TOYOTA

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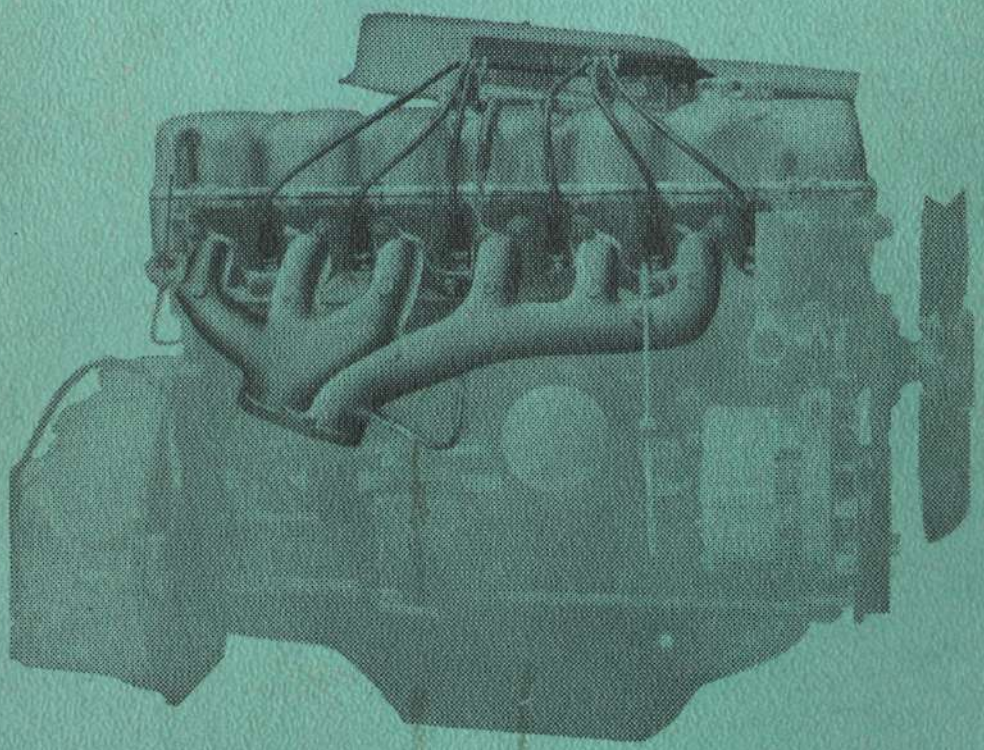
2M & M ENGINE REPAIR MANUAL



TOYOTA MOTOR SALES CO., LTD.

SECTION

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2M & M ENGINE

REPAIR MANUAL

TOYOTA MOTOR SALES CO., LTD.

EXPORT - TECHNICAL DIVISION

FOREWORD

This manual has been published separately for the guidance of the Servicemen in maintaining the best performance designed and built in these 2M and M model engines.

It contains the general description and construction with all up-to-date information and specifications at the time of this publication.

It is recommended that this manual should be kept readily available for reference at all times. Also this may be used for the training of your Servicement in regards to the special features, function, operation and maintenance of these engines.

We reserve the right to change the specifications and data without further notice.

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DESCRIPTION

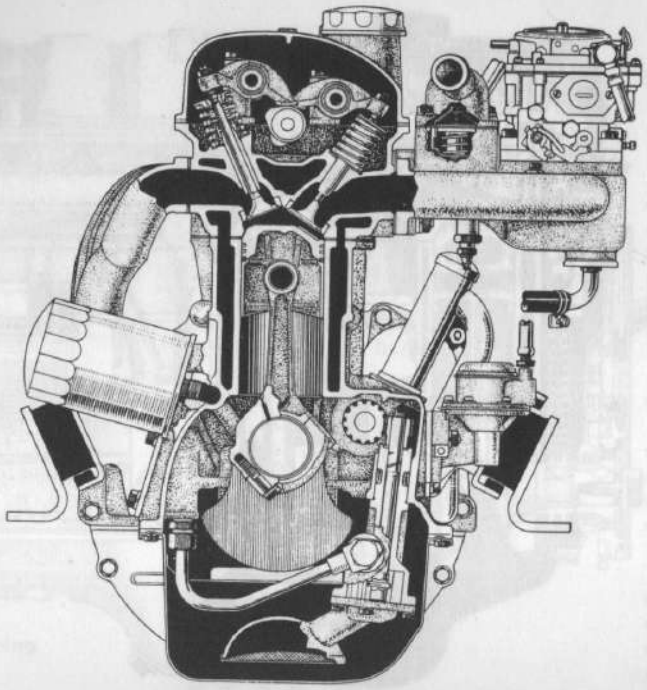

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Fig.0-1 Engine Cross Section - Front View

GENERAL

The 2M and M engines are a completely newly designed six cylinder in-line engine with a single overhead camshaft, driven by a sprocket chain, minimizing the vibrations, and the engine disagreeable sounds. This engine has been produced by the endeavoring efforts of the Toyota Motor Company engineers, with long experience, and technical knowledge. Considerable consideration has been regarded in the performance, durability, and serviceability.

Special Features

High performance

By utilizing the single overhead camshaft, the valve mechanism compared with the conventional overhead valve system, the operation of the valves has been improved by the direct constant contact of the valve mechanism with the camshaft.

The cylinder head being made of an aluminum alloy, and with the semi-hemisphere combustion chambers, allow efficient heat distribution. Also together with the independent inlet and outlet ports, provide smooth performance during slow, intermediate, and high speed operations.

The length of individual inlet manifold ports has been carefully studied to obtain an even draw of intake fuel mixture.

The exhaust manifold is separated into two groups with Nos.1,2,3, as one, and Nos.4,5,6 as another. These are grouped together at the primary muffler with separate exhaust pipes.

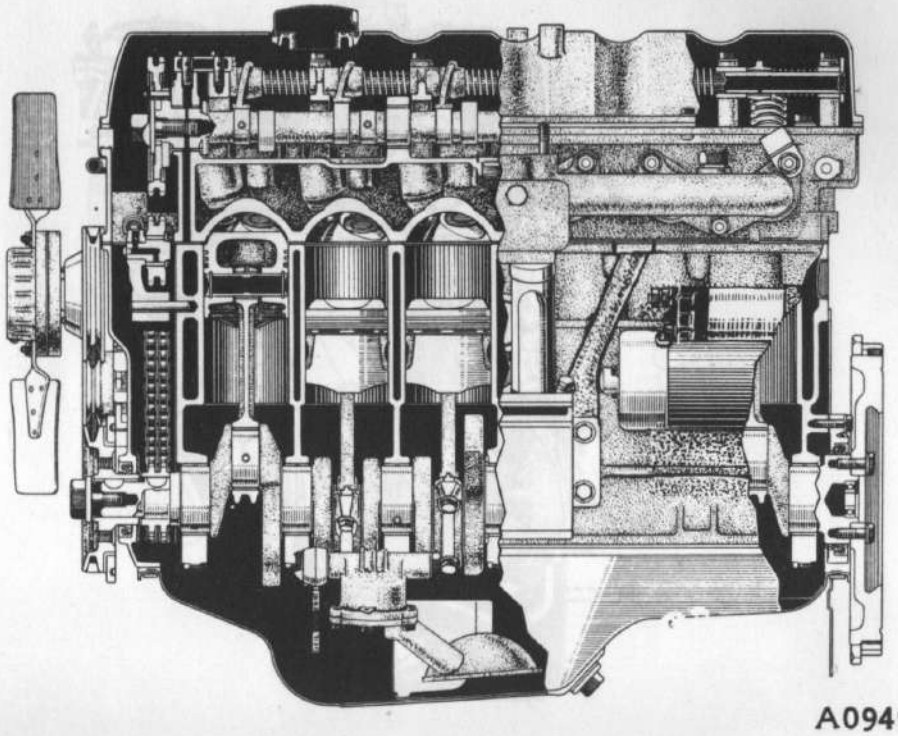

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Fig.0-2 Engine Cross Section - Side View

Quietness

The engine being a six cylinder construction provided with seven main bearings, is well balanced, and the engine disagreeable sounds are minimized.

To improve the balance, a torsional damper is installed at the front of the crankshaft, resulting less vibrations, and engine disagreeable sounds during high speed operation.

Light and compact

To lighten the overall weight, aluminum alloy has been utilized as much as possible, which enables in making the engine weight only 180 kilograms for a 2,000 cubic centimeter displacement engine.

By using a single chain drive system, the mechanism has been simplified, and also results in shortening the engine overall length. Also to aid this, the water pump and the fan have been installed at the right side.

Serviceability

The valve adjustment is facilitated due to the installation of the rocker arms.

No special tools and gauges are required to perform the valve adjustment. Just remove the cylinder head cover, and the adjustment can be accomplished.

Also the engine does not require the removal from the car to perform the valve adjustment.

SPECIFICATIONS

Engine

Model		2M	M
Type		Gasoline, four-cycle, in line OHC	same
Number of cylinder		Six	same
Bore and Stroke		75 x 85 mm (2.87 x 3.35")	75 x 75 mm (2.87 x 2.87")
Displacement		2,253 cc (137.5 cubic in.)	1,988 cc (121.5 cubic in.)
Compression ratio		8.8 to 1	same
Compression pressure		11 kg/cm² (156 psi) at 250 rpm	same
Max. explosive pressure		50 kg/cm² (711 psi) at 3,600 rpm	same
Max. mean effective pressure		9.8 kg/cm² (139 psi) at 3,600 rpm	10.12 kg/cm² (144 psi) at 3,600 rpm
Gross hosepower (SAE)		115 HP at 5,200 rpm	110 HP at 5,200 rpm
Gross max. torque (SAE)		17.6 m-kg (127 ft-lb) at 3,600 rpm	16.3 m-kg (117.9 ft-lb) at 3,600 rpm
Min. fuel consumption		215 g/hp-hr (0.469 lb/hp-hr) at 2,400 rpm fuel load	same
Dimension:	Length	779 mm (30.7")	same
	Width	730 mm (28.7")	same
	Height	710 mm (28.0")	same
Service weight W/lubricant, Coolant, Air Cleaner & Starter		180 kg (396 lb)	same
Piston type		Semi-hemisphere head	same
Piston material		Aluminum	same
Piston compression ring		Two	same
Piston oil ring		One	same
Intake valve	opens	B.T.D.C. 10°	same
	closes	A.B.D.C. 54°	same
Exhaust valve	opens	B.B.D.C. 50°	same
	closes	A.T.D.C. 14°	same
Intake valve clearance (Cold)		0.10 mm (0.004")	same
Exhaust valve clearance (Cold)		0.19 mm (0.007")	same
Ignition timing		B.T.D.C. 10° at 500 - 600 rpm	same
Firing order		1-5-3-6-2-4	same
Air cleaner type		Replaceable felt element	same
Fuel pump type		Diaphragm	same
Lubricating method		Full pressure feed	same
Oil pump type		Trochoid	same
Oil filter type		Unit replaceable type	same
Oil pan capacity		4.4 liters (4.65 US qts., 3.87 Imp. qts.)	same
Oil filter cpacity		0.8 liter (0.85 US qt., 0.70 Imp. qt.)	same
Coolant capacity:	w/o heater	9.6 liters (10.2 US qts., 8.4 Imp. qts.)	Manual transmission
		9.5 liters (10.1 US qts., 8.3 Imp. qts.)	Toyoglide
	w/heater	10.5 liters (11.1 US qts., 9.2 Imp. qts.)	Manual transmission
		10.4 liters (11.0 US qts., 9.1 Imp. qts.)	Toyoglide

Carburetor

Air horn diameter		72 mm (2.83")	same
Main venturi dia.	Primary	25 mm (0.98")	24 mm (0.94")
	Secondary	30 mm (1.18")	29 mm (1.14")
Large venturi dia.	Primary	14.6 mm (0.575")	same
	Secondary	15.6 mm (0.614")	same
Small venturi dia.	Primary	7.0 mm (0.276")	same
	Secondary	7.0 mm (0.276")	same
Throttle bore dia.	Primary	35 mm (1.38")	same
	Secondary	35 mm (1.38")	same
Main jet dia.	Primary	1.06 mm (0.04")	0.98 mm (0.0386")
	Secondary	1.70 mm (0.067")	1.55 mm (0.061")
Slow jet dia.	Primary	0.55 mm (0.0216")	0.55 mm (0.0216")
	Secondary	0.55 mm (0.0216")	0.55 mm (0.0216")
Power jet dia.		0.92 mm (0.036")	0.80 mm (0.031")
Pump jet dia.		0.55 mm (0.0216")	0.55 mm (0.0216")
Economizer jet dia.		1.00 mm (0.039")	same

Main air bleeder dia.	Primary	0.5 mm (0.020")	same
	Secondary	0.5 mm (0.020")	same
Slow air bleeder	Primary No.1	0.8 mm (0.031")	same
	" No.2	1.3 mm (0.051")	same
	Secondary	0.6 mm (0.024")	same
Power piston operation vacuum		90 ~ 100 mm Hg (3.54 ~ 3.94 inHg)	8.0 ~ 100 mmHg (3.1 ~ 3.9 InHg)
Float level		9.5 mm (0.374") at raised position	same

Alternator

Voltage	12 volts	same
Output	456 watts	same

Starter Motor

Drive	Over-running clutch magnet switch	same
Voltage	12 volts	same
Output	0.8 kilowatt (1.1 HP)	same

Battery

Voltage	12 volts	same
Capacity	40 amp/hr (20 hr. rating)	same
Electrolyte specific gravity	1.260	same

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ENGINE TUNE-UP

Fuel filter inspection

1. Check and clean the element, and the glass bowl.
   The element should be replaced normally every 20,000 kilos or 12,000 miles.
   This replacement depends largely on the condition of fuel supply.

Fan belt inspection & adjustment

1. Check the fan belt deflection. Adjust the fan belt deflection to 16 mm (0.63") when pull scale is 12 kg (26.4 lbs), by loosening the alternator adjusting bar bolt.

2. Replace the fan belt if defective.

Distributor inspection and adjustment

Check the following points, and if defective, adjust, correct or replace as necessary.

1. The point gap should be adjusted to 0.4 to 0.5 mm (0.016 to 0.020").

2. Check and adjust the cam dwell angle by adjusting the distributor points to 38 to 44 degrees.

3. Dress the points if necessary with a point file. If the pits on the points are excessive, the points must be replaced.
   Always replace the points as a set.

4. Check the point spring tension. The specified spring tension should be from 540 to 660 grams or 19 to 23 oz.

5. Check and test the condenser capacity which should be from 0.20 to 0.24 microfarad.

6. Check the governor advance and the vacuum advance controller for advance characteristics in Distributor section.

7. Lubricate the cam lobes, point arm rubbing block, and point arm pivot. Refer to Distributor section.

Valve clearance adjustment

1. The adjustment must be performed while the engine is cold.

2. Tighten the cylinder bolts to specified torque.
   Specified torque:
   Cylinder head bolts-
   7.5 to 8.5 m-kg
   (54.25 to 61.5 ft-lb)
   Rocker shaft support bolts & nuts-
   3.0 to 4.5 m-kg
   (21.7 to 32.5 ft-lb)
   Camshaft bearing cap attaching nuts
   1.7 to 2.3 m-kg
   (12.3 to 16.6 ft-lb)

3. Check the rocker arm and the stem clearance with a feeler gauge as follows:

a. Remove the No.1 cylinder spark plug, and check the compression stroke. When the "indent hole" on the camshaft front bearing cap and the "timing line" on the camshaft flange are aligned at compression stroke, the No.1 cylinder is at the firing position.
   With this setting, the following valves may be adjusted.
   Intake: 1-2-4 (cylinders)
   Exhaust: 1-3-5 (cylinders)

b. Crank the engine exactly one revolution.
   At this position, the following valves may be adjusted.
   Intake: 3-5-6 (cylinders)
   Exhaust: 2-4-6 (cylinders)

c. Specified clearance: (cold)
   Intake: 0.1 mm (0.004")
   Exhaust: 0.18 mm (0.007")

d. Tighten the lock nut securely after adjustment, and recheck the clearance

4. When the No.1 cylinder is at the firing position, check the chain looseness by referring to Chain in Engine, Inspection & Repair section, page 2-33.

Engine inspection during warm-up

Warm the engine to operating temperature which should be 75 to 85°C or 167 to 185°F.

1. Check the oil pressure.
2. Check the battery charging condition.
3. Check for oil, and coolant leak.

Ignition initial timing inspection

1. Connect a timing light onto the No.1 spark plug, and a tachometer to the ignition coil.
2. To set the initial octane selector adjustment, align the arrow mark with the adjusting knob center line until the thick line just disappears, then readjust to meet the gasoline octane rating used, by referring to the following "Octane selector adjustment" paragraph.
3. Start engine and run at idle speed.
   Engine idle speed:
   MS41 550 to 600 rpm
   MS41-C
   D range 550 to 600 rpm
   N range 620 to 650 rpm
4. Aim the timing light at the timing graduations on the timing chain cover.
   NOTE: The zero indicates Top Dead Center, and figure 15 indicates 15 degrees B.T.D.C.
5. Adjust the timing to following specification by loosening the distributor clamp, and rotating the distributor body as required. Tighten the clamp.
   Ignition initial timing:
   MS41 10° B.T.D.C.
   MS41-C 10° B.T.D.C..

Octane selector adjustment

1. Depending on the gasoline octane rating, the ignition timing must be adjusted as required.
2. To test, run the car at 20 kilos per hour or 12 miles per hour, and depress the accelerator pedal all the way to the floor. At this time, the engine should have a slight "ping", but it should fade out gradually as the car picks up the speed.
3. If the engine "pings" excessively, turn the adjuster towards the "R" mark.
4. If the engine does not "ping", turn the adjuster towards the "A" mark.
   NOTE: One graduation of the adjuster is equal to 10.4 degrees of crankshaft angle.
   Turning the adjuster towards the "A" mark will advance the timing, and towards the "R" will retard the timing.
   The limit of adjustment is 20.8° of the crankshaft angle, and has no relation with the vacuum advance.

Compression test

1. Warm up the engine to operating temperature 75 ~ 85°C (167 ~ 185°F) before the test.
2. Remove all spark plugs.
3. Disconnect the secondary wire from the ignition coil.
4. The throttle valve must be fully opened during the test.
5. Always use a full charged battery to obtain engine revolution of more than 250 rpm.
6. The reading of each cylinder must be taken more than twice to obtain a correct reading.

7. Record the highest compression reading when the gauge needle is steady.

8. If maximum reading is not within the specified compression reading, insert few drops of engine oil into the cylinder, and make the compression test. If the compression increases, this indicates worn piston rings. The piston rings must be replaced. If the reading is still low, the valve seating is improper causing compression leak.
Specified compression:
To exceed 11 kg/cm^2 (156 psi.) at 250 rpm
The difference between each cylinder should not exceed 1 kg/cm^2 or 14.22 psi.
The compression reading should not be less than 9 kg/cm^2 or 123 psi.

Spark plug inspection

1. Remove all spark plugs.

2. Check the spark plugs for the following defects, and replace if necessary.
Cracked or chipped insulator.
Excessive electrode erosion.
Excessive carbon deposit in insulator tip.
Defective gasket.
Glazed or blistered porcelain.
NOTE: If excessive carbon deposit is observed on the insulator tip, replace with a Hot range type spark plugs.
If spark plugs show burning White or rapid electrode wear, replace with a Cold range type spark plugs.

3. If the insulator and the electrode are oily, clean with cleaning solvent and a brush.

4. When cleaning with a abrasive type cleaner, do not operate too long to prevent porcelain damage.

5. Adjust the spark plug gap by bending the ground electrode to obtain the specified gap of 0.7 to 0.8 mm or 0.028 to 0.032" with a gap gauge.

6. Install the spark plugs, and tighten finger tight, then tighten to 1.4 to 2.0 m-kg (10 to 14.5 ft-lb) torque.

Carburetor inspection & adjustment

For detail operation and procedures refer to Carburetor, Fuel System section.

1. Start the engine and check the carburetor fuel level.

2. The fuel level should align with the fuel level line of the gauge. If the level is not satisfactory, adjust before proceeding with the operation.

3. It is also necessary to check the fuel pump pressure, and the needle valve of the float.

4. The adjustment of the carburetor should be performed with the air cleaner installed.

5. Remove the intake manifold suction hole plug, then install the adapter to connect the vacuum gauge.
Connect the vacuum gauge hose to the adapter.

6. Turn the throttle adjusting screw in or out until the engine operates smoothly without stalling at possible lowest revolution.

7. Turn the idle adjusting screw to obtain maximum vacuum gauge reading.

8. Turn the throttle adjusting screw, and the idle adjusting screw alternately to obtain a steady and maximum vacuum reading with smooth engine operation at lowest possible revolution.

Idling speed:

MS41	550 to 600 rpm
MS41-C	
D range	550 to 600 rpm
N range	620 to 650 rpm

Vacuum:

MS41	400 to 470 mmHg (16 to 19 inHg)
MS41-C	same as above

9. To check the acceleration pump, the air cleaner must be removed from the carburetor.

10. Do not operate the engine and open the throttle valve completely from a closed position, and observe the condition of fuel discharge from the pump jet.

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ENGINE

Excessive Oil Consumption

1. Oil leak

a. Loose oil pan drain plug	Tighten
b. Loose oil pan attaching bolts	Tighten
c. Defective oil pan gasket	Replace gasket
d. Loose timing gear cover or defective gasket	Tighten bolts or replace gasket
e. Defective crankshaft oil retainer	Replace oil strainer
f. Defective crankshaft oil seal/s	Replace oil seal/s
g. Defective rocker arm cover gasket	Replace gasket
h. Loose fuel pump mounting or defective gasket	Tighten bolts or replace gasket
i. Loose oil cleaner	Tighten

2. Excessive oil consumption

a. Defective piston rings	Replace piston rings
b. Ring gaps in line	Correct gap positions
c. Worn piston rings or sticky ring grooves	Replace rings
d. Carbon deposit in oil return hole of oil ring	Replace rings
e. Excessive piston and cylinder bore wear	Replace pistons and bore cylinders
f. Defective valve stem oil seal/s	Replace oil seal/s

Hard Starting

1. Slow cranking speed

a. Improper grade oil	Replace with proper grade oil
b. Discharged battery	Charge battery
c. Defective battery	Recharge battery
d. Loose or defective battery terminals	Clean, tighten or replace terminals
e. Defective starter motor	Repair, or replace

2. Defective ignition system

a. Burnt distributor points	Clean or replace
b. Incorrect point gap	Adjust
c. Incorrect spark plug gap	Adjust
d. Loose spark plug wire or defective wire/s	Tighten wire/s or replace
e. Defective ignition coil	Replace
f. Defective condenser	Replace

3. Engine

a. Burnt valves	Grind, retouch or replace
b. Compression leak between manifold and gasket	Tighten bolts or replace gasket
c. Loose carburetor mounting bolts	Tighten

Hard Starting (cont'd.)

d. Worn pistons, piston rings and cylinders	Replace pistons, piston rings and bore cylinders
e. Defective cylinder head gasket	Replace

4. Carburetor

a. Defective choke mechanism	Adjust or replace
b. Incorrect engine idle	Adjust
c. Dirty or clogged carburetor	Disassemble and clean

Popping, Spitting & Detonation

1. Ignition system

a. Ignition system wires loose	Check connections and tighten
b. Defective spark plugs	Clean, adjust or replace

2. Air-fuel mixture

a. Lean mixture	Clean and adjust carburetor
b. Dirty carburetor	Clean
c. Clogged fuel pipes	Clean or replace pipes
d. Gas leak from carburetor or intake manifold	Tighten or replace gasket

3. Valve

a. Incorrect valve clearance	Adjust
b. Sticky valve/s	Repair or replace
c. Weak valve springs	Replace
d. Incorrect valve timing	Check and adjust chain looseness

4. Cylinder head

a. Excessive carbon deposit in cylinder head	Remove carbon
b. Clogged water passage in cylinder head	Clean water passage or replace cylinder head
c. Defective cylinder head gasket	Replace gasket

5. Spark plug

a. Incorrect heat range plugs	Replace

6. Exhaust system

a. Restricted manifold or muffler	Clean or replace

Improper Engine Idle

1. Carburetor

a. Incorrect idle adjustment	Adjust

Improper Engine Idle (cont'd.)

2. Air leak

a. Air leak between carburetor base and intake manifold	Tighten bolts

3. Valve

a. Incorrect valve clearance	Adjust
b. Improper valve seating	Grind valve seats
c. Excessive clearance between valve stem and guide	Replace valve and guide

4. Cylinder head

a. Defective cylinder head gasket	Replace gasket

Engine Misses at Acceleration

1. Carburetor

a. Clogged accelerating system	Disassemble and clean
b. Lean mixture	Clean or repair

2. Ignition system

a. Defective spark plugs	Clean or replace plugs
b. Defective ignition wire	Replace wire/s
c. Incorrect distributor point gap	Adjust point gap
d. Defective ignition coil	Replace

3. Engine

a. Burnt or incorrect valve adjustment	Adjust clearance or replace valve/s
b. Compression leak	Repair engine
c. Defective cylinder head gasket	Replace gasket

Noisy Engine

One of the most difficult of all trouble-shooting operation is to locate the source of noise in the engine. Every rotating or reciprocating part is a potential source of noise. Certain noises possess characteristics which can be detected. These characteristics vary and experience is the best guide in most cases.

1. Crankshaft bearing

a. Worn bearings	Replace
b. Worn crankshaft journals	Grind or replace crankshaft
c. Clogged oil passage in cylinder block	Clean oil passage
d. Melted crankshaft bearing	Replace bearing and check lubricating system

Noisy Engine (cont'd.)

2. Connecting rod and clearance

a. Worn bearings	Replace
b. Worn crankpin journals	Grind or replace crankshaft
c. Bent connecting rod	Straighten or replace
d. Melted bearings	Replace bearings and check lubricating system
e. Insufficient engine oil	Replenish oil

3. Piston, piston pin and piston rings

a. Worn cylinder bores	Bore and hone cylinder bores
b. Worn piston or piston pin	Replace pistons and pins
c. Sticky piston	Replace piston/s
d. Defective piston rings	Replace piston rings

4. Other components

a. Incorrect valve timing	Check and adjust chain looseness
b. Worn crankshaft center thrust bearing	Replace
c. Worn timing gear	Replace
d. Excessive valve clearance	Adjust clearance

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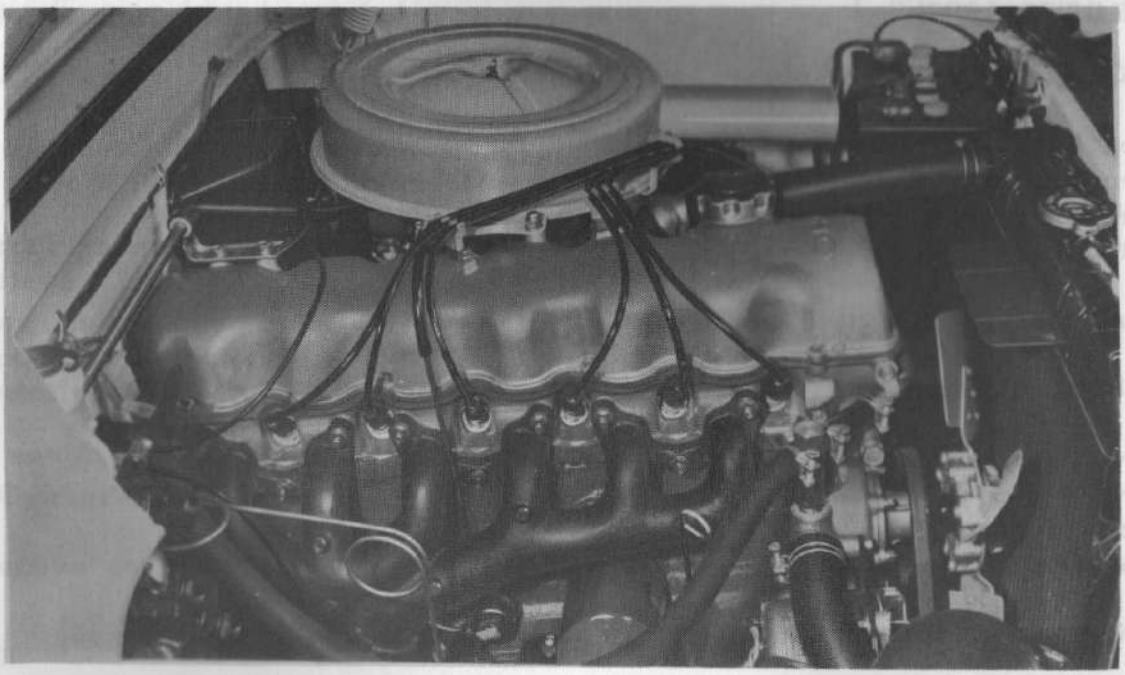


Fig. 2-1 Engine right side view V1117

REMOVAL

1. Disconnect the positive battery cable from the battery terminal.
2. Disconnect the engine room light wiring at the hood hinge right-hand side.
3. Remove the hood assembly.
4. Drain the cooling system.
5. Remove the air cleaner assembly.
6. Remove the accelerator rod assembly with the bracket.
7. Disconnect the heater outlet hose if installed.
8. Disconnect the wire from the oil pressure sender gauge.
9. Disconnect the alternator wiring.
10. Disconnect the Toyoglide oil cooler inlet flexible hose from the inlet tube if installed.
11. Remove the radiator outlet hose.
12. Disconnect the clutch flexible hose from the release cylinder tube.
13. Remove the radiator inlet hose.
14. Disconnect the wiring from the distributor.
15. Disconnect the wiring from the water temperature sender gauge.
16. Remove the battery to engine ground cable.
17. Disconnect the coil wire from the ignition coil.
18. Disconnect the fuel hose from the fuel filter assembly, then remove the fuel filter assembly with the bracket.
19. Disconnect the Toyoglide oil cooler outlet flexible hose from the outlet tube if installed.
20. Remove the battery to starter motor cable.

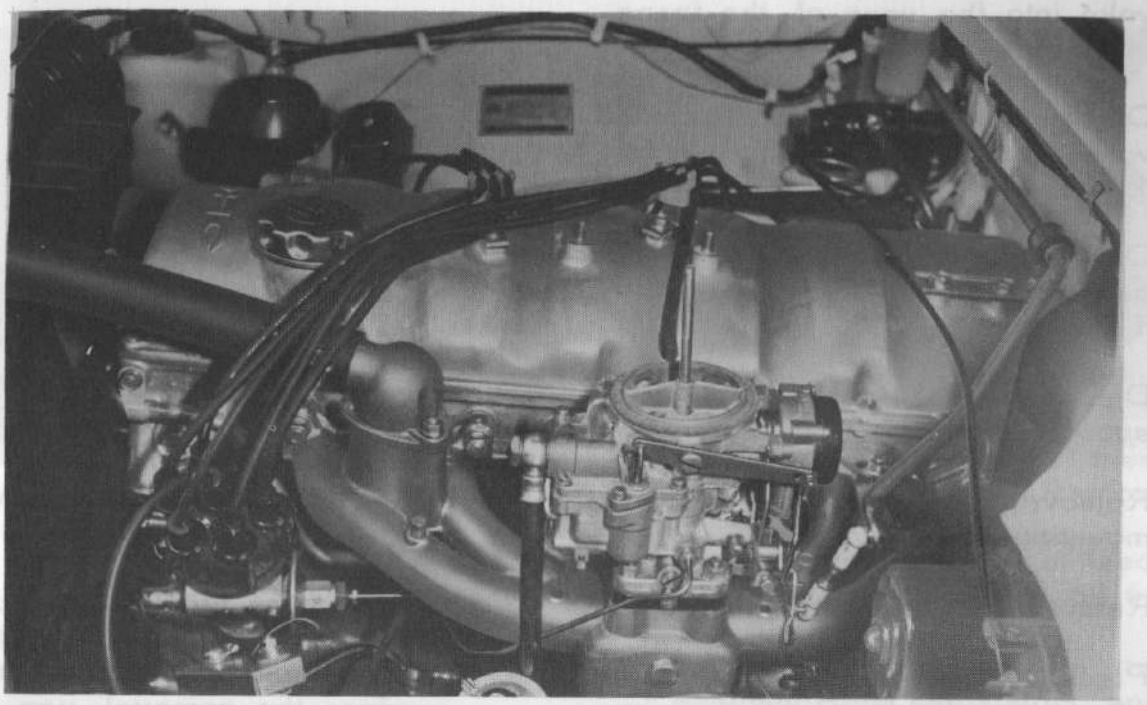


Fig.2-2 Engine left side view V1118

21. Disconnect the starter motor wires.

22. Disconnect the heater water control cable from the water valve if installed.

23. Disconnect the heater inlet hose from the heater water valve, if installed.

24. Remove the radiator.

25. Jack the car, and support with suitable stands.

26. Remove the rear engine under cover RH.

27. Remove the front right-hand side engine mounting insulator bolts from the frame.

28. Disconnect the exhaust pipe from the front exhaust manifold.

29. Disconnect the back-up light wiring, if Toyoglide is installed.

30. Disconnect the low speed connecting rod from the shift outer lever, if installed.

31. Disconnect the high speed connecting rod from the cross-shaft if installed.

32. Disconnect the gearshift rod from the cross-shaft, if installed.

33. Remove the cross-shaft, if installed.

34. Remove the control shift lever retainer from the extension housing, if installed.

35. Remove the rear engine under cover LH.

36. Remove the front left-hand side engine mounting insulator bolts from the frame.

37. Remove the exhaust pipe support bracket.

38. Disconnect the speedometer cable from the transmission assembly.

39. Remove the propeller shaft.
To prevent the oil leak from the rear of the transmission assembly, insert the universal joint sleeve

yoke into the rear of the transmission assembly.

40. Disconnect the overdrive solenoid wiring or back-up light wiring, if installed.

41. Disconnect the overdrive lock out cable from the overdrive housing, if installed.

42. Disconnect the exhaust pipe No.1 support from the frame.

43. Remove the four rear engine mounting bracket bolts.

44. Remove the jack and the stands.

45. Place a jack under the transmission assembly. Raise the transmission assembly with the jack, then remove the rear engine mounting bracket.

46. Install the lifting wire onto the engine hangers, and lift the engine slightly, then remove the front right-hand side engine mounting insulator.

47. Remove the jack from the transmission assembly, and lift the engine towards the front together with the transmission assembly with a suitable hoist.

NOTE: When removing the engine with the transmission assembly, care should be taken not to damage the overdrive lock out switch.

DISASSEMBLY

1. Remove the flywheel housing under cover, starter motor, and the transmission assembly.

2. Remove the clutch cover, and the clutch disc without dirtying the disc with oil.

Fig.2-3 Transmission Assembly Removal

3. Inspect the input shaft front bearing (pilot bearing).
If the input shaft front bearing requires the removal, use the Main Drive Front Bearing Puller 09303 35010.

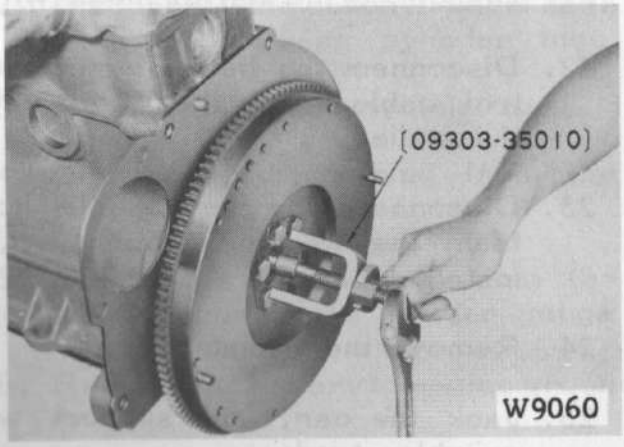


Fig.2-4 Input Shaft Front Bearing Removal

4. Remove the flywheel.

5. Remove the rear end plate (1).

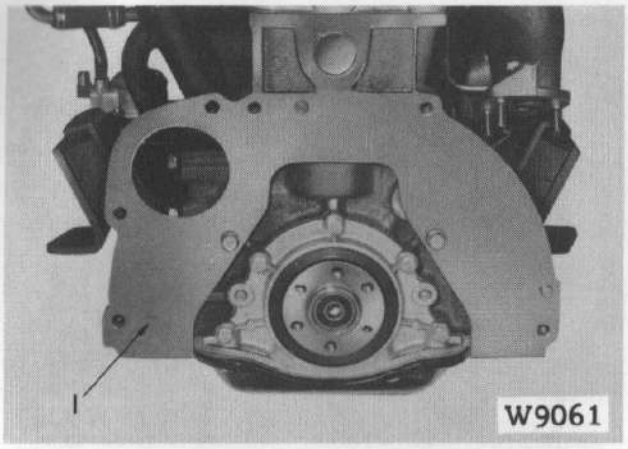


Fig. 2-5 Removing Rear End Plate

6. Install the engine assembly onto the engine work stand, and drain the engine oil.

7. Remove the oil level gauge (1).

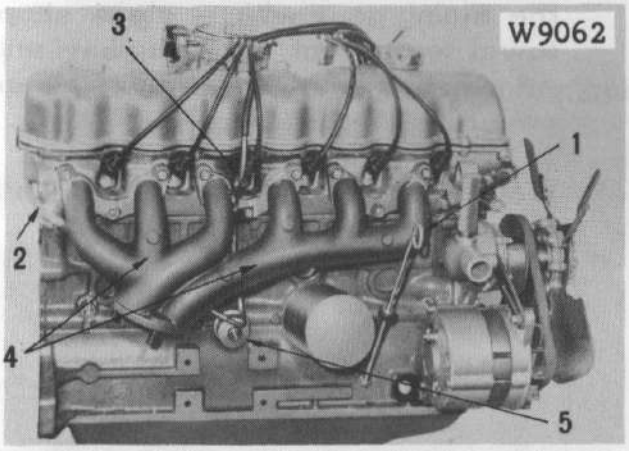


Fig. 2-6 Engine Right-side View

8. Remove the automatic choke stove inlet (2), and the automatic choke stove outlet (3) from the exhaust manifold, and the carburetor.

9. Remove the exhaust manifold (4).

10. Remove the oil pressure sender gauge (5).

11. Remove the oil filter using the Oil Filter Band Wrench 09228-41010.

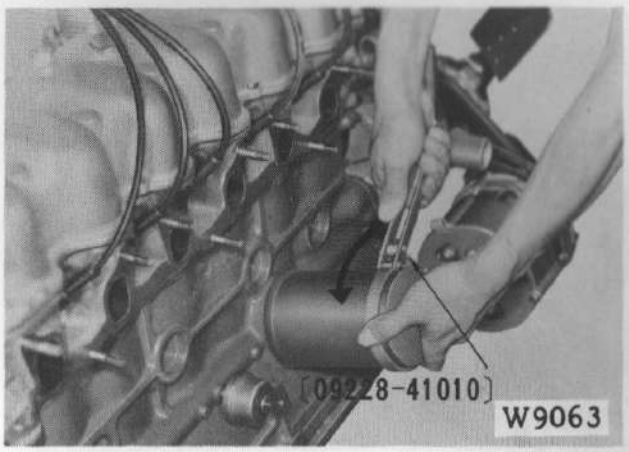


Fig. 2-7 Oil Filter Removal

The above wrench is utilized only for the removal of the oil filter.

12. Loosen and remove the nut (6) securing the alternator, and the adjusting bar. Next remove the alternator (1) assembly with the bracket.

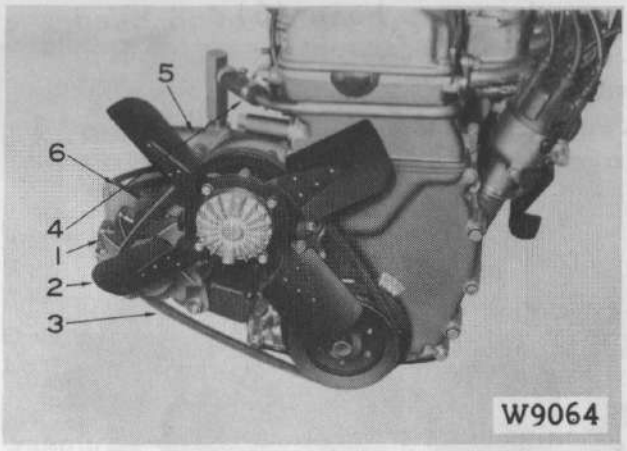


Fig. 2-8 Removing Related Parts with the Water Pump

13. Remove the fan (2), and the fan belt (3).

14. Loosen the clamp (4), and remove the water pump (5) with the hose.

15. Remove the fuel pipe (1), and the vacuum pipe (3).

Fig.2-9 Removing Related Parts of Carburetor

16. Remove the distributor assembly (3).
17. Remove the carburetor (4).
18. Remove the hose clamp (1), and the hose (2), then remove the by-pass hose (6).

Fig.2-10 Removing Related Parts of Fuel Pump

19. Remove the fuel pump (3), and the front engine mounting bracket LH (4) with the insulator.
20. Remove the ventilator tube (5).
21. Remove the engine hanger (1), and the intake manifold (2).

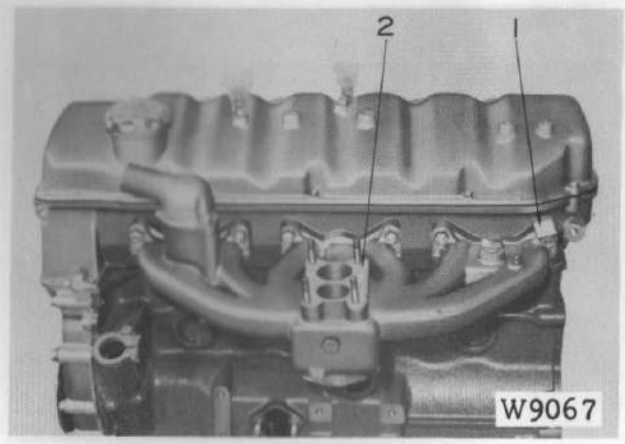


Fig.2-11 Removing Related Parts of Manifold

22. Remove the cylinder head cover.

CAUTION: Whenever the cylinder head cover should be removed to check or repair, always cover the timing gear with a clean shop towel to prevent dropping any nut or washer into the timing chain cover.

23. Remove the union bolt (1), and the union (2).

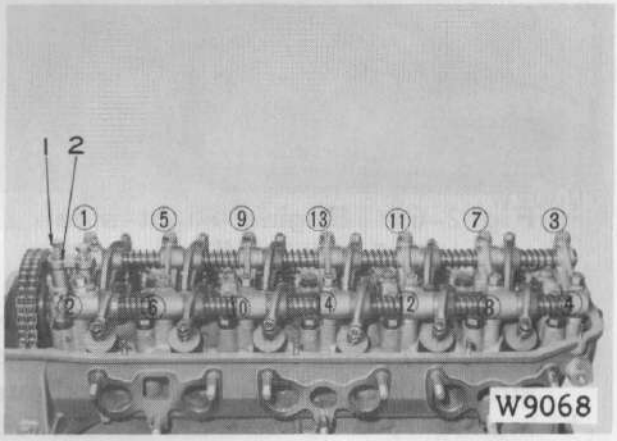


Fig.2-12 Removing Rocker Shaft

24. Loosen and remove the valve rocker support retaining bolts and nuts in the order shown in figure 2-12. Do not loosen and remove the bolts and nuts at one time but perform the removal procedures in twice or three times.

25. Remove the chain tensioner (1).

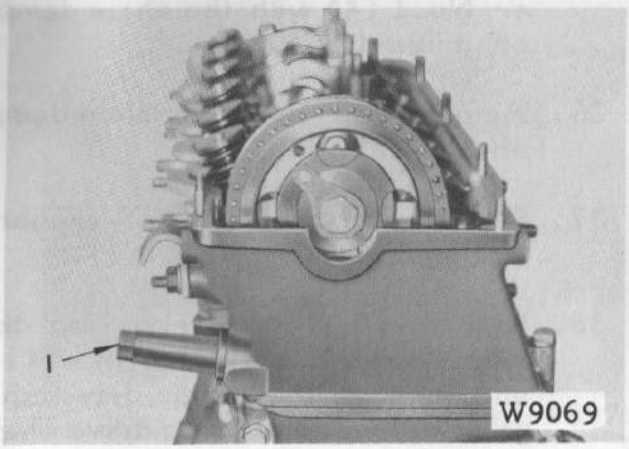


Fig.2-13 Removing Chain Tensioner

NOTE: Before removing the chain tensioner, check the valve timing to facilitate the assembly, replacement, and adjustment.
Refer to inspection of chain looseness on page 2-33.

26. Remove the camshaft timing gear.

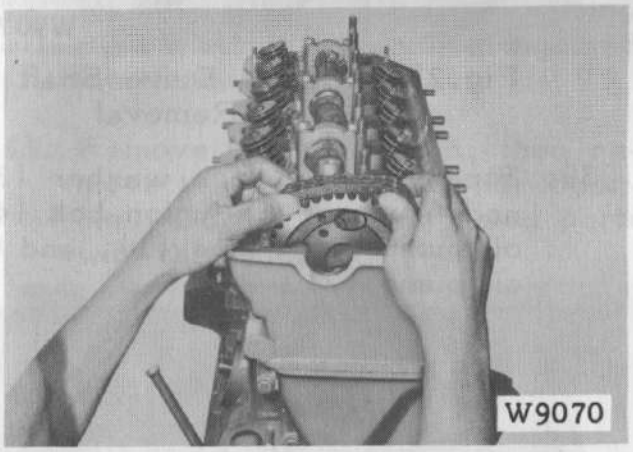


Fig.2-14 Removing Timing Gear

CAUTION: The timing gear bolt is a left-hand thread bolt, so care should be taken in loosening this bolt.

27. Remove the camshaft bearing caps No.1 (1), No.2 (2), No.3 (3), and No.4 (4).

28. Remove the camshaft (5).

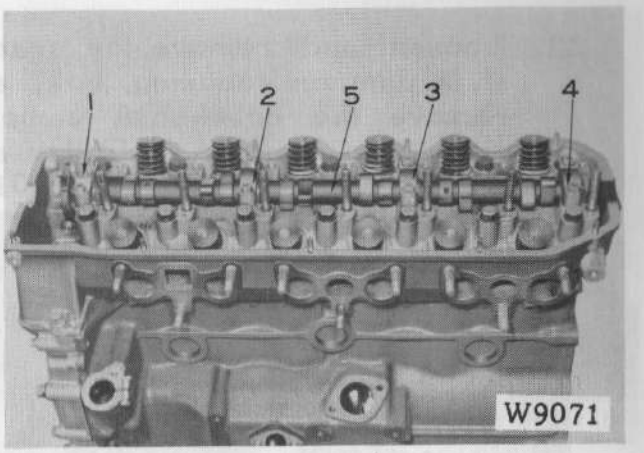


Fig.2-15 Camshaft Bearing Caps Removal

After removing the camshaft, replace the bearing caps, and tighten finger tight.
If the bearings require cleaning, mark the bearings.

29. Loosen and remove the cylinder head bolts in the order illustrated in figure 2-16 to prevent warpage. Do not loosen and remove the cylinder head bolts at one time. Perform the removal in twice or three procedures.

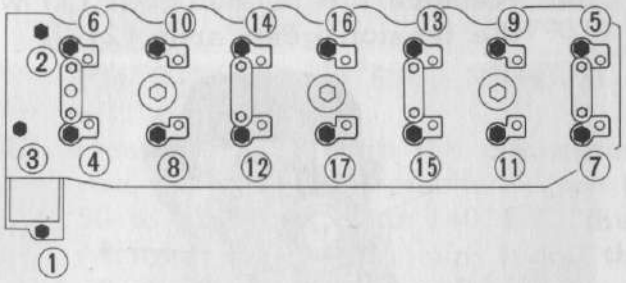


Fig.2-16 Cylinder Head Bolts Removal

30. Remove the cylinder head and the cylinder head gasket. In removing never slide the cylinder head because two dowel pins are installed in the cylinder block.

31. Remove the oil pan.

32. Loosen and remove the crankshaft damper securing bolt, and remove the crankshaft damper using the Crankshaft Pulley and Drive Gear Puller 09213-60013.

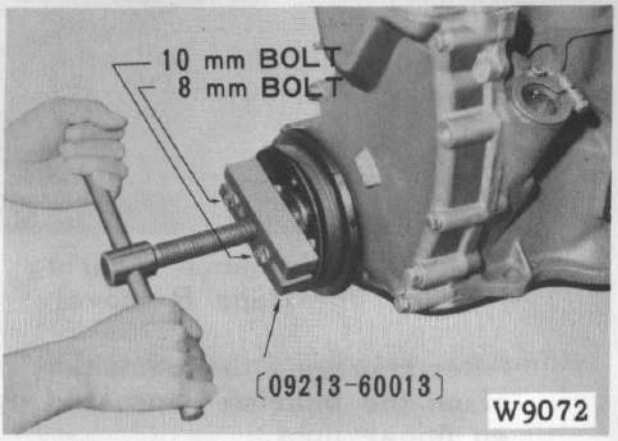


Fig. 2-17 Crankshaft Damper Removal

CAUTION: Use a 10 mm bolt, and a 8 mm bolt to attach the puller. If the balancing weight is attached in the 10 mm bolt hole, do not remove the balancing weight from the crankshaft damper.

33. Remove the timing chain cover.

34. Remove the tension gear (1) with the tension gear arm (2).

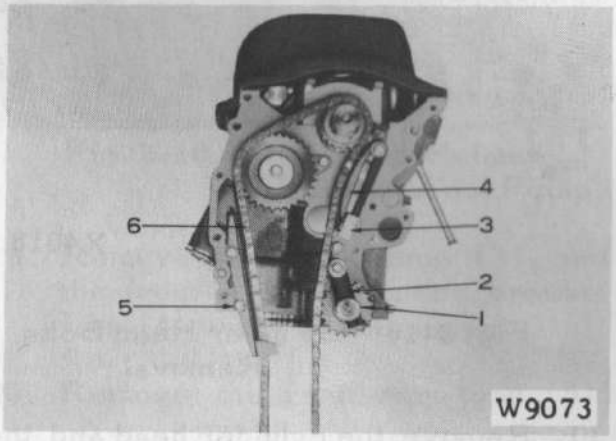


Fig. 2-18 Removing Related Parts of Timing Chain

35. Remove the chain vibration damper No.1 (4) with the chain damper guide (3).

36. Remove the chain vibration damper No.2 (5).

37. Remove the crankshaft oil slinger, and remove the chain (6).

38. Remove the bolts securing the pump drive shaft thrust plate (1), and remove the pump drive shaft gear (2) with the pump drive shaft.

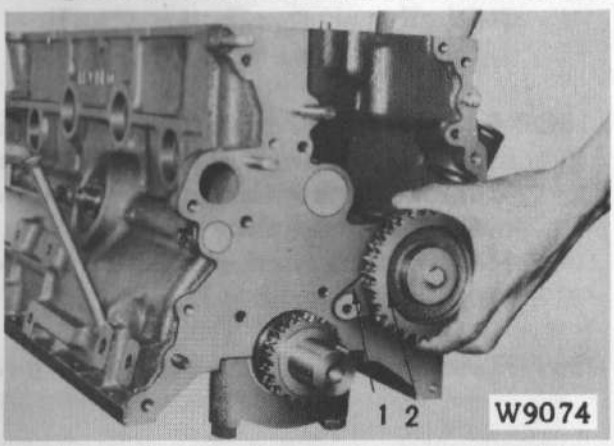


Fig. 2-19 Pump Drive Shaft Removal

39. Straighten the lock washer (3), and remove the union bolt (4), oil pump outlet pipe (1), and the oil pump (2).

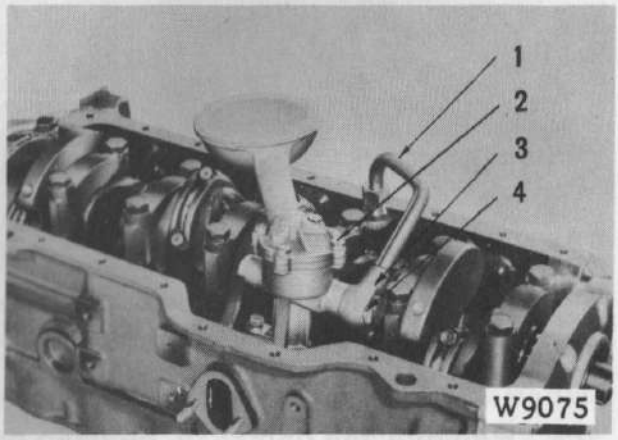


Fig. 2-20 Oil Pump Removal

40. Remove the connecting rod caps, then remove the pistons towards the cylinder head.

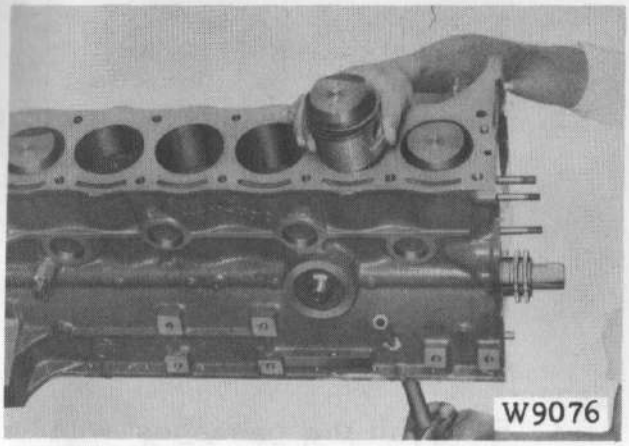


Fig. 2-21 Removing Pistons

After removing the pistons, always replace the connecting rod bearings and caps onto the respective connecting rods and secure with the cap bolts finger tight.

41. Remove the crankshaft rear oil seal retainer.

42. Remove the crankshaft bearing caps with the lower bearings and the thrust washers.

43. Remove the crankshaft, then remove the crankshaft upper bearings. Do not mix the mated parts with the others.

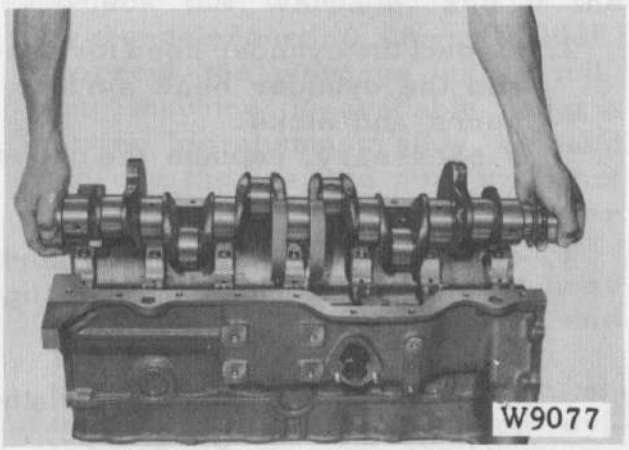


Fig. 2-22 Crankshaft Removal

44. Remove the piston rings from each piston with the Piston Ring Expander.

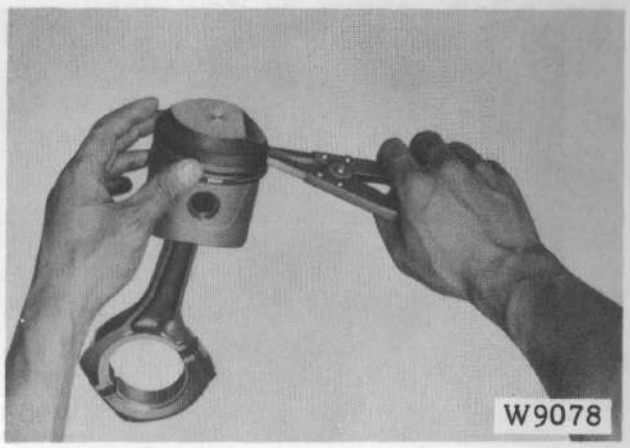


Fig. 2-23 Piston Ring Removal

The removed piston rings should be laid in accordance with the cylinder number.

45. Remove the piston pin snap rings.

Fig. 2-24 Snap Ring Removal

46. Heat the piston with the connecting rod assembly in a piston heater to 50 to 60°C (122 to 140°F), then remove the piston pin from the piston and the connecting rod. Do not mix the mated parts with the others.

47. Mark the valves and the valve springs.

48. Remove the valves with the Valve Spring Compressor.

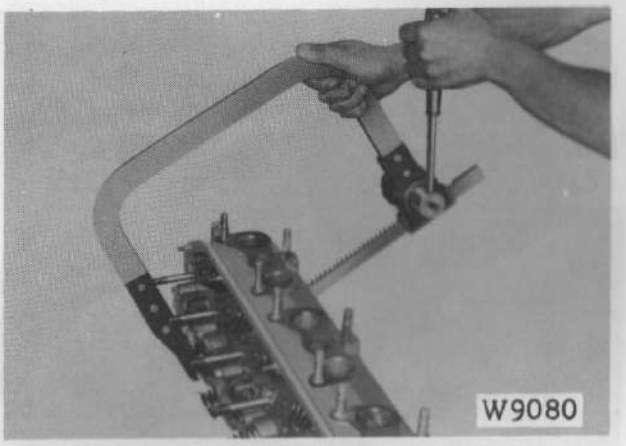


Fig. 2-25 Valve Removal

49. Remove the valve guide oil seals from the valve guides.

50. Remove the retainer spring (1), valve rocker support No.3 (2), compression springs (3), valve rocker arm No.1 (4), and the valve rocker arm No.2 (5) from the valve rocker shafts (9).
Repeat the removal and remove supports No.2 (6), and the other related parts.
Finally, loosen and remove the two screws (7), and remove the valve rocker shafts (9) from the valve rocker support No.1 (8).

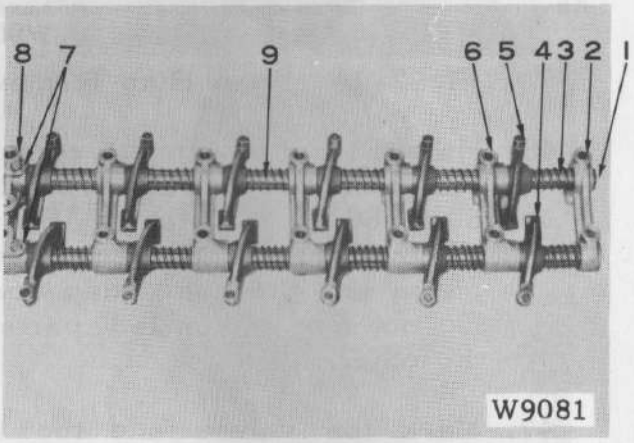


Fig. 2-26 Valve Rocker Shafts Removal

The removed valve rocker arms should be laid in accordance with the cylinder number.

INSPECTION & REPAIR

General

1. Wash the disassembled parts thoroughly before inspection and repair to remove the dirt, oil, carbon and water scale.

2. Check the cylinder block and the cylinder head for cracks, and water leak before washing.

3. Blow all the passages with compressed air, and remove the deposits. Check the passages for clogging.

4. Remove the carbon deposit from the top of pistons, cylinder head, and valves without scratching or damaging the parts.

5. Do not mix or change the original mated parts of the valves, bearings or bearing caps.

Cylinder head

1. Remove the carbon deposit in the combustion chambers. Do not scratch the cylinder head surface or the valve seats.

2. Inspect the cylinder head for cracks and the cylinder head surface for burrs and nicks.
If necessary, replace the cylinder head.

3. Check the cylinder head surface for flatness as illustrated in figure 2-27.

The measuring points of flatness is illustrated in figure 2-28.

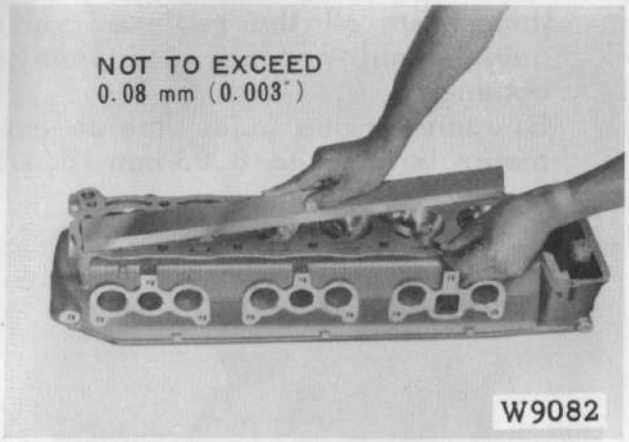


Fig.2-27 Cylinder Head Surface Flatness Inspection

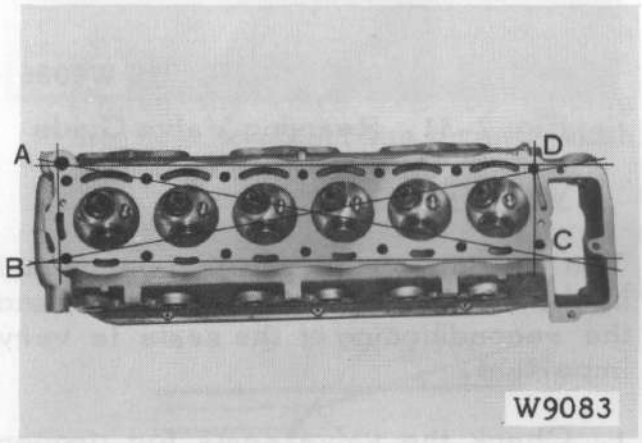


Fig.2-28 Flatness Measuring Points

4. Check the warpage, and if the warpage exceeds 0.08mm (0.003"), correct the warpage with a milling machine if available using a cutter for aluminum alloy, or hand scrape the warped portion. If not repairable, replace the cylinder head.
   Always dress the cylinder head after milling with an oil stone and grinder cutting oil.
   Never use a surface grinder similar to finishing a cast iron cylinder head.

Valve stem guide

1. Check the clearance between the valve stem and the respective valve guides.
   Measure the inner diameter of the guides with an inside dial gauge, and the valve stem with a micrometer.
   The specified clearance should be 0.025 to 0.055 mm (0.001 to 0.002") for the intake, and 0.035 to 0.070 mm (0.0014 to 0.0027") for the exhaust.
   The clearance limit should be 0.07 mm (0.0027") for the intake and 0.08 mm (0.0032") for the exhaust.

   NOTE: Excessive clearance will cause lack of power, poor idling, noisy valves, burning of oil, and other defects. In overall the performance of the engine will decrease.

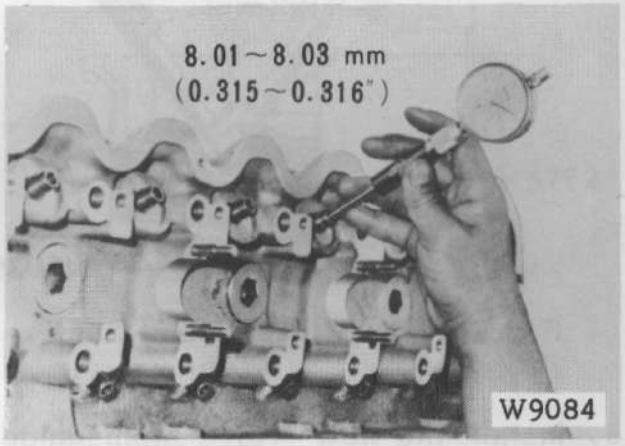


Fig.2-29 Checking Valve Guide Clearance

2. To replace the valve guide, break off the upper half of the valve guide with a suitable brass rod as illustrated in figure 2-30, then remove the valve guide toward the combustion chamber using the Valve Stem Guide Remover & Replacer 09201-60010.

   The cylinder should be heated to 80 to 100°C or 176 to 212°F for removal and also for installation of the valve stem guide.

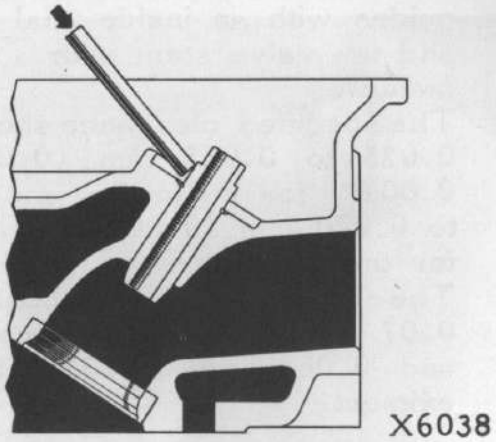


Fig. 2-30A Breaking Valve Stem Guide

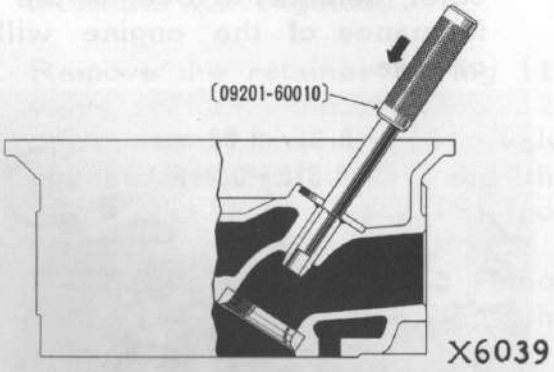


Fig. 2-30B Valve Stem Guide Removal

3. Install the new valve stem guide from the top of the cylinder head with the Valve Stem Guide Replacer 09201-41010 until the snap ring contacts the cylinder head.
   The fitting tolerance between the cylinder head, and the valve guide should be 0.022 to 0.051 mm or 0.001 to 0.002".

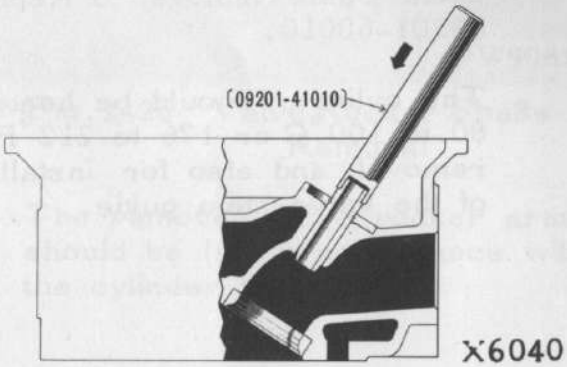


Fig. 2-30C Installing Valve Guide

4. After installing the valve guide, then ream all the replaced valve guides until proper clearance is obtained.
   Specified valve guide inside diameter is 8.01 to 8.03 mm (0.315 to 0.316").

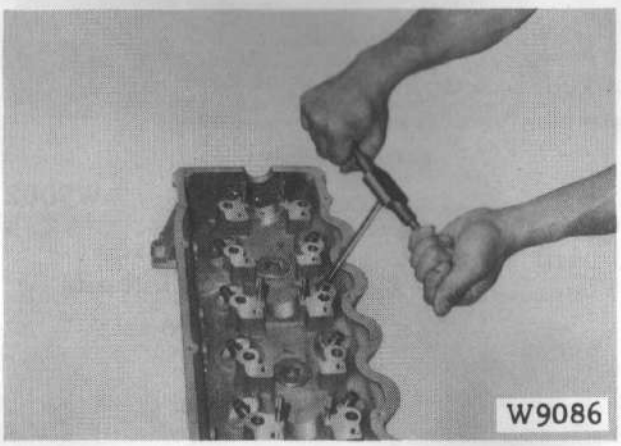


Fig. 2-31 Reaming Valve Guide

Valve seat

The seating of the valves is essential in the performance of the engine, and the reconditioning of the seats is very important.

1. Check the valve seats for proper valve seating, and damage.
   Correct the valve seats or replace the cylinder head if necessary.

2. The refacing of the valve seats may be performed with a suitable eccentric valve seat grinder or a cutter, but the valve guides must be free of carbon or other deposits, for proper centering of the pilot in the valve guide.
   The valve seat angle is 45° for both intake and exhaust valves.
   If a valve seat cutter (R-351 Valve Seat Cutter BTC) is used, three different cutters of 15°, 45° and 75° are required.
   If these cutters are used, first, use the cutter 15°, and cut the seat surface roughly to size. Next use the 75° cutter, and cut the seat surface to approximate size. Finally, use the 45° cutter, and cut to correct size.

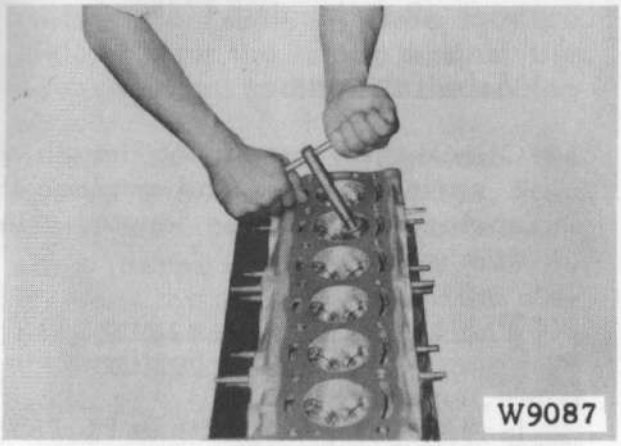


Fig. 2-32 Refacing Valve Seat with Cutter

Cut slightly to leave an allowance for lapping.
Finish the valve seat by lapping the seat to obtain the proper width of 1.4 mm (0.055").

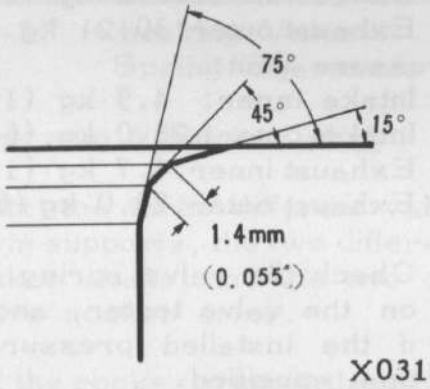


Fig. 2-33 Valve Seat Angle

3. The valve seat angle is 45°, and the width is 1.4 mm (0.055"). If this width exceeds, cut the bottom with the 15° cutter, and the upper with the 75° cutter to obtain the proper contact.

4. After cutting the valve seat, the valve should contact the seat exactly at the center.
To check, apply a thin coat of red lead on the valve seat, and insert the valve. Apply a light pressure on the valve to check the contact.
If the seating is too high, use the 75° cutter, and if too low, use the 15° cutter.

5. Lap the valves and the valve seats with a lapping compound. Apply a light pressure during lapping.

NOTE: Whenever the valve seat is to be cut, check the installed length of the outer valve spring.
If the installed length exceeds more than 43.0 mm (1.773") for the intake, or more than 43.2 mm (1.740") for the exhaust, insert a suitable washer between the valve spring and the cylinder head to obtain the specified installed length.

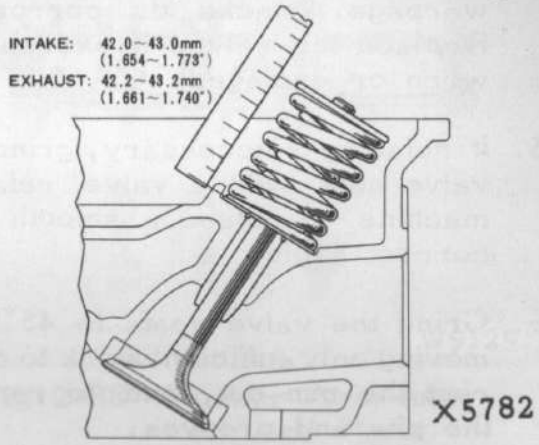


Fig. 2-34 Checking Valve Spring Installed Height

Valves

Specification:

Head diameter:	
Intake	40 mm (1.6")
Exhaust	34 mm (1.34")
Overall length:	
Intake	113 mm (4.46")
Exhaust	120.5 mm (4.74")
Stem diameter:	
Intake	7.975 to 7.985 mm (0.314 to 0.3143")
Exhaust	7.960 to 7.975 mm (0.312 to 0.314")
Valve seat angle	45° (both)
Valve head edge height limit:	
Intake	0.8 mm (0.031")
Exhaust	1.0 mm (0.039")

1. Remove all the deposits from the valves with a wire brush or a buffing wheel.
2. Check the valve face and the edge of the valve head for pits, grooves, scores and other defects.
3. Check the valve stem for bend and grooves at the neck of the stem.
4. Check the valve head for burns, warpage, cracks or corrosion. Replace the valves if excessively worn or damaged.
5. If refacing is necessary, grind the valve seat with a valve refacing machine to obtain a smooth and correct angle.
6. Grind the valve seats to 45° removing only sufficient stock to correct the run-out, and to remove the pits and grooves.
   If the valve head edge width is less than 0.8 mm (0.031") for the intake, and 1.0 mm (0.039") for the exhaust after grinding, replace the valves.

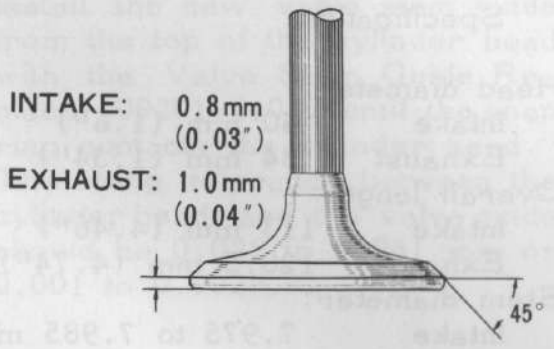


Fig.2-35 Valve Seat Width X0315

7. Remove all grooves and scores from the end of the valve stem, then chamfer as necessary. Do not remove more than 0.5 mm or 0.02" of the stock.
8. Lap the valves slightly with lapping compound for proper contact. Remove all the compound thoroughly from the valve, and the seat after lapping.

Valve springs

1. Check the valve spring length with a spring tester, and replace the springs if the free length is less than specified.

Table 2-1 Valve spring specification

Free length:
- Inner spring: 45.4 mm (1.787")
- Outer spring: 52.3 mm (2.059")

Installed length:
- Intake inner: 39.0 mm (1.535")
- Intake outer: 42.0 mm (1.654")
- Exhaust inner: 39.2 mm (1.543")
- Exhaust outer: 42.2 mm (1.661")

Installed pressure:
- Intake inner: 5.4 kg (11.9 lb)
- Intake outer: 30.83 kg (67.8 lb)
- Exhaust inner: 5.2 kg (11.4 lb)
- Exhaust outer: 30.21 kg (66.5 lb)

Pressure limit:
- Intake inner: 4.9 kg (10.8 lb)
- Intake outer: 28.0 kg (61.6 lb)
- Exhaust inner: 4.7 kg (10.3 lb)
- Exhaust outer: 28.0 kg (61.6 lb)

2. Check the valve spring pressure on the valve tester, and replace if the installed pressure is less than specified.

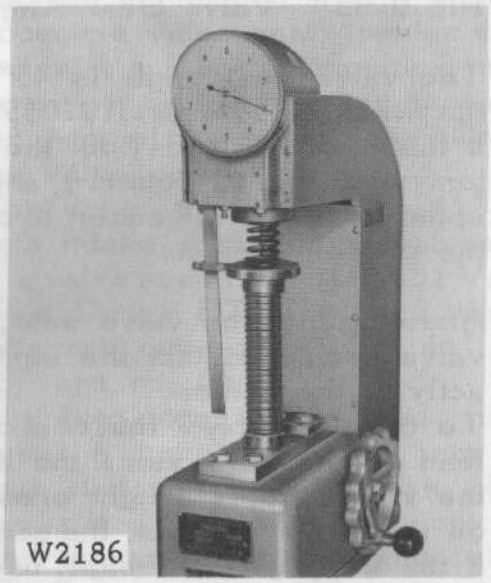


Fig.2-36 Valve Spring Tester

3. Check the valve spring squareness with a steel square, and a surface plate. Place the spring against the square edge, and rotate the spring slowly.
   Check the clearance between the spring and the square edge. Replace the outer spring if the clearance exceeds 1.9 mm (0.075"). Replace the inner spring if the clearance exceeds 1.6 mm (0.063).

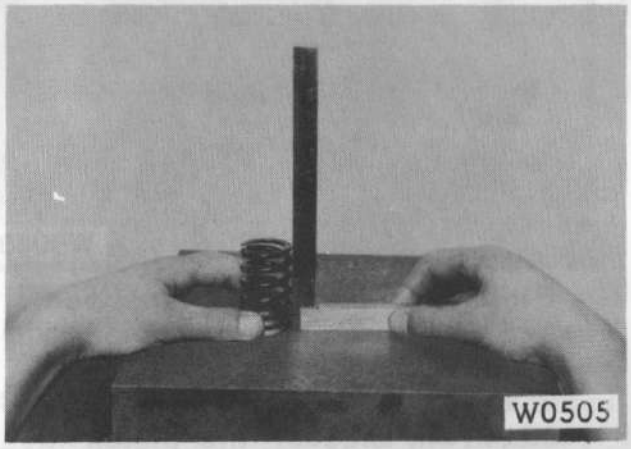


Fig. 2-37 Checking Valve Spring Sqareness

Rocker arm & Rocker shaft

Do not mix the three different valve rocker arm supports, the two different valve rocker shafts, and the two different valve rocker arms.

1. Check the rocker arms at the camshaft lobes contacting ends. If the rocker arm end shows excessive wear, replace the rocker arm. If the wear is slight, and is serviceable, reface the end with an oil stone.

2. Check the rocker arm bushing for wear by installing the arm onto the rocker shaft.
   If the clearance exceeds 0.1 mm (0.004"), replace the rocker arm and/or the rocker shaft.
   If the rocker arm and the rocker shaft are replaced, ream the rocker arm bushing with an adjustable reamer to obtain the proper clearance of 0.007 to 0.049 mm or 0.0003 to 0.0019" between the shaft and the bushing.

Rocker arm shaft diameter:
18.472 to 18.493 mm
(0.7272 to 0.7281")
Rocker arm bushing bore:
18.500 to 18.521 mm
(0.7283 to 0.7292")

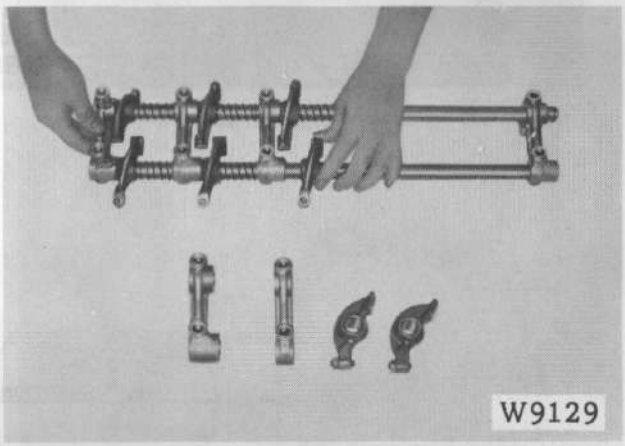


Fig. 2-38 Rocker Arm and Related Parts

Cylinder block

1. Wash the cylinder block thoroughly, and check for cracks. Minute cracks are difficult to be detected with naked eyes, and special equipment may be necessary for this purpose. Replace the block if defective.

2. Check the flatness of the cylinder block gasket surface, following the same procedures recommended for the cylinder head.
   If the warpage exceeds 0.05 mm (0.002"), grind the surface or replace the cylinder block.

3. Check the cylinder bore for out-of-round or taper wear with a cylinder bore gauge. Measure the bore of each cylinder at the top, middle, and bottom placing the gauge at right angle, and parallel to the center line of the cylinder block.

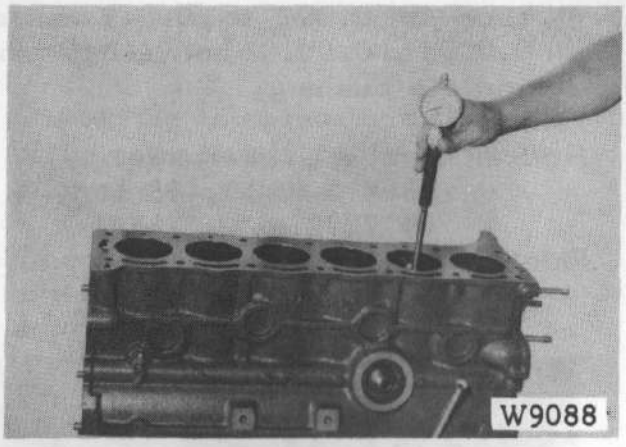


Fig. 2-39 Measuring Cylinder Bores

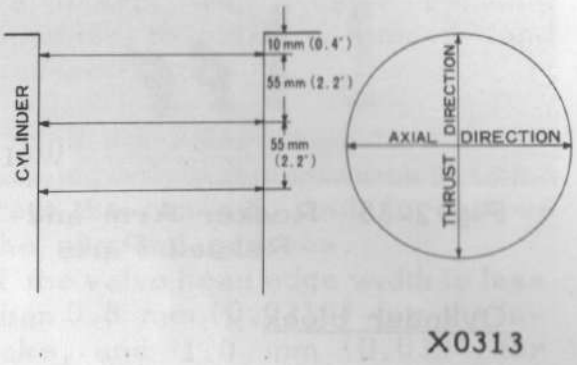


Fig. 2-40 Measuring Points of Cylinder Bore

4. If the cylinder bore is deeply scored and burnt, and/or out-of-round, and/or the taper exceeds the wear limit of 0.2 mm (0.008"), bore the cylinder bore, and use oversize piston.

CAUTION: Even one cylinder requires boring, the rest must be bored, and new oversize pistons must be installed.

5. If the cylinder walls have minor surface defects, but the out-of-round, and the taper are within the limit, hone the cylinder walls and install new pistons with proper clearance limit.

NOTE: The numerals stamped on the cylinder block upper surface show the finished cylinder bore size of each within the corresponding size in the following table at the assembly of the engine in the factory.

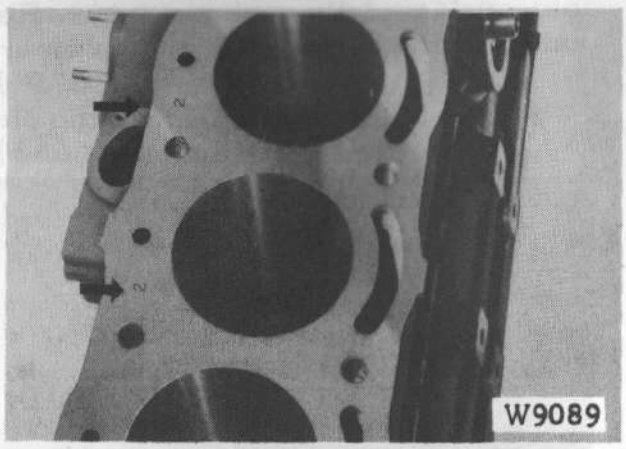


Fig. 2-41 Numerals Stamped on Cylinder Block

In the same manner, the mark on the front side of the piston head shows the piston skirt diameter, and the mark on the rear side of the piston head shows the piston pin bore size.

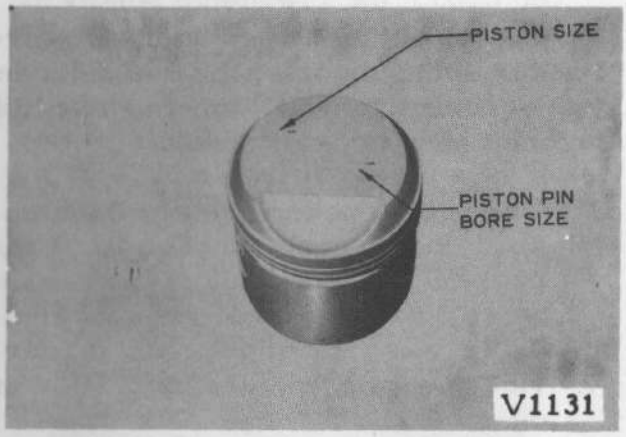


Fig. 2-42 Markings on Piston Head

Table 2-2 Standard piston diameter

Marking No. 1

Bore diameter:	75.00 to 75.01 mm (2.9527 to 2.9531")
Piston diameter:	74.96 to 74.97 mm (2.9512 to 2.9516")
Piston clearance:	0.03 to 0.05 mm (0.0012 to 0.0020")

Marking No.2

Bore diameter: 75.01 to 75.02 mm (2.9531 to 2.9535")

Piston diameter: 74.97 to 74.98 mm (2.9516 to 2.9520")

Piston clearance: 0.03 to 0.05 mm (0.0012 to 0.0020")

Marking No.3

Bore diameter: 75.02 to 75.03 mm (2.9535 to 2.9539")

Piston diameter: 74.98 to 74.99 mm (2.9520 to 2.9524")

Piston clearance: 0.03 to 0.05 mm (0.0012 to 0.0020")

Table 2-3 Oversize piston diameter & cylinder bore

STD

Piston diameter: 74.96 to 74.99 mm (2.9512 to 2.9524")

Cylinder bore: 75.00 to 75.03 mm (2.9527 to 2.9539")

O/S 0.25

Piston diameter: 75.21 to 75.24 mm (2.9610 to 2.9622")

Cylinder bore: 75.25 to 75.28 mm (2.9626 to 2.9638")

O/S 0.50

Piston diameter: 75.46 to 75.49 mm (2.9709 to 2.9720")

Cylinder bore: 75.50 to 75.53 mm (2.9724 to 2.9736")

O/S 0.75

Piston diameter: 75.71 to 75.74 mm (2.9807 to 2.9819")

Cylinder bore: 75.75 to 75.78 mm (2.9823 to 2.9835")

O/S 1.00

Piston diameter: 75.96 to 75.99 mm (2.9906 to 2.9917")

Cylinder bore: 76.00 to 76.03 mm (2.9921 to 2.9933")

O/S 1.25

Piston diameter: 76.21 to 76.24 mm (3.0004 to 3.0016")

Cylinder bore: 76.25 to 76.28 mm (3.0020 to 3.0031")

O/S 1.50

Piston diameter: 76.46 to 76.49 mm (3.0102 to 3.0114")

Cylinder bore: 76.50 to 76.53 mm (3.0118 to 3.0130")

6. Select the cylinder with the most wear first to determine the oversize piston to be used.

7. Always measure the piston skirt at right angle to the piston pin boss with a micrometer. The piston pin should be removed before measuring and the temperature should be about 20°C (68°F) when measuring.

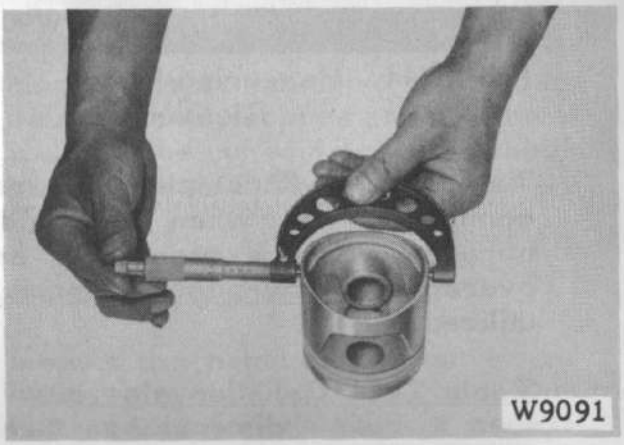


Fig.2-43 Measuring Piston Diameter

8. Check the piston to cylinder clearance with a ribbon feeler gauge of 0.03 mm (0.001") thickness, and 12 to 15 mm (0.5 to 0.6") wide. To check, place the feeler gauge into the cylinder extending the entire length of the piston at 90° from the piston pin boss. Invert the piston, and install into the cylinder with the piston pin bore parallel to the crankshaft axis. Attach a pull scale to the end of the feeler gauge, and pull the scale straight up reading the scale required to pull out the feeler gauge. The correct scale reading should be from 1.0 to 2.5 kg (2.2 to 5.5 lbs).

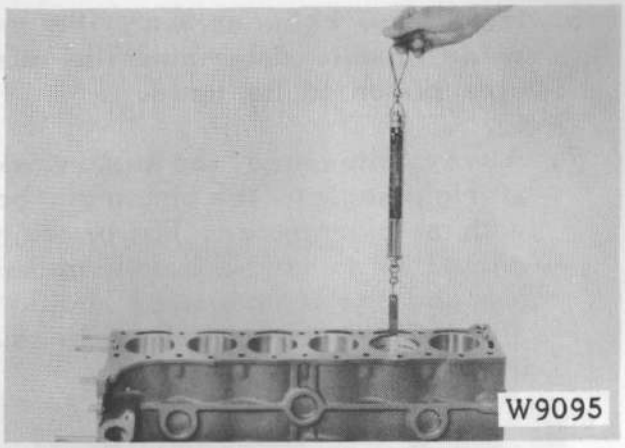


Fig. 2-44 Measuring Piston Clearance

The use of cylinder sleeve is recommended only when the cylinder bore is worn excessively, and oversize of 1.50 pistons cannot be utilized.

Table 2-4 Cylinder sleeve dimensions

O/S 4.0

Sleeve outer diameter:
79.091 to 79.126 mm
(3.114 to 3.119")

Cylinder block bore:
79.031 to 79.086 mm
(3.111 to 3.114")

Fitting tolerance:
0.04 to 0.06 mm
(0.0016 to 0.0024")

O/S 4.5

Sleeve outer diameter:
79.591 to 79.626 mm
(3.134 to 3.135")

Cylinder block bore:
79.531 to 79.586 mm
(3.131 to 3.133")

Fitting tolerance:
0.04 to 0.06 mm
(0.0016 to 0.0024")

9. Bore the cylinder in accordance with the sleeve size to be installed.
The fitting tolerance between the cylinder block and sleeve should be 0.04 to 0.06 mm (0.0016 to 0.0024").

10. The pressure required is 2,000 to 3,000 kg (4,400 to 6,600 lbs) and the sleeve must be installed flush to the cylinder block gasket surface.
If the pressure required is less, select the next oversize sleeve.

11. Bore the sleeve to fit the standard piston. Hone the bores after boring.

12. If the O/S 4.0 is no longer serviceable, remove the sleeve toward the top of the cylinder block with a press. If the removal is difficult, bore the sleeve/s to facilitate the removal.

13. The next oversize sleeve should be installed

Distributor shaft bushing

1. Check the bushing for run-out and scores. If necessary, replace the bushing.

2. Check the clearance between the bushing and the distributor shaft. If the clearance exceeds 0.08 mm (0.003"), replace the bushing using the Distributor Shaft Bushing Replacer 09212-41010.

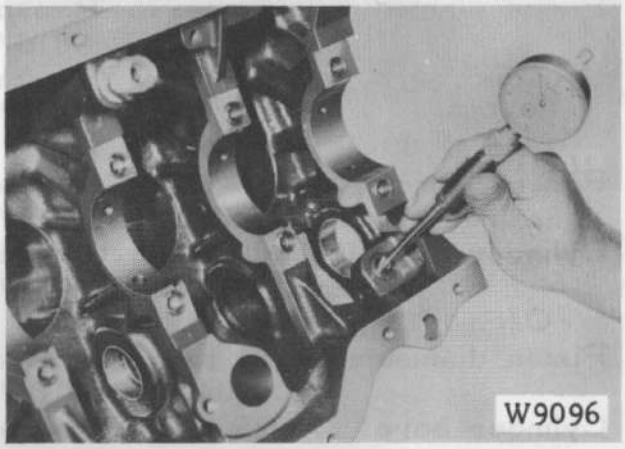


Fig. 2-45 Measuring Distributor Shaft Bushing Bore

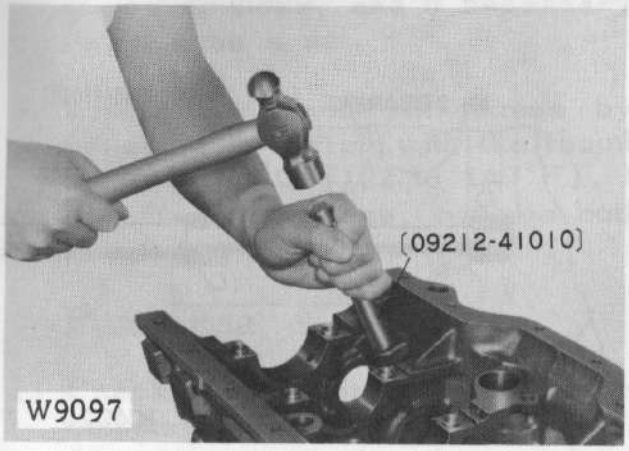


Fig.2-46 Replacing Distributor Shaft Bushing

Specification:

Bushing bore:	12.456 to 12.481 mm (0.4904 to 0.4914")
Fitting tolerance:	0.020 to 0.086 mm (0.0008 to 0.0034")
Oil clearance:	0.0100 to 0.048 mm (0.0004 to 0.0019")
Clearance limit:	0.08 mm (0.0031")

Pump drive shaft

1. Check the pump drive shaft run-out, and if it exceeds 0.01 mm (0.0004"), the pump drive shaft must be straightened or replaced. The run-out is one-half of maximum reading.

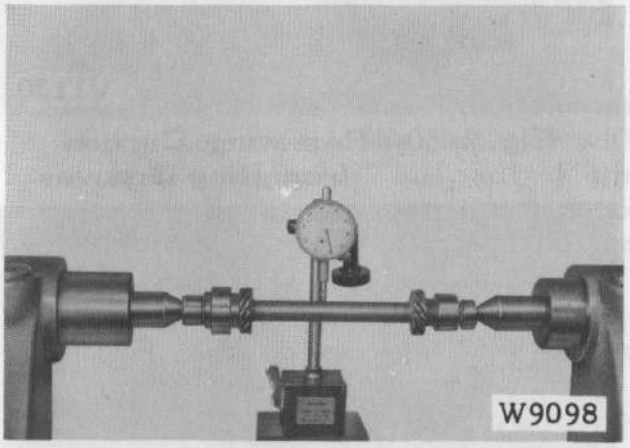


Fig.2-47 Checking Pump Drive Shaft Run-out

2. Check the pump drive shaft end-play which should be 0.06 to 0.13 mm (0.0024 to 0.0051"). If the pump drive shaft end-play exceeds 0.3 mm (0.0118"), replace the thrust plate.

3. Check the distributor drive gear and the pump drive gear for excessive wear and scores. If necessary, replace the pump drive shaft.

4. Inspect the pump drive shaft journals for pits, scores and abnormal wear. The run-out or taper should be less than 0.01 mm (0.0004").

Pump drive shaft bearing

1. Inspect the pump drive shaft bearings for wear, scores, poor contact and partially melted. If necessary, replace the pump drive shaft bearings.

2. Measure the pump drive shaft bearing inner diameter with an inside dial gauge, and also measure the journal diameter with a micrometer. If the difference between the journal diameter and the bearing inner diameter exceeds 0.08mm (0.003"), replace the pump drive shaft bearing.
   The specified oil clearance should be 0.025 to 0.060 mm (0.0010 to 0.0023").

Table 2-5 Pump drive shaft bearing specification

Pump drive shaft journal diameter:

Front bearing (No.1):
40.959 to 40.975 mm
(1.6126 to 1.6132")

Rear bearing (No.2):
32.959 to 32.975 mm
(1.2976 to 1.2982")

Pump drive shaft bearing bore:
Front bearing (No.1):
41.000 to 41.025 mm
(1.6142 to 1.6152")
Rear bearing (No.2):
33.000 to 33.025 mm
(1.2992 to 1.3002")
Fitting tolerance between bearing and cylinder block:
Front bearing (No.1):
0.015 to 0.060 mm
(0.0006 to 0.0024")
Rear bearing (No.2):
same as above
Oil clearance:
Front bearing (No.1):
0.025 to 0.066 mm
(0.0010 to 0.0026")
Rear bearing (No.2):
same as above
Oil clearance limit:
Front bearing (No.1):
0.08 mm (0.0031")
Rear bearing (No.2):
same as above

3. If the pump drive shaft bearing requires replacement, use the Pump Drive Shaft Bearing Replacer 09233-41010 as illustrated in figures 2-48 and 2-49.
When the front bearing (No.1) should be replaced, use the rear bearing (No.2) as a guide.

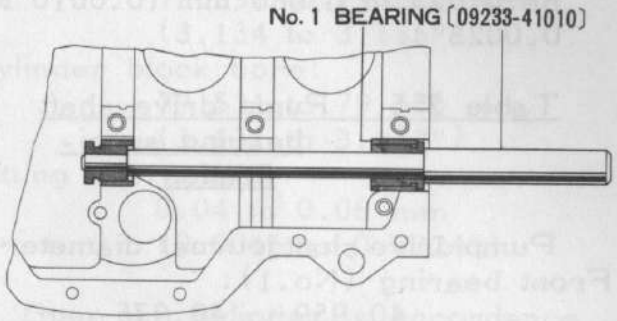


Fig.2-48 Replacing Front Bearing (No.1) X4019

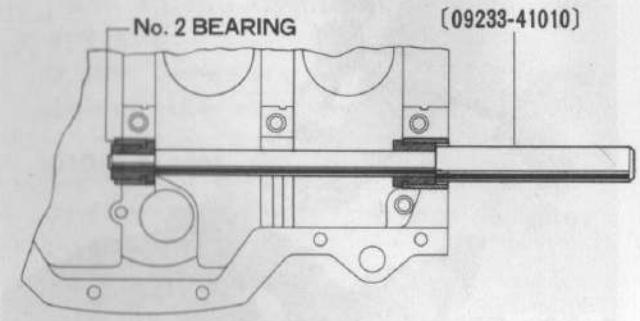


Fig.2-49 Replacing Rear Bearing (No.2)

Piston, Piston pin

1. Carefully remove the carbon deposit from the piston ring grooves, and piston head.
Each piston is marked with an "indent" indicating the piston diameter, and the piston pin bore on the head.

Fig.2-50 Removing Carbon from Ring Grooves

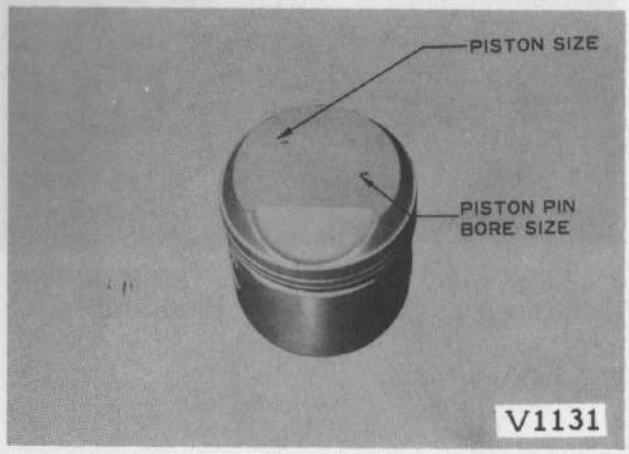


Fig.2-51 Markings on Head

2. Inspect the ring grooves for wear, burrs or nicks, and if necessary, replace as a set.

3. Check the piston pin fitness by pressing in the pin with the thumb at 50 to 60°C (122 to 140°F). If the fitness is loose, replace both the piston and the pin.

Piston ring

1. Check the ring for wear, and other defects. If the pistons are replaced, the rings must be also replaced at the same time.
The ring size must be selected to meet the size of the piston, and the ring of standard size has no mark of the ring size.
The rings are marked, and these marks must face upward when installed.

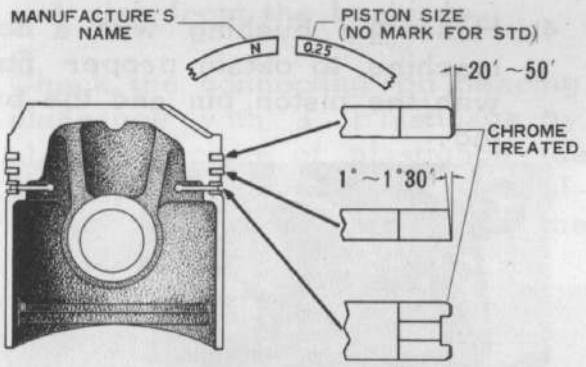


Fig.2-52 Piston Ring

2. Install each ring into the cylinder bore, and check the ring gap with a feeler gauge. The gap of the ring is the same on all rings of 0.15 to 0.35 mm or 0.0059 to 0.014".

3. Check the rings with the piston grooves for clearance.
The clearance between the compression ring No.1 and the piston should be 0.03 to 0.07 mm (0.0012 to 0.0027"). For the compression ring No.2, the clearance should be 0.02 to 0.06 mm (0.0008 to 0.0024").
The oil ring clearance should be 0.02 to 0.065 mm (0.0008 to 0.0026").

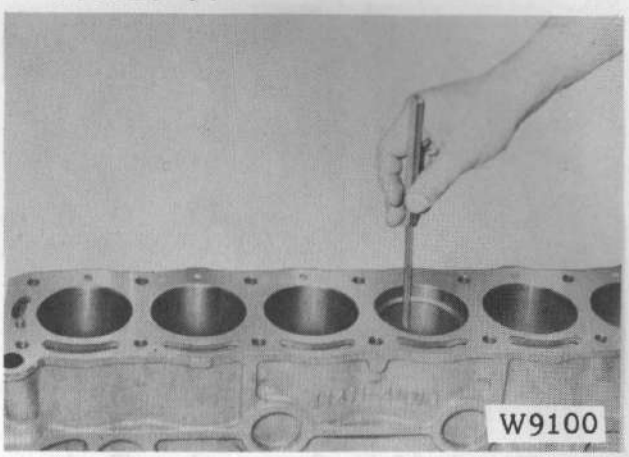


Fig.2-53 Measuring Ring Gap

Fig.2-54 Checking Groove Clearance

Connecting rod

1. Check the connecting rods for defects at the thrust surfaces on both sides. If necessary, replace the connecting rod/s.

If replaced, the cylinder number must be stamped on the corresponding location of the connecting rod.

2. Check the connecting rod alignment for bend and twist with a Connecting Rod Aligner as illustrated in figure 2-55.
The allowance of bend and twist per 100 mm (3.94") is 0.15 mm (0.006").
For inspection, use the "V" block for three point contact with the face

plate evenly. If correction cannot be made, replace the connecting rod.

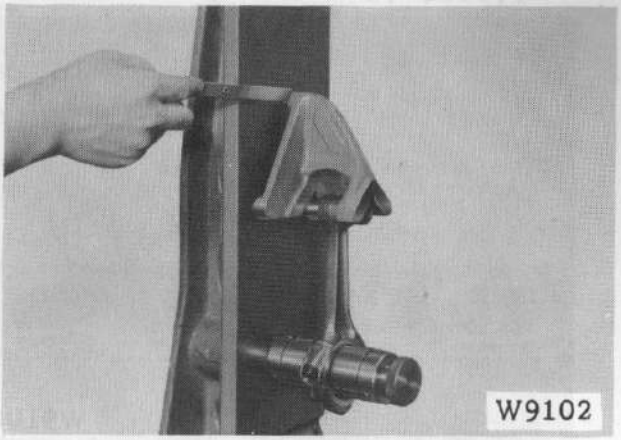


Fig. 2-55 Connecting Rod Alignment

3. Assemble the connecting rod onto the crankshaft, and check the thrust play between the connecting rod thrust surface and the crankshaft. The thrust play should be 0.110 to 0.246 mm (0.0043 to 0.0097"). The limit of thrust play is 0.3 mm (0.012").

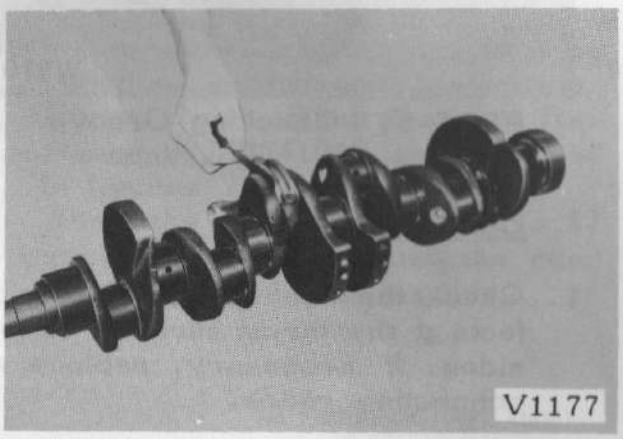


Fig. 2-56 Measuring Thrust Play

Connecting rod bushing

1. Check the clearance of the piston pin, and the connecting rod bushing with an inside dial gauge, and a micrometer. The clearance is 0.005 to 0.011 mm (0.0002 to 0.0004") at 20°C (68°F).
   The pin fitness must be determined by pushing in the pin into the bushing with the thumb.
2. To remove the bushing, use the Connecting Rod Bushing Remover and Replacer 09222-30010.

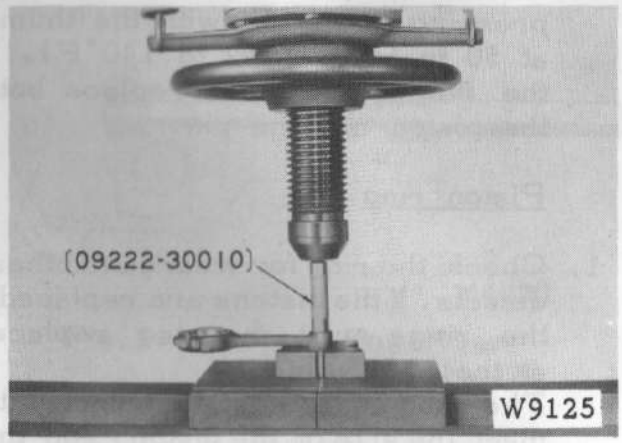


Fig. 2-57 Bushing Removal

3. To install, use the same tool as above aligning the oil hole in the bushing with the oil hole in the connecting rod.
4. Hone the bushing with a honing machine to obtain proper fitness with the piston pin and the bushing.

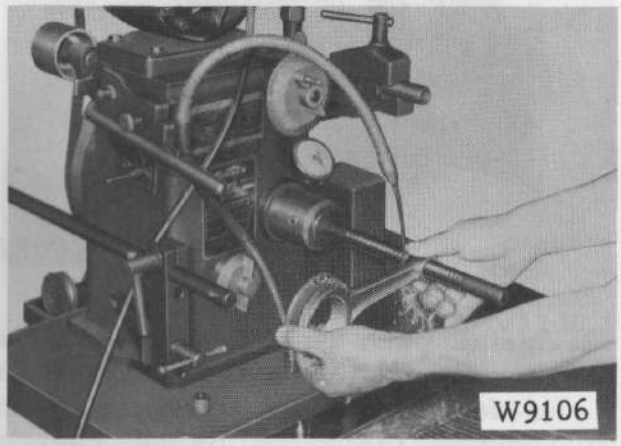


Fig. 2-58 Honing Bushing

Connecting rod bearing

The connecting rod bearings are Kelmet precision type bearing inserts.

CAUTION: Do not scrape or insert any shim. Do not file or lap the bearing cap or bearing to obtain the specified clearance.

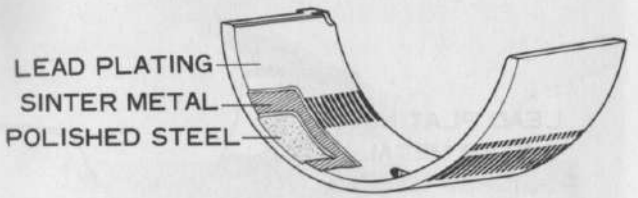


Fig. 2-59 Connecting Rod Bearing X4022

1. Check the bearing for poor contact, worn thin, partially melted or heavily scored. If necessary, replace the bearings.
2. Remove any deposit of oil, dirt or foreign matter from the pin journals and also from the bearings.
3. Check the connecting rod bearing clearance with a Plastigage by placing a piece of plastigage the full width of the pin journal parallel to the crankshaft. Avoid the oil hole of the journal.

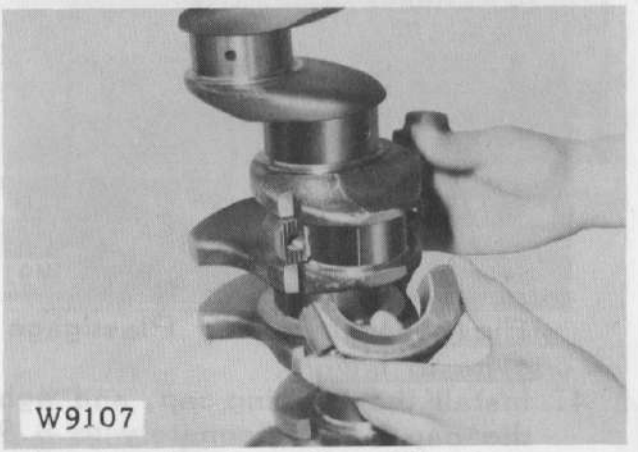


Fig. 2-60 Installing Plastigage

4. Install the bearing cap and tighten the cap bolts alternately to 4.2 to 4.8 m-kg (30 to 35 ft-lb) torque.

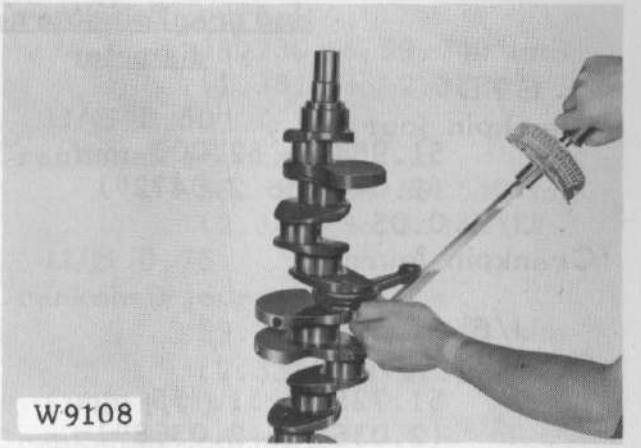


Fig. 2-61 Installing Con-rod Cap

CAUTION: Do not turn the connecting rod and the cap.

5. Remove the bearing cap without removing the plastigage. Check the compressed width of the plastigage at the widest point with the plastigage scale on the cover. This reading is the clearance between the connecting rod bearing and the crankpin journal.
This clearance should be 0.02 to 0.07 mm (0.001 to 0.003"), and the limit is 0.08 mm (0.0032").

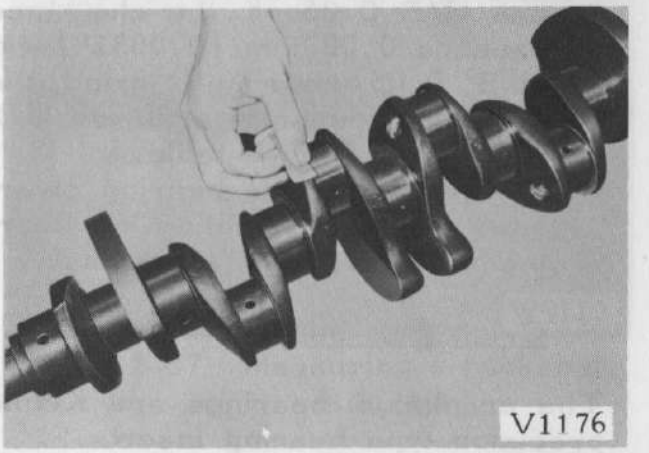


Fig. 2-62 Measuring Plastigage Width

6. If the bearings are to be replaced, refer to the Table 2-6.

Table 2-6 Con-rod bearing size and crankpin journal diameter

STD
Crankpin journal:
51.984 to 52.000 mm
(2.0466 to 2.0472")
U/S 0.05
Crankpin journal:
- - - - - - - - - - -
U/S 0.25
Crankpin journal:
51.725 to 51.735 mm
(2.0364 to 2.0368")
U/S 0.50
Crankpin journal:
51.475 to 51.485 mm
(2.0266 to 2.0270")
U/S 0.75
Crankpin journal:
51.225 to 51.235 mm
(2.0167 to 2.0171")
U/S 1.00
Crankpin journal:
50.975 to 50.985 mm
(2.0069 to 2.0073")

NOTE:
If a new crankshaft is used, always use a standard size bearings. When the bearing clearance exceeds with the standard bearings, use U/S 0.05. If the clearance exceeds 0.08 mm (0.0031") with U/S 0.05 bearings, grind the crankpin journals, and use U/S 0.25 of the above table.
Always check the bearing clearance before assembling the bearing onto the crankpin journal.

Crankshaft bearing

The crankshaft bearings are Kelmet precision type bearing inserts.

CAUTION: Do not scrape or insert any shim. Do not file or lap the bearing caps or bearings to obtain the specified clearance.

1. Check the bearing for improper contact, worn thin, partially melted or heavily scored. If necessary, replace the bearings.

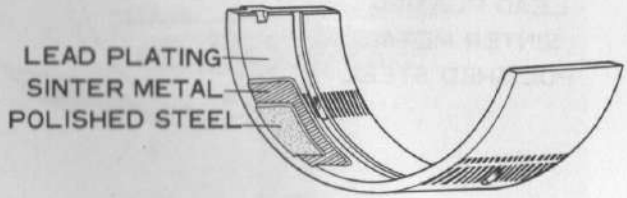


Fig. 2-63 Crankshaft Bearing

2. Remove any deposit of oil, dirt or foreign matter from the crankshaft main journals, and also from the main bearings.

3. Check the crankshaft main bearing clearance with a Plastigage by placing the piece of plastigage the full width of the bearing on the main journal parallel to the crankshaft. Repeat the same operation as the connecting rod bearing.

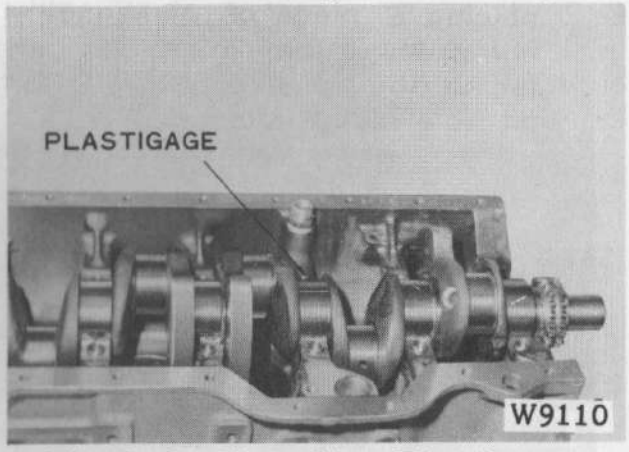


Fig. 2-64 Installing Plastigage

4. Install the bearing cap, and tighten the cap bolts alternately to 9.9 to 10.9 m-kg (71.3 to 78.5 ft-lb) torque.

CAUTION: Do not turn the crankshaft.

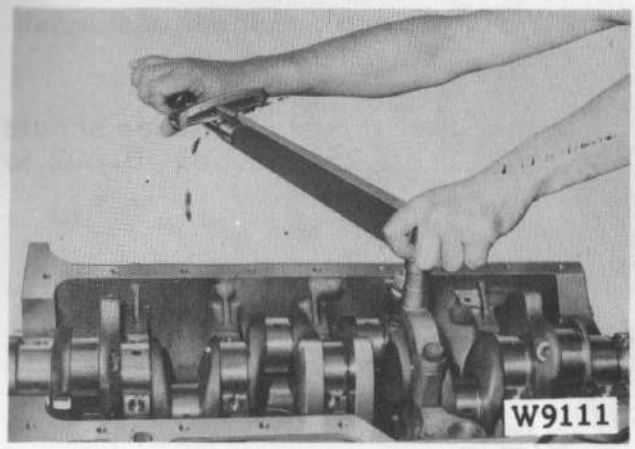


Fig.2-65 Installing Main Bearing Cap

5. Check the bearing clearance with the plastigage scale on the cover, and if the clearance exceeds 0.08 mm (0.0031"), the bearings must be replaced.
Specified clearance is 0.02 to 0.07 mm (0.001 to 0.003").

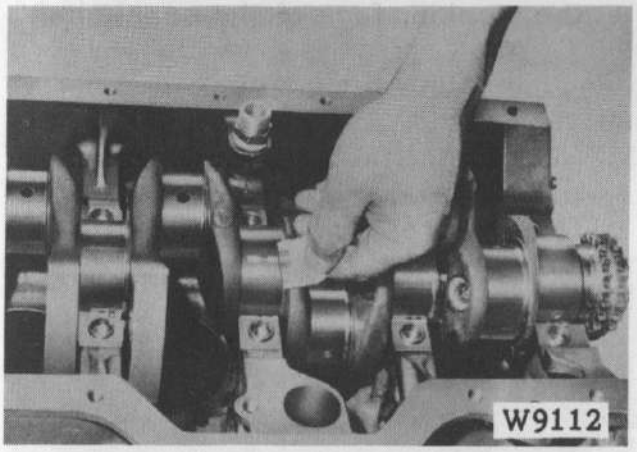


Fig.2-66 Measuring Plastigage Width

Table 2-7 Crankshaft bearing size & crankshaft journal diameter

STD
Crankshaft journal:
59.984 to 60.000 mm
(2.3616 to 2.3622")
U/S 0.05
Crankshaft journal:
- - - - - - - - - - - -
U/S 0.25
Crankshaft journal:
59.730 to 59.740 mm
(2.3516 to 2.3520")
U/S 0.50
Crankshaft journal:
59. 520 to 59.530 mm
(2.3433 to 2.3437")
U/S 0.75
Crankshaft journal:
59.230 to 59.240 mm
(2.3319 to 2.3323")
U/S 1.00
Crankshaft journal:
58.980 to 58.990 mm
(2.3220 to 2.3224")

Crankshaft

1. Check the crankshaft for run-out and straighten, and replace the crankshaft if the run-out exceeds 0.03 mm (0.0012").
Attach a dial gauge to the center bearing journal, and rotate the crankshaft one complete turn.
Read one-half the difference of the maximum gauge reading.

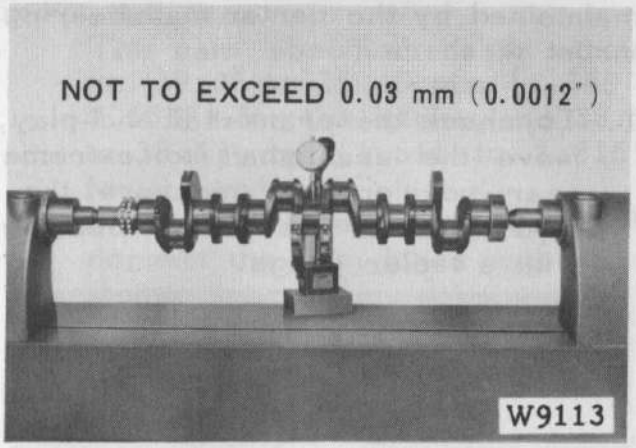


Fig.2-67 Measuring Crankshaft Run-out

2. Inspect the crankpin journals for wear and scores, and if the eccentric or taper wear exceeds 0.01 mm (0.0004"), grind the crankpin journals in relation with the connecting rod bearing size in Table 2-6, and use the suitable under-size connecting rod bearings.

3. Inspect the crankshaft main journals for wear, scores, and eccentric or taper wear. If the wear exceeds 0.01 mm (0.0004"), grind the main journals in relation with the crankshaft main bearing size in Table 2-7, and use the suitable under-size main bearings.

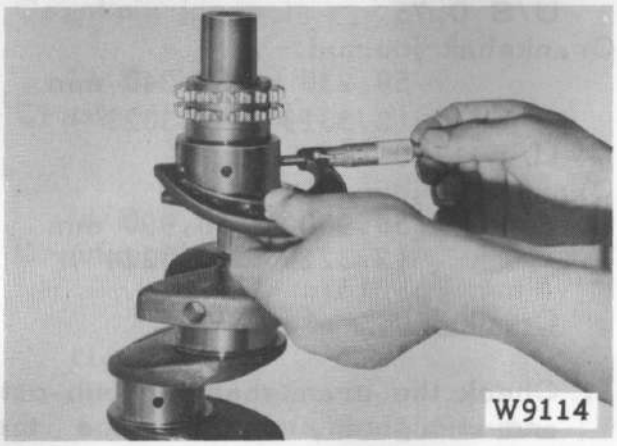


Fig. 2-68 Measuring Crankpin and Main Journal Wear

Crankshaft thrust clearance

The crankshaft thrust clearance is maintained by the center main bearing thrust washers.

1. To check the crankshaft end-play, move the crankshaft to extreme rear position, and measure the rear side of the center bearing with a feeler gauge.

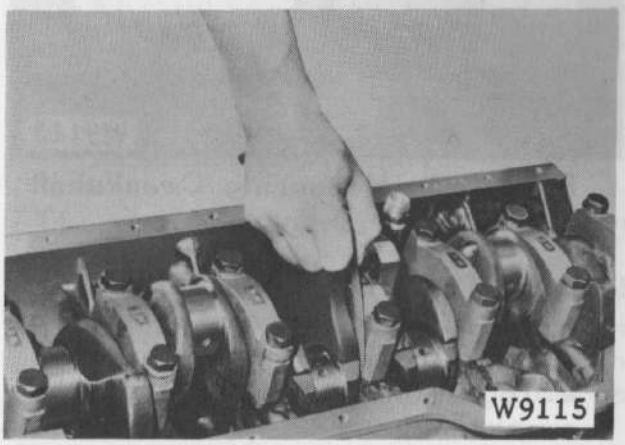


Fig. 2-69 Measuring End-play

2. If the clearance exceeds 0.3 mm (0.012"), replace the thrust washers.

The specified thrust clearance should be 0.05 to 0.25 mm or 0.002 to 0.010".

Table 2-8 Thrust washer thickness

STD	
Thickness:	2.925 to 2.975 mm (0.1152 to 0.1171")
O/S 5	
Thickness:	2.990 to 3.040 mm (0.1177 to 0.1197")
O/S 10	
Thickness:	3.050 to 3.100 mm (0.1201 to 0.1220")

CAUTION:
When installing the thrust washers, always position the oil grooves on the thrust washers facing towards the working face of the crankshaft.

Crankshaft timing gear

1. Inspect the timing gear for damage, cracks and chipped teeth. If defective, replace the gear.

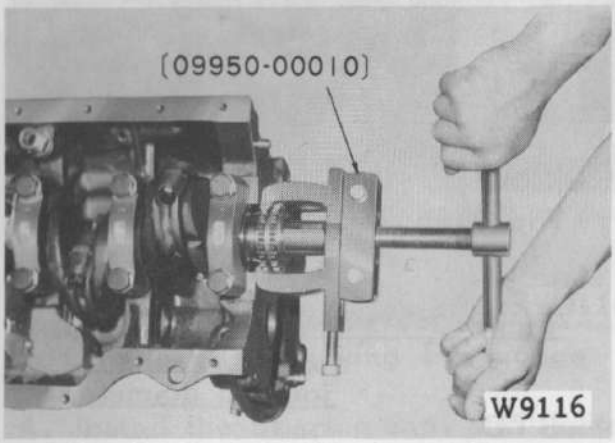


Fig. 2-70 Timing Gear Removal

2. To assemble the new timing gear, the ⊕ and "O" marks on the gear should be placed towards the front, and use the Crankshaft Damper & Oil Seal Replacer 09214-41010.

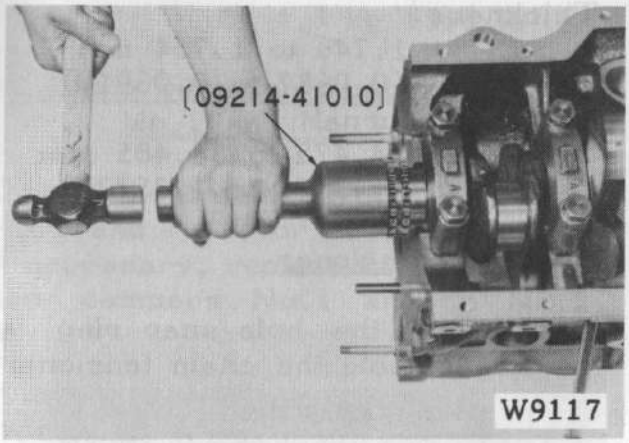


Fig.2-71 Assembling Timing Gear

Camshaft

1. Check the camshaft run-out, and if it exceeds 0.05 mm (0.0020"), the camshaft must be straightened or replaced.
   The run-out is one-half of maximum reading.

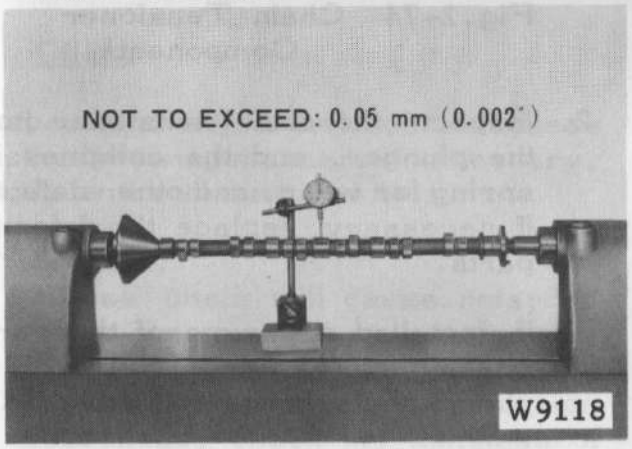


Fig.2-72 Checking Camshaft Run-out

2. To check the camshaft end-play, install the camshaft, and camshaft bearing caps, and tighten the cap bolts to 1.7 to 2.3 m-kg or 12 to 17 ft-lb torque, and check the clearance between the camshaft, and the camshaft bearing No.2 with a feeler gauge.
   The camshaft bearing is the lower bearing of the extreme front side.

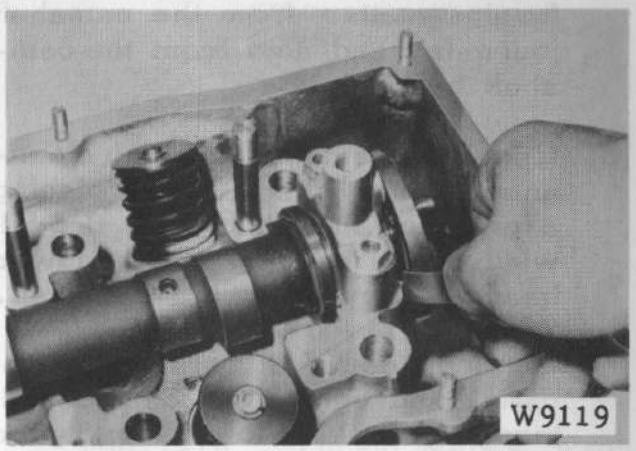


Fig.2-73 Measuring End-play

3. If the clearance exceeds 0.3 mm (0.012"), replace the camshaft bearing No.2.
   The specified clearance is 0.055 to 0.155 mm (0.0022 to 0.0061").

4. Inspect the camshaft cam lobes for pits, scores and abnormal wear. If the intake cam height is less than 39.0 mm (1.535"), and the exhaust cam height is less than 38.0 mm (1.496"), replace the camshaft.
   The cam specified height should be 39.35 to 39.45 mm (1.549 to 1.553") for the intake, and 38.37 to 38.47 mm (1.511 to 1.515") for the exhaust.
   If the cam lobes are serviceable, correct the cam lobes with an oil stone.

Camshaft bearing

The camshaft bearings are Kelmet precision type bearing inserts. Inspect the camshaft bearings in the same manner as the crankshaft bearing.

1. Check the bearing for improper contact, worn thin, partially melted or heavily scored. If necessary, replace the bearings.

2. Remove any deposit of oil, dirt or foreign matter from the camshaft journals, and also from the camshaft bearings.

3. Check the camshaft bearing clearance with a Plastigage by placing a piece of the plastigage the full width of the bearing onto the lower bearing parallel to the camshaft.

4. Install the camshaft, and the bearing caps, and tighten the cap bolts alternately to 1.7 to 2.3 m-kg or 12 to 17 ft-lb torque.
Do not turn the camshaft.

5. Check the bearing clearance with the plastigage scale on the cover, and if it exceeds 0.1 mm (0.004") the bearings must be replaced. The specified clearance should be 0.012 to 0.064 mm (0.0005 to 0.0025").

Table 2-9 Camshaft bearing size & camshaft journal diameter

STD
Thickness:
1.496 to 1.504 mm
(0.0589 to 0.0592")
Camshaft journal:
34.979 to 34.995 mm
(1.3771 to 1.3778")

U/S 0.05
Thickness:
1.521 to 1.529 mm
(0.0599 to 0.0602")
Camshaft journal:
- - - - - - - - - - -

U/S 0.125
Thickness:
1.561 to 1.569 mm
(0.0615 to 0.0618")
Camshaft journal:
34.845 to 34.855 mm
(1.3719 to 1.3722")

U/S 0.25
Thickness:
1.621 to 1.629 mm
(0.0638 to 0.0641")
Camshaft journal:
34.725 to 34.735 mm
(1.3671 to 1.3675")

U/S 0.50
Thickness:
1.746 to 1.754 mm
(0.0687 to 0.0691")
Camshaft journal:
34.475 to 34.485 mm
(1.3573 to 1.3577")

Chain tensioner

1. Remove the hole snap ring, and disassemble the chain tensioner.

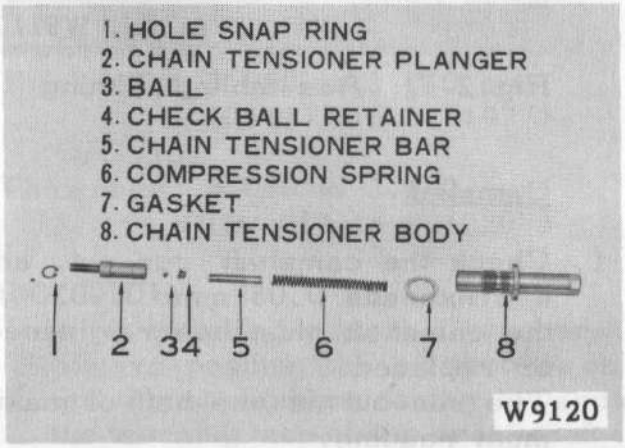


Fig.2-74 Chain Tensioner Components

2. Inspect the chain tensioner body, the plunger, and the compression spring for wear, and other defects. If necessary, replace the defective parts.

3. If installed pressure of the spring is less than 3.8 kg (8.4 lb), replace the compression spring.

4. If the clearance between the body and the plunger exceeds 0.12 mm (0.005"), replace the body and the plunger.

Specification:
Chain tensioner body inner diameter:
15.000 to 15.027 mm
(0.5906 to 0.5916")
Plunger diameter:
14.950 to 14.968 mm
(0.5886 to 0.5893")
Spring free length:
110 mm (4.331")
Spring installed length:
62.9 mm (2.476")

Spring installed pressure:
4.3 kg (9.6 lb)

Chain vibration dampers No.1 and No.2

Check the rubbers of the dampers No.1 and No.2 for wear and cracks. If necessary, replace the chain vibration dampers No.1 and/or No.2.

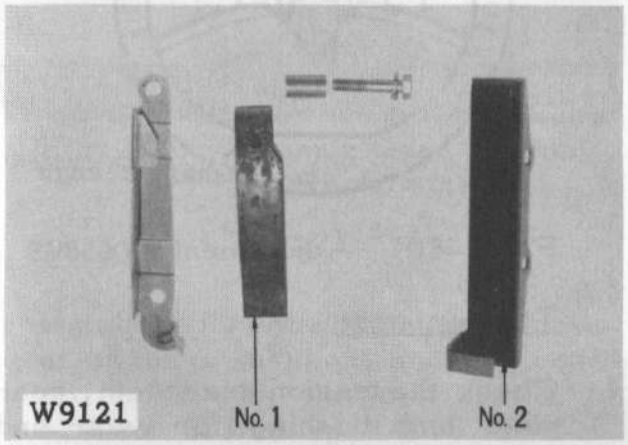


Fig.2-75 Chain Vibration Dampers

Chain

Inspect and adjust the chain looseness in the following manner. If necessary, replace the chain.

CAUTION:
Loose chain will cause retarded valve timing.

1. Before inspecting the chain tension looseness, check the tightness of the cylinder head securing bolts, and the chain tension with the chain tensioner.

2. Align the V-groove on the crankshaft pulley with the graduation on the chain cover.

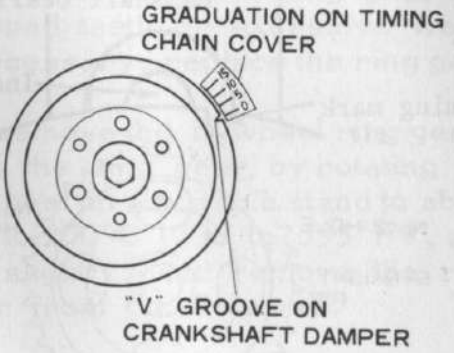
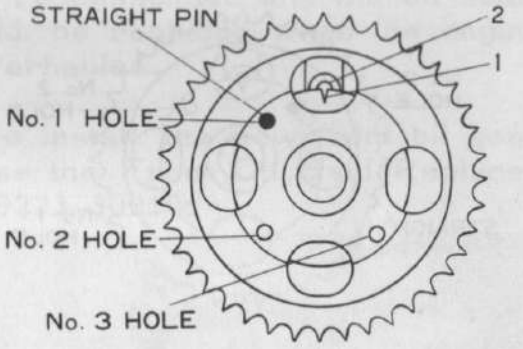


Fig.2-76 Timing Marks X4028

3. Check to see if the timing mark (1) in the camshaft flange is within the indent hole (2) (4 mm in diameter) in the camshaft front bearing cap when looked straight through the opening in the camshaft gear.



X4100

Fig.2-77 Aligning Holes in Timing gear

4. If the timing mark (1) if off the mark counterclockwise, adjust the chain as shown figure 2-78 above. Remove the camshaft gear attaching bolt, which is left-hand threaded, from the camshaft. Then rotate the camshaft gear on the camshaft clockwise until the straight pin on the camshaft flange fits in the No. 2 straight pin hole in the camshaft gear.

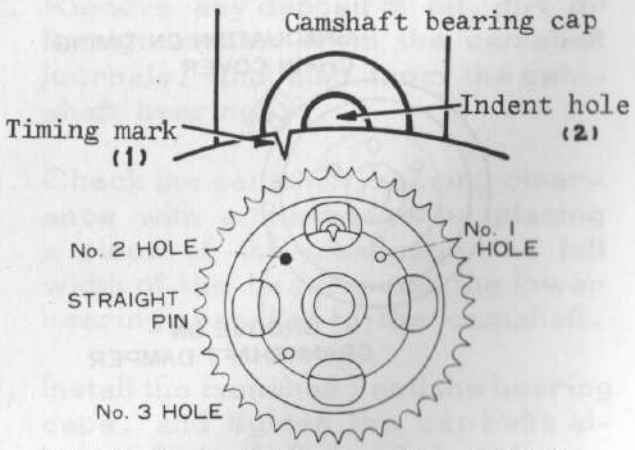


Fig.2-78 Adjustment X5808

5. If the V-groove is still off the mark, try the No.3 straight pin hole. The chain needs replacement if the straight pin must surpass the No.3 straight pin hole to get timing mark (1) within the indent hole (2).

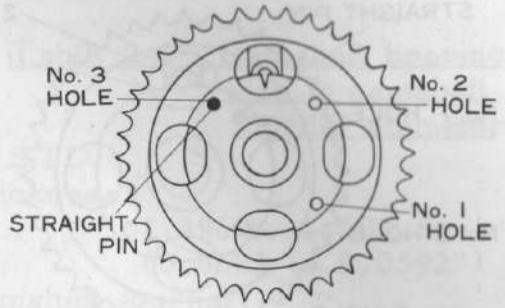


Fig.2-79 Adjustment X4102

Note: When the straight pin is install into the No.2 hole, the valve timing will advance 6 degrees more than inserting into the No.1 hole. Also if the No.3 hole is used for the valve timing, the advance will be 6 degrees more than No. 2 hole.

When the timing line aligns within the indent hole, the valve timing will be from 6 degrees advanced to 6 degrees starded. in other words the valve timing will be plus or minus 6 degrees either way.

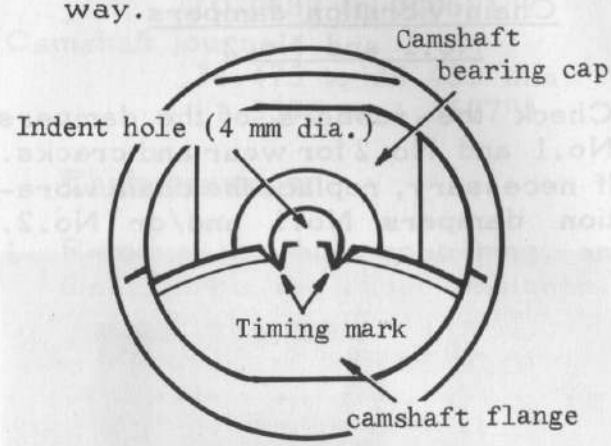


Fig.2-80 Adjustment X5809

Tension gear

1. Check the tension gear teeth, gear shaft and bushing for wear and other defects. If necessary, replace the tension gear, gear shaft, and the bushing.

Specification:

Bushing inner diameter:
20.000 to 20.021 mm
(0.7874 to 0.7957")

Gear shaft diameter:
19.967 to 19.980 mm
(0.7861 to 0.7866")

Oil clearance:
0.020 to 0.054 mm
(0.0008 to 0.0021")

Thrust clearance:
0.05 to 0.65 mm
(0.002 to 0.026")

Oil clearance limit:
0.1 mm (0.004")

Thrust clearance limit:
1.0 mm (0.04")

2. If replacing the bushing, use the Connecting Rod Remover and Replacer 09222-30010.

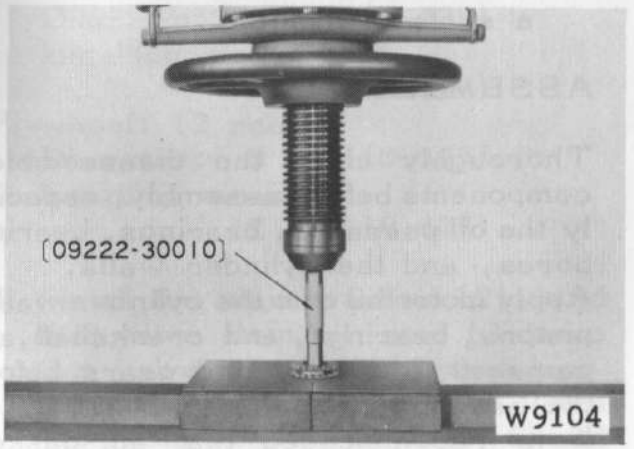


Fig. 2-80 Tension Gear Bushing Replacement

Flywheel

1. Install the flywheel aligning the dowel on the crankshaft, and tighten the six bolts with the lock plates to 5.7 to 6.3 m-kg (40.5 to 45.6 ft-lb) torque.

2. Position a dial gauge against the flywheel surface, and check the run-out.
   This run-out should not exceed 0.2 mm or 0.008". If the run-out exceeds, remove the flywheel and check the contacting surface of the flywheel, and the crankshaft.
   Remove any dirt or foreign matter. If necessary, replace the flywheel.

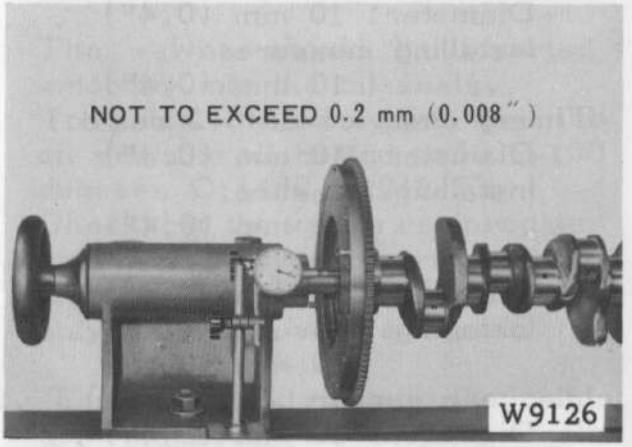


Fig. 2-81 Measuring Flywheel Run-out

3. Check the flywheel ring gear for chipped teeth or excessive wear. If necessary, replace the ring gear.

4. To remove the flywheel ring gear, heat the ring gear by rotating the flywheel on a suitable stand to about 160 to 200°C (320 to 395°F), and tap slightly, and remove the ring gear from the flywheel.

5. Remove the preservation oil from the ring gear, and also clean the flywheel where the ring gear fits.

6. Heat the ring gear to about 200°C (395°F), and install the ring gear onto the flywheel as quickly as possible. The ring gear must be installed while still hot.

Crankshaft oil seal

It is recommended that the oil seals should be replaced when the engine is overhauled.

1. To install the new front oil seal, use the Front Oil Seal Replacer 09223-50010.

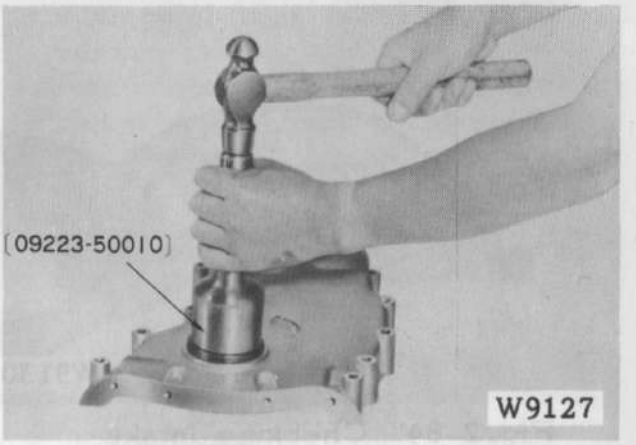


Fig. 2-82 Installing Front Oil Seal

2. Install the new rear oil seal using the Crankshaft Rear Oil Seal Replacer 09223-41010.

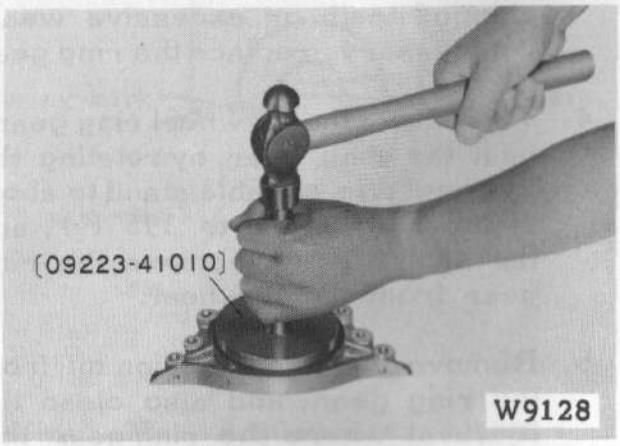


Fig. 2-83 Installing Rear Oil Seal

Intake manifold

1. Inspect the intake manifold for corrosion, cracks or other damage. If necessary, replace the manifold.

2. Check the distortion of the intake manifold as illustrated in figure 2-84.
If the distortion exceeds 0.2 mm (0.008"), replace the intake manifold.

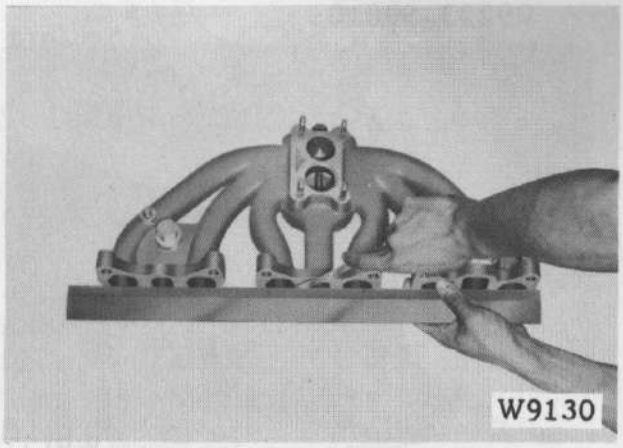


Fig. 2-84 Checking Intake Manifold Distortion

Exhaust manifold

1. Inspect the exhaust manifolds for corrosion, cracks or other damage.

2. Check the distortion of the exhaust manifolds in the same manner as the intake manifold.
If the distorsion exceeds 0.4 mm (0.016"), grind the surfaces with a surface grinder.

ASSEMBLY

Thoroughly clean the disassembled components before assembly, especially the oil passages, bearings, bearing bores, and the cylinder walls.
Apply motor oil onto the cylinder walls, pistons, bearings, and crankshaft, and camshaft journals, and gears before the assembly.
It is recommended that all gaskets, packings and the oil seals are to be replaced upon assembly.
To prevent the oil leak the use of a sealer is also essential.
Each clearance previously checked and adjusted must be rechecked upon assembly.
When installing bolts into the aluminum parts threaded portions, apply a few drops of motor oil onto the bolt threads.
If the aluminum parts threads are stripped, correct them using "Helisert" (coil insert).
Service Torque Specifications should be adhered whenever tightening the bolts or nuts specified with torque.

Table 2-11 Straight pin (dowel) installing measure

Flywheel housing: (2 req'd.)
Diameter: 10 mm (0.4")
Installing measure:
10 mm (0.4")
Timing chain cover: (2 req'd.)
Diameter: 10 mm (0.4")
Installing measure:
10 mm (0.4")
Oil seal retainer: (2 req'd.)
Diameter: 10 mm (0.4")
Installing measure:
10 mm (0.4")
Idle gear support: (1 req'd.)
Diameter: 10 mm (0.4")
Installing measure:
38 mm (1.5")
Cylinder block & head: (2 req'd.)
Diameter: 8 mm (0.3")
Installing measure:
7 mm (0.28")

Camshaft flange: (1 req'd.)
Diameter: 8 mm (0.32")
Installing measure:
8 mm (0.32")
Flywheel: (2 req'd.)
Diameter: 8 mm (0.32")
Installing measure:
12 mm (0.47")

1. Install the plain washer (2), and the valve stem oil seal (3), onto the valve stem guide by pushing the oil seal. Assemble the valve (1), compression springs (4) and (5), and the valve spring retainer (6).
Compress the valve springs with a valve spring compressor, then install the valve spring retainer lock (7).

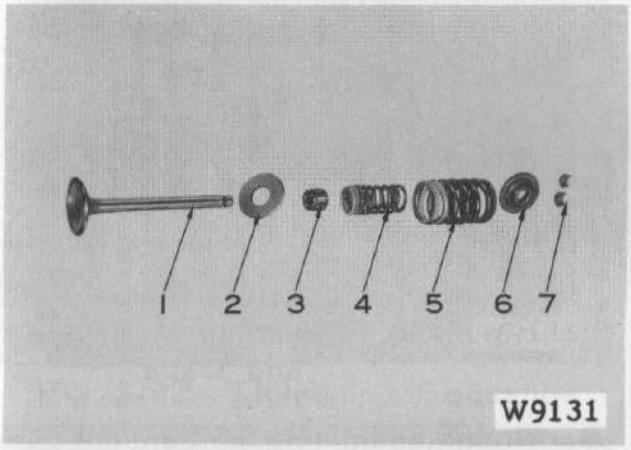


Fig.2-85 Valve Assembly Components

The valves should be inserted smoothly into the oil seals.
To soften the oil seals, heat the oil seals in oil heated to 60 to 100 degrees C (140 to 212°F).
Check that the valves reciprocate smoothly.
Replace the oil seal, if it does not stay on the valve stem guide.

2. The connecting rod and the piston are marked with Toyota marks indicating the front.
To install the piston pin into the piston pin bore, heat the piston with a piston heater to 50 to 60°C (122 to 140°F) to facilitate the installation.
Assemble the piston and the connecting rod with the piston pin mating the marks.

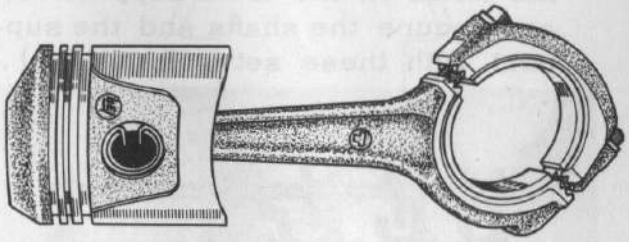


Fig.2-86 Piston and Con-rod

3. Install the piston pin snap rings.

4. Clean the bearing fitting portion, and carefully install the bearing.

5. The piston rings are provided with marks as illustrated in figure 2-87, and these marks should be faced upward upon installation.
The No.1 rings are chrome plated on the outside, while the No.2 rings are ferrous oxide treated to distinguish the No.1 and No.2 compression rings.
Assemble the piston rings onto the piston with the ring expander.

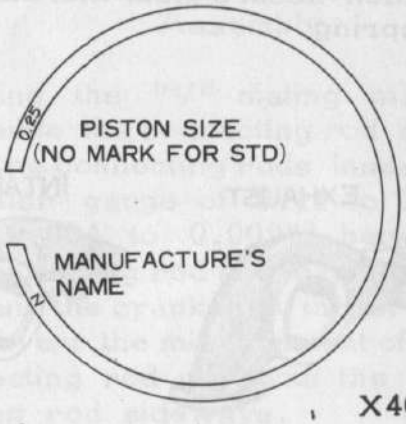


Fig.2-87 Piston Ring Marks

6. The exhaust side rocker arm shaft (3) is provided with a retainer spring groove at the rear of the shaft.

Both shaft (2) and (3) are provided with set screw holes to secure the rocker arm shaft front support.
Align the holes on the shafts with the holes on the front support (1), and secure the shafts and the support with these set screws (4).

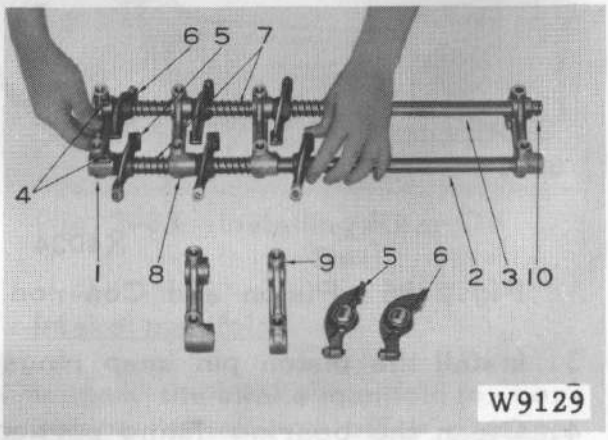


Fig. 2-88 Valve Rocker Shafts and Related Parts

7. The rocker arms (5) and (6) are marked S or E. The S mark is for the intake side, and the E is for the exhaust side. These marks should face toward the front upon assembly.
Assemble the valve rocker arms compression springs (7), valve rocker support No.2 (8), and the valve rocker support No.3 (9), then secure them with the retainer spring.

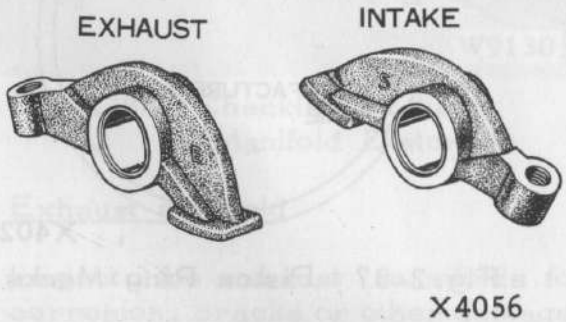


Fig. 2-89 Valve Rocker Arm Marks

8. Install the lower halves of the camshaft bearings No.2 (1), No.1 (2) onto the cylinder head. Apply motor oil onto the bearings, then install the camshaft.
Install the upper halves of No.1 (3) of the camshaft bearings into the bearing caps No.1 (4) and No.2 (5). Lubricate the camshaft bearing journals, and the cap bearings.
As the bearing caps are provided with sequence numbers on the upper surface, the caps must be installed in the sequence upon assembly.

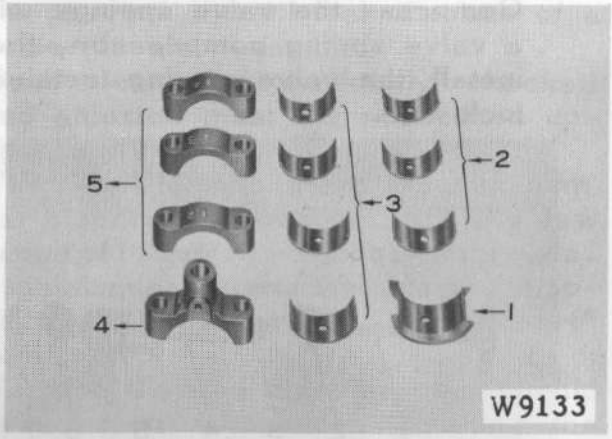


Fig. 2-90 Camshaft Bearings and Caps

9. When assembling the bearing caps, position them with the arrow mark facing the front.
Tighten the cap bolts alternately to 1.7 to 2.3 m-kg (12.2 to 16.6 ft-lb). If the stud bolts are loosened tighten the stud bolts to 1.1 to 1.5, m-kg (7.9 to 10.8 ft-lb) torque.

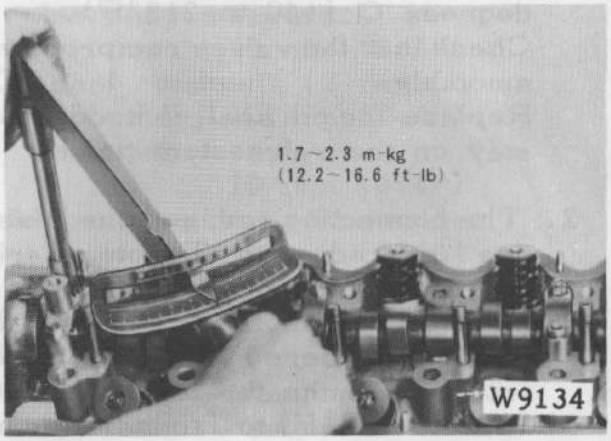


Fig. 2-91 Assembling Camshaft

10. Assemble the crankshaft bearings, thrust washers, and the crankshaft onto the cylinder block with the thrust washer oil grooves facing toward the crankshaft thrust surfaces.

11. Install the crankshaft bearing caps onto the cylinder block adhering the marks and numbers in each cap, then tighten the cap bolts alternately to 9.9 to 10.9 m-kg or 71.3 to 78.5 ft-lb as illustrated sequence in figure 2-92. Always check if the crankshaft rotates smoothly, and the crankshaft thrust clearance is 0.05 to 0.25 mm or 0.002 to 0.010".

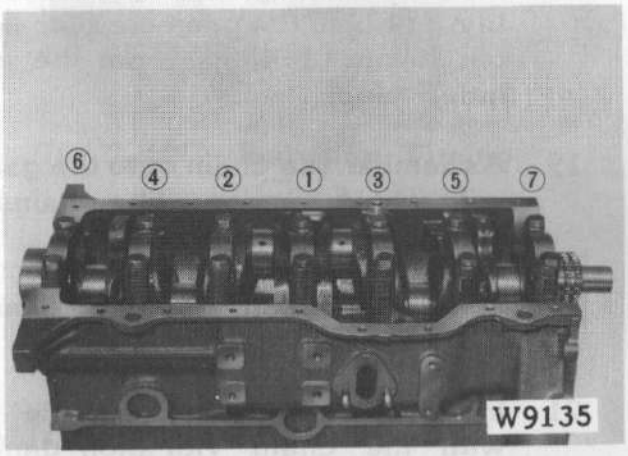


Fig. 2-92 Tightening Sequence

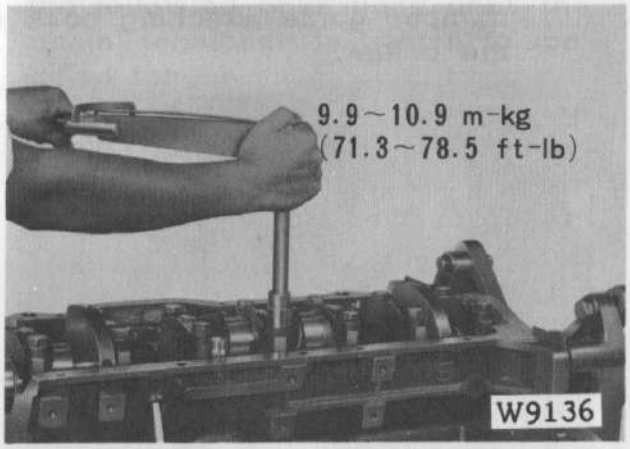


Fig. 2-93 Assembling Crankshaft

12. Lubricate the piston, rings, and the piston pin. Space the piston ring gaps as illustrated.

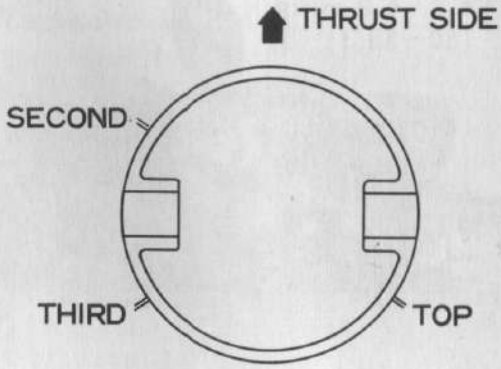


Fig. 2-94 Spacing Piston Ring Gaps

13. Install the piston assembly into the cylinder block using a piston ring compressor with the Toyota mark facing the front of the cylinder block.

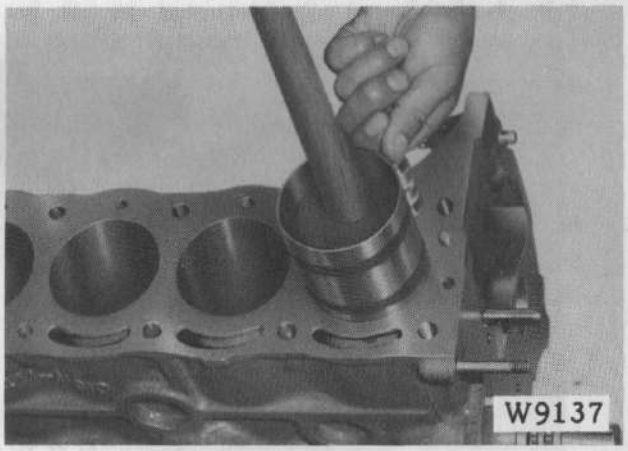


Fig. 2-95 Assembling Piston Assembly

14. Aligning the "V" mating mark, assemble the connecting rod caps onto the connecting rods inserting a feeler gauge of 0.11 to 0.24 mm (0.004 to 0.009") between the connecting rod and cap thrust side and the crankshaft thrust side to prevent the misalignment of the connecting rod cap with the connecting rod sideways.
Tighten the connecting rod cap bolts to 4.2 to 4.8 m-kg (30.2 to 34.6 ft-lb) torque.
The specified thrust clearance is 0.11 to 0.24 mm (0.004 to 0.009").

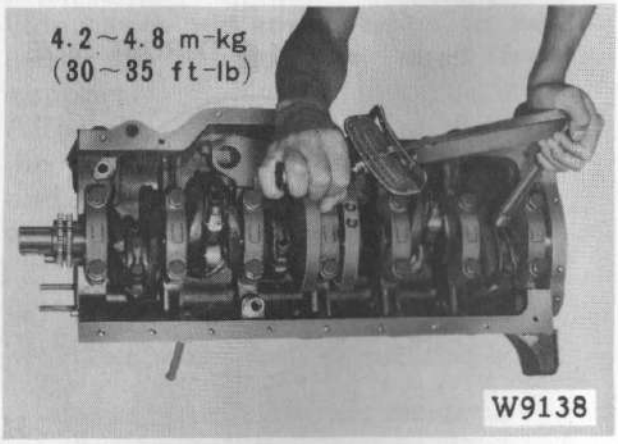


Fig. 2-96 Tightening Bearing Cap Bolts

15. Assemble the pump drive shaft assembly (2) onto the cylinder block, and tighten the pump drive shaft thrust plate (1) attaching bolt.

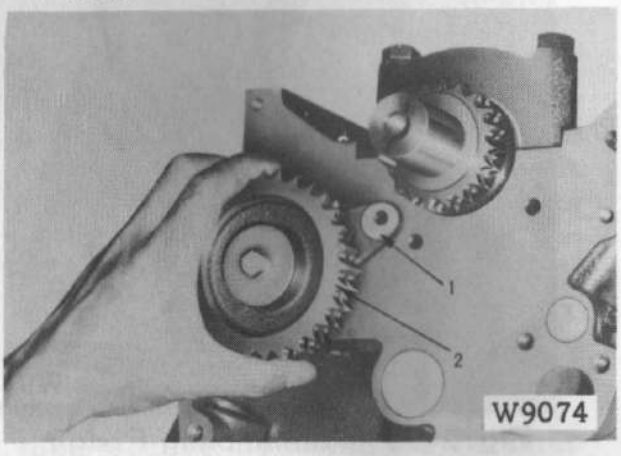


Fig. 2-97 Assembling Pump Drive Shaft

16. The crankshaft timing gear is provided with an "O" mark (1). When the No. 1 piston is positioned at T.D.C. this "O" mark will be at the lower position.

17. Positioning this "O" mark at the lower position, align the timing marks (Toyota) on the crankshaft gear with the pump drive shaft gear as illustrated in figure 2-98.

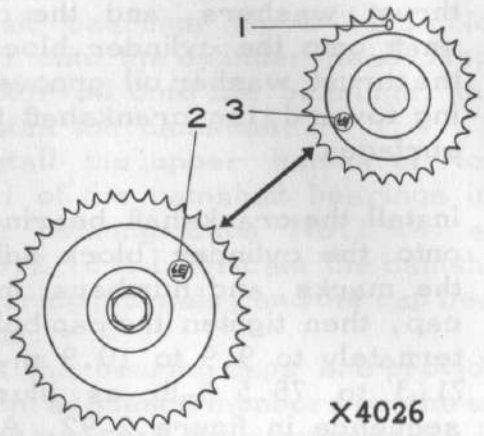


Fig. 2-98 Aligning Timing Marks

18. Assemble the tension gear assembly (1) onto the projected straight pin 38 mm (1.496") from the cylinder block.

19. Assemble the chain onto the gears with a light tension. The chain has no mating mark.

20. Install the chain vibration damper No. 2 (5).

21. Install the chain damper guide (3) with the chain vibration damper No. 1 (4), and tighten the chain damper guide attaching bolts with the collar.

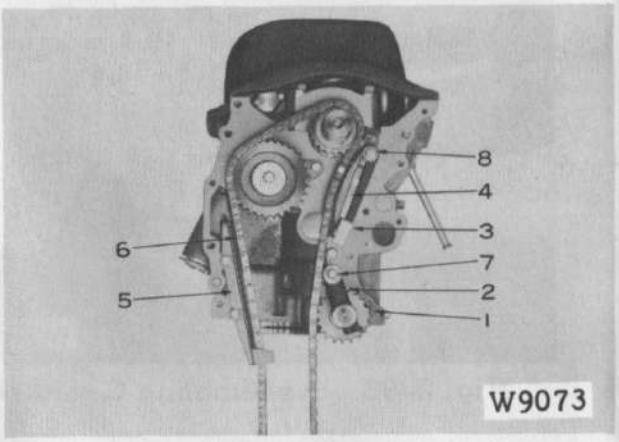


Fig. 2-99 Installing Timing Chain

22. Install the crankshaft oil slinger.

23. Install the timing chain cover and the gaskets No.1 and N0.2 onto the cylinder block.
Tighten the 8 mm attaching bolts (0.315") to 1.5 to 2.1 m-kg or 10.8 to 15.1 ft-lb torque, and the 10 mm (0.394") bolts to 3 to 4 m-kg (21.6 to 28.8 ft-lb) torque.

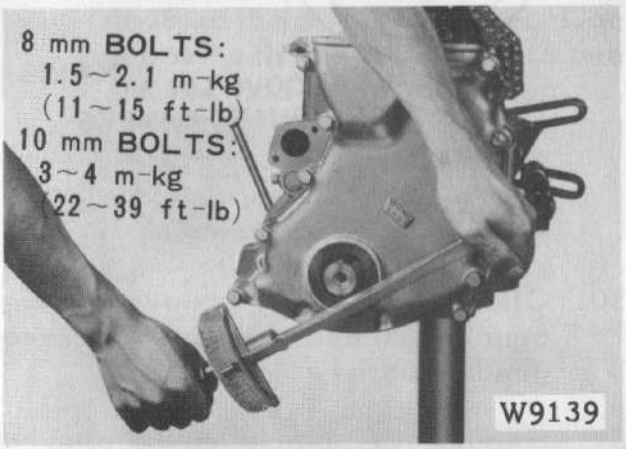


Fig.2-100 Installing Timing Chain Cover

24. Pull up the chain (1) lightly, and tighten the chain carefully to the chain vibration damper No.2 (2) with a cord.

CAUTION:
Do not turn the crankshaft during the following operations until the chain tensioner is tighten to specified torque.
Cover the upper portion of the chain cover with a clean shop towel to prevent the bolt or washer from dropping into the chain cover.

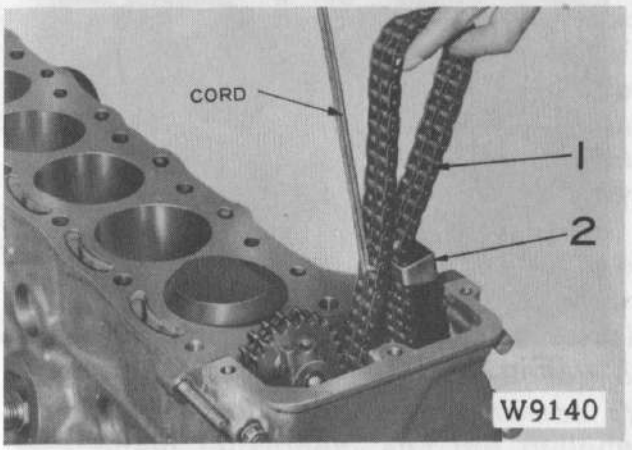


Fig.2-101 Installing Timing Chain

25. Install the crankshaft damper with the Crankshaft Damper & Oil Seal Replacer 09214-41010.

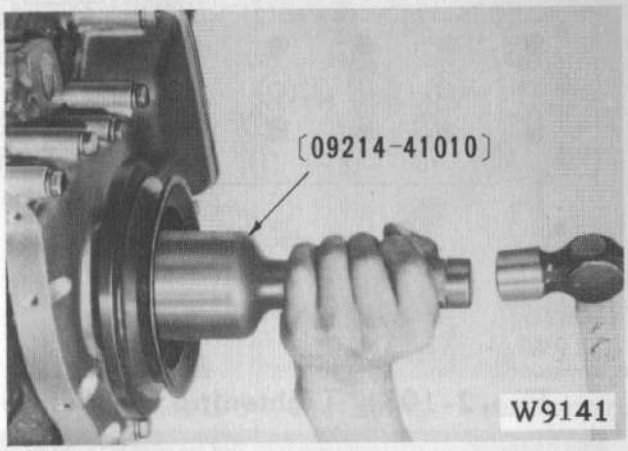


Fig.2-102 Installing Crankshaft Damper

26. Install the crankshaft damper retaining bolt and tighten to 6.0 to 7.0 m-kg (43.2 to 50.4 ft-lb) torque while aligning the crankshaft damper "V" groove and the zero graduation on the chain cover.

27. Install a new cylinder head gasket aligning the dowel pin holes in the gasket with the dowel pins and place the cylinder head onto the cylinder block. Do not slide the cylinder head on the block.
Apply liquid sealer onto the head if available.

28. Tighten the cylinder head bolts a little at a time with a torque wrench in the sequence illustrated in figure 2-103.
Finally tighten the three 8 mm (0.315") bolts to 1.5 to 2.1 m-kg (10.8 to 15.1 ft-lb), the fourteen 13 mm (0.5") bolts to 7.5 to 8.5 m-kg (54 to 61 ft-lb) torque.

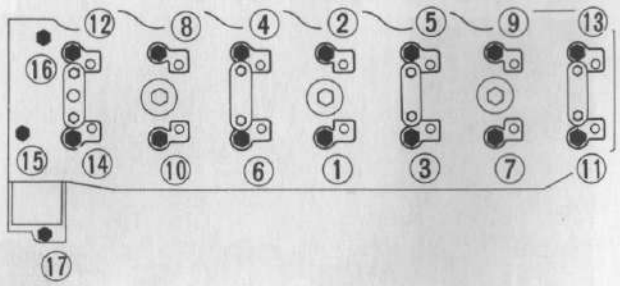


Fig. 2-103 Tightening Sequence

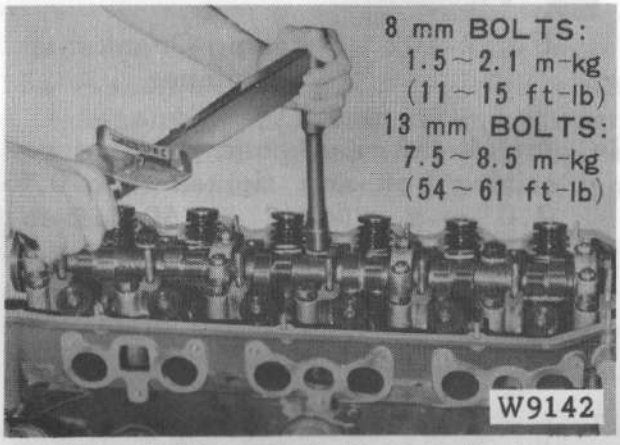


Fig. 2-104 Installing Cylinder Head

Installing the timing chain and the camshaft gear onto the camshaft

29. Align the "indent hole" on the camshaft front bearing cap (No. 1) with the timing "line" in the camshaft timing gear installing flange of the camshaft.

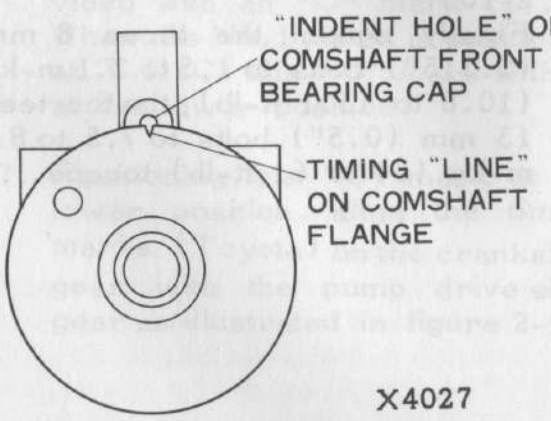


Fig. 2-105 Timing Marks Alignment No. 1

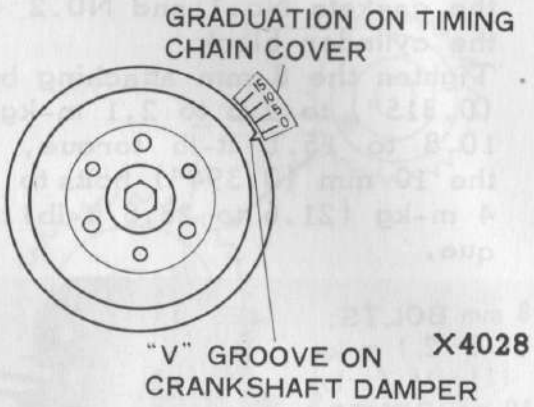


Fig. 2-106 Timing Marks Alignment No. 2

30. Check if the "V" groove on the crankshaft damper and the zero graduation are aligned.

31. Secure the camshaft to prevent the camshaft from misaligning sideways with the "indent hole" on the camshaft front bearing (No. 1). Next, aligning the straight pin (1) on the camshaft, and the straight pin inserting hole (2) on the timing gear, install the camshaft timing gear onto the camshaft with the timing chain.
At this time, the tension of the timing chain should be balanced on each side, and check if the chain is engaged with the tension gear sprockets.

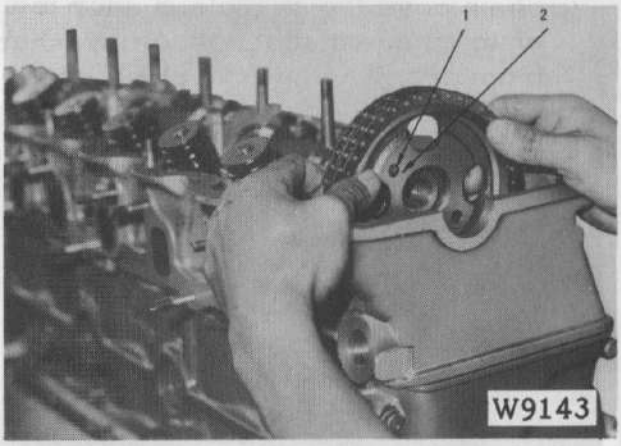


Fig. 2-107 Installing Camshaft Timing Gear

CAUTION:
When selecting the straight pin inserting hole (2) position, refer to Chain section on page 2-33.

32. Install and tighten the camshaft gear retaining bolt (left-hand thread) with a lock washer and a lock plate to 6.5 to 7.5 m-kg (46.8 to 54 ft-lb) torque. Lock the bolt with the lock plate to prevent the bolt from loosening.

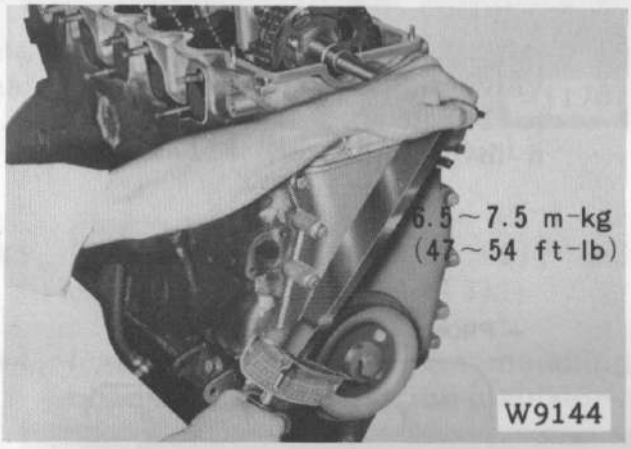


Fig. 2-108 Tightening Camshaft Timing Gear

33. Install the chain tensioner onto the cylinder head with the gasket, and tighten the chain tensioner to 3.0 to 4.0 m-kg (21.6 to 28.8 ft-lb) torque.

CAUTION:
Rotate the crankshaft twice, and check the valve timing by referring to Chain section on page 2-33.
If these marks do not align, repeat the procedures described in paragraph 29 to 33.
Always cover the upper portion of the chain cover with a clean shop towel to prevent dropping any bolt or nut into the chain cover.
Check that the chain tensioner plunger is able to move backward 5 mm. If the plunger is unable to move, adjust the tensioner by placing the gasket/s between the chain tensioner, and the cylinder head.

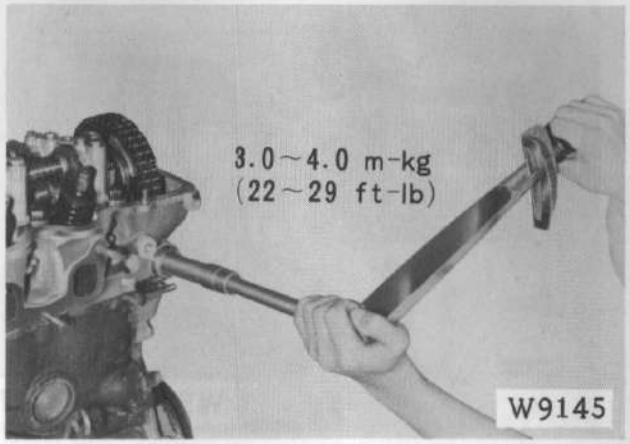
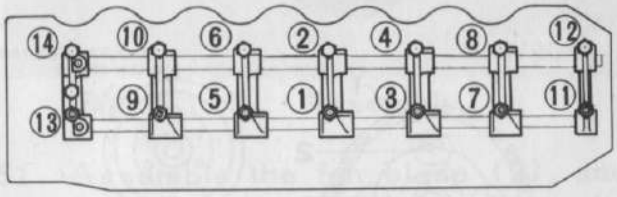


Fig. 2-109 Installing Tensioner

34. Install the valve rocker support assembly onto the cylinder head, by placing all the valve adjusting screws properly on the top of the valve stem, then tighten securing bolts and nuts a little at a time with a torque wrench in the sequence illustrated in figure 2-110. The final tightening torque should be 3.0 to 4.5 m-kg (21.6 to 32.4 ft-lb) for the attaching bolts. If the stud bolt/s is replaced, tighten the stud bolt/s to 1.5 to 2.0 m-kg (10.8 to 14.4 ft-lb) torque.



TORQUE: 3~4.5m-kg
(22~32 ft-lb)

X4029

Fig. 2-110 Valve Rocker Support Tightening Sequence

35. Install the union bolts (1) onto the valve rocker support No.1, and the camshaft front bearing cap No.1 with the unions (2).
Tighten the bolts to o.8 to 1.2 m-kg (5.8 to 8,6 ft-lb) torque.

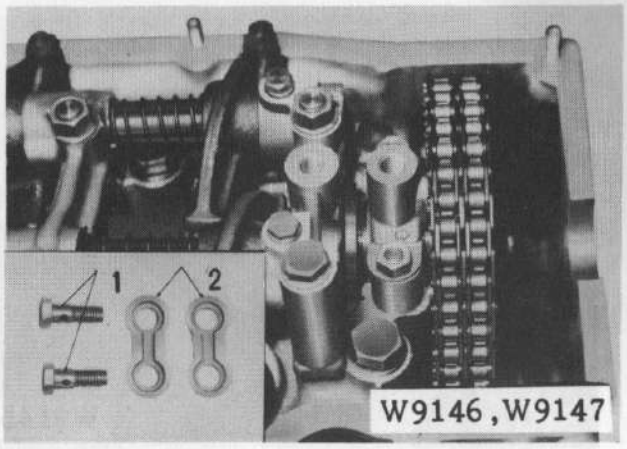


Fig.2-111 Installing Union Bolts

ADJUSTMENT

Valve clearance

36. Align the "indent hole" (1) on the front side of the camshaft front bearing cap (No.1) with the timing "line" (2) on the camshaft timing gear installing flange of the camshaft.
Also the "V" groove on the crankshaft damper and the zero graduation on the timing chain cover should align.

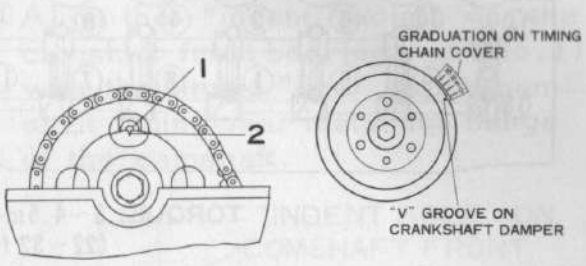


Fig.2-112 Valve Clearance Adjustment No.1

37. The condition described in the previous paragraph 36 is that the No.1 piston is at T.D.C., so adjust the intake valve clearance (cold) of (1), (2) and (4) to 0.10 mm (0.004"), and the exhaust valve clearance (cold) of (1), (3), and (5) to 0.18 mm (0.007").

38. Next, turn the crankshaft one complete turn, and align the "V" groove on the crankshaft damper with the zero graduation on the timing chain cover.
Now, adjust the intake valve clearance (3), (5) and (6), and the exhaust valve clearance (2), (4), and (6) the same as paragraph 37.
After the adjustment, tighten the valve adjusting screw lock nuts to 1.6 to 2.2 m-kg (11.5 to 15.8 ft-lb) torque.

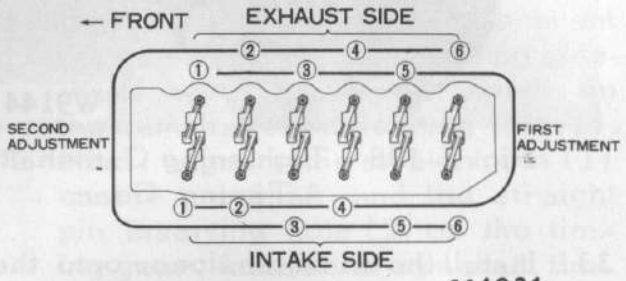


Fig.2-113 Adjusting Valve Clearance

39. Install the semi-circular plug, and the cylinder head gasket, then install the cylinder head cover.

40. Install the ventilation tube (1) onto the cylinder block.

41. Install the fuel pump assembly (2) onto the cylinder block.

42. Install the intake manifold (1) and the gasket onto the cylinder head. Apply a liquid sealer onto the manifold attaching bolts, and tighten the bolts to 3.0 to 4.0 m-kg or 21.6 to 28.8 ft-lb. If the stud bolts are loosened, tighten the stud bolts to 2.0 to 2.5 m-kg (14.4 to 18 ft-lb) torque.
Install the water temperature sender gauge into the intake manifold,

and tighten the gauge to 3.5 to 4.5 m-kg (25.2 to 32.4 ft-lb) torque.

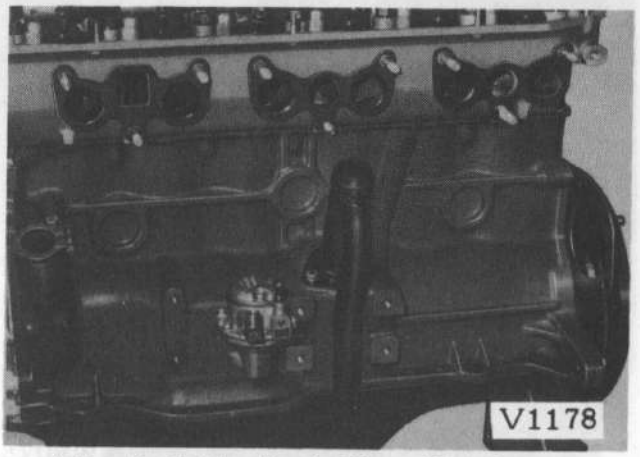


Fig. 2-114 Installing Fuel Pump

43. Install the carburetor (2), and connect the fuel pipe (3).

44. Install the engine front mounting bracket LH (4) with the insulator.

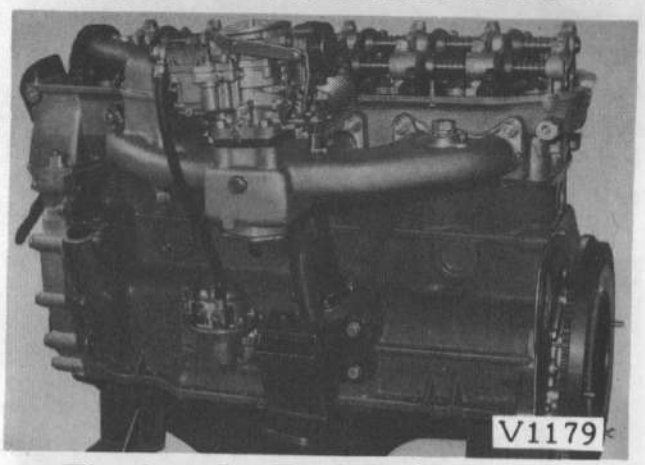


Fig. 2-115 Engine Assembly

45. Install the distributor assembly into the cylinder block placing the distributor adjuster as illustrated in figure 2-116. For details refer to Engine Electrical section paragraph Installation on page 6-18.

46. Connect the vacuum pipe onto the distributor.

47. Install the water pump assembly (5) in figure 2-117.

48. Install the by-pass hose (4) to the water hose joint in figure 2-117.

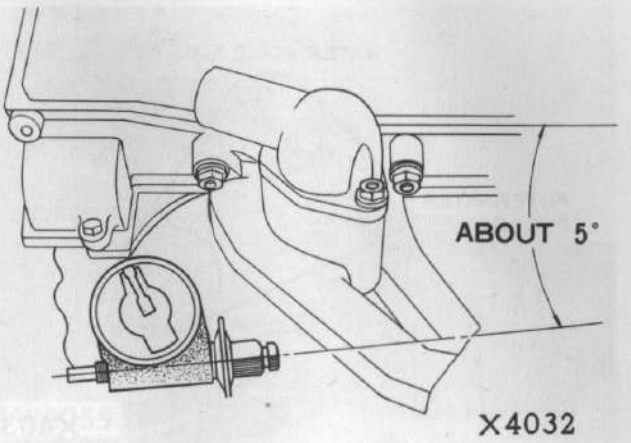


Fig. 2-116 Installing Distributor

49. Assemble the alternator (1) with the bracket in figure 2-117.

50. Connect the water by-pass pipe (6) to the by-pass hose (4), and the manifold side hose, then install it onto the cylinder head.

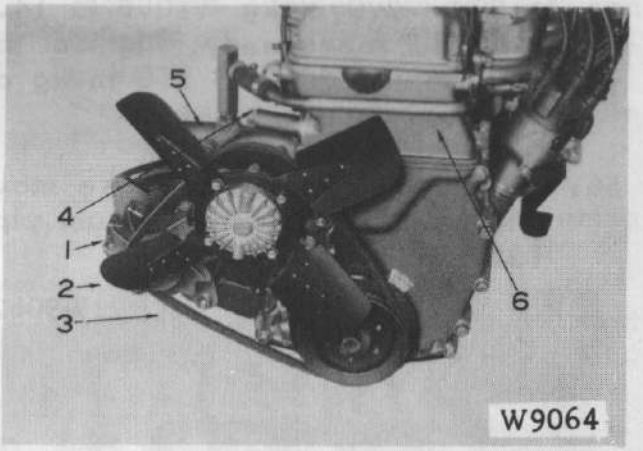


Fig. 2-117 Assembly

51. Assemble the fan blade (2), and the fan belt (3), then adjust the fan belt tension so that the fan belt deflection will be 16 mm (0.630") when 12 kg (26.5 lb) is applied as illustrated in figure 2-118.

52. Install the oil pressure sender gauge (5) onto the engine in figure 2-119.

53. Install the oil filter assembly with the hand. If the oil filter attaching union is removed, tighten to 2.5 to 3.5 m-kg (18 to 25 ft-lb).

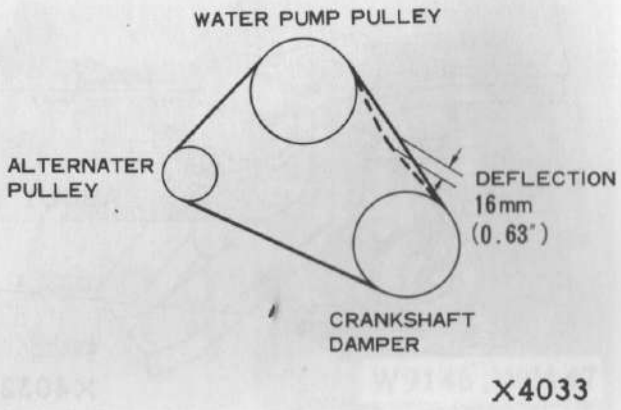


Fig. 2-118 Fan Belt Tension

54. Install the oil level gauge rod (1) (dip stick) into the rod pipe on the cylinder block.

55. Install the exhaust manifold (4) with the gasket onto the cylinder head, and tighten the attaching bolts to 1.5 to 2.0 m-kg (10.8 to 14.4 ft-lb). If necessary, tighten the stud bolts to 0.8 to 1.0 m-kg or 5.8 to 7.2 ft-lb torque.

56. Install the automatic choke stove inlet pipe (2), and the exhaust pipe (3).

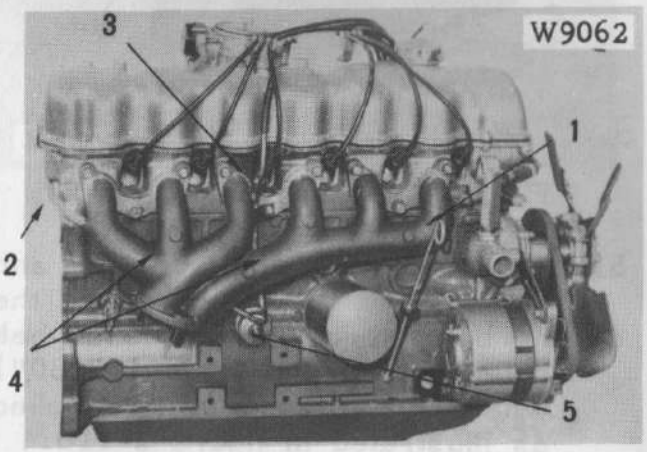


Fig. 2-119 Assembly

57. Install the oil pump assembly (2), and the oil pump outlet pipe (1), tighten the union bolt (3) to 3.0 to 4.0 m-kg (22 to 29 ft-lb) torque, and lock it with the lock washer (4).

The olive (oil seal) straight connector (5) should be tightened to 2.5 to 3.5 m-kg (18 to 25 ft-lb) torque.

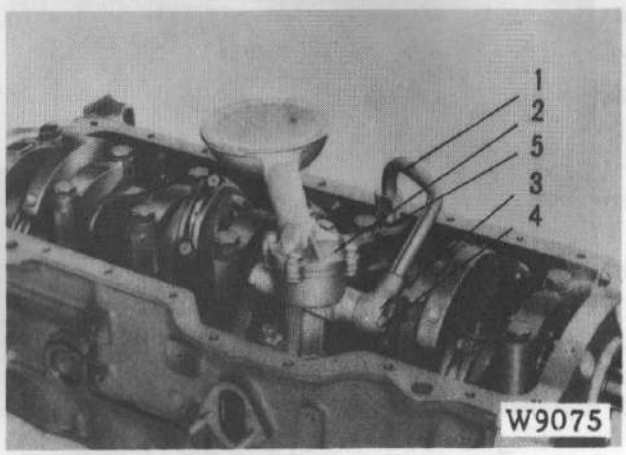


Fig. 2-120 Installing Oil Pump Assembly

58. Install the oil seal retainer (1), and the gasket with the oil seal (2).

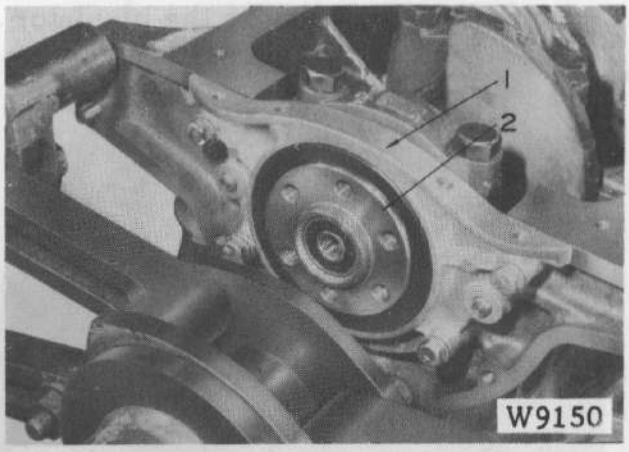


Fig. 2-121 Installing Oil Retainer

59. Install the oil pan with the gasket onto the cylinder block, and tighten the bolts to 0.4 to 0.7 m-kg (3 to 5 ft-lb) torque.
Tighten the oil pan drain plug to 3 to 4 m-kg (21.6 to 28.8 ft-lb) torque if necessary.

60. Remove the engine assembly from the work stand.

61. If the input shaft front bearing is removed, install the bearing with the Input Shaft Front Bearing Replacer 09304-30012.

Fig. 2-122 Installing Bearing

62. Install the flywheel, and the attaching bolts with the lock plate, then tighten the bolts to 5.7 to 6.3 m-kg (41 to 45.4 ft-lb) torque. Lock the bolts with the lock plate.

63. Assemble the clutch cover, clutch disc, with the Clutch Guide Tool 09301-36010, then insert the end of the Tool into the input shaft front bearing. Tighten the clutch cover to flywheel attaching bolts to 0.8 to 1.3 m-kg (5.8 to 9.4 ft-lb) torque, then remove the Tool.

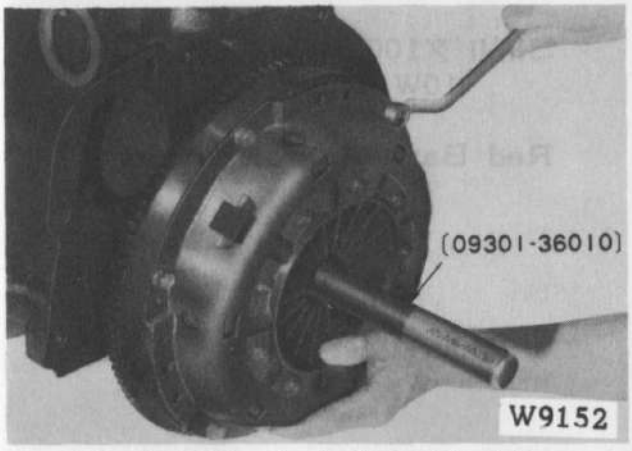


Fig. 2-123 Installing Clutch Cover

64. Assemble the flywheel housing under cover, starter motor, and the transmission assembly.

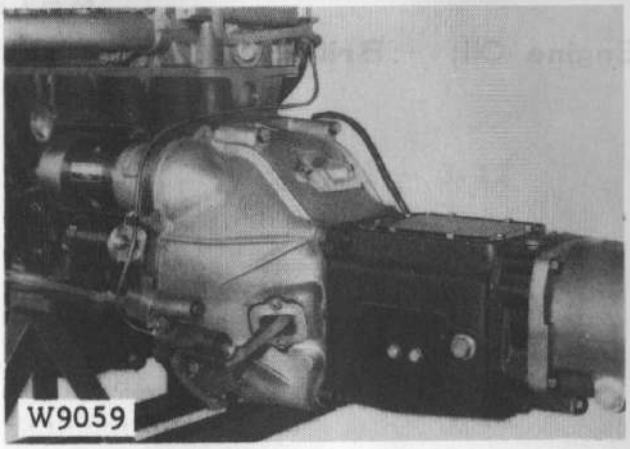


Fig. 2-124 Installing Transmission

INSTALLATION

Follow the removal procedures in the reverse order.

1. Refill the engine with coolant, and engine oil. Also refill the transmission with gear lublicant. Refer to Recommended Petroleum Products on page 2-48.

2. Tune-up the engine by referring to Engine Tune-up section.

3. Air-bleed the clutch system, and replenish the brake fluid if necessary.

4. Check and if necessary, adjust the hood for proper closing.

Recommended Petroleum Products

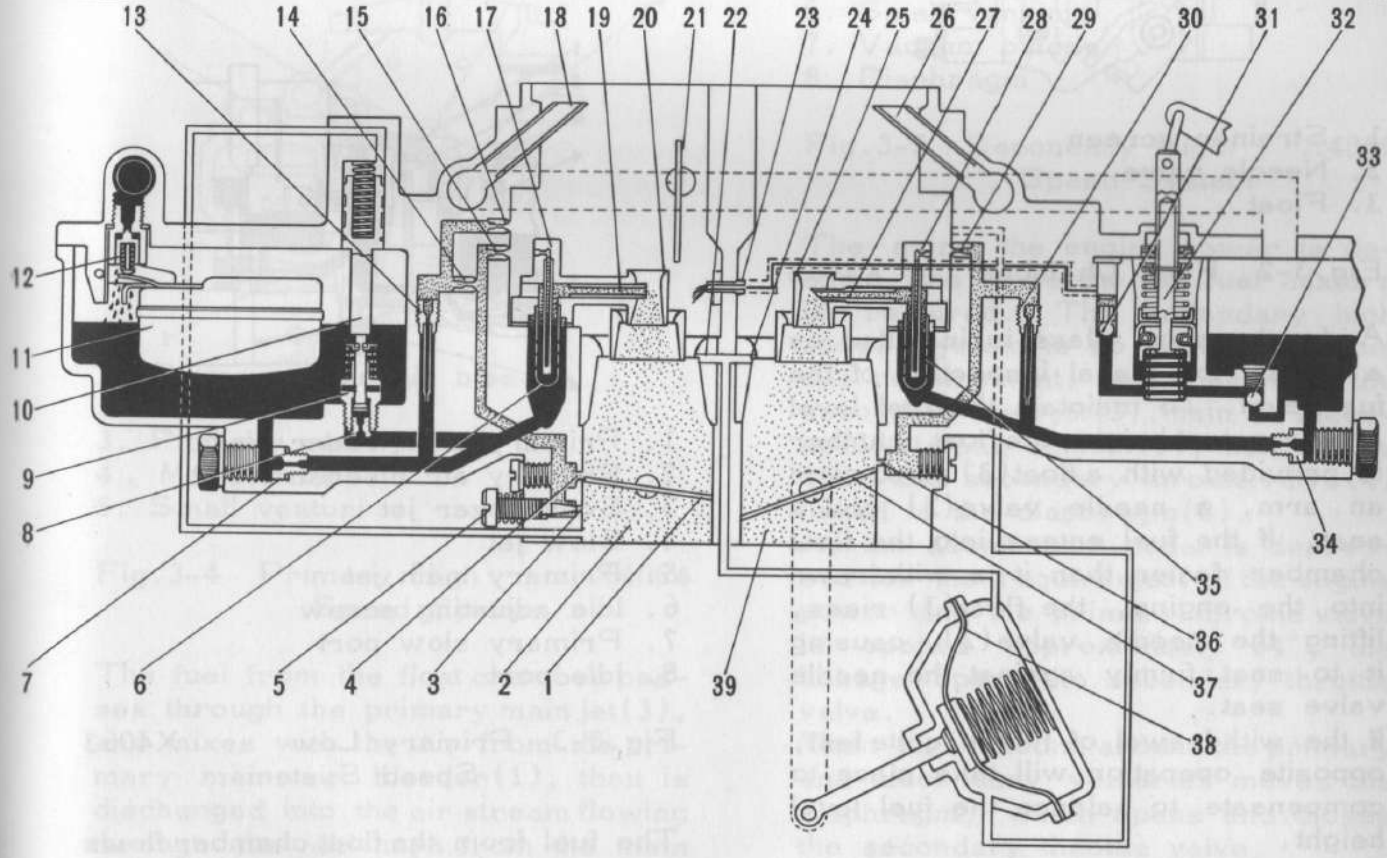
Engine Oil:	British Petrol Co.(B.P.)	BP Viscostatic Longlife
		BP Viscostatic
		BP Energol HD20W, HD30 & HD40
	Caltex	RPM Premium Motor Oil HD SAE30
		RPM Special Motor Oil 10W - 30
	Esso Standard	Extra Motor Oil 20W - 20 - 40
		Esso Motor Oil 20W
		Esso Motor Oil 30
	Mobile	Mobile Oil Special 10W - 30
		Mobile Oil Arctic 20W
		Mobile Oil A30
	Shell	Shell X100 Motor Oil 10W - 30
		Red Band Autoil Plus 30

FUEL SYSTEM

CARBURETOR

DESCRIPTION

The carburetor is a two-barrel type which insures proper carburetion under various driving conditions.
Both the primary system and the secondary system are provided with a triple venturi.
The primary system consists of the low speed system, high speed system, power system, accelerating system, and automatic choke system enabling the air-fuel mixture to be supplied to the engine as required for normal driving conditions. The secondary system consists of the low speed system and high speed system.
At high speed, and heavy load, the diaphragm is operated by the vacuum produced around the large venturies in the primary and secondary bores, and opens the secondary throttle valve linked to the diaphragm. So proper air-fuel mixture is supplied to the carburetor.
The secondary low speed system is provided to supply proper air-fuel mixture at the kickup condition.



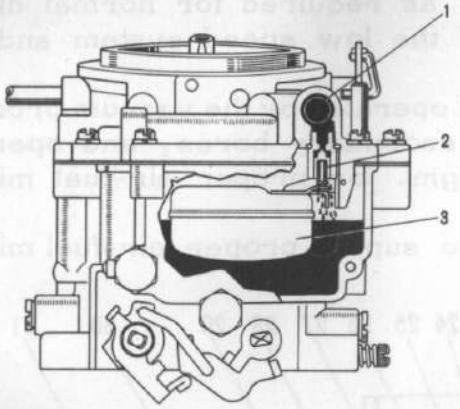
1. Primary throttle valve
2. Primary bore
3. Idle port
4. Primary slow port
5. Idle adjusting screw
6. Primary vapor tube
7. Primary main jet
8. Power jet
9. Power valve
10. Power piston
11. Float
12. Needle valve
13. Primary slow jet
14. Economizer jet
15. Primary air bleeder No.2
16. Primary air bleeder No.1
17. Primary main air bleeder
18. Air vent
19. Primary main nozzle
20. Primary small venturi
21. Choke valve
22. Primary vacuum bleeder
23. Pump jet
24. Secondary vacuum bleeder
25. Secondary small venturi
26. Air vent
27. Secondary main jet
28. Secondary main air bleeder
29. Secondary air bleeder
30. Secondary slow jet
31. Pump discharge weight
32. Pump plunger
33. Check ball
34. Secondary main jet
35. Secondary vapor tube
36. Secondary slow port
37. Secondary throttle valve
38. Diaphragm
39. Secondary bore

Fig.3-1 Cross Sectional View of Carburetor Y1784

CONSTRUCTION & OPERATION

Float Chamber & Air Vent System

The float chamber serves as a constant level fuel reservoir. It is necessary to maintain the fuel level at a constant height regardless of whether small or large amount of fuel is being withdrawn.



1. Strainer screen
2. Needle valve
3. Float

Fig.3-2 Float Chamber X4062

A level gauge glass is installed as a cover for visual inspection of the fuel level. To maintain the fuel level at a constant height, the float chamber is provided with a float(3) pivotted on an arm, a needle valve(2) and a seat. If the fuel enters into the float chamber faster than it is withdrawn into the engine, the float(3) rises, lifting the needle valve(2), causing it to seat firmly against the needle valve seat.

If the withdrawal of fuel is quite fast, opposite operation will take place to compensate to balance the fuel level height.

These items are very important to obtain proper performances of the carburetor. Air vent tubes are provided to maintain the same air pressure in the air horn and the float chamber. This compensates the clogging effect of the air cleaner.

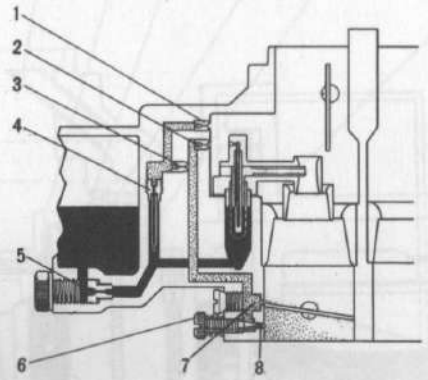
Low Speed System

Low speed systems are provided in both the primary bore and the secondary bore.

The primary low speed system supplies the fuel at light load and low speed. The secondary low speed system supplies the fuel at heavy load and low speed.

When the secondary throttle valve is opened by the kickup mechanism, the vacuum operating on the second main nozzle decreases and the amount of the fuel flowing through the secondary bore becomes very little.

To compensate this, the low speed system is provided to the secondary bore to get the proper air-fuel mixture.



1. Primary air bleeder No.1
2. Primary air bleeder No.2
3. Economizer jet
4. Slow jet
5. Primary main jet
6. Idle adjusting screw
7. Primary slow port
8. Idle port

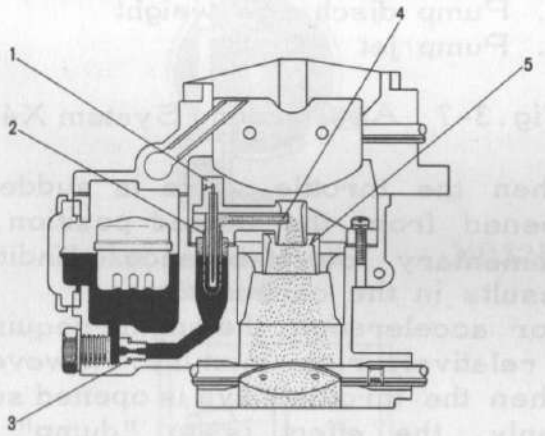
Fig.3-3 Primary Low Speed System X4063

The fuel from the float chamber flows through the primary main jet(5), then the slow jet(4), and mixes with the air from the primary air bleeder No.1 (1). After passing through the economizer jet(3), the fuel mixes with the air from the primary air bleeder No.2 (2), and flows down into the primary slow port(7) and the idle port(8) to be discharged in spray form into the intake manifold.

When the throttle valve starts to open slightly, as the edge of the throttle valve moves past the slow port(7), the intake manifold vacuum is applied onto the slow port and this port starts discharging the air-fuel mixture same as the idle port(8)

Primary High Speed System

This system consists of the primary main jet(3), main air bleeder(1), main nozzle(4), and small venturi (5), and is provided to supply the air-fuel mixture for intermediate throttle opening or part-load operating requirements.

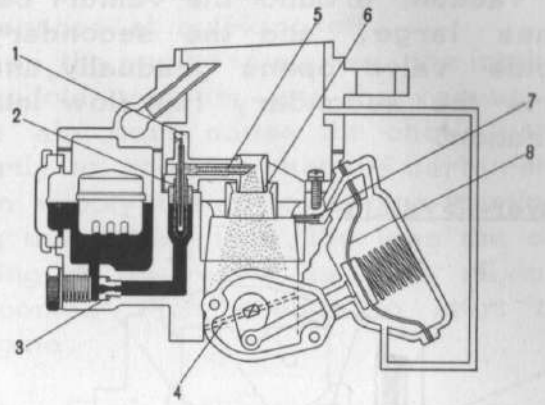


1. Primary main air bleeder
2. Vapor tube
3. Primary main jet
4. Main nozzle
5. Small venturi

Fig.3-4 Primary High Speed System X4064

The fuel from the float chamber passes through the primary main jet(3), and mixes with the air from the primary main air bleeder(1), then is discharged into the air stream flowing through the air horn from the main nozzle(4). The main air bleeder is equipped with the vapor tube(2) to prevent the incorrect engine idling and hard engine starting vehicle is owing to the percolation at high temperature, by separating the bubble from the fuel and discharging it into the atomozphere from the air bleeder.

Secondary High Speed System



1. Secondary main air bleeder
2. Vapor tube
3. Secondary main jet
4. Secondary throttle valve
5. Main nozzle
6. Small venturi
7. Vacuum bleeder
8. Diaphragm

Fig.3-5 Secondary High Speed System X4066

The more the engine power is desired, the more the air-fuel mixture is required. The secondary high speed system is so devised to meet this requirement, and consists of the secondary main jet(3), main air bleeder(1), small venturi(6), main nozzle (5), and secondary throttle valve(4) linked to the diaphragm(8).

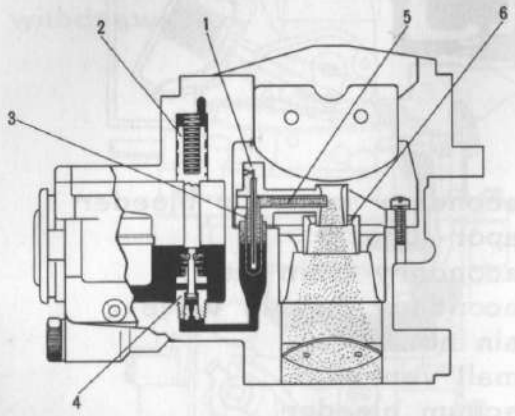
As the accelerator pedal is depressed for the requirement of the engine power and the primary throttle valve is opened approximately 64°, the linkage opens the secondary throttle valve.

Then the vacuum around the primary and secondary venturies moves the diaphragm, which opens and closes the secondary throttle valve.

However, while the engine revolution is not high enough, there is no produced vacuum enough to operate the diaphragm, and the necessary mixture is supplied only from the primary bore. This causes the air flow through the primary venturi to quicken, accomplishing a complete atomization of the fuel and uniform distribution of the air-fuel mixture to the cylinders.

As the engine revolution increases, the vacuum around the venturi becomes large, and the secondary throttle valve opens gradually, and starts the secondary fuel flow into operation.

Power System

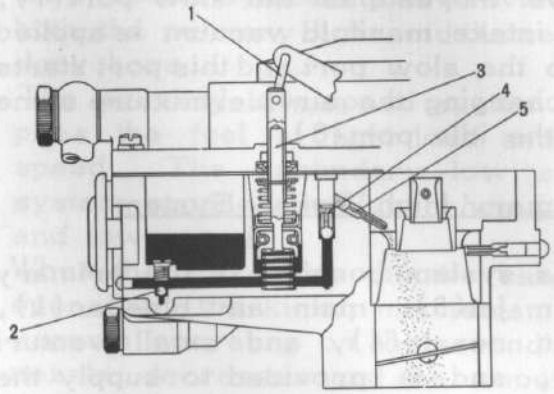


1. Primary main air bleeder
2. Power piston
3. Vapor tube
4. Power valve
5. Main nozzle
6. Small venturi

Fig.3-6 Power System X4068

As the secondary throttle valve closes at heavy load and low engine revolution, the air-fuel mixture, which is required by the engine, must be supplied only from the primary bore.
To compensate this, an additional device is incorporated in the carburetor. At part-load, that is to say, when the throttle valve is only partly opened, the power piston(2) is lifted up by the intake-manifold vacuum. So the power valve(4) at the bottom of the float chamber is in the closed position. When the throttle valve is fully opened, the intake-manifold vacuum decreases. So the power piston(2) is lowered by the spring tension and opens the power valve. When the power valve opens, the fuel flows down, being controlled through the power jet, and joins with the fuel from the main jet.
This extra fuel can be discharged from the main nozzle(5).

Accelerating System



1. Throttle connecting rod
2. Check ball
3. Pump plunger
4. Pump discharge weight
5. Pump jet

Fig.3-7 Accelerating System X4069

When the throttle valve is suddenly opened from the closed position, a momentary out-of-balance condition results in the carburetor.
For acceleration, the engine requires a relatively rich mixture. However, when the throttle valve is opened suddenly, the effect is to "dump" air into the intake manifold, thus suddenly reducing the manifold vacuum. The sudden change in air flow, plus the need for a momentary richness, result inadequate supply of fuel for acceleration from the main nozzle.
To overcome this momentary lapse, which could cause a "flat spot" in engine performance, an accelerating system is incorporated in the carburetor. The pump plunger(3) is linked to the throttle valve so that whenever the throttle valve is opened, the plunger will be pushed down into the fuel in the pump cylinder.
The fuel closes the check ball(2), lifts up the discharged weight(4), and is discharged into the air stream passing through the air-horn from the pump jet(5).

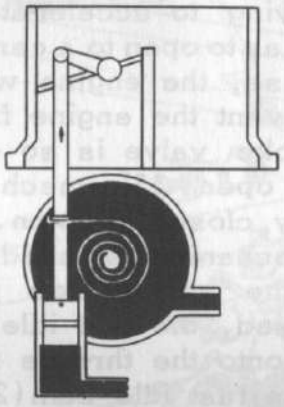
Automatic Choke System

The automatic choke system is operated by the exhaust temperature,

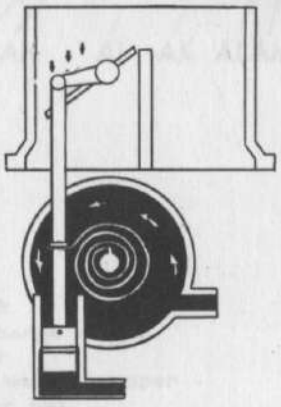
intake manifold vacuum, and air velocity with the air horn.

Starting Cold Engine

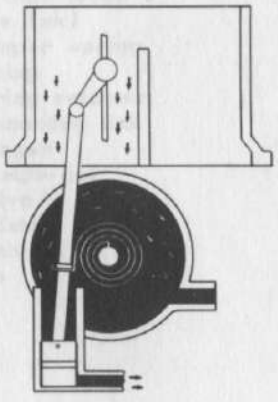
The thermostatic spring is adjusted so that the choke valve can close fully at 25°C (77°F), and therefore, below this temperature, the choke valve will be closed completely.
However, some choke valve opens approximately 5° by bimetal temperature constant, spring constant and tolerance at marking-off.
When the engine is started, the intake-manifold vacuum and the vacuum in the air horn cause the choke valve partly to open so that the carburetor can supply the air for engine starting. As the colder it is, the less the opening of the valve is, the mixture becomes rich enough to start the engine.



No.1 Choke Valve Fully Closed X0325



No.2 Partially Opened X0326



No.3 Fully Opened X0327

Fig.3-8 Automatic Choke Operation

After Engine Starts

After the engine starts, the vacuum applying on the vacuum piston, and the air intake pressure exerted on the choke valve increase, and the choke valve tends to open further until proper engine revolution is obtained balancing with the pressure of the thermostatic spring.

After Engine Warms Up

As the engine warms up, the air entering into the thermostatic case is heated by the exhaust manifold, causing the thermostatic spring to expand and decreases the spring tension until the choke valve opens completely.
If the throttle valve is opened suddenly during warm-up of the engine, the choke valve will close momentarily due to decrease of the intake-manifold vacuum to maintain a smooth acceleration of the engine.

Fast Idle

When the engine is started at low temperature with the carburetor choked, higher engine revolution is required to prevent the engine from stalling. To meet this requirement, an additional system is provided for the carburetor.

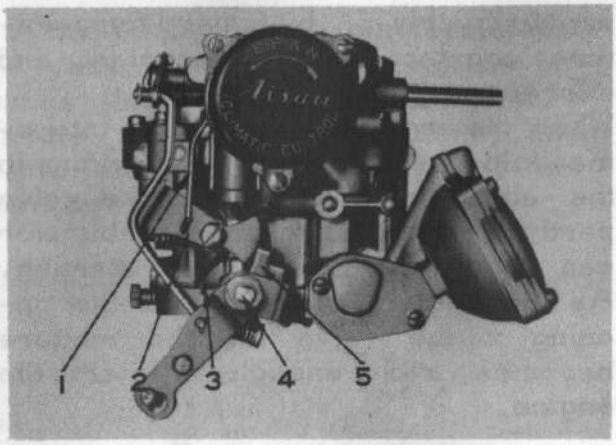


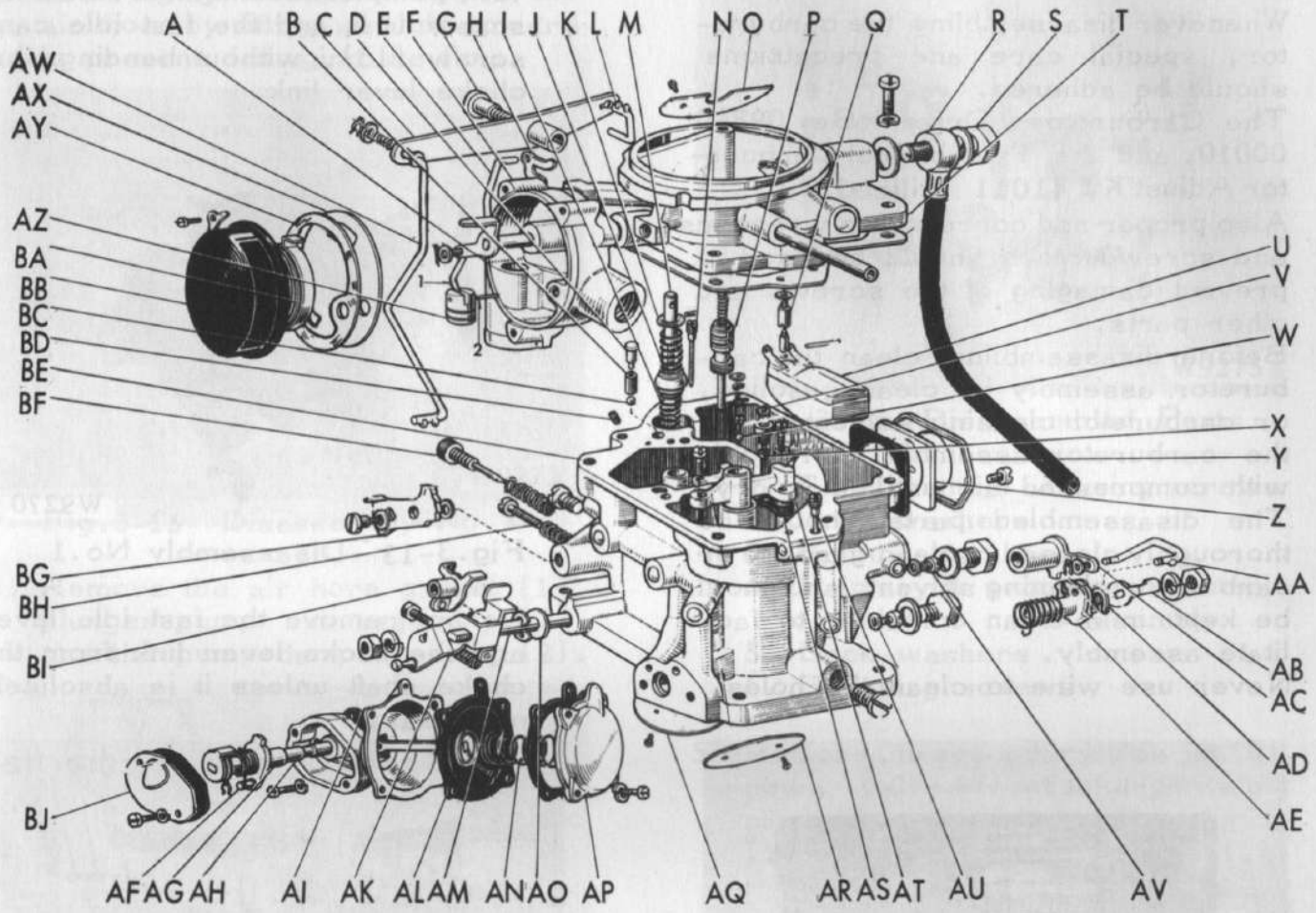
Fig.3-9 Fast Idle & Unloader V0043

When the carburetor is in the choked position, the fast idle lever(5) moving together with the throttle shaft contacts against the fast idle cam(2) linked to the choke lever link(1), and the throttle valve is slightly opened.
For this reason, the idling revolution becomes slightly higher. Even though the engine warms up, and the choke valve is fully opened, the fast idle is still in operation.

In order to obtain a normal idling, depress the accelerator pedal fully to return the fast idle cam to its original position.
Also when starting a cold engine, it is necessary to depress the accelerator pedal fully to return the cam.

Unloader

When starting to drive with a cold engine without warming up the engine, and trying to accelerate, the choke valve has to open to a certain position. otherwise, the engine will stall.
To prevent the engine from stalling, the choke valve is so designed that it will open 35° mechanically from the fully closed position.
This mechanism is called "Unloader".
When the accelerator pedal is fully depressed, the fast idle lever(5) installed onto the throttle shaft contacts onto the fast idle cam(2) and opens the choke valve.



A. Choke shaft
B. Pump discharge weight
C. Pump lever
D. Discharge weight stopper
E. Choke lever link
F. Thermostat case
G. Pump lever attaching screw
H. Fast idle cam lever (for choke link)
I. Pump damper spring
J. Pump spring
K. Pump spring retainer
L. Pump connecting link
M. Pump plunger
N. Primary slow jet
O. Choke valve
P. Power piston
Q. Needle valve
R. Fuel hose
S. Strainer
T. Air horn
U. Float
V. Power valve
W. Steel ball
X. Power jet
Y. Level gauge glass retainer
Z. Level gauge glass
AA. Connecting link
AB. Secondary link arm
AC. Primary link lever
AD. Retainer ring
AE. Secondary link lever
AF. Diaphragm relief lever
AG. Collar
AH. Secondary throttle shaft
AI. Diaphragm housing gasket
AJ. Diaphragm housing
AK. Primary throttle lever
AL. Diaphragm rod
AM. Primary throttle shaft
AN. Diaphragm spring
AO. Primary throttle shaft shim
AP. Diaphragm housing cap
AQ. Primary throttle valve
AR. Secondary throttle valve
AS. Venturi gasket
AT. Secondary small venturi
AU. Secondary slow jet
AV. Primary main jet
AW. Pump connecting link
AX. Coil housing plate
AY. Coil housing gasket
AZ. Vacuum piston
BA. Thermostat bi-metal
BB. Coil housing
BC. Steel ball
BD. Slow passage plug
BE. Body
BF. Idle adjusting screw
BG. Fast idle cam
BH. Throttle adjusting screw
BI. Fast idle lever
BJ. Diaphragm housing cover

Fig. 3-10 Carburetor Components Y1839

DISASSEMBLY

Whenever disassembling the carburetor, special care and precautions should be adhered.
The Carburetor Driver Set 09860 00010. and the Two-barrel Carburetor Adjust Kit 41011 utilized.
Also proper and correct size wrenches and screwdrivers should be used to prevent damaging of the screws and other parts.
Before disassembling, clean the carburetor assembly in clean gasoline, or carburetor cleaning solvent. Blow the carburetor assembly thoroughly with compressed air until it is dry.
The disassembled parts should be thoroughly cleaned in clean gasoline or carburetor cleaning solvent, and should be kept in a clean container to facilitate assembly.
Never use wire to clean the holes.

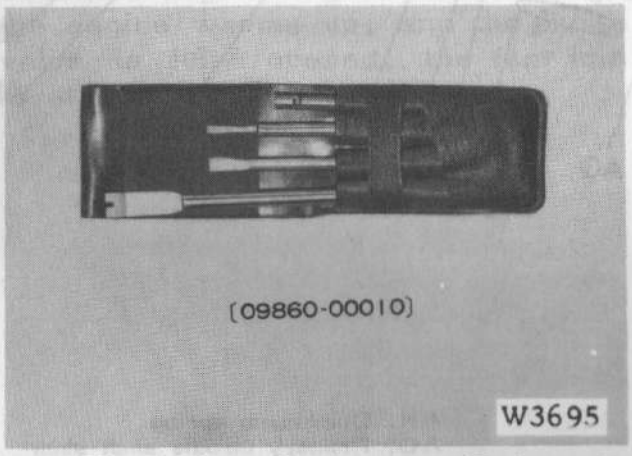


Fig.3-11 Carburetor Driver Set

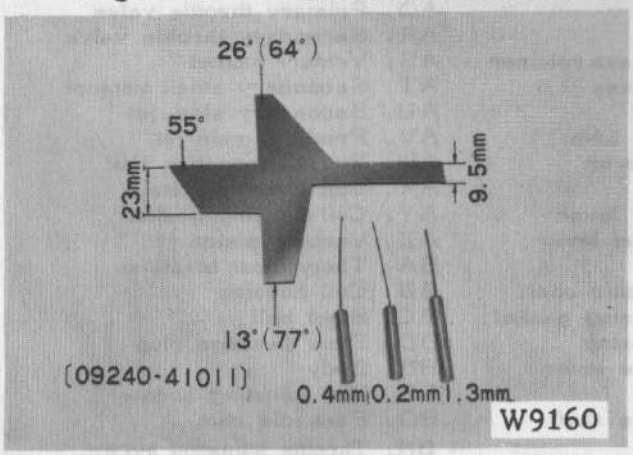


Fig.3-12 Carburetor Adjust Kit

1. Remove the strainer sub-assembly (1), pump connecting link retaining screw (6), and the fast idle cam screw (13), without bending the choke lever link.

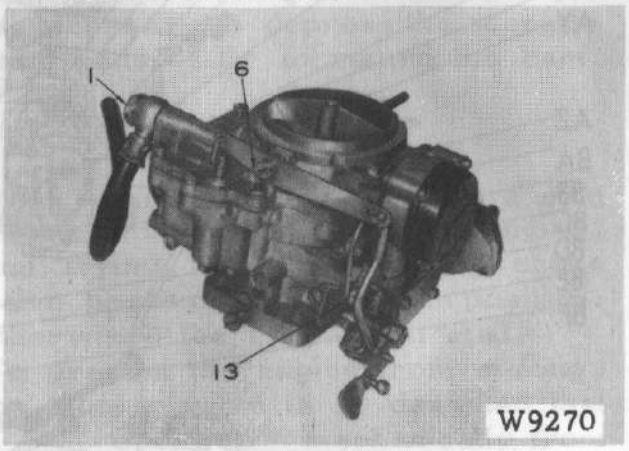


Fig.3-13 Disassembly No.1

Do not remove the fast idle lever and the choke lever link from the choke shaft unless it is absolutely necessary.

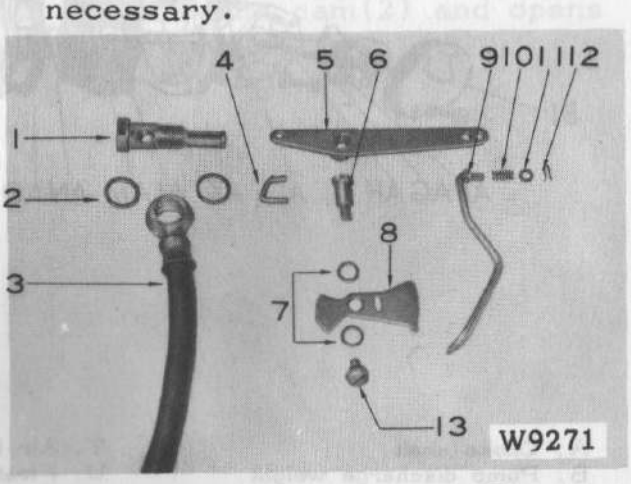


Fig.3-14 Disassembled Parts

1. Strainer sub-assembly
2. Union fitting gasket
3. Fuel hose
4. Pump connecting link
5. Pump arm
6. Pump lever securing screw
7. Spacer
8. Fast idle cam
9. Pump connecting link
10. Pump arm push-spring
11. Push-spring retainer
12. Snap ring
13. Fast idle cam screw

2. Loosen and remove the air horn securing screws, and remove the air horn by lifting straight upward to prevent damaging the float.

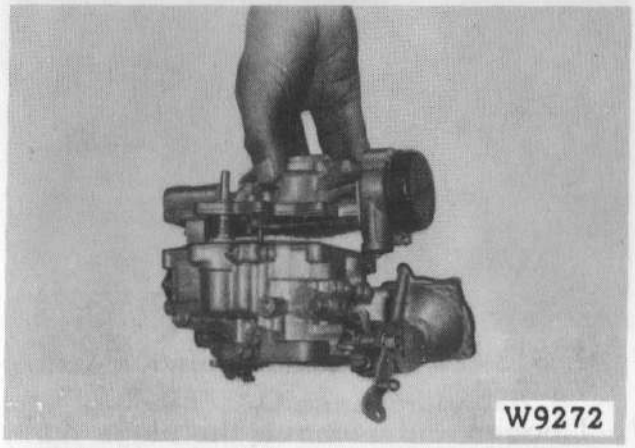


Fig.3-15 Disassembly No.2

3. Remove the air horn gasket (1), plunger pump sub-assembly (3), and the pump damper spring (2).

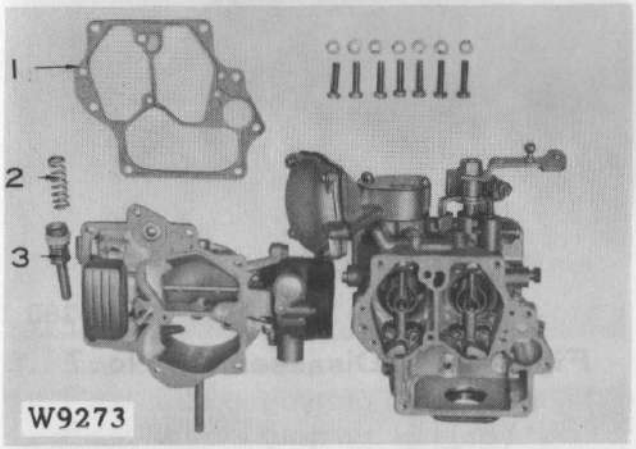


Fig.3-16 Disassembly No.3

4. Loosen and remove the small venturi securing screws (1), and (6).

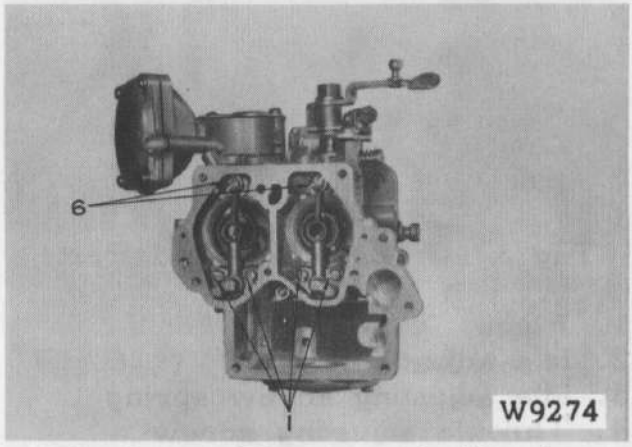


Fig.3-17 Disassembly No.4

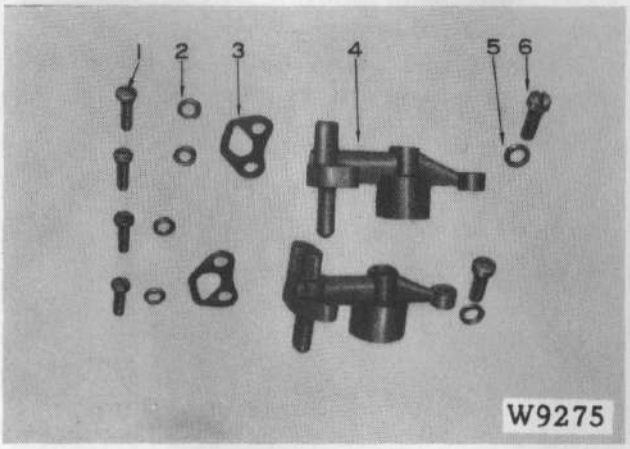


Fig.3-18 Disassembled Parts

1. Small venturi securing screws
2. Lock washers
3. Venturi gaskets
4. Primary & secondary venturi sub-assembly
5. Lock washers
6. Securing screws

5. Remove the secondary slow jet (8), power valve (7), discharge weight stopper (5), slow passage plug (10), slow jet (9), and plug (2).

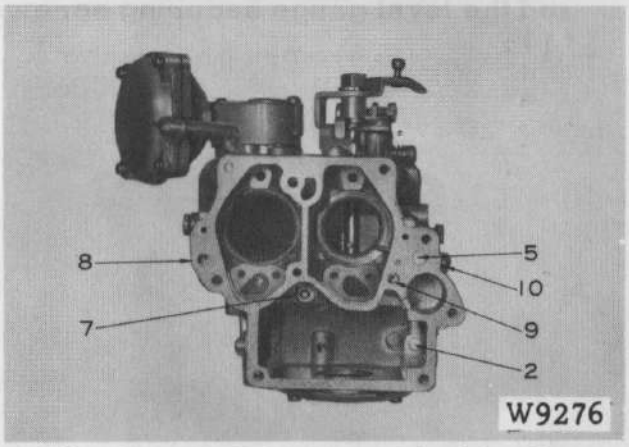


Fig.3-19 Disassembly No.5

The secondary slow jet is chrome plated to identify from the primary slow jet.

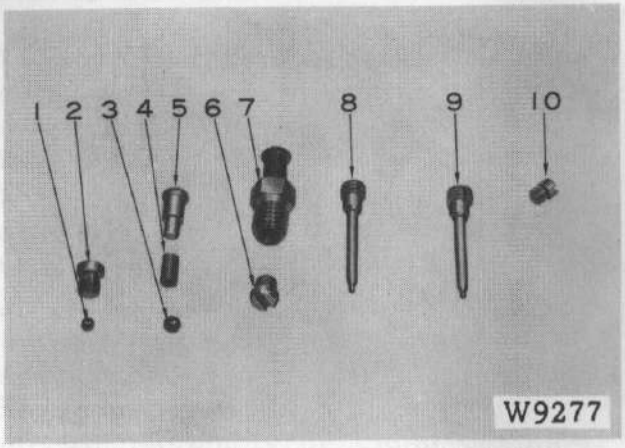


Fig. 3-20 Disassembled Parts

1. Steel ball
2. Plug
3. Steel ball
4. Pump discharge weight
5. Discharge weight stopper
6. Power jet
7. Power valve
8. Secondary slow jet
9. Primary slow jet
10. Slow passage plug

6. Remove the main passage plug (8), and the level gauge securing screws (1).

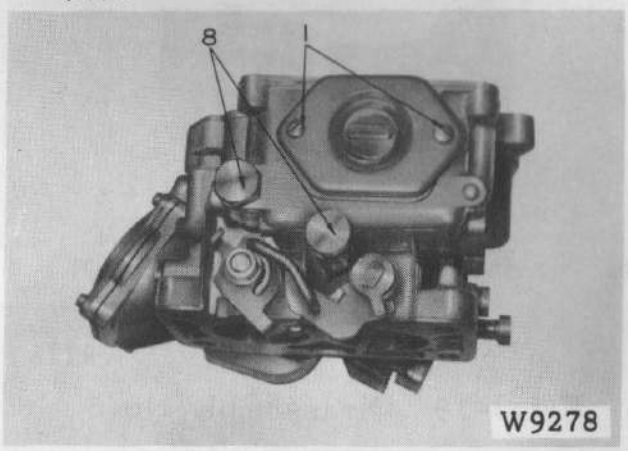


Fig. 3-21 Disassembly No. 6

1. Level gauge securing screws
2. Level gauge glass retainer
3. Level gauge glass
4. Level gauge glass gasket
5. Main jet gaskets
6. Main jets
7. Main passage plug gaskets
8. Main passage plugs

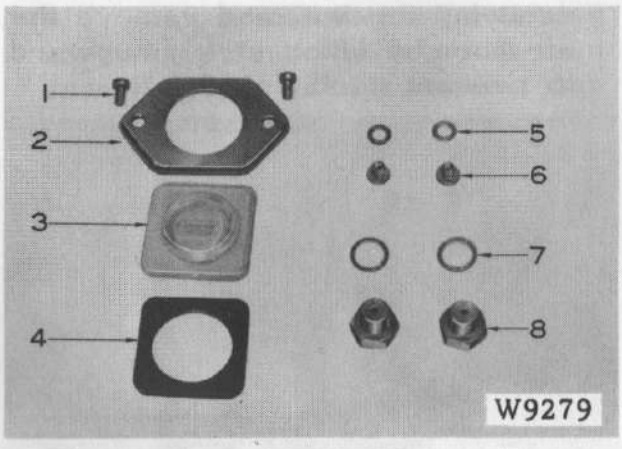


Fig. 3-22 Disassembled Parts

7. Loosen and remove the plugs (1), idle adjusting screw (2), and the throttle adjusting screw (4).

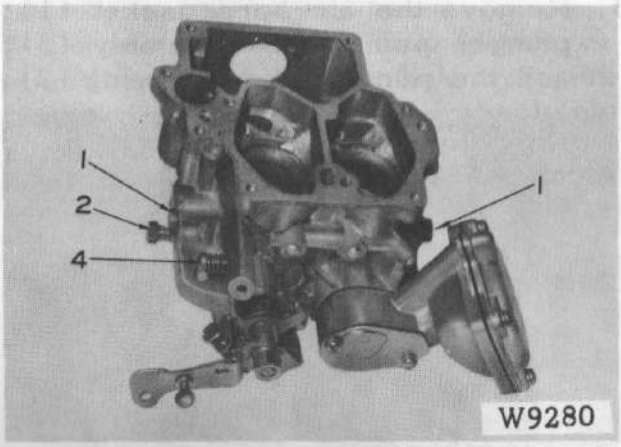


Fig. 3-23 Disassembly No. 7

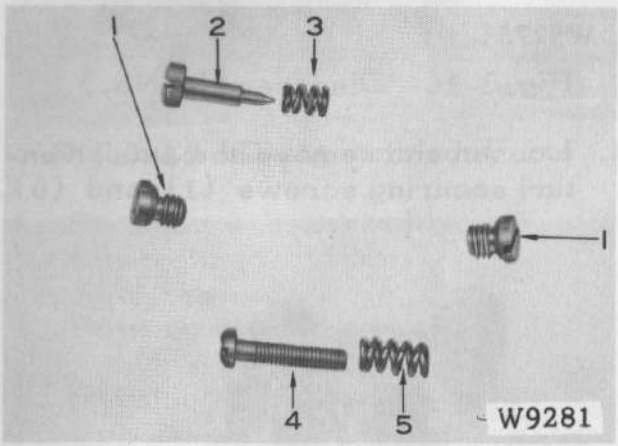


Fig. 3-24 Disassembled Parts

1. Plugs
2. Idle adjusting screw
3. Idle adjusting screw spring
4. Throttle adjusting screw
5. Fast idle adjusting spring

8. Loosen and remove the throttle lever securing nut (1).

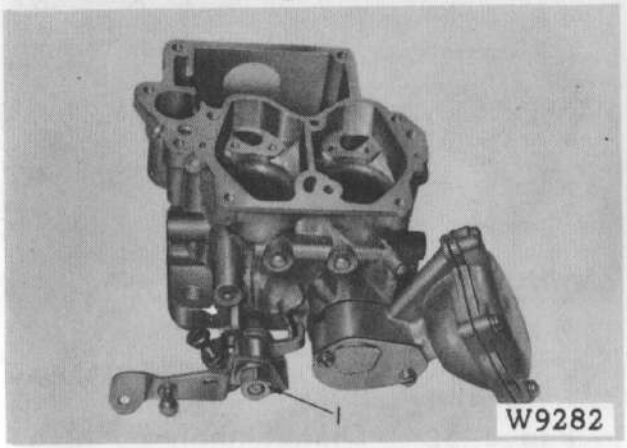


Fig.3-25 Disassembly No.8

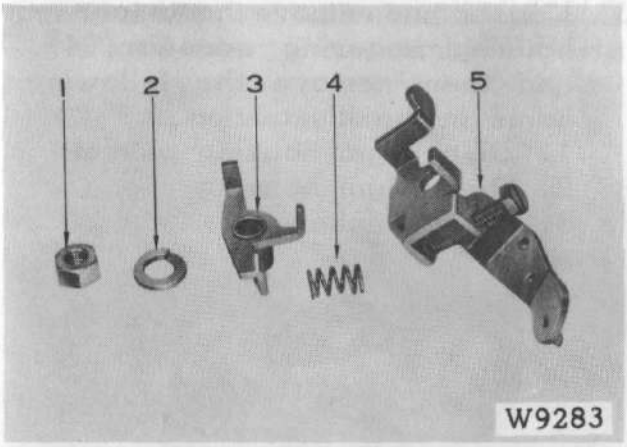


Fig.3-26 Disassembled Parts

1. Throttle lever securing nut
2. Lock washer
3. Fast idle adjusting lever
4. Fast idle adjusting spring
5. Primary throttle lever

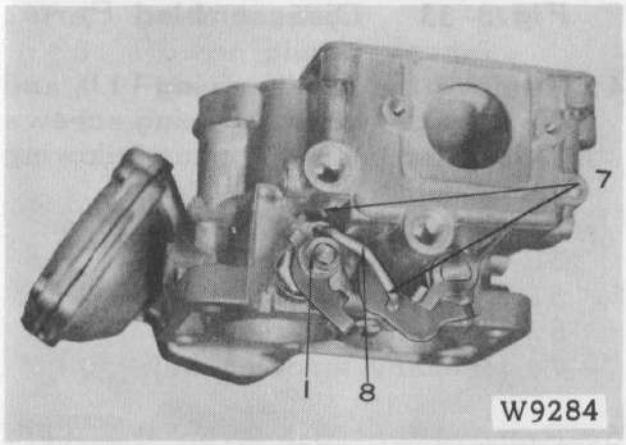


Fig.3-27 Disassembly No.9

9. Remove the connecting link (8), snap rings (7) at both ends, and the throttle lever securing nut (1).

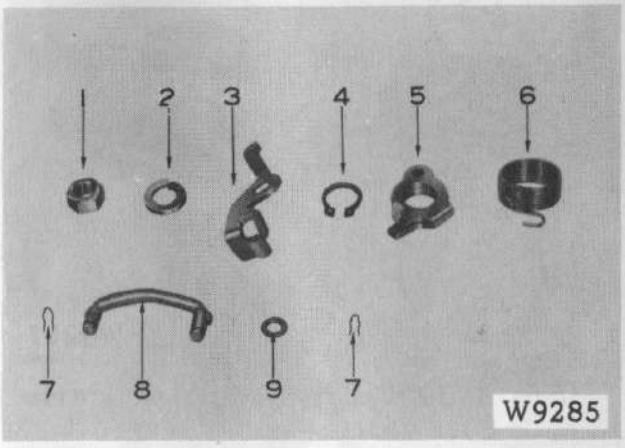


Fig.3-28 Disassembled Parts

1. Throttle lever securing nut
2. Lock washer
3. Secondary lick arm
4. Retainer ring
5. Secondary kick lever
6. Secondary throttle return spring
7. Snap rings
8. Connecting link
9. Push-spring retainer

10. Loosen and remove the diaphragm housing cap securing screws (1) and the diaphragm housing cover securing screws (6).

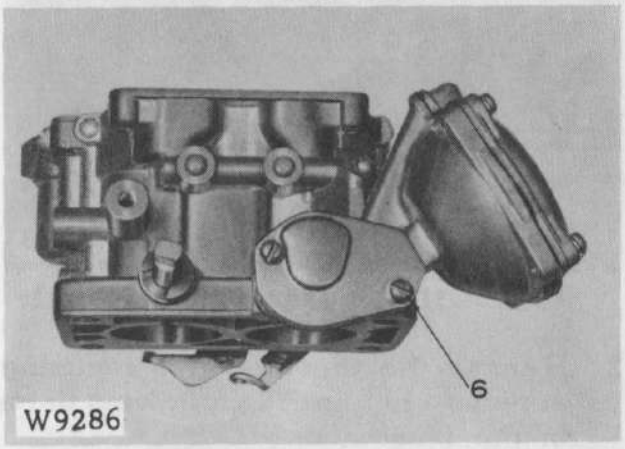


Fig.3-29 Disassembly No.10

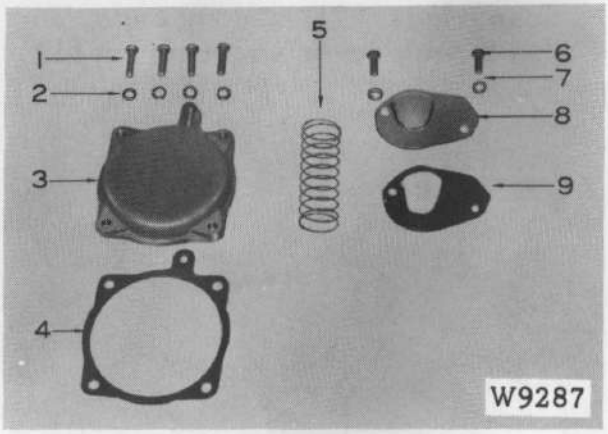


Fig.3-30 Disassembled Parts

1. Screws
2. Lock washers
3. Diaphragm housing cap
4. Diaphragm gasket
5. Diaphragm spring
6. Screws
7. Lock washers
8. Diaphragm housing cover
9. Gasket

11. Remove the snap ring (1), and then remove the diaphragm (2).

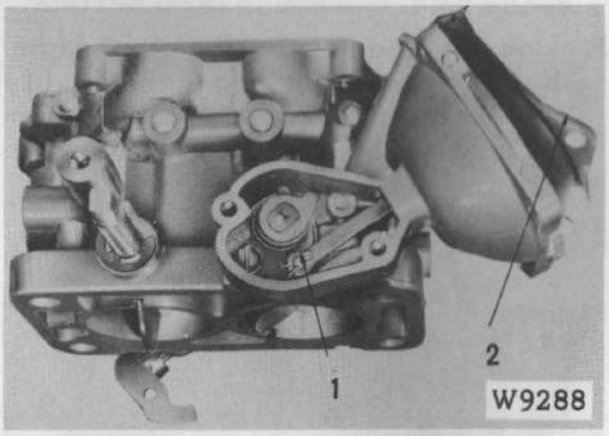


Fig.3-31 Disassembly No.11

12. Remove the throttle valve securing screws (1), and the following parts in the illustration.
    2. Secondary throttle valve
    3. Secondary throttle shaft
    4. Collar
    5. Diaphragm relief valve
    6. Diaphragm relief spring

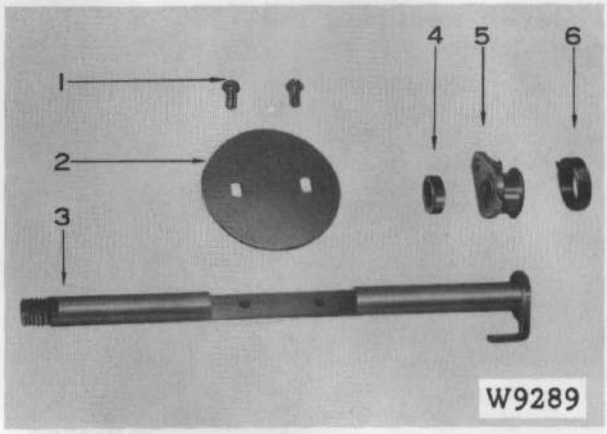


Fig.3-32 Disassembled Parts

13. Loosen and remove the diaphragm housing securing screws (4), and then remove the following items in the illustration.
    1. Diaphragm housing gasket
    2. Diaphragm housing
    3. Lock washers

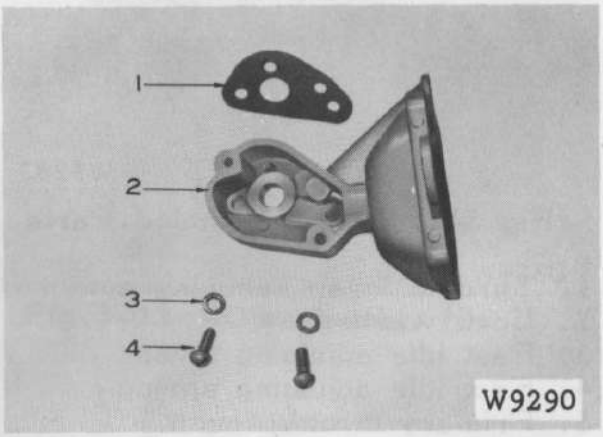


Fig.3-33 Disassembled Parts

14. Remove the retainer ring (1), and the throttle valve securing screws (4), then remove the following items in figure 3-34.
    2. Primary throttle shaft shim
    3. Valve adjusting shim
    5. Primary throttle valve
    6. Primary kick lever
    7. Primary throttle shaft

15. Remove the float lever pin (1), and remove the following items in figure 3-35.
    2. Float
    3. Needle valve seat gasket

4. Needle valve seat
5. Needle valve
6. Needle valve spring
7. Needle valve push pin

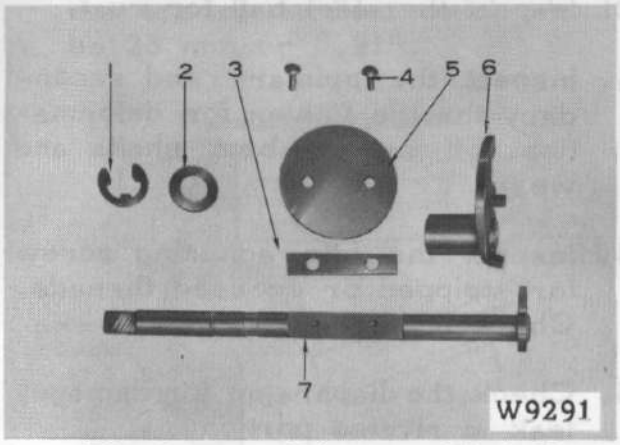


Fig.3-34 Disassembled Parts

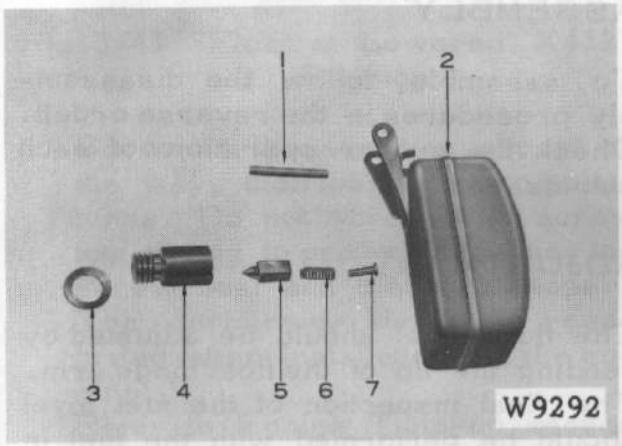


Fig.3-35 Disassembled Parts

16. Remove the power piston stopper securing screw (1), and the following items.
    2. Lock washer
    3. Power piston stopper
    4. Power piston
    5. Power piston spring

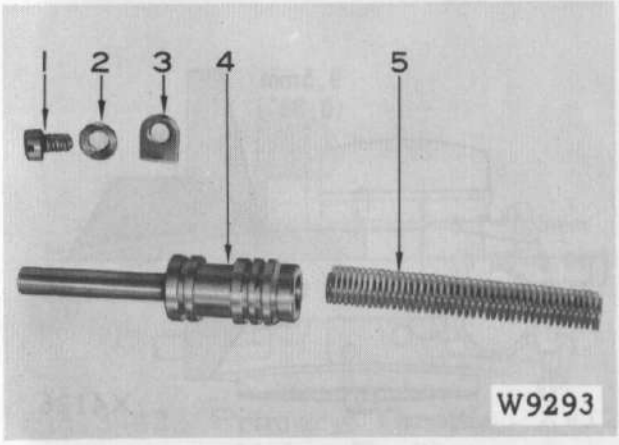


Fig.3-36 Disassembled Parts

17. Remove the coil housing securing screws (1), and remove the following items.
    2. Coil housing retainers
    3. Coil housing
    4. Coil housing gasket

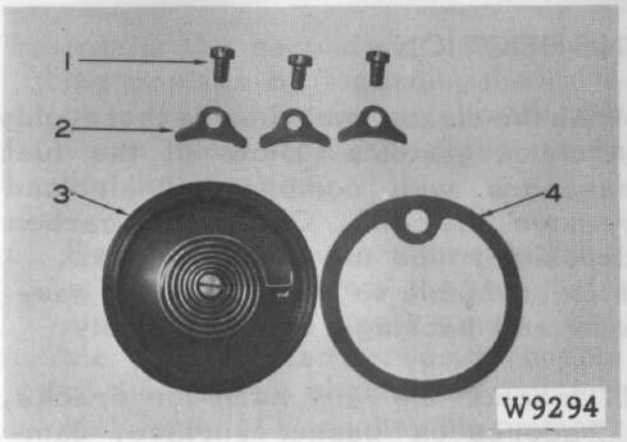


Fig.3-37 Disassembled Parts

18. Remove the cotter pin (6) securing the choke valve shaft, and remove the vacuum piston.
    Remove the fast idle cam lever (8), choke valve retaining screw (3), and the following items.

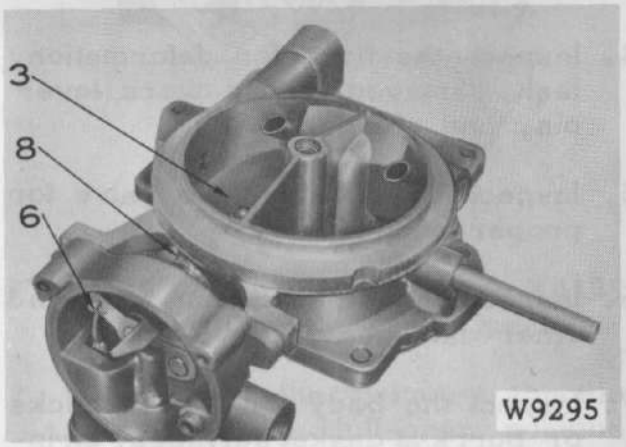


Fig.3-38 Disassembled Parts

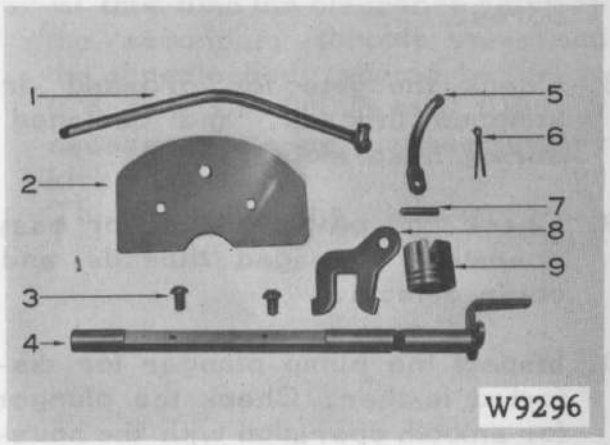


Fig.3-39 Disassembled Parts

1. Choke lever link
2. Choke valve
4. Choke shaft
5. Piston connector
7. Piston pin
9. Vacuum piston

INSPECTION

Wash the disassembled parts thoroughly in clean gasoline. Blow all the fuel passages with compressed air and remove the dirt. Clean the carbon deposit around the throttle valves. It is advisable to replace all the gaskets and packings upon assembly.

1. Inspect the air horn for cracks, scores on gasket surface, damaged threads, and worn shaft bores.
2. Inspect the choke valve and the shaft for bend, wear and binding in the shaft bore or bushing.
3. Check the power piston for proper operation.
4. Inspect the float for deformation, leak, damaged lip and worn lever pin, and pin bore.
5. Inspect the float needle valve for proper seating.
6. Inspect the strainer for rust and other damages.
7. Inspect the body for cracks, nicks or burrs at gasket surfaces, stripped threads, and wear at shaft bores.
8. Check the jets for crossed or stripped threads, and damaged screw head slots.
9. Check the power valve for easy operation, damaged threads and other defects.
10. Inspect the pump plunger for distorted leather. Check the plunger for smooth operation with the housing.
11. Inspect the pump damper spring for rust and proper spring tension.
12. Inspect the steel ball for rust.
13. Inspect the primary and secondary throttle valves for deformation, off set or bent shafts and wear.
14. Inspect the idle adjusting screw for stripped or crossed threads. Check the screw tip.
15. Check the diaphragm for damage, leak at riveted portion.

ASSEMBLY

To assemble, follow the disassembly procedures in the reverse order. Check the proper operation of each sub-assembly.

ADJUSTMENT

The float level should be adjusted by bending the lip of the float hinge arm. The final inspection of the fuel level should be performed with the fuel in the float chamber aligning with the level gauge glass line.

1. Check the float at raised position by inverting the air horn, and check the distance between the top of the float and the air horn surface with the Carburetor Adjust Kit gauge as illustrated.

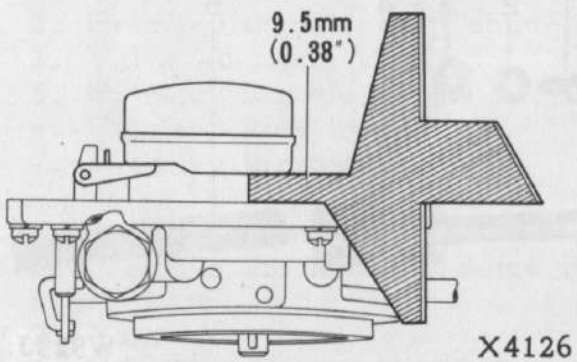


Fig.3-40 Float at Raised Position

2. Check the lowered position by holding the air horn at upright position, and measure the distance between the air horn surface and the top of the float which should be 23 mm or 0.91".

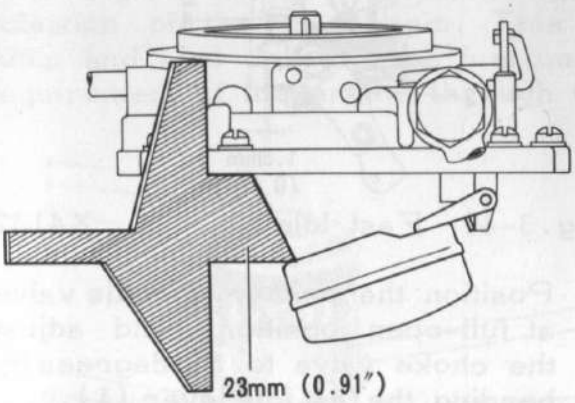


Fig.3-41 Float at Lowered X4127 Position

3. Screw in the adjusting screw all the way, then loosen two complete turns. Do not screw in the screw too strong to prevent damaging the screw seat and the screw taper. The carburetor should be readjusted after installation on the engine.
Refer to Engine Tune-up section on page 1-4.

4. Adjust the primary throttle valve closing position by loosening the valve plate retaining screws, and insert a shim so that the valve plate contacting position against the idle port will not be too high.

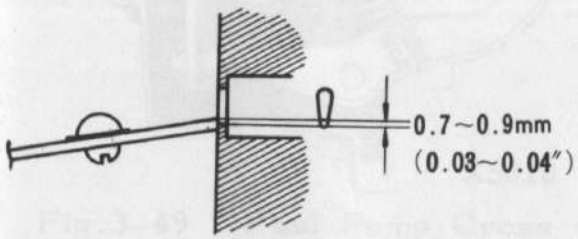


Fig.3-42 Primary Throttle X4128 Valve Position

If possible, use a wire gauge inserted into the port from underneath the valve plate.
The specified over-lap should be from 0.7 to 0.9 mm or 0.03 to 0.04".

5. Adjust the secondary valve closing position by loosening the valve plate retaining screws so that the valve plate contacts closely with the throttle body.

6. Position the primary throttle valve at 64 degrees from the horizontal plane using the angle gauge. With the gauge placed across the bottom of the flange, check if the primary kick arm (1) touches the primary kick lever (2). If defective, bend the kick level so that the kick arm will touch the kick lever.

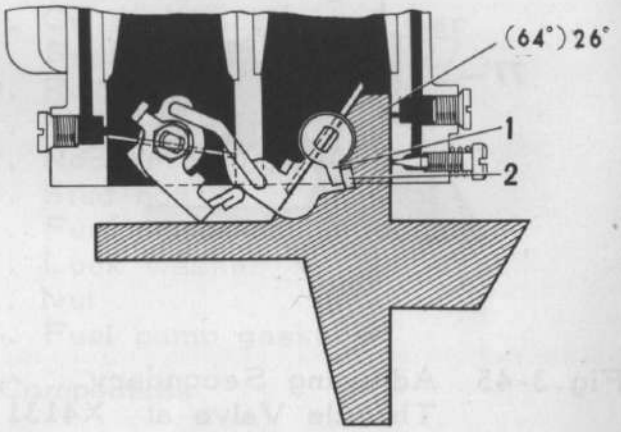


Fig.3-43 Start of Secondary X4129 Throttle Valve Opening

7. Next open the primary throttle valve to the full-open position gradually.
At this time the clearance between the secondary throttle valve and the throttle body should be 0.2 to 0.4 mm or 0.008 to 0.016". If necessary, bend the secondary kick arm (1).
This is called the "kick-up".

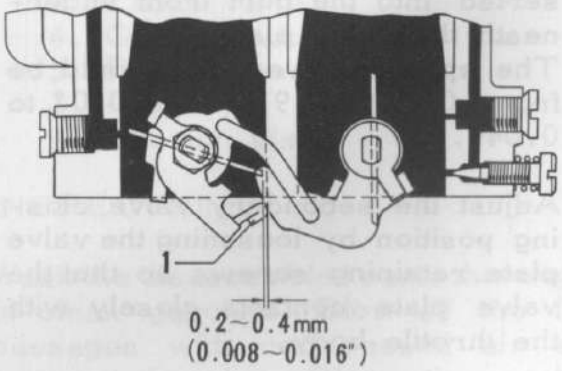


Fig.3-44 Kick-up X4130

8. Positioning the primary throttle valve at full-open, adjust the secondary throttle valve with the angle gauge to 77 degrees by bending the secondary kick arm (1).

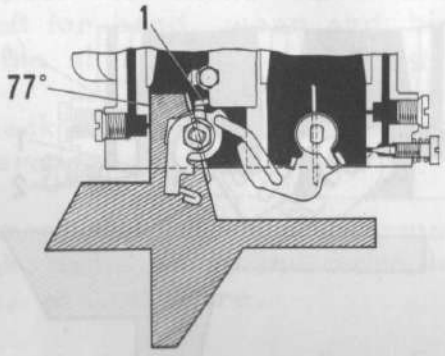


Fig.3-45 Adjusting Secondary Throttle Valve at Full-open Position X4131

9. To adjust the fast idle, perform the following procedures.
Check if the upper portion of the idle cam (3) touches the fast idle lever (4) with the choke valve completely closed. If necessary, bend the choke lever link (1).
When starting the engine with the choke valve closed, adjust the fast idle adjusting screw so that the engine revolution will be 2,700 rpm at first stop of cam.

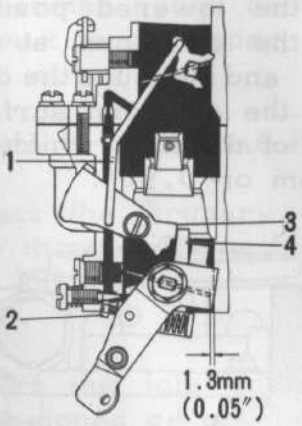


Fig.3-46 Fast Idle X4132

10. Position the primary throttle valve at full-open position, and adjust the choke valve to 55 degrees by bending the fast idle lever (1).

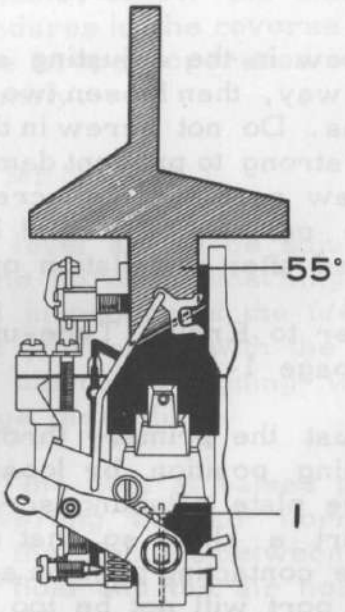
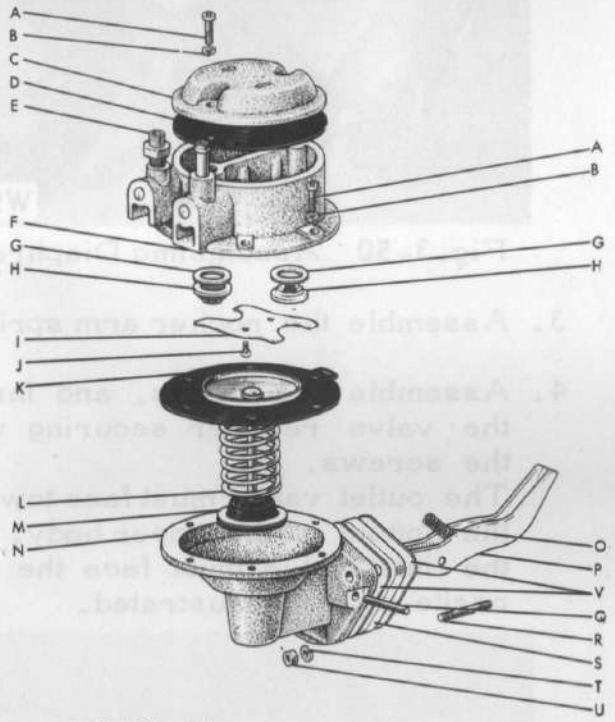


Fig.3-47 Unloader X4133

FUEL PUMP

The fuel pump utilized on the 2M and M model engines are a diaphragm type, and composes of the inlet valve, outlet valve, diaphragm, rocker arm and the upper and lower bodies.

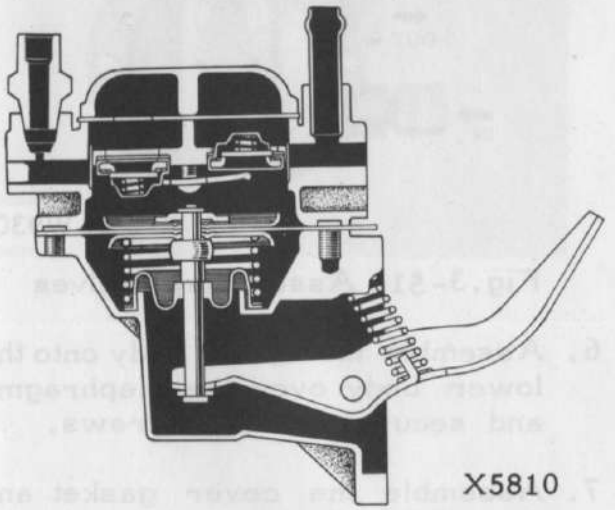
The rotation of the camshaft actuates the rocker arm which in turn converts the pulsation of the diaphragm. This diaphragm movement draws the fuel into the pump and also delivers the fuel under specified pressure and volume to meet the requirement of the engine through the carburetor.



F0197-B

A. Cover securing screw
B. Lock washer
C. Fuel pump cover
D. Fuel pump cover gasket
E. Fuel pump union connetor
F. Fuel pump upper body
G. Valve packing
H. Valve
I. Valve retainer
J. Valve retainer securing screw
K. Diaphragm
L. Diaphragm spring
M. Oil seal packing retainer
N. Fuel pump lower body
O. Rocker arm spring
P. Rocker arm
Q. Rocker arm pin
R. Stud bolt
S. Fuel pump insulator
T. Lock washer
U. Nut
V. Fuel pump gasket

Fig.3-48 Fuel Pump Components



X5810

Fig.3-49 Fuel Pump Cross Section View

Type: Diaphragm
Delivery capacity at 1,500 rpm of camshaft is to exceed 1,800 cc/min. or 3.17 Imp. pts/min, 3.81 US pts per minute.
Delivery pressure should be 0.25 to 0.35 kg/cm^2 or 2.85 to 4.29 psi.
Vacuum should be 300 mm Hg or 11.8 inHg.