TOYOTA

F ENGINE

REPAIR MANUAL

TOYOTA MOTOR SALES CO., LTD.

F ENGINE

REPAIR MANUAL

TOYOTA MOTOR SALES CO., LTD.

EXPORT-TECHNICAL DEPARTMENT

F O R E W O R D

This F engine Repair Manual has been published to furnish information for major repair on the improved engine (from Engine No. F243298) and its related components equipped on the Toyota Land Cruiser, and the Toyota gasoline truck.

In general, it pertains to the F engine equipped on the Toyota Land Cruiser, and also it described on the different components equipped on the F engine utilized for the Toyota gasoline truck.

As this manual is published for the guidance, and reference for the servicemen to acquire a thorough knowledge of the F engine construction, and operation, and also on the various components installed on the F engine.

We recommend that this manual should be available at all times to aid the servicemen in performing the various operations of the maintenance.

All information, and specification contained in this manual are the most up-to-date at the time of this publication, and we reserve the right to change without any notice or incurring obligation.

SECTION INDEX

GENERAL INFORMATION

GENERAL INFORMATION

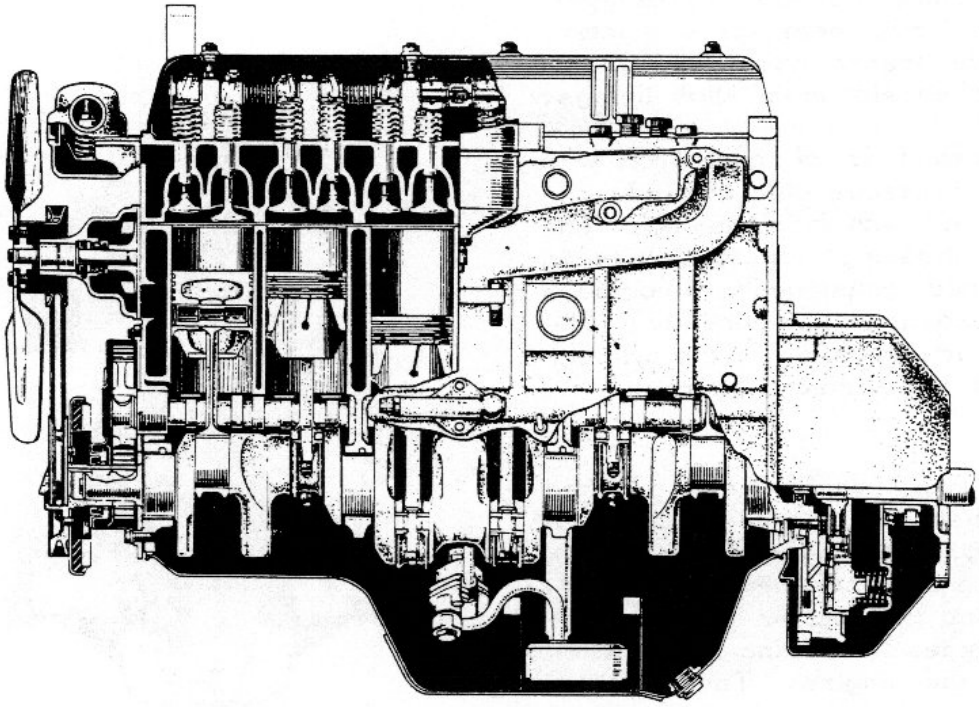


Fig.1-1 Cross Section Side View G1565

The engine is a four-cycle, six cylinder over-head valve type, with force feed lubrication, and water cooled. This engine has a displacement of 3.878 liters (236.7 cu. in), with 90 mm (3.54") bore, and 101.6 mm (4.00") stroke. The compression ratio is 7.8 to 1.

The cylinder head being made of integral casting with wedge shaped type combustion chambers provides efficient heat distribution.
Also together with the independent inlet and outlet ports provide smooth performances during slow, intermediate, and high speed operations.

The cylinder block and crankcase assembly is the major section of the engine, and is cast integrally, forming a rigidly reinforced unit, and is integrally cast with coolant passages in the block for cooling the entire length of the cylinder.

The engine is equipped with a fully counterbalanced crankshaft which contributes smooth engine performances. The crankshaft is supported by four bearings, which are of steel backed aluminum alloy linings and replaceable insert type. The crankshaft end play is controlled by the third crankshaft journal and the bearings. The crankshaft bearing caps are large in size to assure rigid support of the bearings and the crankshaft.

The pistons are of special light alloy with eccentric finished slightly larger at the right angle to the piston pin. Two compression rings and two oil rings are used on each piston.

The connecting rods are "I" beam section forged steel. The upper end is fitted with a clamp bolt to secure the connecting rod onto the piston pin. Connecting rod bearings are interchangeable insert type, and are of steel backed aluminum alloy linings.

The camshaft is of cast iron with cam lobe surfaces chill treated, and is supported with four bearings. The camshaft bearings of steel backed babbitt lined construction provide a uniform expansion and durability. The bearings are installed in the cylinder block and for perfect alignment.

A heavy cast iron flywheel is bolted onto the flange at the rear end of the crankshaft, and ring gear is shrunk fit onto the outer diameter of the flywheel, and the starter clutch pinion gear engages this ring gear when cranking the engine. The flywheel and the crankshaft are accurately balanced to prevent engine vibration, and the flywheel surface is accurately machined for clutch operation.

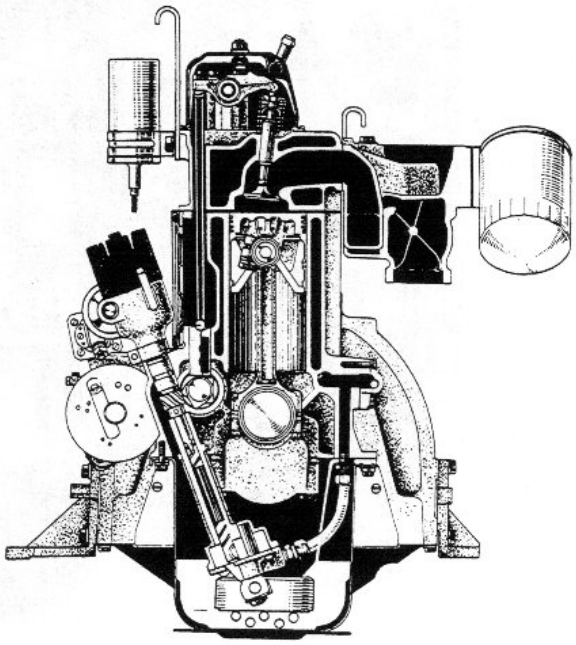


Fig.1-2 Cross Section Front View G1566

The distributor is mounted on the right side of the cylinder block, and is gear driven by the camshaft. The distributor is provided with the centrifugal advancer and the vacuum advancer mechanism to insure efficient performances under various operations.

The carburetor is of 2-barrel type, which ensures appropriate supply of air-fuel mixture as per demands of the engine under various operating conditions, the 2-barrel type is used both in Land Cruiser and trucks commencing from the Engine No. F-294920.
The fuel pump is a diaphragm type, and is operated by the camshaft cam.

The lubrication system is an all forced-feed, partial flow filtering type. The oil pump is a gear type and is driven by the camshaft through the distributor shaft.

The cooling system is a pressure forced circulation type, and the water pump is a six blade impeller centrifugal type, which is driven by the crankshaft pulley through the "V" belt. The radiator is fin and tube type, and the pressure is sustained by the radiator cap. Circulation of the coolant is controlled by the wax pellet element type thermostat.

The charging system is composed of the alternator, and the regulator. The alternator is driven by the crankshaft pulley through the "V" belt. This alternator provides an efficient output at lower engine speeds, and a very high output at cruising speed.

The starter is incorporated with the magnetic switch and the starter clutch. The magnetic switch and the starter clutch enable to accomplish a smooth meshing, and the starter clutch prevents the over-running of the armature.

GENERAL SPECIFICATION

Model		F
Type		Gasoline, four-cycle, in-line OHV, water cool.
Number of cylinder		Six
Bore and stroke		90 × 101.6 mm (3.54 × 4.00")
Displacement		3.878 cc (236.7 cu. in.)
Compression ration		7.8 to 1
Compression pressure		10.5 kg/cm² (149.3 psi) at 200 rpm
Max. explosive pressure		44 kg/cm² (629 psi) at 2,200 rpm
Max. mean effective pressure		9.7 kg/cm² (139 psi) at 2,200 rpm
Max. horsepower		SAE-Gross 155 HP at 4, 000 rpm SAE-Net 138 HP at 4,000 rpm
Max. torque		SAE-Gross 31.7 m-kg (230 ft-lb at 2 ,200 rpm) SAE-Net 29.4 m-kg (213 ft-lb at 2 ,200 rpm)
Min. fuel consumption at full load		214 g/hp-hr (7. 54 Oz/hp-hr) at 2,200 rpm
Piston type		Flat, T-slot
Piston material		Aluminum alloy
Number of compression ring		Two
Number of oil ring		Two
Intake valve	opens	B.T.D.C. 17°
	closes	A.B.D.C. 53°
Exhaust valve	opens	B.B.D.C. 55°
	closes	A.T.D.C. 15°
Valve clearance	intake	0.20 mm (0.008")
	exhaust	0.35 mm (0.014")
Ignition timing		B.T.D.C. 7° at 500 rpm
Improved combution system		B.T.D.C. 7° at 650 rpm
Firing order		1-5-3-6-2-4
Air cleaner		Replaceable felt element type
(Optional)		Oil bath type
Fuel pump type		Diaphragm
Carburetor		Down-draft, two-barrel
Lubricating method		All forced-feed, partial flow filtering
Oil pump type		Gears
Oil filter type		Cartridge type paper filter element
Oil capacity :	crankcase	7 liters (7.4 US qts., 6.2 imp. qts)
	oil cleaner	1 liters (1.1 US qts., 0.9 imp. qts)
Cooling system		Water cooled, pressure forced circulation
Radiator type		Fin and tube pressurized
Water pump type		Six blade impeller centrifugal

Thermostat type		Wax pellet element
Coolant capacity	(FJ)	15.2 liters (16 US qts., 13.4 imp. qts)
	(FA)	19.1 liters (20.2 US qts., 16.8 imp. qts)
Alternator :	voltage	12 volts
	output	480 watts
Starter :	voltage	12 volts
	output	1.3 kilowatts
Battery :	voltage	12 volts
	capacity	50 AH (20 hr. rating)

FOR 2FQ15-B

Type	6-cylinders, in line, O.H.V.
Bore and stroke	90×101.6 mm (3.54×4.00 in.)
Displacement	3,878 cc (236.7 cu.in.)
Compression ratio	7.2 to 1
Max. horsepower	(JIS) 110 HP at 3200 rpm
Max. torque	(JIS) 27.5 m-kg (200 ft-lb.) at 2000 rpm
Battery	12 Volts 45 amp. hr. (20 hr. rate.) ×2
Alternator	24 volts 720 watts
Starter	24 volts 1.8 HP
Fuel tank capacity	90 liters (23.8 US gal., 19.8 imp. gal.)
Cooling system capacity	20 liters (21.1 US qts., 17.6 imp. qts.)
Engine oil capacity	5.0 liters (5.3 US qts., 4.4 imp. qts.)

* *

ENGINE TUNE-UP

In order to maintain the full performances originally built in the engine, a periodic engine tune-up is essential. If any deficiency is encountered during operation of the vehicle, it must be diagnosed immediately, and proper care should be taken by tuning up the engine.

The progress of modern engineering standard has been developed so quickly that it necessitates the use of proper instruments, and well trained mechanics. In order to accomplish the work correctly, and properly, a reliable tube-up equipment are necessary. The procedures described in the following orders should be carefully studied.

Inspection & Adjustment

Battery

1. Check the level of the electrolyte in the battery cells.
   If the electrolyte is found to be low, distilled water should be added to each cell until the level rises to the bottom of the vent well.

2. The specific gravity of a fully charged battery should be 1.260 at 20° C (68° F).
   When the battery specific gravity decreases less than 1.200, and the difference between each cell becomes more than 0.025 reading, the battery should be charged.
   If the difference is more than 0.025 after fully charged, the battery should be inspected in a battery service station.

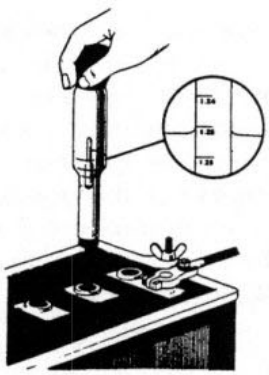


Fig.2-1 Checking Battery Specific Gravity X4916

3. Check the battery terminals, and tighten if necessary. Check the battery case for cracks or other damages.
   Replace if necessary.

4. Clean the terminals and the top of the battery.

5. The battery hold-down clamp nuts should be kept tight and clean.

Engine oil

1. Check the engine oil level, and replenish if necessary.

2. Check the oil for contamination.
   Check if the coolant or gasoline is present in the oil.
   If necessary, replace with proper grade engine oil.
   Oil pan capacity:
   (FJ) - 7.0 liters (7.4 US qts., 6.2 Imp. qts)
   (FA) - 6.5 liters (6.9 US qts., 5.7 Imp. qts)

Coolant

Check the cooling system for leaks, deteriorated hoses, loose hose clamps, and correct coolant level.
If necessary, replenish with drinkable water.
Cooling system capacity:
(FJ) - 15.2 liters (16 US qts., 13.4 Imp. qts)
(FA) - 19.1 liters (20.2 US qts., 16.8 Imp. qts)

"V" belt (fan belt)

1. Inspect the "V" belt condition, and

replace the belt if defective.

2. Check and adjust if necessary for correct tension.
The specified tension is 7 ~ 10 mm (0.28 ~ 0.40") when depressed at midway of the belt with 10 kg (22 lb) pressure.
To adjust the tension, loosen the fan belt adjusting bar bolt, and adjust the alternator on its mounting bracket until the tension of the belt is sufficient.

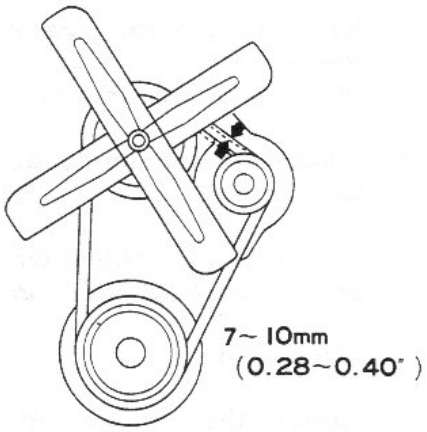


Fig. 2-2 Checking "V" Belt Tension G1567

Fuel filter

1. Check the fuel filter bowl for cracks and if necessary replace.

2. Check the element for damage or excessive dirt.
Replace the element if necessary.

Air cleaner

1. Dry element type.
Clean the element with compressed air at low pressure.
Replace the element if damaged or excessively dirty.

2. Oil bath type.
Wash the element with clean gasoline, and dry it thoroughly before reuse.
Replace the oil with proper grade engine oil up-to the level mark.

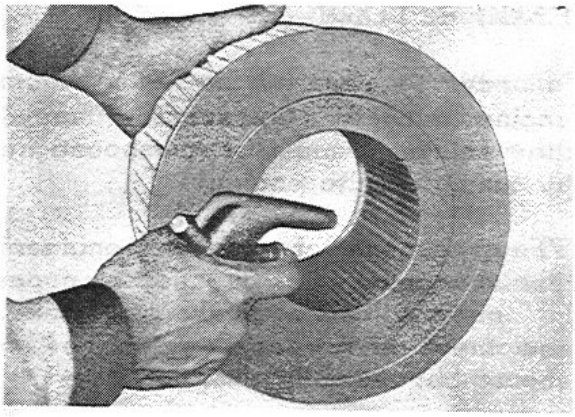


Fig. 2-3 Cleaning Element V4651

Distributor

1. Clean the distributor cap, and inspect for cracks, carbon tracks, and burned or corroded terminals. Replace the cap as necessary.

2. Clean the rotor, and inspect for damage or abnormal condition. Replace the rotor if necessary.

3. Check the distributor centrifugal advance mechanism by turning the rotor in a clockwise direction as far as possible, then release the rotor and confirm if the rotor returns to its retarded position. If the rotor does not return readily, the distributor must be disassembled, and the cause of the trouble should be corrected.

4. Check the vacuum advancer mechanism by pushing in the octane selector, then release the octane selector to confirm if the selector returns to its retarded position. Any stiffness in the operation of the vacuum governor mechanism will affect the ignition timing.
Correct any interference or binding.

5. Clean and dress the breaker points if necessary with a point file.
Never use emery clotch or sandpaper to clean the points since particles will embed, and cause arcing, and rapid burning of the

points. Replace the points that are burned or badly pitted.

6. Check the breaker arm tension with a spring tension tester, by pulling at right angle to the breaker arm point. Read the tester just when the point opens.
The tension should be 400 ~ 550 grams (14 ~ 19 oz).

7. Lubricate the distributor as shown in the following illustration.
Distributor grease indicated by "A".
Engine oil indicated by "B".

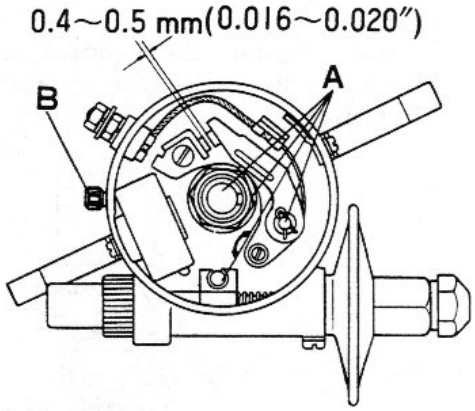


Fig.2-4 Distributor Lubrication G1568

8. Check and adjust the point gap.
The point gap should be adjusted to 0.4 ~ 0.5 mm (0.016 ~ 0.020").
To adjust. turn the crankshaft until the distributor breaker arm rubbing block is on the top of the cam lobe.
Loosen the contact point plate securing screw. then turn the eccentric bolt clockwise or counterclockwise to obtain a specific clearance.

9. Check the condenser capacity which should be 0.20 ~ 0.24 microfarad.
Replace the condenser if necessary.

Spark plug

1. Inspect each plug individually for badly worn electrodes, glazed, broken or blistered porcelain, and replace the plug/s as necessary.

2. Clean the spark plugs thoroughly using a sand blast cleaner.
When cleaning with a sand blast cleaner, do not operate too long to prevent porcelain damage.

3. Inspect each plug for make, and heat range.
All plugs must be of the same make and number or heat range.
If excessive carbon deposits are 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.
Recommended spark plug:

NGK	B-5ES
DENSO	W-14EP

4. Adjust the spark plug gap by bending the ground electrode to obtain the specified gap of 0.7 ~ 0.8 mm (0.028 ~ 0.031") with a spark plug gap gauge.

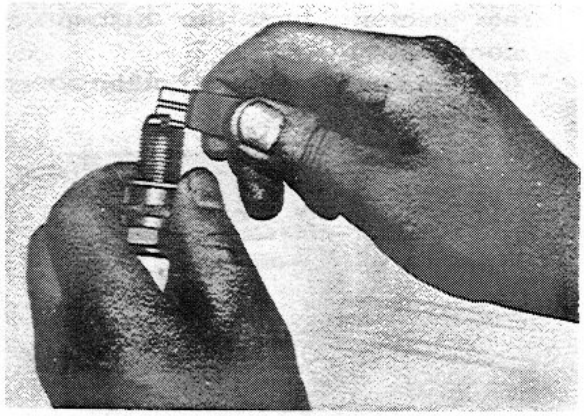


Fig.2-5 Adjusting Spark Plug Gap V2165

Ignition initial timing

1. Set the octane selector at zero, and attach a timing light onto the No.1 spark plug, and a ground.

2. Connect a tachometer, then start the engine, and set it at idling speed of 500 rpm. (650 rpm for USA)
   Aim the timing light to the timing ball in the flywheel with the pointer on the clutch housing.

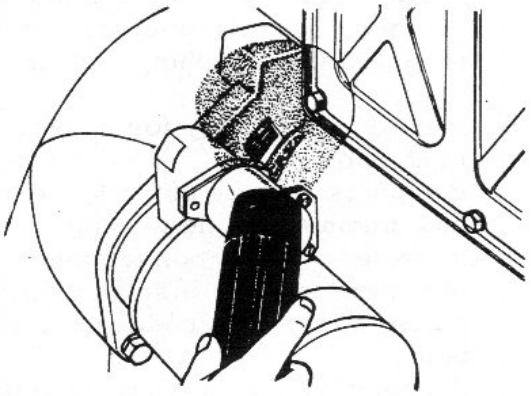


Fig.2-6 Ignition Timing Inspection X4919

3. If the timing pointer, and timing ball do not align, loosen the distributor holder screw, and turn the distributor clockwise or counterclockwise to align the timing ball and the timing pointer.
   If the timing ball is beyond the timing pointer, turn the distributor counterclockwise.
   If the timing ball is before the timing pointer, turn the distributor clockwise.
   Tighten the distributor holder screw securely.

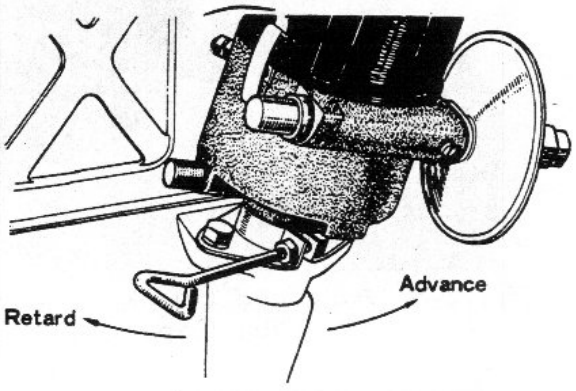


Fig.2-7 Ignition Timing Adjustment X4920

Octane selector

Depending on the gasoline octane rating, the ignition timing must be adjusted as required.

1. To test, drive the car at approximately 30 kph (20 mph) in top speed gear, and depress the accelerator pedal fully.
   At this time, the engine should have a slight "ping" but should fade out gradually as the car picks up the speed.
   If the engine "pings" excessively, turn the adjuster towards the "R" mark.
   If the engine does not "ping" at all, turn the adjuster towards the "A" mark.

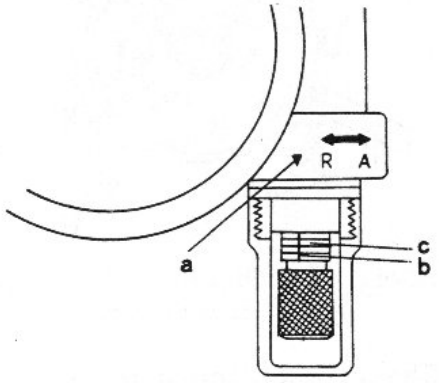


Fig.2-8 Octane Selector X4921

Note:
One graduation of the adjuster is equal to 10.4 degrees of crankshaft angle.
Turning the adjuster towards the "A" mark will advance timing, and towards the "R" mark will retard the timing.
The adjustment of the octane selector has no relation with the vacuum advance.

Inspection During Warm-Up

Warm up the engine to operating temperature to about 75 ~ 85 C (167 to 185 F), and then check the following items).

1. Remove the oil pressure sender gauge unit, and connect the oil pressure indicator gauge into the sender gauge unit removed hole in the cylinder block.
   Run the engine at idle speed, and check the engine oil pressure. The pressure should exceed 0.4 kg/cm² (5.7 psi).
   Next, increase the engine revolution over 2,400 rpm, and check the oil pressure.
   The pressure should be 3.1 ~ 3.5 kg/cm² (44 ~ 50 psi).
   If the oil pressure does not rise to this specified limit, check the lubricating system.

2. Check the battery charging condition.
   If the ammeter needle registers to within the positive side at speed slightly above the idling speed, the battery is being charged, and the operation of the charging system is satisfactory.

3. Check the oil and coolant for leaks.

Valve clearance

Proper adjustment of the intake and exhaust valve clearances is important to prevent burning of the valves, and to obtain satisfactory engine performances.

1. Warm up the engine to operating temperature to about 75 ~ 85° C (167 ~ 185° F).

2. Tighten the cylinder head bolts, manifold retaining nuts, and the valve rocker shaft support retaining nuts and bolts to specified torque.
   Specified tightening torque:
   Cylinder head bolts
   11.5 ~ 13.5 m-kg (83 ~ 98 ft-lb)
   Manifold retaining nuts
   2 ~ 3 m-kg (14 ~ 22 ft-lb)
   Rocker shaft support retaining nuts and bolts
   (10 mm) 3.4 ~ 4.1 m-kg (25 to 30 ft-lb)
   (8 mm) 2 ~ 3 m-kg (14 ~ 22 ft-lb)

3. Set the engine revolution at idling speed of 500 rpm.
   (650 rpm for USA)

4. Check the valve clearance with a feeler gauge.
   To adjust, loosen the lock nut, and turn the adjusting screw until the specified clearances are obtained.
   Tighten the lock nut securely after adjustment, and recheck the clearances.
   Specified clearances at operating temperature:
   Intake valve 0.20 mm (0.0079")
   Exhaust valve 0.35 mm (0.0138")

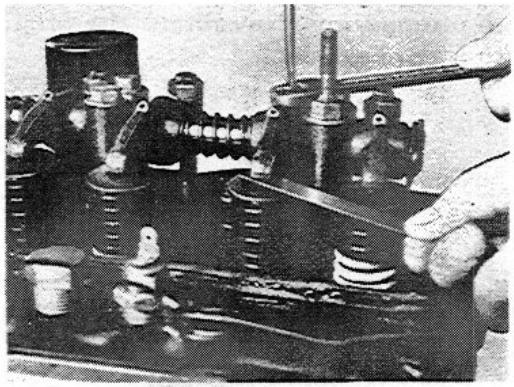


Fig. 2-9 Adjusting Valve Clearances V4345

Compression test

1. Warm up the engine to operating temperature before the test.

2. Remove all spark plugs, and disconnect the high tension wire from the ignition coil.

Note:
Always use a fully charged battery to obtain starter revolution exceeding 200 rpm.
The throttle valve and choke valve must be fully opened during the compression test.

3. Crank the engine with the starter until the gauge reading is steady, and the reading is at the maximum.

Specified compression:
10.5 kg/cm² (150 psi)
at 200 rpm
Limit - 9.0 kg/cm² (128 psi)

Difference of pressure between the cylinders should be less than one kg/cm² (14.2 psi).
If the reading is not within the specified pressure, squirt few drops of engine oil into the cylinder having the low reading.
If the compression pressure increases, the piston rings may be defective, and the pressure does not increase, the valves may not be seating properly.
If necessary, overhaul the engine for correction.

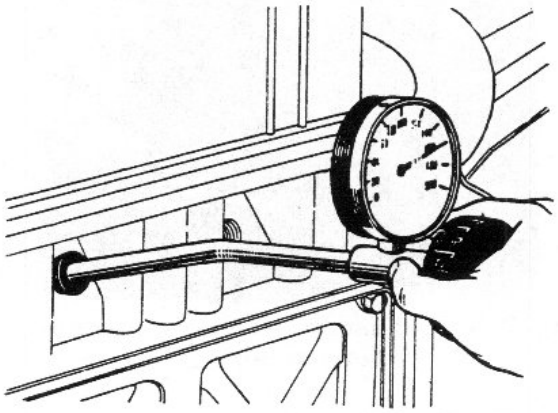


Fig. 2-10 Testing Compression Pressure X4923

Carburetor

For detail operation and procedures refer to Carburetor in Fuel System. The adjustment of the carburetor should be performed with the air cleaner installed.

1. Remove the intake manifold suction hole plug, then installed the adapter to connect a vacuum gauge.
   Connect the vacuum gauge hose onto the adapter.
2. Connect a tachometer onto the ignition coil.
3. Start the engine, and run it at idle speed, and check the carburetor fuel level.
   The fuel level should align with the fuel level line of the level gauge glass.
   If the level is not satisfactory, it should be adjusted before proceeding with the operation.
4. Turn the throttle valve adjusting screw in or out until the engine operates smoothly without stalling at lowest possible revolution.
5. Turn the idle adjusting screw to obtain highest steady vacuum at idle speed.
6. Turn the throttle valve adjusting screw and the idle adjusting screw alternately to obtain a steady and highest vacuum with smooth operation at engine idle speed.
   The engine idle speed is 500 rpm, and the vacuum gauge reading should exceed 460 mm Hg (18 in Hg). (650 rpm, 420 mm Hg [16.5 in Hg] for USA)
7. Stop the engine, and remove the air cleaner cap from the carburetor and test the operation of the acceleration pump.
   To test the acceleration pump, do not operate the engine.
   Open the throttle valve fully from closed position, and observe the condition of fuel spary from the pump jet.
8. For the emission control system refer to the Emission Control Manual.

ENGINE

TROUBLE SHOOTING

The possible faults, and their remedies are listed in the following table. When the symptoms of troubles are detected, proper care must be taken immediately before proceeding to the next probable cause.

Symptoms & Probable Causes	Remedies
Loss of Power	
1. Low compression	
a. Improper valve clearance	Adjust valve clearance
b. Compression leak from valve seat/s	Lap valve/s or seat/s
c. Sticky valve stem	Correct or replace valve
d. Weak or defective valve springs	Replace valve springs
e. Compression leak at cylinder head gasket	Replace gasket
f. Piston ring sticking or defective	Replace piston rings
g. Worn piston ring or cylinder	Overhaul engine
h. Worn or scored cylinder or piston	Overhaul engine
2. Incorrect ignition system	
a. Incorrect ignition timing	Adjust ignition timing
b. Defective spark plug/s	Clean, adjust or replace spark plug/s
c. Defective distributor points	Dress, or replace points, also check condenser
d. Incorrect octane selector setting	Adjust octane selector
3. Insufficient fuel	
a. Clogged carburetor	Disassemble, and clean carburetor
b. Clogged fuel pipe	Clean fuel pipe
c. Dirty fuel tank	Clean fuel tank
d. Air in fuel system	Check connections, and tighten
e. Defective fuel pump	Repair or replace
f. Clogged fuel filter	Clean filter or replace
g. Fuel line leaks	Check connections, and tighten
4. Insufficient air intake	
a. Restricted air cleaner	Clean or replace element
b. Closed choke valve	Repair choke mechanism
5. Overheating	
a. Insufficient coolant	Replenish
b. Loose "V" belt	Adjust "V" belt
c. Worn or defective "V" belt	Replace "V" belt
d. Defective thermostat	Replace
e. Defective water pump	Replace
f. Clogged or leaky radiator	Flush, repair or replace
g. Incorrect ignition timing	Adjust ignition timing
h. Brakes dragging	Adjust brakes
i. Improper grade engine oil	Replace with proper grade oil

Symptoms & Probable Causes	Remedies
j. Lean mixture	Adjust carburetor or repair
k. Incorrect valve clearance	Adjust valve clearance
l. Restricted exhaust	Clean or replace
m. Incorrect distributor advance	Repair distributor
n. Cooling system passages clogged	Clean passages
o. Radiator fins clogged or obstructed	Clean radiator fins

Excessive Oil Consumption

1. Oil leak	
a. Loose oil pan drain plug	Tighten drain plug
b. Loose oil pan attaching bolts	Tighten bolts
c. Defective oil pan gasket	Replace gasket
d. Loose timing gear cover or defective gasket	Tighten bolts or replace gasket
e. Defective crankshaft oil seal/s	Replace oil seal/s
f. Defective cylinder head cover gasket	Replace gasket
g. Loose fuel pump retaining bolts or defective gasket	Tighten bolts or replace gasket
h. Loose oil filter cap bolt or defective gasket	Tighten or replace gasket
2. Excessive oil consumption	
a. Broken or worn piston rings	Replace piston rings
b. Ring gaps in line	Correct gap positions
c. Sticky ring grooves	Replace piston rings
d. Carbon deposit in oil return hole of oil ring	Replace piston rings
e. Excessive piston and cylinder wear	Replace pistons, and bore cylinders
f. Defective valve stem oil seal/s	Replace oil seal/s
g. Worn valve stem or valve stem guide	Replace valve, and valve stem guide
h. Wrong grade oil for climatic conditions	Replace with proper grade oil

Hard Starting

1. Slow cranking speed	
a. Improper grade oil	Replace with proper grade oil
b. Discharged battery	Charge battery
c. Defective battery	Replace battery
d. Loose or defective battery terminal/s	Clean, tighten or replace
e. Defective starter motor	Repair or replace starter motor
2. Ignition system	
a. Burnt distributor points	Clean or replace
b. Incorrect point gap	Adjust
c. Incorrect spark plug gap	Adjust

Symptoms & Probable Causes	Remedies
d. Loose spark plug wire or defective wire/s	Tighten wire/s or replace
e. Defective ignition coil	Replace
f. Defective condenser	Replace
g. Incorrect connection of primary wire/s	Check, and correct wire/s connection
h. Incorrect ignition timing	Adjust ignition timing
3. Engine	
a. Burnt valve/s	Grind, retouch or replace valve/s
b. Loose carburetor mounting nuts	Tighten
c. Worn pistons, piston rings and cylinders	Replace pistons, piston rings and bore cylinders
d. Defective cylinder head gasket	Replace
e. Loose intake manifold retaining nuts or defective gasket	Tighten bolts or replace gasket
f. Incorrect valve timing	Adjust valve timing
g. Incorrect valve clearance	Adjust valve clearance
4. Fuel system	
a. Defective choke mechanism	Adjust or replace
b. Defective magnetic valve	Replace magnetic valve
c. Incorrect engine idle speed setting	Adjust idle speed setting
d. Dirty or clogged carburetor	Disassemble and clean
e. Loose carburetor mounting nuts	Tighten nuts
f. Float setting incorrect	Adjust float setting
g. Leaking fuel pump, line or carburetor	Check and repair
Popping, Spitting & Detonation	
1. Ignition system	
a. Ignition system wires loose	Check connections and tighten
b. Defective spark plug/s	Clean, adjust or replace
c. Incorrect ignition timing	Adjust ignition timing
d. Incorrect heat range spark plugs	Replace spark plugs
2. Air-fuel mixture	
a. Lean mixture	Clean and adjust carburetor
b. Dirty carburetor	Clean
c. Clogged fuel pipes or filter	Clean or replace pipes or filter
d. Gas leak from carburetor or intake manifold	Tighten
e. Water in fuel line or carburetor	Clean fuel line and replace fuel
f. Intake manifold gasket leak	Replace gasket

Symptoms & Probable Causes	Remedies
3. Valve & cylinder head	
a. Incorrect valve clearance	Adjust valve clearance
b. Sticky valve/s	Repair or replace
c. Weak valve spring/s	Replace valve spring/s
d. Excessive carbon deposit in cylinder head	Remove carbon
e. Clogged water passage in cylinder head	Clean water passage
f. Defective cylinder head gasket	Replace gasket
4. Intake & exhaust system	
a. Incorrect installation of heat control valve spring	Adjust spring
b. Heat control valve sticky	Repair valve
c. Restricted muffler	Clean or replace
Rough Engine Idle	
1. Fuel system	
a. Incorrect carburetor idle adjustment	Adjust carburetor
b. Incorrect float setting	Adjust float setting
c. Water in fuel	Replace fuel
2. Engine	
a. Intake manifold gasket leaks	Tighten manifold retaining nuts or replace gasket
b. Incorrect valve clearance	Adjust valve clearance
c. Improper valve seating	Grind valve/s or seat/s
d. Excessive clearance between valve stem, and valve stem guide	Replace valve/s, and guide bushing/s
e. Defective cylinder head gasket	Replace gasket
f. Incorrect ignition timing	Adjust ignition timing
g. Loose engine mounting bolts or worn mounting insulator	Tighten bolts or replace mounting insulator
Engine Misses at Acceleration	
1. Fuel system	
a. Clogged accelerating system	Disassemble, and clean
b. Defective pump plunger	Replace pump plunger
2. Ignition system	
a. Defective spark plug/s	Replace spark plug/s
b. Defective spark plug wire/s	Replace wire/s
c. Incorrect distributor point gap	Adjust point gap
d. Defective ignition coil	Replace ignition coil
e. Incorrect ignition timing	Adjust ignition timing
3. Engine	
a. Burnt or incorrect valve clearance adjustment	Replace valve/s or adjust valve clearance

Symptoms & Probable Causes	Remedies
b. Compression leak	Engine overhaul
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 posses characteristics which can be detected. These characteristics vary, and experience is the best guide in most cases.

1. Crankshaft bearings	
a. Worn bearings	Replace bearings
b. Worn crankshaft journals	Grind or replace crankshaft
c. Melted crankshaft bearing	Replace bearing, and check lubricating system
2. Connecting rod, and bearings	
a. Worn bearings	Replace bearings
b. Worn crankpin journals	Grind or replace crankshaft
c. Bent connecting rod	Straighten or replace connecting rod
d. Melted connecting rod bearings	Replace bearing, and check lubricating system
3. Piston, piston rings, and piston pin	
a. Worn cylinder bores	Bore, and hone cylinders
b. Worn piston or piston pin	Replace piston with pin
c. Sticky piston	Replace piston with pin
d. Borken piston ring/s	Replace piston rings
4. Other components	
a. Excessive camshaft end-play	Replace camshaft thrust plate
b. Worn crankshaft bearing thrust surface	Replace bearing/s
c. Worn valve lifter/s	Replace lifter/s
d. Excessive valve clearance	Adjust valve clearance
e. Insufficient engine oil	Replenish oil

Removal (For FJ series)

1. Remove the bolts retaining the engine hood onto the hood hinge, then remove the engine hood.
2. Drain the cooling system.
3. Remove the radiator grille, and the hood lock support rod.
4. Disconnect the hood lock from the radiator support, and remove the radiator support.
5. Disconnect the heater hose from the radiator pipe.
6. Disconnect the radiator upper hose from the water outlet housing, also disconnect the radiator lower hose from the water pump.
7. Remove six retaining bolts, and remove the radiator assembly.
8. Remove the two heater hoses.
9. Disconnect the battery to starter cable and the battery to ground cable from the battery terminals.
10. Disconnect wires from the starter magnetic switch terminal.
11. Disconnect the fuel hoses, and remove the fuel filter assembly.
12. Disconnect the primary wire from the ignition coil terminal.
13. Disconnect the rod end of high and low shift rod from the high and low shift link lever.
14. Remove the air cleaner assembly.
15. Disconnect the wires from the alternator.
16. Disconnect the throttle rod, choke rod and the accelerator rod from the carburetor.
17. Remove the vacuum hose connecting on intake manifold and the check valve of the transfer front drive controller.
18. Disconnect the wires from the water temperature sender gauge unit and the oil pressure sender gauge unit.
19. Remove the nuts, and disconnect the exhaust pipe from the exhaust manifold.
20. Disconnect the parking brake cable from the intermediate lever.
21. Disconnect the front propeller shaft from the transfer output front shaft flange.
22. Remove the engine under covers RH and LH.
23. Remove the transmission under cover.
24. Remove the hole pin, and disconnect the high and low shift rod from the transfer high and low shift inner lever.
25. Remove the high and low shift link lever No.3, and the high and low shift rod.
26. Unhook the clutch release fork spring, and remove the clutch release cylinder assembly from the engine mounting rear bracket.
27. Loosen the clamp screws, and disconnect the vacuum hoses from the transfer diaphragm cylinder.
28. Remove the front drive indicator switch.
29. Disconnect the speedometer drive cable from the transmission.
30. Disconnect the rear propeller shaft from the transmission.

31. Disconnect the gear shifting rod, and the gear selecting rod from the gear shift outer lever and the gear select outer lever.

32. Loosen and remove the nuts retaining the engine mounting rear insulators onto the frame.

33. Remove the nuts retaining the engine mounting front insulator onto the frame.

34. Install the lifting hooks onto the engine hangers.
Raise the engine slightly, and carefully towards the front together with the transmission with a suittable hoist.

Removal (For FA series)

1. Remove the hood assembly.
a. Screw in the bolts of the hood support stopper all the way, and remove the hood hinge torsion bar support.

b. Remove the bolts retaining the hood onto the hood hinges, and remove the hood with the hood hinge torsion bars.

2. Drain the cooling system.

3. Disconnect the battery to starter cable and the battery to ground cable from the battery terminals. Remove the battery clamp, and then remove the battery.

4. Disconnect the battery to starter cable and other wirings from the magnetic switch on the starter.

5. Disconnect the fuel hose from the fuel filter.
Disconnect the primary wire from the ignition coil terminals.

6. Disconnect the wirings from the oil pressure sender gauge unit, and the water temperature sender gauge unit.

7. Disconnect the wirings from the alternator.

8. Disconnect the accelerator linkage. Disconnect the throttle and choke rods from the carburetor.

9. Disconnect the vacuum hose from the intake manifold to the connector tube.

10. Loosen the alternator adjusting bar bolt, and then remove the fan and the fan pulley.

11. Remove the radiator upper and lower hoses.

12. Remove the fan shroud aseembly.

13. Radiator removal.
a. Remove the radiator grille and the hood lock support rod.

b. Remove the hood lock, and then remove the radiator support.

c. Remove the bolts retaining the radiator to the radiator and front fender apron support, and then remove the radiator.

14. Remove the engine under cover RH and LH.

15. Loosen and remove the nuts, and disconnect the exhaust pipe from the exhaust manifold.

16. Remove the shift lever using the Transmission Gear Shift Lever Remover 09305-55010.

17. Remove the transmission cover, and remove the parking brake lever assembly.

18. Disconnect the speedometer drive cable from the speedometer shaft sleeve on the transmission.
Disconnect the wirings from the back-up light switch.

19. Remove the propeller intermediate

shaft, propeller shaft, and the center support bearing support assembly.

20. Unhook the clutch release spring from the clutch release fork, and then remove the clutch release cylinder.

21. Remove the bolts retaining the engine mounting front insulators onto the frame.

22. Remove the frame cross-member No.2.

23. Remove the bolts retaining the engine mounting rear insulators onto the frame.

24. Remove the air cleaner assembly. Disconnect the wires, and remove the horn bracket together with the horns and horn relay.

25. Install the lifting hooks onto the engine hangers.
Raise the engine slightly, and carefully towards the front together with the transmission with a suitable hoist.

Disassembly

1. Remove the flywheel side cover, and the flywheel housing under cover.

2. Remove the four bolts retaining the transmission onto the clutch housing, and then remove the transmission assembly from the clutch housing.

3. Remove the clutch release bearing with the bearing hub from the clutch release fork, and then remove the clutch release fork.

4. If the same clutch cover assembly is to be installed after the engine is assembled, mark the clutch cover, and the flywheel so that the clutch cover can be installed in the original position.

5. Install the Clutch Guide Tool 09301-55022 to support the clutch disc during disassembly.
Loosen all clutch cover retaining bolts a turn at a time to prevent distortion of clutch cover until the spring pressure on the clutch pressure plate is released.
Remove all bolts, Clutch Guide Tool, clutch cover assembly and the clutch disc.
Do not dirty the clutch disc with oil.

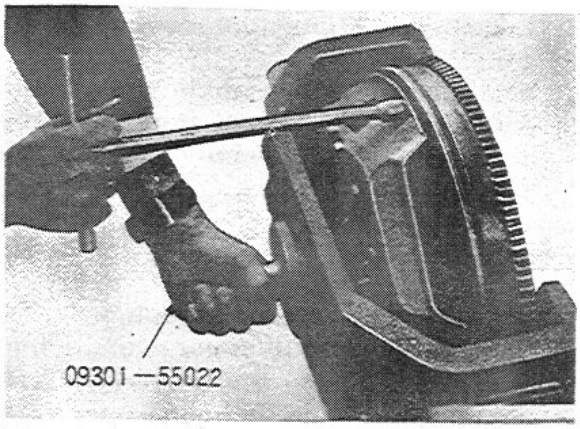


Fig.3-1 Removing Clutch Cover V0549

6. Remove the starter and the ground cable.

7. Straighten the flywheel bolt lock washers, and remove the flywheel retaining bolts.
Next, be carefull not to damage the flywheel ring gear, and remove the flywheel with the ring gear.

8. Remove the clutch housing.
The following operations should be performed on the engine work stand.

9. Install the engine onto a work stand, and drain the engine oil.

10. Remove the oil filter inlet and outlet pipes, then remove the oil filter assembly from the manifold.

11. Disconnect the magnetic valve wire from the ignition coil terminal.

Disconnect the vacuum pipe and carburetor fuel pipe from the carburetor, and then remove the carburetor assembly.

12. Remove the "V" belt adjusting bar bolt, and disengage the "V" belt, then remove the alternator from the bracket.

13. Loosen the hose clamps, and remove the water pump by-pass hose.

14. Remove the water pump retaining bolts, and remove the water pump with fan, and the "V" belt adjusting bar.

15. Remove the water outlet and the water outlet housing from the cylinder head.

16. Disconnect the vacuum pipe and carburetor fuel pipe from the distributor and the fuel pump.
Remove the vacuum and fuel pipe.

17. Disconnect the high tension cords from the spark plugs and ignition coil.
Disconnect the primary wire from the distributor terminal bolt.
Remove the distributor clamp securing bolts, then pull out the distributor.
Remove the oil level gauge.

18. Remove the ignition coil from the cylinder head.

19. Remove the fuel pump retaining bolts, and remove the fuel pump.

20. Remove the bolt attaching the oil filler tube clamp onto the valve lifter cover, then drive out the oil fiiler tube from the cylinder block.

21. Remove the nuts retaining the manifold onto the cylinder head, and remove the intake manifold together with the exahust manifold and gasket.

22. Remove the cylinder head cover and gasket.

23. Disconnect the valve rocker shaft oil delivery union, spring and the oil connection sleeve from the valve rocker shafts.
Remove the valve rocker shaft support retaining nuts and bolts, and remove the valve rocker mechanism.

24. Take out the push rods.
Remove the valve lifter cover and the gasket.
Next, pull out the valve lifters from the cylinder block.
If difficult to remove the valve lifters, tilt the engine sideways on the engine work stand, and tap the cylinder block lightly with a mallet.

The valve lifters and push rods should be placed in a rack in their proper sequence so these can be installed in the original position in the cylinder block.

25. Remove the valve rocker shaft oil delivery union from the oil delivery pipe.
Loosen and remove the cylinder head bolts in the order illustrated in figure 3-2 to prevent warpage.
Do not loosen and remove the cylinder head bolts at one time.

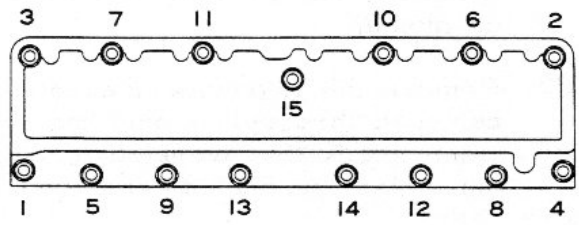


Fig. 3-2 Cylinder Head Bolts Removal X4969

Perform the removal in twice or three procedures.
Remove the cylinder head and the gasket.

26. Tilt the engine sideways on the engine work stand, and remove the oil pan attaching bolt, then remove the oil pan and the gakset.

27. Remove the oil strainer shell assembly.
Disconnect the oil pump outlet pipe at the cylinder block.
Cut the lock wire, and remove the oil pump retaining bolt, then pull out the pump assembly.

28. Remove the crankshaft pulley using the Crankshaft Pulley & Gear Puller 09213 – 60014.

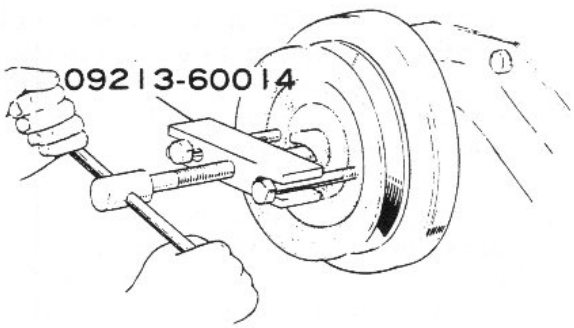


Fig. 3-3 Removing Crankshaft Pulley X4925

29. Remove the timing gear cover and the gasket.
Slide out the oil slinger from the crankshaft.

30. Remove the two bolts retaining the camshaft thrust plate onto the cylinder block by working through the holes in the camshaft timing gear.

31. Remove the camshaft by pulling it out through the front of the block.
Support the camshaft carefully when removing so as not to damage the camshaft bearings.

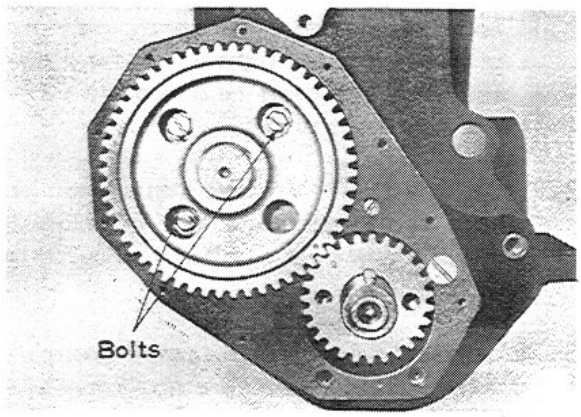


Fig. 3-4 Removing Camshaft V4346 Thrust Plate Bolts

32. Remove the screws and the bolts retaining the crankcase end plate onto the cylinder block, then take out the crankcase end plate and the gasket.

33. If necessary, remove the crankshaft timing gear.
Before removing the gear, remove the sliding key on the crankshaft, then remove the crankshaft timing gear using the Crankshaft Pulley & Gear Puller 09213 – 60014.

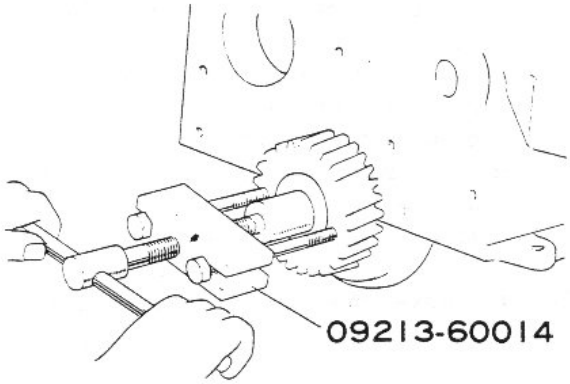


Fig. 3-5 Removing Crankshaft Timing Gear X4927

34. Remove the cotter pins, and the connecting rod bearing cap nuts.
Remove the connecting rod bearing cap, and push the connecting rod and the piston assembly out to the top of the cylinder with the handle of the hammer.
Avoid damaging the crankpin jour-

nal on the cylinder wall when removing the piston and connecting rod.
Replace the respective connecting rod bearing caps onto the connecting rods after removal.
Make sure that all connecting rods and pistons are marked so that these can be installed in their original locations.

35. Loosen and remove the crankshaft bearing cap retaining bolts, and remove the bearing caps, bearings and the shims.

36. Be carefull, and remove the crankshaft, and the bearings from the cylinder block.
Remove the crankshaft rear oil seal.
Take care not to change the combination of the crankshaft bearing caps, bearings and the adjusting shims.

37. Remove the piston rings from each piston.
The removed piston rings should be laid in accordance with the cylinder number.

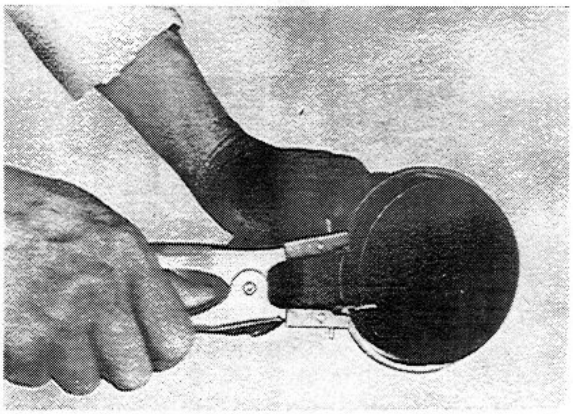


Fig.3-6 Removing Piston Rings W0461

38. Remove the piston pin bolt, then push out the piston pin from the piston and the connecting rod.
Do not change the original mated parts with the other.

39. Compress the valve spring using a valve spring compressor, and remove the valve spring retainer locks, spring retainer, spring, valve stem oil seal and the spring seat.
Slide out the valve.

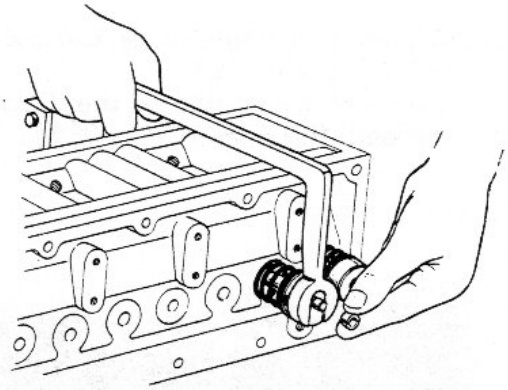


Fig.3-7 Removing Valve Spring Retainer Locks X4929

40. Remove the lock springs from each end of the valve rocker shaft, and slide the valve rocker arms, valve rocker shaft supports and the springs off the valve rocker shaft.

Inspection & Repair

Wash the disassembled parts thoroughly before inspection, and repair to remove the dirt, oil, carbon, and water scale.
Check the cylinder block, and the cylinder head for cracks, and water leak before washing.
Blow all passages with compressed air, and remove the deposits. Check all passages for clogging.
Remove the carbon deposits from the top of pistons, cylinder heads, and the valves without scratching or damaging the parts.
Do not mix or change the original mated parts of the valves, bearings or the bearing caps.

Cylinder Head

1. Remove the carbon deposits from the combustion chambers with a scraper, and a wire brush.
Be carefull not to damage the cyl-

inder head gasket surface.

2. Check the cylinder head for cracks, and the gasket surface for burrs, and nicks.
   Replace the head if cracked.

3. Check the flatness of the cylinder head gasket surface.
   Correct or replace if the distortion exceed 0.15 mm (0.006").

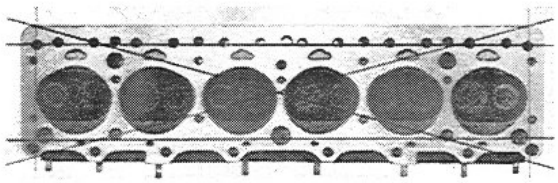


Fig.3-8 Measuring Points of Cylinder Head V4347

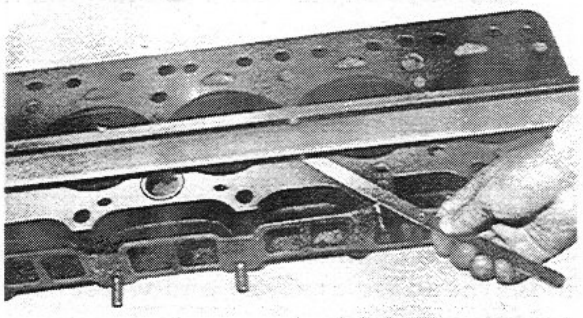


Fig.3-9 Measuring Distortion of Cylinder Head V4348

4. Check the distortion of the manifold gasket surface.
   Correct or replace if the distortion exceeds 2.0 mm (0.08").

Valve Stem Guide

1. Check the clearance between the valve stem, and the respective valve stem guide.
   Measure the inner diameter of the valve stem guide with an inside micrometer or inside dial gauge, and the valve stem with a micrometer.
   The specified clearance should be 0.025 ~ 0.060 mm (0.0010 to 0.0026") for the intake and 0.035 to 0.07 mm (0.0014 ~ 0.0028") for the exhaust.
   The clearance limit is 0.10 mm (0.004") for the intake, and 0.12 mm (0.005") for the exhaust.
   If the clearance exceeds the limit, replace the valve, and/or the valve stem guide.

2. To replace the valve stem guide remove the valve stem guide towards the top of the cylinder head with the Valve Stem Guide Remover & Replacer 09201-60010.

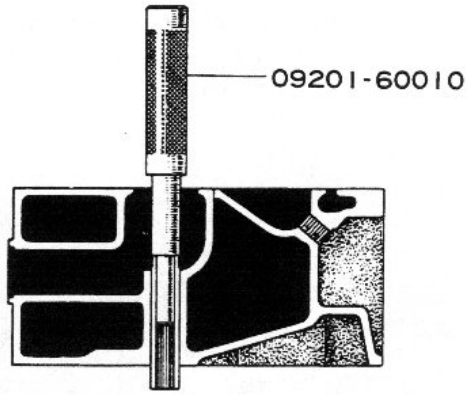


Fig.3-10 Valve Stem Guide Removal X4931

Install the new valve stem guide from the top of the cylinder head with the Valve Stem Guide Re-

mover & Replacer 09201-60010. The valve stem guide should be so installed that the extrusion of the guides will be 16.5 ~ 17.5 mm (0.65 ~ 0.69").

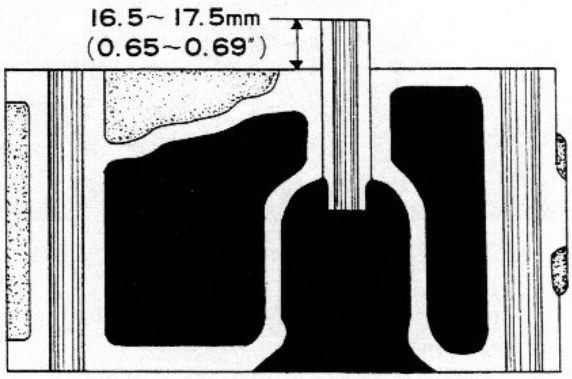


Fig.3-11 Valve Stem Guide X4932 Extrusion (Intake)

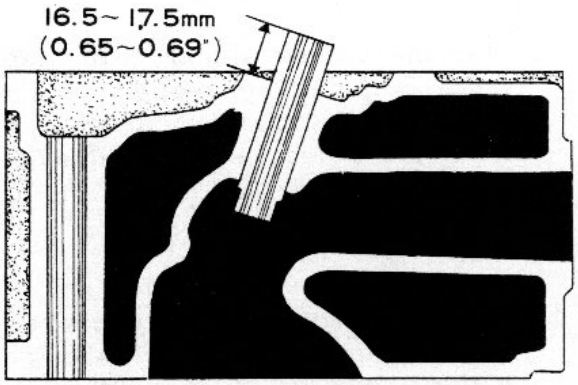


Fig.3-12 Valve Stem Guide X4933 Extrusion (Exhaust)

3. After installing the valve stem guide then ream all the replaced valve stem guides until proper clearance is obtained.
   Valve stem diameter:

Intake valve	7.970 ~ 7.985 mm (0.3138 ~ 0.3144")
Exhaust valve	7.960 ~ 7.975 mm (0.3134 ~ 0.3140")

Valve Seat

Reconditioning the valve seats is very important because the seating of valves must be perfect for the engine to deliver the power and performance. No matter what type of equipment is used, it is essential that the valve stem guides are free from carbon or dirt to insure proper centering of pilot in the guide.
The valve seat angle is 45 for both intake, and exhaust valves. The valve seat reamer is used to reface the valve seat, three different reamers, 15°, 45° and 65° being required.

1. Check the valve seat for proper seating with the valve.
   If necessary, the seat must be reconditioned with a valve seat reamer. If the valve stem guide is not to the specified clearance, remove and replace the valve stem guides before reconditioning the valve seats.

2. After cutting the valve seat, the valve should contact the seat exactly at the center, and proper width should be 1.4 mm (0.055") for the intake, and 2.1 mm or 0.083" for the exhaust.
   To check, apply a thin coat of red lead on the valve seat, and insert the valve.
   Apply light pressure on the valve to check the contact.
   If the seating is too high, use the 65° angle cutter, and if too low, use the 15° angle cutter.

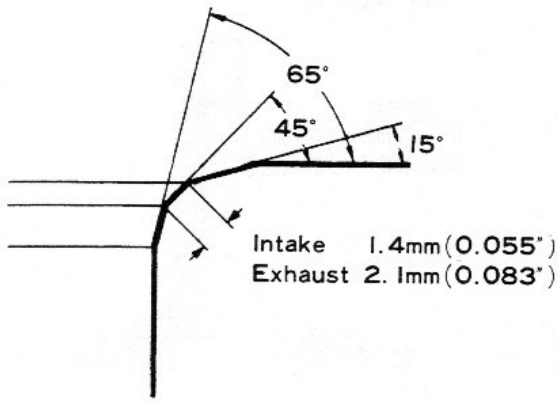


Fig.3-13 Valve Seat Angle X4934

3. Lap the valve lightly with a lapping compound to match the seat.
   Remove all compound thoroughly from the valve, and seat after lapping.

Valve

1. Remove all deposits from the valve 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 bent condition, the end of the stem for grooves or scores.

4. Check the valve head for sign of burning or erosion, warpage, and cracking.
   Defects, such as minor pits, grooves, etc., may be removed.
   Discard valves that are severely damaged.

5. If refacing is necessary, grind the valve with a valve refacing machine to obtain a smooth, and correct angle.
   Grind the valve 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 valve.

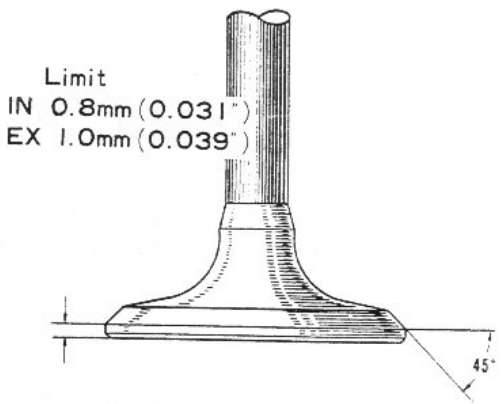


Fig.3-14 Valve Head Edge X0315

6. Remove all grooves, and scores from the end of the valve stem, then chamfer as necessary.
   Do not remove more than 0.5 mm (0.02") of the stock.
   Specified overall length:

Intake valve	124.5 ~ 125.1 mm (4.902 ~ 4.925")
Exhaust valve	124.7 ~ 125.3 mm (4.909 ~ 4.933")

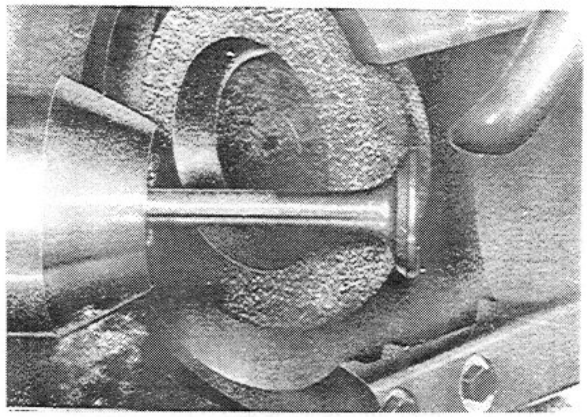


Fig.3-15 Grinding Valve V0716

7. Lap the valves slightly with a lapping compound for proper contact. Remove all compound thoroughly from the valve, and the valve seat after lapping.

Valve Spring

1. Check the spring for proper pressure at the specified spring length. If the pressure of any spring approaches the wear limit, replace the spring.

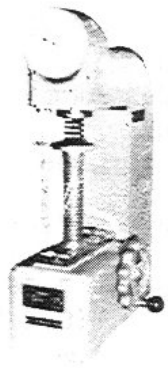


Fig.3-16 Spring Pressure Test W1587

Free length	51.5mm (2.028")
Installed length	43.0mm (1.693")
Installed pressure	32.5kg (71.5lb)

Installed pressure limit 27.0 kg (59.4 lb)

2. Check the valve spring squareness with a steel square, and a surface plate.
Stand the spring, and steel square on end on the surface plate.
Slide the spring up to the steel square. Revolve the spring slowly and observe the space between the top coil of the spring, and the steel square.
If the spring is out of square more than 2.0 mm (0.079"), replace it.

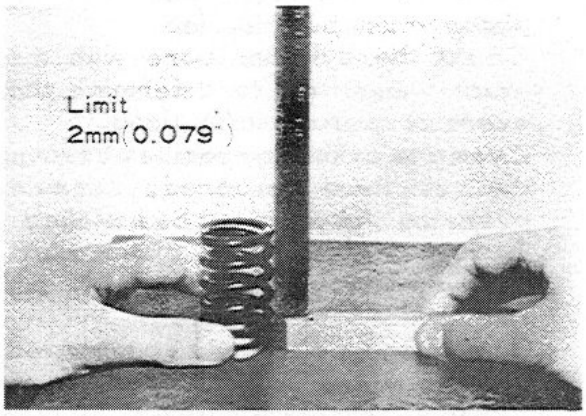


Fig.3-17 Valve Spring Squareness W0505

3. If the thickness of the valve spring seat is less than 0.5 mm (0.020") replace the spring seat.
Specified thickness is 1.0 mm or 0.039".

Valve Rocker Arm & Shaft

1. Check the valve rocker arm and the shaft.
If the wear of the arm end and shaft is excessive, replace both.

2. Check the shaft to rocker arm clearance.
The clearance should be 0.007 to 0.042 mm (0.0003 ~ 0.0016"), and the limit is 0.10 mm (0.0039").
Valve rocker shaft outer diameter is 18.479 ~ 18.493 mm (0.7275 to 0.7280").
If the clearance exceeds the limit, replace the rocker arm bushing, and/or the rocker arm shaft.
To remove the rocker arm bushing, use the Connecting Rod Bushing Remover & Replacer 09222-30010.

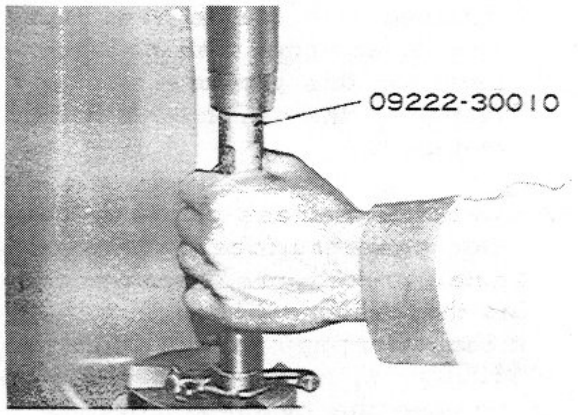


Fig.3-18 Replacing Rocker Arm Bushing V3135

When assembling the bushing, apply oil between the rocker arm and the bushing, and align the oil hole of the bushing with that of the rocker arm.
Ream the bushing with an adjustable reamer to obtain proper clearance.

3. If the valve end of the rocker arm is slightly worn, it can be corrected to a certain degree by using the valve refacing machine.

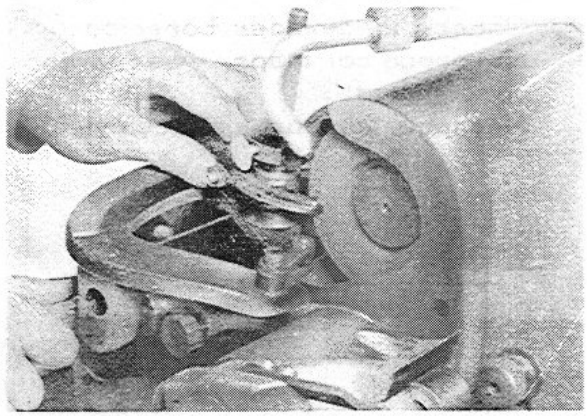


Fig.3-19 Refacing Rocker Arm V3136

4. Check the spring for rust, and weakness.

Cylinder Block

1. Wash the cylinder block thoroughly, and check for cracks, and the gasket surface for burrs and nicks. Minute cracks are difficult to be detected with a naked eye, and a special equipment may be necessary for this purpose.
   Replace the cylinder block if cracked.

2. Check the flatness of the cylinder block gasket surface, following the same procedures recommended for the cylinder head.
   If the warpage exceeds 0.15 mm (0.006"), grind the surface or replace the cylinder block.

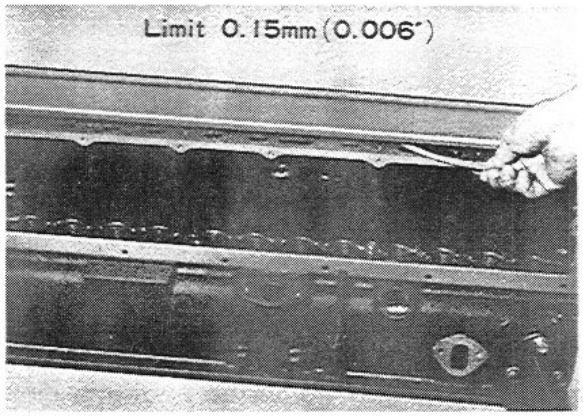


Fig.3-20 Cylinder Block Surface Flatness Inspection V4349

3. Check the cylinder bore for out-of-round or taper wear with a 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.

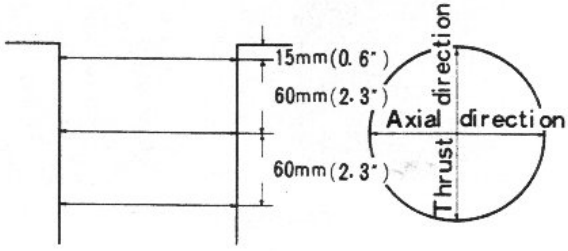


Fig.3-21 Measuring Points of Cylinder Bore X0313

4. If the wear is less than 0.2 mm (0.008"), remove the ridge at the top of the bore with a ridge reamer, and use the high limit standard size pistons to obtain satisfactory performance.

5. Cylinder/s with deep scores, burns, out-of-round or taper wear, require boring, and oversize piston must be installed.
   Select the cylinder bore with the most wear first to determine the oversize piston to be used.
   Even one cylinder requires boring, the rest must be bored, and new oversize pistons must be installed.
   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 or 68°F when measuring.

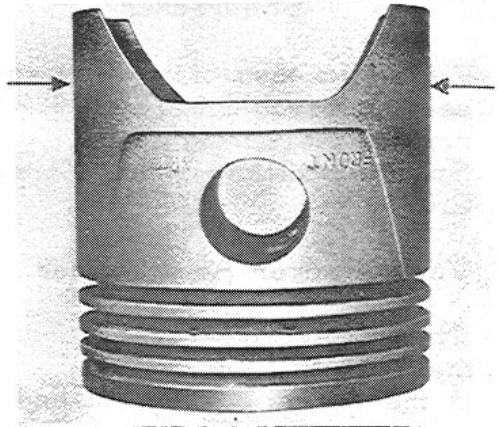


Fig.3-22 Measuring Piston Diameter V4350

STD	89.955 ~ 90.005 mm (3.5415 ~ 3.5435")
O/S-0.25	90.209 ~ 90.259 mm (3.5515 ~ 3.5535")
O/S-0.50	90.463 ~ 90.513 mm (3.5615 ~ 3.5635")
O/S-0.75	90.717 ~ 90.767 mm (3.5715 ~ 3.5735")

O/S-1.00 90.971 ~ 91.021 mm
(3.5815 ~ 3.5835")
O/S-1.50 91.479 ~ 91.529 mm
(3.6015 ~ 3.6035")

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

6. After the cylinders are bored and honed, check the fittness with the pistons in the following manner. Check the piston to cylinder bore clearance with a ribbon feeler gauge of 0.03 ~ 0.05 mm (0.0012 to 0.0020") thickness, and 12 mm (0.5") wide.
To check, position the ribbon in the cylinder bore so that it extends the entire length of the piston at 90° from the piston pin location. Invert the piston, and install it into the bore so that the end of the piston is about 35 mm (1.5") below the parallel to the crankshaft axis.
Attach a tension scale onto the end of the ribbon, and pull the scale straight up reading the scale required to pull out the ribbon. The correct scale reading should be from 1.0 ~ 2.5 kg (2.2 to 5.5 lb).
If the scale reading is greater than the maximum allowable reading, try another piston or lightly hone the cylinder bore to obtain the proper fittness.
If the scale reading is less than the minimum allowable reading, try another piston, or if standard size, try a standard high limit piston. If proper fittness cannot be obtained, it will be necessary to rebore the cylinder to the next oversize piston.

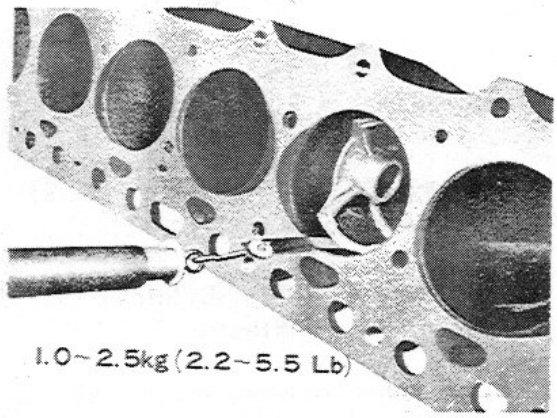


Fig. 3-23 Measuring Piston V4351 to Cylinder Clearance

7. The use of cylinder sleeve is recommended only when the cylinder bore is worn excessively, and O/S-1.50 piston cannot be utilized.

a. Bore the cylinder bore in accordance with the liner size to be installed.

Sleeve outer diameter:
94.16 ~ 94.21 mm
(3.707 ~ 3.709")
Cylinder bore
94.06 ~ 94.10 mm
(3.703 ~ 3.705")

b. Measure the outer diameter of the sleeve with a micrometer.

c. The cylinder should be bored until it leaves 0.06 ~ 0.15 mm (0.002 ~ 0.006") of bore-to-sleeve press fit, then press the sleeve in under pressure of 2,000 to 3,000 kg (4,400 ~ 6,600 lb) until it becomes flush with the cylinder block surface.

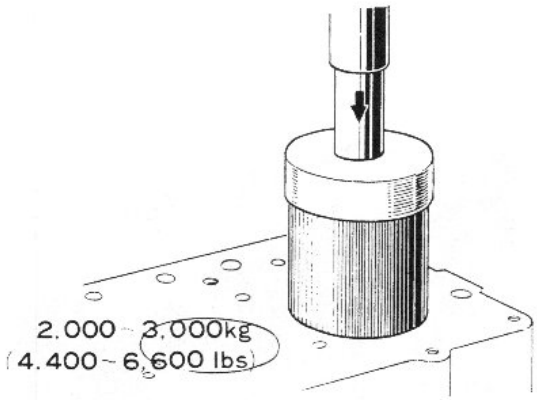


Fig.3-24 Installing Cylinder X1700 Sleeve

d. If the pressure is less than 2,000 kg (4,400 lb), replace the sleeve with next oversize sleeve.

e. If the sleeve has been installed, bore and hone the sleeve to fit the standard size piston.

f. When the initial sleeve has been worn out, remove the sleeve towards the cylinder head with a press. If the removal is difficult, bore the sleeve to reduce the wall thickness, to facilitate the removal.

Valve Lifter & Push Rod

1. Check the valve lifters for wear, and damage. Replace the valve lifter if the wear or damage is excessive.

2. Inspect the clearance between the valve lifter, and cylinder block. If the clearance exceeds 0.1 mm (0.004"), determine the oversize valve lifter, then ream the valve lifter bore with a reamer to the specification.

The valve lifter clearance should be 0.019 ~ 0.075 mm (0.0007 to 0.0030").
The clearance is obtained by measuring both lifter, and lifter bore, and taking the difference of the two.

Valve lifter diameter - STD:
25.097 ~ 25.128 mm
(0.9881 ~ 0.9894")
Valve lifter diameter - O/S-0.05:
25.147 ~ 25.178 mm
(0.9902 ~ 0.9913")

3. Check the ends of the push rods for nicks, grooves, roughness or excessive wear.
Check the push rod for bend.

Piston & Piston Pin

1. Carefully remove the carbon from the piston ring grooves, and piston head. Each piston is provided with a "FRONT" mark on the piston side, and with piston size mark on the 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 40 ~ 60°C (100 ~ 140°F). If the fitness is loose, replace both the pin, and the piston.

Piston Ring

1. Check the piston rings for wear, and other defects.
If the piston requires replacement, the rings should be replaced at the same time.
Select the correct size rings to meet the piston size.
Always install the rings with the marks facing upward.

2. Clean the piston ring grooves thoroughly before checking the clearance.
Check the rings with the piston grooves for clearance.

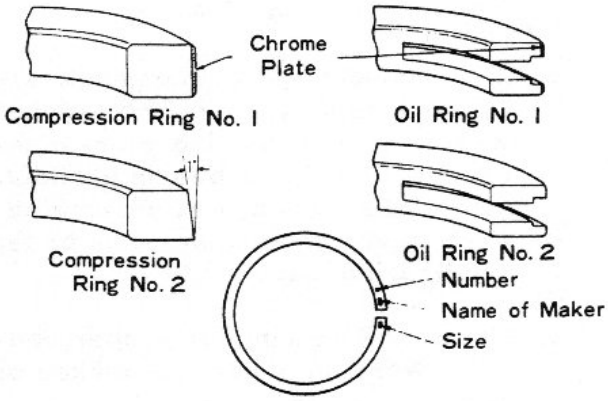


Fig. 3-25 Piston Ring X4942

Clearance between rings & ring grooves:
Compression ring No. 1:
0.03 ~ 0.07 mm (0.0012 ~ 0.0028″)
Compression ring No. 2:
0.02 ~ 0.06 mm (0.0008 ~ 0.0024″)
Oil ring No. 1: 0.02 ~ 0.06 mm (0.0008 ~ 0.0024″)
Oil ring No. 2: 0.02 ~ 0.065 mm (0.0008 ~ 0.0026″)

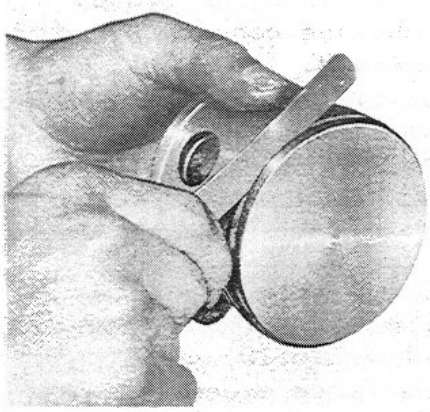


Fig. 3-26 Measuring Groove Clearance W5361

3. Install each ring into the cylinder bore, and check the ring end gap with a feeler gauge.
If only the rings are replaced without boring the cylinders, measure the ring end gap at lower position of the cylinder bore where the wear is minimum.

Piston ring end gap:
Compression ring No. 1
0.20 ~ 0.40 mm (0.008 ~ 0.016″).
Compression ring No. 2, Oil ring No. 1 & No. 2. 0.15 ~ 0.35 mm (0.0059 ~ 0.0137″)

If the gap is less than the specification, correct with a file.

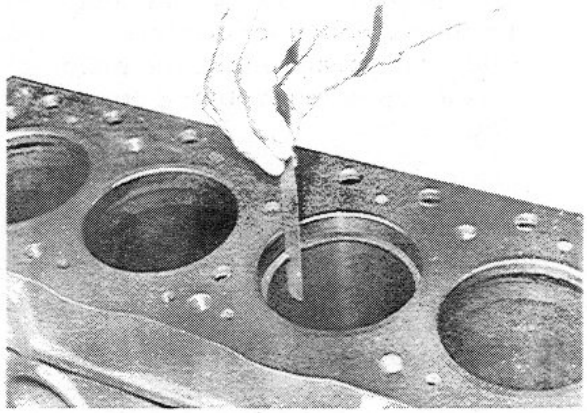


Fig. 3-27 Measuring Ring End Gap W5090

Connecting Rod

1. Install the connecting rod onto the the crankshaft, and measure the thrust clearance.
Clearance should be 0.11 ~ 0.23 mm (0.004 ~ 0.009″), and the limit is 0.3 mm (0.012″).
Also check the connecting rod for defect on thrust surface of both sides.
If defective, replace the connecting rod.

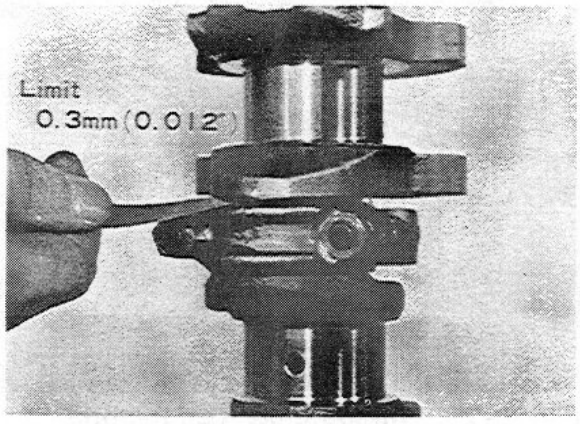


Fig. 3-28 Measuring Thrust Clearance V0733

2. If replaced, the cylinder number must be stamped on the camshaft side of the connecting rod.

3. Connecting rod alignment.
Inspect the connecting rod for twist or bent condition using a feeler gauge, and a connecting rod aligner.

a. Remove the connecting rod bearings from the connecting rod and cap, then install the piston pin in the upper end of the connecting rod.

b. Place the connecting rod on the arbor of the aligning ficture, and tighten the connecting rod cap nuts.

c. Place the "V" block on the top of the piston pin, and slide it against the face plate. If all three points of "V" block contact the face plate, the connecting rod alignment is satisfactory.

d. If any of the three points on the "V" block fails to contact the face plate, and the clearance at these points exceeds more than 0.1 mm (0.004"), the connecting rod should be corrected.

e. In such a case, correct the bend or twist until all three points on the "V" block contact the face plate properly.

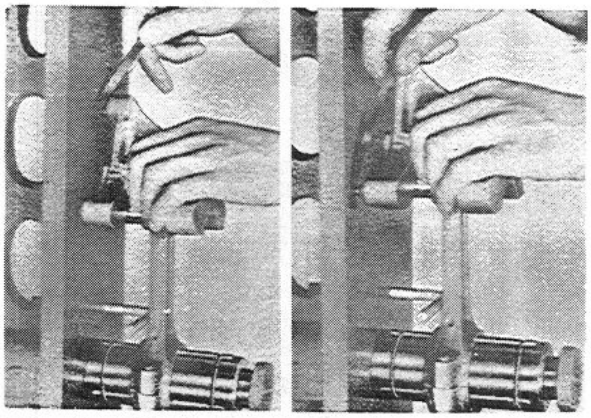


Fig. 3-29 Measuring Connecting Rod for Bend & Twist W0483 W0484

Connecting Rod Bearing

1. The connecting rod bearings are of the insert type, micro finished with high quality and close tolerance, and these bearings should never be scraped, ground or filed. Also never insert any shim or lap the bearing cap.

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

3. Check the oil clearance in the following manner with a Plastigage.
Clean the connecting rod bearing, and the crankpin journal.
Place the Plastigage full width of the crankpin journal, parallel to the crankshaft avoiding the oil hole of the crankpin journal.
Install the connecting rod and cap, then tighten the connecting rod nuts with a torque wrench to 4.8 ~ 7.6 m-kg (35 ~ 55 ft-lb) torque.
Never turn the connecting rod or the crankshaft.
Remove the cap taking care not to move the Plastigage.
Measure the width of the compressed Plastigage at the widest point using a Plastigage scale printed on the cover.
The oil clearance should be 0.02 to 0.06 mm (0.0008 ~ 0.0024"), and the limit is 0.10 mm (0.004").
If the clearance exceeds 0.10 mm (0.004"), replace the bearings with the undersize bearings, and grind the crankpin journals to fit the bearings.

4. Replacing the bearings.
If a new crankshaft is to be used, always use a standard size bearings.
When the bearing oil clearance exceeds the limit with the standard bearings, use U/S-0.05 bearings.
If the oil clearance exceeds with the U/S-0.05 bearings, grind the crankpin journals, and use U/S-

0.25 bearings. Even after grinding the crankpin journals to the regular dimension, always check the oil clearance before installation.

Crankpin journal finished diameter:
Bearing size - STD:
Crankpin journal:
53.98 ~ 54.00 mm
(2.1252 ~ 2.1260")
Bearing size U/S-0.25
Crankpin journal:
53.74 ~ 53.75 mm
(2.1157 ~ 2.1161")
Bearing size U/S-0.50:
Crankpin journal:
53.49 ~ 53.50 mm
(2.1059 ~ 2.1063")
Bearing size U/S-0.75:
Crankpin journal:
53.24 ~ 53.25 mm
(2.0961 ~ 2.0965")
Bearing size U/S-1.00:
Crankpin journal:
52.99 ~ 53.00 mm
(2.0862 ~ 2.0866")

Note.
The bearings are supplied as a set, and in replacement, always replace the bearing as a set.

Crankshaft

1. Check the crankshaft journals, crankpin journals for wear, and scores.
Also check the oil seal contact surfaces.
Check the oil holes for clogging.

2. Check the crankshaft for bend. If the bend exceeds 0.05 mm or 0.002", replace the crankshaft.
To measure the bend, perform the following procedures.
Place a dial gauge onto the second or third crankshaft journal, and rotate the crankshaft slowly to read the maximum, and minimum values.
Bend equals: Max. value minus Min. value divided by two.

3. Inspect the crankpin journals for wear, scores, and if the eccentric or taper wear exceeds 0.03 mm (0.0012"), grind the crankpin journals, and use under-size connecting rod bearings. Refer to Connecting Rod Bearing on page 3-20.

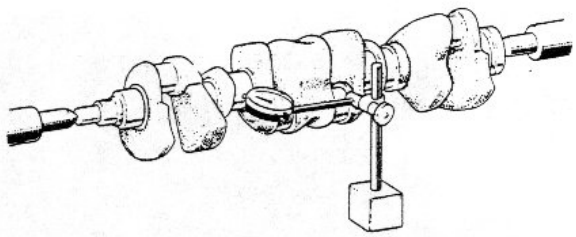


Fig.3-30 Measuring Crankshaft Bend X4952

4. Inspect the crankshaft journals for wear, scores, and eccentric or taper wear. If the wear exceeds 0.03 mm (0.0012"), grind the journals, and use under-size bearings. Refer to Crankshaft Bearings.

Crankshaft Bearing

The crankshaft bearings are also same micro finished insert type, therefore, the same procedures of inspection, and oil clearance check should be performed as the connecting rod bearings.
These bearings should never be scraped, ground or filed.
Also never lap the bearing cap to obtain the proper bearing oil clearance.

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

2. Assemble the crankshaft, and check the crankshaft thrust clearance at the third bearing.
If the clearance exceeds 0.3 mm

(0.118"), replace the crankshaft bearings.
The specified clearance is 0.06 to 0.16 mm (0.0024 ~ 0.0065").

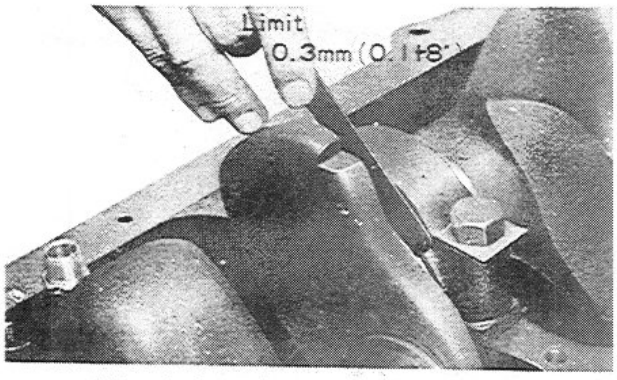


Fig.3-31 Measuring Thrust V0551

3. Assemble the crankshaft, and check the oil clearance with a Plastigage.
The oil clearance should be 0.035 to 0.045 mm (0.0014~0.0018"), and the limit is 0.10 mm (0.004").
Tightening torque of crankshaft bearing cap bolts:
Front, second & third:
12.5 ~ 15 m-kg
(90 ~ 108 ft-lb)
Rear: 10.5 ~ 13 m-kg
(76 ~ 94 ft-lb)

Caution:
When assembling the bearing caps, install the same shim thickness that were removed from the bearing caps when disassembled.
Never turn the crankshaft while the Plastigage is in place.

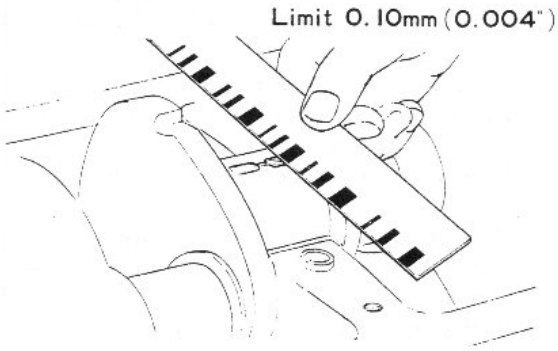


Fig.3-32 Measuring Oil Clearance X4956

If the clearance exceeds 0.10 mm (0.004"), replace the bearings with the under-size bearings, and grind the crankshaft journals to fit the bearings.

4. Replacing the bearings.
If a new crankshaft is to be used, always use a standard size bearings.
When the oil clearance exceeds the limit with the standard bearings, use U/S-0.05 bearings.
If the oil clearance exceeds 0.10 mm (0.004") with U/S-0.05 bearings, grind the crankshaft journals and use U/S-0.25 bearings.
The bearings are supplied as a set, and in replacement, always replace the bearings as a set.

Crankshaft journal finished diameter:
Bearing size - STD:
Crankshaft journal:

Front	66.97 ~ 67.00 mm (2.6366 ~ 2.6378")
Second	68.47 ~ 68.50 mm (2.6957 ~ 2.6969")
Third	69.97 ~ 70.00 mm (2.7547 ~ 2.7559")
Rear	71.47 ~ 71.50 mm (2.8138 ~ 2.8150")

Bearing size - U/S-0.25:
Crankshaft journal:

Front	66.745 ~ 66.755 mm (2.6278 ~ 2.6281")
Second	68.245 ~ 68.255 mm (2.6868 ~ 2.6872")
Third	69.745 ~ 69.755 mm (2.7459 ~ 2.7463")
Rear	71.245 ~ 71.255 mm (2.8049 ~ 2.8053")

Bearing size - U/S-0.50:
Crankshaft journal:

Front	66.505 ~ 66.515 mm (2.6183 ~ 2.6187")
Second	68.005 ~ 68.015 mm (2.6774 ~ 2.6778")
Third	69.505 ~ 69.515 mm (2.7364 ~ 2.7368")
Rear	71.005 ~ 71.015 mm (2.7955 ~ 2.7959")

Bearing size - U/S -0.75:
Crankshaft journal:

Front	66.245 ~ 66.255 mm (2.6081 ~ 2.6085")
Second	67.745 ~ 67.755 mm (2.6671 ~ 2.6675")
Third	69.245 ~ 69.255 mm (2.7262 ~ 2.7266")
Rear	70.745 ~ 70.755 mm (2.7852 ~ 2.7856")

Bearing size - U/S -1.00:
Crankshaft journal:

Front	65.985 ~ 65.995 mm (2.5978 ~ 2.5982")
Second	67.485 ~ 67.495 mm (2.6569 ~ 2.6573")
Third	68.985 ~ 68.995 mm (2.7159 ~ 2.7163")
Rear	70.485 ~ 70.495 mm (2.7750 ~ 2.7754")

Camshaft

1. Check the camshaft bearing journals, cam lobe surfaces, and the distributor drive gear for wear, pits, scores and abnormal wear.

2. Check the camshaft for bend.
If the bend exceeds 0.05 mm or 0.002" , replace the camshaft.
To measure the bend, perform the following procedures.
Place a dial gauge onto the second or third journal, and rotate the camshaft slowly to read the maximum and minimum value.
Bend equals: Maximum value minus Minimum valve divided by two.

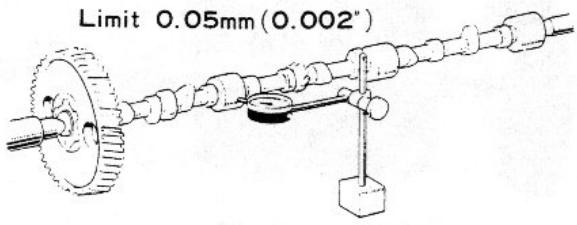


Fig. 3-33 Checking Camshaft for Bend X4947

3. Check the camshaft journals for roundness or taper, and if it exceeds 0.05 mm (0.002"), the camshaft journals should be ground and under-size bearings should be installed.
Refer to Camshaft Bearing on page 3-24.

4. Inspect the cam lobes, and if the lift of the cam lobes are excessively worn more than the specified limit, replace the camshaft.

Cam lobe height:

Intake	38.36 ~ 38.46 mm (1.510 ~ 1.514")
Exhaust	38.25 ~ 38.35 mm (1.506 ~ 1.510")

Cam lobe height limit:

Intake	38.0 mm (1.496")
Exhaust	37.9 mm (1.492")

5. Check the camshaft thrust clearance with a feeler gauge.
The clearance should be 0.085 to 0.147 mm (0.003 ~ 0.006"), and if the clearance exceeds 0.2 mm (0.008"), replace the camshaft thrust plate.

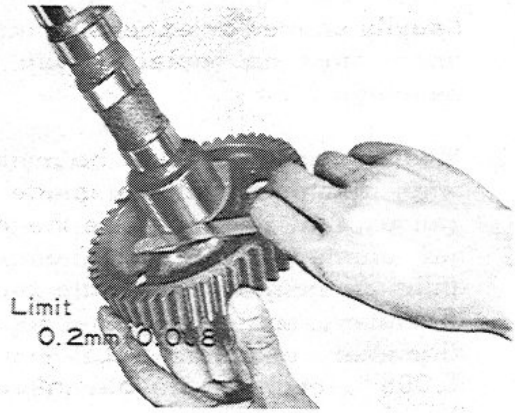


Fig. 3-34 Measuring Thrust Clearance V3171

6. Inspect the camshaft timing gear for cracks, chipped teeth or excessive wear. If necessary, replace the gear.
To remove the camshaft timing gear, remove the camshaft snap ring, and support the thrust plate

on the spacer, and then press out the shaft from the gear.

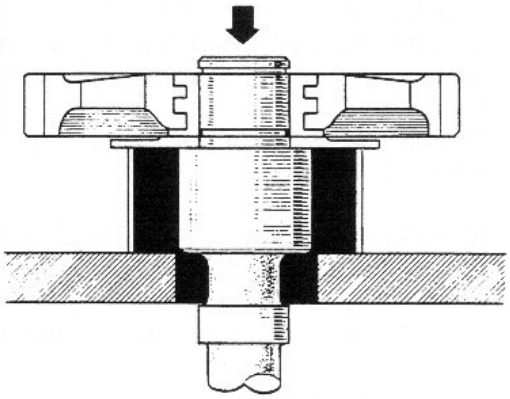


Fig.3-35 Camshaft Timing Gear Removal X4960

7. To assemble the camshaft timing gear, place the thrust plate to the camshaft, and make sure that the woodruff key is seated in the shaft keyway.
   Firmly support the camshaft at back of the front journal, then press and install the gear.
   Next, install the snap ring.

Camshaft Bearing

1. Check the bearings for poor contact, worn thin, partially melted, heavily scored or excessive clearance must be replaced with new bearings.

2. Measure the camshaft 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 journal bearing diameter exceeds 0.15 mm or 0.006", replace the journal bearings.
   Specified oil clearance is 0.025 to 0.075 mm (0.0010 ~ 0.0030").

NOTE:
The bearings are supplied as a set, and in replacement always replace the bearings as a set.

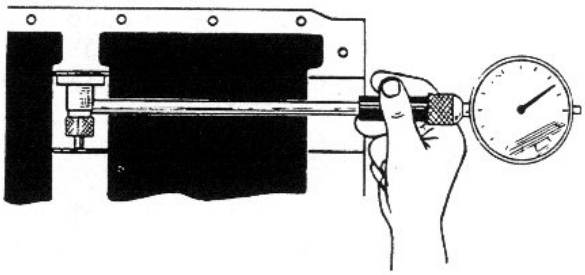
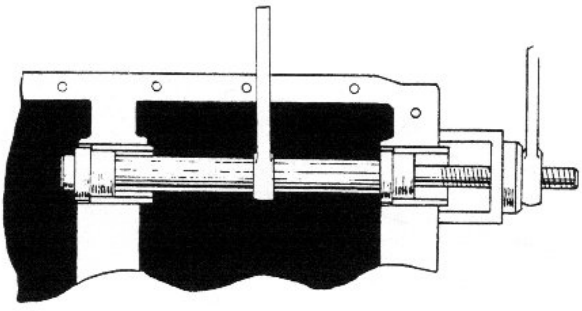


Fig.3-36 Measuring Camshaft Bearing Bore X4948

3. Bearing removal.
   a. Drive out the camshaft rear expansion plug from the cylinder block.

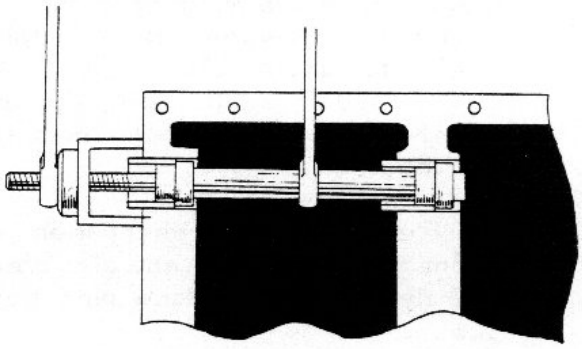
   b. Remove the front end and second bearings using the Camshaft Bearing Remover & Replacer 09215-60010.
   Place the front and second bearing adapters against the rear ends of their respective bearings, and place the replacer against the front part of the cylinder block. Insert the replacer shaft into these three parts, and screw in the retainer nut onto the replacer shaft. Hold the slotted portion of the shaft with a wrench to prevent the shaft from turning. By screwing in the retainer nut with another wrench, the front, and second bearings will be pulled out to the front.



Front and Second

Fig.3-37 Camshaft Bearing Removal X4951

c. Remove the third and rear bearings towards the rear of the cylinder block using the Camshaft Bearing Remover & Replacer in the same manner.



Third and Rear

Fig.3-38 Camshaft Bearing X4950 Removal

4. Bearing installation.
If a new camshaft is to be used, always use a standard size bearings.
If the oil clearance exceeds with the standard size bearings, grind the camshaft journals, and use under-size bearings.
Even after grinding the camshaft journals to the regular dimension, always check the oil clearance before installation.

a. Before installing the bearings, mark the position of the oil hole on the front face of each bearing bore to enable lining up the oil hole in the bearing with the oil hole in the cylinder block.

b. Install the correct bearings using the Camshaft Bearing Remover & Replacer 09215-60010.

c. If the bearings have been properly installed, only a very light cut is required to ream the bearings to proper size.

d. Blow all cuttings of the bearings with compressed air, and wash the cylinder block thoroughly with cleaning solvent. Blow out all oil passages.

e. Coat the rear expansion plug with a sealer, and install the plug into the cylinder block.

Camshaft journal finished diameter:
Bearing size - STD:
Camshaft journal:

Front	47.955 ~ 47.975 mm (1.8880 ~ 1.8888")
Second	46.455 ~ 46.475 mm (1.8289 ~ 1.8297")
Third	44.955 ~ 44.975 mm (1.7699 ~ 1.7707")
Rear	43.455 ~ 43.475 mm (1.7108 ~ 1.7116")

Bearing size - U/S-0.125:
Camshaft journal:

Front	47.840 ~ 47.850 mm (1.8835 ~ 1.8839")
Second	46.340 ~ 46.350 mm (1.8244 ~ 1.8248")
Third	44.840 ~ 44.850 mm (1.7654 ~ 1.7657")
Rear	43.340 ~ 43.350 mm (1.7063 ~ 1.7067")

Bearing size - U/S-0.25:
Camshaft journal:

Front	47.700 ~ 47.710 mm (1.8780 ~ 1.8783")
Second	46.200 ~ 46.210 mm (1.8189 ~ 1.8193")
Third	44.700 ~ 44.710 mm (1.7598 ~ 1.7602")
Rear	43.200 ~ 43.210 mm (1.7008 ~ 1.7012")

Bearig size - U/S-0.50:
Camshaft journal:

Front	47.460 ~ 47.470 mm (1.8685 ~ 1.8689")
Second	45.960 ~ 45.970 mm (1.8094 ~ 1.8098")
Third	44.460 ~ 44.470 mm (1.7504 ~ 1.7508")
Rear	42.960 ~ 42.970 mm (1.6913 ~ 1.6917")

Bearing size - U/S-0.75:
Camshaft journal:

Front	47.200 ~ 47.210 mm (1.8583 ~ 1.8587")
Second	45.700 ~ 45.710 mm (1.7992 ~ 1.7996")
Third	44.200 ~ 44.210 mm (1.7402 ~ 1.7406")
Rear	42.700 ~ 42.710 mm (1.6811 ~ 1.6815")

Bearing size - U/S-1.00:
Camshaft journal:

Front	46.940 ~ 46.950 mm (1.8480 ~ 1.8484")
Second	45.440 ~ 45.450 mm (1.7890 ~ 1.7894")
Third	43.940 ~ 43.950 mm (1.7299 ~ 1.7303")
Rear	42.440 ~ 42.450 mm (1.6709 ~ 1.6713")

Clutch Pilot Bearing

Inspect the clutch pilot bearing in the crankshaft.
If the bearing requires the removal, use the Input Shaft Front Bearing Puller 09303-55010.

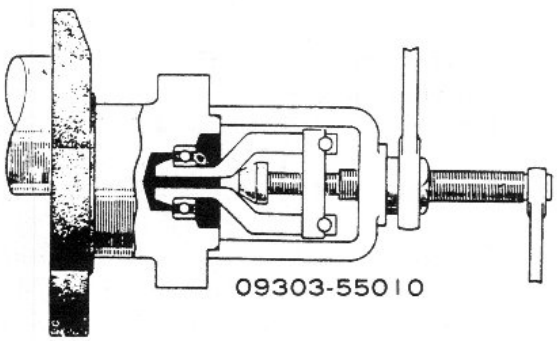


Fig.3-39 Clutch Pilot Bearing Removal G1569

Flywheel

1. Check the clutch disc contacting surface for cracks, scores, and other defects.
   Correct or replace the flywheel as necessary.

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

   a. To remove the flywheel ring gear, heat the ring gear by rotating the flywheel on a suitable stand to about 150 ~ 200°C or 300 ~ 390°F, and tap lightly, and remove the ring gear from the flywheel.

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

   c. Heat the ring gear to about 200°C (390°F), and install the ring gear onto the flywheel as quickly as possible. The ring gear must be installed while the gear is still hot.

3. Assemble the crankshaft with the flywheel onto the cylinder block. To assemble, refer to Engine Assembly on page 3-29.
   Next, install the clutch housing onto the cylinder block. Position a dial gauge onto the clutch disc contacting surface of the flywheel, and check the run-out.
   If the run-out exceeds 0.2 mm or 0.008", remove the flywheel, and check the contacting surfaces of the flywheel and the crankshaft. Remove any dirt or foreign matter, and if necessary, replace the flywheel.

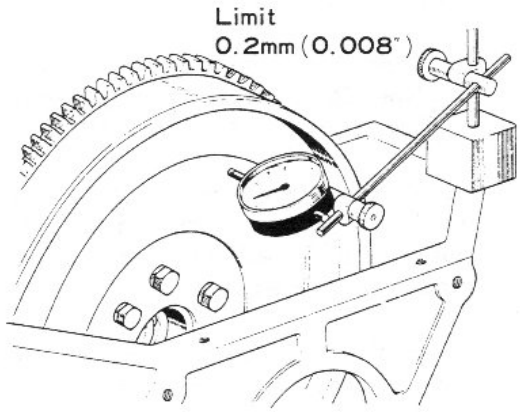


Fig.3-40 Measuring Flywheel Run-Out X4963

Clutch Housing

Inspect the clutch housing alignment with a surface plate, and a dial gauge. Place the clutch housing on the surface plate, and set the dial gauge onto the transmission case attaching surface of the clutch housing.
This surface parallelism should not exceed 0.20 mm (0.008"), and if it exceeds this limit, correct or replace the clutch housing.

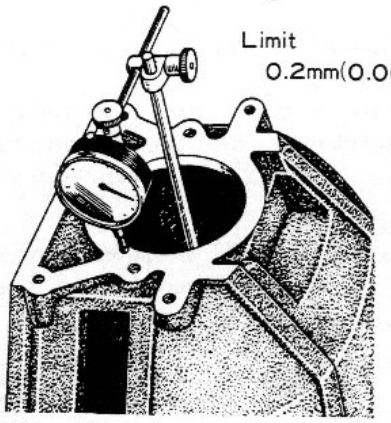


Fig.3-41 Checking Surface Parallelism X4964

Crankshaft Oil Seals

It is recommended that all oil seals should be replaced upon assembly.
To remove the crankshaft front oil seal, pry it out from the timing gear cover with a screwdriver.
Install the new oil seal so that the open end of the seal is towards the inside of the timing gear cover, and drive in place with the Transmission

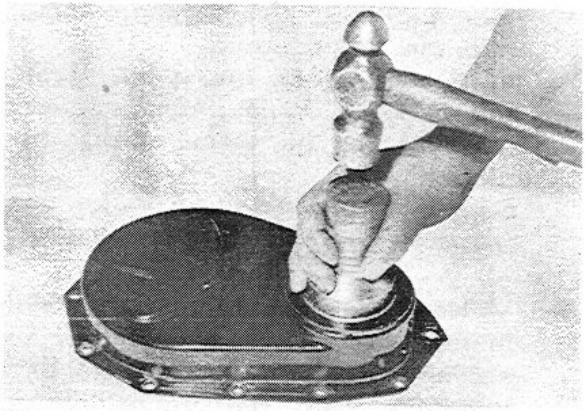


Fig.3-42 Installing Crankshaft Front Oil Seal V0550

Rear Bearing Replacer 09309-12010 or Rear Wheel Bearing Replacer 09515-35010.

NOTE:
Replacement of the crankshaft rear oil seal after the crankshaft and the oil pan are assembled. Pry out the oil seal with a screwdriver, and remove it.
To install, use the Crankshaft Rear Oil Seal Replacer 09223-60010, and drive it in place.

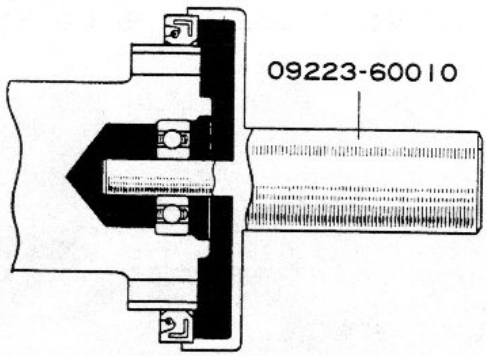


Fig.3-43 Oil Seal Installation G1570

Assembly

Before assembly, all rotating or sliding parts such as; cylinders, pistons, bearings, shafts, and others, should be lubricated with engine oil. All gaskets, packings, oil seals, cotter pins and lock washers should be replaced upon assembly. To prevent oil leak, use liquid sealer for bolts, packings, and gaskets.
Recheck the oil clearance, backlash, and thrust clearance upon assembly. Service torque specifications should be adhered whenever tightening the bolts and nuts specified with torque.

1. Piston to connecting rod assembly.

a. Assemble the piston to the connecting rod with the FRONT mark on the piston towards the front of the engine.
Also an oil hole is provided in the connecting rod journal, and it

should be towards the camshaft.

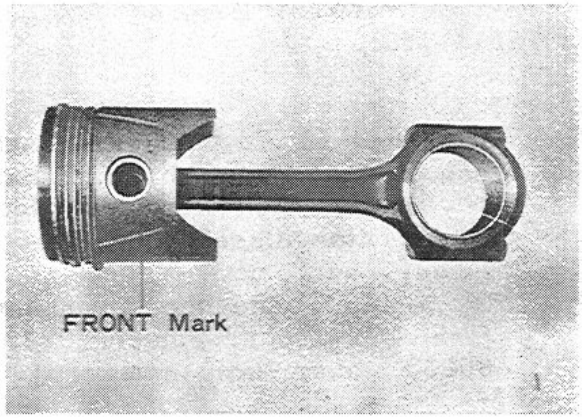


Fig.3-44 Connecting Rod & V4352 Piston

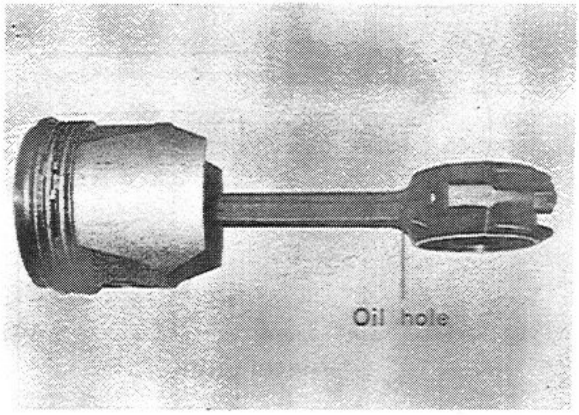


Fig.3-45 Connecting Rod & V4353 Piston

b. Place the piston in a piston vise.
Assemble the connecting rod to the piston, and install the piston pin.
Before tightening the piston pin bolt, center the piston pin in the piston, and the connecting rod in the center of the two piston pin bosses.
Tighten the piston pin bolt to 5.4 to 7.0 m-kg (39 ~ 51 ft-lb) torque, and move the piston on the pin from side to side, checking that the connecting rod is at the center of the piston pin.

Caution:
Before assembling the piston, heat the piston in a piston heater to 40 ~ 60° C (100 ~ 140° F) for about 5 minutes.

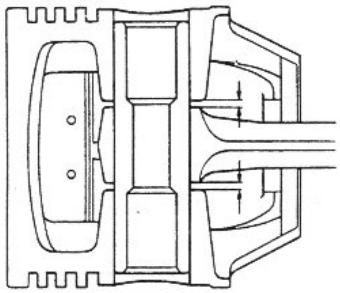


Fig.3-46 Piston & Connecting Rod Assembly G1571

2. Assemble the piston rings onto the piston.
The piston rings are provided with marks, and these marks should be faced upward upon installation.

NOTE:
Irsert the oil ring expander to oil ring No. 1 grove, and install the oil ring No. 1.

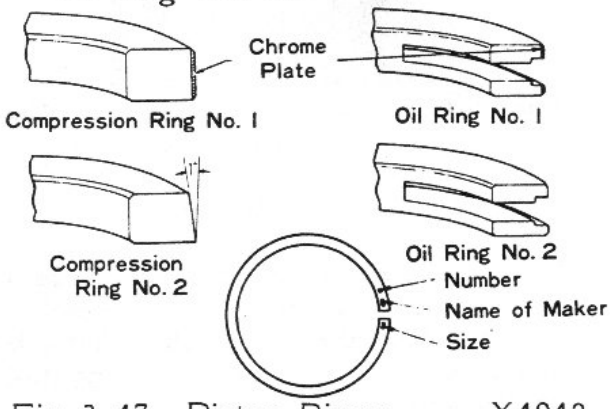


Fig.3-47 Piston Rings X4942

3. Insert the valve into the valve stem guide, and install the valve spring seat, valve spring, valve stem oil seal and the valve spring retainer onto the valve stem.
Next, compress the valve spring with a valve spring compressor, then install the valve spring retainer locks.
See that the retainer locks seat properly in the valve stem groove.

4. Valve rocker mechanism assembly.
Install the valve rocker arms, springs, and the valve rocker shaft supports onto the valve rocker shafts, then install the valve rocker shaft lock springs.

NOTE:

There are two kinds of rocker arms; intake and exhaust, and these should be assembled as shown in figure 3-48.

One end of each rocker shaft is plugged. The open end of each shaft should be placed towards the center when assembled. The oil delivery union, spring, and oil connecting sleeve are assembled between the two valve rocker shafts.

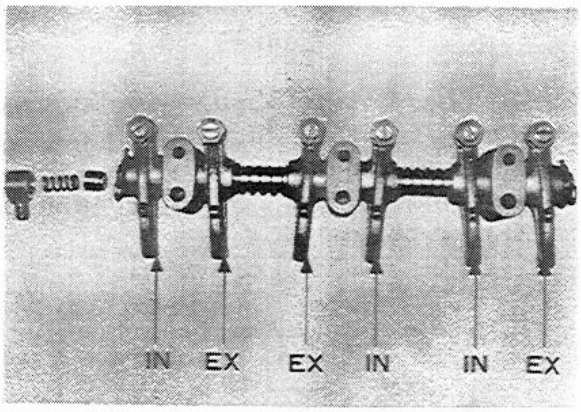


Fig.3-48 Valve Rocker Mechanism V4354

5. Clean the bearing fitting portion, and install the crankshaft bearing upper halves onto the cylinder block, then install the crankshaft and the crankshaft rear oil seal. Apply a light coat of engine oil onto the crankshaft journals and the bearings.

6. Install the crankshaft bearing lower halves onto the bearing caps, then install the bearing caps and the shims onto the cylinder block. Apply a liquid sealer onto the contact surface of the front and rear bearing caps and the cylinder block to prevent the oil leak.

Tighten the bearing cap retaining bolts as follows:

Front, second & third: 12.5 ~ 15 m-kg (90 ~ 108 ft-lb)

Rear: 10.5 ~ 13 m-kg (76 ~ 94 ft-lb)

Rotate the crankshaft to assure that the bearings are not too tight.

Caution:

When assembling the bearing caps, install the same thickness shims that were removed from the bearing caps during disassembly.

7. Install the connecting rod bearing upper halves onto the connecting rods.

With the FRONT mark on the piston be sure that this side will face towards the front of the engine. Also make sure that the ring gaps are properly spaced around the circumference of the piston.

Be sure to install the pistons in the original cylinders.

Apply light coat of engine oil onto the piston, piston rings and the cylinder bores.

Install the piston ring compressor onto the piston, and push the piston in with a hammer handle until it is slightly below the top of the cylinder.

Be sure to guide the connecting rods to avoid damaging the crankpin journals.

Install the connecting rod bearing lower halves onto the connecting rod caps, then install the connecting rod caps onto the connecting rods.

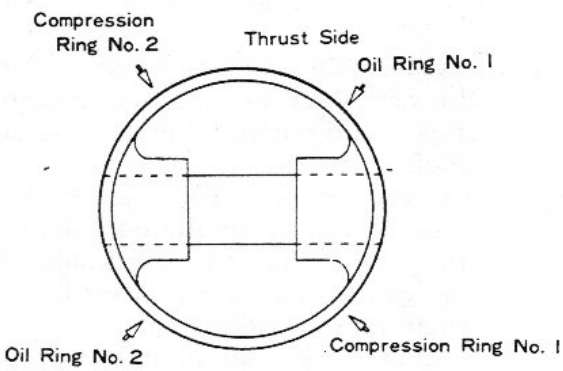


Fig.3-49 Spacing Piston X4957 Ring Gaps

Tighten the bearing cap retaining nuts to 4.8 ~ 7.6 m-kg (35 ~ 55 ft-lb) torque, and lock with the cotter pins

Rotate the crankshaft to assure that the bearings are not too tight.

8. Install the crankcase endplate with the gasket.

9. Inspect the crankshaft timing gear for chipped teeth or excessive wear. If necessary, replace the gear.
   To remove the gear, refer to Crankshaft Timing Gear, Removal on page 3-10.
   To install the gear, use the Crankshaft Pulley & Gear Replacer 09214-60010, and by tapping the Replacer with a hammer.
   Drive the gear onto the crankshaft until it is in the original position.

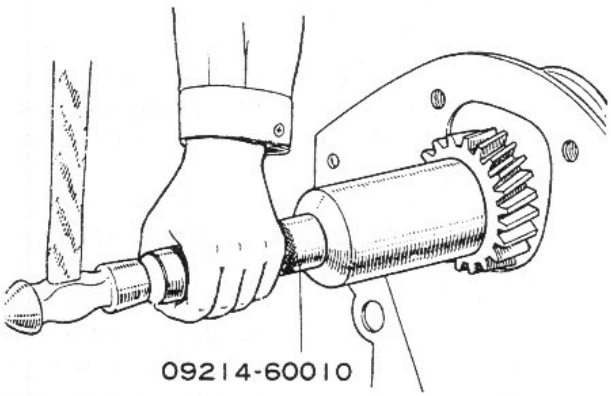


Fig.3-50 Installing Crankshaft Timing Gear X4954

10. Apply light coat of engine oil onto the camshaft journals and the bearings, and carefully insert the camshaft.
    At this time, align each of the mating marks on the camshaft timing gear with the crankshaft timing gear, and then push the camshaft into position.
    Tighten the camshaft thrust plate retaining bolts to 2.0 m-kg (14.5 ft-lb) torque.

11. **Check the gear backlash between the camshaft timing gear and the crankshaft timing gear with a narrow feeler gauge.**
    The gear backlash should be 0.05 to 0.125 mm (0.002 ~ 0.005").
    If the gear backlash exceeds 0.20 mm (0.008"), replace the camshaft gear, and or the crankshaft timing gear.

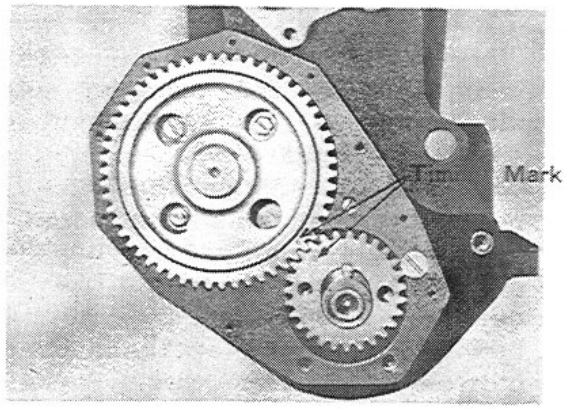


Fig.3-51 Aligning Timing Marks V4346

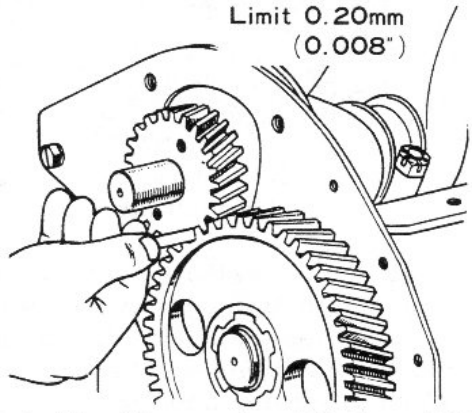


Fig.3-52 Measuring Timing Gear Backlash X4958

12. Check the camshaft, and crankshaft gear run-out with a dial gauge.

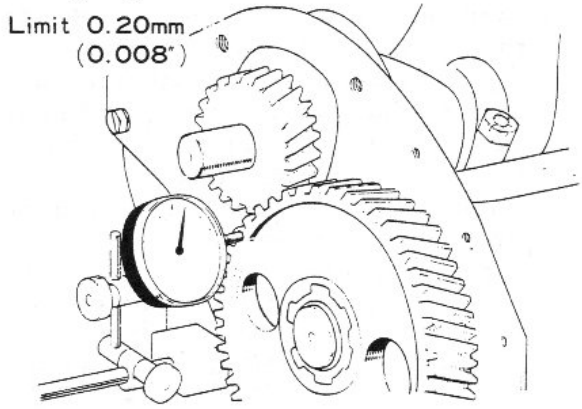


Fig.3-53 Checking Run-Out X4962

The camshaft, and crankshaft gear run-out should not exceed 0.20 mm (0.008").
If the run-out is excessive, the gear must be removed and replaced.

13. If the timing gear oil nozzle was removed, screw in the oil nozzle with a screwdriver, and lock the oil nozzle in place by punching at two places.
Position the oil supply hole of the oil nozzle to direct the oil onto the timing gears.

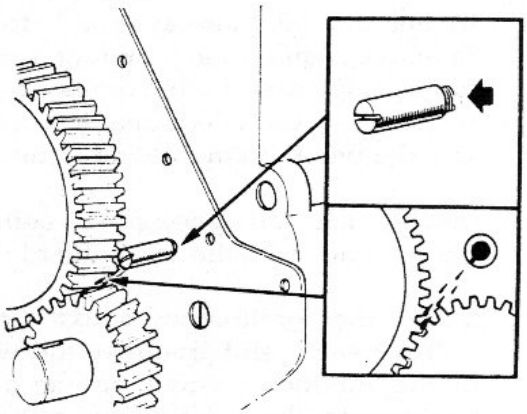


Fig.3-54 Timing Gear Oil Nozzle X4968

14. Install the oil slinger onto the crankshaft.
Install the timing gear cover with the gasket, and tighten the cover retaining bolts to 1.6 m-kg (12 ft-lb) torque.

15. Position the key and install the crankshaft pulley onto the crankshaft with the Crankshaft Pulley & Gear Replacer 09214-60010.

16. Install the oil pump together with the pipes, and tighten the oil pump retaining bolt to 1.0 ~ 1.6 m-kg (7 ~ 12 ft-lb) torque. Connect the pipe securely.
Lock the oil pump retaining bolt with a wire.
Install the oil strainer shell assembly.

17. Apply liquid sealer onto the oil pan gasket, and install the oil pan and the oil pan gasket.
Tighten the oil pan attaching bolts to 0.6 ~ 1.2 m-kg (4 ~ 9 ft-lb) torque.

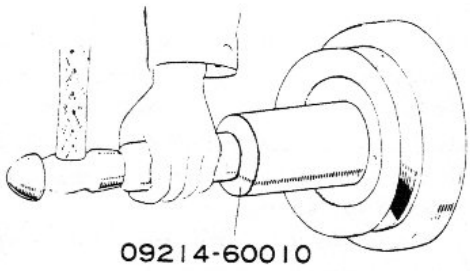


Fig.3-55 Installing Crankshaft Pulley X4955

18. Assemble the oil pressure regulator with the gasket.
Tighten the bolts to 2.0 m-kg or 14 ft-lb torque.

19. Clean the cylinder head, and the cylinder block gasket surface.
Position the new cylinder head gasket through the dowels on the cylinder block, and install the cylinder head together with the air cleaner support bracket.
Tighten the bolts a little at a time with a torque wrench in the sequence as illustrated.
The specified torque is 11.5 to 13.5 m-kg (83 ~ 98 ft-lb).

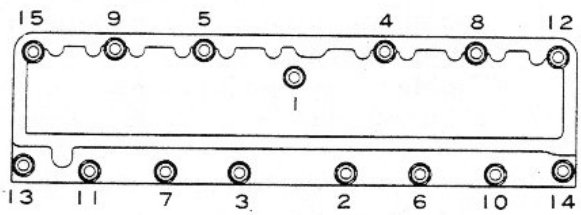


Fig.3-56 Tightening Sequence X4969

20. Install the oil delivery pipe.
Install the valve lifters in their original positions.

21. Install the push rods, and then assemble the valve rocker mechanism onto the cylinder head.
Install the valve rocker shaft oil delivery union, spring and the connecting sleeve.
Connect the oil delivery pipe with the oil delivery union.
Valve rocker shaft support retaining bolts and nuts tightening torque.
10 mm bolts and nuts: 3.4 ~ 4.1 m-kg (25 ~ 30 ft-lb)
8 mm bolts: 2 ~ 3 m-kg (14 ~ 22 ft-lb)

22. Adjust the valve clearance by positioning each piston at T.D.C. of compression stroke.

Valve clearance:

Intake	0.20 mm (0.0079")
Exhaust	0.35 mm (0.0138")

The valve clearance should be readjusted after warming up the engine.
Refer to Valve Clearance in Engine Tune-up section.

23. Install the valve lifter cover with the gasket.

24. Install the fuel pump with the gasket onto the cylinder block.

25. Position the manifold gasket, and install the intake and exhaust manifold assembly.
Tighten the retaining nuts to 2 to 3 m-kg (14 ~ 22 ft-lb) torque.

26. Install the carburetor onto the intake manifold.

27. Install the water outlet housing assembly together with the thermostat and the gasket.

28. Install the carburetor fuel pipe with the vacuum pipe.
Connect the carburetor fuel pipe to the carburetor and the fuel pump.

29. Install the water pump assembly and the gasket. At this time, also install the alternator adjusting bar.
Connect the water pump by-pass hose.

30. Install the alternator onto the bracket.

31. Install the oil filter assembly to the manifold, and then connect the oil filter inlet and outlet pipes to the oil filter, oil pressure regulator and the union on the cylinder block.

32. Install the oil pressure sender gauge unit onto the cylinder block.

33. Install the ignition coil onto the cylinder head, and connect the wire of the magnetic valve on the carburetor to the ignition coil positive terminal.

34. Install the oil filler tube into the cylinder block, and secure the tube clamp.

35. Remove the engine assembly from the engine work stand.

36. Position the clutch housing together with the engine mounting rear brackets through the two dowels on the cylinder block.
Tighten the clutch housing retaining bolts to 8.0 m-kg (58 ft-lb) torque.

37. Carefully install the flywheel onto the crankshaft.
Place the lock plates, and tighten the flywheel retaining bolts to 6 to 7 m-kg (43 ~ 51 ft-lb) torque.
Lock the bolts with the lock plates.

38. Align the mating marks on the clutch cover and the flywheel, and assemble the clutch cover and the

clutch disc always using the Clutch Guide Tool 09301-55022.
Tighten the clutch cover retaining bolts to 3 m-kg (22 ft-lb) torque.

39. Distributor installation.
a. Rotate the crankshaft until No.1 piston is positioned at T.D.C. after compression stroke.
Align the timing ball in the flywheel with the pointer on the clutch housing.

b. Set the octane selector at normal position.
Position the distributor rotor as shown in figure 3-57, then push the distributor down into position until the distributor gear is fully meshed with the camshaft gear. Make sure the distributor shaft is properly engaged in the oil pump shaft.
Next, rotate the distributor housing clockwise until the breaker points are just starting to open. Tighten the holder screw securely.
Connect the vacuum pipe to the distributor and carburetor. The final adjustment should be performed using the timing light and the engine at idle speed.
To adjust, refer to Ignition Initial Timing in Engine Tune-up section.

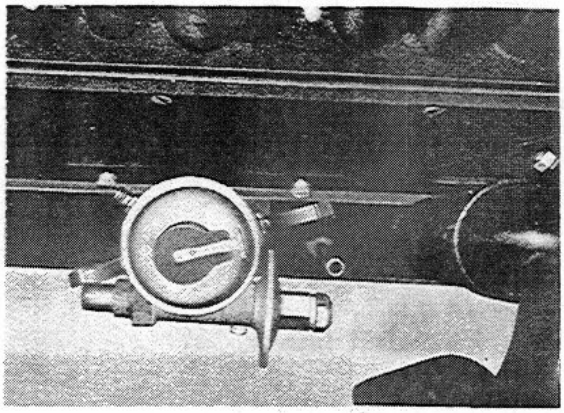


Fig.3-57 Distributor Installation V4355

40. Install the fan pulley and the fan. Engage the "V" belt, and adjust the "V" belt tension.
The specified tension is 7 ~ 10 mm (0.28 ~ 0.40") when depressed at midway of the belt with 10 kg (22 lb) pressure.

41. Install the air cleaner assembly.

42. Install the starter and the ground cable to the clutch housing.

43. Check the clutch release lever height with the Clutch Pressure Lever Height Gauge 09302-25010 and if necessary, adjust the lever height with the clutch pressure lever adjusting bolts.
The lever height should be 74.5 mm (2.93") for FJ, or 76.5 mm (3.01") for FA from the transmission contacting surface of the clutch housing.

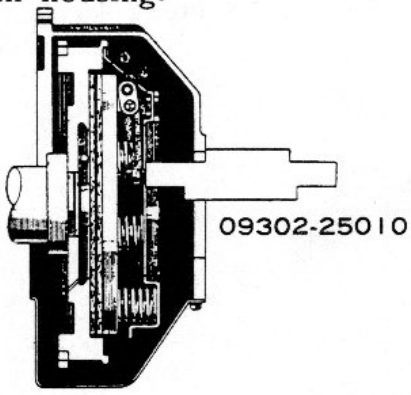


Fig.3-58 Clutch Release Lever Height G1572

44. Apply multipurpose grease onto the contacting surfaces of the clutch release bearing, clutch pressure lever adjusting bolts, release bearing hub, release fork and release fork ball.
Install the clutch release fork and the clutch release bearing hub together with the bearing.
Install the release bearing hub clips.
Install the release fork boot and the boot plate.

45. Apply multipurpose grease onto the transmission front bearing retainer and the input shaft spline, and then install the transmission assembly to the clutch housing.

Tighten the transmission retaining bolts to 7.5 ~ 8.0 m-kg (54 ~ 58 ft-lb) torque.

46. Install the flywheel housing under cover, and the side cover.

47. Install the oil level gauge.

Installation

Follow the removal procedures in the reverse orde

1. Refill the engine with coolant and lubricant.
   Engine oil capacity (w/oil filter):
   FJ - 8.0 liters (8.45 US qts., 7.05 Imp. qts)
   FA - 7.5 liters (7.93 US qts., 6.61 Imp. qts)
   Coolant capacity:
   FJ - 15.2 liters (16 US qts., 13.4 Imp. qts)
   FA - 19.1 liters (20.2 US qts., 16.8 Imp. qts)

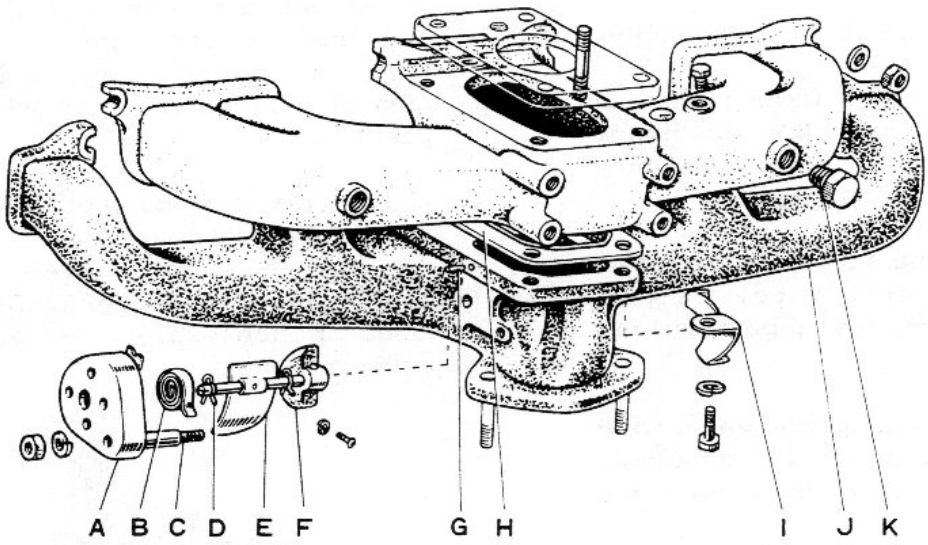
2. Check and adjust the clutch release fork end play.
   The end play should be 5.3 mm or 0.21".

3. Tune-up the engine by referring to Engine Tune-Up section.

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

INTAKE & EXHAUST SYSTEM

INTAKE & EXHAUST MANIFOLDS



A. Heat control bimetal case
B. Heat control valve coil
C. Case bolt
D. Retainer spring
E. Heat control valve
F. Heat control shaft
G. Dowel pin
H. Manifold gasket
I. Counter weight stopper
J. Exhaust manifold
K. Taper screw plug

Fig.4-1 Intake and Exhaust Manifolds Components G1573

The intake manifold is of a "D" shaped cross section which aids in atomizing, and even distribution of fuel mixture to each cylinder.
The exhaust manifold if designed to reduce back pressure to a minimum.
Located on the inside of the exhaust manifold is the thermostatically operated heat control valve. This valve in the exhaust manifold directs the hot exhaust gas against the center of the intake manifold when the engine is cold.

As the engine warms up, the heat control valve coil closes the valve, and directs the exhaust gas away from the intake manifold.
This thermostatic control results in the proper temperature of the incoming gas under all operating conditions.
The tension of heat control valve coil is very important. If too tight, the heat will not be turned off, and the intake gas heats as the engine warms up, causing the incoming gas to expand several times greater than normal, and it will be impossible to get a normal fuel charge into the cylinders. If it sticks in the "heat on" position, it will result in poor engine performance, overheating and detonation.

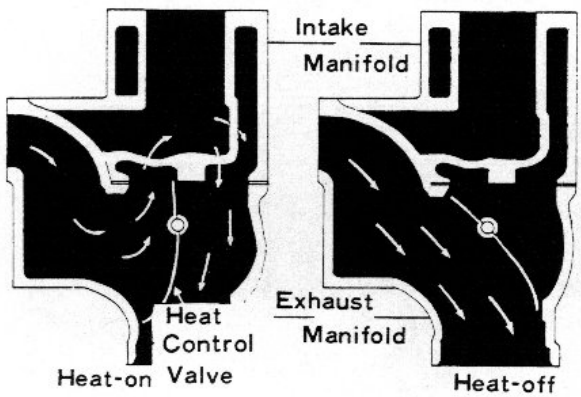


Fig.4-2 Heat Control Valve X4976 Operation

Removal

1. Remove the air cleaner assembly.
2. Disconnect the oil filter inlet, and outlet pipes from the oil filter. Remove the oil filter assembly from the intake manifold.
3. Disconnect the throttle rod, choke rod, accelerator wire, vacuum pipe, and the fuel pipe from the carburetor.
4. Disconnect the magnetic valve wire from the ignition coil terminal, and then remove the carburetor assembly.
5. Disconnect the exhaust pipe from the exhaust manifold.
   Loosen and remove the manifold retaining nuts, then remove the intake and exhaust manifolds and the gaskets.

Inspection

1. Inspect the manifold for corrosion, cracks or any other damage.
   If defective, replace the manifold.
2. Check the distortion of the manifold gasket surface.
   Correct or replace if the distortion exceeds 2.0 mm (0.08").

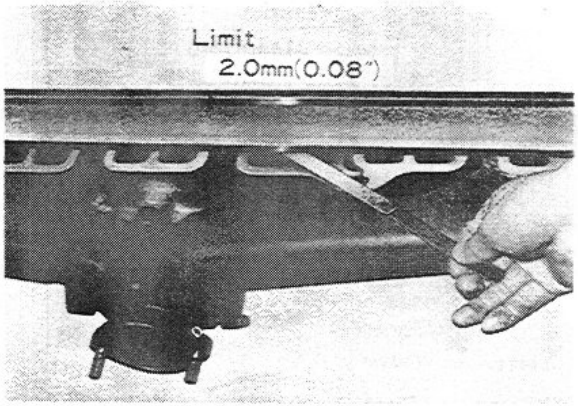


Fig.4-3 Checking Manifold Distortion V4356

3. Check the heat control valve to make sure it is hooked onto the dowel pin.
   It is essential that the coil should be wound just enough to hook its end onto the dowel pin.
   This is approximately 1/2 of a turn of the coil from its unhooked position.
4. Check the heat control valve for free movement.
   To free a sticky valve, use a penetrating oil, and graphite mixture. If necessary, replace the related parts.

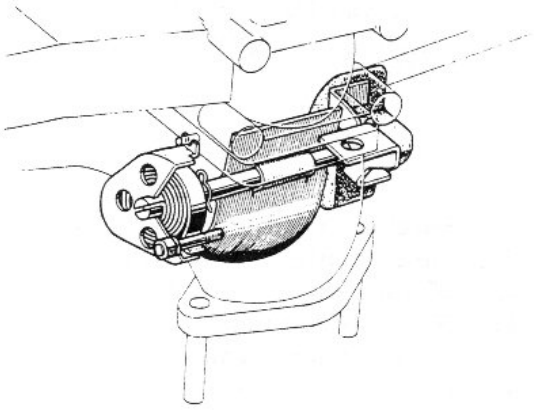


Fig.4-4 Heat Control Valve Y5720

5. Check the heat control valve on the car, and make sure that the coil keeps the valve at "heat-on" position when the engine is cold. The valve is at "heat-off" position when the engine is at normal operating temperature.

Installation

Follow the removal procedures in the reverse order.

NOTE:

1. When installing the heat control valve coil, make sure that the coil is hooked onto the dowel pin making 1/2 of the coil from its unhooked position.
2. When installing the manifold, a new manifold gasket should be used.
3. Tighten the manifold retaining nuts to 2 ~ 3 m-kg (14 ~ 22 ft-lb) torque.

EXHAUST PIPE & MUFFLER

The exhaust pipe extends from the exhaust manifold to muffler, and is attached to the manifold with two retaining nuts. This connection between the exhaust manifold, and the exhaust pipe is sealed by a gasket. The rear end of the exhaust pipe is installed in the muffler, and held in place by a clamp. The muffler is supported at the frame side rail by a clamp bracket, and a clamp. The front end of the tail pipe is installed to the muffler by a clamp while the rear end is supported onto the frame with a clamp.

Exhaust Pipe Replacement

Loosen the clamp attaching the rear end of the exhaust pipe to the muffler. Remove the retaining nuts from the stud bolts at the exhaust pipe flange. Remove the pipe front end from the manifold, and remove it from the bottom of the vehicle.
To install the exhaust pipe, make sure the clamp is in place at the front end of the muffler. Install the rear end of the exhaust pipe into the muffler, and the front end of the pipe into the manifold. Using a new gasket, install the pipe flange and tighten the nuts securely. Tighten the clamp bolt at the rear of the exhaust pipe.

Muffler & Tail Pipe Replacement

Loosen the clamp attaching the tail pipe to the muffler, and remove the clamp attaching the pipe to the frame. Remove the pipe from the muffler.
Loosen the exhaust pipe clamp. Remove the nut, and washer from the muffler clamp bolt, and remove the bolt from the clamp. Remove the muffler towards the rear of the vehicle.
Make sure that the clamp is in place at the front end of the muffler, and install the exhaust pipe into the muffler. Install the muffler in the clamp, and secure it in place with the bolt, nut and washer.
Install a clamp on the rear end of the muffler, then install the front end of the tail pipe into the muffler, and tighten the bolt securely. Install a clamp at the rear end of the pipe, and tighten the bolt until the pipe is secured in place.

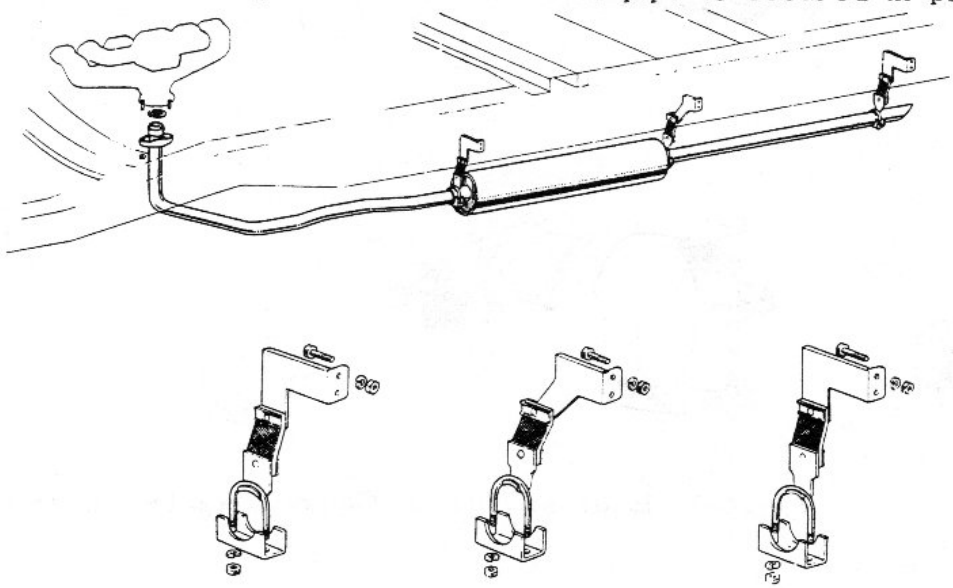


Fig.4-5 Exhaust System Components (FA series) Y2109

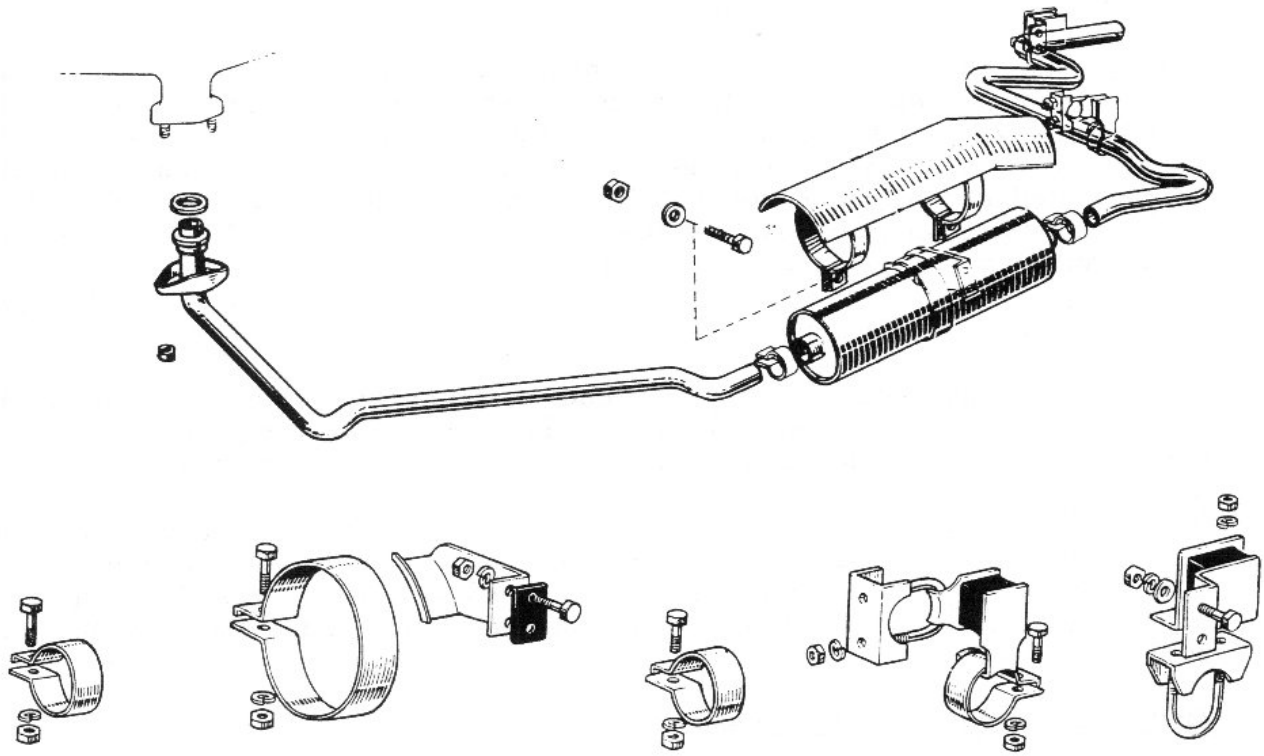


Fig.4-6 Exhaust System Components (FJ-RHD) Y2107

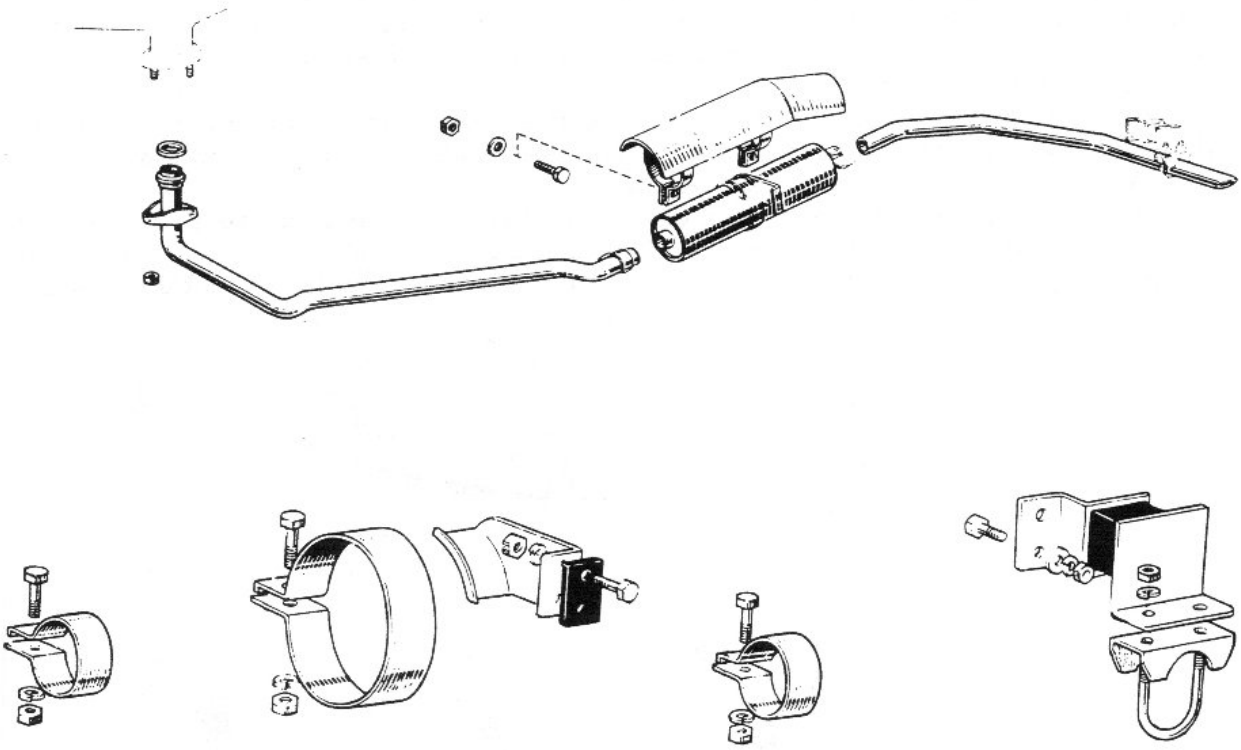


Fig.4-7 Exhaust System Components (FJ-LHD) Y2108

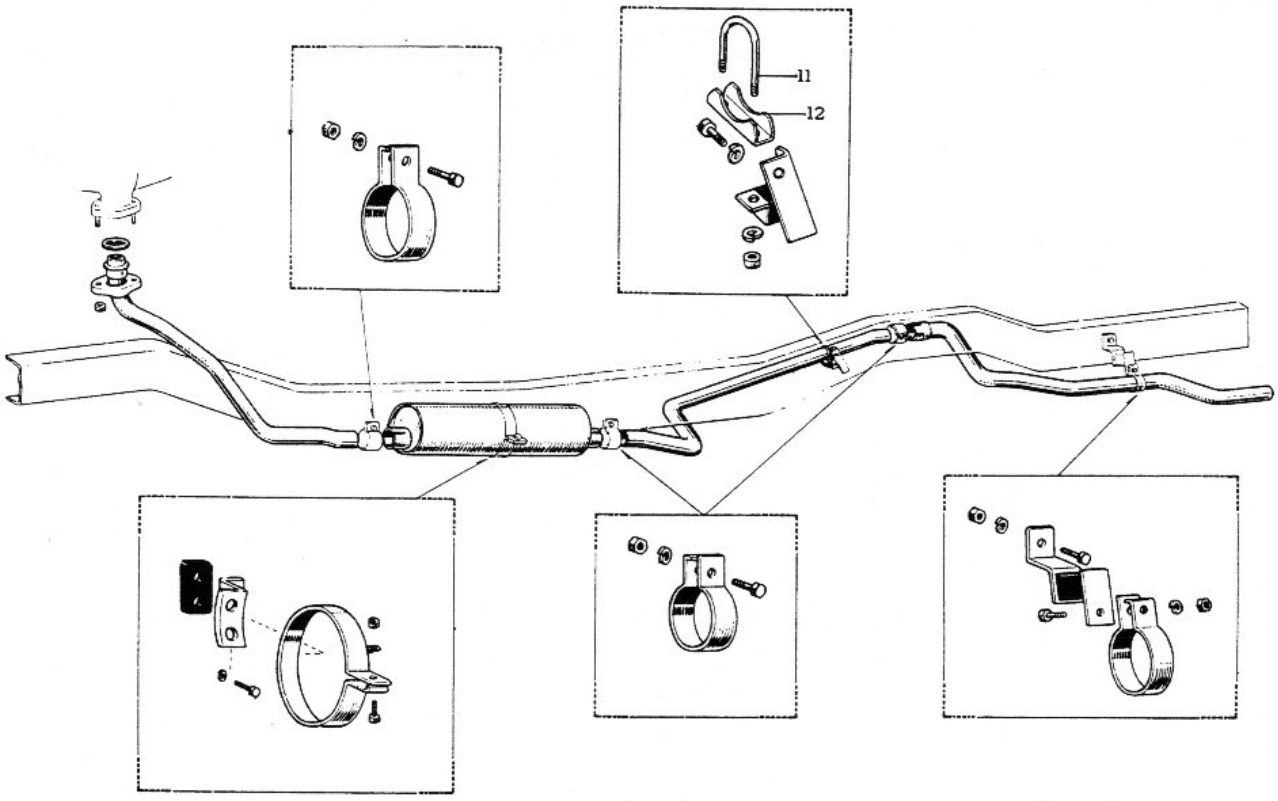


Fig.4-8 Exhaust System Components (FJ-55V) G1696

FUEL SYSTEM

TROUBLE SHOOTING

Before diagnosing the trouble shooting of the carburetor, check the manifold mounting bolts, cylinder compression, and the ignition system.

Symptoms & Probable Causes	Remedies
Carburetor	
1. Flooding	
a. Improper seating or damaged float needle valve, and seat	Replace needle valve, and seat
b. Incorrect float level	Adjust float level
c. Leaky float	Replace float
d. Worn float tab	Replace float
e. Worn float pin & related parts	Replace float pin & related parts
f. Defective air-horn gasket or loose attaching screws	Replace gasket & tighten screws
g. Fuel pump excessive pressure	Check fuel pump
2. Rough idling	
a. Incorrect idle adjustment	Adjusting idling
b. Defective idle adjusting screw	Replace idle adjusting screw
c. Plugged idle passage, idle port	Clean passage & port
d. Improper low speed jet seating	Tighten jet or replace
e. Worn throttle shaft	Replace shaft
f. Loose vacuum pipe union	Tighten union
g. Plugged economizer jet	Clean jet
h. Improper low speed system passage seal	Tighten plug or replace seal
i. Defective flange gasket	Replace gasket
j. Defective magnetic valve	Replace magnetic valve
3. Excessive fuel consumption	
a. Float level too high	Adjust float level
b. Plugged air bleeder	Clean or replace air bleeder
c. Loose plug or jet	Tighten plug or jet
d. Defective power valve	Replace power valve
e. Defective gaskets	Replace gaskets
f. Vacuum leaks from power piston vacuum passage	Check vacuum passage
g. Worn step-up-rod and jet (FJ)	Replace jet and rod
h. Choke valve opens improperly	Check & repair choke linkage and related parts
i. Clutch slippage	Adjust or replace clutch
j. Dragging brakes	Adjust brakes
k. Incorrect tire inflation	Correct tire inflation
4. Poor acceleration (lack of rich fuel mixture for acceleration)	
a. Defective accelerating pump	Replace plunger
b. Plugged pump jet	Clean or replace jet

c. Discharge check valve operating improperly	Replace discharge check valve
d. Defective accelerator linkage	Adjust linkage
e. Defective operation of power piston	Replace power piston or spring
f. Defective power valve	Replace power valve
g. Incorrect step-up-rod height (FJ)	Adjust height of rod
h. Plugged power jet	Clean or replace jet
i. Float level too low	Adjust float level
j. Incorrect throttle opening	Adjust throttle linkage

5. Stalling (lack of fuel mixture at high speed)

a. Plugged main jet	Clean
b. Incorrect float level	Adjust float level
c. Defective operation of power piston	Replace power piston or spring
d. Defective power valve	Replace power valve
e. Incorrect step-up-rod height (FJ)	Adjust height of rod
f. Worn throttle valve shaft	Replace throttle valve shaft
g. Defective gaskets	Replace gaskets
h. Incorrect throttle opening	Adjust throttle linkage

6. Poor cold weather operation

a. Improper choke operation	Replace choke related parts
b. Incorrect fast idle	Adjust fast idle

Fuel Pump

1. Fuel leaks from fuel pump

a. Loose fuel pump cover screws	Tighten screws
b. Defective diaphragm	Replace diaphragm
c. Defective union fitting threads	Replace union fitting

2. Oil leaks from fuel pump

a. Loose rocker arm pin	Replace rocker arm pin
b. Defective fuel pump mounting	Tighten attaching bolts or replace gasket

3. Insufficient fuel delivery

a. Loose fuel pipe connections	Tighten connections
b. Defective diaphragm	Replace diaphragm
c. Defective valve(s)	Replace valve(s)
d. Cracked or broken fuel pipe	Replace fuel pipe
e. Broken or weak rocker arm spring(s)	Replace spring(s)

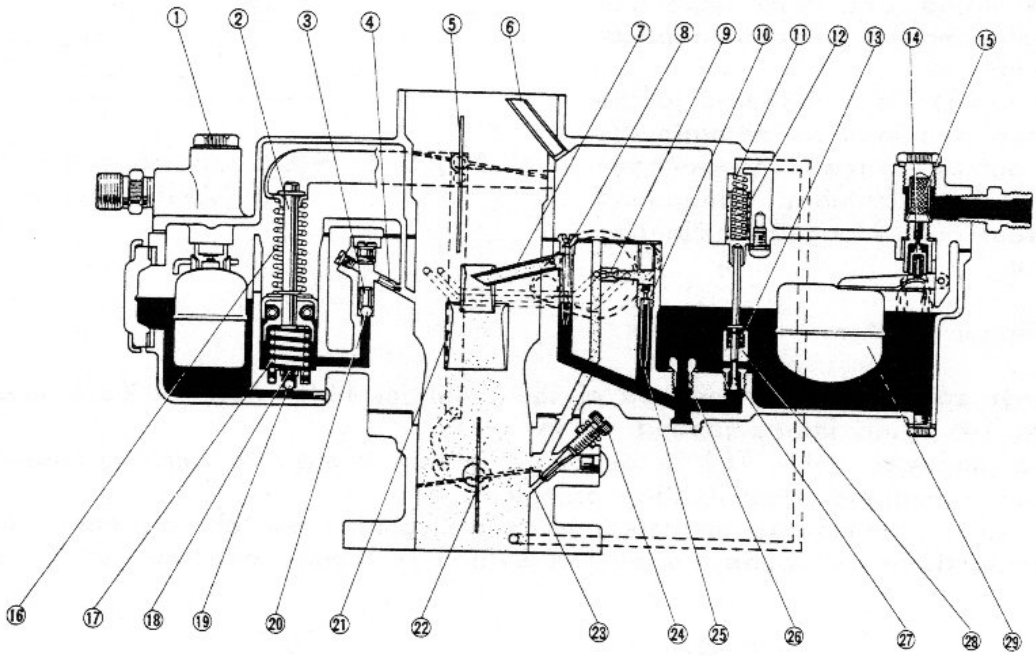
4. Noisy fuel pump

a. Loose fuel pump mounting	Tighten mounting bolts
b. Worn or defective rocker arm	Replace rocker arm
c. Defective rocker arm spring	Replace rocker arm spring

CARBURETOR (OLD) -For FJ

Construction & Operation

1. Float chamber and air vent system
2. Low speed system
3. High speed system
4. Power system
5. Accelerating system
6. Choke and Fast idle system



1. Main passage plug
2. Pump plunger
3. Discharge weight
4. Pump jet
5. Choke valve
6. Air vent
7. Main nozzle
8. Main air bleed jet
9. Economizer jet
10. Slow jet
11. Power piston spring
12. Power piston
13. Power valve spring
14. Needle valve
15. Strainer
16. Pump spring
17. Pump damping spring
18. Ball retainer
19. Check ball
20. Check ball
21. Venturi
22. Throttle valve
23. Idle port
24. Idle adjusting screw
25. Air bleed tube
26. Main jet
27. Power valve
28. Power valve seat
29. Float

Fig.5-1 Cross Section View of Carburetor Y5716

1. Float chamber & Air vent system

The float chamber serves as a constant fuel reservoir. The fuel enters into the float chamber thru the strainer (1), and the needle valve (2). The quantity of fuel is regulated by the needle valve opening movement from the valve seat, and also by the fuel pump pressure.
Proper fuel level is maintained by the float (5) proper seating of the needle valve, and the correct pump pressure.
These items are very important to obtain proper performances of the carburetor.
Air vent(6) is connected to the air-horn provided to maintain the same air pressure in the air-horn and the float chamber, eliminating the effect of a clogged air cleaner element.

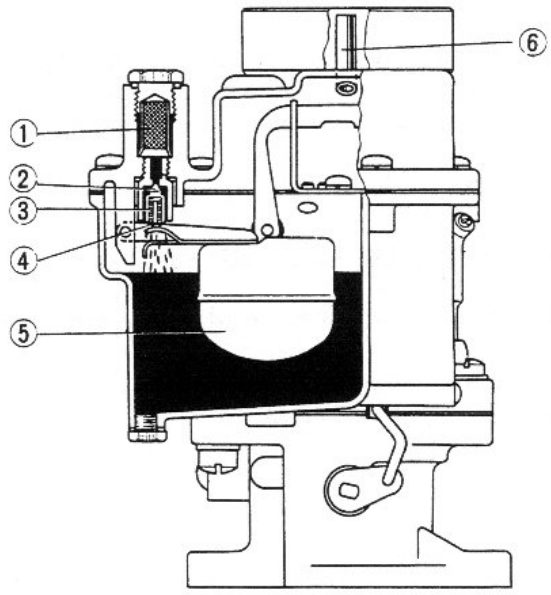


Fig.5-2 Float Chamber & Air Vent System G1316

2. Low speed system

The low speed system consists of the main jet (1), slow jet (3), economizer jet (4), and idle adjusting screw (5).
Also a magnetic valve (6) is provided in this system to prevent engine from continuous running after ignition circuit is off.
The magnetic valve is operated when the ignition switch is turned on, and the economizer jet opens. When the switch is turned off, the economizer jet

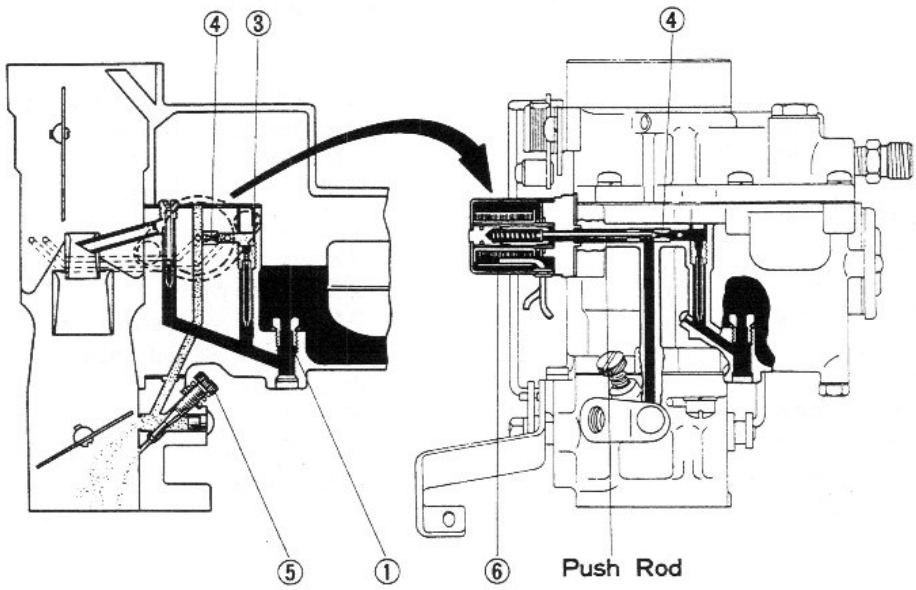


Fig.5-3 Low Speed System Y5717

is closed by the magnetic valve, and the fuel does not discharge when the engine is at stopped condition.
Therefore, the fuel does not overflow even though the temperature in the engine compartment is high.
The fuel from the float chamber flows through the main jet then to the slow jet, and the economizer jet, and mixes with the air from the air bleeder, and flows down into the idle port to be discharged into the intake manifold in spray form.
The fuel flow is controlled through the main jet, and step-up-rod, slow jet, and the economizer jet.
The idle fuel discharge is controlled by the idle adjusting screw.
When the throttle valve starts to open slightly, and as the edge of the throttle valve moves past the slow port, the intake manifold vacuum is applied onto the slow port, and this port starts discharging the air-fuel mixture same as the idle port.

3. High speed system

The high speed system consists of the main jet (4), main air bleeder (2), main nozzle (1), and the small venturi.

As the throttle valve opens gradually, low pressure area transfers from the slow port to the main nozzle. The pressure difference between the main nozzle, and the float chamber forces the fuel to flow through the main fuel system.
As the throttle valve opens, and also the step-up-rod is sunk down, the fuel passage of the main jet becomes spread. The fuel flows through the main jet, and up thru the fuel passage.
The air entering through the main air bleeder, and mixes with the fuel, then the air-fuel mixture flows up the main nozzle.
The fuel flow is controlled by the main nozzle and the step-up-rod.

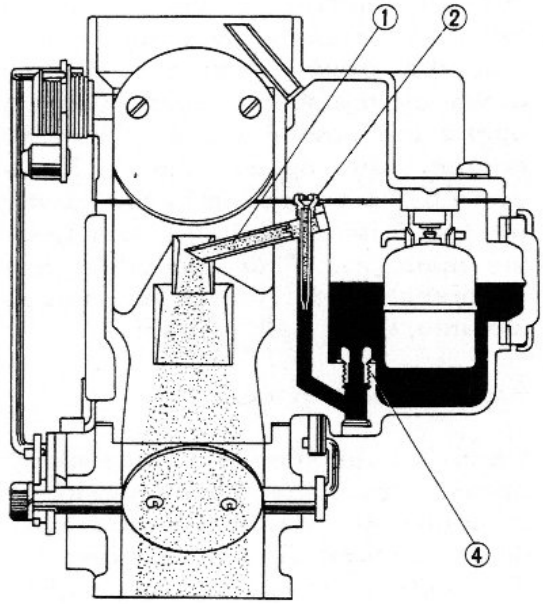


Fig.5-4 High Speed System G1317

4. Power system

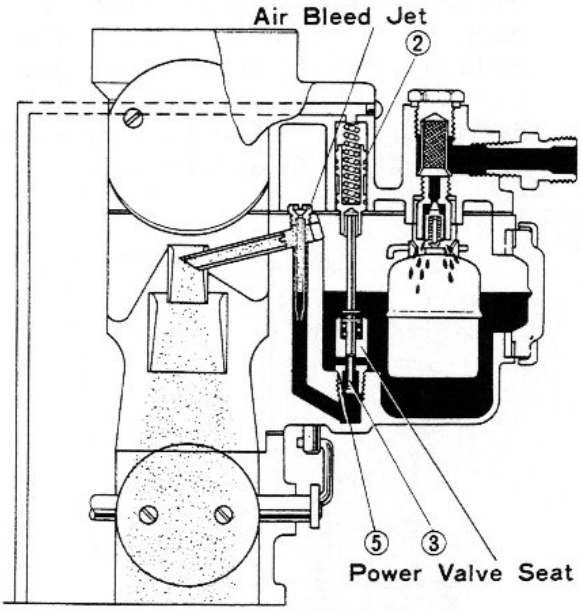


Fig.5-5 Power System G1318

At full opened throttle, when full engine power is desired, an increase of rich fuel mixture is required.
At light load when the intake manifold vacuum is high, the mani-

fold vacuum pulls up the power piston (2) to close the power valve (3).
As the throttle valve is opened fully, the manifold vacuum drops, and the power piston is pushed down by the spring tension, which opens the power valve. When the power valve opens, the fuel flows down being controlled by the power jet (5), joins with the fuel from the main jet. This extra fuel can be discharged from the main nozzle into the small venturi.

5. Accelerating system

When the throttle valve is suddenly opened from the closed position, a momentary out-of-balance condition occurs in the carburetor. To obtain an immediate engine power additional rich fuel mixture is required. However, when the throttle valve is opened suddenly, the effect is to "dump" air into the intake manifold, thus suddenly reducing the manifold vacuum. This sudden change of air flow, plus the need for a momentary richness of fuel, results inadequate supply of fuel for acceleration from the main nozzle.

To overcome this momentary lapse which could cause a "flat spot" or engine lugging, accelerating system is incorporated in this carburetor.
When the accelerator pedal is depressed for quick acceleration, the plunger (1) connected to the throttle valve is pushed down onto the fuel in the pump cylinder. The fuel pushes the check ball (5), and the discharge weight (2), and flows out from the pump jet (3) to richen the mixture necessary for acceleration.
When the throttle is closed, the pump piston is pulled upward so that the pump chamber becomes refilled with fuel, ready for the next acceleration period.

6. Choke & Fast idle system

When the engine is cold, the fuel vapor contained in the fuel mixture supplied by the carburetor condenses on the cold intake manifold, and cylinder walls. Thus, the air fuel mixture entering the combustion chambers will be exceedingly lean making ignition difficult, and even if ignited the engine will have inadequate power.

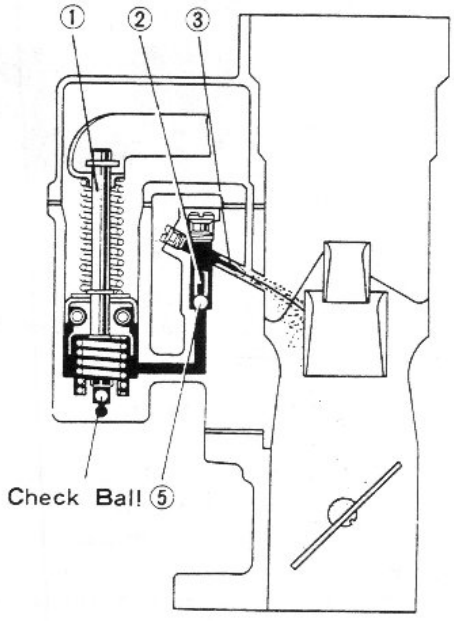


Fig.5-6 Accelerating System G1319

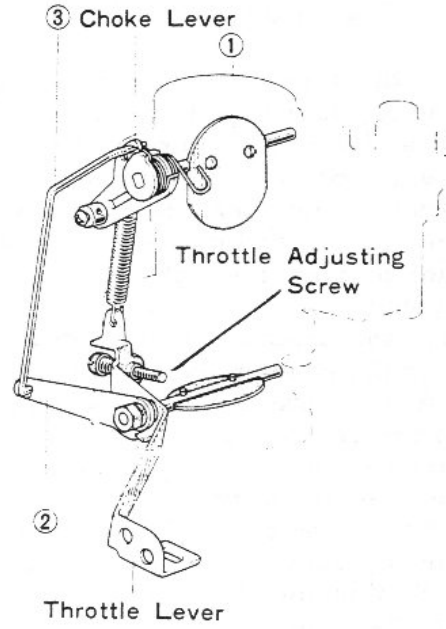


Fig.5-7 Choke & Fast Idle System G1320

In operation, closing the choke valve (1) lessens the air flow, and the vacuum is directly effected on the main nozzle causing the fuel to be discharged from this point to form a richer mixture. When the carburetor is in choked position, the fast idle lever (2) on the throttle shaft connects onto the choke lever with the fast idle connector (3), and the throttle valve is opened slightly.
For this reason, the idling revolution is lightly higher (fast idle).

Removal

1. Remove the air cleaner assembly.

2. Disconnect the choke and throttle rod wires from the carburetor. Disconnect the accelerator wire, fuel pipe and the vacuum pipe from the carburetor.

3. Disconnect the magnetic valve wire from the ignition coil terminal.

4. Loosen and remove the carburetor mounting nuts, and remove the carburetor. After removing the carburetor, cover the intake port of the manifold with a clean shop towel to prevent dust or dirt from entering.

Disassembly

For disassembly, and assembly operations of the carburetor, the Carburetor Driver Set 09860-11010, and the Carburetor Adjust Kit 09240-60030 should be utilized.
Proper wrenches with correct sizes should be used, and the parts removed must be thoroughly washed with clean gasoline or carburetor cleaning fluid.
The disassembled parts should be kept in a clean container to facilitate the assembly.

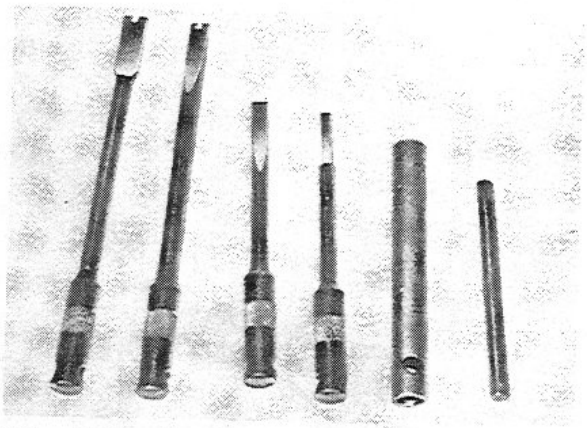


Fig.5-8 Carburetor Driver Set V4357

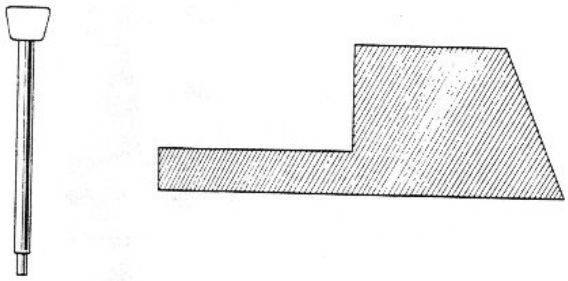


Fig.5-9 Carburetor Adjust Kit G1574

1. Remove the magnetic valve (1), fast idle connector (2), and the throttle lever spring (3).

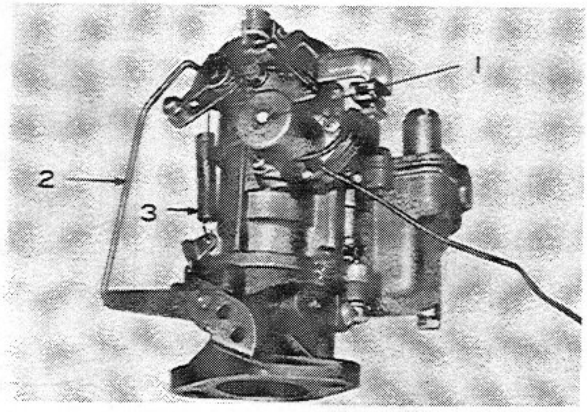


Fig.5-10 Carburetor Disassembly V4358

2. Loosen and remove the five screws attaching the air-horn, and separate the air-horn from the carburetor main body without damaging the float.

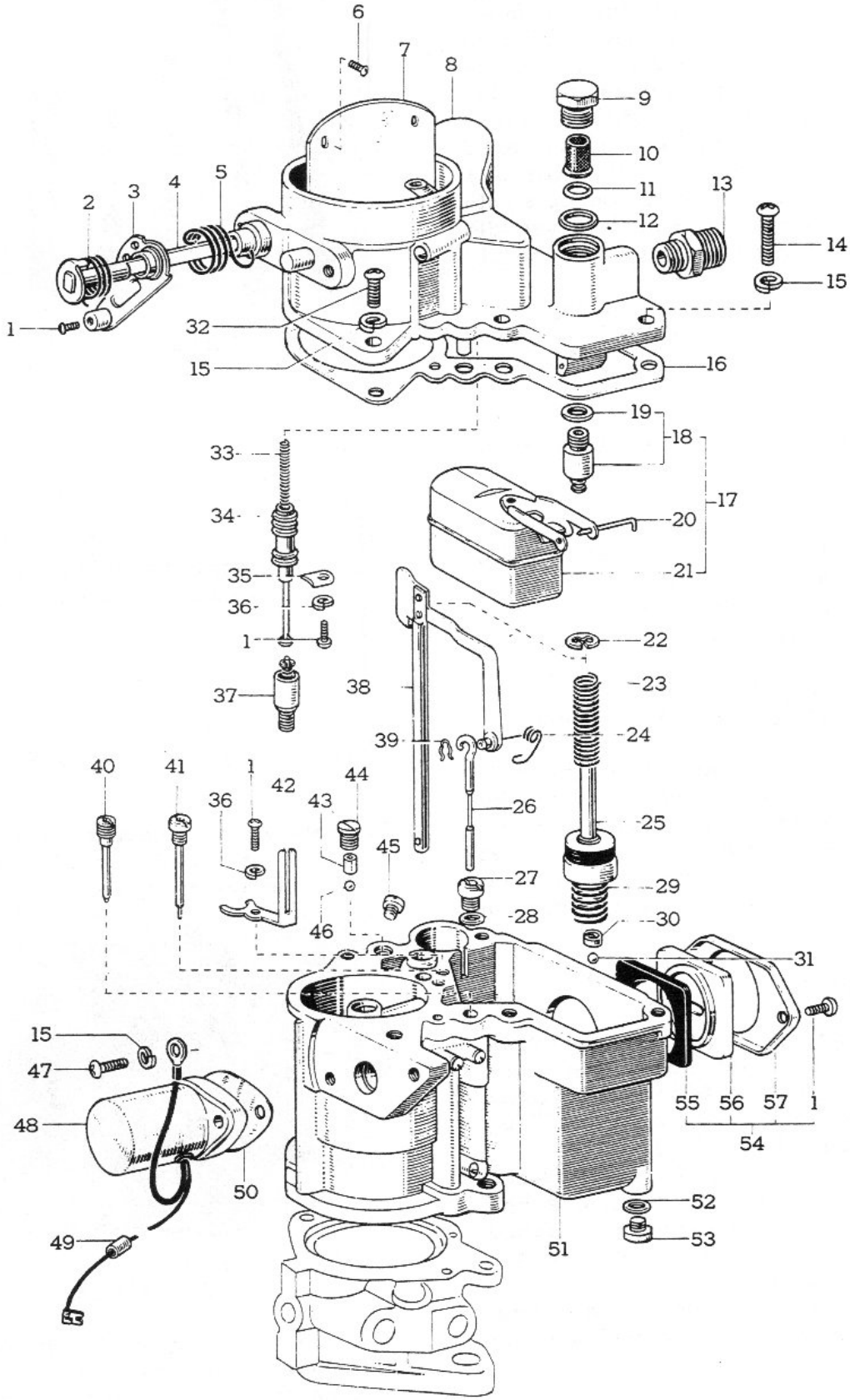


Fig.5-11 Carburetor Components

Y6164

1. Screw
2. Choke back spring
3. Choke lever
4. Choke shaft sub-assy
5. Choke valve relief spring
6. Choke valve set screw
7. Choke valve
8. Air horn
9. Main passage plug
10. Strainer
11. Strainer cap
12. Inlet strainer gasket
13. Fitting
14. Screw
15. Spring washer
16. Air horn gasket
17. Float & needle sub-assy
18. Needle valve sub-assy
19. Needle valve seat gasket
20. Float lever pin
21. Float sub-assy
22. Pump spring retainer
23. Pump spring
24. Step up rod spring *
25. Pump plunger
26. Step up rod *
27. Main jet
28. Main jet gasket
29. Pump dumping spring
30. Ball steel retainer
31. Steel ball
32. Set screw
33. Power piston spring
34. Power piston
35. Power piston stop
36. Spring washer
37. Power valve
38. Lifter rod
39. Snap ring
40. Slow jet sub-assy
41. Main air bleeder sub-assy
42. Guide
43. Pump discharge weight
44. Plug
45. Pump jet plug
46. Steel ball
47. Set screw
48. Valve sub-assy
49. Ring
50. Gasket
51. Carburetor body
52. Pump jet screw gasket
53. Nut plug
54. Carburetor level gage sub-assy
55. Level gage gasket
56. Level gage glass
57. Level gage clamp

* up to E.No. F-257653(APR.,'68)

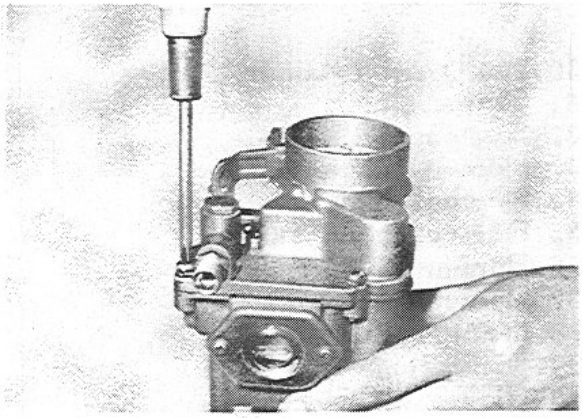


Fig.5-12 Removing Air-horn V4359

3. Remove the throttle connecting link. Loosen and remove the two screws retaining the main body to the flange, and separate the main body from the flange.

4. Air-horn disassembly.

   a. Remove the float lever pin, then remove the float, needle valve push pin, spring and the needle valve.

   b. Screw out the needle valve seat and the gasket.

   c. Remove the main passage plug, gasket and the strainer.

   d. Remove the power piston stopper, and then, take out the power piston and the spring.

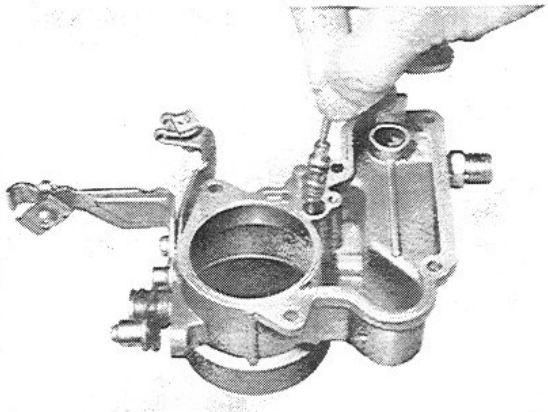


Fig.5-13 Removing Power Piston V4360

5. Carburetor main body disassembly.

   a. Slide out the lifter rod together with the pump plunger and the metering rod.
   Remove the pump spring.
   Remove the lifter rod guide.

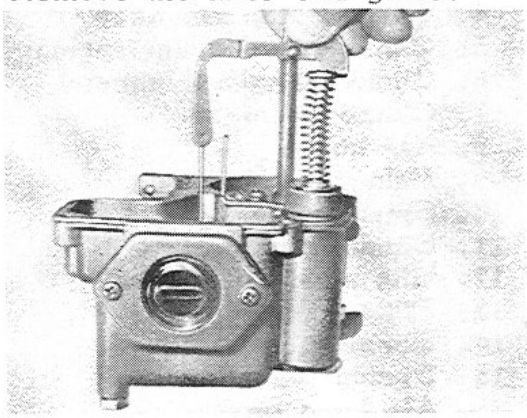


Fig.5-14 Removing Lifter Rod & Pump Plunger V4361

   (1) Remove the snap ring, step-up rod spring and the step-up-rod from the lifter rod.
   (2) Remove the "E" ring, pump plunger and the spring from the lifter rod.

Fig.5-15 Lifter Rod Components V4362

   b. Loosen and remove the main jet (1), and the power valve (2).

   c. Loosen and remove the slow jet (3) and the main air bleeder (4).

   d. Remove the screw plug (5), and invert the carburetor body to remove the pump discharge weight and the check ball.

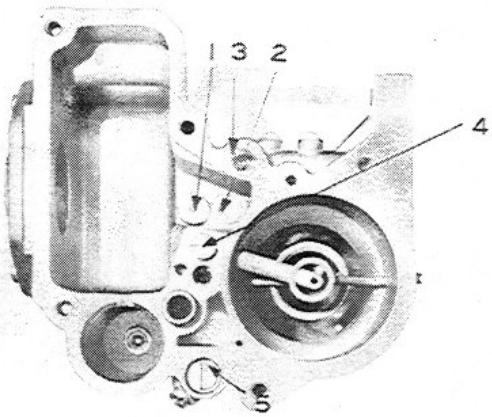


Fig.5-16 Main Body Disassembly V4363

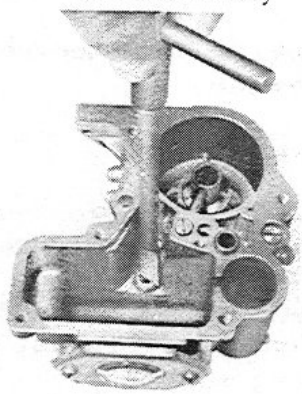


Fig.5-17 Removing Main Jet V4364

6. Screw out the idle adjusting screw and the spring..

Inspection & Repair

Wash the disassembled parts in clean gasoline, blow the fuel passages with compressed air, and remove the dirt.
Wash the exterior of the parts with a soft brush.
Wash and clean the carbon deposits around the throttle valves.
Never use a wire for cleaning the jets.

Air-horn

1. Inspect the air-horn for cracks, nicks or burrs at gasket surface.

2. Inspect the float for deformation, leak, damaged tabs, and worn lever pin and pin bores.

3. Check the float needle valve for proper seating.
To check the needle valve seating, invert the air-horn, and assemble the needle valve assembly and the float, and then suck the main fuel passage.
At this time, if any leak is present, the valve seating is not satisfactory.

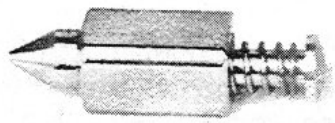


Fig.5-18 Needle Valve Inspection W6746

4. Check the power piston for smooth movement.

5. Inspect the strainer for rust and other damage.

6. Check the choke valve for proper choking, smooth movement, and for excessive play of the choke valve shaft.
If necessary, replace the choke valve or shaft in the following manner.

a. Remove the choke valve retaining screws, and remove the choke valve.

b. Next, slide out the choke shaft together with the choke lever, choke valve relief spring, and the choke valve spring from the air-horn.

c. Inspect the choke valve, and the shaft for bend, wear, and binding in the shaft bores of the air-horn.

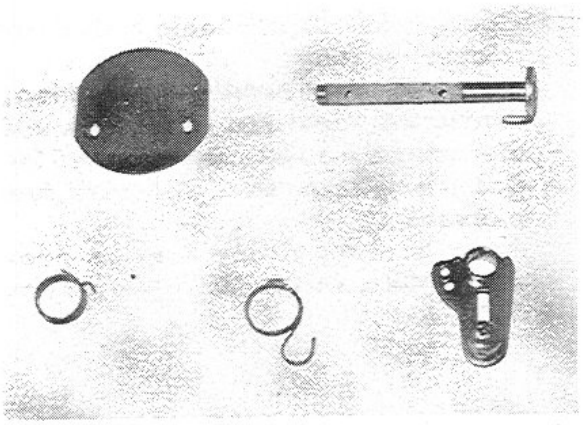


Fig.5-19 Choke Shaft Components V4365

d. To assemble, follow the disassembly procedures in the reverse order with the following cautions.

(1) Lubricate the sliding portion of the choke shaft with multipurpose grease.
(2) Adjust the valve position so that it will choke firmly.
(3) After checking the choke shaft for smooth operation, rivet the screw ends slightly.

Carburetor Body

1. Inspect the carburetor body for cracks, nicks or burrs at gasket surfaces, and stripped threads.

2. Check the power valve for smooth operation and proper seating.

3. Check the jets and air bleeder for damaged threads, damaged head slots, and damaged holes.

4. Check the pump plunger and the lifter rod for wear of sliding portion, defective leather, smooth operation with the plunger bore. Check the spring for rust and weakness.

5. Inspect the check ball and the pump discharge weight for rust, nicks or burrs.

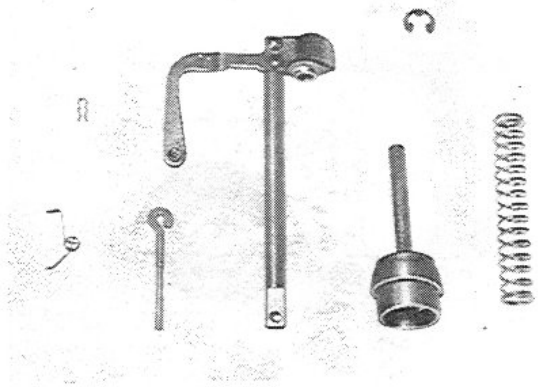


Fig.5-20 Pump Plunger Components V4362

6. Inspect the step-up-rod for bend and wear.

Flange

1. Inspect the flange for cracks, nicks or burrs at gasket surfaces.

2. Check the idle adjusting screw for damaged threads, and also the seating surfaces.
Check the spring for weakness.

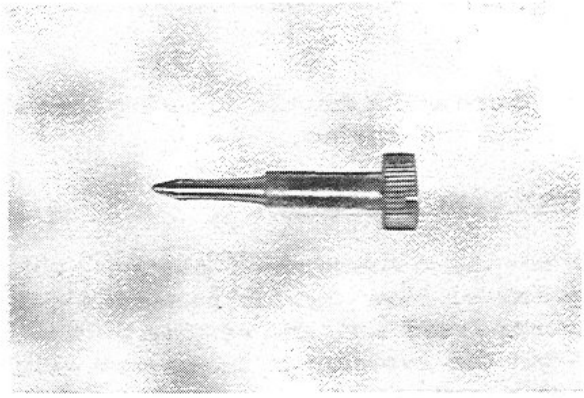


Fig.5-21 Idle Adjusting Screw W3727

3. Check the throttle valve if it closes firmly or not, and check the valve for smooth operation and excessive play of the throttle shaft.
If necessary, replace the throttle shaft or the throttle valve in the following manner.

a. Remove the throttle valve retaining screws, and take out the throttle valve.

b. Loosen and remove the nut retaining the throttle lever and the fast idle lever, and remove the levers.

c. Pull out the throttle shaft from the flange.

d. To assemble, follow the disassembly procedures in the reverse order with the following cautions.

(1) Lubricate the sliding portion of the throttle shaft with multipurpose grease.
(2) Adjust the throttle valve to close firmly at fully closed position.
(3) After checking the throttle shaft for smooth operation, rivet the screw ends slightly.

Assembly & Adjustment

All gasket should be replaced upon assembly.
To assemble, follow the disassembly procedures in the reverse order. Upon assembly, the following adjustments are very important to obtain proper carburetor for all engine speeds.

Air-horn

1. When assembling the float and the needle valve, adjust the float level by bending the tabs on the float lever.
   There are two adjustments with the float.
   One with the float at raised position and the other with the float at lowered position.
   The final inspection should be performed with the level gauge glass line.

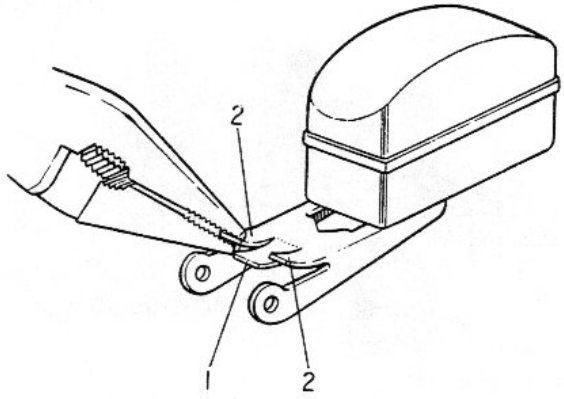


Fig.5-22 Float Level Adjument X4985

2. For the adjustment at raised position, invert the air-horn, and check the clearance between the end of the float, and the air-horn gasket surface with a gauge as shown in the illustration.
   To check, use the Carburetor Adjust Kit 09240-60030.
   The clearance should be 5.8 mm (0.23").
   To obtain a correct clearance, bend the tab at (1) in figure 5-22.

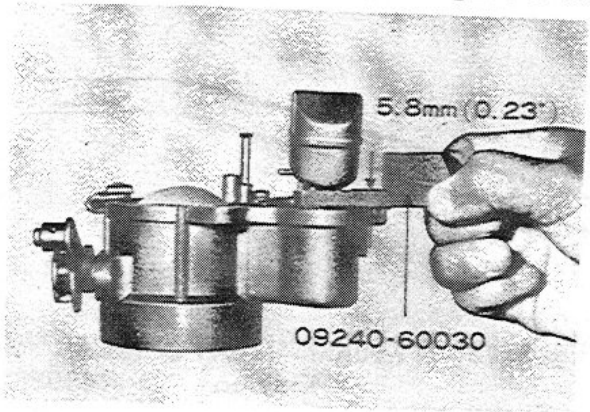


Fig.5-23 Raised Position Measurement V4366

3. For adjustment at lowered position, hold the air-horn at upright position and measure the clearance between the air-horn gasket surface and the end of the float.
   To check, use the Carburetor Adjust Kit 09240-60030.
   The clearance should be 20 mm (0.8").
   To obtain a correct clearance, bend the float tabs at (2) in figure 5-22.

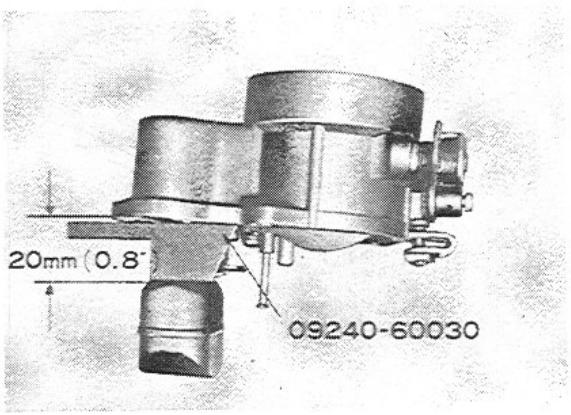


Fig.5-24 Lowered Position Measurement V4367

Flange

1. When assembling the throttle valve and shaft, close the throttle valve completely, and check the valve position with the slow port.
   If the valve position is not proper as shown in the illustration, replace the throttle valve, and the shaft.

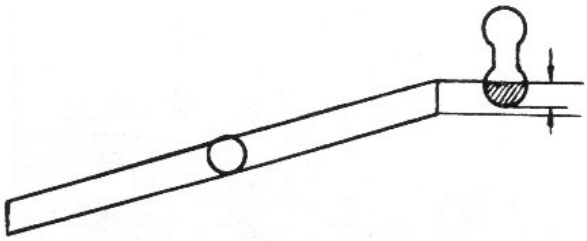


Fig.5-25 Throttle Valve Closed Position X4988

2. When installing the idle adjusting screw, screw in all the way, then unscrew one and a half of a turn.

Carburetor Main Body

1. Assemble the carburetor body on the flange.
   Before assembling the lifter rod and the pump plunger to the carburetor body, remove the step-up-rod from the lifter rod.
   After assembling the lifter rod, and the pump plunger to the carburetor body, install the throttle connecting link, and then check the height of the step-up-rod position using the Carburetor Adjusting Kit 09240-60030 as shown in the illustration.
   This height should be 28.5 mm (1.12"), and if necessary, adjust by bending the throttle connecting link (1).

CAUTION:
This check should be done upon closing the throttle valve completely and not operating the throttle adjusting screw.

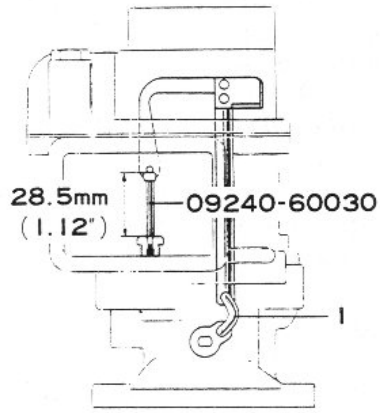


Fig.5-26 Step-up-rod Adjustment X4989

2. When installing the throttle adjusting screw, screw in until it touches the flange, and then screw in about 3/4 of a turn.
   At this time, check the throttle valve position with the slow port as shown in the illustration.

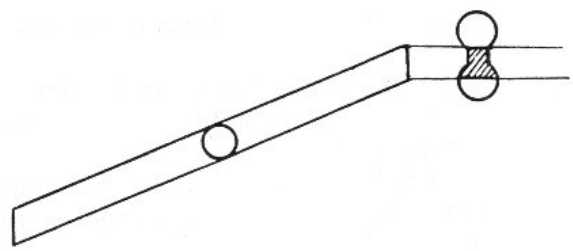


Fig.5-27 Throttle Valve Position X4990

To adjust the valve position, screw in or out the throttle adjusting screw.
The final adjustment should be re-adjusted during engine tune-up operation.

3. After assembling the carburetor, the adjustment of the fast idle must be performed.
Close the choke valve completely, and check the opening angle of the throttle valve.
Place the angle gauge in the Carburetor Adjust Kit 09240-60030 on the throttle valve as shown in the figure 5-28.
If necessary, adjust by bending the fast idle connector.

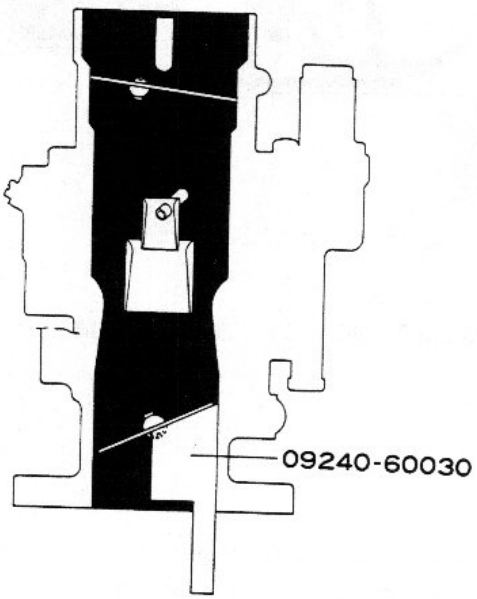


Fig. 5-28 Fast Idle Adjustment G1575

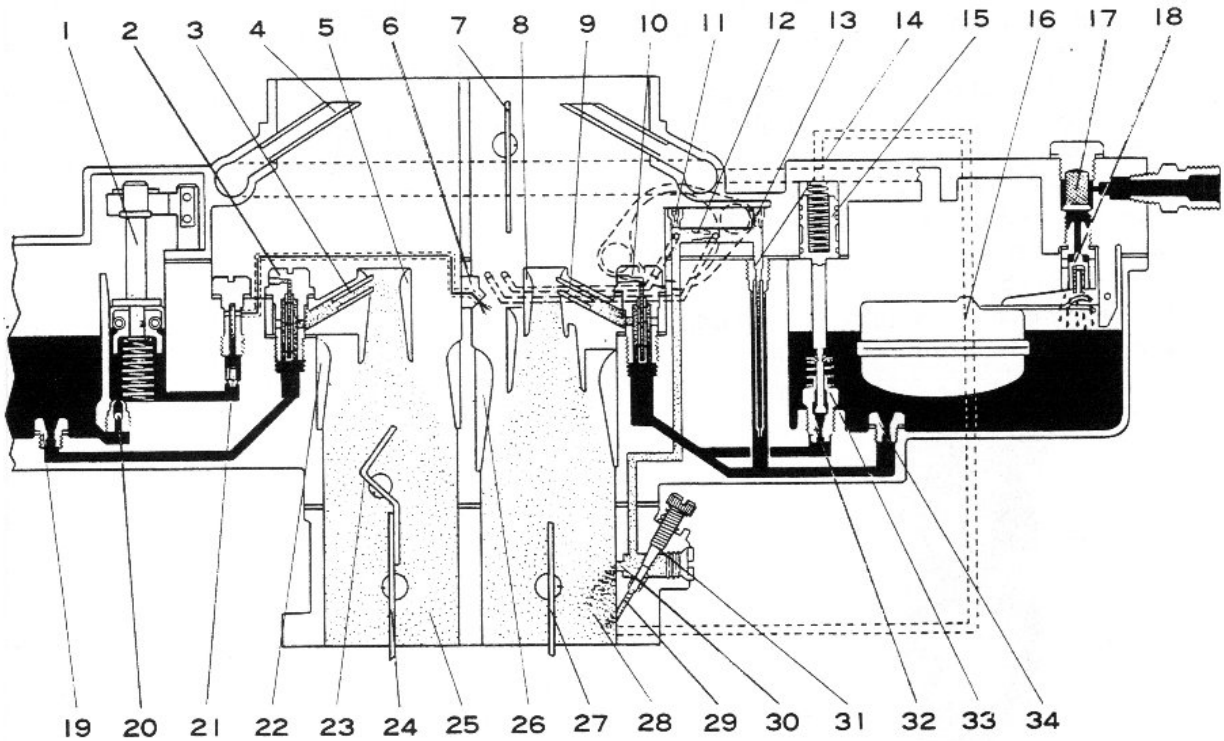
Installation

Follow the removal procedures in the reverse order.

Check the fuel leak from the connections.
Check the throttle valve to open fully at the time when the accelerator pedal is fully depressed.
After the engine is warmed up, adjust the engine idling speed by referring to the Engine Tune-Up section.

CARBURETOR (OLD) -for FA

Construction & Operation



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

Fig.5-29 Cross Section View of Carburetor Y2110

The fuel supply relations are divided into the following systems.

1. Float chamber & Air vent system.
2. Low speed system.
3. Primary high speed system.
4. Secondary high speed system.
5. Power system.
6. Accelerating system.
7. Choke & Fast idle system.

1. Float chamber & Air vent system.

The fuel enters into the float chamber through the strainer (1), needle valve (2), and the valve seat (3). The quantity of fuel is regulated by the needle valve opening movement from the valve seat, and also by the fuel pump pressure. Proper fuel level is maintained by the float, needle valve, and the correct fuel pump pressure. These items are very important to obtain proper performances of the carburetor.

Air vents (4) are provided to keep the float chamber with the same pressure as that of the pressure present in the air-horn, eliminating the effect of a clogged air cleaner element.

These are also connected to the air-horns of the primary, and the secondary.

A level gauge glass is installed as the cover for visual inspection of the fuel level.

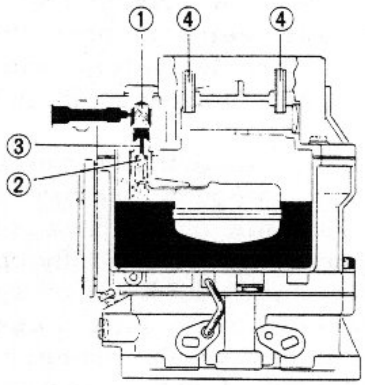


Fig.5-30 Float Chamber & Air Vents X4991

2. Low speed system

The low speed system consists of the slow jet (1), economizer jet (2), primary air bleeder No.1 (3) and No.2 (4), and the idle adjusting screw (5).

These are provided only in the primary side, which control the fuel discharge necessary for light engine load at low speed.

Also a magnetic valve is provided in this system to prevent engine from continuous running after ignition circuit is off. The magnetic valve is operated when the ignition switch is turned on, and economizer jet opens.

When the ignition switch is turned off, the economizer jet is closed by the magnetic valve, and fuel does not discharge when the engine is at stopped condition.

Therefore, the fuel does not overflow even though the temperature within the engine compartment is high.

At idle speed, air is drawn into the air-horn which enters the float chamber through the vent tube, and into the primary air bleeders. The pressure in the float chamber is maintained the same as in the air-horn.

The pressure difference between the float chamber, and the discharge ports which is due to the high manifold vacuum, forces the fuel to flow through the idle system. The fuel is forced to flow through the primary main jet, slow jet, and economizer jet into the discharge passage. The fuel is controlled through the economizer jet and the slow jet.

The air entering through the primary air bleeders mixes with the fuel. The air-fuel mixture travels down the fuel passage, and is discharged through the discharging holes.

As the throttle valve opens slightly, each hole discharges the fuel by the manifold vacuum. The idle fuel discharged is controlled by the idle adjusting screw which seats in the idle port.

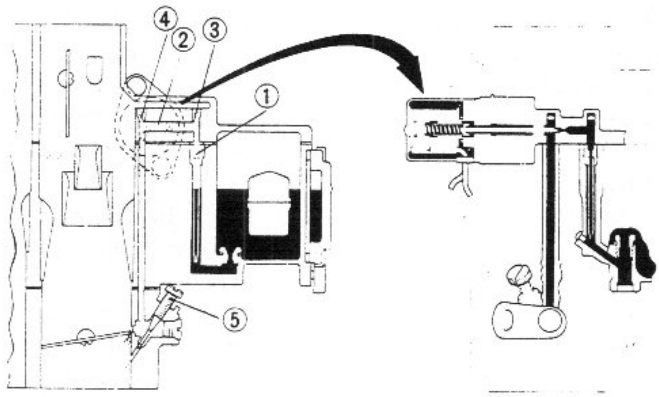


Fig.5-31 Low Speed System Y5988

3. Primary high speed system

When the throttle valve (1) opens, low pressure area is transferred from the idle discharge holes to the main fuel nozzle (2).
The pressure difference between the main nozzle, and the float chamber forces the fuel to flow through the main fuel system.
The fuel passes through the main jet (3) into the bottom of the fuel passage, and flows up the fuel passage. The air entering through the main air bleeder (4) into the fuel passage mixes with the fuel. Then, the air-fuel mixture flows up the main nozzle. Here, the mixture is atomized, and is mixed with the air stream through the air-horn.

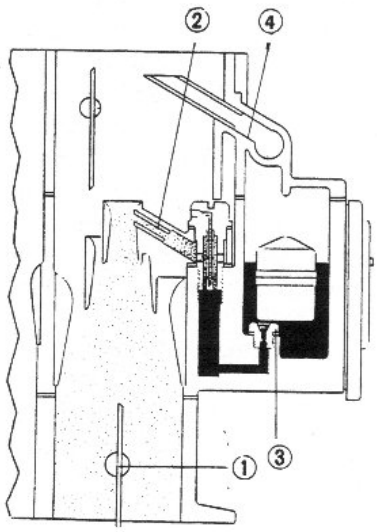


Fig.5-32 Primary High Speed System X4993

4. Secondary high speed system

The secondary high speed system consists of the secondary main jet (1), air bleeder (2), small venturi (3), and main nozzle (4).
A high speed valve (5) is provided above the secondary throttle valve (6), and this high speed valve shaft arm is installed with a balancing weight, and is retained with a nut at the shaft end.
As the accelerator pedal is depressed, and the primary throttle valve opens approximately 55°, the linkage starts to open the secondary throttle valve, and both valves are fully opened at the same time.
However, while the engine speed is not high enough, the high speed valve remains closed even though both throttle valves are fully opened and secondary high speed system remains inactive. This causes the air flow through the primary venturi to become faster accomplishing a complete atomization of fuel, and uniform distribution of air-fuel mixture to the cylinders.

As the engine speed increases, the air flow becomes strong enough to overcome the weight of the high speed valve weight, then the high speed valve opens gradually, and starts the secondary fuel flow into operation.

The secondary system is independent of the primary system. The fuel flows from the float chamber passes through the secondary main jet, and travels up the main air bleeder where air is mixed with the fuel.

The fuel travels to the secondary main nozzle, and is discharged from the main nozzle into the small venturi atomizing, and mixing with the air drawn into the carburetor.

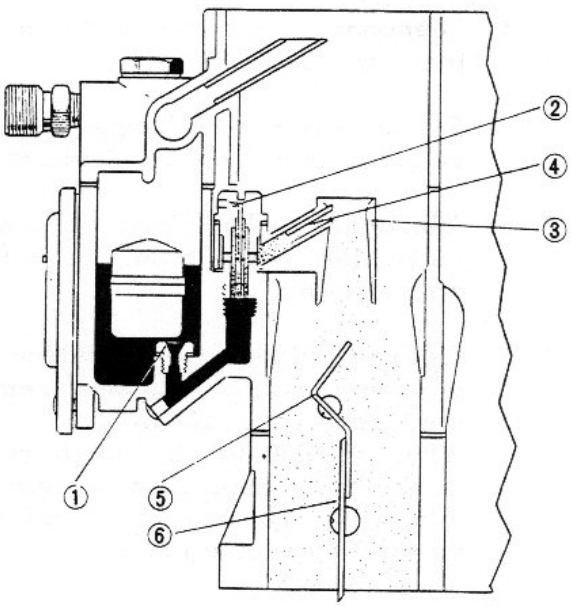


Fig.5-33 Secondary High Speed System X4994

5. Power system

As the secondary side is provided with a high speed valve, the primary side has the supply sufficient air-fuel mixture required for low speed operation when the throttle valve is completely opened.

For this purpose, power valve (1) is installed at the bottom of the float chamber.

At light load, the vacuum in the intake manifold pulls the power piston (2) up, and closes the power valve.

As the primary throttle valve is opened completely, the vacuum in the intake manifold drops, and the power piston is pushed down by the spring of the power piston, which opens the power valve.

When the power vaive opens, the fuel will flow through the power jet (3), and into the bottom of the fuel passage where the fuel joins with the fuel from the primary main jet.

This supplies additional fuel required for heavy load, and low speed with full throttle.

The transfer of primary and secondary operations is performed very smoothly by the actuation of the power valve, and high speed valve.

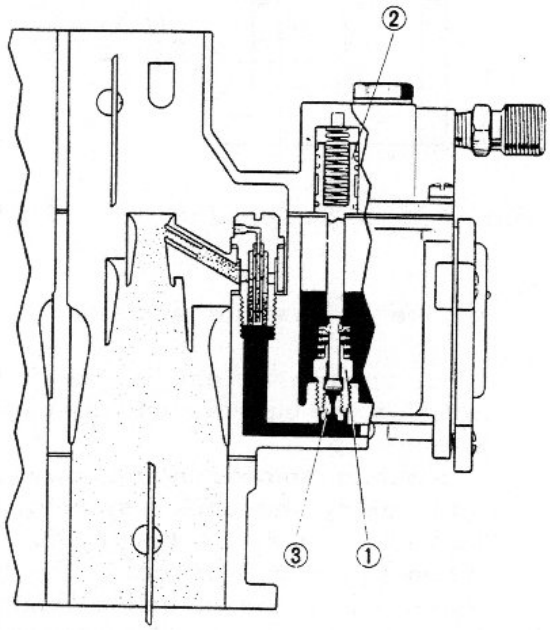


Fig.5-34 Power System X4995

6. Accelerating system

The accelerating system is provided only in the primary side. When the accelerator pedal is depressed for quick acceleration, the pump plunger (1) connected to the throttle valve is pushed down onto the fuel in the pump cylinder. The

fuel pushes open the discharge weight (2), and travels up into the accelerating pump jet (3), and from there the fuel is discharged into the venturi to richen the mixture necessary for acceleration. In addition, the power system is also operated to supply additional fuel for acceleration.

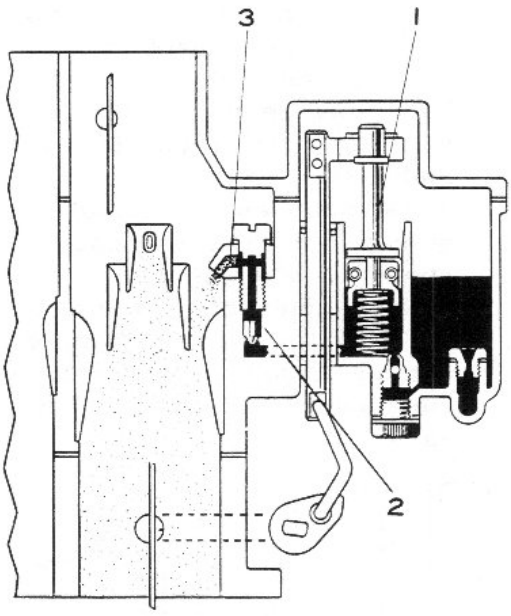


Fig.5-35 Accelerating System X4996

7. Choke & Fast idle system

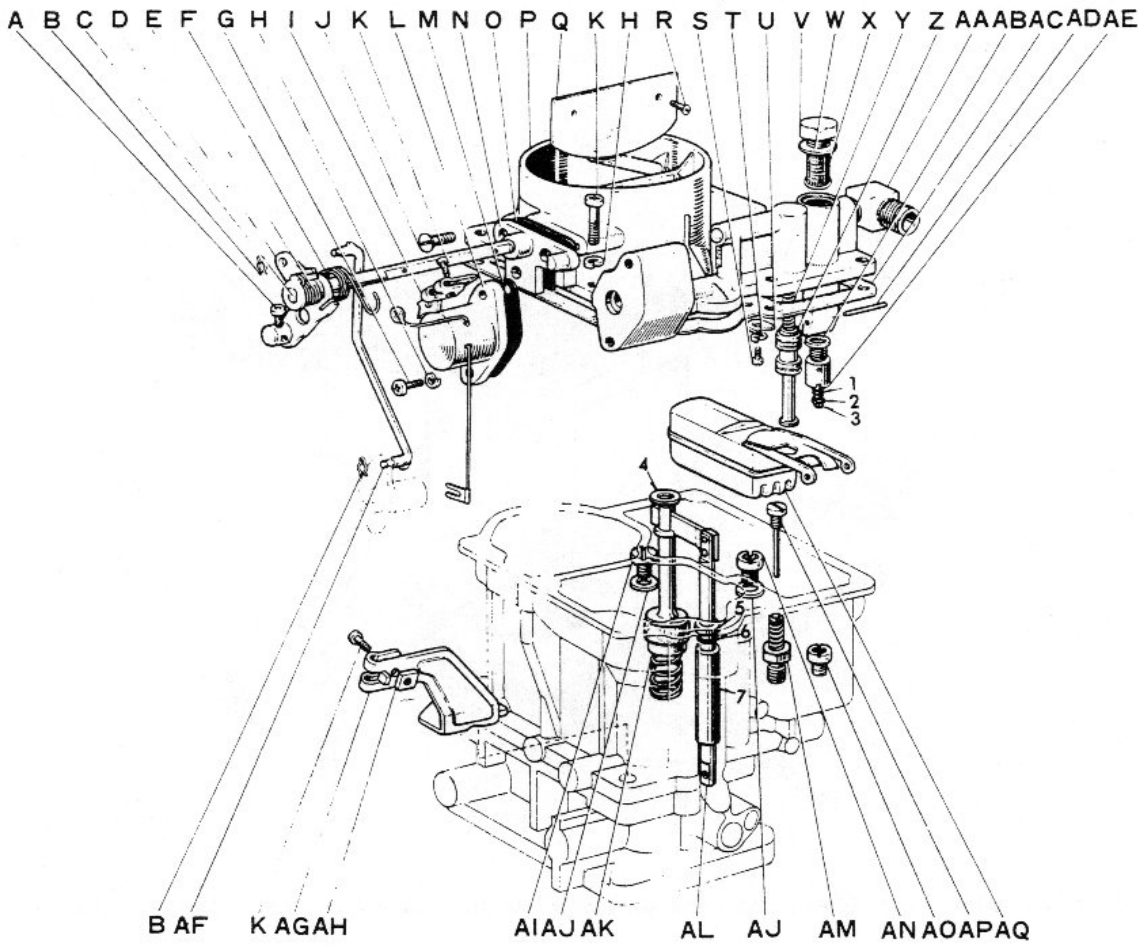
The choke system is used for starting the engine, until the engine warms up.
To obtain smooth engine operation upon using the choke system, the fast idle system is provided.
When the engine is cold, the fuel vapor contained in the fuel mixture supplied by the carburetor condenses on the cold intake manifold, and cylinder walls. Thus, the air fuel mixture entering the combustion chambers will be exceedingly lean making ignition difficult, and even if ignited will have low available power so that the engine will have inadequate power. This action is especially noticeable during cold weather starting.
In operation, closing the choke valve lessens the air flow, and the vacuum is directly effected on the main nozzle causing the fuel to be discharged from this point to form a richer mixture.
When the carburetor is in choked position, the throttle lever contacts against the fast idle cam, and the throttle valve is opened slightly. For this reason, the idling revolution is slightly higher (fast idle).

Removal

1. Remove the air cleaner assembly.
2. Disconnect the throttle rod wire, and the choke rod wire from the carburetor.
3. Disconnect the accelerator link from the carburetor.
4. Disconnect the fuel pipe, and the vacuum pipe from the carburetor.
5. Disconnect the magnetic switch valve lead wire from the ignition coil terminal.
6. Loosen and remove the carburetor mounting nuts, and then remove the carburetor assembly.
   After removing the carburetor, cover the intake port of the manifold with a clean shop towel to prevent dust or dirt from entering.

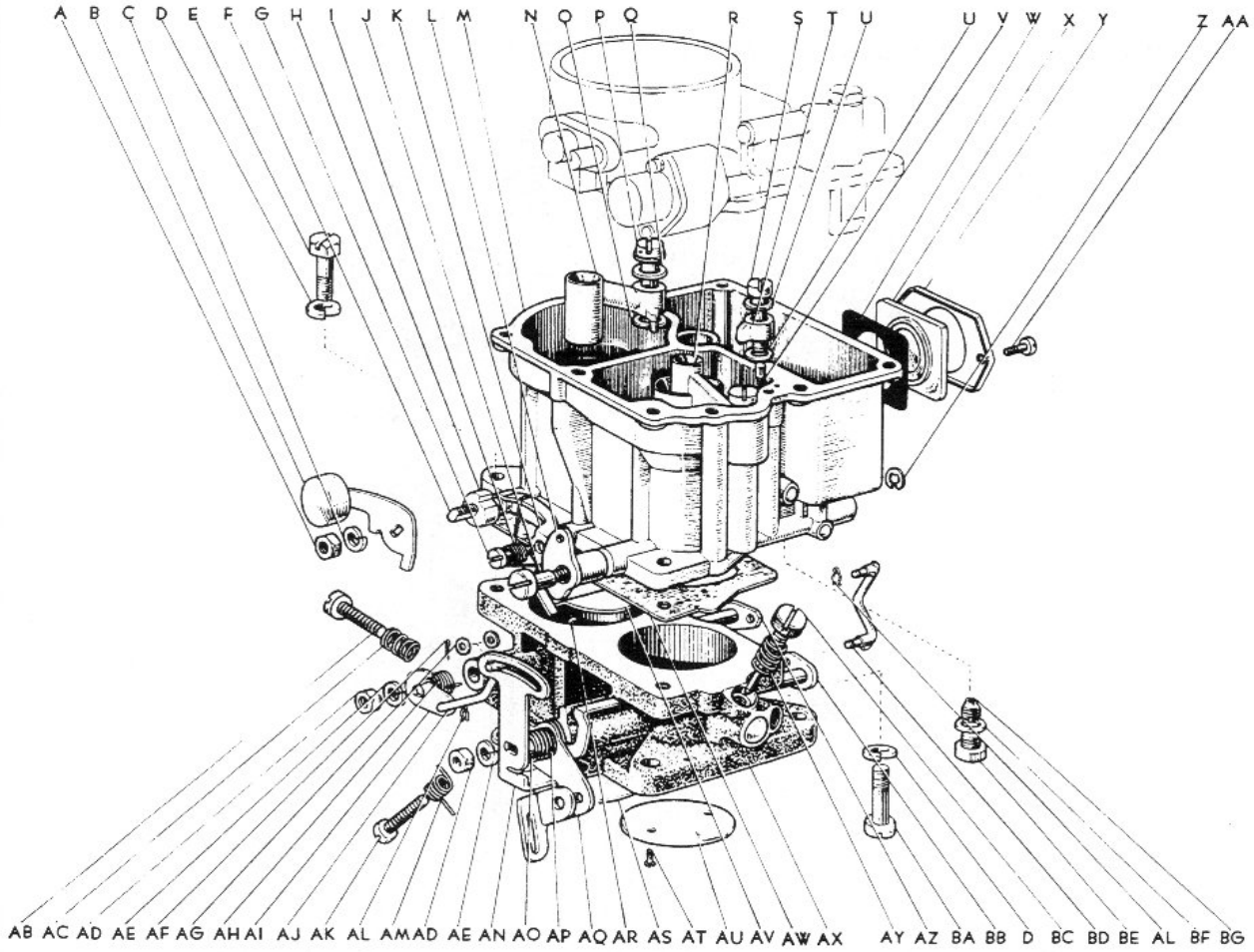
Disassembly

For disassembling, and assembling operations of the carburetor, the Carburetor Driver Set 09860-11010, and the Carburetor Adjust Kit 09240-60040 should be utilized.
Proper wrenches with correct sizes should also be used, and the parts removed must be thoroughly washed with clean gasoline or carburetor cleaning fluid.
These removed parts should be kept in clean container to facilitate the assembly.



A. Choke wire clamp screw
B. Snap ring
C. Choke shaft
D. Choke lever
E. Choke valve relief spring
F. Choke retracting spring
G. Screw
H. Lock washer
I. Choke wire clamp
J. Set screw
K. Screw
L. Magnetic valve
M. Gasket
N. Choke lever adapter
O. Adapter gasket
P. Air horn
Q. Choke valve
R. Screw
S. Screw
T. Lock washer
U. Power piston stopper
V. Main passage plug
W. Gasket
X. Strainer
Y. Power piston spring
Z. Power piston
AA. Fitting
AB. Gasket
AC. Air horn gasket
AD. Float lever pin
AE. Needle valve
AF. Fast idle connector
AG. Throttle wire clamp
AH. Nut
AI. Secondary main jet
AJ. Gasket
AK. Pump damping spring
AL. Lifter rod
AM. Power valve
AN. Primary main jet
AO. Primary main spare jet
AP. Slow jet
AQ. Float

Fig.5-36 Carburetor Components Y6165



A. Nut
B. High speed valve shaft lever
C. Lock washer
D. Lock washer
E. Retaining bolt
F. High speed shaft
G. Stop lever set screw
H. High speed valve stopper
I. High speed valve stop lever spring
J. Fast idle set screw
K. High speed valve stop lever
L. Fast idle cam
M. Carburetor body
N. Secondary small venturi
O. Gasket
P. Primary main air bleeder
Q. Gasket
R. Primary small venturi
S. Pump jet screw
T. Pump jet
U. Gasket
V. Pump discharge weight
W. Level gauge gasket
X. Level gauge glass
Y. Level gauge retainer
Z. Retainer ring
AA. Screw
AB. Throttle adjusting screw
AC. Spring
AD. Nut
AE. Lock washer
AF. Cotter pin
AG. Throttle shaft washer
AH. Secondary throttle return spring
AI. Secondary throttle lever
AJ. Throttle shaft link
AK. Fast idle adjusting screw
AL. Snap ring
AM. Spring
AN. Throttle shaft arm
AO. Throttle lever collar
AP. Primary throttle return spring
AQ. Throttle lever
AR. Screw
AS. Secondary throttle valve
AT. Screw
AU. Primary throttle valve
AV. High speed valve
AW. Flange gasket
AX. Flange
AY. Idle adjusting screw spring
AZ. Secondary throttle shaft
BA. Screw
BB. Primary throttle shaft
BC. Idle adjusting screw
BD. Pump connecting link
BE. Nut plug
BF. Gasket
BG. Discharge check valve

Fig.5-37 Carburetor Components Y6166

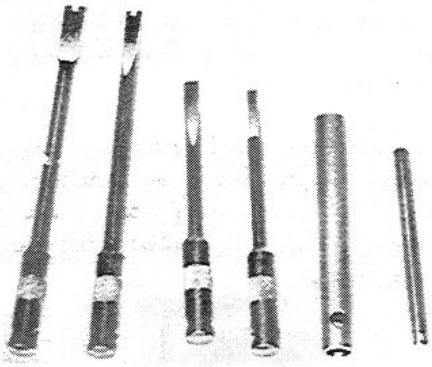


Fig.5-38 Carburetor Driver Set V4357

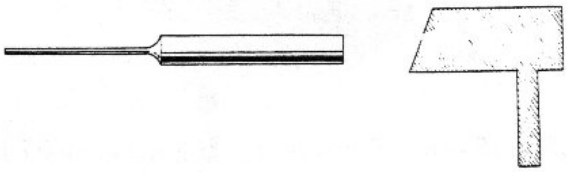


Fig.5-39 Carburetor Adjust Kit G1579

1. Remove the magnetic valve and the choke wire clamp from the air-horn.

2. Remove the snap ring, and then disconnect the fast idle connector from the fast idle cam.

3. Remove the air-horn retaining screws, and separate the air-horn from the carburetor body.
   Also remove the gasket.
   When removing, remove the air-horn straight upward without damaging the float.

4. Carburetor body disassembly.

   a. Remove the pump connecting link, and take out the lifter rod with the pump plunger.
   Next, take out the pump damping spring.

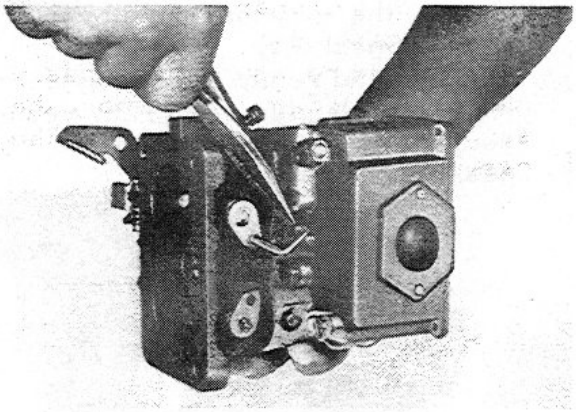


Fig.5-40 Removing Pump Connecting Link V0571

b. Loosen and remove the pump jet screw, then take out the pump jet and the gaskets.

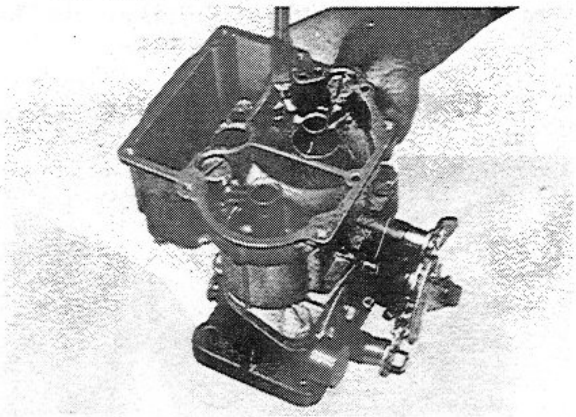


Fig.5-41 Removing Pump Jet V0572

c. Invert the carburetor body, and remove the pump discharge weight.

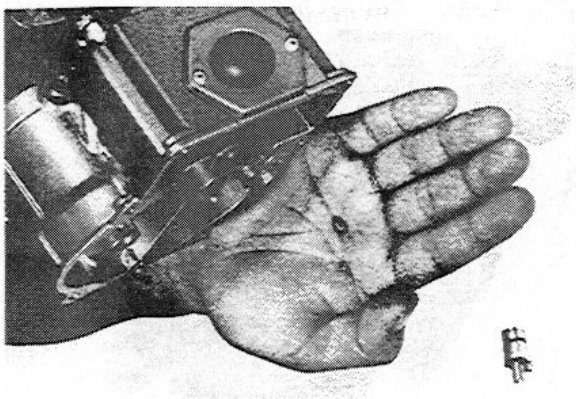


Fig.5-42 Removing Pump Discharge Weight V0573

d. Loosen and remove the primary main air bleeder, and re-

moved the primary small venturi and the gaskets.
Loosen and remove the secondary main air bleeder, and remove the secondary small venturi and the gaskets.

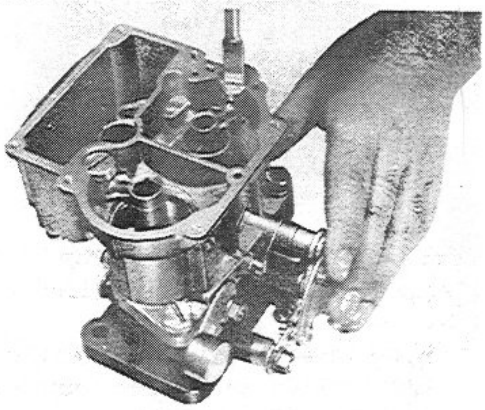


Fig.5-43 Removing Primary Main Air Bleeder V0574

e. Loosen and remove the slow jet.

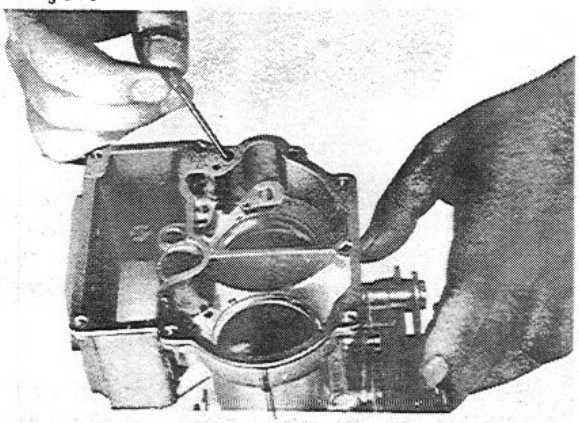


Fig.5-44 Removing Slow Jet V0575

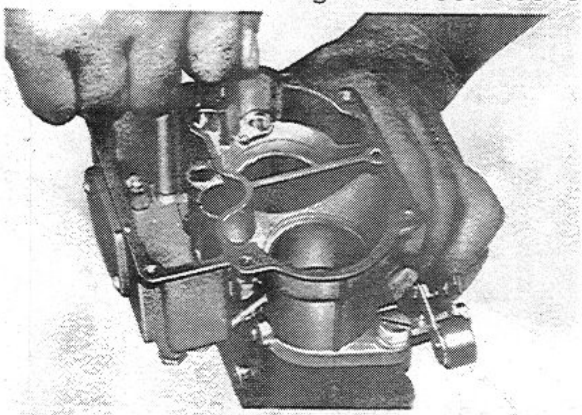


Fig.5-45 Removing Power Valve V0576

f. Loosen and remove the power valve with the power valve wrench in the Carburetor Driver Set 09860-11010.

g. Loosen and remove the primary main jet, secondary main jet, and the gaskets which are installed at the bottom of the float chamber.

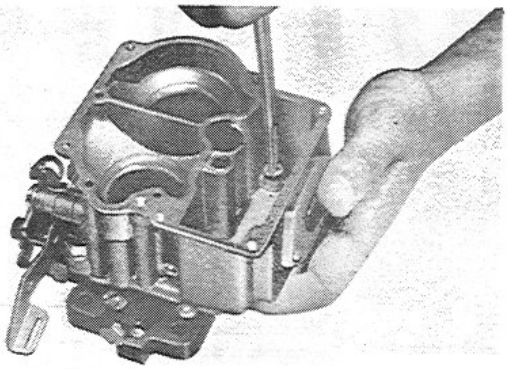


Fig.5-46 Removing Secondary Main Jet V0796

h. Loosen and remove the two bolts, and a screw retaining the flange onto the carburetor body and separate the flange from the carburetor body.

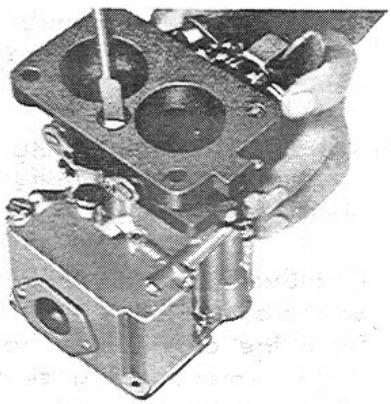


Fig.5-47 Removing Retaining Screw V0797

i. Loosen and remove the nut plug and the gasket at the lower part of the float chamber, and remove the discharge check valve.

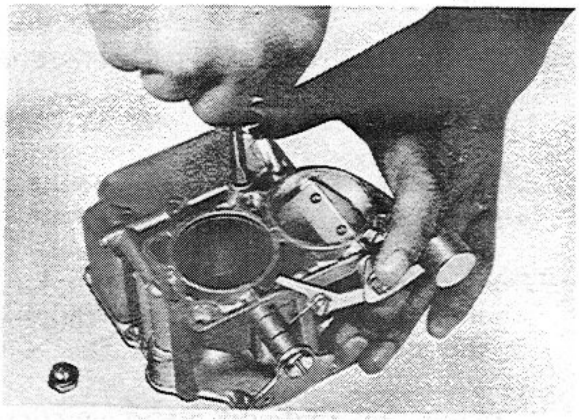


Fig.5-48 Removing Discharge Check Valve V0798

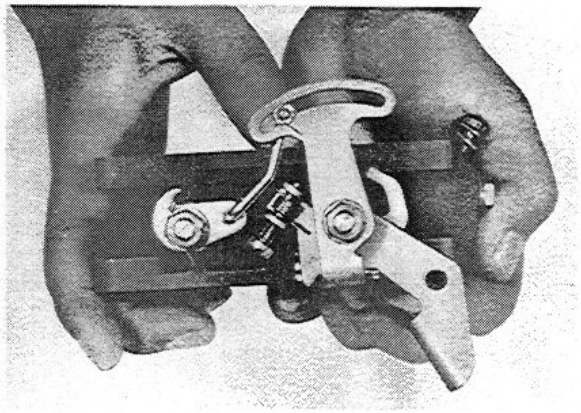


Fig.5-49 Throttle Valve Mechanism V0799

i. Remove the nut, and then take out the high speed valve shaft lever and the high speed valve stopper.

k. Remove the high speed valve stop lever and the spring.

l. If necessary in removing the high speed valve shaft, loosen and remove the high speed valve retaining screws, and take out the high speed valve, next, remove the retainer ring, and then slide the shaft out of the carburetor body.

m. Loosen and remove the fast idle set screw, and remove the fast idle cam.

5. Flange disassembly.
Check the primary and secondary throttle valves for proper closing, smooth movement, and excessive play of the shaft, and if necessary, disassemble and replace the damaged part/s.

a. To disassemble the throttle valve mechanism, remove the snap ring, and disconnect the throttle shaft link from the secondary throttle lever.

b. Loosen and remove the secondary throttle valve retaining screws, and remove the secondary throttle valve. Next, remove the throttle lever retaining nut, and take out the throttle lever and the spring from the secondary throttle shaft.
Slide the secondary throttle shaft from the flange.

c. Loosen and remove the primary throttle valve retaining screws, and remove the primary throttle valve.
Remove the nut, and then take out the primary throttle shaft arm, spring, and the throttle lever.
Slide out the primary throttle shaft from the flange.

d. Screw out the idle adjusting screw and the spring.

6. Air-horn disassembly.

a. Remove the float lever pin, and then remove the float, and the needle valve assembly.
If necessary, loosen and remove the needle valve seat.

b. Remove the power piston stopper, and then slide out the power piston and the spring.

c. Loosen and remove the main passage plug and the gasket, and take out the strainer.

d. Check the choke valve for proper choking, smooth movement,

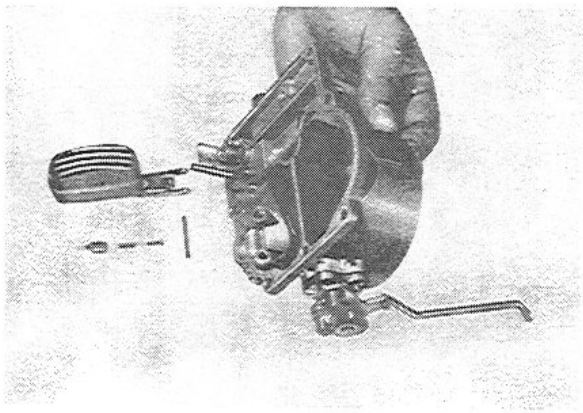


Fig.5-50 Float & Needle Valve Removal V0800

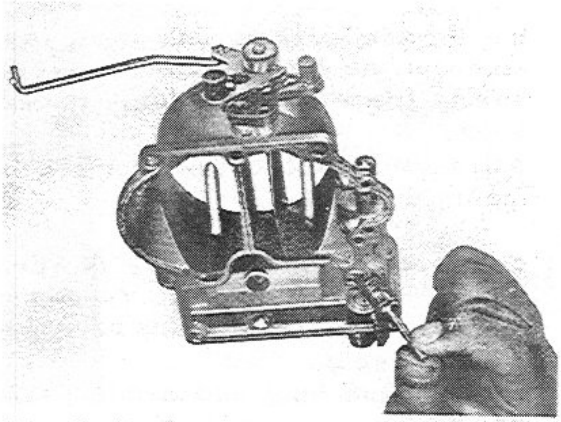


Fig.5-51 Removing Power Piston V0801

and excessive play of the choke shaft.
If necessary, disassemble the choke valve mechanism.
To disassemble, loosen and remove the choke valve retaining screws, and take out the choke valve. Next, slide out the choke shaft, relief spring, choke lever, and the choke retracting spring from the air-horn.

Inspection

Wash the all disassembled parts thoroughly in clean gasoline, blow the fuel passages with compressed air, and remove the dirt.
Wash the exterior parts with a soft brush.
Wash and clean the carbon deposits around the throttle valves.

Never use a wire for cleaning the jets. Replace the parts if defective.

Air-horn

1. Inspect the air-horn for cracks, nicks or burrs at gasket surface.

2. Inspect the choke valve and the shaft for bend, wear and binding in the shaft bore.

3. Inspect the float for deformation, leak, damaged tabs, and worn lever pin and pin bores.

4. Check the float needle valve for proper seating.
To check the needle valve seating, invert the air-horn, and assemble the needle valve assembly and the float, and then suck the main fuel passage.
At this time, if any leak is present, the valve seating is not satisfactory.

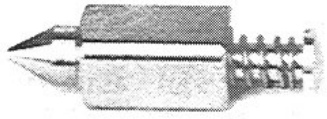


Fig.5-52 Needle Valve Inspection W6746

5. Inspect the strainer for rust and other defect.

6. Check the power piston for smooth movement.

Carburetor Body

1. Inspect the carburetor body for cracks, nicks or burrs at gasket surfaces and damaged threads.

2. Check the power valve for smooth operation and proper seating.

3. Check the jets for damaged threads damaged head slots and damaged holes.

4. Check the pump plunger and the lifter rod for wear of sliding portion, defective leather, smooth operation with the plunger bore.
Check the spring for rust and weakness.

5. Check the discharge valve operation, and the discharge weight for rust, nicks or burrs.

6. Check the high speed valve for deformation, and shaft for twist, bend or wear, and binding in the shaft bore.

Flange

1. Inspect the flange for cracks, nicks or burrs at gasket surface.

2. Check the idle adjusting screw for damaged threads, and also seating surface.

3. Check the throttle valves for burrs and deformation.
Check the throttle shaft bore for wear or binding.

Assembly & Adjustment

All gaskets should be replaced upon assembly.
Before assembling, check that the fuel passages are already cleaned.
All sliding or rotating portions should be coated with multipurpose grease, and be checked for proper operation.
To assemble, follow the disassembly procedures in the reverse order.
Upon assembling, the following adjustment is very important to obtain proper carburetion for all engine speeds.

1. Air-horn

a. Choke valve mechanism assembly.
(1) Install the choke valve relief spring, choke lever, and the choke retracting spring onto the choke shaft.
Next, slide the choke shaft into the air-horn.
(2) Position the choke valve, and tighten the choke valve retaining screws firmly.
(3) Hook the end of the choke retracting spring onto the choke lever adapter, and check the choke valve for proper choking and smooth movement.
If necessary, loosen the choke valve retaining screws, and adjust the valve position so that it will choke closely.
After adjusting, tighten the retaining screws securely, and rivet the screw ends slightly.

b. When assembling the float and the needle valve, adjust the float level by bending the tabs of the float lever.
There are two adjustments with the float.
One is with the float at raised position, and the other is with the float at lowered position.
The final inspection should be performed with the fuel in the float chamber aligning with the level gauge glass line.

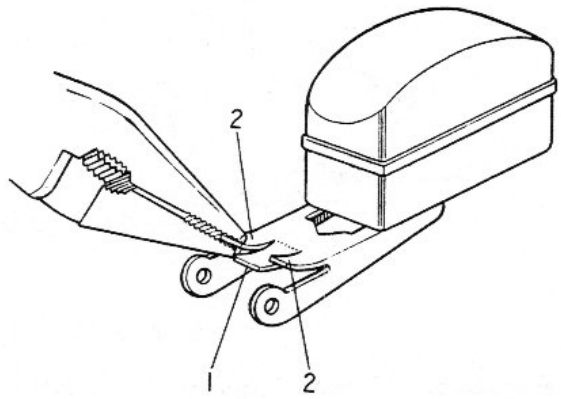


Fig.5-53 Float Tab X4985

(1) For raised position of the float, invert the carburetor, and measure the clearance between the upper surface of the float and the gasket surface of the air-horn.
To measure, use the Carburetor Adjust Kit 09240-60040.
This clearance should be 8 mm (0.31").
To obtain a correct clearance, bend the tab at (1) in figure 5-53.

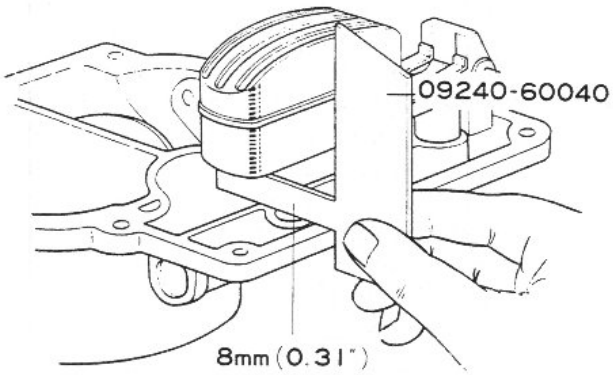


Fig.5-54 Float Raised Position Measurement X4997

(2) For lowered position of the float, measure the clearance between the upper surface of the float and the gasket surface of the air-horn.
To measure, use the Carburetor Adjust Kit 09240-60040.
This clearance should be 24 mm (0.94").
To obtain a correct clearance, bend the tabs at (2) in figure 5-53.

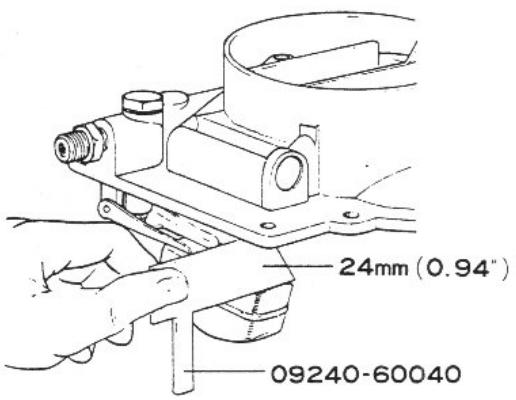


Fig.5-55 Float Lowered Position Measurement X4998

c. Place the spring, and slide the power piston into the piston bore, and then secure the power piston stopper.

2. Flange

a. Throttle valve mechanism assembly.
(1) Slide the secondary throttle shaft into the flange, and then assemble the throttle return spring and the secondary throttle lever onto the end of the shaft.
Tighten the throttle lever retaining nut.
Install the secondary throttle valve and secure the throttle valve retaining screws.
Check the throttle valve if it closes firmly or not, and check the valve for smooth operation.
Rivet the screw ends slightly.
(2) Slide the primary throttle shaft into the flange, and then install the throttle lever, throttle return spring, collar, and the primary throttle shaft arm.
Tighten the throttle shaft arm retaining nut.
Next, position the primary throttle valve, and secure the valve retaining screws.
After checking the primary throttle valve for smooth operation, rivet the screw ends slightly.
(3) Connect the secondary throttle lever and the primary throttle shaft arm with the throttle shaft link.

b. After assembling the primary and secondary throttle valves, check the opening angle of the primary and secondary valves.
To check, open the primary throttle valve fully, and check the secondary throttle valve opening condition.
At this time, also the secondary throttle valve should be opened completely.
If necessary, adjust by bending the throttle shaft link.
After adjustment, check the link

for free movement.

c. When installing the idle adjusting screw, screw in all the way, and then screw back about one and a half of a turn.

3. Carburetor body.

a. Assemble the high speed valve stop lever and the stop lever spring.
Tighten the stop lever set screw.

b. Install the fast idle cam, and tighten the set screw.

c. High speed valve assembly.
(1) Install the high speed valve shaft lever onto the high speed shaft and tighten the nut securely.
(2) Next, slide the high speed shaft into the carburetor body and then install the retainer ring.
(3) Position the high speed valve and secure the valve retaining screws.
Check the high speed valve for smooth operation.
(4) Check the clearance between the valve and the throttle bore with a wire gauge in the Carburetor Adjust Kit 09240-60040.
When the high speed valve is completely closed, this clearance should be 1.0 mm (0.4").
To adjust the clearance, loosen the valve retaining screws, and adjust the clearance to specification.

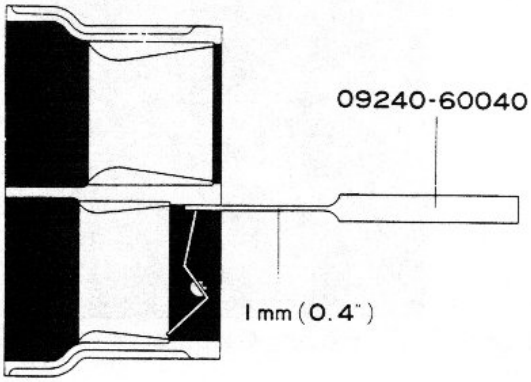


Fig.5-56 High Speed Valve Adjustment X5000-A

d. Install the discharge check valve and the gasket, and tighten the nut plug.

e. Position the primary and secondary small venturies and the gaskets into the air-horn, then tighten the main air bleeders securely.

f. Place the pump discharge weight into the fuel passage, and then install the pump jet and the gaskets.
Secure the pump jet screw.

g. Install the power valve, primary main jet, secondary main jet and the slow jet.

4. Assemble the flange together with the throttle wire clamp, and the flange gasket onto the carburetor body.
Tighten the retaining bolts, and the screw securely.

5. Place the spring, and assemble the lifter rod and the pump plunger onto the carburetor body.
Next, connect the pump lifter rod and the primary throttle shaft with the pump connecting link.

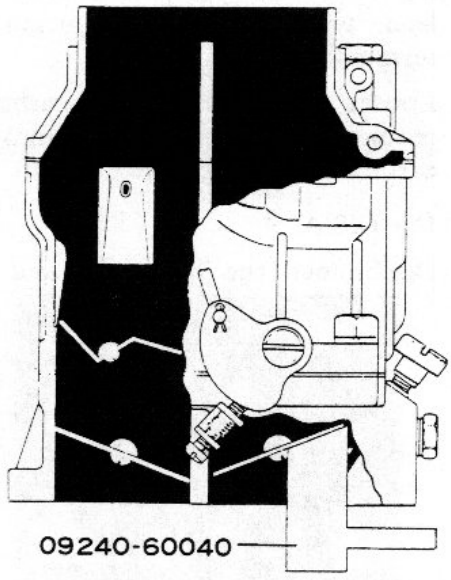


Fig.5-57 Fast Idle Adjustment X5027-A

6.. Assemble the air-horn together with the float and the gasket onto the carburetor body.
Next, connect the choke lever, and the fast idle cam with the fast idle connector.

7. After assembling the carburetor, the adjustment of the fast idle should be performed.
Close the choke valve completely, and check the primary throttle valve opening angle with the Carburetor Adjust Kit 09240-60040 as shown in figure 5-57.
If necessary, adjust the valve opening angle by turning the fast idle adjusting screw.

8. After assembling the carburetor, check the position of high speed valve stop lever.
When the secondary throttle valve starts to open, the high speed vlave should move freely.

Installation

Follow the removal procedures in the reverse order.
Check the fuel leak from the connections.
Check the throttle valve to open fully at the time when the accelerator pedal is fully depressed.
If necessary, adjust the accelerator linkage.
After the engine is warmed up, adjust the engine idling speed.

CARBURETOR - for FJ . FA * * * * * * * * * * * * * * * * * *

Removal .

FJ, FA

1. Remove the air cleaner cap.
2. Disconnect the fuel pipe and vacuum pipe from the carburetor.
3. Disconnect the choke wire and accelerator flexible wire from the carburetor. (FJ)
Disconnect the choke wire, throttle wire and the accelerator link from the carburetor. (FA)
4. Disconnect the magnetic switch valve lead wire from the ignition coil terminal.
5. Loosen and remove the carburetor mounting nuts, and then remove the carburetor assembly.

For U.S.A.

1. Disconnect the hose (4), and then.

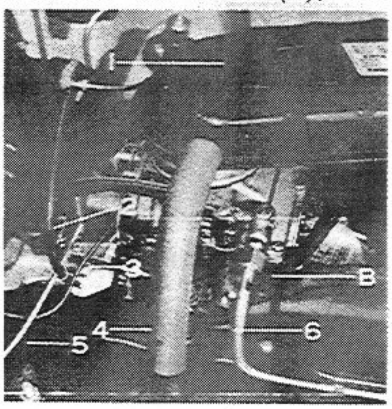


Fig. 5-58 Removing Carburetor 0190

remove the air cleaner cap (1) with hose.

2. Disconnect the fule pipe (6) and hoses B, C and D.
(B... retardor ports, C... vacuum port, D... diaphragm)
3. Disconnect the choke wire (5) and accelerator flexible wire (2) from the carburetor.
4. Disconnect the magnetic switch valve lead wire (3) from the ignition coil terminal.
5. Loosen and remove the carburetor, mounting nuts, and then remove the carburetor assembly.

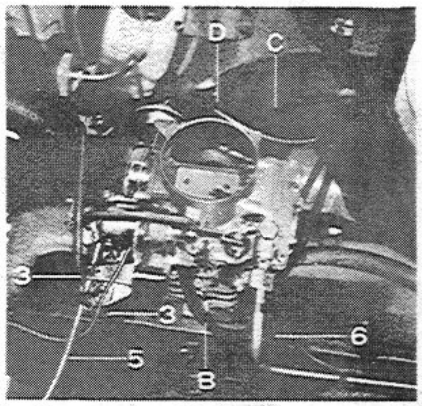
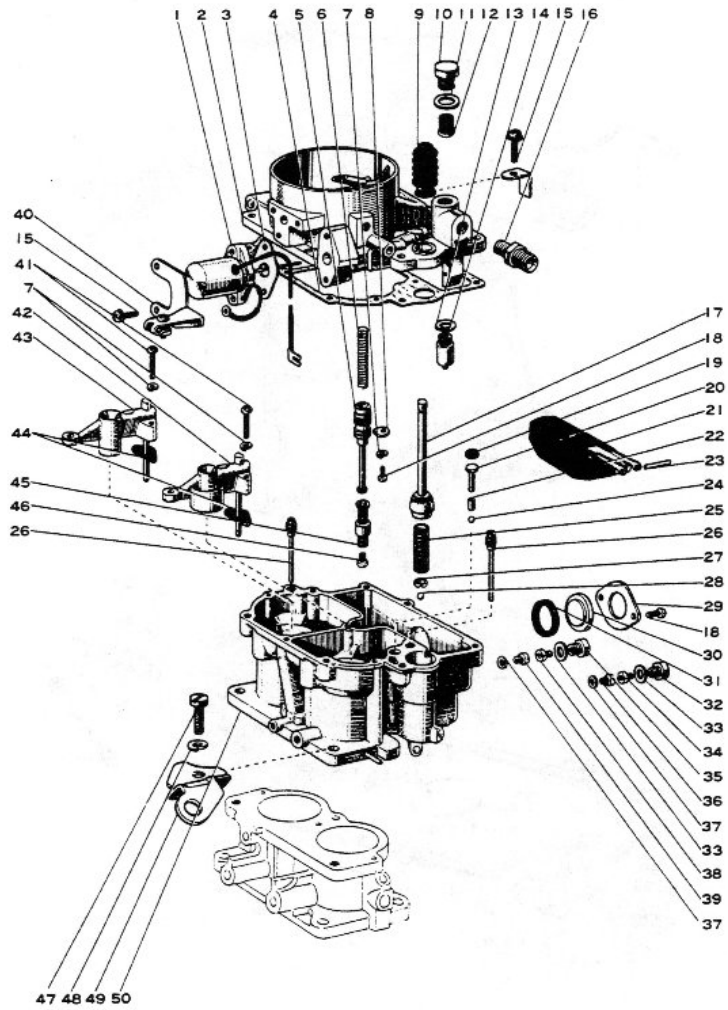


Fig.5-59 Removing Carburetor 01901

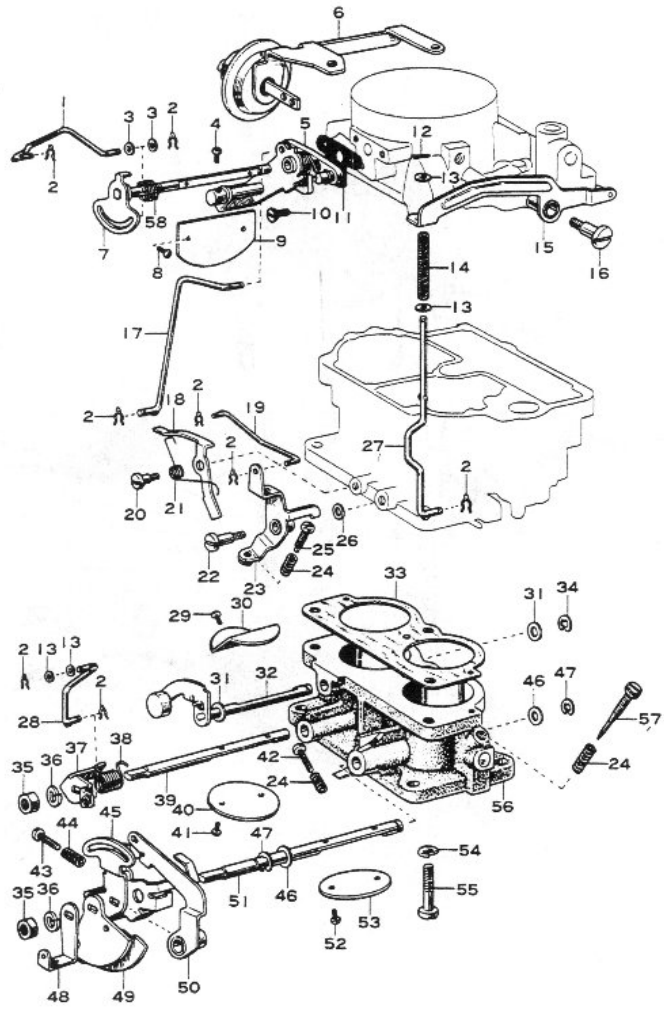
After removing the carburetor, cover the in take port of the manifold with a clean shop towel to prevent dust or dirt from entering.



1. Valve subassembly
2. Air-horn
3. Gasket
4. Air-horn gasket
5. Power piston
6. Power piston spring
7. Lock washer
8. Power piston stopper
9. Boot
10. Main passage plug
11. Strainer gasket
12. Strainer
13. Needle valve seat gasket
14. Needle valve subassembly
15. Screw
16. Fitting
17. Pump plunger
18. Screw
19. Gasket
20. Stopper
21. Float subassembly
22. Pump discharge weight
23. Float lever pin
24. Steel ball
25. Spring
26. Slow jet subassembly
27. Check ball retainer
28. Steel ball
29. Level gauge
30. Level gauge glass
31. Gasket
32. Main passage plug
33. Gasket
34. Primary main jet (spare)
35. Plug
36. Primary main jet
37. Gasket
38. Power jet (spare)
39. Secondary main jet
40. Choke wire clamp
41. Screw
42. Primary main venturi
43. Secondary small venturi
44. Venturi gasket
45. Power valve subassembly
46. Power jet
47. Bolt
48. Lock washer
49. Accelerator wire support
50. Carburetor body

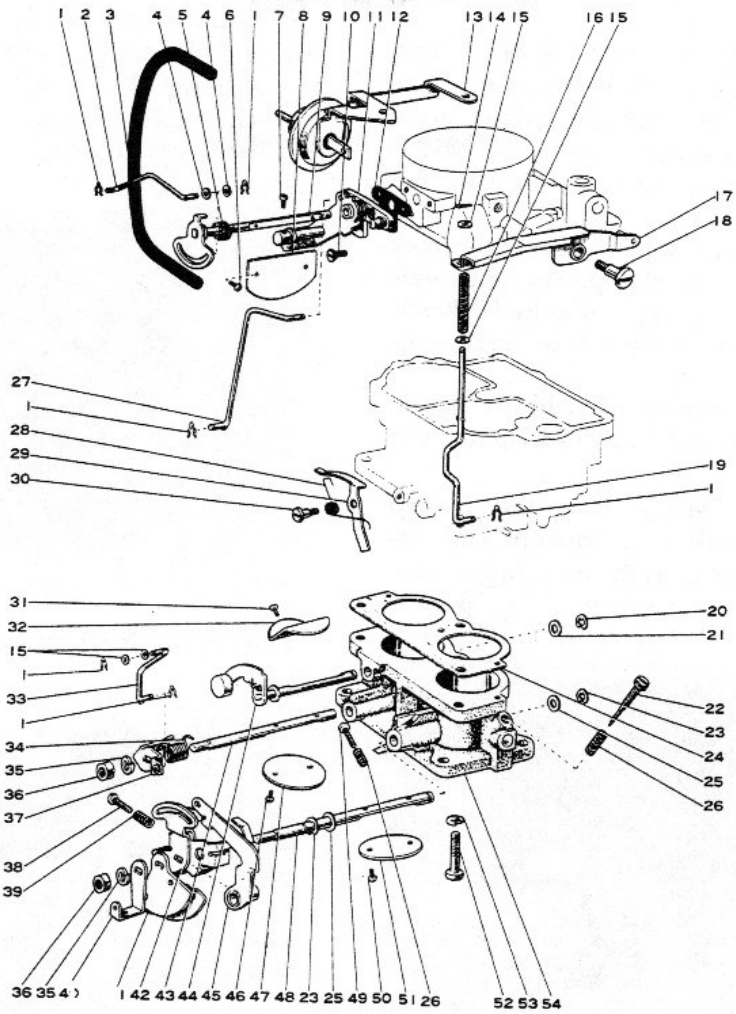
※ FJ ····· Up to E. No. 29492
FA ····· Up to E. No. 30175

Fig. 5-60 Carburetor Components 11331



1. Connecting link
2. Snap ring
3. Plate washer
4. Screw
5. Choke lever
6. Diaphragm subassembly
7. Choke shaft
8. Screw
9. Choke valve
10. Screw
11. Gasket
12. Cotter pin
13. Washer
14. Spring
15. Pump arm
16. Pump arm set screw
17. 1st idle connector
18. High speed valve stop lever
19. Connector
20. Stop lever set screw
21. High speed valve stop lever spring
22. Screw
23. Lever
24. Idle adjust screw spring
25. Screw
26. Washer
27. Pump connecting link
28. Throttle shaft link
29. Screw
30. High speed valve
31. Shim
32. High speed shaft
33. Flange gasket
34. Retainer ring
35. Nut
36. Lock washer
37. Secondary throttle lever
38. Secondary throttle return spring
39. Secondary throttle shaft
40. Secondary throttle valve
41. Screw
42. Throttle adjusting screw
43. Screw
44. Spring
45. Primary throttle shaft arm
46. Primary throttle shaft shim
47. Retainer ring
48. Return spring arm
49. Throttle lever
50. 1st idle adjusting lever
51. Primary throttle shaft
52. Screw
53. Primary throttle valve
54. Lock washer
55. Screw
56. Flange
57. Idle adjusting screw
58. Choke valve relief spring

Fig. 5-61 Carburetor Components (U.S.A.) 11332



1. Snap ring
2. Connecting link
3. Pipe
4. Plate washer
5. Choke valve relief spring
6. Screw
7. Screw
8. Choke valve
9. Choke shaft
10. Screw
11. Choke lever
12. Case gasket
13. Diaphragm subassembly
14. Cotter pin
15. Washer
16. Spring
17. Pump arm
18. Pump arm set screw
19. Pump connecting link
20. Retainer ring
21. Shim
22. Idle adjusting screw
23. Retainer ring
24. Flange gasket
25. Primary throttle shaft shim
26. Idle adjusting screw spring
27. 1st idle connector
28. High speed valve stop lever spring
29. High speed valve stop lever
30. Stop lever set screw
31. Screw
32. High speed valve
33. Throttle shaft link
34. Secondary throttle return spring
35. Lock washer
36. Nut
37. Secondary throttle lever
38. Screw
39. Spring
40. Return spring arm
41. Throttle lever
42. Primary throttle shaft
43. Secondary throttle shaft
44. High speed shaft
45. 1st idle adjusting lever
46. Screw
47. Secondary throttle valve
48. Primary throttle shaft
49. Throttle adjusting screw
50. Screw
51. Primary throttle valve
52. Screw
53. Lock washer
54. Flange

Fig. 5-62 Carburetor Components 11333

Disassembly

For disassembling, and assembling operations of the carburetor, the Carburetor Driver Set (09860-11010) and Carburetor adjusting gauge (09240-00010) or (09240-60050) should be utilized.

Proper wrenches with correct sizes should be used, and the parts removed must be thoroughly washed with clean gasoline or carburetor cleaning fluid.

These removed parts should be kept in clean container to faciliate the assembly.

1. Remove the snap ring of pump connecting link (5), loosen and remove the pump arm securing screw (3), and then remove the pump arm (1) and connecting link.

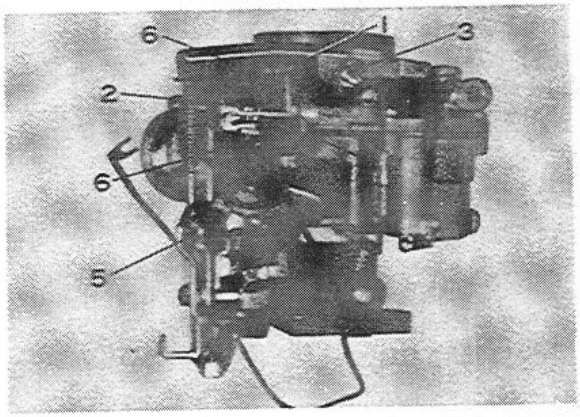


Fig. 5-63 Removing Pump Arm with Link 01902

2. Loosen and remove the choke wire clamp securing screw (6), and remove the choke wire clamp (4), magnetic valve (2) and gasket from the air-horn.

3. Remove the snap ring of the connecting link (2), connector (3) and 1st idle connector (1) from the carburetor. (Fig. 5-64)

4. Loosen and remove the air horn retaining screws, then remove the diaphragm, and separate the air horn from the carburetor body. Also remove the gasket.
   When removing, remove the air-horn straight upward without damaging the float.

5. Carburetor body disassembly.
   a. Remove the pump plunger spring (1), if necessary to remove the steel ball, remove the check ball retainer (2), and take out the steel ball (3).

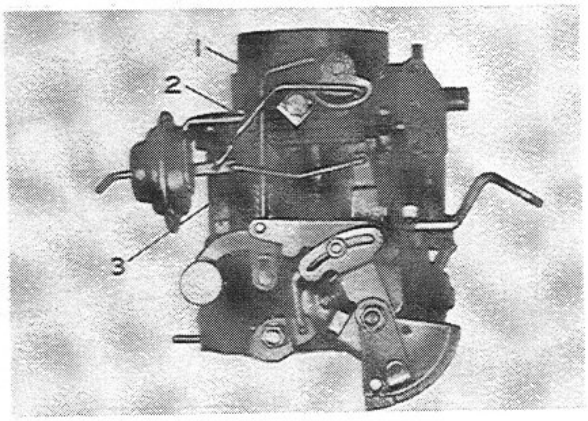


Fig. 5-64 Removing Links 01903

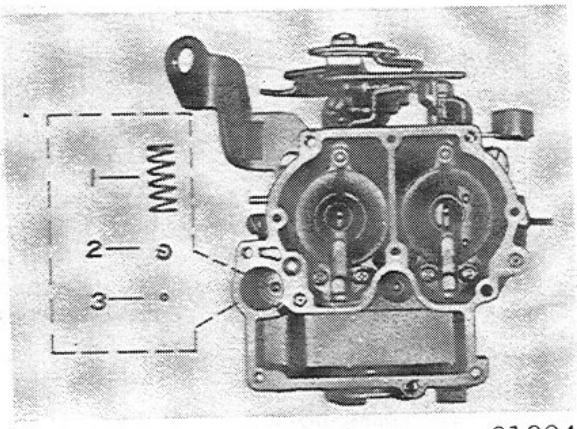


Fig. 5-65 Removing Pump Spring 01904

   b. Remove the gasket (1), stopper (2), pump discharge weight (3), and steel ball (4).

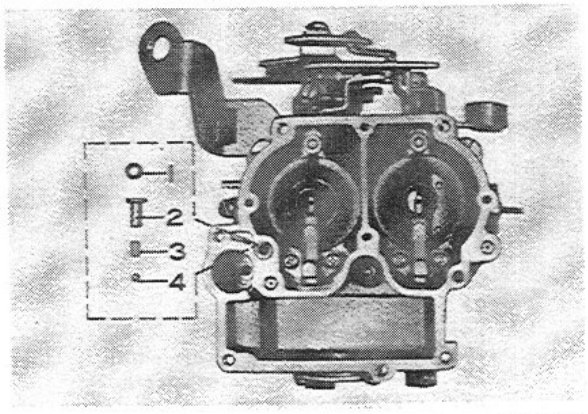


Fig. 5-66 Removing Pump Discharge Weight 01905

c. Loosen and remove the primary main venturi retaining screws, and removed the primary main venturi (1) and the gasket.

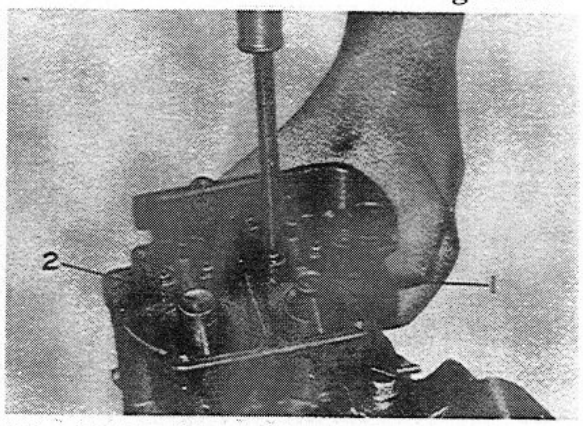


Fig. 5-67 Removing Venturies 01906

Loosen and remove the secondary small venturi retaining screws and remove the secondary small venturi (2) and the gasket from the carburetor body.

d. Loosen and remove the two slow jets (1). (Fig. 5-69)

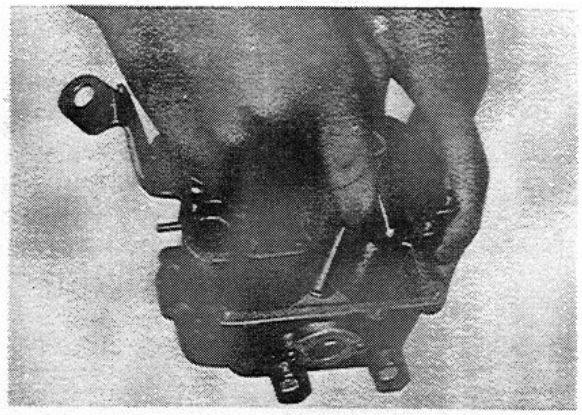


Fig. 5-68 Removing Power Valve 01907

e. Loosen and remove the power valve sub-assembly (2) with the power valve wrench (3) in the Carburetor Driver Set 09860-11010.
If necessary to remove the power jet, loosen and remove the power jet from the power valve. (Fig. 5-69)

f. For removing the primary main jet (3), loosen and remove the main passage plug (1) with the primary main spare jet (2), and then loosen and remove the primary main jet with the gasket. For removing the secondary main jet (4), loosen and remove it in the same manner as primary main jet. (Fig. 5-70).

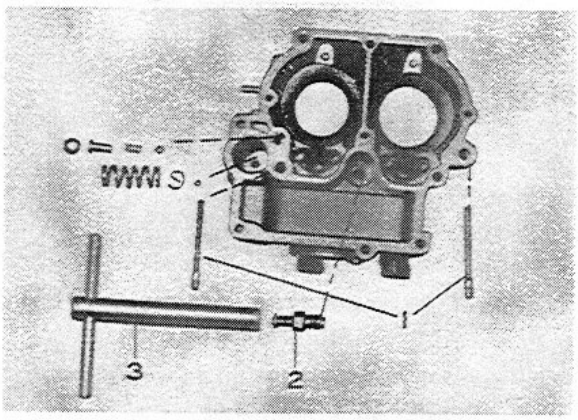


Fig. 5-69 Removing Slow Jets and Power Valve 01908

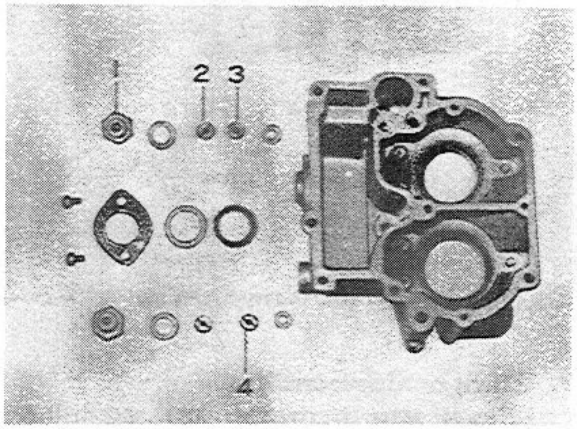


Fig. 5-70 Removing Primary and Secondary Main Jets 01909

g. Loosen and remove the two screws, remove the level gage clamp, glass and gasket.

h. Loosen and remove the two bolts on the carburetor body and the retaining screw on the flange, and separate the flange from the carburetor body. (Fig. 5-71).

i. Loosen and remove the screw (4), remove the lever (5) and washer (6). (Fig. 5-72).

j. Loosen and remove the stop lever securing screw (3), remove

the high speed valve stop lever (1) and high speed valve stop lever spring (2).

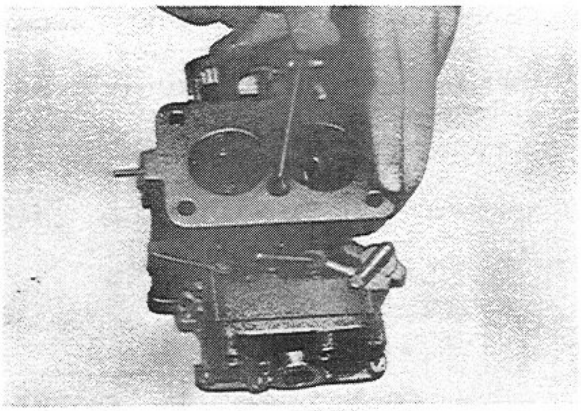


Fig. 5-71 Removing Retaining Screws 01910

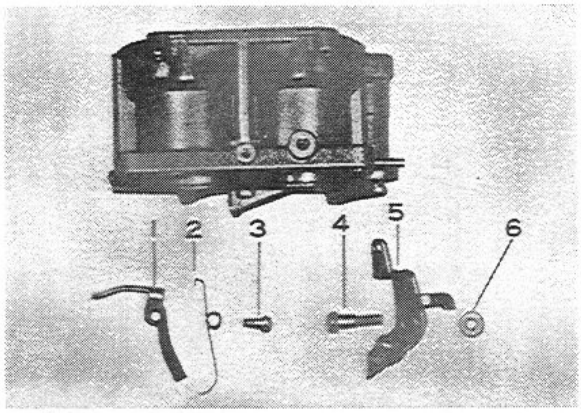


Fig. 5-72 Removing Levers 01911

6. Flange disassembly
Check the primary and secondary throttle valves, and high speed valve for proper closing, smooth movement, and if necessary, disassemble and replace the damage parts.

a. Loosen and remove the idle adjusting screw (6) from the flange (7).

b. For disassembling the high speed valve.
① Loosen and remove the two securing screw (4) retaining the high speed valve.
② Remove the high speed valve (3).
③ Remove a retainer ring (1) and the shim (2) from the high speed shaft (5).
④ Slide the high speed shaft from the flange (7).

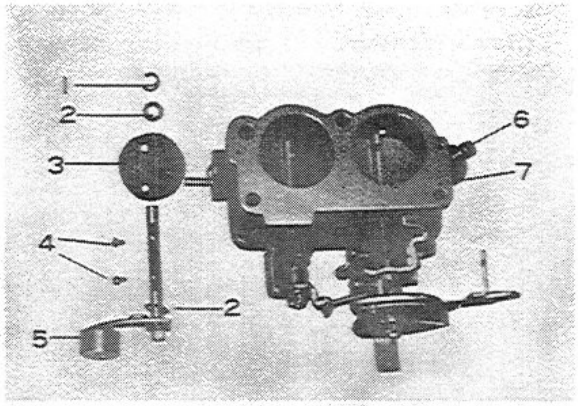


Fig. 5-73 Disassembling High Speed Valve 01912

Caution :
As the valve securing screw ends are calked, always file the screw ends with a suitable file.

c. For disassembling the throttle valve mechanism.
① Remove the snap ring (7), and disconnect the throttle shaft link (8) from the secondary throttle lever (6).
② Loosen and remove the secondary throttle valve retaining screw (2, 4), and remove the secondary throttle valve (3), next, slide the secondary throttle shaft (1) with the secondary throttle return spring (5) from the flange.

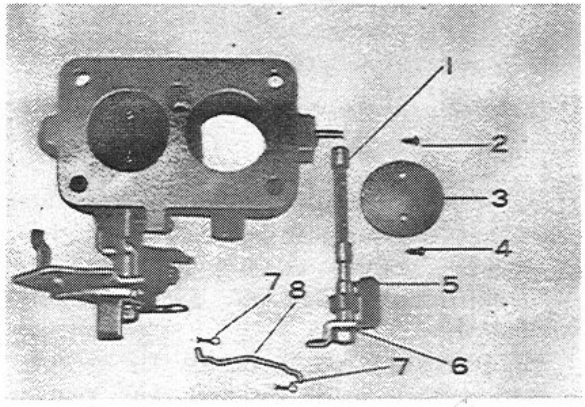


Fig. 5-74 Disassembling Secondary Throttle Valves 01913

③ Loosen and remove the primary throttle valve retaining screw (4), and remove the primary throttle valve (3), and then remove a retainer ring (1) and the shim (2).
Slide the primary throttle shaft from the flange.
Loosen and remove the throttle lever securing nut (8), disassemble the return spring arm (7), throttle lever (6), primary throttle shaft arm (5) and 1st idle adjusting lever (9).

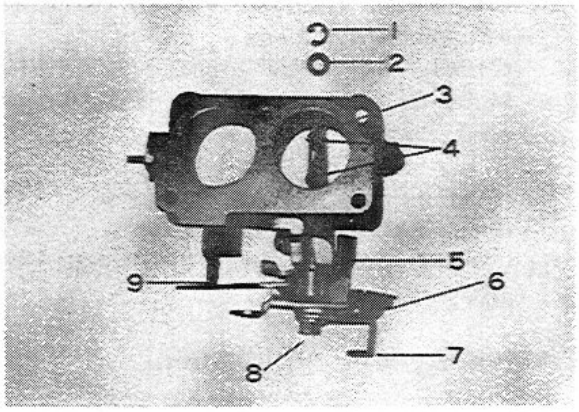


Fig. 5-75 Disassembly Priming Throttle Valve 01914

7. Air-horn disassembly.
a. Remove the float lever pin (4), and then remove the float (5) and the needle valve assembly. (needle valve (1), spring (2), pin (3).)
If necessary, loosen and remove the needle valve seat.

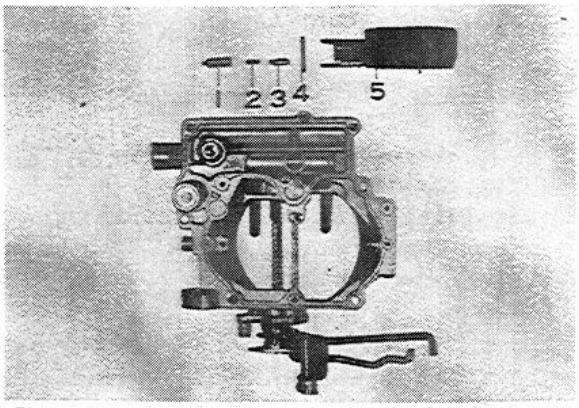


Fig. 5-76 Removing Flat 01915

b. Remove the power piston stopper (2), and then slide out the power piston and the spring (3).

c. Remove the pump plunger (4) and the boot (5).

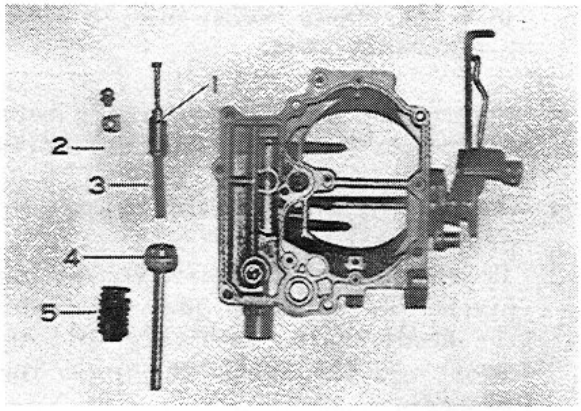


Fig. 5-77 Removing Power Piston and Pump 01916

d. Loosen and remove the main passage plug and the gasket, and take out the strainer.

e. Check the choke valve for proper choking, smooth movement, and excessive play of the choke shaft.
If necessary, disassemble the choke valve mechanism.
For disassembling the choke valve mechanism, loosen and remove the choke valve retaining screws, and take out the choke valve.
Next, slide out the choke shaft, relief spring and the choke lever from the air-horn.

Inspection

Wash the all disassembled parts thoroughly in clean gasoline, blow the fuel passages with compressed air, and remove the dirt.
Wash and clean the carbon deposits around the throttle valves.
Never use a wire for cleaning the jets.
Replace the parts if defective.

Air-horn

1. Inspect the air-horn for cranks, nicks or burrs at gasket surface.
2. Inspect the choke valve and the shaft for bend, wear and binding in the shaft bore.
3. Inspect the float for damaged tabs, and worn lever pin and pin bores.
4. Check the float needle valve for proper seating.
   To check the needle valve seating, invert the air-horn, and assemble the needle valve assembly and the float, and then suck the main fuel passage.
   At this time, if any leak is present, the valve seating is not satisfactory.
5. Inspect the strainer for rust and other defect.
6. Check the power piston for smooth movement.
7. Check the pump plunger for wear of sliding portion, defective leather and boot (crack, deterioration), smooth operation with the pump plunger bore.
8. Inspect the diaphragm operation.
   Operation stroke of rod :
   8～10 mm (0.32～0.39")
   When the diaphragm is sucked, the diaphragm rod must operate smoothly and fully.

Carburetor body

1. Inspect the carburetor body for cracks, nicks or burrs at gasket surfaces and damaged threads.
2. Check the power valve for smooth operation and proper seating.
3. Check the pump discharge weight, steel ball and stopper for rust, nicks or burrs.
4. Check the pump plunger spring and steel ball for rust and weakness.
5. Check the jets for damaged threads, damaged head slots and damaged holes.

Flange

1. Inspect the flange for cracks, nicks or burrs at gasket surface.
2. Check the idle adjusting screw for damaged threads and tapered portion.
3. Check the throttle valves for burrs and deformations.
   Check the throttle shaft for twist, bend or wear, and binding in the shaft bore.
4. Check the high speed valve for deformation, and shaft for twist bend or wear, and binding in the shaft bore.

Assembly and adjustment

All gaskets should be always replaced upon assembly.
Before assembling, check that the fuel passages are thoroughly cleaned.
All sliding or rotating portions should be always coated with multipurpose grease, and be checked for proper operation.
To assemble, follow the disassembly procedures in the reverse order.

1. Assemble the Air-horn

a. Choke valve mechanism assembly

1. Assemble the choke lever onto the air-horn.
Install the choke valve relief spring onto the choke shaft, and then, slide the choke shaft into the air-horn.
2. Position the choke valve, and tighten the choke valve retaining screws firmly.
3. Hook the end of the choke valve relief spring onto the choke lever

and check the choke valve for proper choking and smooth movement.
If necessary, loosen the choke valve retaining screws, and adjust the valve position so that it will choke firmly.
After adjusting, tighten the retaining screws securely, and rivet the screw ends slightly.

b. Float mechanism assembly.

When assembling the float and the needle valve, adjust the float level by bending the tabs of the float.
Adjustments of the float are in two methods.
One of them is at raised position and the other is at lowered position.
The final inspection should be performed with the fuel in the float chamber aligning with the level gauge glass indent.

1. For raised position of the float.

Invert the air-horn, and then measure the clearance between the upper surface of the float and the gasket surface of the air-horn.
To measure, use the Carburetor adjust Kit (09240-60050) or (09240-00010). This clearance should be 4.1 mm (0.161")
To obtain a correct clearance, bend the tab at (1.) in figure (5-80) .

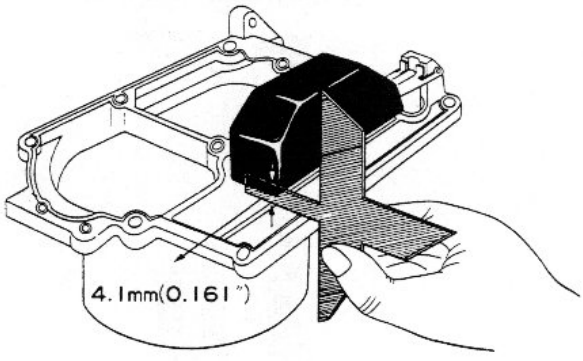


Fig. 5-78 Flat Raised Position Measurement 11334

2. For lowered position of the float.

Raise the float, and the clearance between the needle valve push pin and the float tab should be 1.0 mm (0.04").
For inspection, utilized the wire gauge of the float level gauge within the Carburetor Adjust Kit.

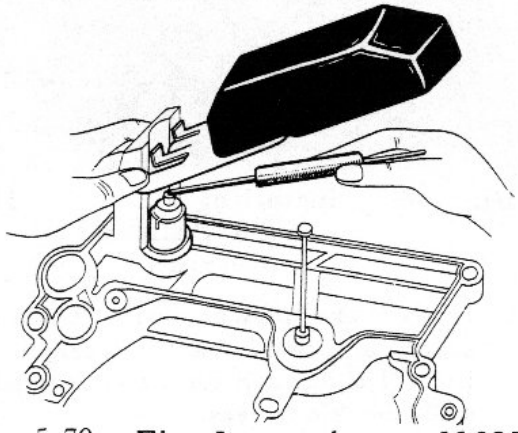


Fig. 5-79 Flat Lowered Position Measurement 11335

To obtain the correct clearance, bend the tabs at (2) in Figure (5-80) .

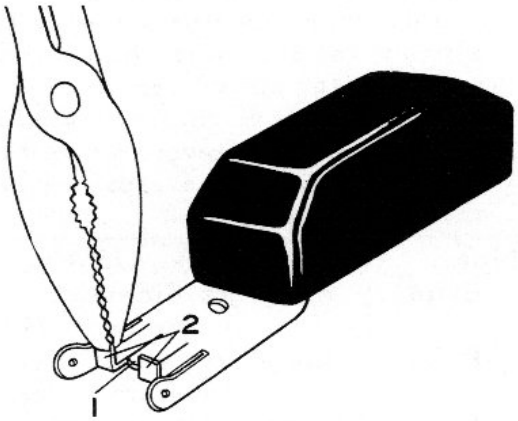


Fig. 5-80 Flat Tab Adjustments 11336

c. Place the spring, and slide the power piston into the air-horn, then secure the power piston stopper.
d. Install the pump plunger and the boot onto the air-horn.

2. Assemble the Carburetor Body

a. Install the steel ball and the check ball retainer into the pump cylinder bottom using the pincers.

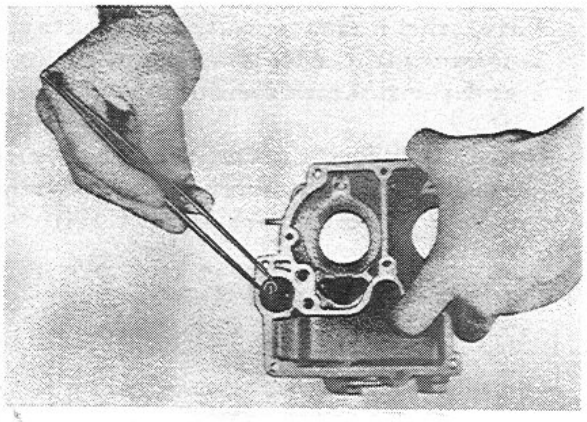


Fig. 5-81 Installing Steel Ball and Retainer 01917

b. Install the power valve with jet, using a power valve wrench and install the main jets, passage plugs and the slow jets.
For cars operating at high altitude, under-size primary main jet (1.08 mm diameter) and power jet (0.8 mm diameter) are installed as a spare part within the main passage plugs for correct fuel mixture supply. For cars operating at high altitude (about more than 2,000 m or 6,600 ft. above sea level), the original primary main jet(1.12mm diameter) and power jet (0.9 mm diameter) should be replaced with the above spare jets.

Note: (FJ, FA) (Ex. USA)
Primary main jet diameter : 1.12 mm (0.044″)
Primary main jet spare : 1.08 mm (0.043″)
Secondary main jet diameter : 2.0 mm (0.079″)
Power jet diameter : 0.9 mm (0.035″)
Power jet spare diameter : 0.8 mm (0.032″)
(Refer to servise specification procedure on USA Carburetor)

c. Install the gasket, level gauge glass and the clamp.
Note : Direction of the level gauge glass should be with the indent on the inside.

d. Install the primary main venturi and the secondary small venturi with the gaskets into the body.

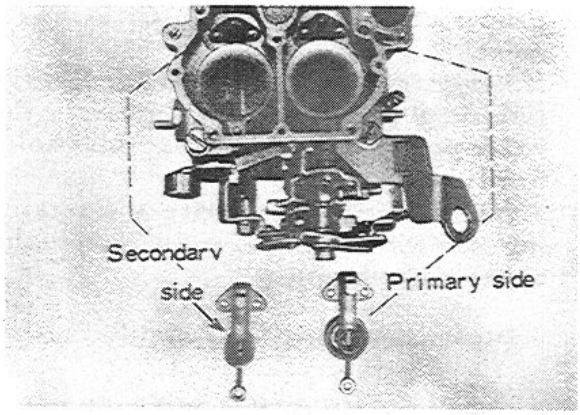


Fig. 5-82 Installing Venturies 01918

e. Insert the steel ball (4), pump discharge weight (3), stopper (2) and the gasket (1).
Note : For discharge weight installing direction, assemble as illustrated in Figure (5-84).

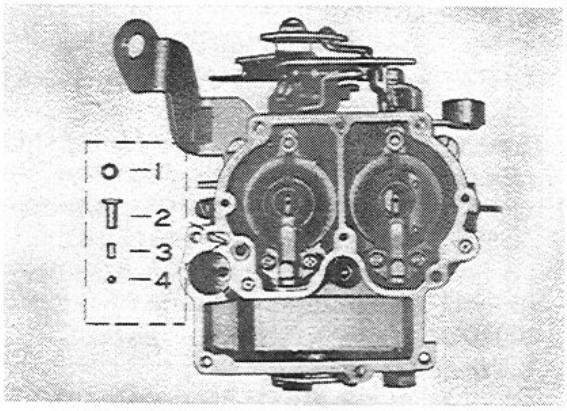


Fig. 5-83 Insert Pump Discharge Weight 01905

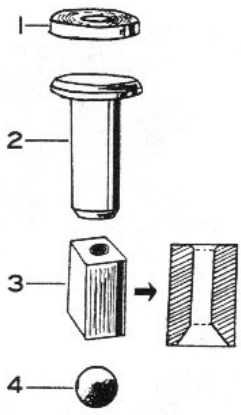


Fig. 5-84 Discharge Weight Installing Direction 11337

f. Install the high speed valve stop lever (1) and lever spring (2), on to the body, and tighten the stop lever securing screw (3).
Install the idle adjust screw spring (8) and screw onto the lever (5), and assemble the lever onto the body with the screw (4).

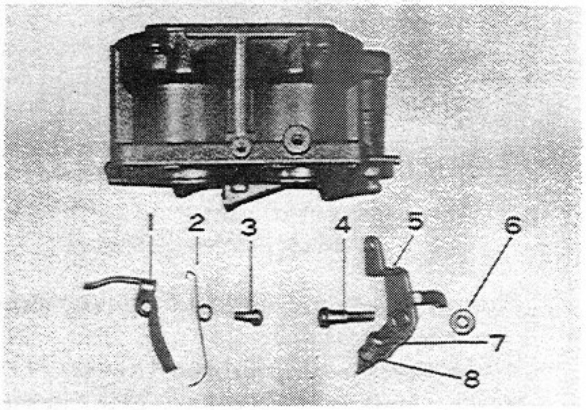


Fig. 5-85 Installing Levers 01911

3. Assemble the Flange

Throttle valve mechanism assembly.

a. Insert the secondary throttle shaft (2) into the flange (1), and install the secondary throttle valve (3) onto the shaft, then secure the throttle valve retaining screws (4).
Install the throttle return spring (6) and secondary throttle lever (5) onto the end of shaft, and tighten the throttle lever retaining nut (7).

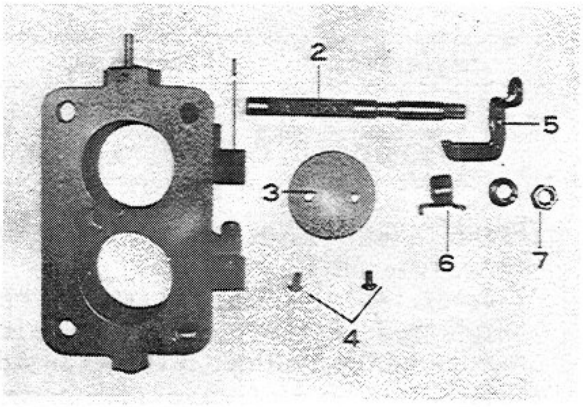


Fig. 5-86 Assembling Secondary Throttle Valve 01919

Check the throttle valve if it closes firmly or not, and the valve for smooth operation.
Calk the screw ends slightly.

CAUTION :
1. Install the thicker throttle valve onto the secondary side, and the thinner one onto the primary side.
2. The valves must be installed from the underneath.
3. Use the longer screws for secondary valve side.

b. Insert the primary throttle shaft (2) into the flange.
Adjust the installing position of the primary throttle shaft by inserting shims (1) so that the flat surface of the shaft portion will be at the center of the bore, and the thrust play is less than 0.4 mm (0.004")

Parts No.	Thickness
21581-41010	0.1 mm (0.004")
21581-32010	0.2 mm (0.008")
21583-41010	0.3 mm (0.012")
21583-32010	0.6 mm (0.024")

Thickness the thrust shims.

Install the primary throttle valve (3), and install the primary throttle shaft arm (5), 1st idle adjusting lever (6), throttle lever (7) and return spring arm (9), then tighten the nut (8).
Connect the secondary throttle lever (4) and primary throttle shaft arm with the throttle shaft link (10).
To check after assembling, the periphery surface of both the secondary and the primary throttle valves must contact completely against the bores when the valves are fully closed, and then calk the valve securing screw ends.
To check the opening angles of the primary and secondary valves, when the primary throttle valve are fully opened, check the secondary throttle valve opening condition, at this time, the secondary throttle valve should be opened

fully.

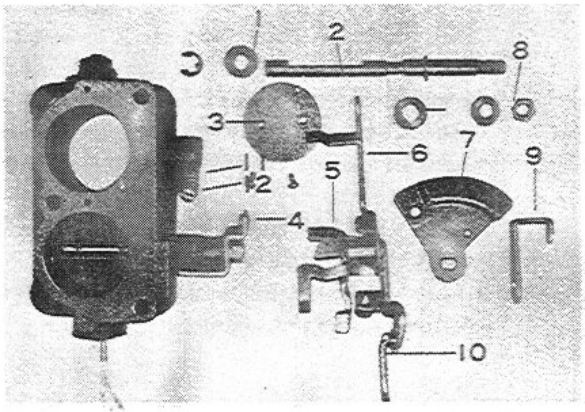


Fig. 5-87 Assembling Primary Throttle Valve 01920

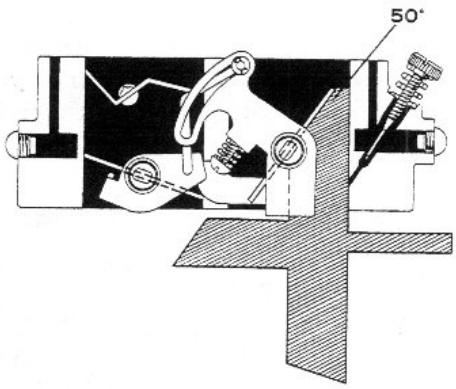


Fig. 5-88 "2nd" Touch Adjustment 11338

For inspection, use the angle gauge stamped with 50° mark.
If necessary, adjust by bending the throttle shaft link.
After adjustment, check the link for free movement.
Install the 1st idle adjusting screw and the spring to the primary throttle shaft arm.
Install the throttle adjusting screw (12) with the spring (11) onto the flange.
Install the idle adjusting screw with the spring onto the flange.
When installing, screw in all the way, and screw back about one and a half turns.

c. Assemble the high speed valve.
Install the shim (6) onto the high speed shaft (5), and insert the high speed shaft into the flange, then, install the shim (2) and the retainer ring (1).

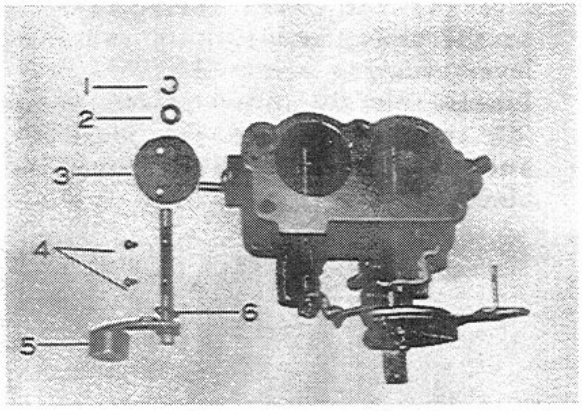


Fig. 5-89 Assembling High Speed Valve 01912

The thrust play should be less than 0.4 mm (0.016").
If necessary, adjust the thrust play with two different thicknesses shims.

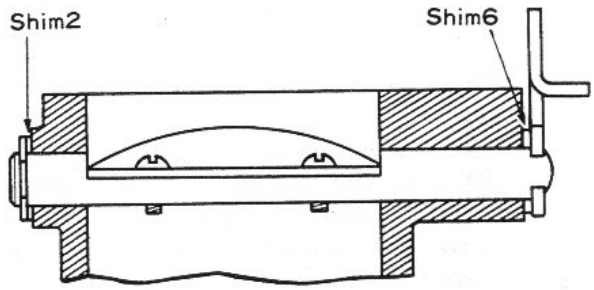


Fig. 5-90 Shim Adjustment 11339

Parts No.	Thickness
21681-21060	0.1 mm (0.004")
21682-21060	0.2 mm (0.008")

Install the high speed valve (3) onto the shaft.
Adjust the clearance between the high speed valve and the bore with a wire gauge in the carburetor adjust kit.
When the high speed valve is completely closed, this clearance should be 1.0 mm (0.004").
After assembling the high speed valve, check for smooth movement.

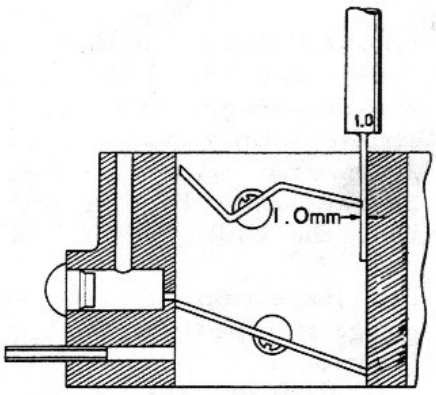


Fig. 5-91 High Speed Valve Adjustment 11340

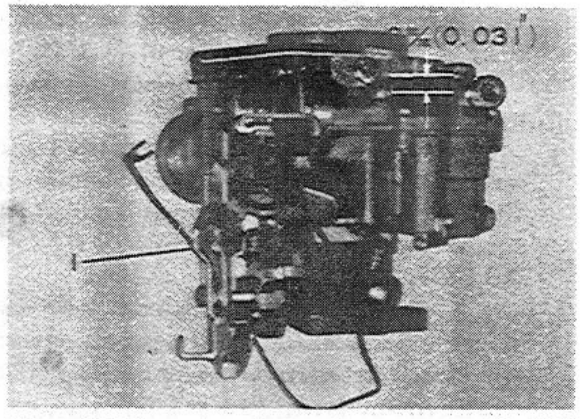


Fig. 5-92 Acceierating Pump Adjustment 01902

Assemble the flange together with the accelerator wire support and flange with gasket onto the carburetor body.
Tighten the flange securing bolts and the screw securely.
Assemble the air-horn assembly with the gasket and the diaphragm sub-assembly onto the carburetor body.
Install the pump arm and connect the connectors.
Install the vacuum pipe onto the carburetor.

ADJUSTMENT

To adjust the carburetor, use the Carburetor Adjust Kit 09240-60050. When the primary throttle valve is fully opened, at this time, check the secondary throttle valve should fully open, then adjust in the following manner.

1. Adjust the accelerating pump
   Stroke of the accelerating pump should be 8 mm (0.31") by bending the pump connecting link (1).

2. Damper Valve Stop Lever disengaging angle. (If applicable)
   When the secondary throttle valve starts to open ("Seco-touch"), adjust the "A" portion so that the clearance between the stop lever and arm is maintained at the following measurement.
   For inspection, use the 0.5 mm wire gauge.

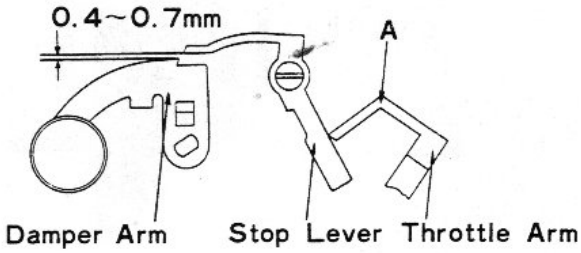


Fig. 5-93 Stop Lever Disengaging Angle Adjustment 11341

3. First Idle Opening Angle
   a. Position the throttle opening angle at 4°30'
   (Tighten 1½ of a turn after the throttle adjusting screw contacts the throttle arm.)
   b. Tighten until the fast idle screw end contacts the fast idle lever.
   c. Position the choke valve at fully closed condition (over choke), and loosen the fast idling screw until the clearance of 0.95 ~ 1.17 mm between the throttle valve and flange is obtained.
   For inspection, use the 1.0 mm wire gauge, or the angle gauge stamped with 21° mark.

4. Throttle Positioner (For U.S.A.)
   a. Expose the diaphragm to atmospheric pressure, contact the screw with the throttle arm, and

tighten the screw until the clearance of 0.66～0.86 mm (0.026～0.034") between the throttle valve and flange is obtained.

b. Adjust the stop lever and link so that the measurement between the throttle arm stopper end and screw will be 2～3 mm (0.078～0.118").

c. Confirm that the end of the screw completely disengages from the throttle arm when pushing the diaphragm link rod with hand.

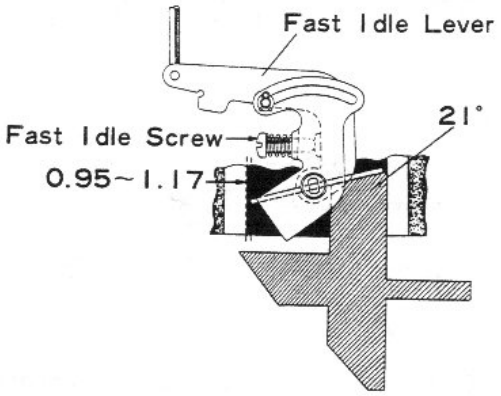


Fig. 5-94 First Idle Opening Angle 11342

Stop Lever — This (A) portion must be adjusted.

When the diaphragm is at atmospheric pressure, this (B) portion must always stop.

Caution : Perform the throttle positioner adjustment after completing the paragraph 3 adjustment.

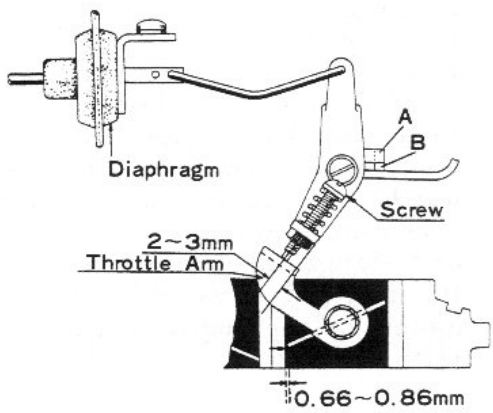


Fig. 5-95 Throttle Positioner Adjustment 11343

5. Choke Pulling Angle Adjustment. Fully close the choke valve, push the diaphragm link rod of fully stroke (apply vacuum of 130 ± 10 mmHg onto the diaphragm) and adjust by bending the link so that the choke valve will be at 38° "A".

For inspection, use the adjusting gauge stamped with 38° mark.

Caution :

1. Perform the choke pulling angle adjustment after completing the throttle positioner adjustment as per paragraph 4.
2. After completing the pulling angle adjustment, release the diaphragm link rod (expose the diaphragm to atmospheric pressure), and confirm whether the choke valve closes fully when the choke lever is pulled.

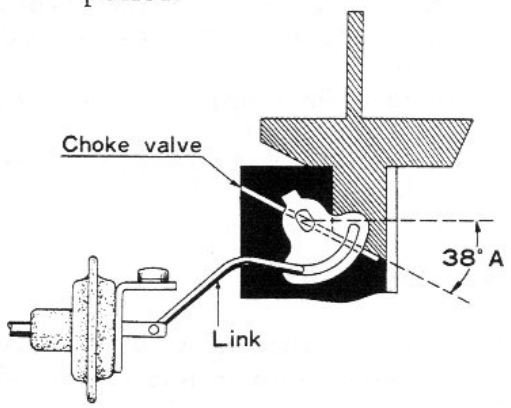


Fig. 5-96 Choke Pulling Angle Adjustment 11344

6. Reloader Adjustment.

1. Adjust by bending the "A" portion either to the left or right so that the clearance between the high speed arm stopper and fast idle lever arm will be 0.5～1.0mm (0.020～0.039") when the choke valve is fully closed (over choke).
2. θ= At 40°, the high speed valve must smoothly rotate from fully closed position to fully opened position.
   θ= At 50°, the high speed valve should not rotate more than about 20°.

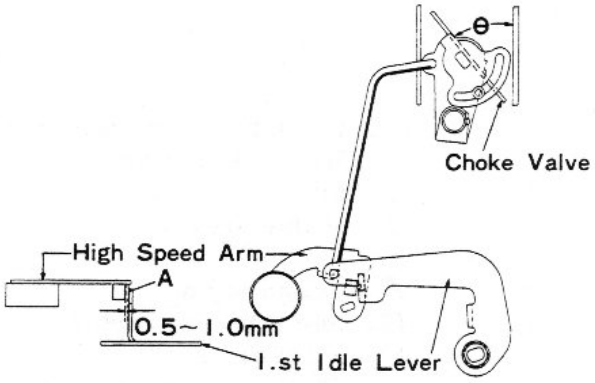


Fig.5-97 Reloader Adjustment 11345

7. Idle Adjusting Screw Loosening Allowance.
Loosen about 1-1/4 turns from fully closed position.

8. Throttle Adjusting Screw Tightening Allowance.
Tighten about 1/2 of a turn after the throttle adjusting screw end contacts the throttle arm.

* *

FUEL PUMP

The diaphragm type fuel pump is operated by a rocker arm (5) that reaches through the side of the crankcase, and rides on a special cam on the engine camshaft.
In operation, the diaphragm (4) is pulled down against the tension of the diaphragm spring (2) by the action of the cam, and rocker arm.
This causes a partial vacuum in the pump chamber which opens the inlet valve (1), and applies this vacuum to inlet line from the fuel filter.
Further movement of the camshaft releases the rocker arm, and the diaphragm spring pushes the diaphragm up, the inlet valve closes, and the outlet valve (3) is forced to open permitting the fuel to be forced into the outlet line, and up to the carburetor. Each revolution of the camshaft repeats this operation bringing additional fuel through the inlet, and outlet valves, and up to the carburetor.

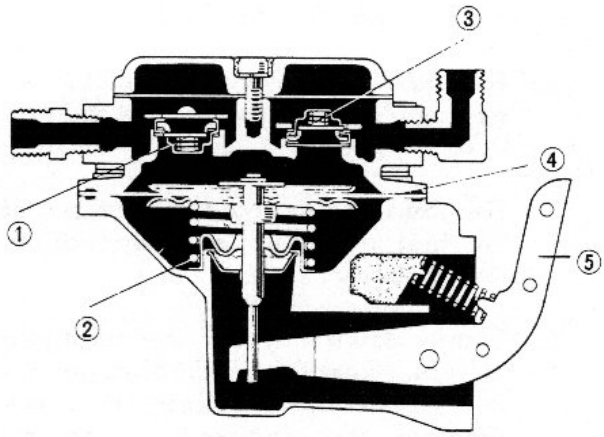
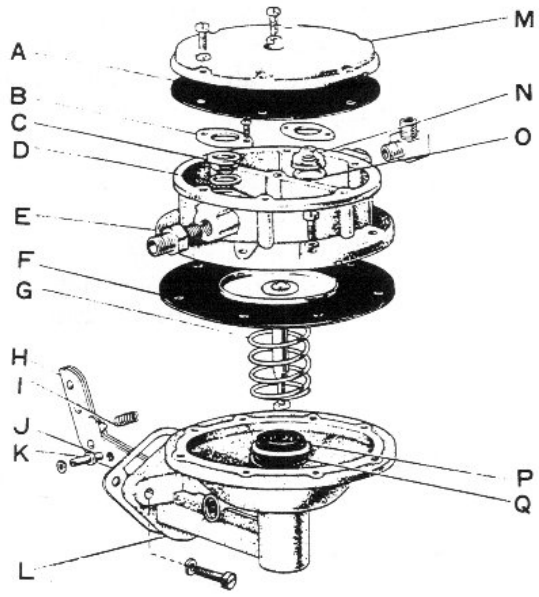


Fig.5-98 Fuel Pump Cross Section View X5028-A

Specification:

Type	Diaphragm
Delivery capacity at 1,000 rpm of camshaft	More than 2,100 cc/min (2.22 US qts/min., 1.85 Imp. qts/min)
Delivery pressure at 1,000 rpm of camshaft	0.24 ~ 0.34 kg/cm² (3.4 ~ 4.8 psi)

Removal & Disassembly



A. Fuel pump cover gasket
B. Valve retainer
C. Inlet valve
D. Valve gasket
E. Union
F. Diaphragm
G. Diaphragm spring
H. Rocker arm
I. Rocker arm spring
J. Rocker arm spacer
K. Rocker arm pin
L. Fuel pump lower body
M. Fuel pump cover
N. Outlet valve
O. Valve gasket
P. Oil seal retainer
Q. Oil seal

Fig. 5-99 Fuel Pump Components X5029-A

1. Disconnect the fuel inlet and outlet pipes from the fuel pump.
2. Remove the mounting bolts, and remove the fuel pump and the gasket.
3. Remove the screws, and separate the fuel pump upper body from the lower body.
4. Press down and turn the diaphragm to disconnect the diaphragm pull rod from the rocker arm, then remove the diaphragm, spring, oil seal retainer, and the oil seal.
5. Remove the fuel pump cover, and the gasket.
   Next, remove the two valve retainers, inlet valve, outlet valve, and the gaskets.
6. Using a shank drill, and drill out the rivetted head of the rocker arm pin, then press out the rocker arm pin.
   Remove the rocker arm, rocker arm spring and the washers.

Inspection

Wash all the disassembled parts in clean gasoline, and blow the passages with compressed air.

1. Check the pump cover, and the pump body for cracks, defective threads, and worn arm pin holes.
2. Check the diaphragm for tear and worn pull rod.
3. Check the springs for weakness and corrosion.
4. Check the rocker arm for wear.
5. Check the valves for proper operation.

Assembly & Installation

Always replace the gaskets and the oil seal upon assembly.

1. Install the rocker arm spring, rocker arm, two washers, and new rocker arm pin.
   Rivet the end of the rocker arm pin securely.

2. Place the diaphragm spring, oil seal retainer, and the oil seal through the diaphragm shaft. In similar manner as for disassembling the diaphragm, press down the center of the diaphragm with the thumb, and turn the diaphragm, and connect the end of the diaphragm pull rod onto the rocker arm.

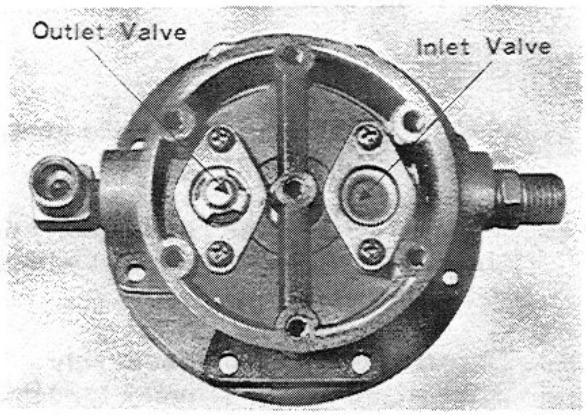


Fig. 5-100 Valve Installation V4368

3. Install the valves over the gaskets onto the upper body, and secure the valves with the valve retainers and screws.

4. Install the fuel pump cover, and the gasket onto the fuel pump upper body.

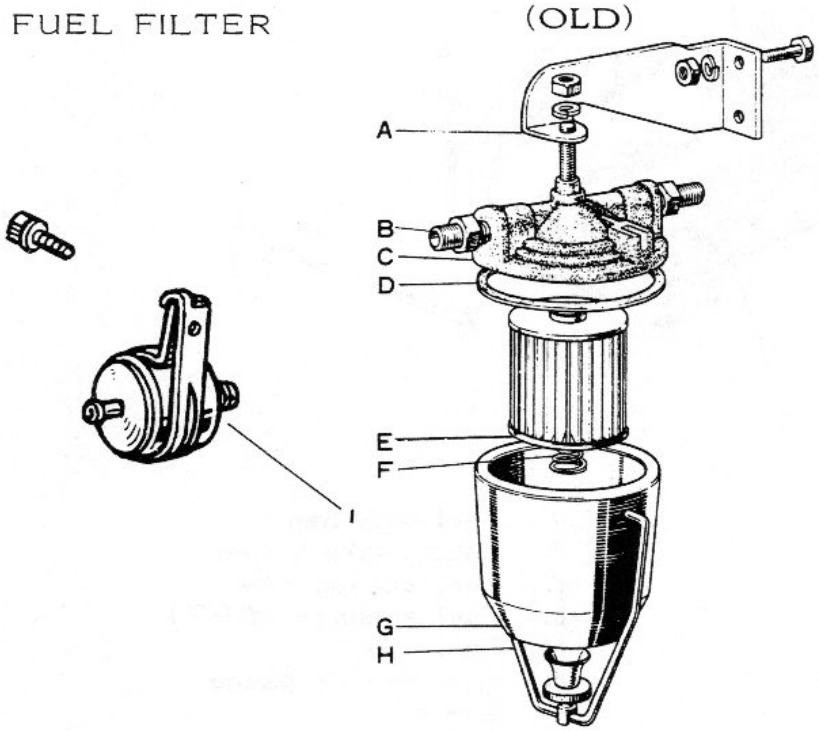
5. Assemble the fuel pump upper body onto the fuel pump lower body insuring that all screws pass through the holes in the diaphragm without tearing the fabric, then tighten the screws evenly and securely.

6. Install the fuel pump and new gasket onto the cylinder block.

7. Connect the fuel inlet and outlet pipes onto the fuel pump.

* *

FUEL FILTER (OLD)



A. Fuel filter support
B. Fitting
C. Fuel filter body
D. Filter bowl gasket
E. Fuel filter element
F. Filter element spring
G. Filter bowl
H. Filter bowl bail
I. Filter assembly

Fig. 5-101. Fuel Filter Components X5032

The fuel filter is a replaceable element type. This type serves to prevent the carburetor from clogging by filtering the particles of dirt or other foreign matters which may be contained in the fuel. If this element is allowed to clog, the engine performances will be impaired. At frequent intervals, disassemble, and take out the element, and clean with clean gasoline. Replace the element every 18,000 kilos (12,000 miles).

Removal

1. Loosen the filter bowl bail nut.
2. Remove the filter bowl, spring, filter element and gasket.

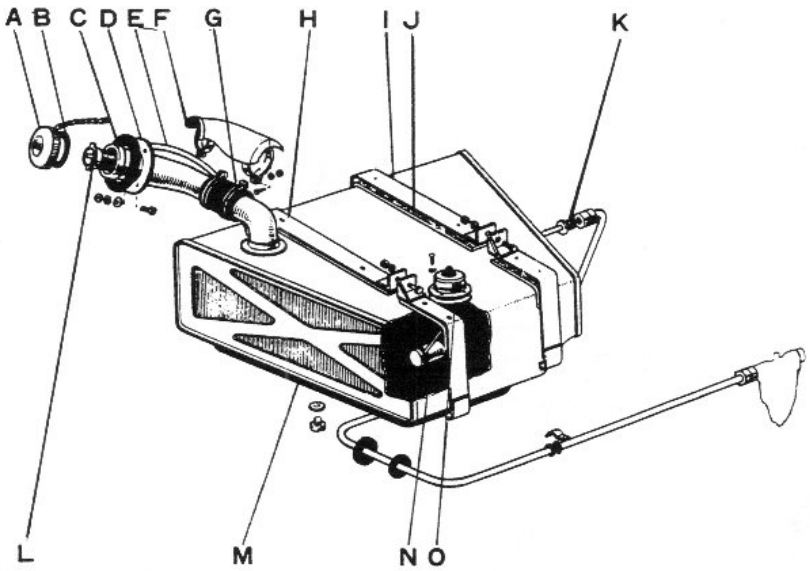
Inspection

1. Wash all parts thoroughly in cleaning solvent.
2. Check the bowl for clips around the rim, which will cause difficulty in sealing.
3. Inspect the filter element for rust or restriction.

Installation

1. Install a new gasket, filter element, spring, and bowl.
2. Tighten the filter bowl bail nut partially, and turn the bowl slightly to seal properly.
3. Tighten the bail nut securely. Start engine, and check for leak.

FUEL TANK & FUEL PIPES - For FJ series



A. Fuel tank cap
B. Gasket
C. Packing
D. Outer inlet pipe
E. Breather hose
F. Inlet pipe cover
G. Inlet pipe joint
H. Fuel tank band
I. Fuel tank band
J. Band packing shim
K. Fuel suction tube
L. Fuel strainer (OPT)
M. Fuel tank
N. Fuel sender gauge
O. Gasket

Fig. 5-102 Fuel Tank Components X5033

Removal

1. Remove the driver's seat or passenger seat.
2. Disconnect the wire from the fuel sender gauge.
3. Remove the drain plug from the bottom of the fuel tank, and drain the fuel from the fuel tank.
4. Disconnect the fuel hose from the fuel suction tube.
5. Remove the fuel tank inlet pipe cover, next, loosen the fuel tank inlet pipe joint clamp screw.
6. Disconnect the breather hose from the fuel tank.
7. Remove the connecting bolts on the fuel tank bands, and remove the fuel tank bands.
8. Remove the fuel tank and the band packing shims.
9. Remove the screws, and take out the fuel sender gauge.

Inspection

1. Inspect the fuel tank for cracks, corrosion and leak.
   If any defect is present, repair or replace as necessary.
2. Check the fuel hose and unions, and if defective, replace as necessary.
3. Water and dust accumulation in the fuel tank will cause the carburetor or fuel pump malfunction.
   If the accumulation of sediment in the tank, and fuel filter is excessive, the fuel tank should be removed and flushed, and the fuel line from the fuel pump to the tank should be blown out.

Installation

Follow the removal procedures in the reverse order.
Fuel lines must be securely fastened in position with the clamps.
Make sure that all connections are tight to prevent fuel leakage.

1. Screw
2. Spring washer
3. Fuel sender gauge
4. Fuel sender gauge gasket
5. Fuel tank sub-assembly
6. Gasket
7. Hexagon bolt
8. Fuel tube
9. Bolt
10. Spring washer
11. Fuel hose clamp
12. Spring washer
13. Gromet
14. Plate washer
15. Bolt
16. Breather tube joint piece
17. Breather tube joint bracket
18. Bolt
19. Plate, washer
20. Spring washer
21. Nut
22. Hose
23. Hose
24. Hose
25. Fuel tank cap assy
26. Fuel upper pipe sub-assembly
27. Hose clamp
28. Fuel inlet lower pipe
29. Fuel tank inlet pipe rubber
30. Fuel inlet hose joint
31. Grommet
32. Plate washer
33. Bolt
34. Fuel inlet box cover hinge
35. Fuel inlet box cover upper spring
36. Fuel inlet box cover hinge washer
37. Fuel inlet box hinge
38. Fuel inlet box cover lower spring
39. Plate washer
40. Screw
41. Cotter pin
42. Fuel inlet box lock plate

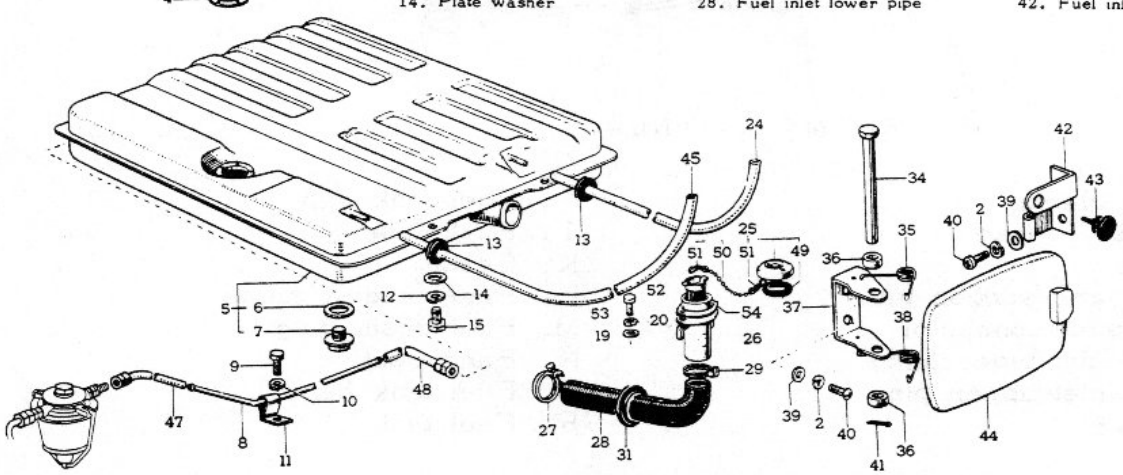


Fig. 5-103 Fuel Tank Components for FJ55V G1691

Removal - For FJ55V

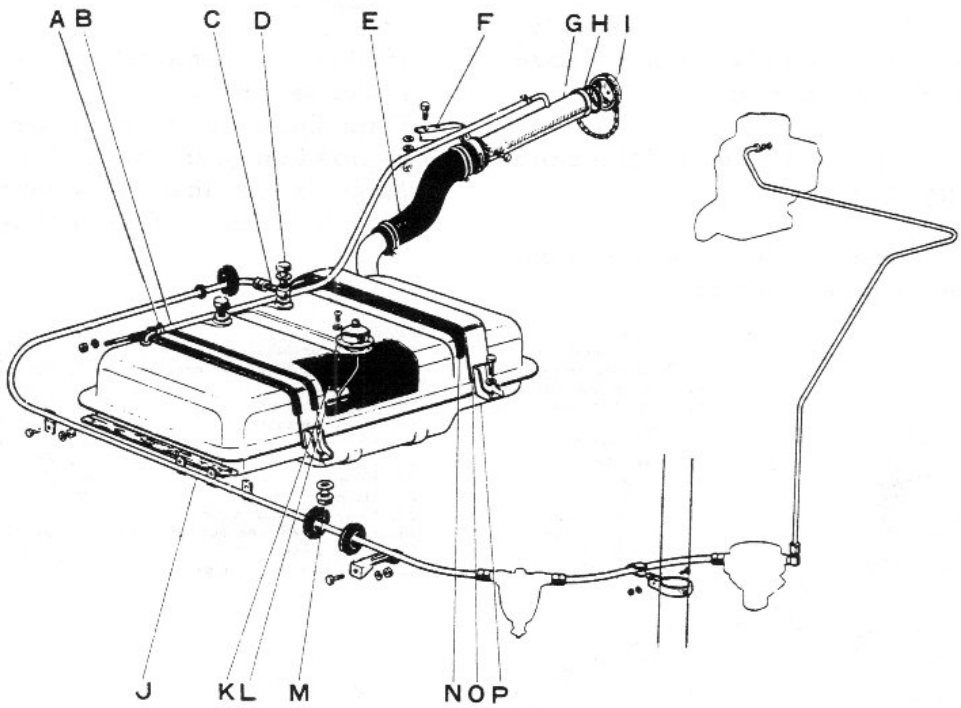
1. Remove the service hole cover on the rear floor, and disconnect the wire from the fuel sender gage.
2. Using the crank handle, and remove the spare tire from the spare tire carrier.
3. Drain the fuel from the fuel tank.
4. Loosen the clamp and disconnect the fuel tank inlet pipe connection, and the breather hose from the fuel tank.
5. Loosen the nut, and disconnect the fuel hose from the fuel tank suction tube.
6. Remove the cross-member together with the spare tire carrier under the fuel tank.
7. Remove the fuel tank mounting bolts, and withdraw the fuel tank assembly.

Inspection

Refer to inspection of fuel tank in the previous section for FJ series.

Installation

Follow the removal procedures in the reverse order.
Fuel lines must be securely fastened in position with the clamps.
Make sure that all connections are tight to prevent fuel leakage.



A. Hose clamp
B. Breather hose
C. Union
D. Fuel tank suction tube
E. Inlet pipe connector
F. Fuel inlet pipe clamp
G. Fuel inlet upper pipe
H. Gasket
I. Fuel tank cap
J. Fuel hose
K. Gasket
L. Fuel sender gauge
M. Fuel drain plug
N. Band seat
O. Fuel tank band
P. Fuel tank

Fig. 5-104 Fuel Tank Components for FA X5034

Removal - For FA

1. Drain the fuel from the fuel tank.
2. Remove the driver's seat.
3. Disconnect the wire from the fuel sender gauge.
4. Loosen the hose clamp, and disconnect the breather hose from the fuel tank.
5. Loosen the nut, and disconnect the fuel tank hose from the fuel tank suction tube.
6. Loosen the fuel tank inlet pipe connector clamp, and disconnect the pipe connection from the fuel tank.
7. Remove the fuel tank band, and the band seat, then remove the fuel tank assembly.
8. Remove the fuel sender gauge.

Inspection

Refer to inspection of fuel tank for FJ series.

Installation

Follow the removal procedures in the reverse order.
Fuel lines must be securely fastened in position with the clamps.
Make sure that all connections are tight to prevent fuel leakage.

AIR CLEANER

The air cleaner functions primarily to remove dust and dirt from the air which is drawn into the carburetor, and to the engine.
The standard air cleaner on the F model engine is of a felt element type and oil bath type air cleaner is option for FA only.

The construction of these air cleaners are as shown in the figures.

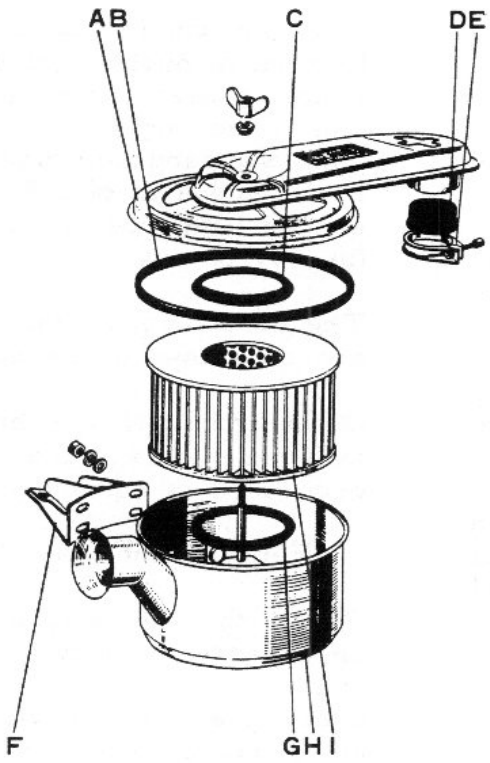
Disassembly of the air cleaner is self-explanatory, and the assembly procedure is equally simple.

Felt element type

Check the element, and if damaged or excessively dirty, replace the element.
Clean the element with compressed air at low pressure blowing from inside towards the outside.

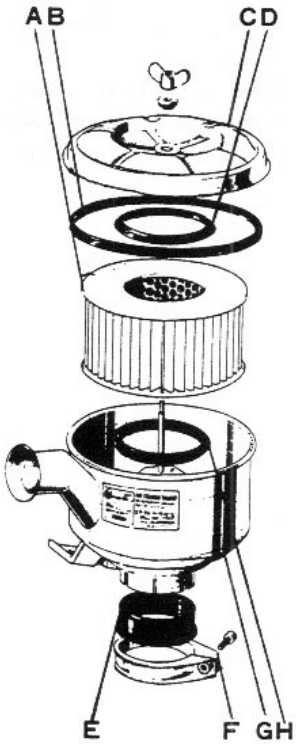
Oil bath type

Wash the element with cleaning solvent, and dry it thoroughly before use.
Check the oil, and if excessively dirty replace the oil with proper grade engine oil up-to the level.



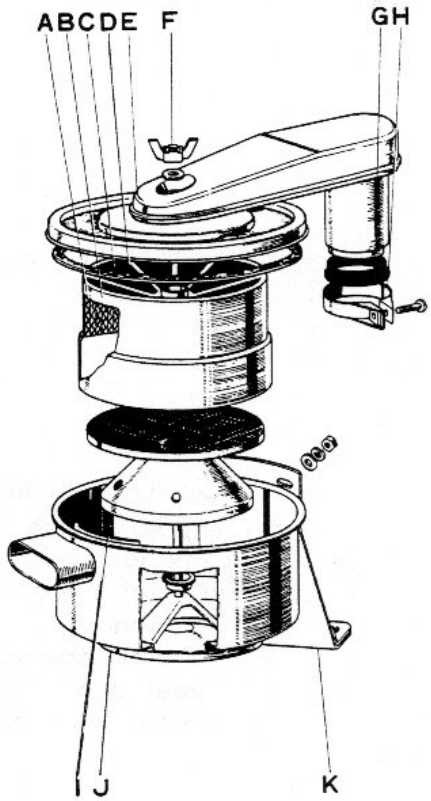
A. Air cleaner cap
B. Case gasket
C. Gasket
D. Outlet collar gasket
E. Clamp
F. Air cleaner support bracket
G. Gasket
H. Air cleaner case
I. Air cleaner filter element

Fig. 5-105 Felt Element Type Air Cleaner Component (FJ) X4970-A



A. Air cleaner filter element
B. Cap gasket
C. Air cleaner cap
D. Gasket
E. Air cleaner to carburetor gasket
F. Clamp
G. Air cleaner case
H. Gasket

Fig. 5-106 Felt Element Type Air Cleaner Components (FA) X4972-A

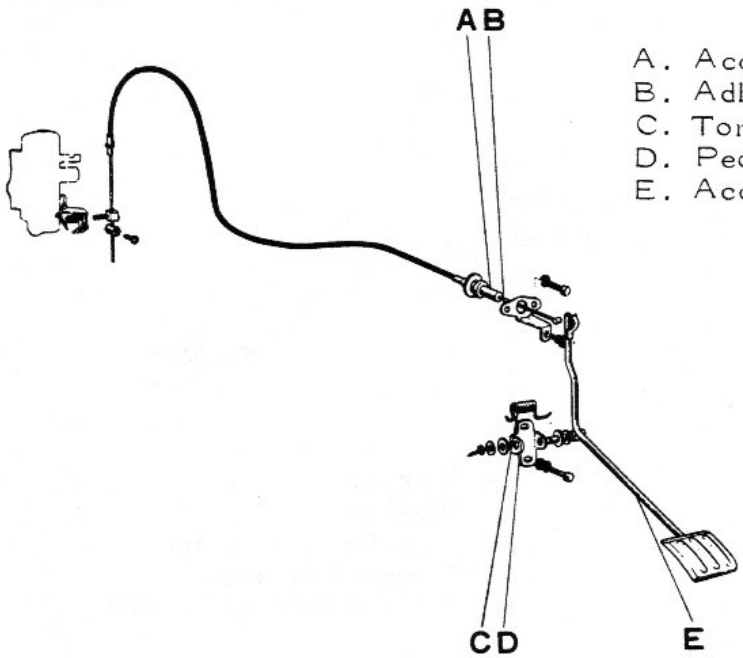


A. Air cleaner filter element
B. Element case
C. Cap gasket
D. Wire net
E. Air cleaner cap
F. Cap nut
G. Gasket
H. Clamp
I. Filter bottom case
J. Air cleaner case
K. Support bracket

Fig. 5-107 Oil Bath Type Air Cleaner Components X4973

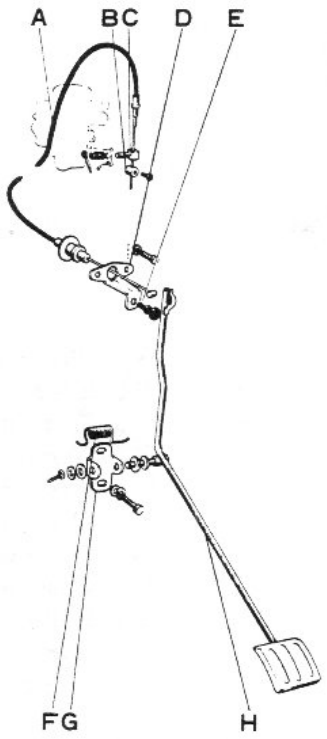
ACCELERATOR LINKAGE

Disassembly of the accelerator linkage is self-explanatory. Assembly procedures are equally simple. When assembling, lubricate the sliding or rotating portions with multipurpose grease. After assembling, recheck the accelerator pedal for smooth operation.



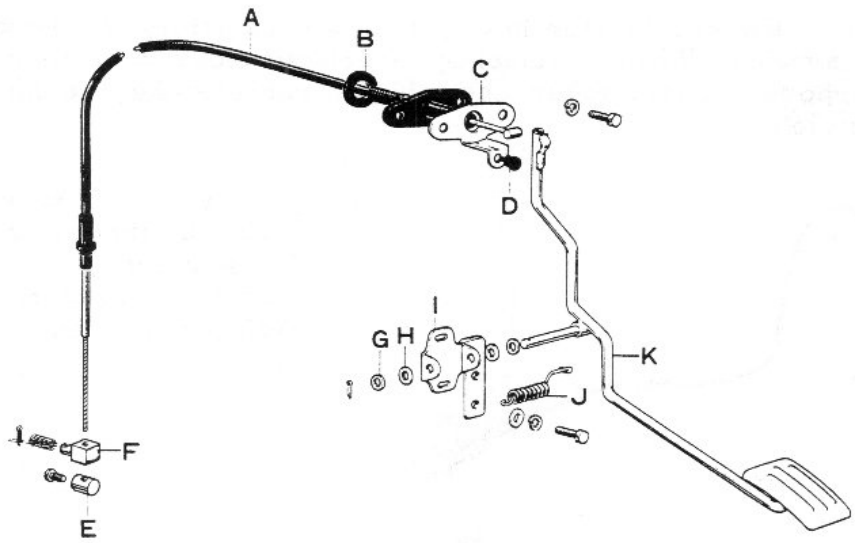
A. Accelerator flexible wire
B. Adle adjusting stopper channe
C. Torsion spring
D. Pedal rod support
E. Accelerator pedal

Fig. 5-108 Accelerator Linkage (FJ series RHD) G1692



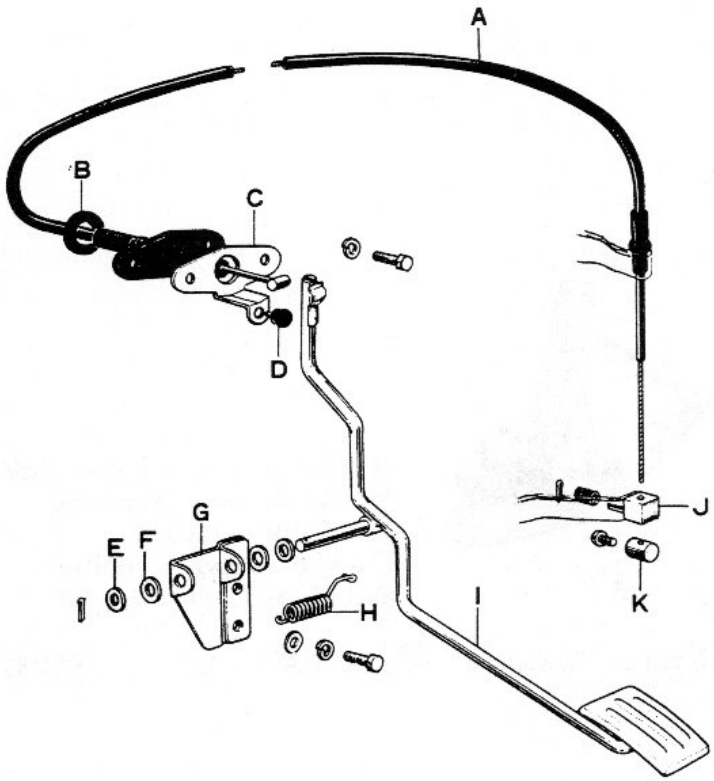
A. Accelerator flexible wire
B. Throttle wire stopper
C. Link joint pin
D. Idle adjusting stopper channel
E. Cushion
F. Torsion spring
G. Pedal rod support
H. Accelerator pedal

Fig. 5-109 Accelerator Linkage (FJ series LHD) G1693



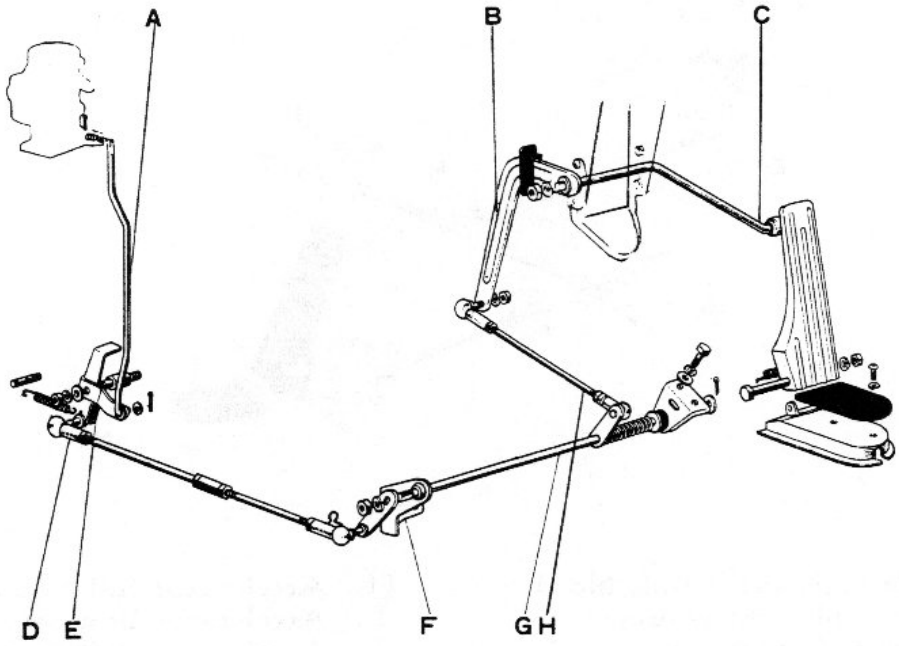
A. Accelerator flexible wire
B. Washer
C. Idle adjusting stopper channel
D. Cushion
E. Flexible wire stopper
F. Link joint pin
G. Washer
H. Washer
I. Pedal rod support
J. Torsion spring
K. Accelerator pedal rod

Fig. 5-110 Accelerator Linkage (FJ55V RHD) G1694



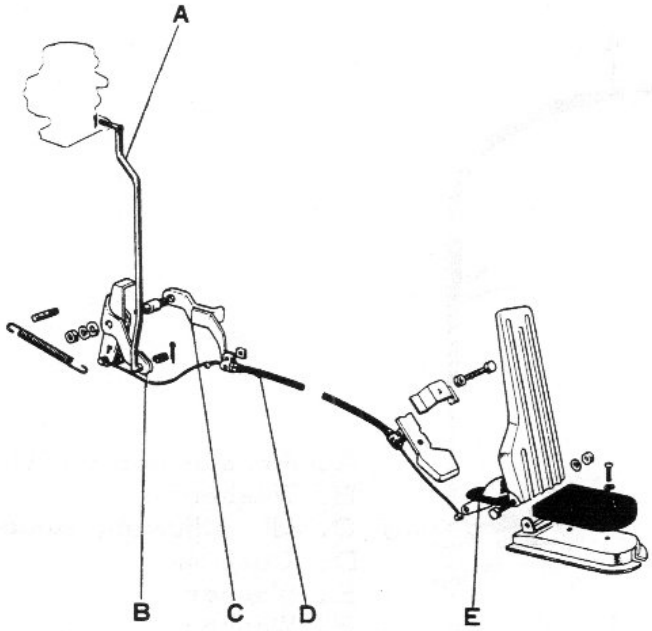
A. Accelerator flexible wire
B. Washer
C. Idle adjusting stopper channel
D. Cushion
E. Washer
F. Washer
G. Pedal rod support
H. Torsion spring
I. Accelerator pedal rod
J. Link joint pin
K. Flexible wire stopper

Fig. 5-111 Accelerator Linkage (FJ55V LHD) G1695



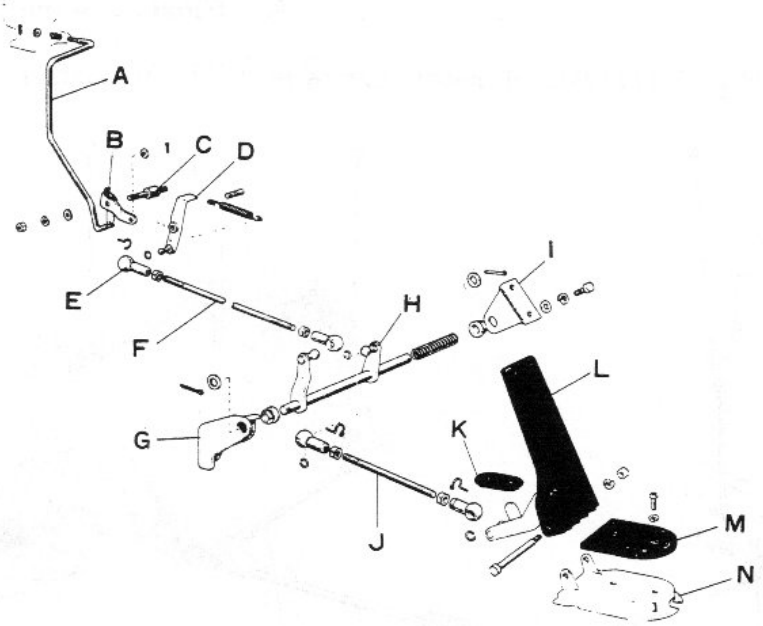
A. Side accelerator link
B. Link rod arm
C. Link torque rod
D. Connecting rod end
E. Link arm
F. Rod support
G. Link shaft
H. Accelerator rod

Fig. 5-112 Accelerator Linkage (FA RHD) X5036



A. Side accelerator link
B. Link arm support
C. Link bracket
D. Accelerator cable
E. Accelerator pedal

Fig.5-113 Accelerator Linkage OLD (FA LHD) X5037



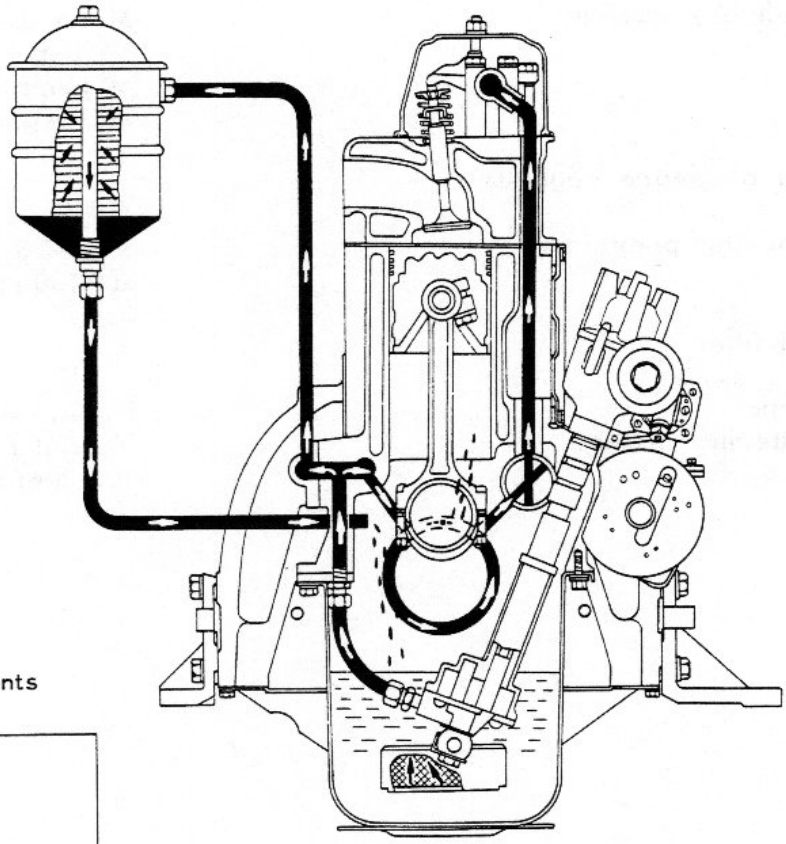
A. Engine side accelerator link No. 1
B. Accelerator link arm stopper
C. Accelerator link arm pin
D. Accelerator bellcrcnk
E. Accelerator ball joint socket
F. Accelerator link connecting rod
G. Accelerator link bearing No. 2
H. Accelerator link rod assy
I. Accelerator link bearing No. 1
J. Accelerator connecting rod No. 1
K. Grommet
L. Accelerator pedal
M. Accelerator pedal hinge packing
N. Accelerator pedal support bracket

Fig. 5-114 Accelertor Linkage (FA LHD)

LUBRICATING SYSTEM

DESCRIPTION

The lubricating method on this engine is all force feed type insuring positive lubrication. The high pressure oil discharged from the oil pump is divided into two parts. One part enters into the oil hole in the cylinder block, while the other after passing through the oil pressure regulator flows through the oil filter where it is cleaned, and returns to the oil pan. The oil stream entering the oil hole lubricates the main bearings, and is again divided into two parts. One part lubricates the camshaft bearings. The other passes through the crankshaft hole, and lubricates the connecting rod bearings, and in addition lubricates the pistons, and cylinders through the holes in the crank pin bearing bores. The oil stream lubricating the camshaft bearings is again divided. The one part lubricating the second bearing after passing through a pipe passes through the rocker arm shaft.



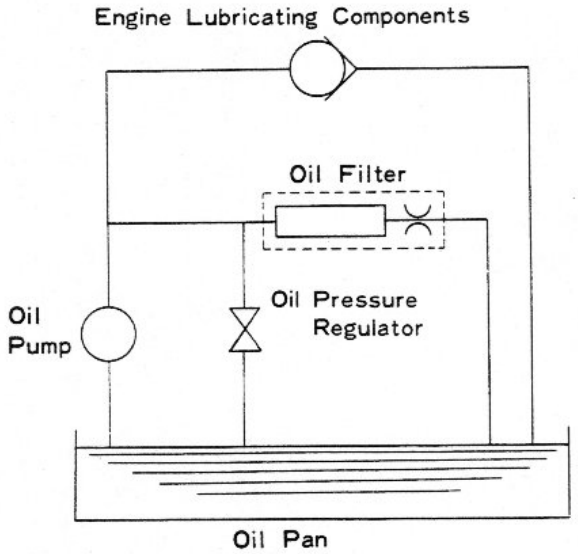


Fig.6-1 Lubricating System G1314 Y5714

and lubricates the push rods, and lifters. The other part lubricating the front bearing on the camshaft passes through the oil passages in the front end plate, and is discharged through the timing gear oil nozzle, and lubricates the crankshaft, and camshaft gears.

The oil pressure in the lubricating system is maintained at the pressure of 3.1 ~ 3.5 kg/cm^2 (44 ~ 50 psi) by means of a safety valve in the oil pressure regulator. When the pressure rises above this value, the oil is by-passed to the oil pan to reduce the pressure.

Specifications:

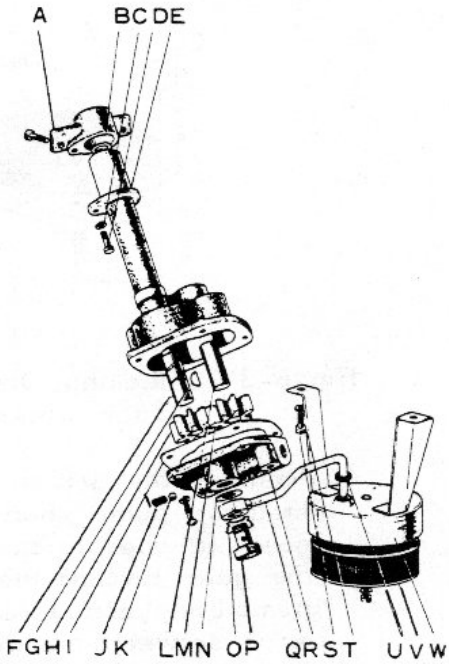
Oil pump	
Type	Gear type
Delivery quantity	More than 16 liters (17 US qts., 14 Imp. qts.) per minute at 1000 rpm of pump at 50 ~ 60° C (122 ~ 140° F) at 1 kg/cm^2 (14.2 psi)
Oil pressure regulator	
Opening pressure	3.1 ~ 3.5 kg/cm^2 (44.3 ~ 50 psi) at 2400 rpm of engine at 80° C (176° F)
Oil filter	
Type	Paper element
Filtering method	Partial flow
Capacity	0.8 liters (0.85 US qts., 0.7 Imp. qts.)

TROUBLE SHOOTING

Symptoms & Probable Causes	Remedies
Low oil pressure	
1. Lubrication system	
a. Oil suction restricted	Clean oil suction line
b. Oil pressure regulator valve faulty	Repair oil pressure regulator valve
c. Insufficient oil	Replenish oil and check for leaks
d. Wrong grade oil for climatic conditions	Replace with proper grade oil
2. Cooling system (overheating) Refer to Cooling System trouble shooting	
3. Engine	
a. Incorrect bearing clearance	Replace bearings
b. Worn main bearings	Replace bearings
c. Worn connecting rod bearings	Replace connecting rod bearings
Excessive oil consumption	
Refer to Engine trouble Shooting.	

OIL PUMP

The oil pump consists of two gears. The oil pump gears are driven by the distributor shaft which is driven by the spiral gear on the camshaft. The pump inlet pipe is fitted with oil strainer shell to prevent entry of small particles of sludge, etc. into the oil pump.



(page 6-3, figure 6-2)

A. Oil pump supporter
B. Body thrust ring
C. Lock washer
D. Bolt
E. Oil pump body
F. Oil pump shaft
G. Oil pump shaft key
H. Oil pump drive gear
I. Oil pump cover gasket
J. Valve spring
K. Valve ball
L. Oil pump driven shaft
M. Oil pump driven gear
N. Gasket
O. Union bolt washer
P. Suction pipe union bolt
Q. Oil pump inlet pipe
R. Oil pump cover
S. Bolt
T. Lock washer
U. Rubber washer
V. Oil strainer
W. Oil strainer shell

Fig.6-2 Oil Pump Components X5039

Removal & Disassembly

1. Remove the engine front under cover, engine room under cover RH and LH for FJ.
   Remove the engine under cover RH and LH for FA.

2. Remove the flywheel side cover and the flywheel housing under cover.

3. Remove the front propeller shaft for FJ series.

4. Drain the engine lubricant.

5. Remove the oil pan attaching bolts, and remove the oil pan, and the gasket.

6. Remove the oil strainer shell, next loosen both union nuts on the oil pump pipe.

7. Remove the lock wire and oil pump retaining bolt, and then remove the oil pump and the pipe from the cylinder block.

8. Straighten the union bolt lock washer and remove the union bolt, lock washer, gasket and the oil pump inlet pipe from the oil pump cover.

9. Remove the oil pump cover, and then slide out the oil pump driven gear and the oil pump drive gear together with oil pump shaft from the oil pump body.

Inspection & Repair

Wash the disassembled parts with cleaning solvent, and inspect for defects.

1. Inspect the pump shaft for excessive wear, and scores. If the diameter is less than 13.9 mm or 0.547", replace the shaft.

   Drive shaft diameter:
   13.985 ~ 14.000 mm
   (0.5506 ~ 0.5512")
   Driven shaft diameter:
   13.961 ~ 13.968 mm
   (0.5496 ~ 0.5499")
   Drive shaft to body clearance:
   0.014 ~ 0.057 mm
   (0.0006 ~ 0.0022")

   Drive shaft to gear clearance:
   0.014 ~ 0.042 mm
   (0.0006~0.0016")

2. Inspect the oil pump gears for excessive wear, or damage. If defective, replace the gears.

3. Install the gear on the driven gear shaft. Press the gear toward the center of the pump body, and measure the clearance between the gear teeth, and the body with a feeler gauge. If clearance exceeds 0.2 mm (0.0079"), replace the gear.
   Specified clearance:
   0.025 ~ 0.105 mm
   (0.001 ~ 0.004")

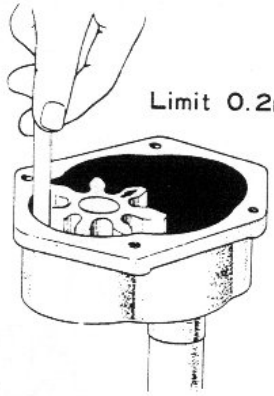


Fig.6-3 Checking Driven Gear Clearance X5040

4. Remove the driven gear, and install the pump shaft with the drive gear attached to the pump. Press the gear toward the center of the pump body, and measure the clearance between the gear teeth, and the pump body with a feeler gauge.

If the clearance exceeds 0.2 mm (0.0079"), replace gear and/or the shaft.
If the clearance still exceeds the limit after replacement, replace the pump assembly.

Specified clearance:
0.025 ~ 0.105 mm
(0.001 ~ 0.004")

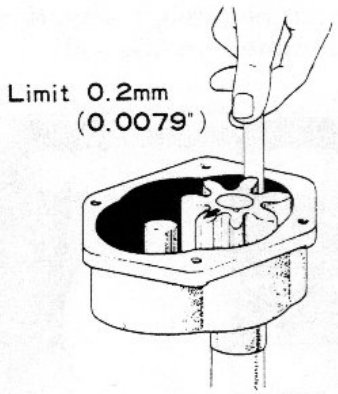


Fig.6-4 Checking Drive Gear Clearance X5041

5. Measure the backlash between the drive, and driven gears with a narrow feeler gauge.
The backlash should be within 0.45 to 0.65 mm (0.018 ~ 0.026").

The limit of backlash is 0.95 mm (0.037").

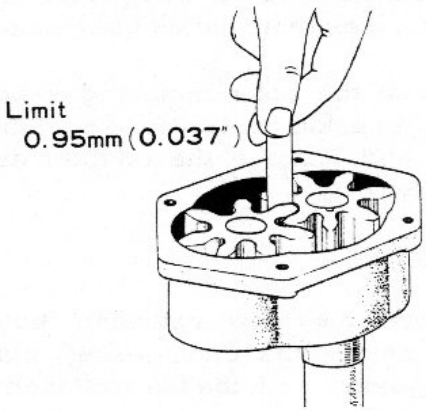
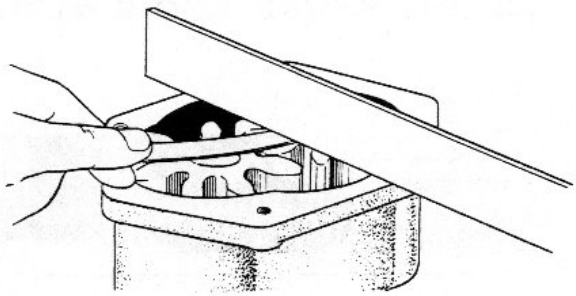


Fig.6-5 Checking Backlash X5042

6. Measure the space between the gear, and straight-edge with a feeler gauge. Lay the straight-edge on the pump cover, and measure the space between the straight-edge, and the gear contacting surface on the pump cover with a feeler gauge. If the sum of these values measured exceeds 0.15 mm (0.006"), replace the gears or the pump assembly.



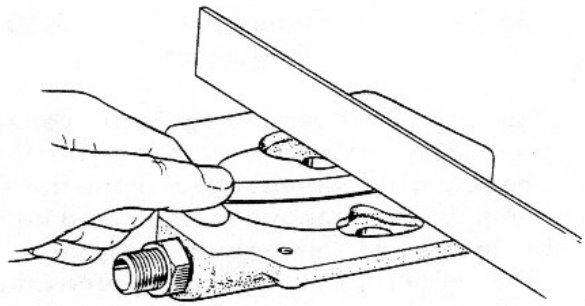


Fig.6-6 Checking Gear End-play X5043 X5044

Specified clearance:
0.03 ~ 0.09 mm
(0.0012 ~ 0.003")

Assembly

Follow the disassembly procedures in the reverse order.

1. After assembly, check the gears for free movement.

2. After the assembly is completed, submerge the oil pump inlet pipe in a container filled with clean engine oil, then rotate the oil pump shaft, and check if the oil flow out from the outlet port.

Installation

Follow the removal procedures in the reverse order.
When installing the oil pan, the oil pan gasket should be used new one.
Run the engine, and check for oil leak.

OIL PRESSURE REGULATOR

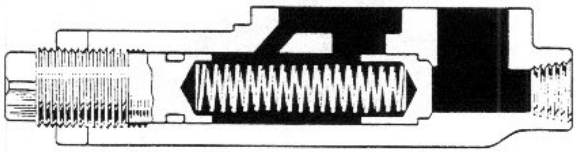


Fig.6-7 Oil Pressure Regulator X5045

The oil pressure regulator serves as safety valve preventing the high pressure oil discharged from the oil pump to rise above a specified value by means of the adjusting valve.
The relief valve operating pressure is between 3.1 to 3.5 kg/cm^2 (44 to 50 psi) with the engine speed of 2,400 rpm.

NOTE: This pressure should be measured after the engine is properly warmed up.

When the valve spring is weakened or when the valve fails to close tight, the pressure of the oil delivered to the crankshaft bearings decreases, and may cause the bearings to burn. In such cases, remove the oil pressure regulator, disassemble by unscrewing the adjusting bolt, and clean the inside thoroughly. If the valve spring is found to be weakened, replace the spring and valve.
After installing the oil pressure regulator, adjust the oil pressure to the specified value by screwing or unscrewing the adjusting bolt.

OIL FILTER (Up to E.N. 273210)

The engine is equipped with an oil filter assembly incorporating a replace able type element. The oil filter assembly is located on the left side of the engine mounted on the intake manifold. The function of the oil cleaner is to filter the engine oil flowing thru the filter from the oil pressure regulator, and removing any foreign element contained in the oil.

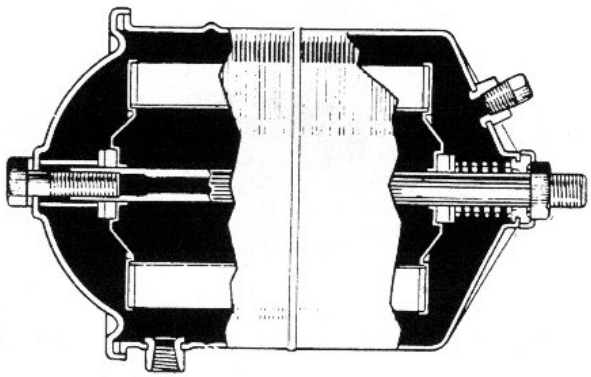


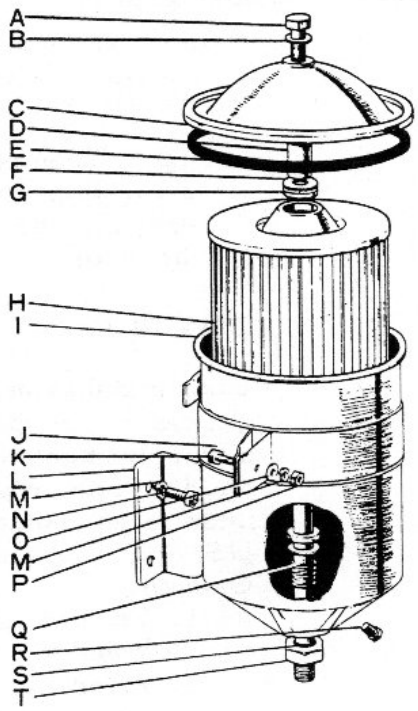
Fig.6-8 Oil Filter X5046

Removal

1. Remove the drain plug from the bottom of the oil filter case, and drain the oil into a container.
2. Disconnect the oil filter inlet and outlet pipes from the oil filter case.
3. Remove the bolts mounting the oil filter bracket to the intake manifold, and remove the oil filter assembly.

Disassembly

1. Remove the cap retaining bolt, and remove the cap, gasket, collar, gasket and the filter element.
2. Slide the gasket, support spring and washer out of the oil filter cartridge guide.
3. Remove the oil filter cartridge guide.



A. Cap retaining bolt
B. Gasket
C. Cleaner cap
D. Upper space collar
E. Body gasket
F. Element support washer
G. Gasket
H. Oil filter element
I. Oil filter case
J. Oil filter clamp band
K. Bolt
L. Oil filter bracket
M. Lock washer
N. Bolt
O. Washer
P. Nut
Q. Filter support spring
R. Drain plug
S. Cartridge guide gasket
T. Oil filter cartridge guide

Fig.6-9 Oil Filter Components G1576

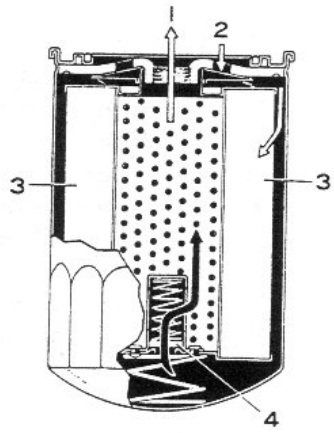
Assembly

Follow the disassembly procedures in the reverse order. Wash out the sludge contained in the bottom of the filter case.
If the filter element is extremely dirty, replace the element. Do not wash the element with gasoline for reuse.
All gaskets should be replaced uppon assembly.

Installation

Follow the removal procedures in the reverse order. Check the oil level, and replenish as required. Run the engine, and check for oil leak.

OIL FILTER (From E.N. 273211)



1. To oil circuit
2. From oil pump
3. Element
4. Relief valve

Fig.6-10 Oil Filter 10502

Removal

Remove the oil filter by using a Oil Filter Band Wrench (09228-41010) or (09228-41011).

NOTE: Upon removal, some oil may drip, therefore, place a tray to prevent the oil from dripping to the floor.

Installation

Upon installation, confirm that the filter gasket is properly in position, and securely tighten the casing with the hands. The engine oil capacity of the filter is approximately 0.8 liter (0.85 US qt., 0.70 Imp.qt.).

Caution:

1. Do not use the Oil Filter Band Wrench upon installation.
2. After operating the engine, check that no oil leakage is present, and also check the engine oil level.

COOLING SYSTEM

DESCRIPTION

The cooling system is of a pressure forced circulation type, insuring positive cooling efficiency.

The radiator is a fin and tube type, which comparatively light, and excels in heat dissipation.

The water pump is a direct driven with a fan mounted at the front for positive cooling efficiency under excessive heavy load operation.
Water is drawn from the bottom of the radiator by the water pump, and is forced circulated through the passages, and water jackets in the engine cylinder block, and the cylinder head, and is returned through the water outlet into the radiator, where it is cooled by the air drawn through the radiator.

Pressure type radiator cap maintains a pressure of approximately 0.3 ~ 0.5 kg/cm² (4 ~ 7 psi) in the cooling system when the engine is at normal operating temperature.

The thermostat is a wax pellet element type, and it enables the engine to warm up quickly in cold weather, and gives efficient regulation of the water temperature.

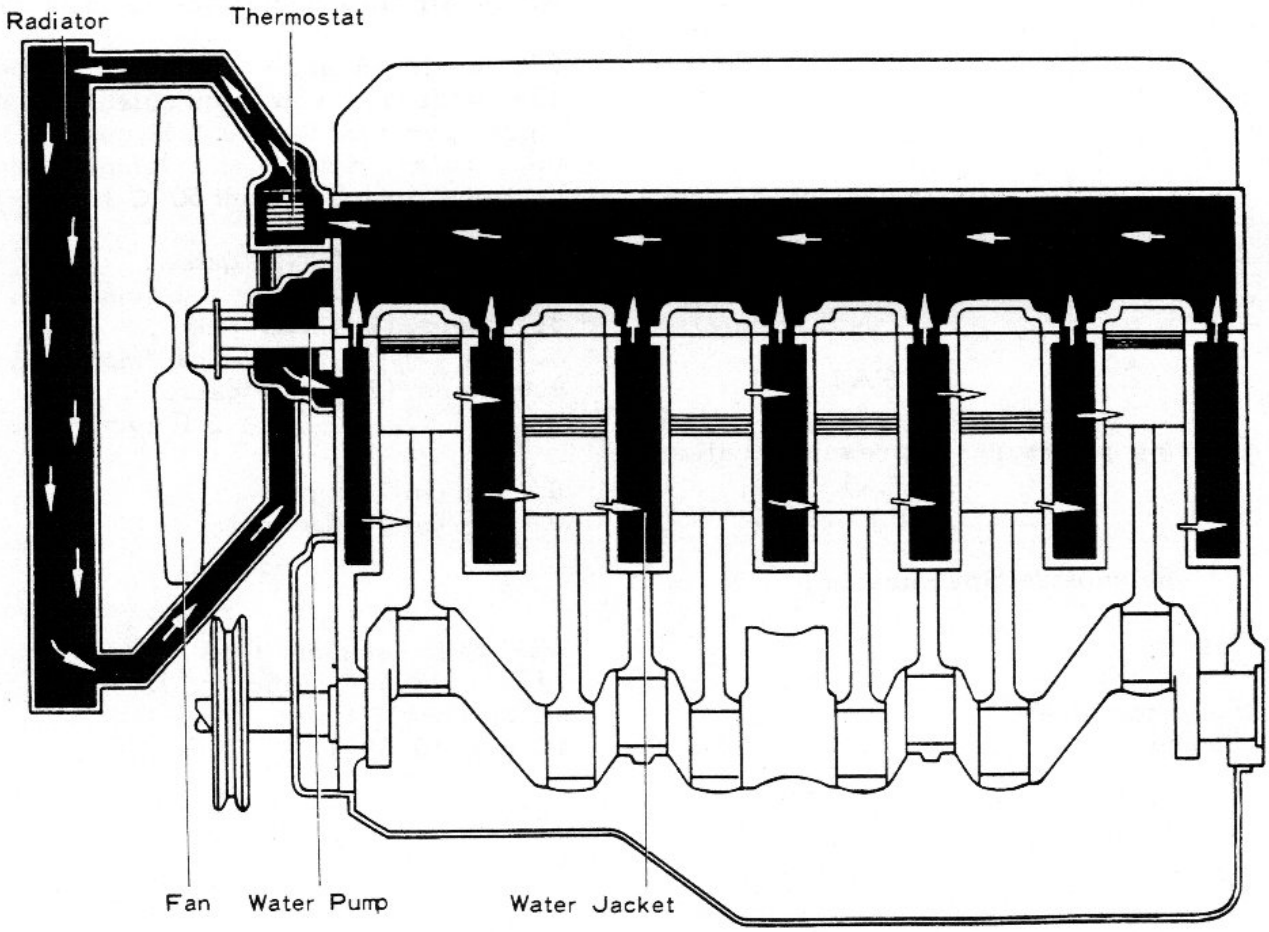


Fig.7-1 Cross Section of Cooling System X5047

Water Pump Specification:

Type	Six blade impeller centrifugal type
Delivery capacity	140 liters (37 US gals., 31 Imp. gals) per minute at 2,500 rpm at 70°C or 158°F
Revolution ratio with crankshaft	1 to 1.39
Water seal	Mechanical seal

Radiator Specification:

Type	Pressure cooling corregated fin and tube type
Radiator capacity - (FJ series)	490 Kcal/min at air velocity 8m/sec (26 ft/sec), water circulation 60 liters per minute (16US gals., 13Imp. gals), difference of temperature between air and coolant 50°C (122°F)
(FJ-55V only)	510 Kcal/min at air velocity 8 m/sec (26 ft/sec), water circulation 60 liters per minute (16 US gals., 13 Imp. gals), difference of temperature between air and coolant 50°C (122°F)
(FA)	870 Kcal/min at air velocity 12 m/sec (39 ft/sec), water circulation 150 liters per minute (40 US gals., 33 Imp. gals), difference of temperature between air and coolant 50°C (122°F)
Coolant capacity - (FJ series)	5.0 liters (1.3 US gals., 1.1 Imp. gal.)
(FJ-55V only)	5.2 liters (1.4 US gals., 1.1 Imp. gal.)
(FA)	9.0 liters (2.4 US gals., 2.0 Imp. gal.)
Opening pressure of pressure valve	
(FA)	0.5 kg/cm² (7 psi)
(FJ series)	0.9 kg/cm² (12.8 psi)

Thermostat Specification:

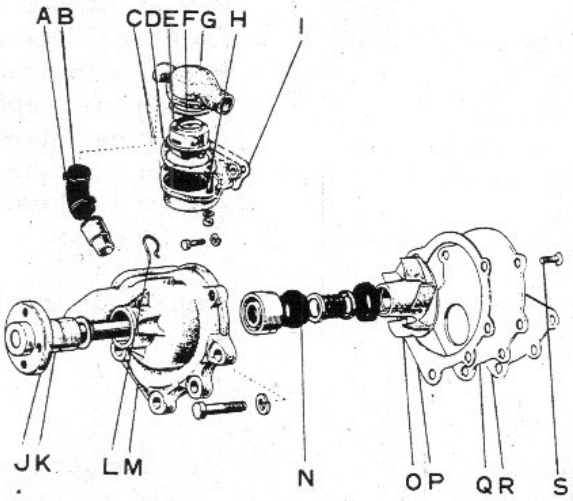
Type	Wax pellet element type
Opens at	74.5 ~ 78.5°C (166 ~ 173°F)
Fully opens at	90°C (194°F)
Stroke	10 mm (0.39")

TROUBLE SHOOTING

Symptoms & Probable Causes	Remedies
1. Overheating	
a. Lack of coolant	Replenish, and check for leak/s
b. Loose V-belt	Adjust V-belt
c. Oil soaked or defective V-belt	Replace V-belt
d. Defective thermostat	Replace thermostat
e. Water pump inoperative	Repair or replace water pump
f. Clogged cooling system	Clean radiator, and water jacket
g. Incorrect ignition timing	Adjust ignition timing
h. Brakes dragging	Adjust brakes
i. Damaged manifold heat control valve coil	Replace coil
j. Sticky manifold heat control valve shaft.	Repair or replace shaft
2. Overcooling	
a. Defective thermostat	Replace thermostat
b. Extremely cold weather	Cover radiator
3. Loss of coolant	
a. Leaky radiator	Repair radiator
b. Loose connections or defective hose	Tighten connections or replace hose
c. Leaky water pump	Repair or replace water pump
d. Leak at cylinder head gasket	Tighten bolts or replace gasket
e. Cracked cylinder head or block	Replace
f. Engine operating at too high temperature	See overheating causes
4. Noisy cooling system	
a. Defective water pump bearing	Replace bearing assembly
b. Loose or bent fan blades	Tighten, repair or replace baldes
c. Defective V-belt	Replace V-belt

WATER PUMP

A centrifugal type water pump is mounted on the cylinder block above the timing gear cover of the engine. The water pump is of the grease filled, sealed ball bearing type, requiring no daily greasing. The rotor action of the water pump forces the coolant through the engine water passage, radiator, and connections.



A. Hose clamp
B. By-pass hose
C. Water outlet
D. Gasket
E. Thermostat
F. Gasket
G. Water outlet housing
H. Stud bolt
I. Gasket
J. Pulley seat
K. Water pump bearing
L. Bearing retaining wire
M. Water pump body
N. Shaft seal
O. Water pump rotor
P. Gasket
Q. Seat plate
R. Gasket
S. Screw

Fig.7-2 Water Pump Components Y2111

Removal

1. Drain the cooling system, and remove the alternator adjusting bar.
2. Remove the fan, fan pulley and the "V" belt.
3. Loosen the hose clamps, and disconnect the radiator lower hose and the by-pass hose from the water pump.
4. Remove the water pump retaining bolts, and remove the water pump assembly and the gasket.

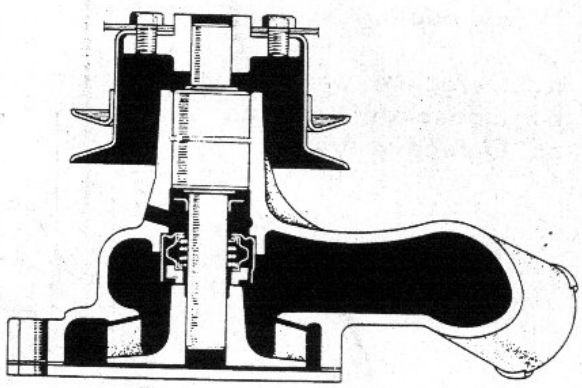


Fig.7-3 Water Pump Cross Section G1315

Disassembly

1. Remove the water pump seat plate and the gasket.

2. Remove the water pump pulley seat with the Water Pump Pulley Seat Puller 09235-60010.

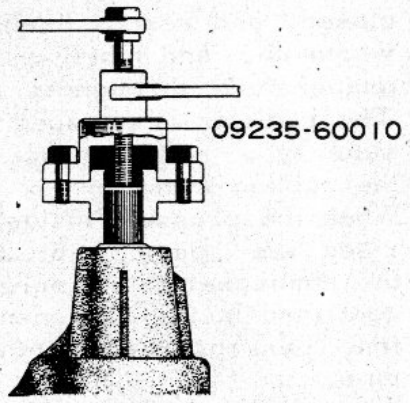


Fig.7-4 Pulley Seat Removal X5049

3. Pull out the water pump bearing retaining wire with a pliers.

4. Support the water pump body on the Water Pump Bearing Remover & Replacer 09238-40010, and press the water pump bearing out of the body.
   Next, take out the water pump rotor and the shaft seal.

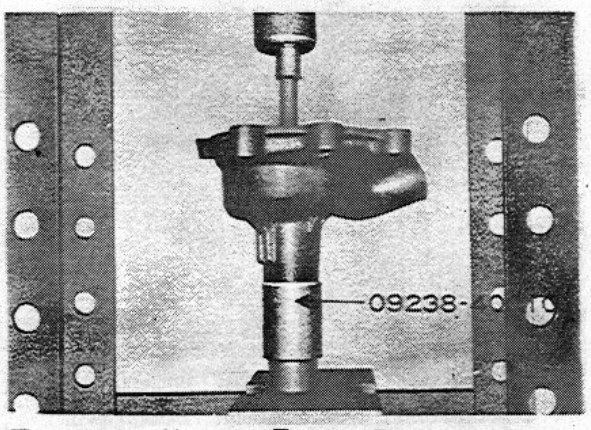


Fig.7-5 Water Pump Bearing Removal V4369

Inspection

Wash all disassembled parts except the water pump bearing and the shaft seal in cleaning solvent.

The bearing is a permanently sealed and lubricated bearing, and should not be washed in cleaning solvent.

1. Inspect the bearing for roughness or excessive end play.
   Remove any rust or scale from the bearing shaft with an emery cloth.
   The bearing should be wrapped in cloth while removing the rust or scale to prevent emery dust from entering the bearing.

2. Inspect the water pump seal thrust washer for pit marks or scoring.

3. Inspect the water pump body and the rotor for cracks, and wear.

4. It is recommended that the water pump shaft seal and the gasket should be replaced upon assembly.

Assembly

1. Install the water pump bearing into the pump body with the Water Pump Bearing Remover & Replacer 09238-40010, applying pressure onto the outer race until it seats properly.

2. Install the bearing retaining wire into the pump body.

3. Install the pulley seat onto the bearing shaft until the seat is flush. with the end of the bearing shaft with a press.

4. Assemble the water pump shaft seal and the seal thrust washer into the seal guide of the pump body, and then install the water pump rotor onto the bearing shaft with the Water Pump Bearing Remover & Replacer 09238-40010, and a press.

5. After installation, check the clearance between the blade of the rotor with the water pump body.
   The clearance should be 0.3 to 0.7 mm (0.012 ~ 0.027").

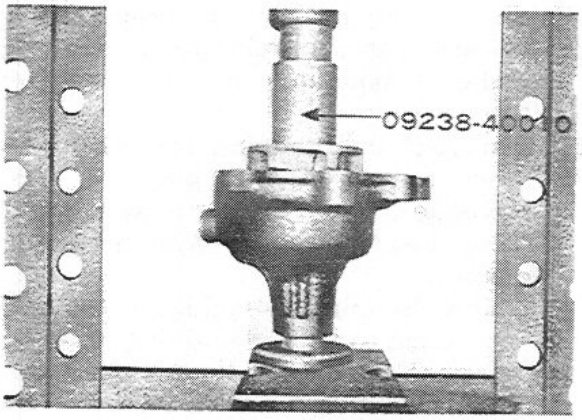


Fig.7-6 Installing Water Pump Rotor V4370

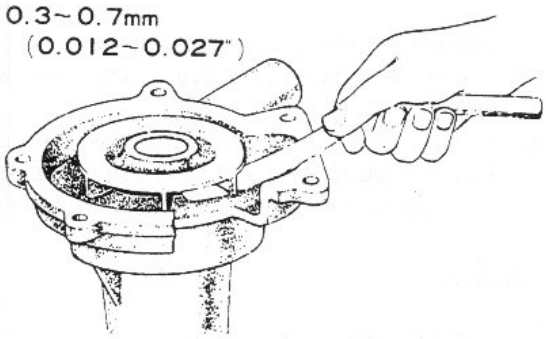


Fig.7-7 Checking Clearance X4917

6. Install the water pump seat plate with the gasket, and tighten the retaining screws.

7. After assembly, check the water pump rotor for free movement.

Installation

Follow the removal procedures in the reverse order.

NOTE:

1. Always replace the gasket.

2. Adjust the "V" belt tension to 7 to 10 mm (0.28 ~ 0.40").

3. Start the engine after installation and check for water leak.

RADIATOR

The radiator assembly consists of a fin and tube type core connecting the upper and lower tanks. A water by-pass is included in the cooling system. This provides some circulation of coolant even though the thermostat is closed, and results in a faster engine warm-up, and more uniform coolant temperature throughout the engine. The radiator is equipped with a pressure type radiator cap which seals the cooling system.

When the pressure inside the radiator rises the specified pressure above the atmospheric pressure, the valve contained in the cap opens to form a free passage through the overflow pipe.

When the radiator water cools, and the pressure inside the radiator becomes less than the atmospheric pressure, the reverse valve inside the cap opens to permit the outside air to enter, and prevents formation of vacuum inside the radiator.

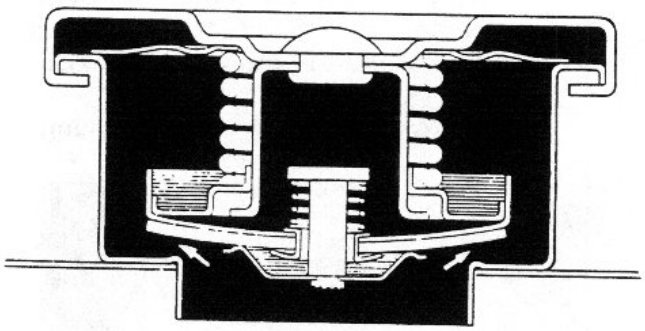


Fig.7-8 Pressure Relief G1110

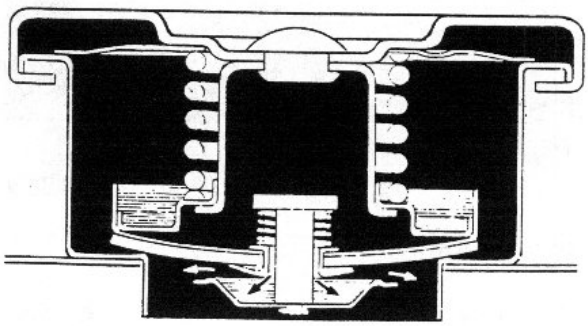


Fig.7-9 Vacuum Relief G1111

The radiator cap on the Toyota Truck (FA series) is similar to that on Toyota Land Cruiser (FJ series) except the pressure release lever is incorporated on the FA cap.
To prevent the blow-off of steam when checking the coolant level, this radiator cap is provided with the pressure release lever which allows the steam to escape before the cap is removed as the lever is raised.

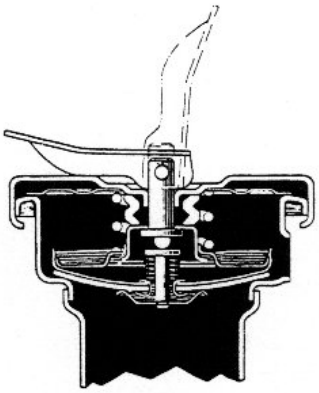


Fig.7-10 Pressure Release X5052 Lever (FA)

Removal

For FJ

1. Drain the cooling system.
2. Loosen the clamp screws, and remove the radiator upper and lower hoses.
3. Remove the bolts retaining the radiator to the radiator support. Take care not to damage the fins with the fan, and remove the radiator upward.

For FA

1. Drain the cooling system.
2. Loosen the clamp screws, and remove the radiator upper and lower hoses.
3. Remove the bolts retaining the fan shroud onto the radiator and front fender apron bracket.
4. Remove the radiator grille, and the hood lock support rod.
5. Disconnect the hood lock assembly from the radiator support, and remove the radiator support.
6. Remove the radiator retaining bolts and then remove the radiator.

Inspection & Repair

1. Check the radiator for leaks from the upper tank, lower tank, and the core.
   Repair if necessary.
2. Check the radiator core fin for clogging the air passages.
   If necessary, repair the fins.
3. If clogging of the radiator core is more than 20 percent of the radiator area, replace the radiator.
4. Check the radiator cap operation. Many types of pressure gauges are available for use. Therefore, it is recommended that the gauge manufacturer's instructions be followed when performing the test. The specified pressure should be 0.8 kg/cm^2 (11 psi) for FJ series and 0.3 kg/cm^2 (4 psi) for FA.

Installation

Follow the removal procedures in the reverse order.

THERMOSTAT

Inspection

The thermostat which opens at normal temperature should be replaced. Sub-merge the thermostat into hot water for testing. Agitate the water thoroughly during the test to obtain uniform temperature.
The thermostat is satisfactory if it begins to open, fully open and closes at specified temperature. Replace the thermostat if not within specified limit.

ENGINE ELECTRICAL SYSTEM

DESCRIPTION

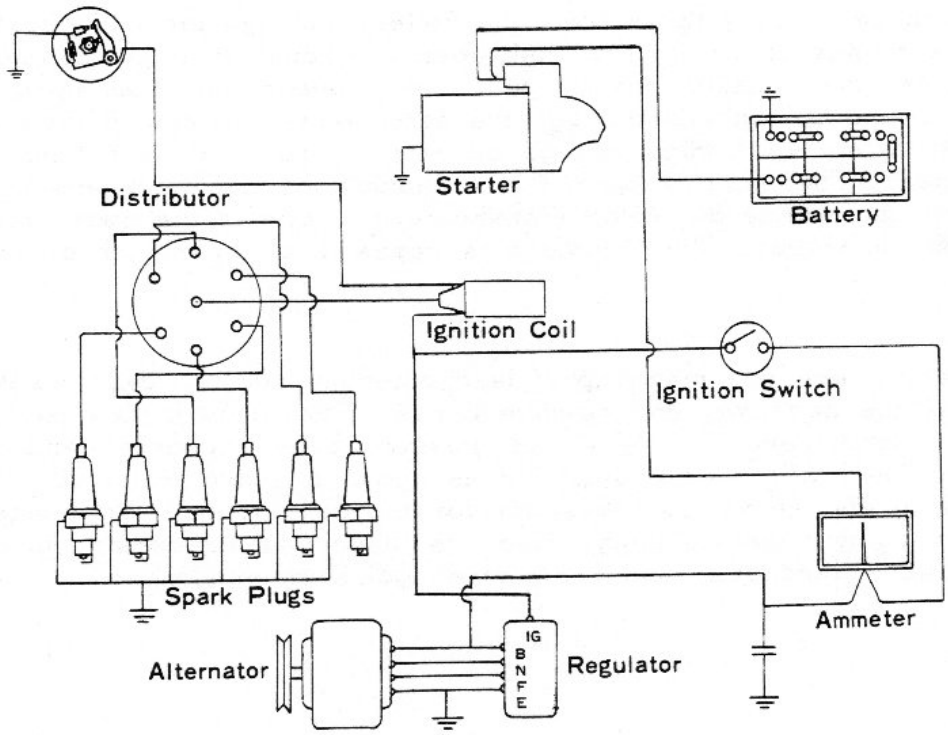


Fig.8-1 Wiring Diagram of Engine Electrical System X5054

The wiring diagram of the engine electrical system is as shown in figure 8-1. This engine is equipped with a 12 volt electrical system. This engine has four electrical systems: starting, charging, ignition, and battery.

Starting system:
The starter, having the magnetic switch, is activated by turning the ignition switch key. The starter equipped on the F engine has the following characteristics. It is compact, and light. The output is large, and is a sealed type to prevent entry of dirt, and dust. The slippage of the starter clutch is very little, and the armature does not over-run.
The operation of the starter clutch, and the magnetic switch enables to accomplish a smooth, and trouble-free gear meshing. The use of mold commutator has increased the durability of the commutator against the centrifugal force.
Also the use of molds for the magnetic switch terminals has extremely reduced the possibility of having short circuiting, and poor insulation. The armature brake is designed to apply when the starter clutch returns completely to it original position.

Charging system:
The charging system includes the alternator, and the alternator regulator, and this alternator consists of two major parts; a stator, and a rotor. The stator is composed of a large number of windings assembled on the inside of a laminated core that is attached to the frames. The rotor revolves within the stator on bearings located in each end frame. Two brushes are required to carry current through the two slip rings to the rotor coils wound concentric with the shaft of the rotor. Six rectifier diodes are mounted in the rectifier holder.
The function of the alternator regulator in the charging system is to regulate the generator voltage to a pre-set value.

Ignition system:
The ignition system consists of the primary (low-voltage), and secondary (high voltage) circuits. When the distributor breaker points are closed, the primary or low-voltage current flows from the battery through the ignition switch to the primary windings of the ignition coil, then to ground through the closed breaker points. When the breaker points open, the magnetic field built up in the primary windings of the coil moves through the secondary windings of the coil producing high voltage current. High voltage current is produced each time the breaker points open. The high voltage flows through the coil high tension lead to the distributor cap where the rotor distributes it to one of the spark plug terminals in the distributor cap. This process is repeated for every power stroke of the engine.

Battery:
The battery plates are made up of lead-antimony alloy grids, and these are of two kinds, the negative, and positive plates. The grids in the positive plates are filled with lead peroxide PbO^2 as positive active material, and the negative plates are filled with spongy lead Pb as negative active material.
As these grids serve as passages for the electric current during charging, and discharging, lead-antimony alloy is used in their construction to provide the necessary hardness, and resistance against corrosion.

TROUBLE SHOOTING

Symptoms & Probable Causes	Remedies
Starter	
1. Starter does not turn or slow cranking of engine	
a. Poor contact of ignition switch points	Replace ignition switch
b. Poor connection of ignition switch conjunction terminal	Repair conjunction terminal
c. Poor connection of magnetic switch "50" terminal	Repair conjunction terminal
d. Open wiring between ignition switch, and magnetic switch "50" terminal	Repair or replace wiring
e. Poor connection of battery ground cable	Clean, and tighten
f. Poor connection of battery terminals	Clean, and tighten
g. Weak battery	Recharge or replace
h. Burned or poor contact of magnetic switch contact plate	Replace magnetic switch
i. Open magnetic switch pull-in coil circuit	Replace magnetic switch
j. Open magnetic switch holdering coil circuit	Replace magnetic switch
k. Poor contact of brushes	Dress commutator, and brushes
l. Burned commutator	Lathe cut commutator
m. Commutator mica too high	Under cut mica
n. Shorted starter field coil	Replace field coil
o. Shorted starter armature	Replace armature
p. Poor tension of brush spring/s	Replace spring/s
q. Poor soldering of starter field coil	Solder field coil
r. Worn bushing/s	Replace bushing/s
2. Starter turns, but pinion does not mesh with ring gear	
a. Starter clutch pinion gear worn	Replace starter clutch
b. Defective starter clutch (over running clutch)	Replace starter clutch
c. Poor movement of clutch on helical spline	Clean, and correct
d. Worn bushing/s	Replace bushing/s
e. Poor magnetic switch pinion travel	Adjust moving stud
f. Missing drive lever set pin	Replace, and correct
g. Flywheel ring gear worn	Replace ring gear
3. Starter keeps running	
a. Melted magnetic switch contact plate	Replace magnetic switch

Symptoms & Probable Causes	Remedies
b. Shorted magnetic switch coil	Replace magnetic switch
c. Ignition switch returns poorly	Replace ignition switch

Alternator, Regulator & Battery

1. Battery discharges

a. Loose or worn "V" belt	Adjust or replace "V" belt
b. Shorted or opened alternator stator coil	Replace stator
c. Opened alternator rotor coil	Replace rotor
d. Poor contact of brushes and slip rings	Clean or replace
e. Defective rectifier/s	Replace rectifier/s
f. Regulator out of a adjustment	Adjust regulator
g. Burned or poor contact of regulator points	Dress points or replace regulator
h. Lack or insufficient electrolyte of battery	Replenish or replace
i. Shorted battery plates	Replace battery
j. Poor connection of battery terminal/s	Clean, and tighten
k. Open wiring between ignition switch terminal, and regulator "IG" terminal	Repair or replace wiring
l. Open wiring between regulator "F" terminal, and alternator "F" terminal	Repair or replace wiring

2. Battery overhcarges

a. Poor connection of regulator "E" terminal	Clean and repair
b. Burned or melted regulator points	Replace regulator
c. Regulator out of adjustment	Adjust regulator

Ignition System

1. Starter turns but engine will not start

a. Weak battery	Recharge battery
b. Excessive moisture on high tension leads	Remove moisture, and dry
c. Cracked or leaky distributor cap or rotor	Replace cap or rotor
d. Broken wire in primary circuit	Repair or replace wire
e. Burned or improperly adjusted breaker points	Adjust or replace points
f. Defective condenser	Replace condenser

Symptoms & Probable Causes	Remedies
2. Hard starting	
a. Weak battery	Replace battery
b. Defective spark plug/s	Replace spark plug/s
c. Defective breaker points	Replace breaker points
d. Loose connection in primary circuit	Tighten or repair
e. Defective condenser	Replace condenser
f. Defective ignition coil	Replace ignition coil
g. Cracked or leaky distributor cap or rotor	Replace cap or rotor
3. Engine misses	
a. Dirty or defective spark plug/s	Clean, adjust or replace spark plug/s
b. Loose high tension lead/s or defective insulation	Tighten, repair or replace lead/s
c. Cracked distributor cap	Replace cap
d. Improper breaker points adjustment	Adjust breaker points

STARTER

Construction

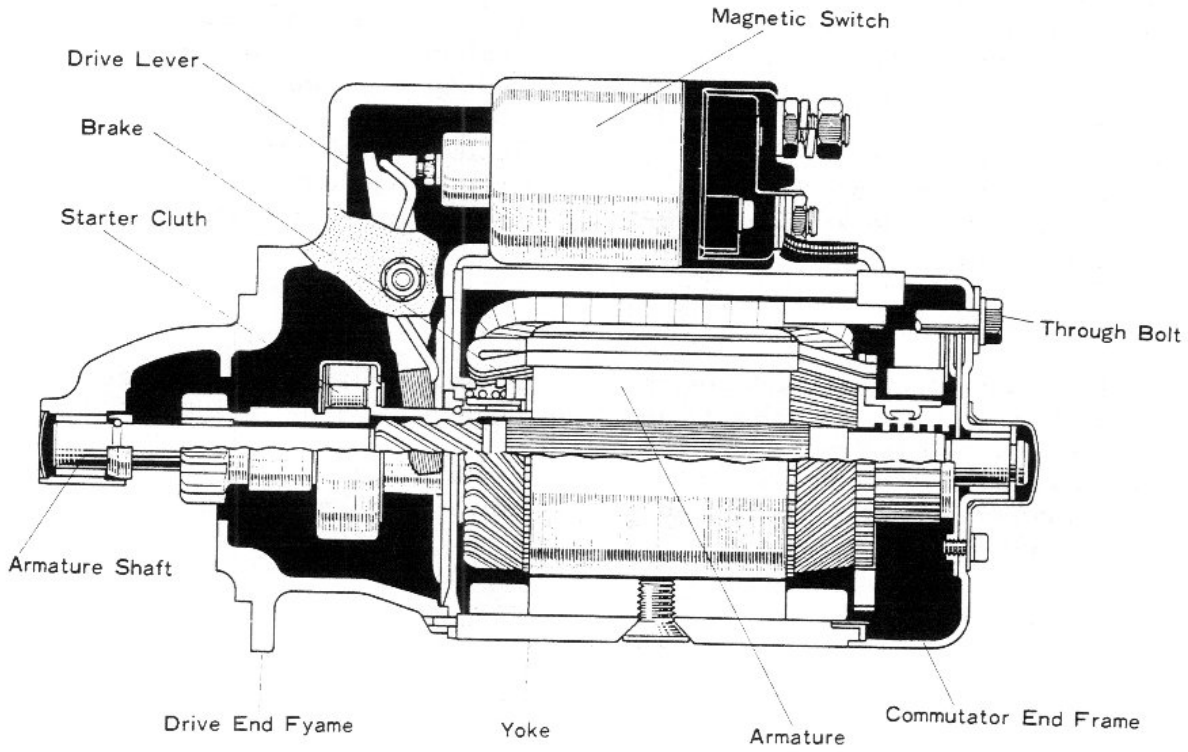


Fig.8-2 Cross Sectional View of Starter Y1578

The principal components of the starter consist of the starter armature, starter clutch, field coils and pole cores, starter drive housing, yoke commutator end frame, brushes, and the magnetic switch.

The engagement of the starter clutch pinion to the flywheel ring gear is a screw push type. It is of the series type, and the fiel coils are connected in series with the armature circuit.

The field coil windings are of heavy copper wire to withstand the large current encountered during starting operation.

The helical splines on the armature shaft facilitates the engagement of the starter clutch pinion to the flywheel ring gear. As the starter clutch is pushed out by the pinion drive lever, the turning occurs, and this enables a smooth engagement of the gears. As the starter clutch pinion engages with the ring gear, the turning force of the starter armature pushes the starter clutch pinion into a complete mesh without further force of the pinion drive lever. Due to the small force required in actuating the pinion drive lever, the magnetic switch is very small compared with the unit used on the conventional push in type starter.

The clutch roller slots are on the inner side, and the starter clutch pinion is made integral with the outer side. This makes the inner surface smooth so that the clutch rollers remain steady when subjected to the centrifugal force of the high no-load speed of the armature during starting operation.

The drive ring is retained in its original position by the retracting spring in the starter clutch assembly. The retracting spring tension is only overcome by the pushing action of the drive lever. This retracting spring not only retains the drive ring in its original position, but also acts as a cushion in the pushing motion of the pinion drive lever in connection with the pinion mesh.

Specification

Voltage	12 volts
Max output power	1.3 KW
Actuating time	30 seconds
Direction of revolution	Clockwise as seen from pinion side
Number of poles	Four
Number of pinion teeth	Nine
No-load characteristic:	
Voltage	At 11 volts
Amperage	Less than 50 amperes
Revolution	More than 5,000 rpm
Load characteristic:	
Voltage	At 9.5 volts
Torque	At 0.8 m-kg (5.79 ft-lb)
Amperage	Less than 240 amperes
Revolution	More than 1200 rpm
Lock characteristic:	
Voltage	At 7.0 volts
Amperage	Less than 600 amperes
Torque	More than 1.8 m-kg (13.02 ft-lb)
Weight	8.2 kg (18.01 lb)

Removal

1. Disconnect the battery ground cable from the battery terminal.
2. Disconnect the starter cable and the wire from the starter magnetic switch terminal.
3. Remove the two retaining nut, and then remove the starter toward engine room.

Disassembly

1. Disconnect the field coil lead wire from the magnetic switch terminal.
2. Remove the magnetic switch. (figure 8-3).
3. Remove the bearing cover and the rubber ring, then remove the lock plate and the adjusting washers.

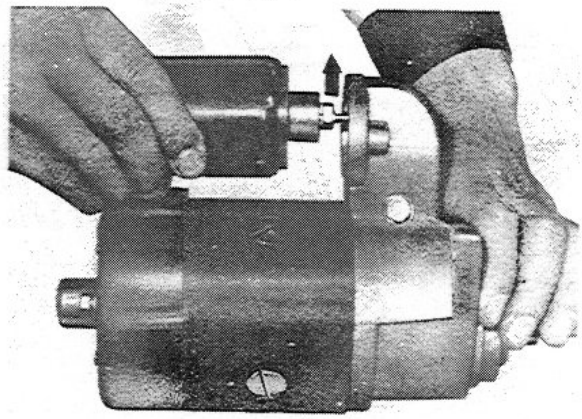
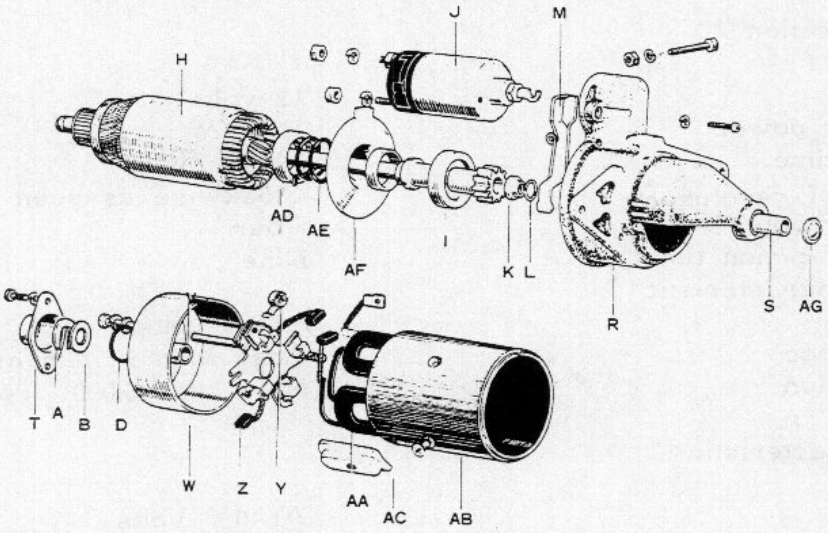
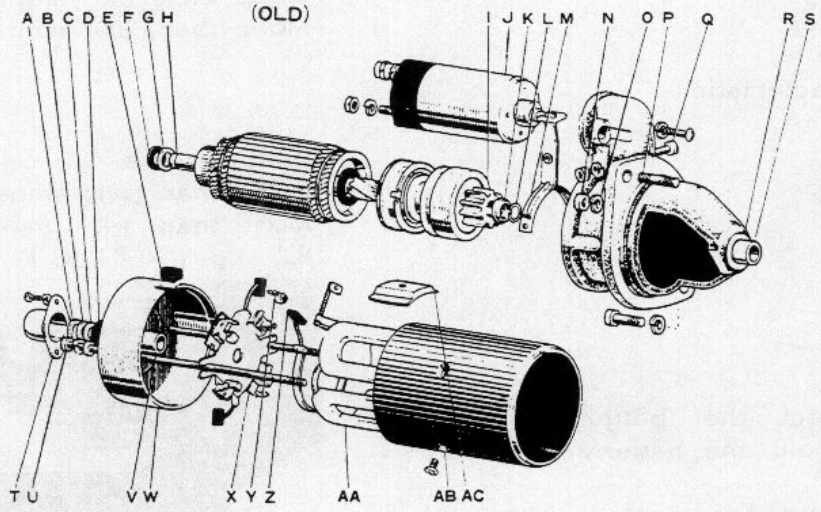


Fig.8-3 Removing Magnetic W8624 Switch

4. Screw out the through bolts, and then remove the commutator end frame.
5. Pull out two brushes which connecting the field coil from the brush holder, and remove the brush holder and the brushes. Remove the thrust washers.





A. Lock plate
B. Washer
C. Washer
D. Rubber ring
E. Rubber bushing
F. Bakelite washer
G. Washer
H. Starter armature
I. Starter clutch
J. Magnetic switch
K. Pinion stop nut
L. Snap ring
M. Pinion drive lever
N. Nut
O. Lock washer
P. Stud bolt
Q. Drive lever set pin
R. Starter drive housing
S. Bushing
T. Bearing cover
U. Through bolt
V. Bushing
W. Commutator end frame
X. Brush holder
Y. Brush spring
Z. Starter brush
AA. Field coil
AB. Starter yoke
AC. Pole core
AD. Spring holder
AE. Starter brake spring
AF. Center bearing
AG. Expansion plug

Fig. 8-4 Starter Components G1577

6. Tap the drive housing lightly, and remove the yoke.

7. Remove the drive lever set pin, and remove the armature, starter clutch, and the pinion drive lever.

8. Remove the snap ring, and the pinion stop collar at the end of the armature shaft, then remove the starter clutch.
   To remove the snap ring, make a tool similar to the one as illustrated in the following illustration, with a suitable size pipe to remove the pinion stop collar toward the starter clutch side first, then remove the snap ring.

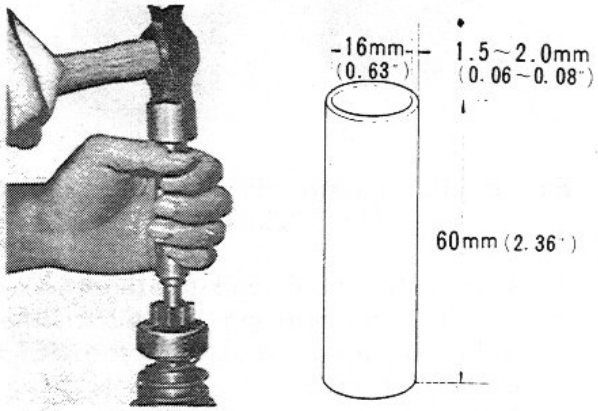


Fig.8-5 Removing Starter Clutch V1134 X3718

Inspection & Repair

Armature

1. Inspect the clearance between the armature shaft, and the bushings.
   The clearance should not exceed 0.2 mm (0.008").
   If exceeds this limit, replace the bushing to obtain a clearance of less than 0.1 mm (0.004").

2. Check the commutator for roughness, burned or scored surface and if necessary dress or cut with a lathe just enough to remove stock to clean the surface, and remove the roughness.
   If the diameter of the commutator is out of round more than 0.3 mm (0.012"), cut the commutator on a lathe.
   The out-of-round should be less than 0.05 mm (0.002").
   The diameter serviceable limit is 33.0 mm (1.30"), and if the limit exceeds, replace the armature.

3. Check the mica depth, and file off the mica if the depth is less than 0.2 mm (0.008").
   The proper depth should be 0.5 to 0.8 mm (0.02 ~ 0.03").

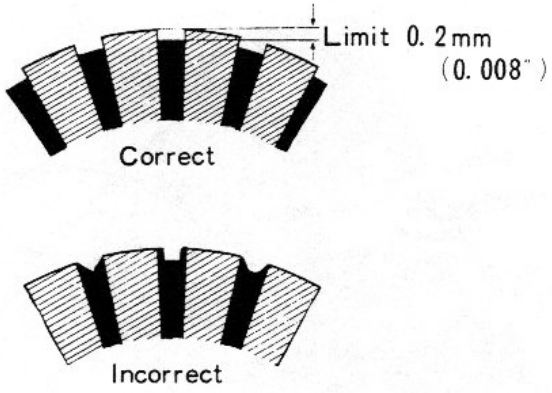


Fig.8-6 Commutator Mica Depth X3719

4. Check the commutator for ground by placing one test prod lead on the commutator, and the other lead on the armature core or shaft.
   If the test lamp lights, the commutator is grounded. Replace the armature.

5. Check the armature for short circuit by placing the armature on a Glowler, and hold a hacksaw blade over the armature core while the armature is rotated.

If the hacksaw blade vibrates, the armature coil is shorted. Replace the armature.

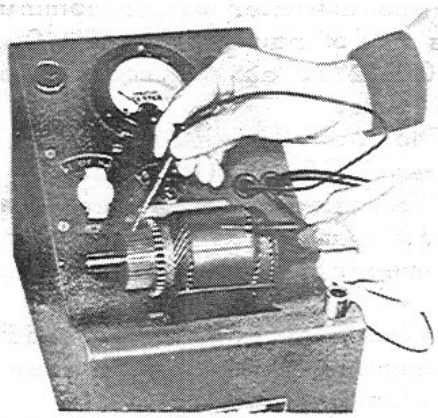


Fig.8-7 Testing Commutator for Ground V2186

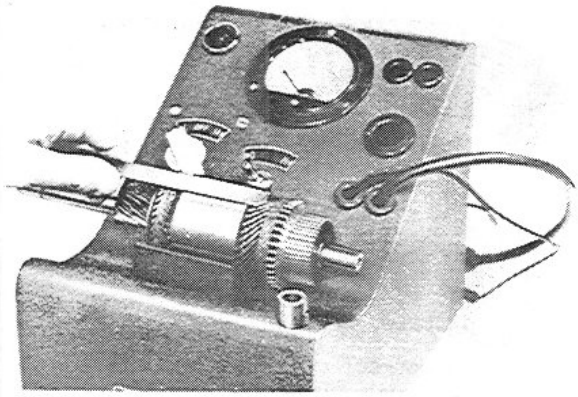


Fig.8-8 Testing Armature Coil for Short V2187

6. Check the armature coil for open circuit by placing the armature on a Glower, and connect the two segments with the test prod leads. Replace the armature if the reading shows inconsistent vibration.

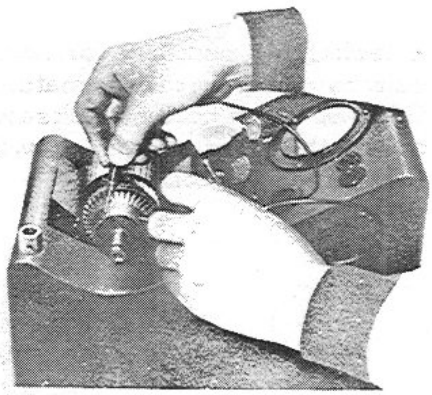


Fig.8-9 Testing Coil for Open Circuit V2188

Field Coil

1. Check the field coil for open circuit by placing one test prod lead on the field coil lead, and the other lead on the field coil other lead. If the tester needle does not move, the field coil has an open circuit, and the field coil must be replace.

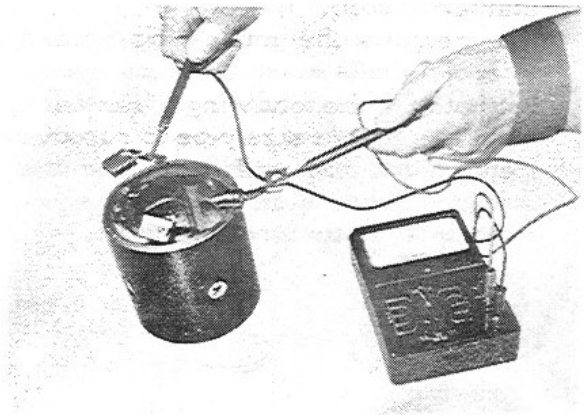


Fig.8-10 Testing Field Coil for Open Circuit V4371

2. Check the field coil for ground by placing one test prod lead on the field coil lead, and the other lead on the starter yoke.
If the tester needle moves, the field coil has a ground circuit. Replace the field coil.

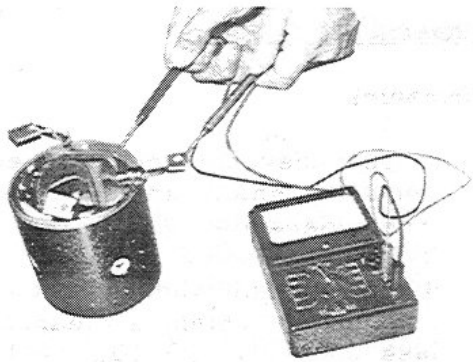


Fig.8-11 Testing Field Coil for Ground V4372

Magnetic Switch

1. Test the pull-in coil motion of the magnetic switch. Connect the test lead as illustrated in figure 8-12. The magnetic switch should pull in the plunger strongly with 8 volts.

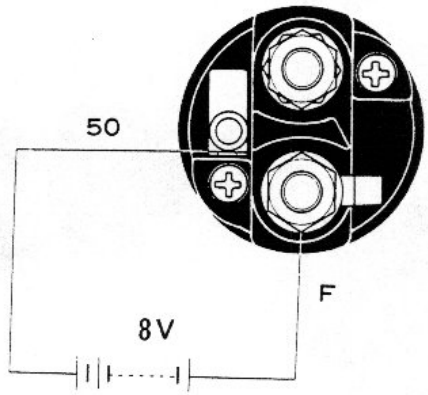


Fig.8-12 Pull-in Coil Test G0721

2. With the magnetic switch in pull-in condition, connect the battery negative lead to the magnetic switch body. Then disconnect the test lead of the battery negative side from the "F" terminal, and the plunger must be pulled in and held in this position. If held, the holding coil is satisfactory.

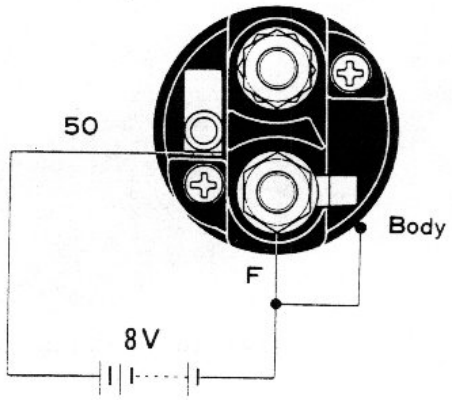


Fig.8-13 Holding Coil Test G0722

3. Check the plunger return test by connecting the battery positive lead to the magnetic switch body, and the negative lead to the "F" terminal. After pushing in the plunger with the hand, and release the hand. At this time, if the plunger returns with 12 volts, the magnetic switch is satisfactory.

4. Adjust the length of the magnetic switch moving stud.
The length should be 34 mm or 1.34".

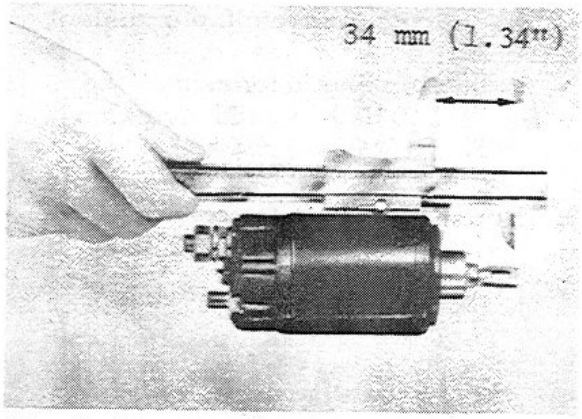


Fig.8-14 Checking Moving Stud W8636

Brush Holder & Brush

1. Check the brush holder insulation. Connect one test prod lead on the brush holder (+) side, and the other lead on the (-) side.
If the tester needle moves, the brush holder is shorted due to defective insulator. Replace the brush holder.

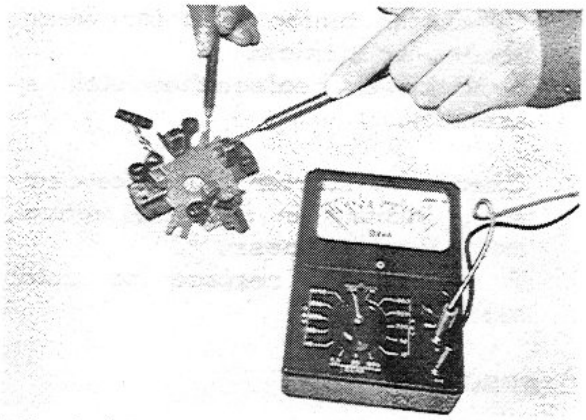


Fig.8-15 Checking Brush Holder Insulation V4373

2. Check the brush length, and if the length is less than 13 mm (0.51"), replace the brush.

3. Check the brush spring tension with a pull scale. The reading of the tension should be made with the spring just off the brush.

   Brush spring tension:
   1,020 ~ 1,380 grams
   (2.25 ~ 3.04 lb)

   Brush spring tension limit:
   600 grams (1.32 lb)

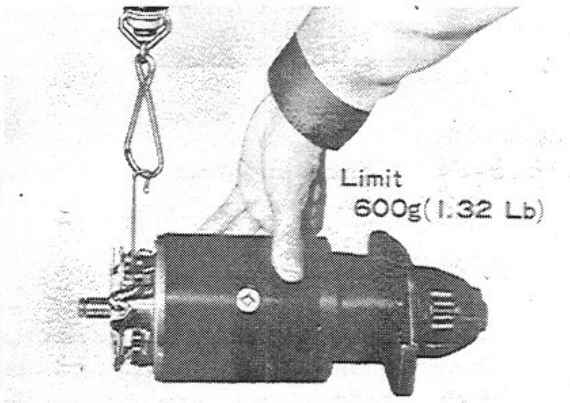


Fig.8-16 Checking Brush Spring Tension V4374

Starter Clutch

1. Check the pinion teeth for wear, score, and chips.
   If defective, replace the clutch asasembly.

2. Check the starter clutch for damage, binding in reverse motion, and also looseness.
   If necessary, replace the clutch assembly.

Assembly

Apply a coat of multipurpose grease on the splines of the armature shaft, drive ring of the starter clutch, armature shaft bushings, and the magnetic switch moving stud.

1. Assemble the starter clutch onto the armature shaft, then install the pinion stop nut, and the snap ring. Lock the pinion stop nut in place by punching at two places. Fig.8-17.

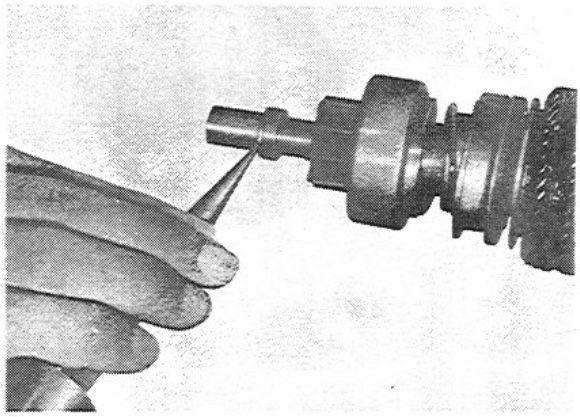


Fig.8-17 Punching Stop Nut V1136

2. When assembling the pinion drive lever to the drive ring of the starter clutch, position the drive ring stopper as shown in figure 8-18.

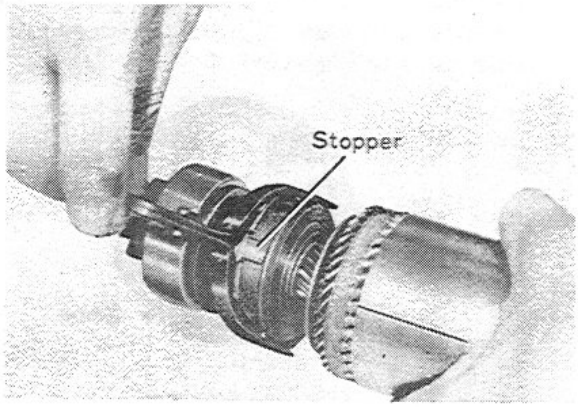


Fig.8-18 Assembling Pinion Drive Lever W8642

3. Assemble the armature, starter clutch, and the pinion drive lever to the drive housing. Tighten the drive lever set pin.

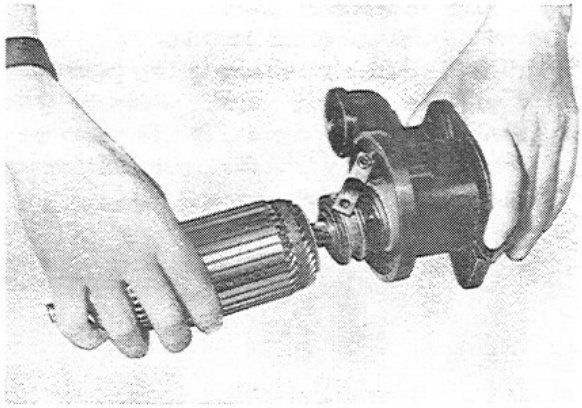


Fig.8-19 Assembling Armature V4375

4. Install the starter yoke.
   Install the steel washer (1), and the bakelite washer (2) onto the armature shaft, then install the brush holder.
   Lift up the brush springs, then insert the brushes.

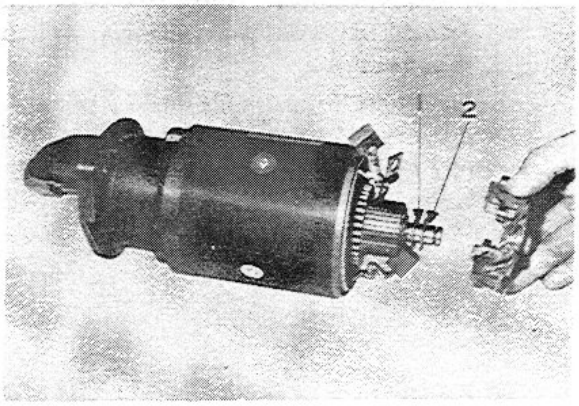


Fig.8-20 Installing Brush Holder V4376

5. Install the commutator end frame, and tighten the through bolts.

6. Install the adjusting washers (1). and the lock plate (2) onto the armature shaft.
   Check the thrust clearance at the rear of the armature shaft with a thickness gauge.
   The thrust clearance should be 0.05 ~ 0.35 mm (0.002 ~ 0.013"), and the limit is 0.8 mm (0.03").
   If necessary, adjust the thrust clearance with the adjusting washer (1).

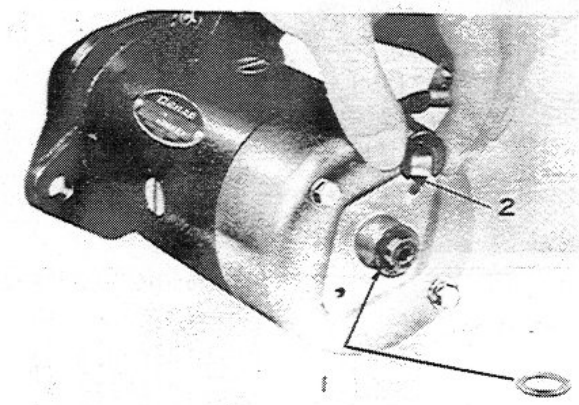


Fig.8-21 Installing Lock Plate W8645

7. Pack multipurpose grease into the bearing cover, and install the rubber ring and the bearing cover.

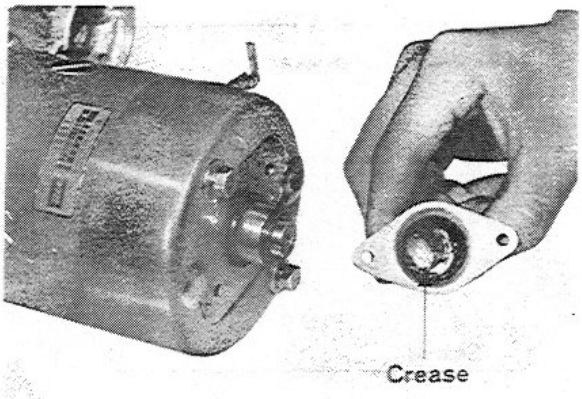


Fig.8-22 Installing End Frame Cover W8646

8. Install the magnetic switch.

9. Check the clearance between the starter clutch pinion, and the pinion stop collar.
   The clearance should be 1 ~ 3 mm (0.04 ~ 0.12"), when the starter is operated under no load.
   If necessary, readjust the length of the magnetic switch moving stud to obtain the specific clearance.
   Connect the field coil lead wire to the magnetic switch "F" terminal.

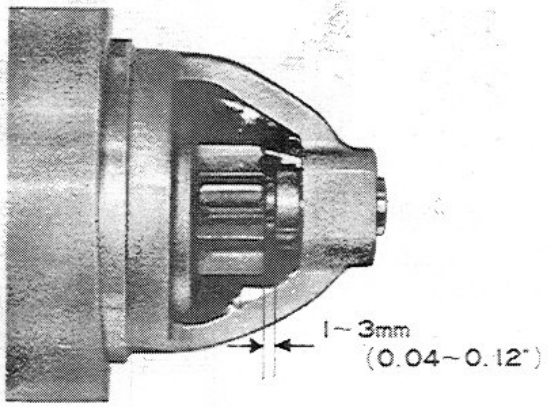


Fig.8-23 Starter Clutch Pinion Clearance W8647

Testing After Assembly

The following tests should be performed after assembling the starter. Use a fully charged battery for the

1. No load test.
   To perform a no-load test, connect the test lead as shown in figure 8-24.

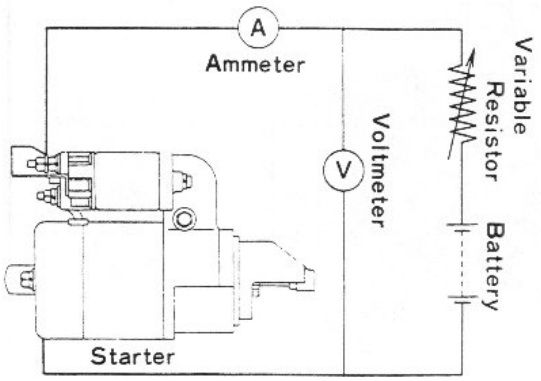


Fig.8-24 Testing Circuit G0154

   At this time, the starter should rotate smoothly at a constant speed of over 5,000 rpm at 11 volts with a current draw of 50 amperes or less.

2. Lock test.
   To perform the lock test, follow the instruction, and procedures outlined in the instruction manual of the tester.
   With the armature locked, the current draw should be less than 600 amperes at 7.0 volts producing a torque of 1.8 m-kg (13.02 ft-lb) or more.

ALTERNATOR & REGULATOR

Construction

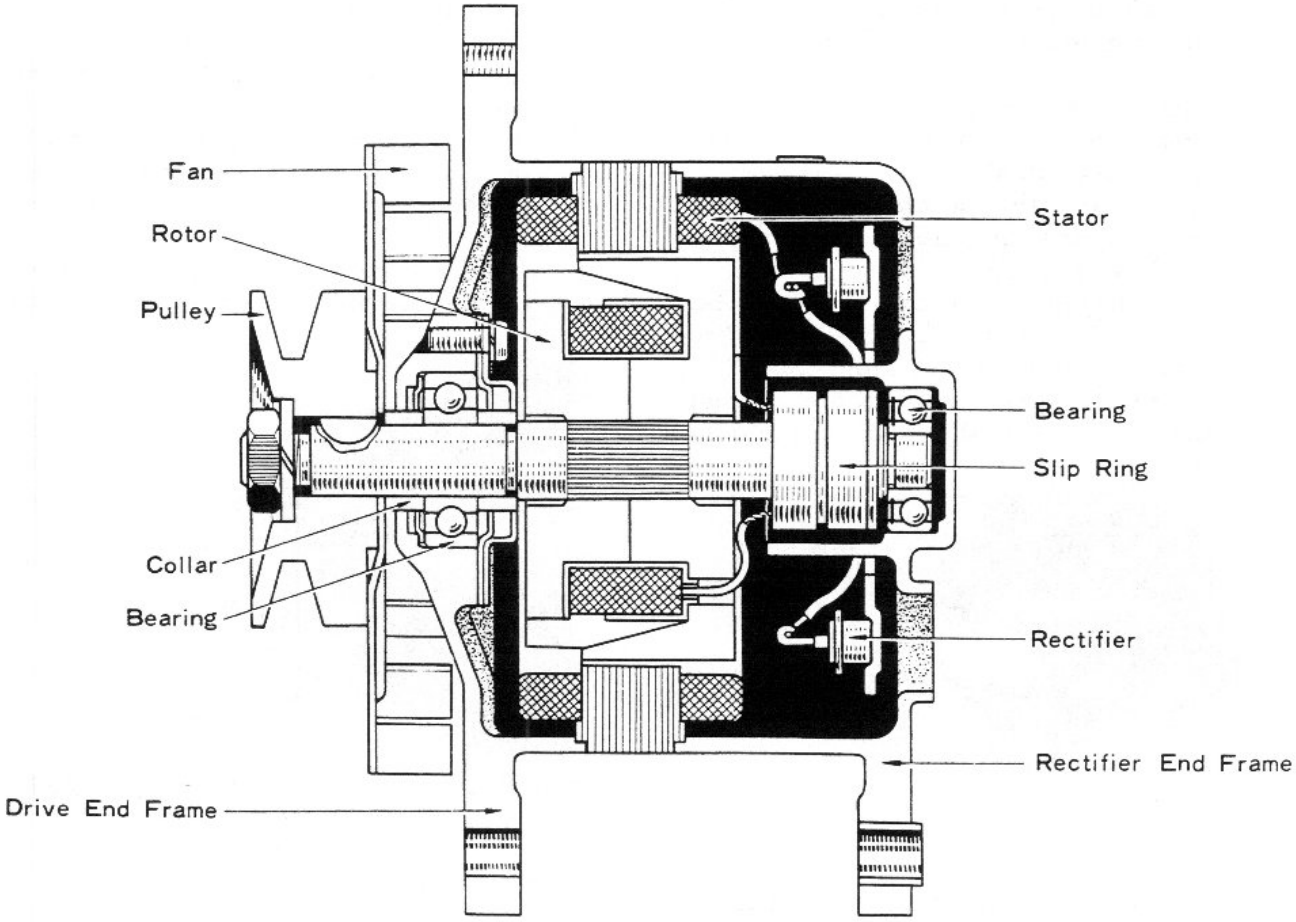


Fig.8-25 Cross Sectional View of Alternator Y5118

The principle components of the alternator consists of the alternator rotor, stator rectifier, and the frames, and the alternator regulator consists of the voltage regulator.

The stator is just a housing which contains the stator windings. The rotor consists of two six-fingered, cup-shaped halves, which when assembled becomes a 12-pole rotor. A rotor coil wound in the shaped of a doughnut, and is connected to the battery through the slip rings and brushes, and the regulator. Alternating current from the alternator is converted into a direct current by a rectifier. The rectifier has a very high resistance to the flow of electrical current in one direction, but a very low resistance in the other direction. Therefore, with the proper polarity, the low resistance allows current to flow from the stator to the battery. The high resistance prevents current from flowing from the battery to the stator. Such rectifiers provided rectification throughout the operating renge of the alternator.

The alternator regulator acts in limiting the alternator voltage to a preset value by controlling the rotor coil current. No. current control is required for such alternator since the current output is controlled by the self-limiting characteristics of the alternator.

Specification:

Voltage	12 volts
Max. output current	40 amperes
Max. output power	480 watts
Direction of revolution	Clockwise as seen from pulley
Stator	Three-phase "Y" type
Rectifying method	All-wave rectified, built-in six diodes
No-load revolution (normal temp.)	14 V, 0 Amp, 800± 150
Output revolution (normal temp.)	14 V, 40 Amp. Less than 3,500 rpm
Weight	4.9 kg (10.88 lb)

Operation

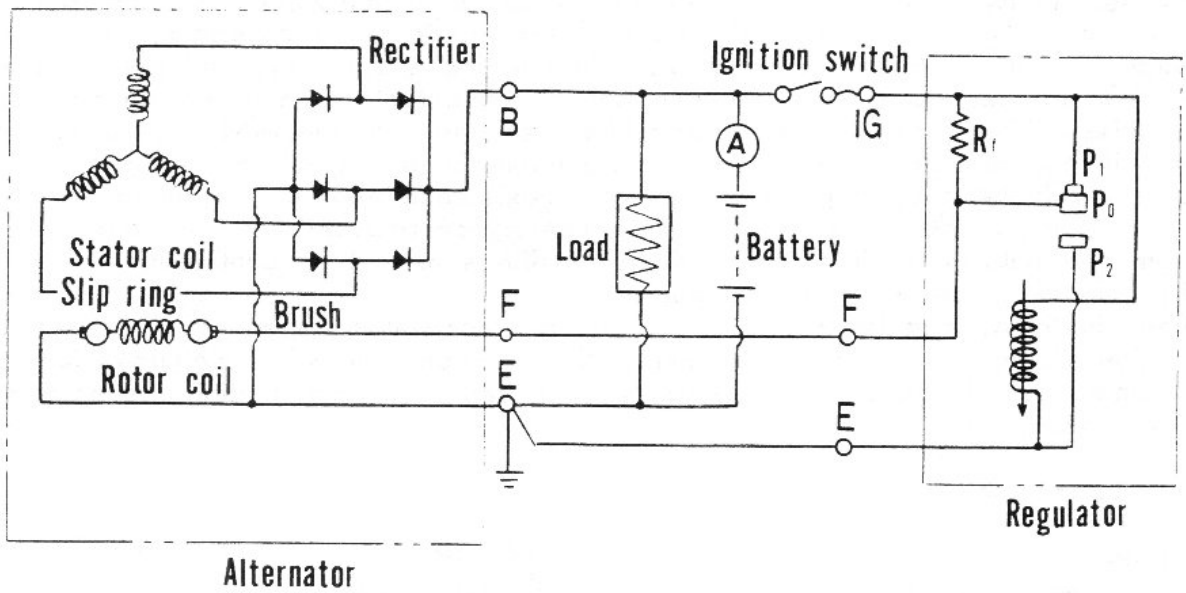


Fig.8-26 Alternator Generating Circuit X6391

When the ignition switch is closed, the battery current flows through the fuse, regulator points "P1" and "P0" and the rotor coil.
As the rotor is rotated, the alternating current is produced which is rectified to direct current by the six rectifiers which are silicone diodes.
If the stator coil output voltage become higher than the voltage in the battery, the current starts flowing to the battery or the load.
The rectifiers prevent the current to flow from the battery to the alternator.
Moreover the stator coil has a self-limiting characteristic in limiting the current flow to the coil to press the value when the revolution increases.
As the voltage at "IG" terminal increases, the pull-in force of the regulator coil increases, and the point "P0" opens from the point "P1". As the point opens, the current flowing through the rotor coil has to pass the control resistance "Rf", and decreases, then the voltage at "B" terminal becomes low.
Under light load at high revolution, point "P0" contacts the point "P2", and the current to the rotor coil is further decreased to control "B" terminal voltage.

Inspection in Car

1. Precaution for operation with the alternator.

   a. Use care when connecting any test equipment to the alternator out-put "B" terminal is connected to the battery at all times, and if the ignition switch closes, the voltage of the "F" terminal is the same.

   b. Allways pay attention to the polarity of the battery, not to connect it to the alternator oppositely. If connected oppositely, large current flows from the battery to

the alternator so that the rectifiers are damaged, and sometimes the falsher unit burns.

c. For quick charging the battery, make sure to disconnect the battery to starter cable.
If not, the rectifier will be damaged.

d. Never rotate the engine at high speed with the "B" terminal lead wire disconnected.
If it is necessary to open the "B" terminal, also disconnect the connector plug for the "F" terminal at the same time.

e. For adjustment of the regulator, make sure to disconnect the lead wires from the regulator.
If not, the points may be melted and fuse may be burn.

f. Take care not to wet the alternator with water or steam when washing the car.

g. Never connect a condenser to the "F" terminal.

2. Pre-check of this test.

a. Loose installation of the alternator.

b. "V" belt tension.

c. Burning fuse.

d. Charging system wiring.

3. Disconnect the "B" terminal lead wire from the alternator and connect a voltmeter and an ammeter as shown in figure 8-27.

4. Check the voltage and amperage of the regulator at normal operating temperature.
Start the engine and increase the engine revolution gradually until the engine revolution reaches from 600 ~ 2,000 rpm. Read the voltage which should be 13.6 ~ 14.6

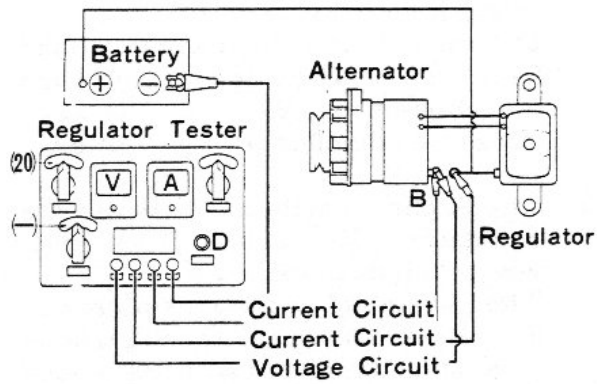


Fig.8-27 Test Circuit G0156

volts, and the current should be less than 10 amperes.
A current flow considerably higher than that specified above, indicates the battery is discharged or the battery plates are shorted.
If the voltmeter needle vibrates, it indicates that the regulator points are rough or improper connection of "F" terminal.
If the voltmeter indicates more than that specified above, it is the indication of the following symptoms.

a. Regulator low speed points melted or high pressure contact.

b. Regulator high speed point gap is too wide.

c. Regulator coil short or open.

d. Control resistance defect.

5. Make the same connection as shown in figure 8-27.
Start the engine, and run it at approximately 1,100 rpm with all light and accessories turning on.
The ammeter should indicate more than 30 amperes and voltage should be 13.6 ~ 14.6 volts.
If the current flow is extremely lower than the specified amperage, the rectifier/s or stator coil are shorted or opened.

Note: If the battery is full charged state and the ammeter reading is less than 30 amperes, it is recom-

mended to discharge the battery to perform this test.
Disconnect the high tension lead from the ignition coil, and turn the starter for about 5 ~ 10 seconds to discharge the battery.

6. Check the resistance between the regulator "IG" and "F" terminal with a circuit tester.
There should be no resistance. If there is any resistance, it indicates that the regulator low speed points contact poorly.

7. Check the resistance between the alternator "F" and "E" terminals with a circuit tester.
The specified resistance is 4.2 ohms, if the resistance is less than 4.2 ohms, the rotor coil is shorted. The resistance is considerably higher than that specified above, the rotor coil or brushes and the slip rings have a high resistance or are opened.

8. Rectifier short test.

a. To test the rectifier plus side, connect the circuit tester (+) lead to the alternator "N" terminal and tester (-) lead to the alternator "B" terminal. This resistance should be infinite (no needle movement). If there is any needle movement the rectifier/s is shorted.

b. To test the rectifier minus side, connect the circuit tester (+) lead to the alternator "E" terminal and (-) lead of the tester to the alternator "N" terminal. This resistance should be infinite (no needle movement). If there is any needle movement, the rectifier/s is shorted.

ALTERNATOR

Removal

1. Disconnect the battery to starter cable from the battery.
2. Disconnect the wirings from the alternator.
3. Remove the air cleaner assembly.
4. Remove the fan belt adjusting bar bolt, and then remove the "V" belt.
5. Remove the alternator retaining bolt, and remove the alternator from the bracket upward.

Disassembly

1. Remove the three through bolts.
2. Separate the drive end frame and the rotor from the rectifier end frame and the stator.
3. Loosen the pulley retaining nut, and remove the pulley, fan, key, and the spacer collar.
4. Remove the rotor from the drive end frame with a press.

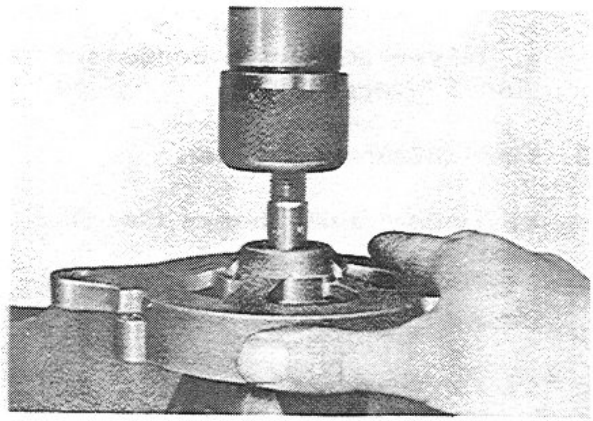
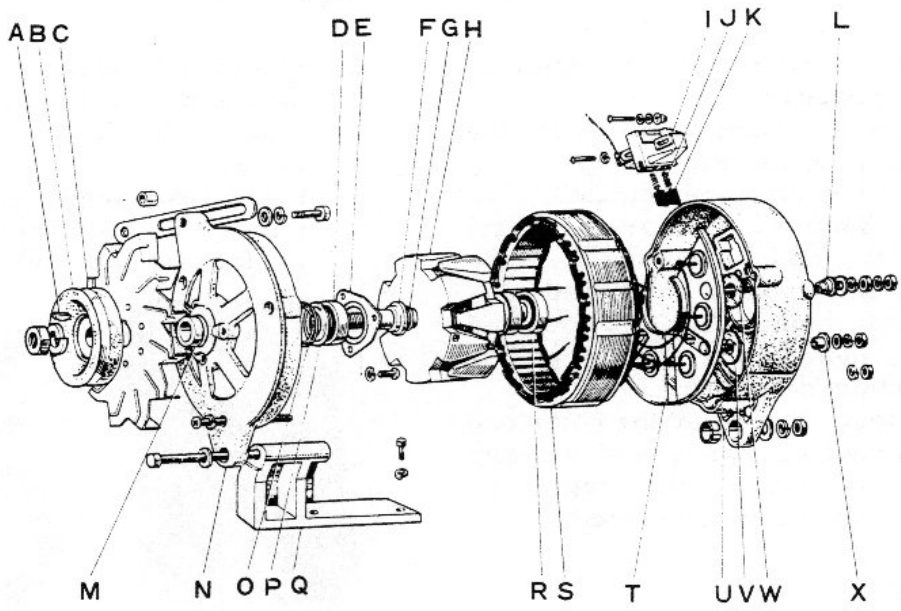


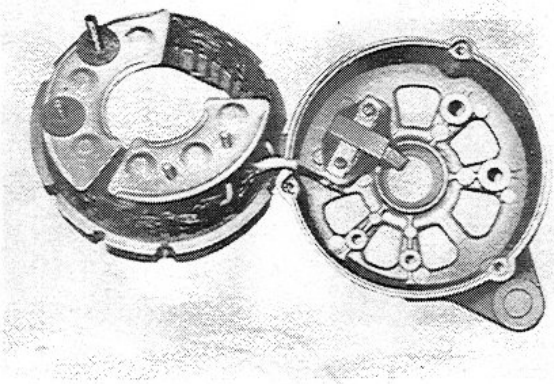
Fig.8-28 Removing Rotor V1138

5. Remove the "B" terminal nuts and insulator and the rectifier holder retaining nuts and insulator.
Remove the brush holder from the rectifier end frame (Fig.8-30).
6. Remove the rear bearing from the rotor shaft with the Injection Pump Spline Shaft Puller 09286-46011 (Fig.8-31).



A. Key
B. Pulley
C. Fan
D. Bearing
E. Bearing retainer plate
F. Space ring
G. Snap ring
H. Rotor
I. Brush holder
J. Brush spring
K. Brush
L. Terminal insulator
M. Collar
N. Drive end frame
O. Felt ring
P. Felt cover
Q. Bracket
R. Bearing
S. Stator
T. Holder w/rectifier
U. Rectifier end frame
V. Insulation washer
W. Insulation washer
X. Insulator

Fig.8-29 Alternator Components G1578



Fing8-30 Brush Holder Removal V4377

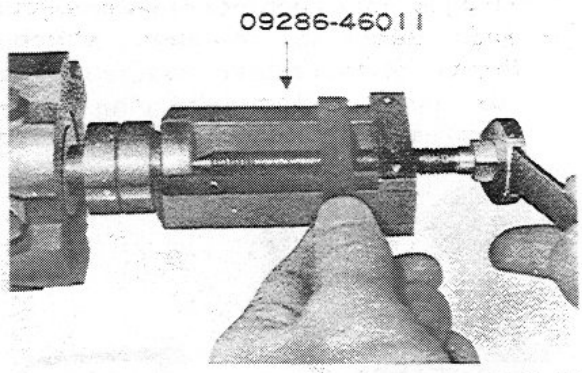


Fig.8-31 Removing Rear Bearing V1139

7. Remove the bearing retainer plate, and remove the front bearing, felt ring cover and the felt ring.

Inspection & Repair

Bearing

Check the bearing for scores, roughness, abnormal noises or damage. If necessary replace the bearing/s.

Rotor

1. Check the rotor coil for open or short circuit.
   Connect a circuit tester from the slip ring to the other ring.
   The coil resistance should be 4.2 ohms. If there is little or no resistance, the coil or slip rings indicate a short or ground, and considerably higher than that specified above, indicates a opened coil or connecting defective.
   If the test shows that the rotor coil is shorted or open, and the slip rings are faulty, the rotor assembly should be replaced.

Fig.8-32 Testing Rotor Coil Open & Short Circuit V1296

2. Connect the tester from the slip ring to the rotor or rotor shaft, and check the insulation between them. If the tester needle moves, the rotor coil or slip rings is defective. The rotor assembly should be replaced.

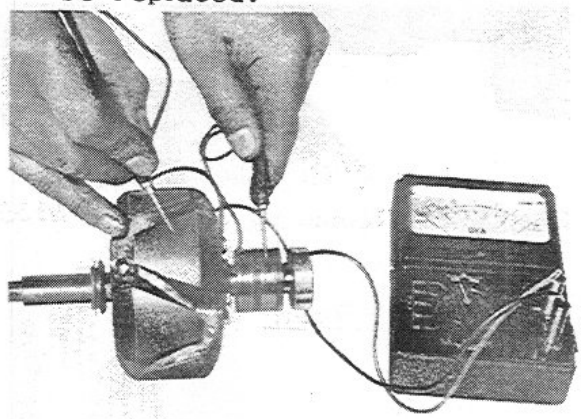


Fig.8-33 Testing Rotor Coil for Ground V2197

Stator

1. Check the stator coil for insulation. Connect the tester between the stator coil lead, and the stator core.
   If the tester needle moves, the coil insulation is defective. Repair or replace stator coil.

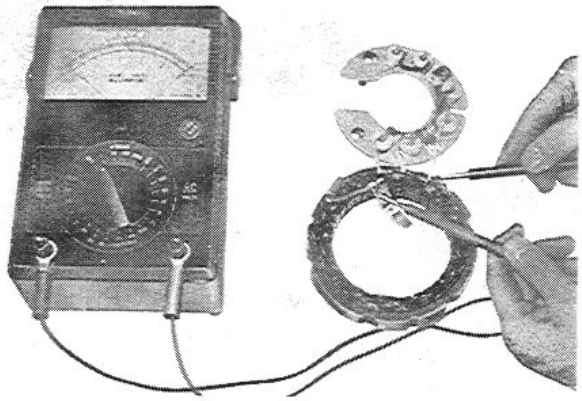


Fig.8-34 Testing Stator Coil Insulation V1142

2. Check the stator coil for open circuit. Disconnect the rectifiers from the stator coil quickly with a soldering iron.
   Check the four loads of the stator coil four conductance between them. If the tester needle does not move, the stator coil is opened, and should be replaced.

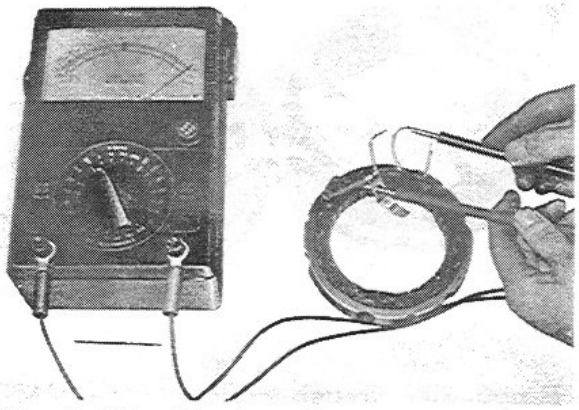


Fig.8-35 Testing Stator Coil for Open Circuit V1145

Brush & Brush Holder

1. Check the brushes for cracks and wear.
   If the protruded brush length is worn beyond 5.5 mm (0.22"), replace the brushes.
   If replacing the brush, assemble the new brush and the brush spring into the brush holder, then solder the brush lead wire to keep the protruded brush length 10 mm (0.4").

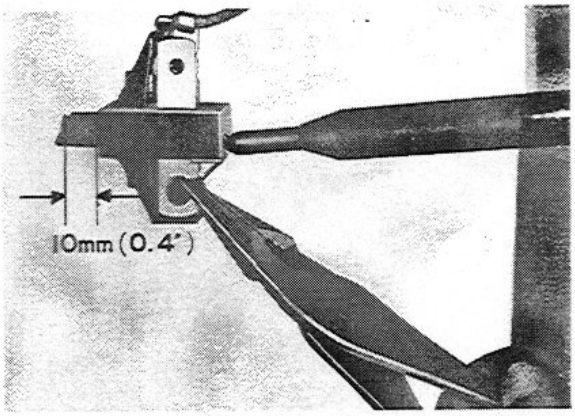


Fig.8-36 Replacing Brush V0216

2. Check the brush movement in the brush holder, and inspect the insulation of the holder with a circuit tester.

Rectifier

Good or defective rectifier is classified by resistance value between the rectifier holder, and the rectifier lead.

1. Rectifier holder positive side.
   Connect the tester (+) lead on the rectifier holder, and (-) lead on the rectifier lead as shown in figure 8-37 and check the resistance.
   Good rectifier will indicate no resistance, and if it indicates a high resistance, the rectifier is opened. Then turn the polarity of the tester and check again. If the needle of the tester moves in either polarity, the rectifier is shorted. If the needle does not move in either porality, the rectifier is opened, and should be replaced as a set.

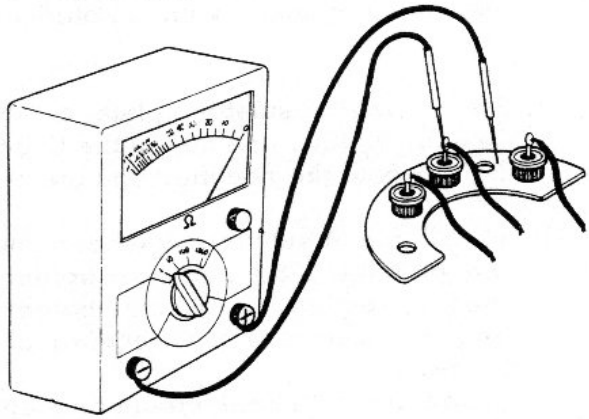


Fig.8-37 Rectifier Test G0172

2. Rectifier holder negative side.
   Connect the tester (-) lead on the rectifier holder, and (+) lead on the rectifier lead as shown in figure 8-38. Switch the tester to resistance check range, and check the resistance.
   Good rectifier will indicate no resistance, and if it indicate high resistance, the rectifier is opened. Then turn the polarity of the tester and check again. If the needle of the tester moves in either polarity, the rectifier is shorted.
   If the needle does not move in either porality, the rectifier is opened, and should be replaced as a set.

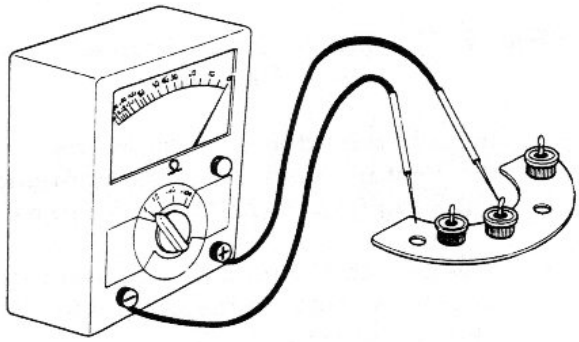


Fig.8-38 Rectifier Test G0173

Assembly

1. Connect the stator coil "N" lead to the brush holder "N" terminal, and the stator coil leads to the rectifiers quickly with a soldering iron.

2. Place the insulator plate on the brush holder, and install the brush holder onto the rectifier end frame.

3. Install the insulation washers onto the positive side rectifier holder. then assemble the rectifier holders and the stator to the rectifier end frame.
   Install the terminal insulators and tighten the "B" terminal nut and the rectifier holder retaining nuts.

4. Assemble the drive end frame. Pack the bearing with multipurpose grease, and install the felt ring, felt ring cover and the front bear ing in the drive end frame.
   Install the bearing retainer plate.

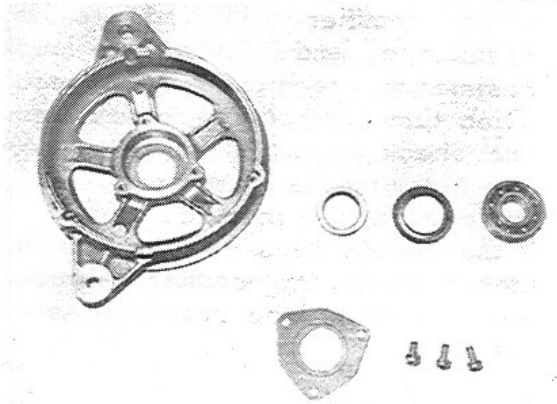


Fig.8-39 Drive End Frame Assembly V4378

5. Install the drive end frame onto the rotor with the Transmission Oil Plug 09325-12010 and a press.

6. Press the brushes against the brush spring pressure into the brush holder.
   Then insert a wire through the access hole in the rectifier end frame, and also into the access hole provided in the brush holder to keep them in their positions.

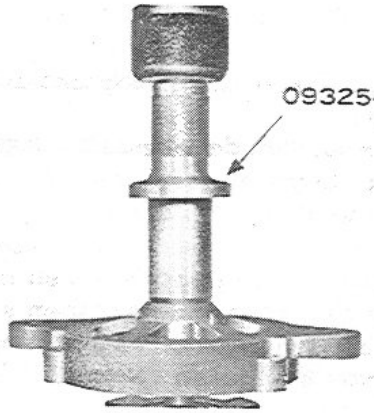


Fig.8-40 Installing Drive End Frame V1150

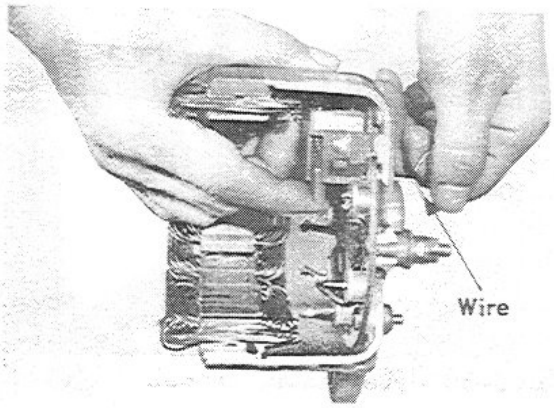


Fig.8-41 Installing Wire V0218

7. Position the stator, and the rectifier end frame, and the stator over the rotor, and align the through bolt holes. Seat the machined portion of the stator core into the step cuts of both end frames.
   Tighten the through bolts, and then remove the wire from the rectifier end frame and the brush holder.

8. Install the spacer collar into the drive end frame. Position the fan, key, pulley, and the lock washer on the rotor shaft, and tighten the pulley retaining nut securely.

Alternator Output Test

Perform the output test in accordance with the circuit shown in the following illustration.

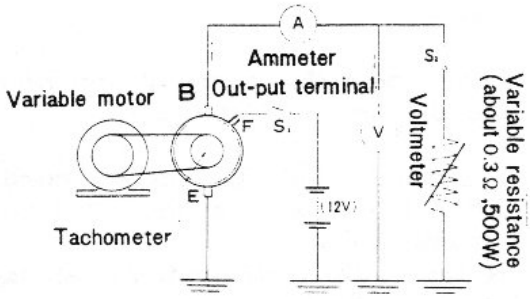


Fig.8-42 Output Test Circuit Y5120

1. Turn on the switch "S1" only, then increase the alternator revolution gradually with a variable motor, until the voltage reading reaches 14.0 volts. Read the revolution of the alternator which should be 650 ~ 950 rpm.

2. Turn on the switch "S1" and "S2" further holding the output voltage at 14.0 volts, and the amperage at 30 ~ 40 with a variable resistance.
   Read the revolution of the alternator which should be less than 3,500 rpm.

Installation

Follow the removal procedures in the reverse order.

REGULATOR

Removal

1. Disconnect the battery to starter cable from the battery.

2. Disconnect the wirings from the regulator terminals.

3. Remove the regulator retaining screws, and remove the regulator.

Performance Test

Always use a fully charged battery. Make the test connection as shown in figure 8-43. Check the voltage, and amperage by varying the alternator revolution gradually, and read the amperage at time when the ammeter needle registers maximum.
Increase the revolution, and read the voltage at the time when the ammeter needle registers one-half of maximum amperage reading. Also increase the alternator revolution until it reaches 4,000 rpm, then read the voltage.
The voltage should be within 13.6 ~ 14.6 volts. To adjust, bend the regulator adjusting arm.

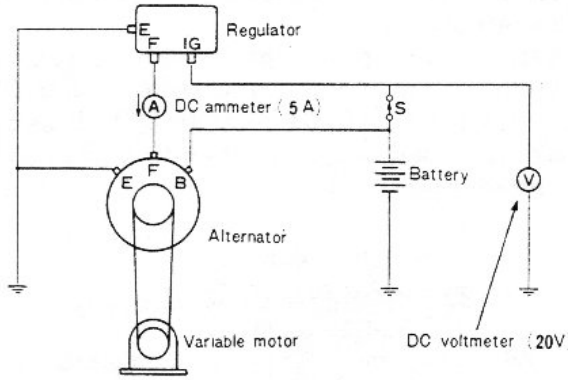


Fig.8-43 Test Circuit X0362

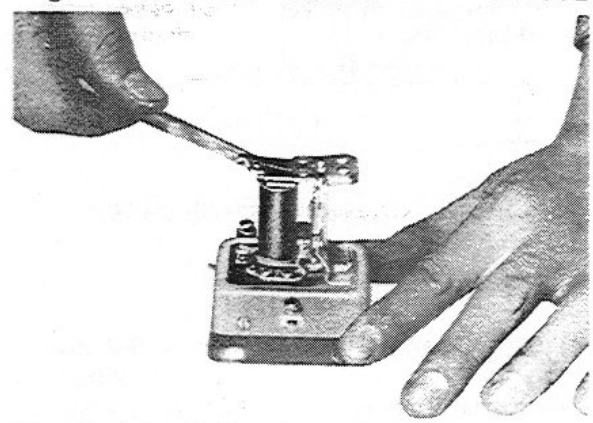


Fig.8-44 Adjusting Regulator Adjusting Arm W5526

Regulator Circuit Test

Connect the circuit tester between the "IG" and "F" terminals. The resistance should be zero.
If there are any resistance, the regulator low speed points are defective. Press the armature, and check the resistance. At this time, the resistance should be 2.8 ohms.

If the resistance is considerably higher than 2.8 ohms, the contact resistance is defective.

Inspection & Adjustment

The mechanical adjustment should be taken when the specified value are not obtained in the regulator performance test.
Dirty regulator points should be dressed with a suitable paper.
After dressing the points, wash them thoroughly with cleaning solvent.
If any points are burned or pitted excessively, replace the regulator assembly.
Check the point gap with a feeler gauge. This point gap should be 0.25 ~ 0.45 mm (0.01 ~ 0.018"). If necessary, adjust it by bending the high speed point holder.

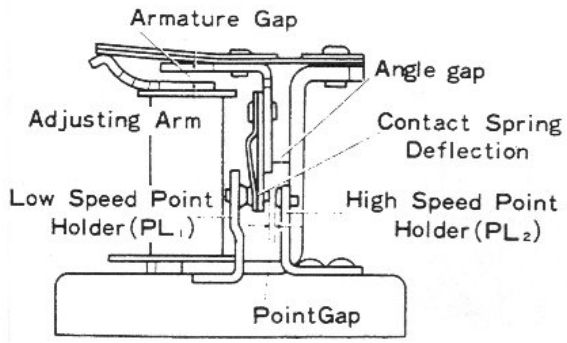


Fig.8-45 Checking Point Cap

Point gap	0.25 ~ 0.45 mm (0.01 ~ 0.018")
Angle gap (actuated)	Over 0.2 mm (0.008")
Armature gap	Over 0.3 mm (0.012")

Installation

Follow the removal, procedures in the reverse order.

DISTRIBUTOR

Removal

1. Disconnect the primary wire from the distributor terminal.

2. Disconnect the high tension cords from the spark plugs, and the ignition coil.
   Release the distributor cap spring clips, and remove the cap.

3. Scrive a mark on the distributor housing and the cylinder block indicating the position of the housing in the cylinder block, and scrive another mark on the distributor housing indicating the position of the distributor rotor.
   These mark can be used as guides when installing the distributor in a correctly timed engine.

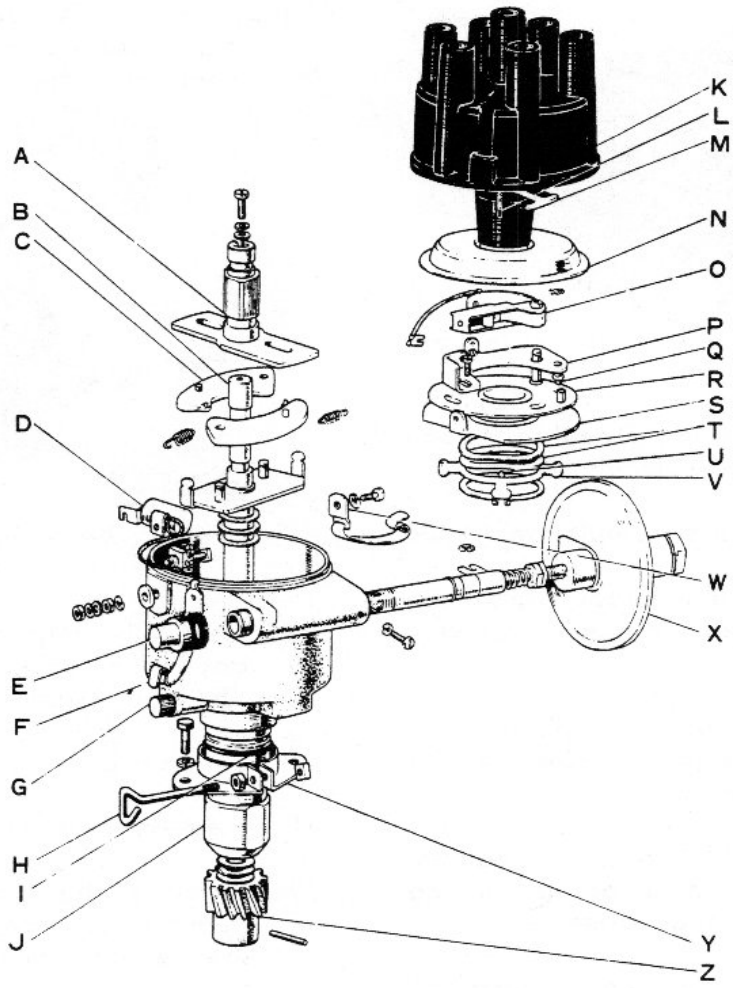
4. Remove the distributor clamp bolts, and lift the distributor out of the cylinder block.

Caution: Do not rotate the crankshaft while the distributor is removed.

Disassembly

1. Remove the rotor and the dust proof cover. Remove the adjuster cap.

2. Loosen the distributor terminal nut.
   Remove the snap ring from the breaker arm pivot, and remove the contact point plate retaining screw, then take out the contact point plate with the breaker arm.



A. Distributor cam
B. Distributor shaft
C. Governor weight
D. Condenser
E. Adjuster cap
F. Spring clip
G. Oil cap
H. Holder screw
I. "O" ring
J. Distributor housing
K. Distributor cap
L. Carbon piece
M. Distributor rotor
N. Dust proof cover
O. Breaker arm
P. Contact point plate
Q. Eccentric bolt
R. Breaker plate
S. Stationary plate
T. Washer
U. Ball
V. Breaker plate set spring
W. Spring clip
X. Vacuum advancer
Y. Distributor clamp
Z. Distributor drive gear

Fig.8-46 Distributor Components Y2137

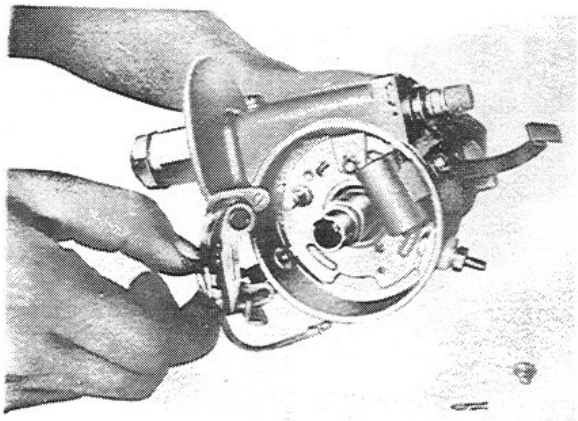


Fig.8-47 Removing Breaker Arm & Point Plate W0863

3. Disconnect the condenser lead wire.
   Remove the distributor cap spring clip, and then remove the condenser.

4. Remove the nut, terminal bolt, washer, insulator washer and the terminal insulator.

5. Remove the "E" ring that secures the vacuum advancer link to the moveable breaker plate.

6. Remove the vacuum advancer retaining screw, and slide the advancer out of the distributor.

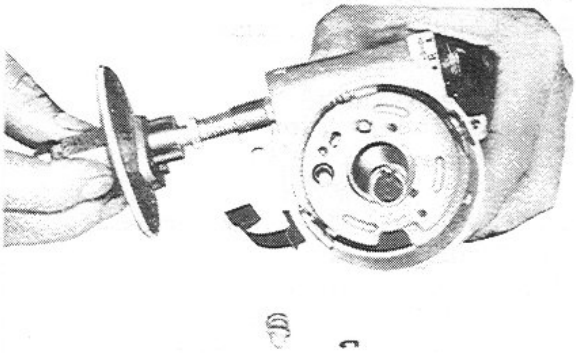


Fig.8-48 Removing Vacuum Advancer W0865

7. Remove the cap spring clip, and lift the breaker plate together with the stationary plate out of the distributor.

8. Remove the screw securing the distributor cam, and remove the cam from the shaft.

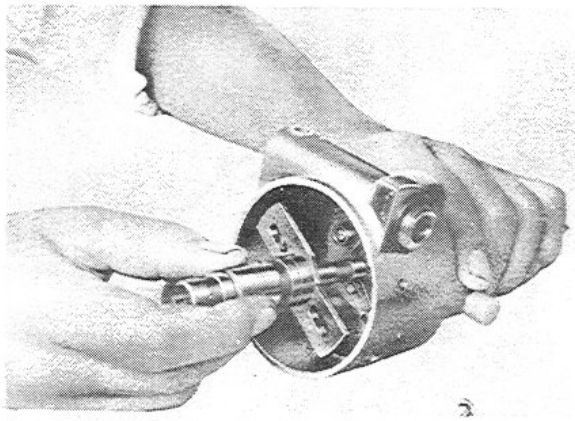


Fig.8-49 Removing Distributor Cam W0866

9. Carefully unhook, and remove the governor springs. Remove the "E" rings that secure the governor weights to the pivot pins, then remove the governor weights.

10. Remove the distributor clamps.

11. Remove the gear roll pin, then remove the gear, washers and the bakelite washer from the shaft.

12. Slide the distributor shaft and the washers out of the distributor housing.

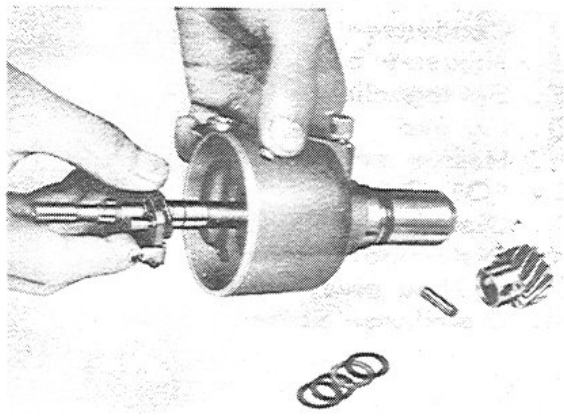


Fig.8-50 Removing Shaft V3680

Inspection & Repair

Wash all the parts with the exception of the vacuum advancer, distributor cap, and the condenser in cleaning

solvent.
Repair or replace any defective part or parts.
Dry the parts with compressed air.

1. Check the distributor cap for cracks, carbon tracks, and burned or corroded terminals, and also the wear of the center carbon piece.
   Carbon protrusion is 9 mm or 0.35", and limit is 7 mm (0.27").

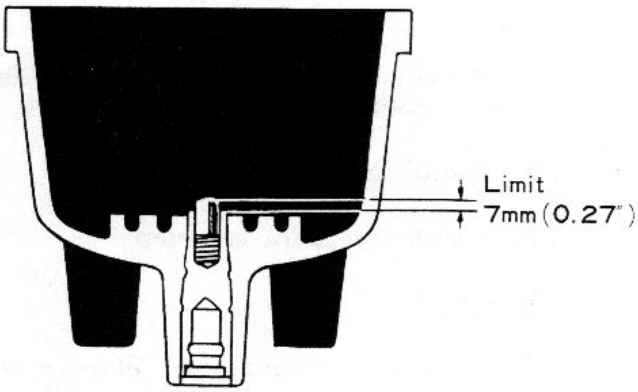


Fig.8-51 Carbon Protrushion X2936

2. Inspect the rotor for damage or deterioration.

3. Inspect the breaker points for burned or pitted condition, and if necessary clean with a point file. Never use emery cloth or sandpaper to clean points since particles will embed, and rapid burning of points.

4. Inspect the distributor shaft for run-out which should not exceed 0.05 mm (0.002").

5. Inspect the governor weight for binding with the pivot pin.

6. Inspect the distributor cam lobes for scoring, and signs of wear. If any lobe is scored or worn, replace the cam.

7. Place the washers on the shaft, and install the shaft into the housing.
   Install the gear onto the shaft, and then insert the gear roll pin.
   Inspect the shaft thrust clearance with a dial gauge or feeler gauge. The clearance should be 0.15 to 0.50 mm (0.006 ~ 0.197"). If the clearance exceeds 0.50 mm or 0.197", adjust with the adjusting washer.

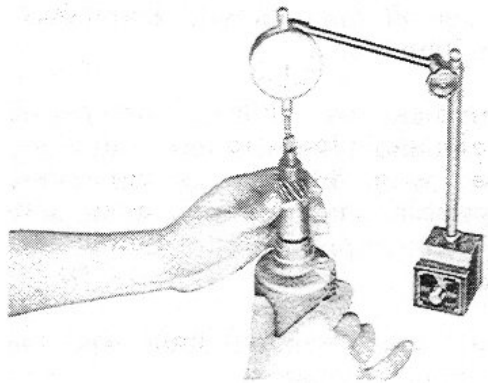


Fig.8-52 Checking Thrust Clearance V3681

8. Check the breaker plate operating resistance.
   The resistance should not exceed 500 grams (1.103 lb).

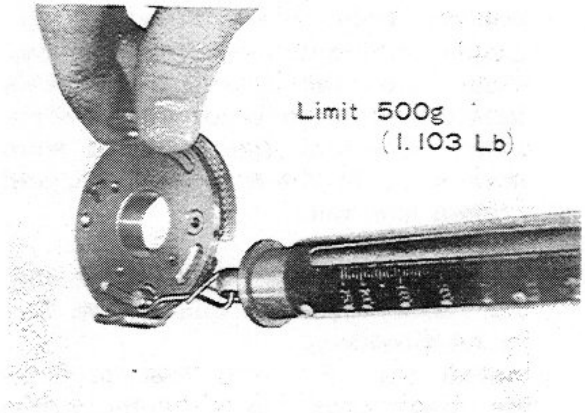


Fig.8-53 Checking Operating Resistance V1168

Assembly

1. Place the washers on the shaft, and apply a few drops of engine oil on the shaft.
   Assemble the shaft into the distributor housing. Next install the gear and the washers onto the shaft, and then install the gear roll pin. Peen the pin end to secure.

2. Position the governor weights on the governor plate, and install the "E" rings.
   Install the governor springs.

3. Coat the distributor shaft slightly with distributor cam lubricant, and install the distributor cam.
   Tighten the cam securing screw, and fill the groove in the upper portion of the cam with distributor cam lubricant.

4. Lubricate the sliding surface of the breaker plate and the stationary plate with distributor lubricant.
   Assemble the breaker plate and stationary plate to the distributor housing.

5. Install the terminal bolt and the terminal insulators.

6. Install the condenser and the cap spring clips those secure the breaker plate.
   Connect the condenser lead wire.

7. Install the breaker arm, and the contact point plate with the eccentric bolt onto the breaker plate.
   Coat the distributor cam lobes lightly with distributor cam lubricant. Connect the breaker arm lead wire to the terminal bolt, and tighten the nut.

8. Slide the vacuum advancer into the housing, and place the link in its position.
   Install the "E" ring that secures the diaphragm link to the moveable breaker plate.
   Set the vacuum advancer (octane selector) at normal position.
   Lubricate the moving portions.

9. Install the rotor on the distributor cam, and check the distributor centrifugal advance mechanism by turning the rotor in a clockwise direction as far as possible, then releasing the rotor to see if the rotor returns it to its retarded position.
   If the rotor does not return readily, the distributor should be disassembled, and the cause of the trouble should be checked.

10. Check the vacuum advancer mechanism by pushing in the octane selector direction, then releasing the octane selector to see if the selector returning to its retarded position.
    Correct any interference or binding.

11. Install the dust proof cover and the rotor.

12. Install the distributor cap.

13. Install the adjuster cap.

Testing

To test the distributor, always use a reliable distributor tester, and perform the following adjustment.

Adjustment

To adjust the distributor, always use a reliable distributor tester, and perform the following adjustments.

Point Gap

1. Install the distributor onto the distributor tester, and remove the cap, rotor, and the dust-proof cover. Connect the positive, and negative leads onto the distributor as per tester instruction manual.

2. Turn the distributor shaft until the breaker arm rubbing block is on the top of the cam lobe.

3. Loosen the contact point plate securing screw, then turn the eccentric bolt clockwise or counterclockwise to obtain a clearance of 0.4 ~ 0.5 mm (0.016 ~ 0.020") with a feeler gauge.
   Tighten the contact point plate securing screw, and recheck the point gap.

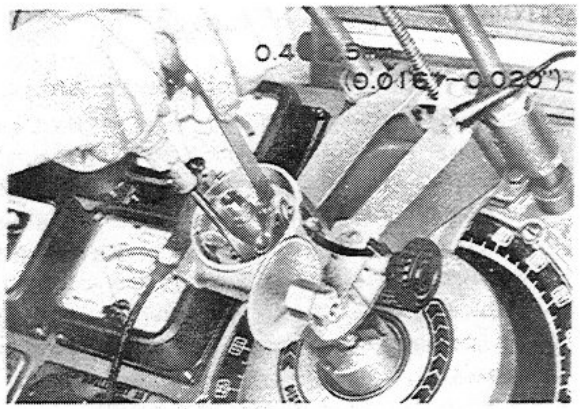


Fig.8-54 Adjusting Point Gap W0871

Cam dwell angle

Check the cam dwell angle, and if the dwell angle is not within the specified degree of 41°, loosen the contact point plate securing screw, and adjust the point gap. If the cam dwell angle is larger than the specification, make the point gap large, and if less, make the point small.

Fig.8-55 Cam Dwell Angle W0870

Breaker arm spring tension

Check the breaker arm spring tension with a pull scale. The spring tension should be 400 ~ 550 grams (14 ~ 19 oz). The scale should be hooked to the breaker arm at right angle, and should be pulled steadily. The reading should be taken just as the point opens. A light difference can be adjusted by spreading the spring outward to increase the tension.

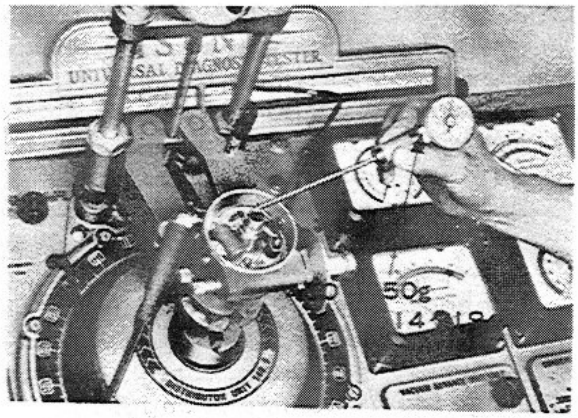


Fig.8-56 Checking Breaker Point Spring Tension W0869

Point resistance

1. Dress the breaker points with a breaker point file if the points are dirty or slightly burnt.

2. Replace the breaker points if pitted or badly burnt.

3. Close the circuit, and check the point resistance. If the voltage drops more than 0.15 volt, clean and align the points. Never use emery cloth to clean the points.

Condenser

Check the condenser capacity which should be 0.20 ~ 0.24 microfarad. If the capacity is more than the limit, replace the condenser.

NOTE: Short or excessive condenser capacity will cause burning of the points.

Advance characteristics

Check the governor advance, and the vacuum advance with the distributor tester.

1. Centrifugal advancer.
   Operate the distributor in the direction of rotation, and adjust the speed to the initial rpm setting listed in the specification.

Move the protrusion scale so that one of the flashes aligns with the zero degree mark.
Slowly increase the rpm to setting specified for the first advance reading listed in the specification.
If the correct advance is not indicated at this rpm, replace the governor springs.
Check the advance at all rpm settings listed in the specification.
Operate the distributor both up and down the rpm ranges.

Centrifugal advancer specification:

Distributor rpm	(Ex. USA) Advance angle
400 ~ 500	Advance begins
900	8~10°
1600	14 ~ 16°

2. Vacuum advancer. (Ex. USA)
Connect the test set vacuum line to the fitting on the vacuum advancer.
Set the test set at 0° advance, zero vacuum, and at 250 rpm.
Check the advance at the first vacuum setting specified in the specification.

Distributor rpm at 250
Advance begins
At 95 ~ 105 mm Hg
(3.74 ~ 4.13 in Hg)

Distributor rpm at 250
Advance 1 ~ 3°
At 120 mm Hg (4.72 in Hg)

Distributor rpm at 250
Advance 5.2 ~ 7.2°
At 200 mm Hg (7.87 in Hg)

Distributor rpm at 250
Advance 7.4 ~ 9.4°
At 300 mm Hg (11.8 in Hg)

If necessary, replace the vacuum advancer assembly.
(Refer to servise specification procedure on USA distributor)

Installation

Install the distributor clamp onto the cylinder block, and loosen the holder screw on the clamp.

1. If the engine has not been cranked while the distributor was removed, install the distributor with the rotor aligned with the mark previously scribed on the distributor housing, and the marks on the distributor housing and the cylinder block. Make sure the distributor shaft is properly engaged in the oil pump shaft.
Secure the holder screw.

2. If the crankshaft was rotated while the distributor was removed from the engine, it will necessary to time the engine.

a. Rotate the crankshaft until No.1 piston is at T.D.C. after compression stroke.
Align the timing ball in the flywheel with the timing pointer on the clutch housing.

b. Push the distributor down into position until the distributor gear is fully mesh with the camshaft gear. Rotate the distributor housing clockwise until the breaker points are just starting to open.
Tighten the holder screw securely.

Ignition timing

Run the engine at 500 rpm, check if the timing ball in the flywheel aligns with the timing pointer on the clutch housing.

Timing too slow

If the ignition timing is too retarded, the combustion will take place after the piston has passed the top dead center. In this case the cylinder volume will be enlarged so that the combustion of the mixed gas will be weak and incomplete. Consequently, the explosion power will be weak, and the cylinder will be subject to the flame for a longer period of time, which result to the following.

1. Engine losing power.

2. Increased fuel consumption.

3. Engine overheating.

4. Lubricating oil on the cylinder walls being burnt, and wasted, causing excessive wear, and damage to the cylinder walls, and piston sides.

5. Large deposit of carbon on the cylinder, and exhaust passages due to incomplete combustion.

Timing too fast

If the ignition timing is too advanced, the explosion will take place before the piston reaches the top dead center so that the piston moving upwards will receive a strong counter-pressure. The explosive pressure, and the crankshaft torque acting against each other will exert a tremendous force on all the frictional parts from the piston to the crankshaft, and causing the engine to knock violently, which result to the following.

1. Engine losing power.

2. Piston head being damaged if counter pressure is too high.

3. Excessive wear, and damage to the piston, and cylinder.

4. Connecting rod, and crankshaft being bent, and in extreme case, the bearing will be damaged.

Adjustment

1. Set the octane selector at zero, and attach a Timing Light onto the No.1 spark plug, and a ground. Start the engine, and run it at idling speed with light aimed at the clutch housing opening.

2. Loosen the holder screw of distributor clamp, and rotate the distributor body clockwise or counterclockwise until the timing ball in the flywheel lines up with the pointer on the clutch housing.

3. Tighten the holder screw, and remove the timing light.

NOTE: The ignition timing of the engine is set at 7° before top dead center.

Octane Selector

Depending on the gasoline octane rating, the octane selector on the vacuum advancer must be adjusted to attain proper ignition timing. With the transmission in top speed gear and keeping the speed at approximately 30 kilos per hour (20 mph), depress the accelerator pedal fully. It the engine pings slightly at this time, the adjustment is satisfactory.
For high octane gasoline, turn the adjuster toward the "A" mark, and for low octane gasoline, turn the adjuster toward "R".

NOTE: Standard position "O" point of the octane selector is obtained by screwing back the vacuum advancer adjuster until the lateral line (b) lines up with a red dot (a) on the distributor housing, and the thick longitudinal line (c) is in line with the end of the housing.
One graduation is equal to 5.2 degrees of the distributor angle.

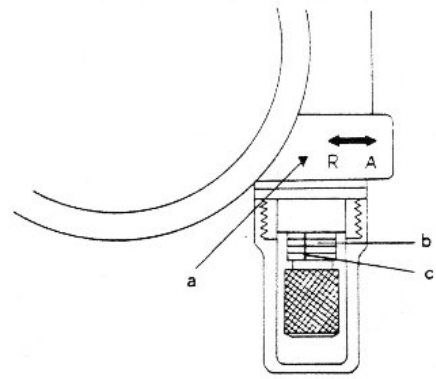


Fig.8-57 Octane Selector X4921

IGNITION COIL

The ignition coil is a unit which transforms low tension current from the battery (primary circuit) to high pulsating current of over 10,000 volts required to ignite the air-fuel mixture.

Inspection

For the coil test, follow the instructions on the tester. Test the coil secondary circuit for open, high resistance, and shorted condition. Also check the coil capacity. To test always heat the coil to operating temperature.

1. Check the primary resistance of the coil with a tester. The resistance reading should be 3 ~ 4 ohms.

2. Check the secondary resistance of the coil with a tester. The resistance reading should be from 6.750 ~ 8.250 ohms.

3. Check the coil for open circuit, and shorts with the tester.

4. To perform a spark test, this test should be made after installing on the car.
   Run the engine at idle speed, and disconnect the No.1 spark plug high tension wire. The spark should jump the distance of more than 6 mm (0.236") toward the cylinder head.

SPARK PLUG

Inspection

Carefully inspect each plug for the following conditions.

1. Cracks, and chips on the insulator inside, and outside.

2. Excessive electrode erosion.

3. Carbon or oil deposits on the insulator tip.

4. Glazed or blistered porcelains.

5. Damaged gaskets or weak gaskets.

NOTE: a. If the spark plugs are fouled with carbon, use "HOT" type plugs.

b. If the spark plugs show signs of being burnt white or rapid wear use "COLD" type plugs.

Adjustment

1. If the insulator, and firing end of the plugs are fouled with oil, clean by brushing in suitable solvent, and air blast.

2. Clean the plug in an abrasive blast type cleaner. Do not prolong the use of the abrasive blast as it will erode the insulation.

Fig.8-58 Cleaning Spark Plug V2205

3. Be sure to remove the abrasive with air blast, then clean the threads with a wire brush.

4. File the center electrode, and ground electrode to obtain flat surface on both electrodes.

5. Adjust the gap by bending the ground electrode to the center electrode.
   The gap should be 0.7~0.8 mm (0.028~0.031").

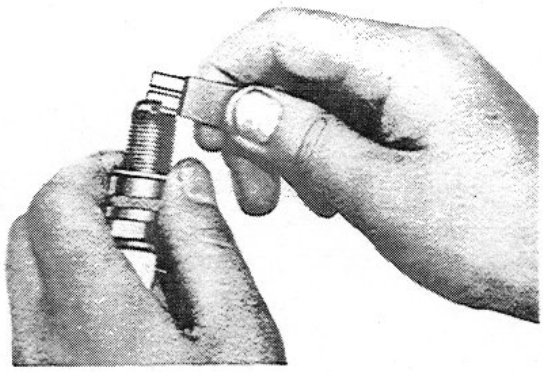


Fig.8-59 Adjusting Spark Plug Gap V2165

BATTERY

Inspection & Adjustment

1. Check the electrolyte level of each cell.
   Add sufficient electrolyte to level rises to the bottom of the vent well. Always use distilled water to replenish the battery.

2. Check the specific gravity of the electrolyte with a hydrometer.
   If the specific gravity reading is below 1.200, and the difference between each cell is more than 0.025, the battery should be recharged.
   Electrolyte specific gravity of a fully charged battery should be 1.250 ~ 1.270 at 20° C (68° F).
   The specific gravity of acid solution to be used as electrolyte, varies according to its temperatures. It is necessary before adjusting the specific gravity that it is converted accordingly to standard temperature reading of 20° C (68° F). For conversion of temperature pertaining to acid specific gravity, the following equation should be used.

$$S20 = ST + 0.0007\ (t-20)$$

S20	Specific gravity at 20° C
ST	Specific gravity at t° C
t	Temperature of electrolyte
0.0007	Temperature coefficient

Electrolyte specific gravity at 20° C (68° F)

1.260 is 100% fully charged state
1.210 is 75% fully charged state
1.160 is 50% fully charged state
1.110 is 25% fully charged state
1.060 is fully discharged state

Charging

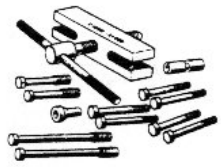
Before placing the battery on the charger, clean the battery terminals, check the electrolyte level, and replenish with distilled water as necessary. Remove all the filler caps while charging, and do not allow the battery electrolyte temperature to rise 45° C (113° F).
Hydrogen, and oxygen gases are produced during normal battery operation. This gas mixture can explode if frames or sparks are brough near the vent openings of the battery.
The sulphuric acid in the battery electrolyte can cause a serious burn if spilled on the skin or spattered in the eyes. It should be flushed away with large quantities of clear water.
For quick charging, make sure to disconnect the battery to starter cable. If not, the rectifier will be damaged.

SST & SERVICE SPECIFICATIONS

SST (SPECIAL SERVICE TOOL) List

1

2



3

4

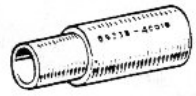
5

6

7

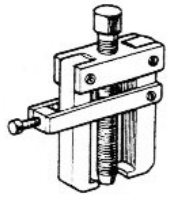
8

9



10

11



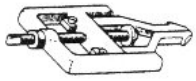
1.	09201-60010	Remover & replacer, valve guide bushing
2.	09213-60014	Puller, crankshaft pulley & gear
3.	09214-60010	Replacer, crankshaft pulley gear
4.	09215-60010	Remover & replacer, camshaft bearing
5.	09222-30010	Remover & replacer, connecting rod bushing
6.	09223-60010	Replacer, crankshaft rear oil seal
7.	09228-41011	Wrench, oil cleaner band
8.	09235-60010	Puller, water pump pulley seat
9.	09238-40010	Remover & replacer, water pump bearing
10.	09240-00010	Adjusting gauge set, carburetor
11.	09286-46011	Puller injection pump spline shaft (for alternator rear bearing)

SST (SPECIAL SERVICE TOOL) List

1

2

3



4

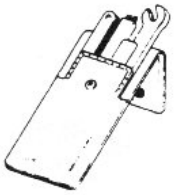
5

6

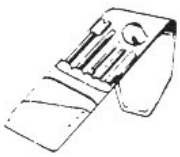
7

8

9

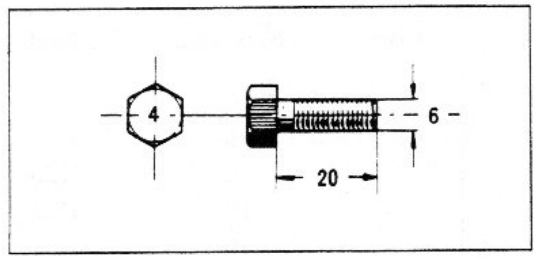


10



1.	09301-55022	Tool, clutch guide
2.	09302-25010	Gauge, clutch pressure lever height
3.	09303-55010	Puller, input shaft front bearing
4.	09304-47010	Replacer, input shaft front bearing
5.	09305-55010	Remover, transmission gear shift lever
6.	09309-12010	Replacer, transmission rear bearing (for crankshaft front oil seal)
7.	09325-12010	Plug, transmission oil (for alternator drive end frame)
8.	09515-35010	Replacer, rear wheel bearing (for crankshaft front oil seal)
9.	09850-00030	Kit, engine adjusting
10.	09860-11010	Driver set, carburetor

STANDARD BOLT TIGHTENING TORQUE



91111 – 4 0 6 2 0
- Part Number
- Length of Bolt: 20 mm
- Basic Major Dia. of Thread: 6 mm
- Bolt Head Mark *

* Bolt Head Mark has the following indications.

Mark on head of bolt	4	5	7
Toyota Standard Classification	4T	5T	7T
Tensile Strength (kg/mm^2)	more than 42	more than 55	more than 75
Brinell Hardness Number	121 ~ 209	147 ~ 227	227 ~ 271
Rockwell Hardness Number	B70 ~ 95	B89 ~ 98	C20 ~ 28
Yield Point (kg/mm^2)	more than 30	more than 45	more than 60

Specified Torque for Standard Bolt

Class	Basic Dia.	Pitch	Standard Torque kg-m	(ft-lb)	Torque Limit kg-m	(ft-lb)
4T	6	1	0.47	(3.4)	0.4 ~ 0.7	(2.9 ~ 5.0)
	8	1.25	1.11	(8.0)	1.0 ~ 1.6	(7.3 ~ 11.6)
	10	1.25	2.25	(16.3)	1.9 ~ 3.1	(13.8 ~ 22.4)
	10	1.5	2.14	(15.5)	1.8 ~ 3.0	(13.0 ~ 21.7)
	12	1.25 (ISO)	4.40	(31.8)	3.5 ~ 5.5	(25.3 ~ 39.7)
	12	1.5	3.89	(28.1)	3.5 ~ 5.5	(25.3 ~ 39.8)
	12	1.75	3.74	(27.0)	3.0 ~ 5.0	(21.7 ~ 36.2)
	13	1.5	5.08	(36.8)	4.5 ~ 7.0	(32.5 ~ 50.6)
	14	1.5	6.33	(45.8)	5.0 ~ 8.0	(36.2 ~ 57.8)
	14	2	5.93	(42.8)	4.7 ~ 7.7	(34.0 ~ 55.7)
	16	1.5	9.57	(69.2)	7.5 ~	(54.2 ~ 79.6)
	16	2	9.10	(65.8)	7.1 ~ 10.6	(51.3 ~ 76.7)
5T	6	1	0.71	(5.1)	0.6 ~ 0.9	(4.4 ~ 6.5)
	8	1.25	1.66	(12.0)	1.5 ~ 2.2	(10.9 ~ 15.9)
	10	1.25	3.34	(24.1)	3.0 ~ 4.5	(21.7 ~ 32.5)
	10	1.5	3.22	(23.3)	2.7 ~ 4.2	(19.5 ~ 30.4)
	12	1.25 (ISO)	6.60	(47.7)	5.0 ~ 8.0	(36.2 ~ 57.8)
	12	1.5	5.84	(42.2)	5.0 ~ 7.0	(36.2 ~ 50.6)
	12	1.75	5.61	(40.6)	4.8 ~ 6.8	(34.7 ~ 49.2)
	13	1.5	7.63	(55.2)	6.5 ~ 9.0	(47.0 ~ 65.1)
	14	1.5	8.90	(65.3)	7.5 ~ 11.0	(54.2 ~ 79.6)
	14	2	9.50	(68.7)	7.0 ~ 10.5	(50.6 ~ 75.9)
	16	1.5	14.36	(103.8)	12.0 ~ 17.0	(86.8 ~ 123.0)
	16	2	13.58	(98.1)	11.5 ~ 16.5	(83.2 ~ 119.2)

Class	Basic Dia.	Pitch	Standard Torque kg-m	(ft-lb)	Torque limit; kg-m (ft-lb)	
6T	6	1	0.71	(5.1)	0.6 ~ 0.9	(4.4 ~ 6.5)
	8	1.25	1.66	(12.0)	1.5 ~ 2.2	(10.9 ~ 15.9)
	10	1.25	3.37	(24.0)	3.0 ~ 4.5	(21.7 ~ 32.5)
	10	1.5	3.20	(23.1)	2.7 ~ 4.2	(19.5 ~ 30.4)
	12	1.25 (ISO)	6.60	(47.7)	5.0 ~ 8.0	(36.2 ~ 57.8)
	12	1.5	5.84	(42.2)	5.0 ~ 7.0	(36.2 ~ 50.6)
	12	1.75	5.61	(40.6)	4.8 ~ 6.8	(34.7 ~ 49.2)
7T	6	1	0.95	(6.9)	0.8 ~ 1.2	(5.8 ~ 8.6)
	8	1.25	2.21	(16.1)	2.0 ~ 3.0	(14.5 ~ 21.7)
	10	1.25	4.49	(32.5)	4.0 ~ 5.5	(28.9 ~ 39.8)
	10	1.5	4.29	(31.0)	3.7 ~ 5.2	(26.8 ~ 37.6)
	12	1.25 (ISO)	8.80	(63.6)	7.5 ~ 10.5	(54.2 ~ 75.9)
	12	1.5	7.78	(56.2)	7.0 ~ 9.0	(50.6 ~ 65.1)
	12	1.75	7.48	(54.1)	6.0 ~ 8.5	(43.3 ~ 61.4)
	13	1.5	10.17	(73.5)	8.0 ~ 12.0	(57.8 ~ 86.8)
	14	1.5	12.67	(91.6)	10.0 ~ 15.0	(72.3 ~ 108.5)
	14	2	11.86	(85.8)	9.5 ~ 14.0	(68.7 ~ 101.2)
	16	1.5	19.15	(138.5)	15.0 ~ 23.0	(108.5 ~ 166.2)
	16	2	18.11	(131.0)	14.0 ~ 22.0	(101.2 ~ 159.0)

Note: The above specified tightening torque is applicable only for female threads cut into steel material.
If the female threads are cut in other materials than steel, and also tightening surface are encountered to heat or vibrations, these specified tightning torque must be reconsidered.

MAIN PARTS TIGHTENING TORQUE

Tightening Parts		Tightening Torque kg-m (ft-lb)	
Cylinder block	Cylinder head	11.5 ~ 13.5	(83 ~ 98)
	Crankshaft bearing cap		
	Front, Second & Third	12.5 ~ 15	(90 ~ 108)
	Rear	10.5 ~ 13	(76 ~ 94)
	Oil pan	0.6 ~ 1.2	(4 ~ 9)
	Oil pump	1.0 ~ 1.6	(7 ~ 12)
Cylinder head	Lock support		
	10 mm bolts and nuts	3.4 ~ 4.1	(25 ~ 30)
	8 mm bolts	2.0 ~ 3.0	(14 ~ 22)
	Spark plug	1.5 ~ 2.1	(11 ~ 15)
	Manifold	2.0 ~ 3.0	(14 ~ 22)
Crankshaft	Flywheel	6.0 ~ 7.0	(43 ~ 51)
Connecting rod	Connecting rod cap	4.8 ~ 7.6	(35 ~ 55)
	Piston pin	5.4 ~ 7.0	(39 ~ 51)

RECOMMENDED LUBRICANT

LUBRICANT & CLASSIFICATION		PRODUCTS											
		AGIP	BP	CALTEX	CASTROL	CHEVRON	ESSO	MOBIL	SHELL	SUN	TEXACO	TOTAL	VALVOLINE
Engine Oil	API SD	F1 Woom 10W/40,20W/50 10W/20,30, 40/50	BP Super Viscostetic 5W/20,10W/40 20W/50 BP Energol HD Oil 10W,20W, 30,40	Custom Five Star Motor Oil 10W/30,10W/40 20W/40,20W/50	Castrol GTX 20W/50 Castrolite 10W/30	Chevron Supreme Motor Oil 5W/30,10W/30, 10W/40,20W/40 Chevron Special Motor Oil 10W,20W/20, 30,40,50	Esso Uniflo 5W/30,10W/40	Mobiloil Super 5W/30,10W/50 20W/50 Mobiloil 5W/20,10W, 20W/20, 20W/30, 30,40,50	Super Motor Oil 10W/30,20W/50	Sunoco Special 5W/30,10W/40, 20W/50 Sunoco Sunlube 10W,20W/20 30,40,50	Havoline Super Premium Motor Oil 5W/30,10W/40, 20W/50 Havoline Motor Oil 5W/20,10W/30, 10W/40,10W, 20W/20,30,40,50	Antigrade GTS 10W/30,10W/40, 20W/40,20W/50	All-climate Motor Oil HDB 10W/30,20W/40, 20W/50 Super HPO HDB 10W,20W,30,40, 50
	API SC			Five Star Motor Oil 10W,20W/20, 30,40,50			Esso Motor Oil 10W,20W, 30,40,50		X-100 5W,10W,20W, 30,40,50			Super HD 10W,20,30, 40,50	
Gear Oil (Transmission, Steering Gear Box Differential)	API GL-4	F1 Rotra Hypoid 90	BP Gear Oil EP 90	Universal Thuban 90	Castrol Hypoy 90	Chevron Multi-service Gear Lubricant 90	Esso Gear Oil GP 90	Mobilube GX 90	Spirax 90	Sun Dual-purpose Gear Oil 90	Universal Gear Lubricant EP 90	Extreme Pression 90	X-18 MD (GL-5) 80/90
Chassis Grease (Ball Joint)	NL G1 No. 1 or No. 2	F1 GR SM	BP Energrease L21M	Molytex Grease 2	Castrol MS3	Chevron Moly Grease 1 or 2	Beacon Q2	Molygrease Special	Retinax AM	Sunoco Multi-duty Grease 1M3 or 2M3	Molytex Grease 2	Multis MS	Special Moly Grease
Wheel Bearing Grease	NL G1 No. 2	F1 Grease 30	BP Energrease L2	Marfak Multi-purpose 2	Castrol LM	Chevron Multi-Motive Grease 2	Esso Multipurpose Grease	Mobilgrease MP or JL	Retinax A	Sunoco Prestige Grease 742EP	Marfak Multi-purpose 2	Multis	Lithium No. 2
Brake Fluid	SAE70R-3 (SAE J1703)	F1 Brake Fluid Super HD	BP Disc Brake Fluid	Caltex Heavy Duty Brake Fluid	Castrol Girling Brake Fluid (Green)	Atlas Special Heavy Duty Brake Fluid 550	Esso Brake Fluid HD400 ... (Far East) Esso Brake Fluid ... (Europe)	Mobil Super Heavy Duty Brake Fluid	Donax B	Sunoco Brake Fluid 550	Texaco Super Heavy Duty Motor Vehicle Brake Fluid	Brake Fluid	ake Fluid
Anti-freeze LLC Long Life Coolant		F1 Anti-freeze	BP Antifrost (LLC)	Startex Anti-freeze Coolant (LLC)	Castrol Anti-freeze	Atlas Permaguard Anti-freeze & Coolant (LLC)	Atlas Permaguard Anti-freeze ... (U.S.A.) (LLC) Esso-Rad Anti-freeze ... (Canada) (LLC) Esso Long Life Coolant ... (Far East) (LLC) Esso Anti-freeze ... (Europe)	Mobil Cooling System Conditioner (LLC)	Shellzone (LLC)	Sunoco Multi-Season Anti-freeze	Texaco Anti-freeze Coolant (LLC)	Antigel (LLC)	Permanent Anti-freeze & Coolant (LLC)
Brake Fluid ...(U.S.A)	DOT 3	Agip F1 Brake Fluid Super HD	BP Disc Brake Fluid	Caltex Heavy Duty Brake Fluid		Atlas Brake Fluid Super Heavy Duty 450	Atlas Brake Fluid HD450	Mobil Super Heavy Duty Brake Fluid		Sunoco Brake Oil 460	Texaco Super Heavy Duty Motor Vehicle Brake Fluid		

SERVICE SPECIFICATION

Engine Specification

Engine model		F
Engine type		Gasoline, 6-cylinder in line, 4 cycle OHV
Bore and stroke		90 x 101.6 mm (3.54 x 4.00 in)
Total piston displacement		3.878 cc (236.7 cu, in)
Compression ratio		7.8 to 1
Compression pressure (at 200 rpm)		10.5 kg/cm^2 (149.3 psi)
Valve Timing	Intake	Opens at B.T.D.C. 17° Closes at A.B.D.C. 53°
	Exhaust	Opens at B.B.D.C. 55° 40° Closes at A.T.D.C. 15° 30° for USA '73 model

Engine Tune-Up

Vehicle		FJ	FA
Fan belt deflection		7 ~ 10 mm (0.28 ~ 0.40") with 10 kg (22 lb)	
Battery specific gravity at 20°C (68°F)		1.260	
Cooling system capacity		15.2 liters (16.1 US qts.) (13.4 Imp. qts.)	19.1 liters (20.2 US qts.) (16.8 Imp. qts.)
Engine Oil Capacity	Oil pan	7.0 liters (7.4 US qts.) (13.4 Imp. qts.)	6.5 liters (6.9 US qts.) (5.7 Imp. qts.)
	Total	8.0 liters (8.5 US qts.) (7.0 Imp. qts.)	7.5 liters (7.9 US qts.) (6.6 Imp. qts.)
Distributor	Point gap	0.4 ~ 0.5 mm (0.016 ~ 0.020")	
	Dwell angle	41°	
	Condenser capacity	0.20 ~ 0.24μF	
Ignition timing (B.T.D.C.)		7°/500 rpm (7°/650 rpm for USA)	
Idle speed		500 rpm (650 rpm for USA)	

Engine model		F
Manifold vacuum at idle speed		460 mmHg (18.1 inHg) [420 mmHg (16.5 inHg) for USA]
Spark plug gap		0.7 ~ 0.8 mm (0.028 ~ 0.031")
Valve clearance (Hot)	Intake	0.20 mm (0.008")
	Exhaust	0.35 mm (0.014")
Compression pressure at 200 rpm		10.5 kg/cm^2 (149.3 psi)
Compression pressure limit		9.0kg/cm^2 (128 psi)
Difference of pressure between cylinders		less than 1 kg/cm^2 (14 psi)

Engine

CYLINDER BLOCK

Engine model		F
Cylinder bore diameter STD		89.995 ~ 90.045 mm (3.5431 ~ 3.5450")
Cylinder bore wear limit		0.2 mm (0.008")
Upper surface warpage limit		0.15 mm (0.006")
Valve lifter bore diameter	STD	25.147 ~ 25.172 mm (0.990 ~ 0.991")
	O/S 0.05	25.197 ~ 25.222 mm (0.992 ~ 0.993")
Cylinder liner	Outer diameter	94.16 ~ 94.21 mm (3.707 ~ 3.709")
	Inner diameter	94.06 ~ 94.10 mm (3.703 ~ 3.705")
	Installing pressure	2000 ~ 3000 kg (4.410 ~ 6.610 lb)
	Fitting tolerance	0.06 ~ 0.15 mm (0.0024 ~ 0.0060")

CYLINDER HEAD

Engine model	F
Cylinder head warpage limit	0.15 mm (0.006")
Valve seat contactiong width (IN)	1.4 mm (0.059")
(EX)	2.1 mm (0.059")
Valve seat refacing angle	45°
Valve seat correcting angle	15° 65°

PISTON, PISTON RING, PISTON PIN

Engine model			F
Outer diameter		STD O/S	89.955 ~ 90.005 mm (3.5415 ~ 3.5435") 0.25 mm 0.50 mm 0.75 mm 1.00 mm 1.50 mm
Cylinder to piston oil clearance			0.03 ~ 0.05 mm (0.0012 ~ 0.0020")
Piston pin installing temperature			40 ~ 60°C (100 ~ 140°F)
Piston ring end gap	Compression ring	No.1	0.20 ~ 0.40 mm (0.008 ~ 0.016")
		No.2	0.15 ~ 0.35 mm (0.006 ~ 0.014")
	Oil ring	No.1	0.15 ~ 0.35 mm (0.006 ~ 0.014")
		No.2	0.15 ~ 0.35 mm (0.006 ~ 0.014")
Piston ring to ring gloove clearance	Compression ring	No.1	0.03 ~ 0.07 mm (0.0012 ~ 0.0028")
		No.2	0.02 ~ 0.06 mm (0.0008 ~ 0.0024")
	Oil ring	No.1	0.02 ~ 0.06 mm (0.0008~ 0.0024")
		No.2	0.02 ~ 0.065 mm (0.0008~ 0.0026")

CONNECTING ROD

Bend or twist limit	0.1 mm (0.004")
Piston pin to bushing clearance Piston pin to bushing clearance limit	0 ~ 0.004 mm (0 ~ 0.00016") 0.05 mm (0.002")
Connecting rod thrust clearance Connecting rod thrust clearance limit	0.11 ~ 0.23 mm (0.004 ~ 0.009") 0.3 mm (0.012")
Bearing clearance Bearing clearance limit	0.02 ~ 0.06 mm (0.0008 ~ 0.0024") 0.1 mm (0.004")
Connecting rod bearing U/S	0.05 mm, 0.25 mm 0.50 mm 0.75 mm 1,00 mm

CRANKSHAFT

Bend limit		0.05 mm (0.002")
Crankshaft thrust clearance Crankshaft thrust clearance limit		0.06 ~ 0.16 mm (0.0024 ~ 0.0065") 0.3 mm (0.118")
Crankshaft journal oil clearance Crankshaft journal oil clearance limit Tapered and out-of-round limit		0.035 ~ 0.045 mm (0.0014 ~ 0.0018") 0.1 mm (0.004") 0.03 mm (0.0012")
Crankshaft journal diameter STD	Front Second Third Rear	66.97 ~ 67.00 mm (2.6366 ~ 2.6378") 68.47 ~ 68.50 mm (2.6957 ~ 2.6969") 69.97 ~ 70.00 mm (2.7547 ~ 2.7559") 71.47 ~71.50 mm (2.8138 ~ 2.8150")
Crankshaft bearing U/S		0.25 mm 0.50 mm 0.75 mm 1.00 mm
Crankpin diameter STD		53.98 ~ 54.00 mm (2.1252 ~ 2.1260")

CAMSHAFT

Engine model		F
Bend limit		0.05 mm (0.002")
Thrust clearance		0.085 ~ 0.147 mm (0.003 ~ 0.006")
Thrust clearance limit		0.2 mm (0.008")
Oil clearance		0.025 ~ 0.075 mm (0.0010 ~ 0.0030")
Oil clearance limit		0.15 mm (0.006")
Camshaft taper and out-of-round limit		0.05 mm (0.002")
Cam lobe height	(IN)	38.36 ~ 38.46 mm (1.510 ~ 1.514")
	(EX)	38.25 ~ 38.35 mm (1.506 ~ 1.510")
Cam lobe height limit	(IN)	38.0 mm (1.496")
	(EX)	37.9 mm (1.492")
Camshaft journal diameter	STD Front	47.955 ~ 47.975 mm (1.8880 ~ 1.8888")
	STD Second	46.455 ~ 46.475 mm (1.8289 ~ 1.8297")
	STD Third	44.955 ~ 44.975 mm (1.7699 ~ 1.7707")
	STD Rear	43.455 ~ 43.475 mm (1.7108 ~ 1.7116")
Camshaft bearing	U/S	0.125 mm 0.25 mm 0.50 mm

VALVE

Engine model		F
Valve head diameter	(IN)	46.0 mm (1.81")
	(EX)	37.5 mm (1.48")
Valve head contacing face angle		45°
Valve stem diameter	(IN)	7.970 ~ 7.985 mm (0.3138 ~ 0.3144")
	(EX)	7.960 ~ 7.975 mm (0.3134 ~ 0.3140")
Valve overall length	(IN)	124.5 ~ 125.1 mm (4.902 ~ 4.925")
	(EX)	124.7 ~ 125.3 mm (4.909 ~ 4.933")
Valve head edge thickness limit	(IN)	0.8 mm (0.031")
	(EX)	1.0 mm (0.039")
Valve correcting limit		0.5 mm (0.02")
Valve stem to bushing oil clearance	(IN)	0.025 ~ 0.060 mm (0.0010" ~ 0.0024")
	(EX)	0.035 ~ 0.070 mm (0.0014" ~ 0.0028")
Valve stem to bushing oil clearance limit	(IN)	0.10 mm (0.004")
	(EX)	0.12 mm (0.005")

VALVE GUIDE BUSHING

Engine model		F
Overall length	(IN)	54 mm (2.23")
	(EX)	59 mm (2.32")
Protrution from cylinder head		16.5 ~ 17.5 mm (0.65 ~ 0.69")
Finished inner diameter		8.01 ~ 8.03 mm (0.315 ~ 0.316")

VALVE LIFTER

Engine model		F
Outer diameter	STD	25.097 ~ 25.128 mm (0.9881 ~ 0.9894")
	O/S 0.05	25.147 ~ 25.178 mm (0.9902 ~ 0.9913")
Oil clearance		0.019 ~ 0.075 mm (0.0007 ~ 0.0030")
Oil clearance limit		0.1 mm (0.004")

VALVE SPRING

Engine model	F
Free length Installed length Installed pressure Installed pressure limit	51.5 mm (2.028") 43.0 mm (1.693") 32.5 kg (71.5lb) 27.0 kg (59.4lb)
Squareness limit	2.0 mm (0.079")

VALVE ROCKER SHAFT & ARM

Engine model	F
Valve rocker shaft outer diameter Valve rocker arm inner diameter	18.479 ~ 18.493 mm (0.7275 ~ 0.7280") 18.500 ~ 18.521 mm (0.7284 ~ 0.7292")
Valve rocker shaft oil clearance Valve rocker shaft oil clearance limit	0.007 ~ 0.042 mm (0.0003 ~ 0.0016") 0.10 mm (0.0039")

Timing Gears

Engine model	F
Timing gear backlash	0.05 mm ~ 0.125 mm (0.002 ~ 0.005")
Timing gear backlash limit	0.20 mm (0.008")
Camshaft timing gear run-out limit	0.20 mm (0.008")

FLYWHEEL

Engine model	F
Run-out limit	0.20 mm (0.008")

MANIFOLD

Engine model	F
Manifold installing surface warpage limit	2.0 mm (0.08")

Lubrication

OIL PUMP

Engine model		F
Oil pump type		Gear type
Delivery quantity	per minute at 1000 rpm of pump at 50 ~ 60°C (122 ~ 140°F) at 1 kg/cm² (14.2 psi)	More than 16 liters (17 US qts., 14 Imp. qts.)
Drive shaft diameter Driven shaft diameter		13.985 ~ 14.000 mm (0.5506 ~ 0.5512") 13.961 ~ 13.968 mm (0.5496 ~ 0.5499")
Drive shaft to body clearance Driven shaft to gear clearance		0.014 ~ 0.057 mm (0.0006 ~ 0.0022") 0.014 ~ 0.042 mm (0.0006 ~ 0.0016")
Gear backlash Gear backlash limit		0.045 ~ 0.065 mm (0.0018~ 0.0026") 0.95 mm (0.037")
Gear teeth to body clearance Gear teeth to body clearance limit		0.025 ~ 0.105 mm (0.0010~ 0.0041") 0.2 mm (0.008")
Gear to pump cover clearance Gear to pump cover clearance limit		0.03 ~ 0.09 mm (0.0012 ~ 0.0035") 0.15 mm (0.006")

OIL PRESSURE REGULATOR

Engine model	F
Opening pressure	3.1 ~ 3.5 kg/cm² (44.3 ~ 50.0 psi) at 2400 rpm of engine at 80°C (176°F)

OIL FILTER

Engine model	F
Filter type Filter method Capacity	Paper element Partial flow 0.8 liters (0.85 US qts., 0.70 Imp. qts.)

Cooling System

RADIATOR

Engine model		F
Type		Pressure cooling corregated fin and tube type
Radiator coolant capacity	FJ 40.43.45 FJ 55-V FA series	5.0 liters (1.3 US gals., 1.1 Imp. gal.) 5.2 liters (1.4 US gals., 1.1 Imp. gal.) 9.0 liters (2.4 US gals., 2.0 Imp. gal.)
Radiator cap opening pressure	FA FJ series	0.5 kg/cm^2 (7 psi) 0.9 kg/cm^2 (12.8 psi)

THERMOSTAT

Engine model	F
Thermostat type Thermostat valve opening temperature. Thermostat valve opening travel	Wox pellet element type Starts to open at 74.5 ~ 78.5°C (166 ~ 173°F) Fully open at 90°C (194°F) 10 mm (0.39")

WATER PUMP

Engine model	F
Type Delivery capacity Rotor to body clearance	Centrifugal type 140 liters (37 US gals., 31 Imp. gals.) per minute at 2,500 rpm at 70°C (158°F) 0.3 ~ 0.7 mm (0.012 ~ 0.027")

Fuel System

FUEL PUMP

Engine model	F
Type Discharge pressure Suction vacuum	Diaphragm 0.24 ~ 0.34 kg/cm^2 (3.4 ~ 4.8 psi) −500 mmHg (19.7 inHg)

CARBURETOR

Vehicle		FJ, FA	FJ (For U.S.A.)
Type		Down-draft, two-barrel	same
Air hone outer diameter	mm (in)	78.0 (3.07)	same
Main Nozzle diameter			
Primary	mm (in)	2.8 (0.11)	3.0 (1.12)
Secondary	mm (in)	2.8 (0.11)	3.0 (1.12)
Venturi diameter Primary – Main	mm (in)	28.0 (1.10)	same
– Small	mm (in)	17.5 x 9.0 (0.69 x 0.35)	same
Secondary – Main	mm (in)	31.0 (1.22)	same
– Small	mm (in)	10.0 (0.39)	17.5 x 9 (0.70 x 0.36)
Throttle bore diameter			
Primary	mm (in)	38 (1.50)	same
Secondary	mm (in)	38 (1.50)	same
Main jet diameter			
Primary	mm (in)	1.16 (0.0457)	1.18 (0.0465)
Secondary	mm (in)	2.0 (0.0787)	1.8 (0.0709)
Slow jet diameter			
Primary	mm (in)	0.5 (0.019)	same
Secondary	mm (in)	0.5 (0.019)	0.8 (0.031)
Economizer jet diameter	mm (in)	1.2 (0.047)	same
Pump jet diameter	mm (in)	0.5 (0.019)	same
Power jet diameter	mm (in)	0.9 (0.035)	0.7 (0.027)
Main air bleed diameter			
Primary	mm (in)	0.5 (0.019)	1.0 (0.039)
Secondary	mm (in)	0.5 (0.019)	1.0 (0.039)
Slow air bleed diameter			
Primary No.1	mm (in)	0.85 (0.0335)	0.9 (0.035)
Primary No.2	mm (in)	1.0 (0.039)	1.3 (0.05)
Secondary	mm (in)	1.0 (0.039)	same
Power piston operating vacuum	mmHg (inHg)	–60 ~ –80 (–2.36 ~ –3.15)	same
Float level			
Raised position (from air horn fitting surface)	mm (in)	4.1 (0.161)	same
Lowered position (between needle valve push pin and float tab)	mm (in)	1.0 (0.039)	same
Fuel level (from body upper surface)	mm (in)	20 (0.79)	same
Accelerating pump stroke	mm (in)	8 (0.31)	same

Vehicle	FJ, FA	FJ (For U.S.A.)
High speed valve to bore clearance mm (in)	1.0 (0.039)	same
Fast idle When the choke valve is fully closed, primary throttle valve open angle from fully closed position	12°	same
Mixture adjusting screw preset position Screw out about 1-1/4 turns		

Engine Electrical System

DISTRIBUTOR

Engine model	F	F (For U.S.A.)
Condenser capacity	0.20 ~ 0.24μF	
Breaker point spring tension	400 ~ 550g (14 ~ 19 OZ)	
Breaker point gap	0.4 ~ 0.5 mm (0.016 ~ 0.020")	
Dwell angle	41°	
Carbon piece length	9 mm (0.394")	
Carbon piece length limit	7 mm (0.276")	
Distributor shaft run-out	0.05 mm (0.002")	
Distributor shaft thrust clearance	0.15 ~ 0.50 mm (0.006 ~ 0.020")	
Breaker plate operating resistance	less than 500 g (17.6 OZ)	

Engine model	F		F (For U.S.A.)	
	mmHg	Advance angle	mmHg	Advance or retard angle
Vacuum advance angle * For 73 model FJ, see poge 9-17.	−90 ~ −110 −200 −300	Advance begins 4~ 6° 7.5~ 9.5°	−30 ~ −70 −90 −110	Retard begins 5° Max. 3° Max.
	rpm	Advance angle	rpm	Advance angle
Governor advance angle	400 ~ 500 900 1600	Advance begins 8~ 10° 14~ 16°	400 ~ 580 980 1800	Advance begins 6.7° 14 ~ 16°

STARTER

Engine model		F
Motor type		Direct current, series wound w/magnetic switch
Rating voltage & output power		12 volts, 1.3 kw
Rating time		30 seconds
Direction of revolution		Clockwise as seen from pinion side
Number of poles		4
Number of pinion teeth		9
No-load characteristic:	Voltage	At 11 volts
	Amperage	Less than 50 ampers
	Revolution	More than 5000 rpm
Load characteristic	Voltage	At 9.5 volts
	Torque	At 0.8 kg-m (5.79ft-lb)
	Amperage	Less than 240 amperes
	Revolution	More than 1200 rpm
Lock characteristic	Voltage	At 7.0 volts
	Amperage	Less than 600 amperes
	Torque	More than 1.8 kg-m (13.0 ft-lb)
Armature shaft bushing inner diameter STD		12.54 ~ 12.56 mm (0.4937 ~ 0.4945")
Armature shaft to bushing clearance		0.10 ~ 0.14 mm (0.0039 ~ 0.0055")
Armature shaft to bushing clearance limit		0.2 mm (0.008")
Armature shaft thrust clearance		0.05 ~ 0.35 mm (0.002 ~ 0.013")
Armature shaft thrust clearance limit		0.8 mm (0.031")
Commutator outer diameter limit		31 mm (1.22")
Commutator out-of-round limit		0.3 mm (0.012")
Commutator mica depth		0.5 ~ 0.8 mm (0.020 ~ 0.031")
Commutator mica depth limit		0.2 mm (0.008")
Brush length		19 mm (0.748")
Brush length limit		12 mm (0.472")
Spring installed tension		1050 ~ 1350 g (37 ~ 47 oz)
Spring installed tension limit		600 g (21 oz)
Magnetic switch moving stud length		34 mm (1.34")
Pinion to stop collar clearance		1 ~ 3 mm (0.04 ~ 0.12")

ALTERNATOR

Engine model	F
Nominal voltage	12 volts
Max. output current	40 ampers
Ground	Negative
Direction of revolution	Clockwise as seen from pulley
Coil connection	Three-phase, "Y" type
Rectifying method	All-wave rectified, built-in six diodes
Rotor coil resistance	4.2Ω
Brush protruded length limit	5.5 mm (0.22")
No-load revolution (normal temp.)	14 volts, 0 ampere 800±150 rpm
Output revoluton (normal temp.)	14 volts, 40 amperes, less than 3500 rpm

ALTERNATOR REGULATOR

Engine model	F
Voltage regulator regulating voltage	13.6 ~ 14.6 volts
Voltage regulator mechanical adjusting values:	
Angle gap (actuated)	Over 0.2mm (0.008")
Armature gap	Over 0.3mm (0.012")
Point gap	0.25 ~ 0.45 mm (0.01 ~ 0.18")
Contact pressure	Over 180 g (6.3 oz)

IGNITION COIL

Engine model	F	F (For USA)
Primary coil registance	3 ~ 4 ohms	1.3 ~ 1.4 ohms
Secondary coil registance	6750 ~ 8250 ohms	13500 ~ 16500 ohms
Resister registance	——	1.3 ~ 1.7 ohms

SPARK PLUG

Engine model		F
Spark plug type	Denso	W17ES
	NGK	B5ES
Spark plug gap		0.7 ~ 0.8 mm (0.028 ~ 0.031")

HIGH TENSION WIRES

Engine model	F
Wire end to end resistance limit	25kΩ

BATTERY

Engine model	F
Electrolyte specific gravity at 20°C (68°F) 1.250 ~ 1.270 1.210 1.160 1.110 1,060	 100% charged state 75% charged state 50% charged state 25% charged state Fully discharged
Voltage	12V

* Remarks

Distributor Charasteristic (For '73 FJ Series W/AI System) :

Distributor Vacuum Retard Angle	Vacuum inHg 6.3 7.48	Retard Angle Retard Begins 3°
Distributor Governor Advance Angle	Dis-rpm 450 900 1800	Advance Angle Advance Begins 7.0° 15.0°

Prepared by

TOYOTA MOTOR SALES CO., LTD.

Export-Technical Depertment

Haruhi Plant

Haruhi-mura, Nishikasugai-gun

Aichi pref. Japan

First printing

June 1972

No. 98087

Printed in Japan

TOYOTA
SERVICE

No. 98087

REPRINTED IN U.S.A. 9/88