Fill the crankcase with the proper grade and quantity of engine oil. Remove the tape from the carburetor air horn. Start the engine and adjust the ignition timing. Operate the engine at fast idle and check all hose connections and gaskets for leaks. Make a final (hot) valve lash adjustment with the engine idling. Install the valve rocker arm cover. Install the air cleaner.

Bearing Replacement

It will be necessary to remove the engine from the chassis to replace camshaft bearings. The bearings are available pre-finished to size and require no reaming for standard and 0.015-inch undersize journal diameters. Number 3 bearing is not interchangeable with the other bearings.

Remove the engine from the chassis, then remove the center of the emove it as shown rings (Fig. 31). ng bore and press

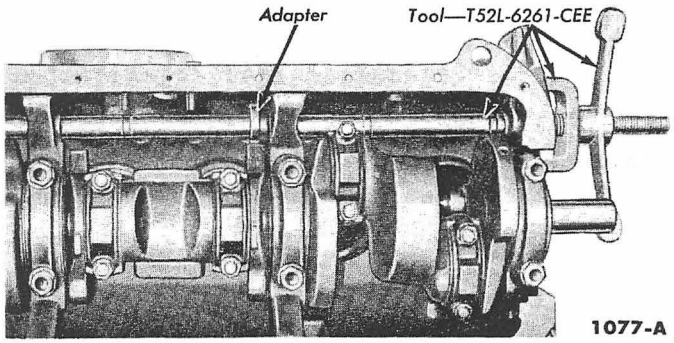


Fig. 31—Camshaft Bearing Replacement

it in place (Fig. 31). ***Number 1 cam bearing must be pressed in 0.005-0.020 inch below the front face of the bearing bore. Press the remaining bearings in sufficiently to align the oil supply holes.***

3. Clean the camshaft rear bearing bore plug recess thoroughly. Coat the flange of a new plug with water resistant sealer and install it with the flange facing out (Fig. 32). Drive the plug in until the flange is flush or slightly below the casting surface. Install the camshaft and related parts. Install the engine in the chassis.

Tappet Replacement

1. Remove the camshaft.

2. Remove and install one tappet at a time through the bottom of the block. A flexible-type holding tool can be used if desired. As each tappet is installed, secure it in the up position.

3. After the tappets are installed, install the camshaft and related parts.

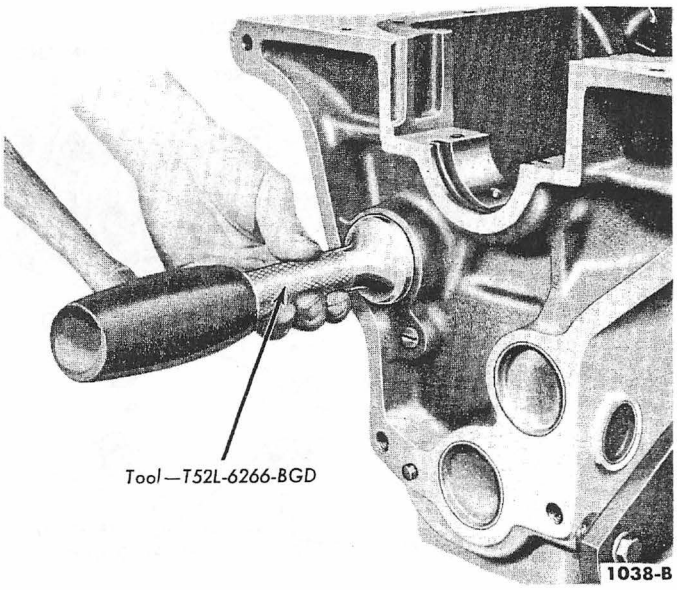


Fig. 32—Camshaft Rear Bearing Bore Plug Installation

8. FLYWHEEL, CRANKSHAFT, AND MAIN BEARINGS

The crankshaft and related parts are shown in Fig. 33. The clutch pilot bushing or bearing replacement procedure is covered in Group 3—Part 1.

Flywheel

The flywheel is piloted on a shoulder and is fastened to the crankshaft by six bolts.

CONVENTIONAL DRIVE OR OVERDRIVE EQUIPPED CARS

Removal

1. Disconnect the drive shaft at the rear universal joint flange. Slide the drive shaft off the transmission output shaft and install Tool 7657 in the transmission extension housing. Remove the speedometer cable from the transmission extension housing and secure it on the frame. Disconnect the gear shift rods from the transmission levers.

On overdrive transmissions, disconnect the governor and solenoid wires at the bullet connectors. Remove the wiring harness clip from the transmission. Disconnect the overdrive manual control cable assembly.

2. Support the engine between the No. 2 cross member and the end of the oil pan, using a jack and a block of wood. Remove the engine rear support. Remove the transmission to flywheel housing retaining bolts and install pilots in the lower holes. Remove the flywheel housing cover. Slide the transmission far enough to the rear to clear the flywheel housing.

3. Remove the starter. Disconnect the clutch release lever retracting spring, then slide the release bearing and hub off the release lever. Remove the clutch bracket to cylinder block bolts and disconnect the engine ground strap. Remove the flywheel housing retaining bolts and remove the flywheel housing.

4. Mark the pressure plate cover and flywheel to facilitate assembly, then loosen the cover to flywheel bolts evenly to release the pressure plate spring tension. Remove the cover, pressure plate, and disc. Remove the flywheel retaining bolts and remove the flywheel.

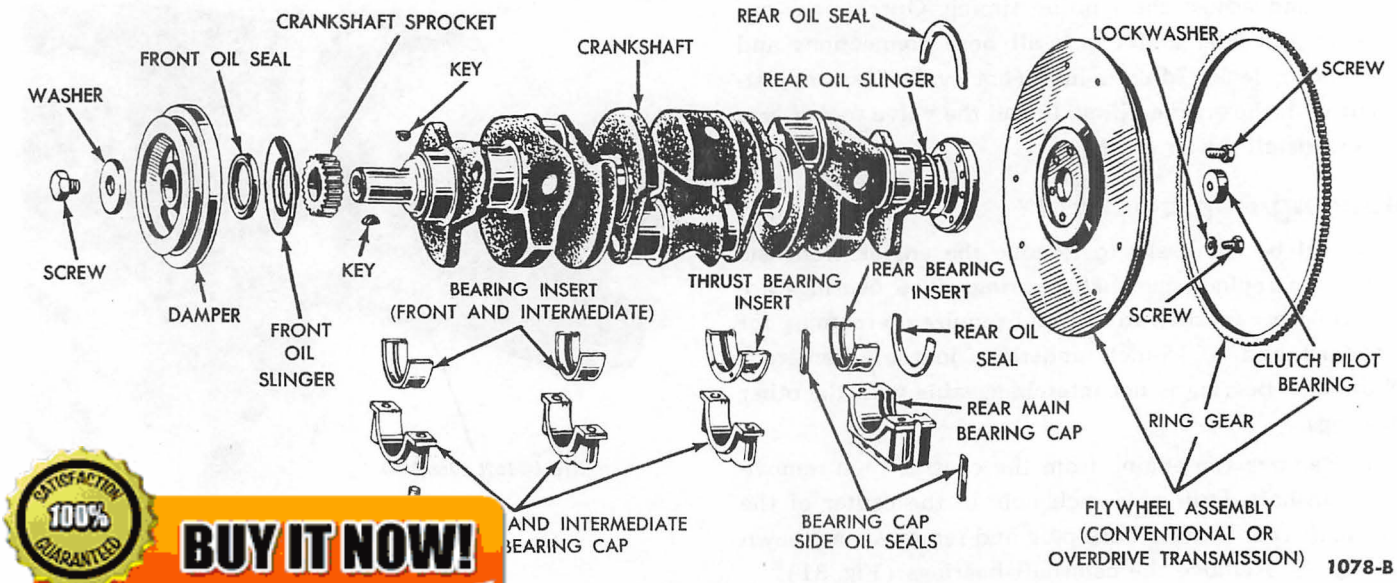
Ring Gear Replacement. Heat the defective ring gear with a blow torch on the engine side of the gear, then knock it off the flywheel. ***Do not hit the flywheel when removing the ring gear.***

Heat the new ring gear evenly until the gear expands enough to slip onto the flywheel. Make sure the gear is seated properly against the shoulder. ***Do not heat any portion of the gear to a temperature higher than 500°F. If this limit is exceeded, the temper will be removed from the ring gear teeth.***

Installation

1. Position the flywheel on the crankshaft flange and install the mounting bolts. Tighten the bolts in sequence across from each other to 75-85 foot-pounds torque. Position the clutch disc, pressure plate, and cover on the flywheel and start the cover bolts. Use Tool 7563-A or -N to align the clutch disc, then evenly tighten the cover bolts to 17-20 foot-pounds torque.

2. Align the engine rear plate on the dowels and



33—Crankshaft and Related Parts

position the flywheel housing. Position the clutch release lever through the slot in the housing. Install the flywheel housing bolts, tightening them to 40-50 foot-pounds torque.

3. Connect the engine ground strap and the clutch bracket. Install the release bearing and hub. Connect the clutch retracting spring. Install the starter and connect the starter cable.

4. Slide the transmission forward on the pilots and install the transmission to flywheel housing upper bolts. Remove the pilot studs and install the lower retaining bolts. Tighten the bolts to 40-50 foot-pounds torque. Install the engine rear support, then remove the jack supporting the engine. Connect the gear shift rods and install the speedometer cable. Adjust the clutch pedal free travel (Group 3—Part 1). Install the flywheel housing cover.

5. Remove the tool from the transmission extension housing and install the drive shaft.

On overdrive transmissions, connect the governor and solenoid wires at the bullet connectors. Install the wiring harness clip on the transmission. Connect the overdrive manual control cable assembly.

CARS WITH AUTOMATIC TRANSMISSION

Removal

1. Disconnect the automatic transmission fluid filler tube and drain the transmission. Remove the converter housing cover assembly. Disconnect the drive shaft at the rear universal joint flange. Slide the drive shaft off the transmission output shaft and install Tool 7657 in the transmission extension housing. Remove the converter drain plugs and allow the fluid to drain from the converter, then install the drain plugs. Disconnect the parking brake rear cable at the equalizer yoke. Remove the engine rear support.

2. Disconnect the speedometer cable and transmission gear shift rods. Support the transmission, then remove the transmission to converter housing bolts, and slide the transmission to the rear.

3. Remove the starter and the transmission filler tube bracket. Remove the converter housing to engine block bolts and remove the converter housing. Remove the converter assembly to flywheel nuts and bolts and remove the converter. Remove the flywheel retaining bolts and remove the flywheel.

Installation

1. Position the flywheel on the crankshaft and install the retaining bolts. Tighten the bolts to 75-85 foot-pounds torque. Position the converter assembly on the [illegible] and nuts. Tighten [illegible]. Position the converter housing and install the lock-[illegible]ts to 45-50 foot-pounds torque.

2. Install the starter and the automatic transmission fluid filler tube bracket. Connect the starter cable. Slide the transmission assembly forward and position it in the converter housing. Install the retaining bolts and tighten them to 40-45 foot-pounds torque. Remove the transmission jack.

3. Connect the speedometer cable and the transmission gear shift rods. Position the engine rear support in place, then place the transmission in position. Install the engine rear support bolts and nuts and tighten them to specifications. Connect the automatic transmission fluid filler tube and the parking brake rear cable. Remove the tool from the transmission extension housing and install the drive shaft. Install the converter housing cover assembly.

4. Fill the transmission with Automatic Transmission Fluid—Type A. Adjust the automatic transmission throttle linkage (Group 4—Part 2).

Crankshaft

REMOVAL

1. Remove the engine from the chassis and install it on a work stand. Remove the distributor, oil level dip stick, water pump, generator, crankshaft damper, cylinder front cover, and the crankshaft front oil slinger. Remove the sprockets and timing chain. Remove the flywheel, crankcase ventilation tube, oil pan, and the oil pump.

2. Make sure all bearing caps (main and connecting rod) are marked so they can be installed in their original locations. Remove the connecting rod bearing caps, using care not to intermix the caps, then push the pistons to the top of the cylinders. Remove the main bearing caps.

3. Carefully lift the crankshaft out of the block so the thrust bearing surfaces are not damaged. Remove the rear journal oil seal from the block and rear bearing cap, and remove the cap to block side seals.

4. If new main and/or connecting rod bearings are to be installed, remove the main bearing inserts from the block and the bearing caps, and/or the connecting rod bearing inserts from the connecting rod and cap. Install new bearings following the procedure under "Main Bearing Replacement" and/or "Connecting Rod Bearing Replacement."

INSTALLATION

1. Be sure the bearings, crankshaft journals, and the rear journal oil seal grooves are clean. Install a new rear oil seal in the cylinder block (Fig. 34), and in the rear main bearing cap (Fig. 35). After installation, cut the ends of the seals flush.

2. Carefully lower the crankshaft into place. ***Be careful not to damage the bearing surfaces.***

3. Check the clearance of each main bearing following the procedure under "Main Bearing Replacement". If the bearing clearances are satisfactory, apply a light coat of engine oil to the journals and bearings, then in-

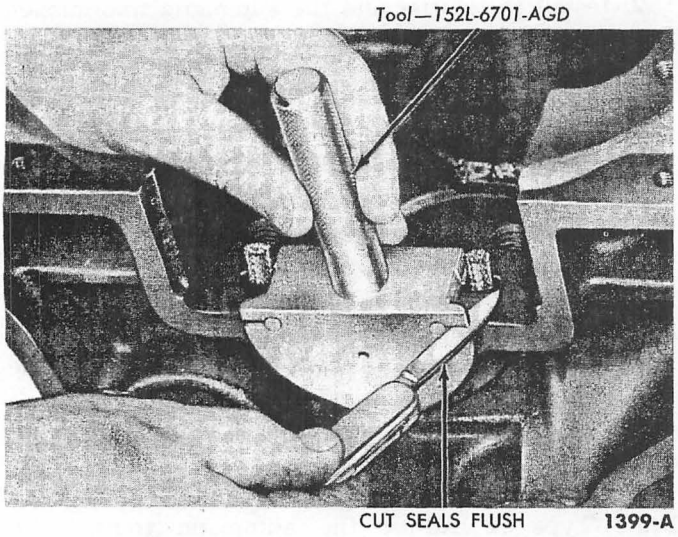
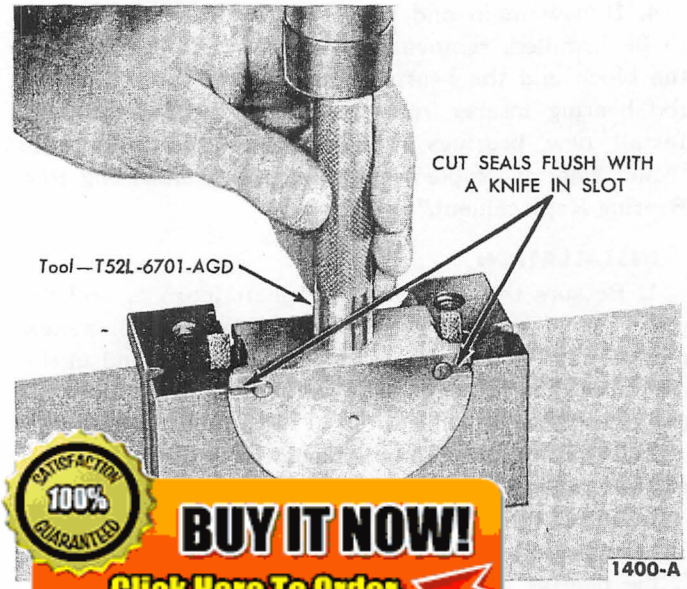


Fig. 34—Rear Oil Seal To Block Installation

stall all the bearing caps except the thrust bearing cap (No. 3 bearing). Tighten the bearing cap bolts to 95-105 foot-pounds torque. Dip the rear bearing cap side seals in light engine oil, then immediately install them in the grooves. ***Do not use sealer on the side seals. The seals are designed to expand when dipped in oil. Using sealer may retard this expansion.*** It may be necessary to tap the seals into place for the last ½ inch of travel. Do not cut the seal projecting ends. Check the side seals for leaks by squirting a few drops of oil into the parting lines between the rear bearing cap and the cylinder block from the outside. Blow compressed air against the seals from the inside of the block. If air bubbles appear in the oil, it indicates possible oil leakage. ***The above test should not be performed on newly installed seals until sufficient time has been allowed for the seals to expand into the seal grooves.***



Fi... Installation

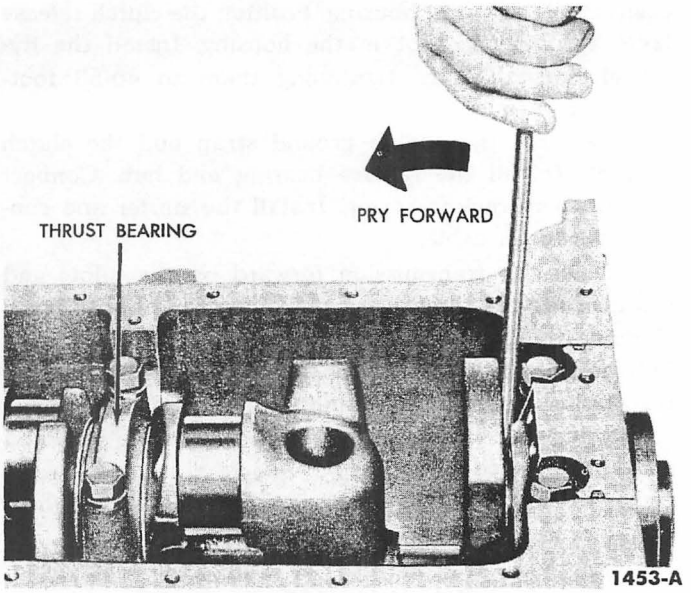


Fig. 36—Pry Crankshaft Forward

4. Install the thrust bearing cap with the bolts finger tight, then pry the crankshaft forward against the thrust surface of the upper half of the bearing (Fig. 36). Hold the crankshaft forward and pry the thrust bearing cap to the rear (Fig. 37). This will aiign the thrust surfaces of both halves of the bearing. Retain the forward pressure on the crankshaft and tighten the cap bolts to 95-105 foot-pounds torque (Fig. 38).

5. Force the crankshaft toward the rear of the engine.

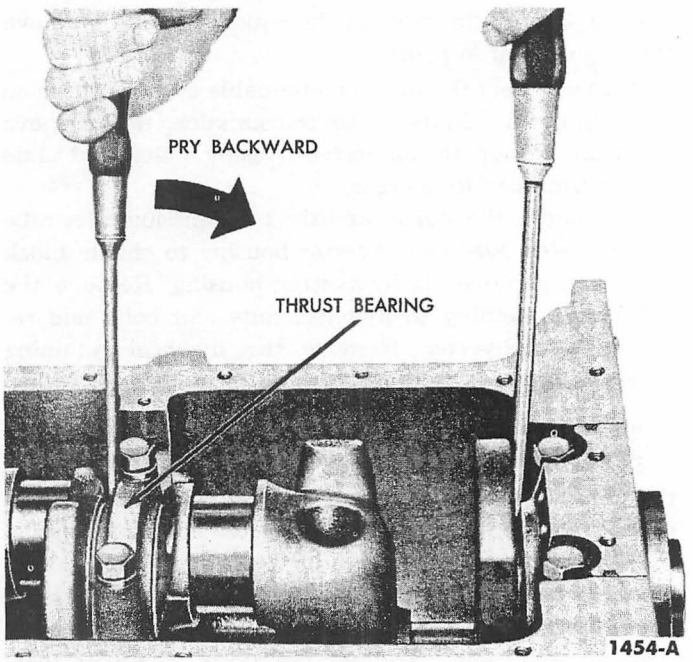


Fig. 37—Pry Cap Backward

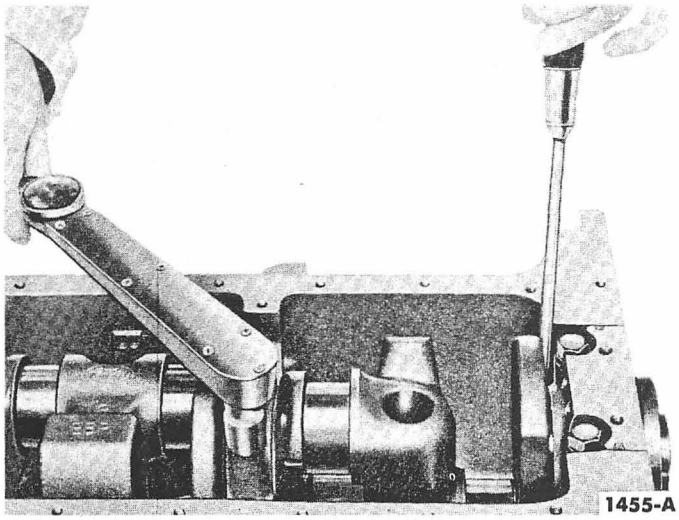


Fig. 38—Tighten Cap

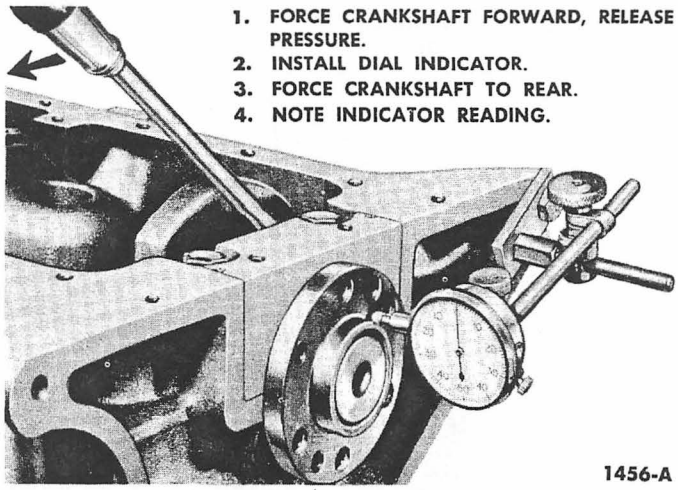


Fig. 39—Crankshaft End Play

Install a dial indicator so the contact point rests against the crankshaft flange and the indicator axis is parallel to the crankshaft axis (Fig. 39). Set the dial on zero, then push the crankshaft forward and note the reading on the dial.

If the end play exceeds the wear limit, replace the thrust bearing. If the end play is less than the minimum limit, inspect the thrust bearing faces for scratches, burrs, nicks, or dirt. If the thrust faces are not defective or dirty, they probably were not aligned properly. Install the thrust bearing and align the faces following the recommended procedure, then recheck the end play.

6. Check the clearance of each connecting rod bearing following the procedure under "Connecting Rod Bearing Replacement." If the bearing clearances are satisfactory, apply a light coat of engine oil to the journals and bearings, then install the connecting rod caps. Tighten the nuts to 45-50 foot-pounds torque. Install the pal nuts and tighten them to 3-4 foot-pounds torque. Check the side clearance between the connecting rods on each crankpin following the procedure under "Piston and Connecting Rod Installation."

7. Install the flywheel, oil pump, oil pump screen and inlet tube assembly, crankshaft damper key, and the oil pan.

8. Install the sprockets and timing chain with the timing marks aligned (Fig. 25). Install the crankshaft front oil slinger, cylinder front cover, and the crankshaft damper. Install the water pump, distributor, crankcase ventilation tube, oil level dip stick, pulley, and fan. Install the generator, then install and adjust the drive

stall the engine in the chassis. Fill and bleed the
h the proper grade
engine and check
the engine at fast
heck all hose con-

nections and gaskets for leaks.

Main Bearing Replacement

The main bearing inserts are selective fit and do not require reaming to size upon installation. ***Do not file or lap bearing caps or use shims to obtain the proper bearing clearance.***

Selective fit bearings are available for service in standard sizes only. Standard bearings are divided into two sizes and are identified by a daub of "red" or "blue" paint. ***Red marked bearings increase the clearance; blue marked bearings decrease the clearance.*** Undersize bearings, which are not selective fit, are available for use on journals that have been reground.

The following procedure is for the engine installed in the chassis with the crankshaft not removed. If the engine is on a work stand follow steps 2-5. In step 4 it is not necessary to support the crankshaft because the engine will be inverted. Also place the plastigage on the crankshaft journal instead of on the bearing surface (Fig. 40).

1. Drain the crankcase. Remove the distributor, oil level dip stick, stabilizer bar, crankcase ventilation tube, flywheel housing inspection cover, oil pan, and the oil pump.

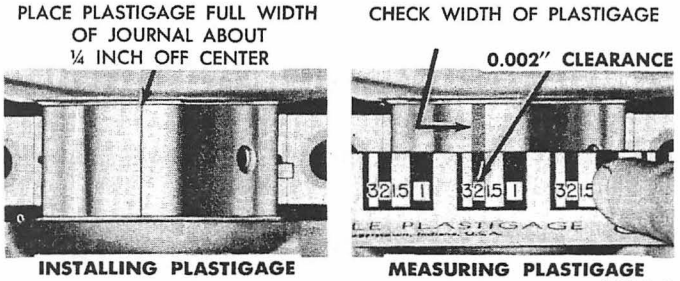


Fig. 40—Installing and Measuring Plastigage—Engine On a Work Stand

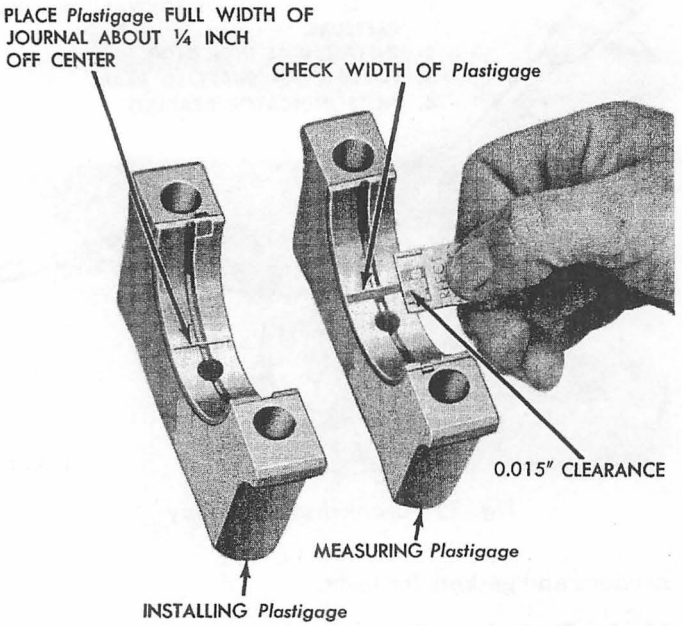


Fig. 41—Installing and Measuring Plastigage—Engine in Chassis

2. ***Replace one bearing at a time, leaving the other bearings securely fastened.*** Remove the main bearing cap to which new bearings are to be fitted. Insert the upper bearing removal tool (Tool 6331) in the oil hole in the crankshaft. Rotate the crankshaft in the direction of engine rotation to force the bearing out of the block.

3. Normally, main bearing journals wear evenly and are not out-of-round. However, if a bearing is being fitted to an out-of-round journal, be sure to fit the bearing to the maximum diameter of the journal. If the bearing is fitted to the minimum diameter with minimum clearance, interference may result, causing an early failure. It is not recommended that bearings be fitted to a crankshaft journal which exceeds the maximum out-of-round specification. ***When replacing standard bearings, it is good practice to first try to obtain the proper clearance with two blue bearing halves.***

To install the upper main bearing, place the plain end of the bearing over the shaft on the locking tang side of the block. Insert Tool 6331 in the oil hole in the crankshaft and rotate the crankshaft in the opposite direction of engine rotation until the bearing seats itself. Remove the tool. Replace the cap bearing. Clean the crankshaft journal and bearings.

4. Support the crankshaft so its weight will not compress the plastigage and provide an erroneous reading by positioning a small jack so it will bear against the counterweight adjoining the bearing which is being checked. Place a piece of Plastigage on the bearing surface the full width of the bearing cap and about ¼ inch off center (Fig. 41). Install the cap and tighten the bolts to 95-105 foot-pounds torque. ***Do not turn the crankshaft while the Plastigage is in place.*** Remove the cap, then using the Plastigage scale, check the width of the Plastigage at the widest point in order to get the minimum clearance. Check the Plastigage at the narrowest point in order to get the maximum clearance. The difference between the two readings is the taper.

If the clearance is less than the specified limits, try two red bearing halves or a combination of red and blue depending on the condition. If the standard bearings do not bring the clearance within the desired limits, grind the crankshaft journal, then install undersize bearings.

5. After the clearance has been checked and found to be satisfactory, apply a light coat of engine oil to the journals and bearings, then install the bearing cap. Tighten the bolts to 95-105 foot-pounds torque.

6. If the rear main bearing is replaced, replace the lower oil seal (in the cap) and the side seals. The upper oil seal can not be replaced unless the crankshaft is removed from the engine.

7. Install the oil pump, oil pump screen and inlet tube assembly, oil pan, flywheel housing inspection cover, crankcase ventilation tube, stabilizer bar, oil level dip stick, and the distributor. Fill the crankcase.

8. Start the engine and check and adjust the initial timing. Operate the engine at fast idle and check for oil pressure and oil leaks.

9. CONNECTING RODS, BEARINGS, PISTONS, PINS, AND RINGS

The piston and connecting rod assembly is shown in Fig. 42.

...und Connecting Rod Removal

...crankcase. Re-
...horn closed. Re-
...stick, crankcase
...tion cover, the stabilizer bar, oil pan, and the oil pump screen and inlet tube.

2. Before removing the piston assemblies, remove any ridge and/or deposits from the upper end of the cylinder bores. Move the piston to the bottom of its travel and place a cloth on the piston head to collect the cuttings. Remove the cylinder ridge with a ridge cutter. ***Never cut into the ring travel area in excess***

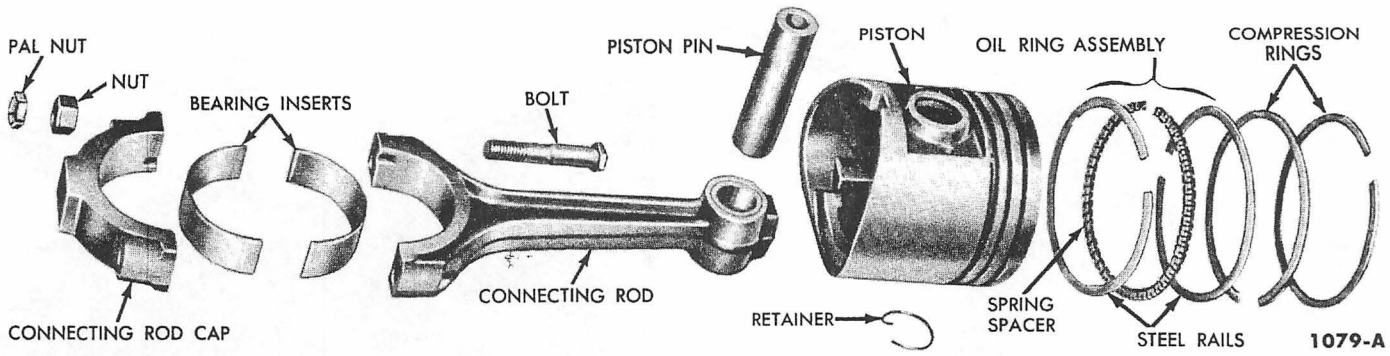


Fig. 42—Piston and Connecting Rod Assembly

of 1/32 inch when removing ridges. After the ridge has been removed, remove the cutter from the cylinder bore, then turn the crankshaft until the piston is at the top of its stroke and carefully remove the cloth with the cuttings.

3. Turn the crankshaft until the connecting rod being removed is down. Remove the pal nuts and the hex head nuts from the connecting rod bolts. Pull the cap off the rod, then push the rod and piston assembly out the top of the cylinder with the handle end of a hammer. ***Avoid damage to the crankpin or the cylinder wall when removing the piston.***

4. If new piston rings are to be installed and the cylinder has not been refinished, remove the glaze from the cylinder wall by passing a fine grit hone or glaze removal tool through the bore a few times. ***Take all the necessary precautions to catch the grit.*** Do not hone more than enough to rough up the finish. Thoroughly clean the cylinder walls and the block after the glaze is removed, then oil the walls.

5. Repeat the above procedure on each assembly.

Piston and Connecting Rod Disassembly

Mark the pistons and pins to assure assembly with the same rod and installation in the same cylinder from which they were removed. Remove the piston rings. Remove the piston pin retainers, then drive the pin out of the piston and rod (Fig. 43). Discard the retainers.

Piston and Connecting Rod Assembly

1. Lubricate all parts with light engine oil. Position the connecting rod in the piston and push the pin into place. ***Assemble the piston and connecting rod with the oil squirt hole in the rod positioned as shown in Fig. 44.***

2. Insert new piston pin retainers by spiraling them into position with the fingers. Do not use pliers. Follow the instructions contained on the piston ring package and install the piston rings.

3. Check the ring side clearance of the compression rings with a feeler gauge inserted between the ring and its lower land (Fig. 45). The gauge should slide freely

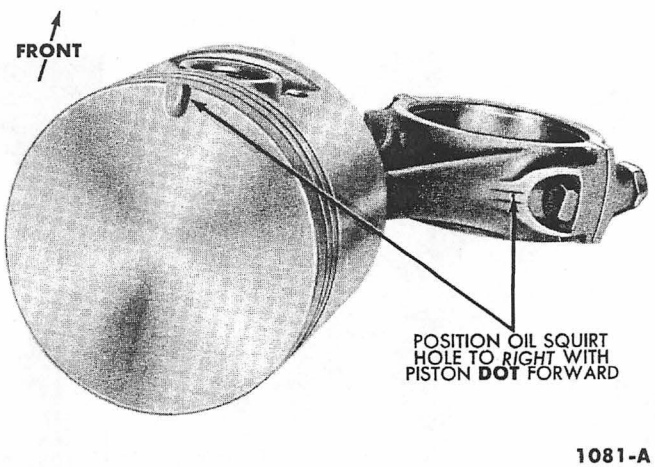


Fig. 44—Correct Position of Oil Squirt Hole

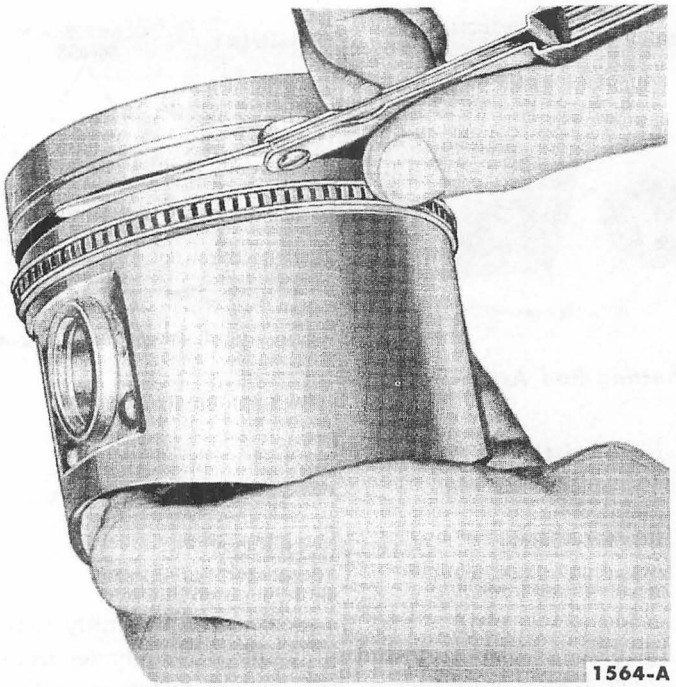


Fig. 45—Piston Ring Side Clearance

around the entire ring circumference without binding. Any wear that occurs will form a step at the inner portion of the lower land. ***If the lower lands have high steps, the piston should be replaced.***

4. Be sure the bearings and journals are clean. If it is necessary to replace the connecting rod bearings, replace them at this time following the procedure under "Connecting Rod Bearing Replacement."

Piston and Connecting Rod Installation

Be sure to install the pistons in the same cylinder from which they were removed, or to which they were fitted. Each connecting rod and bearing cap is numbered from 1 to 6 beginning at the front of the engine. The numbers on the connecting rod and bearing cap must be on the same side when installed in the cylinder bore. If a connecting rod is ever transposed from one block or cylinder to another, new bearings should be fitted, and the rod should be numbered to correspond with the new cylinder number.

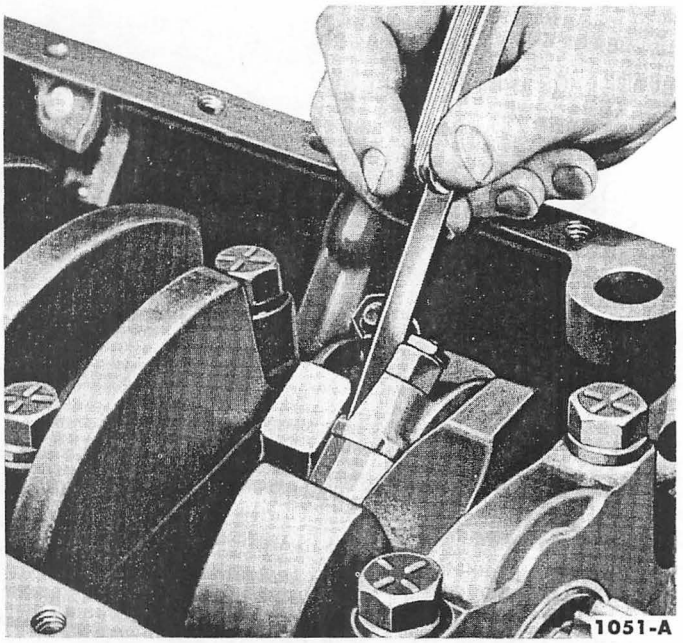


Fig. 47—Connecting Rod Side Clearance

1. Oil the piston rings, pistons, and cylinder walls with light engine oil.

2. Make sure the ring gaps are properly spaced around the circumference of the piston. Install a piston ring compressor on the piston and push the piston in with the handle end of a hammer until it is slightly below the top of the cylinder (Fig. 46). Be sure to guide the connecting rods to avoid damaging the crankshaft journals. ***Install the piston with the indentation in the piston head toward the front of the engine.***

3. Check the clearance of each bearing following the procedure under "Connecting Rod Bearing Replacement." If the bearing clearances are to specifications, apply a light coat of engine oil to the journals and bearings.

4. Turn the crankshaft throw to the bottom of its stroke, then push the piston all the way down until the rod bearing seats on the crankpin. Install the rod cap, then tighten the nuts to 45-50 foot-pounds torque. Install the pal nuts and tighten them to 3-4 foot-pounds torque.

5. After all the piston and rod assemblies have been installed, check the side clearance between the connecting rods on each crankpin (Fig. 47).

6. Install the oil pump screen and inlet tube, oil pan,

stabilizer bar, flywheel housing inspection cover, crankcase ventilation tube, oil level dip stick, and the cylinder head and related parts. Make a preliminary valve lash adjustment. Fill the radiator and the crankcase.

7. Start the engine and operate it for a minimum of 30 minutes at approximately 1200 rpm. Check the valve lash with the engine idling and adjust it if necessary. Make sure there is sufficient oil pressure and the engine does not overheat. Check for oil and coolant leaks. Install the valve rocker arm cover.

Connecting Rod Bearing Replacement

The connecting rod bearings are available for service in standard sizes and undersizes for use on journals that have been reground. Standard bearings are color coded red and blue. ***Red marked bearings increase clearance; blue marked bearings decrease clearance.***

1. Drain the crankcase. Remove the crankcase ventilation tube, flywheel housing inspection cover, stabilizer bar, oil pan, and the oil pump screen and inlet tube. Remove the cap from the connecting rod to which new bearings are to be installed and remove the bearing insert. Push the piston up in the cylinder, then remove the bearing insert from the connecting rod. Clean the crankshaft journal, the cap, and the upper half of the bearing bore.

2. If the crankpin is out-of-round, be sure to fit the bearing to the maximum diameter of the crankpin. It is not recommended to use bearing shims of any type, or to file or lap the bearing caps in order to adjust the bearing clearance. ***When replacing standard bearings, it is good practice to first try to obtain the proper clearance with two blue bearing halves.*** Install the new bearings in the rod and cap. ***Do not get dirt or other foreign matter under the inserts. In time the dirt may distort the bearing and cause bearing failure.*** Pull the rod assembly down firmly on the crankshaft journal. Place a piece of Plastigage on the lower bearing surface, the full width of the cap and about ¼ inch off center. Install the cap and tighten the rod bolts to 45-50 foot-pounds torque. ***Do not turn the crankshaft while the Plastigage is in place.***

3. Remove the cap, then using the Plastigage scale check the width of the Plastigage at the widest point in order to get the minimum clearance. Check the Plastigage at the narrowest point in order to get the maximum clearance. The difference between the two readings is the taper.

If the clearance is less than the specified limits, try two red bearing halves or a combination of red and blue depending upon the condition. If the standard bearings do not bring the clearance within the desired limits, grind the crankpin, then install undersize bearings.

After the bearing clearance has been checked and found to be satisfactory, apply a light coat of engine oil to the crankshaft journal and bearings, then install the rod cap. Tighten the nuts to 45-50 foot-pounds torque, then install the pal nuts and tighten them to 3-4 foot-pounds torque.

4. Repeat the procedure for the remaining connecting rods that require new bearings.

5. After all the bearings that required replacement have been replaced, install the oil pump screen and inlet tube, oil pan, stabilizer bar, flywheel housing inspection cover, crankcase ventilation tube, oil level dip stick, and the cylinder head and related parts. Fill the crankcase, then operate the engine and check for oil pressure and oil leaks.

10. OIL PAN, OIL FILTER, AND OIL PUMP

Oil Pan

REMOVAL

1. Drain the crankcase. Remove the oil level dip stick, the stabilizer bar, and the flywheel housing inspection cover.

2. Remove the oil pan retaining screws and remove the pan and gasket.

INSTALLATION

Make sure the gasket surfaces of the block and rs. Coat the block th sealer and posi-

nst the block and d of the oil pan. Install the remaining screws, then tighten the screws from the center outward in each direction to 12-15 foot-pounds torque.

3. Install the flywheel housing inspection cover, the stabilizer bar, and the oil level dip stick.

4. Fill the crankcase with the proper grade and quantity of engine oil. Operate the engine and check for oil leaks.

Oil Pump

The oil pump is shown in Fig. 48.

REMOVAL

1. Remove the distributor, oil level dip stick, and the oil pan.

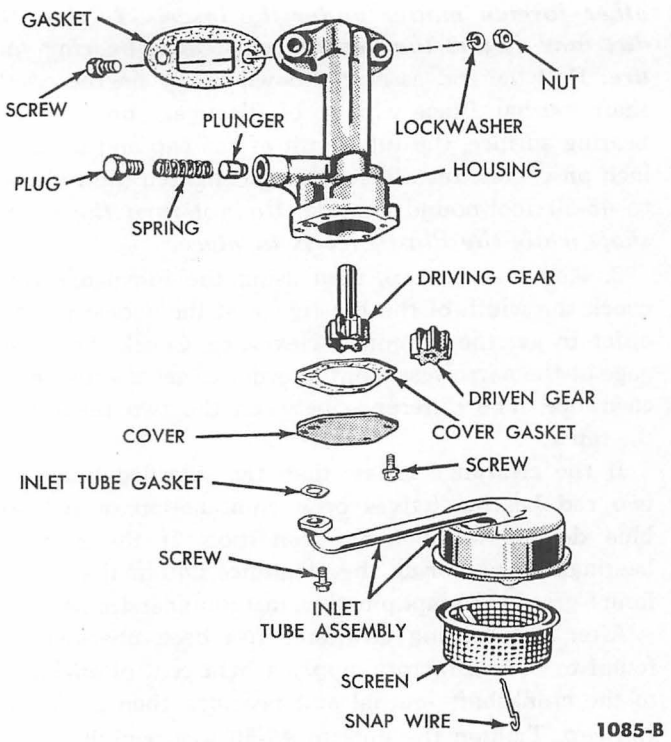


Fig. 48—Oil Pump Assembly

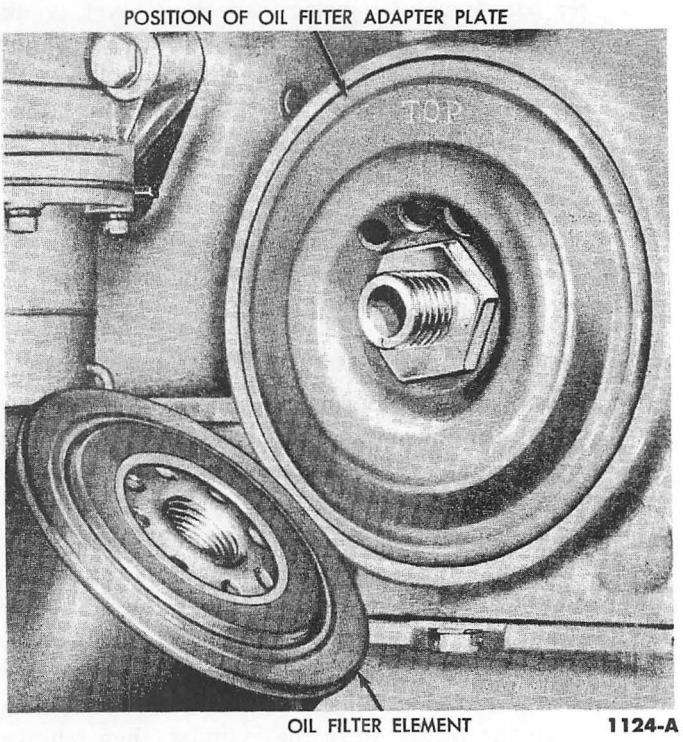


Fig. 50—Oil Filter Replacement

2. Remove the two nuts and lockwashers retaining the oil pump to the cylinder block, then remove the pump and gasket.

3. Thoroughly clean the old gasket material from the mounting pad on the block and pump.

DISASSEMBLY

1. Remove the oil pump cover, inlet tube assembly and gaskets from the oil pump. Remove the snap wire retaining the screen in the inlet tube assembly and remove the screen.

2. Push the oil pump drive shaft and drive gear assembly from the pump housing. Remove the driven gear.

3. Remove the oil pressure relief valve chamber plug, spring, and plunger.

ASSEMBLY

1. Apply a light coat of engine oil to all moving parts.

2. Install the pressure relief valve plunger, spring, and plug. Tighten the plug to 33-38 foot-pounds torque.

3. Slide the drive gear and shaft assembly into the housing. Install the driven gear. Check the end play of the gears (Group 1—Part 1).

4. Apply sealer to both sides of the oil pump cover gasket, then position the gasket on the oil pump. Install the oil pump cover.

5. Install the screen in the inlet tube assembly and secure it with the snap wire.

6. Install the inlet tube gasket, and the inlet tube assembly on the oil pump cover. Tighten the retaining screws to 12-15 foot-pounds torque. Rotate the pump shaft by hand to make sure it turns freely.

INSTALLATION

1. Place a new gasket on the retaining bolts, slide the pump mounting flange over the retaining bolts, and install the lockwashers and nuts. Tighten the nuts to 30-35 foot-pounds torque. Install the distributor and the oil pan and related parts.

2. Fill the crankcase and operate the engine at fast idle and check for oil pressure and oil leaks.

Oil Filter Replacement

The oil filter assembly is shown in Fig. 49.

The filter is removed from the bottom of the car as follows:

1. Place a drip pan under the filter. Unscrew the filter from the adapter fitting.

2. Check to see if the filter adapter plate is properly

positioned (Fig. 50).

3. Coat the gasket on the filter with oil, then place the filter in position on the adapter fitting. Hand tighten the filter until the gasket contacts the adapter face, then advance it ½-turn.

4. Operate the engine at fast idle, and check for oil leaks. If oil leaks are evident, perform the necessary repairs to correct the leakage. Check the oil level and fill the crankcase if necessary.

11. EXHAUST SYSTEM

The exhaust system consists of a muffler inlet pipe, muffler, and a muffler outlet pipe (Fig. 51). These parts are provided as individual service parts. ***When replacing any part of the exhaust system, loosen all the frame attaching bracket clamps to relieve twists in the system, then tighten the clamps after the part is installed.***

Inlet Pipe Replacement

1. Remove the two nuts fastening the inlet pipe to the exhaust manifold. Loosen the outlet pipe clamps and the muffler inlet pipe clamp. Slide the muffler to the rear, then separate the muffler and inlet pipe. Remove the inlet pipe and gasket.

2. Slide the clamp on the new inlet pipe, then slide the inlet pipe into the muffler extension until the slots in the extension are blocked. Do not slide the pipe into the muffler more than 1¾ inches.

3. Install a new gasket on the exhaust manifold outlet flange studs, then connect the inlet pipe to the exhaust manifold. Tighten the bolts to 23-28 foot-pounds torque.

4. Position the muffler, then tighten the outlet pipe clamps. Rotate the inlet pipe clamp downward approximately 45 degrees so the clamp opening is not positioned directly opposite the slots in the muffler extension, then tighten the clamp.

Muffler Replacement

1. Remove the lower half of the outlet pipe to muffler clamp, and the lower half of the outlet pipe rear clamp. Separate the outlet pipe from the muffler.

2. Loosen the inlet pipe to muffler clamp and slide it away from the muffler. Remove the muffler to outlet pipe to frame clamp. Remove the muffler assembly from the inlet pipe.

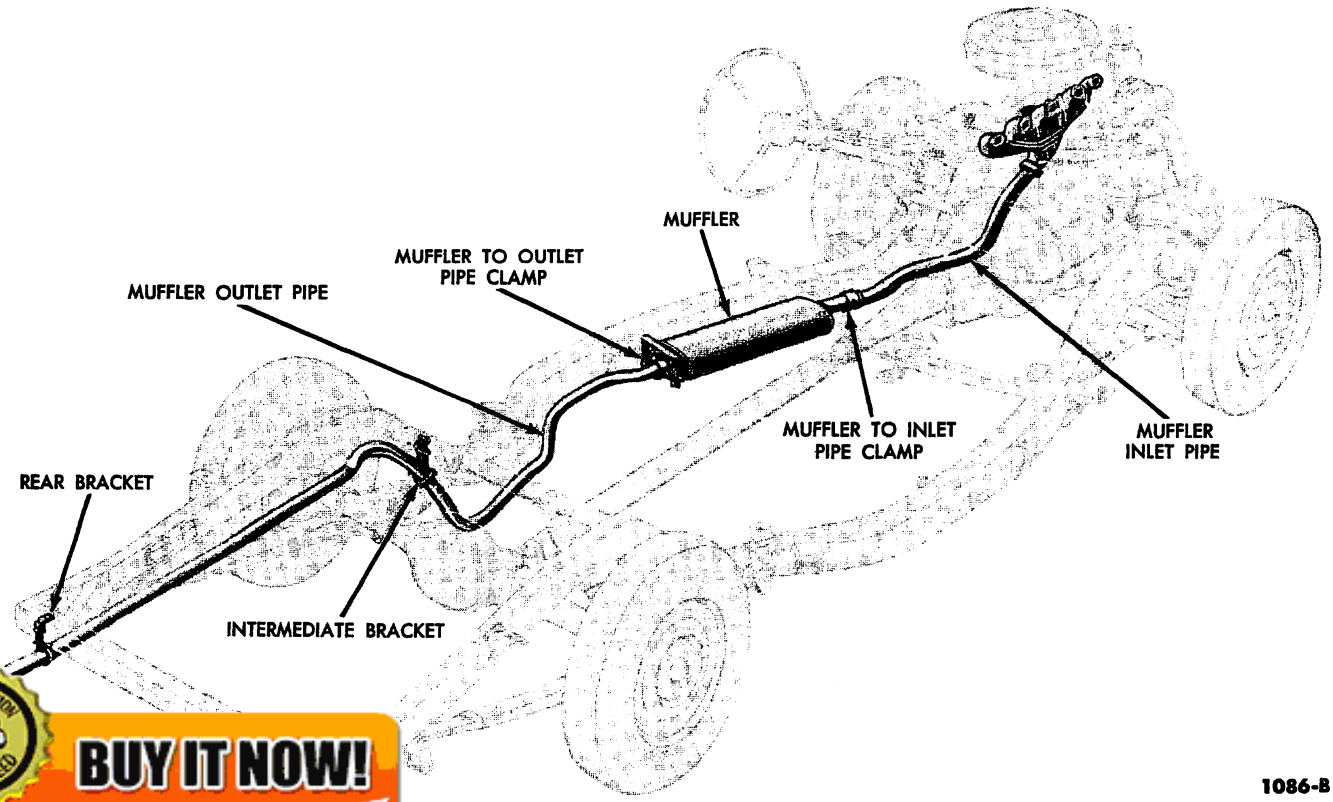


Fig. 51—Exhaust System

3. Position the new clamp and muffler on the inlet pipe. Slide the muffler forward on the inlet pipe until the slots in the muffler extension are blocked. Do not slide the muffler on the inlet pipe more than 1¾ inches.

4. Rotate the inlet pipe clamp downward approximately 45° so the clamp opening is not positioned directly opposite the slots in the muffler extension.

5. Install the outlet pipe to frame clamp. Slide the outlet pipe forward into the muffler extension until the slots in the muffler extension are blocked. Do not slide the pipe into the muffler more than 1¾ inches.

Outlet Pipe Replacement

1. Remove the lower half of the outlet pipe to muffler clamp.

2. Loosen the outlet pipe intermediate clamp and slide it off the frame intermediate bracket.

3. Remove the lower half of the outlet pipe rear clamp. Jack up the frame to provide clearance at the axle and remove the outlet pipe assembly.

4. Position the outlet pipe to frame intermediate clamp on the new outlet pipe, then slide the outlet pipe assembly into place from the rear of the car. Remove the jack from the frame. Slide the pipe into the muffler until the slots in the muffler extension are blocked. Do not insert the pipe more than 1¾ inches into the muffler.

5. Connect, but do not tighten, the lower half of the outlet pipe to muffler clamp and the intermediate clamp.

6. Connect, but do not tighten, the outlet pipe to frame clamp. Check for possible interference between the outlet pipe "kick-up" and the floor pan or fuel tank. Reposition the outlet pipe if necessary, then tighten all clamps.