

**TOYOTA**

**12R ENGINE**

**REPAIR MANUAL**

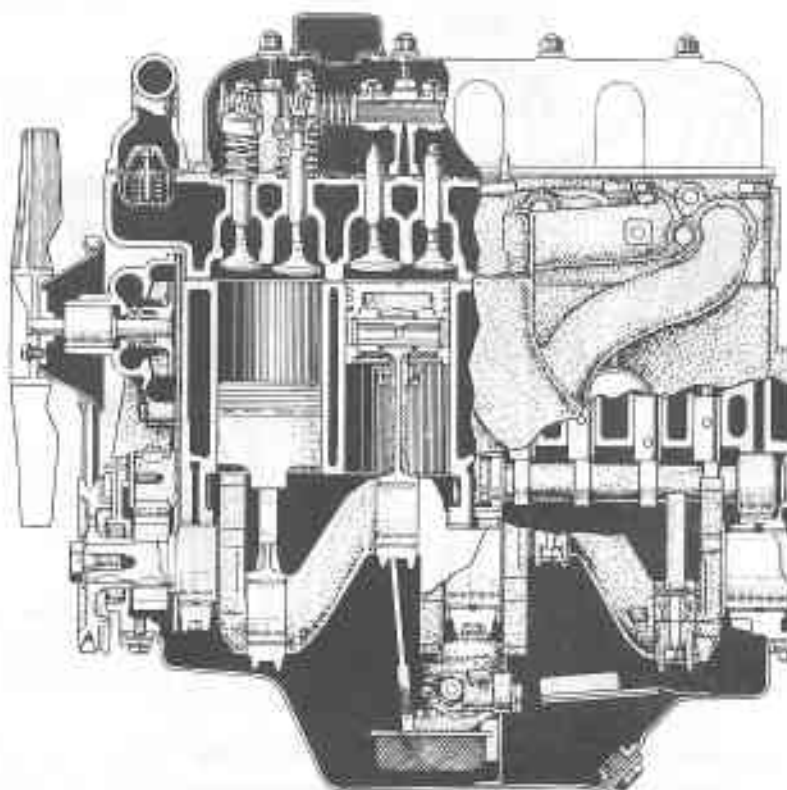
**INCLUDES 2R**

**TOYOTA MOTOR SALES CO., LTD.**

# SECTION INDEX

| NAME                               | SECTION   |
|------------------------------------|-----------|
| <b>GENERAL INFORMATION</b>         | <b>1</b>  |
| <b>ENGINE TUNE-UP</b>              | <b>2</b>  |
| <b>ENGINE</b>                      | <b>3</b>  |
| <b>INTAKE &amp; EXHAUST SYSTEM</b> | <b>4</b>  |
| <b>FUEL SYSTEM</b>                 | <b>5</b>  |
| <b>LUBRICATING SYSTEM</b>          | <b>6</b>  |
| <b>COOLING SYSTEM</b>              | <b>7</b>  |
| <b>CHARGING SYSTEM</b>             | <b>8</b>  |
| <b>STARTING SYSTEM</b>             | <b>9</b>  |
| <b>IGNITION SYSTEM</b>             | <b>10</b> |
| <b>SPECIFICATIONS</b>              | <b>11</b> |

## GENERAL

*Fig. 1-1 Cross Sectional Side View*

Y5500

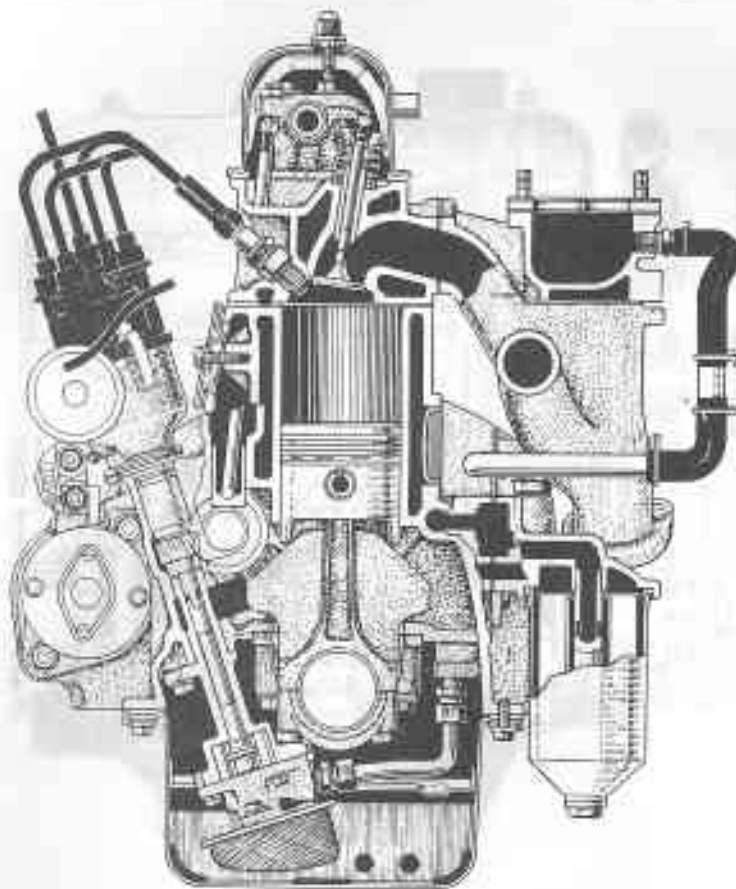
The 2R or 12R engine equipped on the Toyota Corona series, Toyota Hi-Ace, Toyota Hi-Lux and Toyota Toyo-Ace series is of a four-cylinder over-head valve square type.

The construction of the engine equipped on the each vehicle is the same, but their related specification slightly differ. Therefore, the specification for each engine is separately described in the general specification.

The cylinder head assembly is composed of the head with the valve guides, valves, dual type valve springs, rocker arms, shaft and supports, spark plugs, thermostat, water outlet, thermostat case and the intake and exhaust manifolds.

The two-barrel type carburetor is mounted onto the intake manifold. The carburetor equipped on the Corona series is provided with the automatic choke, while the carburetor equipped on the Light-Truck is provided with the manual type choke.

The cylinder block and upper crankcase are integral cast with passages in the block for cooling the entire length of the cylinders. The block forms the major portion of the engine with crankshaft, camshaft, pistons and other related components.



*Fig. 1-2 Cross Sectional Front View*

Y5501

The crankshaft which is either the forged or cast iron type is statically and dynamically balanced to contribute to smooth operation of the engine especially at high speeds. The crankshaft is supported with the three precision type bearing inserts and bearing caps with the center bearing serving as a thrust bearing.

The camshaft is of cast iron with the cam lobe surfaces chill treated, and is offset from the valve lifter to eliminate the wear of the cam. The camshaft is supported with the three precision type bearings which are replaceable for service. The camshaft bearing journals and the cam lobe surfaces are precision finished for quiet and efficient operation of the valves.

The connecting rods are of "I" beam section forged steel with a bronze piston pin bushing at the small end and precision type bearing inserts for the large end.

The pistons are of light alloy and have slightly oval shaped skirts so as to provide closer fit at operating temperature. The piston pin holes are offset 1.5 mm or 0.059" toward the camshaft to provide smooth operation. Three piston ring grooves are cut above the piston pin boss.

The piston rings consist of two compression rings and one oil ring.

The crankshaft pulley drives the water pump, fan and alternator with a V-belt. The distributor is mounted on the right side of the engine which is driven by the camshaft integral gear.

The oil pump is mounted to the lower end of the distributor shaft, and rotates at the same speed as the distributor.

The fuel pump is mounted on the right side of the engine, and is operated by the integral cam of the camshaft.

The valve rocker arm cover is provided with an air inlet cap which is also an oil filter cap.

The intake manifold is of a circular section, and is of an aluminum cast. The main passage is designed to be level when the engine is mounted.

The flywheel is of a high grade cast iron, and is attached onto the rear end of the crankshaft with six bolts. The ring gear is fitted outside of the flywheel to provide the meshing with the starter motor pinion. The flywheel is also statically and dynamically balanced to minimize the engine vibration. The rear surface is smooth machine finished for proper contact with the clutch disc.

### Precaution

Whenever any work is performed on the customer's car, special care should be taken to prevent scratching the body, fender or spoiling the seats or door trim. To perform a satisfactory work, fender covers and seat covers must be utilized during the operation.

The use of Special Service Tools must be emphasized as these tools are so designed to prevent damaging of the components, and also will quicken the work.

During disassembling of any component, it is essential that parts disassembled from the car or main assembly should be placed in sequence to facilitate the final inspection and assembly. Certain mating parts should be marked before disassembling from the main assembly to identify the mating position or for balancing with the main assembly.

Service Torque Specifications should be adhered whenever tightening the bolts or nuts specified with torque.

## GENERAL SPECIFICATION

| ITEMS                   | 2R ENGINE                                        | 12R ENGINE                      |
|-------------------------|--------------------------------------------------|---------------------------------|
| Type                    | 4 cylinder in line, 4-cycle O.H.V.               | Same as left                    |
| Bore x Stroke           | 78 x 78 mm (3.07 x 3.07")                        | 80.5 x 78 mm (3.17 x 3.07")     |
| Piston displacement     | 1490 c.c. (90.9 cu.in.)                          | 1587 c.c. (96.8 cu.in.)         |
| Compression ratio       | 8.3 to 1                                         | 8.5 to 1                        |
| Compression pressure    | 11.0 kg/cm <sup>2</sup> (155 psi) at 250 rpm     | Same as left                    |
| Max. horse-power (SAE)  | 82 HP at 5200 rpm                                | 90 HP at 5400                   |
| Max. torque (SAE)       | 12.4 m-k (90 ft-lb) at 2800 rpm                  | 13.5 m-k (98 ft-lb) at 3000 rpm |
| Number of piston rings: |                                                  |                                 |
| Compression             | Two                                              | Same as left                    |
| Oil                     | One                                              | Same as left                    |
| Valve clearance:        |                                                  |                                 |
| Intake (hot)            | 0.203 mm (0.008")                                | Same as left                    |
| Exhaust (hot)           | 0.356 mm (0.014")                                | Same as left                    |
| Ignition timing         | 8° B.T.D.C. at 550 rpm                           | Same as left                    |
| Firing order            | 1-3-4-2                                          | Same as left                    |
| Spark plug size         | 14 x 19 mm (0.55 x 0.75")                        | Same as left                    |
| Spark plug gap          | 0.8 mm (0.031")                                  | Same as left                    |
| Air cleaner type        | Felt element (RT),<br>Paper element (RH, RN, RY) | Same as left                    |
| Carburetor type         | Down-draft, two barrel                           | Same as left                    |
| Fuel pump type          | Diaphragm                                        | Same as left                    |
| Fuel filter type        | Glass ball type (old),<br>Cartridge type (new)   | Same as left                    |
| Oil pump type           | Trochoid                                         | Same as left                    |
| Oil filter element      | Paper                                            | Same as left                    |
| Oil capacity:           |                                                  |                                 |
| Crank case              | 3.5 liter (3.7 US qts, 3.1 Imp.qts)              | Same as left                    |
| Oil filter              | 0.8 liter (0.85 US qts, 0.70<br>Imp.qts)         | Same as left                    |
| Radiator type           | Corrugated fin and tube                          | Same as left                    |
| Water pump type         | Centrifugal                                      | Same as left                    |
| Thermostat type         | Wax                                              | Same as left                    |
| Battery                 | 12 volt, 35 ~ 50 AH                              | Same as left                    |
| Alternator              | 12 volt, 0.48 kW                                 | Same as left                    |
| Starter                 | 12 volt, 1.1 ps                                  | Same as left                    |
| Coolant capacity:       |                                                  |                                 |
| PT & RY                 | 7.0 liters (7.4 US qts, 6.2 Imp.qts)             |                                 |
| RH                      | 6.7 liters (7.1 US qts, 5.9 Imp.qts)             |                                 |
| RN                      | 6.5 liters (6.9 US qts, 5.7 Imp.qts)             |                                 |
| Fuel tank capacity:     |                                                  |                                 |
| RT, RH                  | 45 liters (11.9 US gal, 9.9 Imp.gal)             |                                 |
| RN                      | 46 liters (12.1 US gal, 10.1 Imp.gal)            |                                 |
| RY                      | 50 liters (13.2 US gal, 11.0 Imp.gal)            |                                 |

**RECOMMENDED SPECIAL SERVICE TOOLS****Engine**

|             |                                           |
|-------------|-------------------------------------------|
| 09850-00030 | Engine Adjust Kit                         |
| 09303-35010 | Input Shaft Front Bearing Puller          |
| 09213-60014 | Crankshaft Pulley & Gear Puller           |
| 09201-60010 | Valve Guide Bushing Remover & Replacer    |
| 09222-30010 | Connecting Rod Bushing Remover & Replacer |
| 09210-31011 | Timing Gear Tool Set                      |
| 09215-31010 | Camshaft Bearing Remover & Replacer       |
| 09304-30012 | Input Shaft Front Bearing Replacer        |
| 09301-36010 | Clutch Guide Tool                         |
| 09214-60010 | Crankshaft Pulley and Gear Replacer.      |

**Carburetor**

|             |                             |
|-------------|-----------------------------|
| 09860-11010 | Carburetor Screwdriver Set  |
| 09240-00010 | Carburetor Adjust Gauge Kit |

**Water Pump**

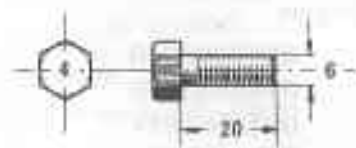
|             |                                       |
|-------------|---------------------------------------|
| 09235-20011 | Water Pump Pulley Seat Puller         |
| 09239-31010 | Water Pump Rotor Puller               |
| 09238-40010 | Water Pump Bearing Remover & Replacer |

**Alternator**

|             |                              |
|-------------|------------------------------|
| 09286-46011 | Injection Pump Spline Puller |
| 09325-12010 | Transmission Oil Plug        |

**Standard Bolt**

91111 - 40620 — Parts 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 <sup>2</sup> ) | 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 <sup>2</sup> )      | more than 30 | more than 45 | more than 60 |

**Specified Torque for Standard Bolt**

| Class | Basic Dia. | Pitch      | Standard Torque<br>m·kg (ft·lb) | Torque Limit: m·kg (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 ( 13.7 ~ 22.4)     |
|       | 10         | 1.5        | 2.14 ( 15.5)                    | 1.8 ~ 3.0 ( 13.0 ~ 21.7)     |
|       | 12         | 1.25 (150) | 4.40 ( 32.8)                    | 3.5 ~ 5.5 ( 35.3 ~ 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 ~ 11.0 ( 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         | 2.25 (150) | 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)                    | 7.0 ~ 10.5 ( 50.6 ~ 75.9)    |
|       | 14         | 2          | 9.50 ( 68.7)                    | 7.5 ~ 11.0 ( 54.2 ~ 79.6)    |
|       | 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)  |
| 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 (150) | 8.80 ( 63.5)                    | 7.5 ~ 10.5 ( 54.2 ~ 75.8)    |
|       | 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 a 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 tightening torque must be reconsidered.



## General

In order to maintain the full performance originally built in the engine, a periodic engine tune-up is essential. If any deficiency is encountered during operation of the car, 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 instrument, and well trained mechanics. The compression ratio has increased, also incorporates a numerous electrical equipment, and other components which can only be taken care with special knowledge and proper care. In order to accomplish the work correctly, and properly, a reliable tune-up equipment are necessary. The procedures described in the following orders should be carefully studied.

To perform the engine adjustment, it is recommended to use the Engine Adjust Kit 09850-00030. This Kit contains the oil stone for breaker points dressing, open-end wrench (7 mm x 8 mm) for the distributor primary lead wire terminal nuts, spark plug gap gauge (0.8 mm x 0.9 mm) and the feeler gauge including for the point gap and the valve clearance adjustments.

## Inspection & Adjustment

### Battery

1. Inspect the specific gravity with a hydrometer.

The specific gravity of fully charged battery should be 1.260 at 20°C (68°F). If the gravity proves to be more than 1.230, there is no need to charge the battery.

If it shows gravity of 1.190 ~ 1.230 the battery must be charged with a quick charger.

At this time, the battery ground cable must be removed from the battery terminal as the car is equipped with the alternator.

If the gravity is less than 1.190, the battery must be removed from the car for proper servicing of the battery station.

If there is a difference of more than 0.025 between the gravity values measured in each cell at fully charged condition, the battery should be serviced at the battery service station.

2. Check the electrolyte level in the battery cells.

Normal electrolyte level should be about 10 mm (0.4") above the plates.

If necessary, replenish the cells with

distilled water.

3. Check the terminals for corrosion and defective connection.

Clean and tighten them if necessary.

4. Check the battery case for cracks or other damage.

If defective, replace the battery.

5. Clean the top of the battery, and apply grease onto the terminals to retard further corrosion.

### Engine Oil

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

2. Check the oil for deterioration, and if excessively dirty, replace the oil.

If the coolant or gasoline is present within the oil, it must be diagnosed, and proper care should be taken.

The recommended engine oil to be utilized should be above SC, SD class (API service classification) with proper oil viscosity.

Engine oil capacity with oil filter:

4.3 liters (4.6 US qts, 3.8 Imp. qts)

**Coolant**

1. Check the cooling system for leak, soft hoses, loose hose clamps and correct coolant level.

Replenish with drinkable water if necessary.

2. Use a reliable brand anti-freeze in cold weather.

Cooling system capacity:

RT RY series:

7.0 liters (7.4 US qts, 6.2 Imp. qts)

RH series:

6.7 liters (7.1 US qts, 5.9 Imp. qts)

RN series:

6.5 liters (6.9 US qts, 5.7 Imp. qts)

**Fan Belt (V-belt)**

1. Check the fan belt for cracks, stretch and wear, and if defective, replace the fan belt.

2. Check and adjust if necessary to correct tension.

The specified tension is 8~13 mm (0.31~0.51") when depressed at midway of the belt with 10 kg (22 lb).

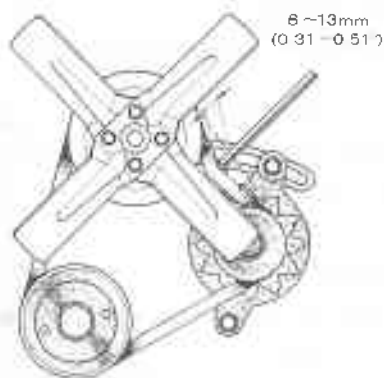


Fig. 2-1 Checking Fan Belt Tension G0850

**Fuel Filter (Glass bowl type)**

1. Check the fuel filter bowl for crack, and check the body for deformation.

Replace as necessary.

2. Clean the element if excessively dirty, and check for damage.

Replace the element with the Kit if necessary.

**Air Cleaner**

1. Clean the element with compressed air of low pressure.

Replace the element if damaged or excessively dirty.

2. Clean the inside of the air cleaner case, and check the seal washer and the gaskets.

If defective, replace as necessary.

**Spark Plugs**

1. Check each plug individually for excessive electrodes wear, glazed, broken or blistered porcelain.

Replace the plugs if necessary.

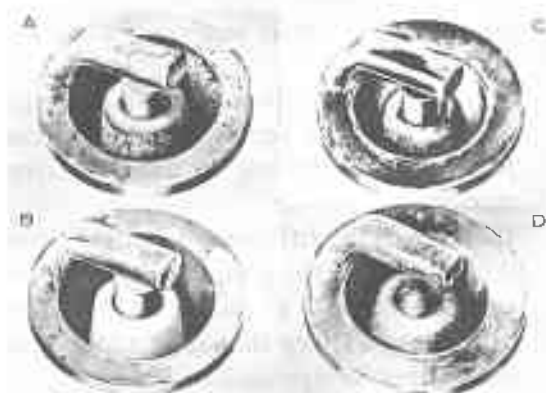
2. Clean the spark plugs thoroughly using a sand blast cleaner.

When cleaning with the abrasive cleaner, do not prolong the cleaning to prevent porcelain damage.

3. Check each spark plug for make and heat range.

All spark plugs must be of same make and also with the same heat range.

If excessive carbon deposits are observed on the insulation tip, replace with a hot range type spark plugs.



- A indicates normal condition
- B indicates overheating
- C indicates carbon deposits
- D indicates abnormal wear

Fig. 2-2 Spark Plug Conditions

V2204

If the spark plugs show burning white or rapid electrode wear, replace with a cold range type.

4. Adjust the spark plug gap by bending the ground electrode to obtain the specified gap of 0.8 mm or 0.031" with the spark plug gauge.

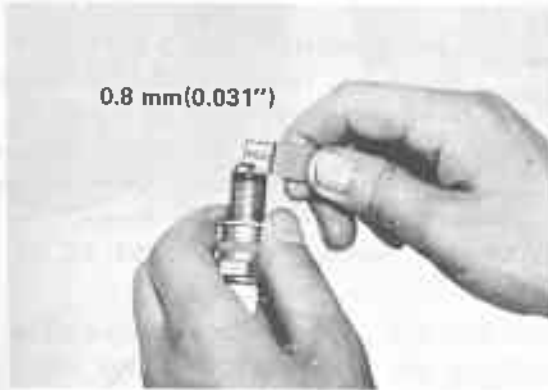


Fig. 2-3 Adjusting Plug Gap

V2165

### Distributor

1. Clean the distributor cap, and inspect for crack, carbon track, and burnt or corroded terminals.
2. Clean the rotor, and check for damage. Replace the rotor if defective.
3. Check the distributor centrifugal advance mechanism by turning the rotor in the clockwise direction as far as possible with the fingers, and see if the rotor returns to its original 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 selector to see if the selector returns to its retarded position. Any stiffness in the operation of the vacuum advancer mechanism will affect the ignition timing. Correct any interference or binding.
5. Clean the breaker points with a point file if necessary. If the points are excessively burnt or pitted, replace the breaker points, and it is recommended that the condenser capacity should be checked.
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 (14.1 ~ 19.4 oz).
7. Check and adjust the point gap. The gap should be 0.45 mm or 0.018".
8. Check the cam dwell angle with the tester. The angle is 50 ~ 54°.
9. Lubricate the "A" portions of the cam lobes shown in the figure, breaker arm



Fig. 2-4 Checking Centrifugal Advancer

V3208



Fig. 2-5 Lubricating Portions

B0737

rubbing block, breaker arm pivot and the distributor shaft hollow portion with Distributor Grease, and the "B" portion of the distributor shaft oil cap and the octane selector sliding surface with engine oil.

### Ignition Timing

1. Inspect the ignition timing using a timing light with the engine at idling speed, and adjust so that the timing pointer will align with the timing ball. At this time, the octane selector must be set at zero advance.

The ignition timing is  $8^{\circ}$  BTDC at 550 rpm.

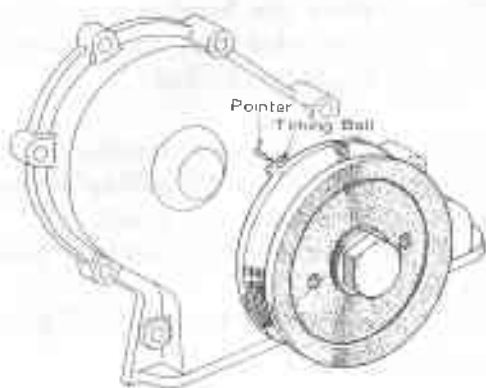


Fig. 2-6 Ignition Timing Mark

G0853

2. To adjust, loosen the distributor clamp bolt, and then turn the distributor housing in the direction required to align the timing marks.

To advance the timing, turn the distributor housing counterclockwise, and to retard the timing, turn it clockwise.

### Octane Selector

1. Depending on the gasoline octane rating, the ignition timing must be adjusted. To test, run the car at 25 to 30 kph (16 ~ 19 mph) in top gear, and depress the accelerator pedal all the way to the floor.
2. If the engine has a slight ignition ping, and it fades out gradually as the car picks up the speed, the ignition timing is

correct.

If the engine pings excessively, turn the octane selector toward the "R" mark to retard the timing.

If the engine does not ping, turn the adjuster toward the "A" mark to advance the timing.

### Note:

- a. One graduation of the adjuster is equal to  $10.4^{\circ}$  of the crankshaft angle.
- b. The octane selector has no relation with the characteristic of the vacuum advancer.

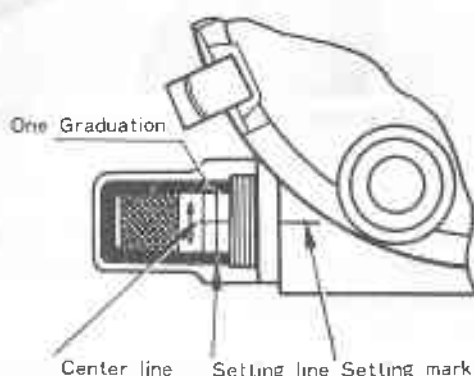


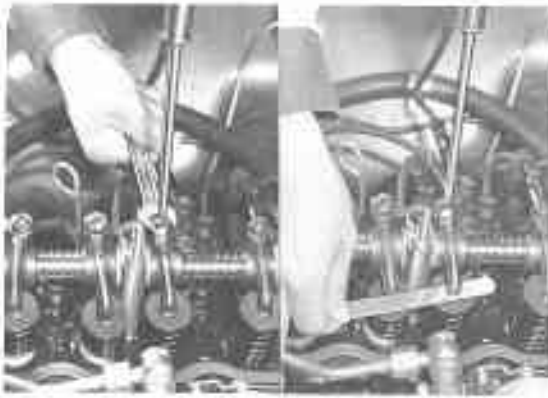
Fig. 2-7 Octane Selector

G0340

### Valve Clearance

1. Warm up the engine till the coolant temperature reaches  $75 \sim 85^{\circ}\text{C}$  ( $167 \sim 185^{\circ}\text{F}$ ).
2. Tighten the cylinder head bolts and the rocker shaft support bolts to specified torque.  
Specified torque:  
Cylinder head bolts:  
 $10.3 \sim 11.7 \text{ m}\cdot\text{kg}$  ( $74.1 \sim 84.2 \text{ ft}\cdot\text{lb}$ )  
Rocker shaft support bolts:  
 $1.8 \sim 2.5 \text{ m}\cdot\text{kg}$  ( $13 \sim 18 \text{ ft}\cdot\text{lb}$ )
3. Set the engine at idling speed to about 550 rpm, and inspect the valve clearance between the rocker arm and the valve stem with a feeler gauge.  
The specified clearance is 0.203 mm

(0.008") for the intake side, and 0.360 (0.014") for the exhaust side.



*Fig. 2-8 Adjusting Valve Clearance* V3214  
V3215

4. To adjust, loosen the lock nut, and turn the adjusting screw until the specified clearance is obtained.  
Tighten the lock nut securely after adjustment, and recheck the clearance.

### Carburetor

1. Check if the fuel level aligns with the line on the level gauge glass at engine idling.  
If the level is incorrect, check and adjust or repair the float level, fuel pump outlet pressure and the needle valve seating.
2. Adjust the engine idling speed as the following procedures.  
The adjustment of the engine idling should be performed with the air cleaner installed.
  - a. Remove the intake manifold suction hole plug, and install the adapter to connect the vacuum gauge.  
Connect the vacuum gauge hose to the adapter.
  - b. Connect a tachometer onto the ignition coil.
  - c. Turn the throttle adjusting screw until the engine operates smoothly without stalling at lowest possible revolution.

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

The engine idling speed should be approximately 550 rpm, and the vacuum reading should be more than 400~500 mmHg (15.6 to 19.5 inHg).

### Note:

Adjust the engine idling speed at the "D" range for the car equipped with the Toyoglide Automatic transmission.

3. Check the acceleration pump.  
To check, remove the air cleaner on RT & RN series and the air intake connector on RH & RY series.  
Next, open the throttle valve completely from the closed position, and observe the condition of the fuel spray from the pump jet.
4. On RT series, check the automatic choke set position.  
If necessary, adjust the choke by referring to the Carburetor in Fuel System.  
On RH, RN and RY series, check if the choke valve opens and closes smoothly.

### Compression Test

1. After warming up the engine to operating temperature, remove all spark plugs.
2. Disconnect the secondary wire from the ignition coil to cut-off the secondary circuit.
3. Insert a compression gauge into the spark plug hole, open the throttle valve fully, and measure the compression of each cylinder.  
Always use a fully charged battery to obtain the engine revolution of more than 250 rpm.

4. The specified compression pressure should be more than  $11.0 \text{ kg/cm}^2$  (156 psi) at 250 rpm, and the limit is  $8.0 \text{ kg/cm}^2$  (115 psi).

The difference of the compression reading between the cylinders should be within  $0.7 \text{ kg/cm}^2$  (10 psi).

\*\*\*\*\*

## ENGINE

|                                       |      |
|---------------------------------------|------|
| TRouble SHOOTING .....                | 3- 1 |
| MAJOR SERVICE .....                   | 3- 5 |
| Removal .....                         | 3- 5 |
| On RH, RY series .....                | 3- 5 |
| On RT, RN series .....                | 3- 6 |
| Disassembly .....                     | 3- 7 |
| Inspection & Repair .....             | 3-10 |
| Cylinder head .....                   | 3-10 |
| Valve seat .....                      | 3-11 |
| Valve guide bushing .....             | 3-12 |
| Valve .....                           | 3-13 |
| Valve spring .....                    | 3-13 |
| Valve rocker arm & rocker shaft ..... | 3-14 |
| Valve lifter .....                    | 3-15 |
| Push rod .....                        | 3-15 |
| Cylinder block .....                  | 3-15 |
| Cylinder bore .....                   | 3-16 |
| Cylinder sleeve .....                 | 3-17 |
| Piston & piston pin .....             | 3-18 |
| Piston ring .....                     | 3-18 |
| Connecting rod .....                  | 3-19 |
| Connecting rod bearing .....          | 3-20 |
| Crankshaft .....                      | 2-22 |
| Crankshaft bearing .....              | 3-22 |
| Crankshaft timing gear .....          | 3-23 |
| Camshaft .....                        | 3-24 |
| Camshaft timing gear .....            | 3-24 |
| Camshaft bearing .....                | 3-25 |
| Flywheel .....                        | 3-26 |
| Crankshaft oil retainer .....         | 3-26 |
| Assembly .....                        | 3-27 |
| Installation .....                    | 3-32 |
| MEMORANDUM .....                      | 3-33 |

## 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 causes.

### Symptoms & Probable Causes

### Remedies

#### Lack of Power

- |                                        |                                                           |
|----------------------------------------|-----------------------------------------------------------|
| 1. Poor compression                    |                                                           |
| a. Incorrect valve clearance           | Adjust valve clearance                                    |
| b. Compression leak from valve seat    | Lap valves and seats                                      |
| c. Sticky valve stem                   | Replace valves and guides                                 |
| d. Weak or broken valve springs        | Replace valve springs                                     |
| e. Leaky cylinder head gasket          | Replace gasket                                            |
| f. Sticky or broken piston rings       | Replace piston rings                                      |
| g. Worn piston rings or cylinder       | Overhaul engine                                           |
| 2. Ignition system improperly adjusted |                                                           |
| a. Incorrect ignition timing           | Adjust ignition timing                                    |
| b. Defective spark plug/s              | Clean, adjust or replace spark plug/s                     |
| c. Defective distributor points        | Correct or replace points, and inspect condenser capacity |
| d. Incorrect octane selector           | Adjust octane selector                                    |
| 3. Lack of fuel                        |                                                           |
| a. Clogged carburetor jet              | Disassemble and clean carburetor                          |
| b. Clogged fuel pipe                   | Clean fuel pipe                                           |
| c. Dirt in fuel tank                   | Clean or replace fuel tank                                |
| d. Air in fuel system                  | Check connections, and tighten                            |
| e. Fuel pump not functioning properly  | Repair or replace fuel pump                               |
| f. Clogged fuel filter element         | Clean or replace filter element                           |
| 4. Insufficient carburetor air intake  |                                                           |
| a. Restricted air cleaner              | Clean air cleaner                                         |
| b. Choke valve partially closed        | Repair or replace choke mechanism                         |
| 5. Overheating                         |                                                           |
| 1. Insufficient coolant                | Replenish coolant                                         |
| b. Loose fan belt                      | Adjust fan belt                                           |
| b. Fan belt worn or damaged            | Replace fan belt                                          |
| d. Inoperative thermostat              | Replace thermostat                                        |
| e. Inoperative water pump              | Repair or replace water pump                              |
| f. Clogged or leaky cooling system     | Clean, repair or replace cooling system                   |
| g. Incorrect ignition timing           | Adjust ignition timing                                    |
| h. Incorrect ignition system           | Tune-up engine                                            |
| i. Brakes dragging                     | Adjust brakes                                             |
| j. Incorrect valve clearance           | Adjust valve clearance                                    |
| k. Exhaust system partially restricted | Clean or replace exhaust system                           |



- |                                                  |                               |
|--------------------------------------------------|-------------------------------|
| l. Incorrect grade, and viscosity oil being used | Replace with correct oil      |
| m. Fuel mixture too lean                         | Overhaul or adjust carburetor |
| n. Radiator fins clogged or obstructed           | Clean radiator fins           |

**Excessive Oil Consumption**

- |                                                                              |                                                     |
|------------------------------------------------------------------------------|-----------------------------------------------------|
| 1. Oil leak                                                                  |                                                     |
| a. Oil pan drain plug loose                                                  | Tighten drain plug                                  |
| b. Oil pan attaching bolts loose                                             | Tighten attaching bolts                             |
| c. Oil pan gasket damaged                                                    | Replace gasket                                      |
| d. Timing gear cover attaching bolts loose or gasket damaged                 | Tighten attaching bolts or replace gasket           |
| e. Oil seal damaged                                                          | Replace oil seal                                    |
| f. Cylinder head cover gasket damaged or valve push rod cover gasket damaged | Replace gasket                                      |
| g. Fuel pump attaching bolts loose or gasket damaged                         | Tighten fuel pump attaching bolts or replace gasket |
| h. Oil filter attaching bolt loose or gasket damaged                         | Tighten attaching bolt or replace gasket            |
| 2. Excessive oil consumption                                                 |                                                     |
| a. Defective piston rings                                                    | Replace piston rings                                |
| b. Ring gaps in line                                                         | Correct gap positions                               |
| c. Piston rings worn or ring grooves sticky                                  | Replace piston rings                                |
| d. Carbon deposit in oil return hole of oil ring                             | Replace rings                                       |
| e. Piston or cylinder worn excessively                                       | Replace pistons or bore cylinders                   |
| f. Valve stem "O" ring damaged                                               | Replace "O" ring                                    |
| g. Valve and guide bushing worn                                              | Replace valve and guide bushing                     |

**Hard Starting**

- |                                          |                                                  |
|------------------------------------------|--------------------------------------------------|
| 1. Slow cranking                         |                                                  |
| a. Improper oil viscosity                | Change to proper viscosity oil                   |
| b. Discharged battery                    | Charge battery                                   |
| c. Defective battery                     | Replace battery                                  |
| d. Poor battery connections              | Clean and tighten or replace battery connections |
| e. Defective starter motor               | Overhaul and repair or replace starter motor     |
| 2. Defective ignition system             |                                                  |
| a. Burnt distributor points              | Replace points                                   |
| b. Points incorrectly adjusted           | Adjust points                                    |
| c. Spark plugs gaps incorrectly adjusted | Adjust spark plug gap                            |
| d. Loose or defective spark plug wires   | Tighten or replace spark plug wires              |
| e. Defective ignition coil               | Replace ignition coil                            |
| f. Loose primary circuit connections     | Tighten connections                              |
| g. Defective condenser                   | Replace condenser                                |

**3. Engine condition**

- |                                              |                                          |
|----------------------------------------------|------------------------------------------|
| a. Burnt valves                              | Repair or replace valves                 |
| b. Leaky manifold gasket                     | Tighten manifold bolts or replace gasket |
| c. Pistons, piston rings, and cylinders worn | Overhaul engine                          |
| d. Defective cylinder head gasket            | Replace gasket                           |
| e. Loose carburetor mounting bolts           | Tighten bolts                            |

**4. Carburetion**

- |                                             |                                  |
|---------------------------------------------|----------------------------------|
| a. Choke operating improperly               | Adjust or repair choke mechanism |
| b. Incorrect engine idling                  | Adjust engine idling             |
| c. Carburetor dirty and passages restricted | Overhaul and clean carburetor    |
| d. Loose carburetor attaching bolts         | Tighten attaching bolts          |
| e. Carburetor overflows                     | Repair carburetor                |

**Popping, Spitting and Detonation****1. Ignition system**

- |                                          |                                         |
|------------------------------------------|-----------------------------------------|
| a. Loosen connections in ignition system | Inspect and tighten connections         |
| b. Defective spark plugs                 | Clean and adjust or replace spark plugs |
| c. Incorrect ignition timing             | Adjust ignition timing                  |
| d. Incorrect heat range plugs            | Replace with correct heat range plugs   |

**2. Air-fuel mixture**

- |                                              |                                                                                  |
|----------------------------------------------|----------------------------------------------------------------------------------|
| a. Lean combustion mixture                   | Clean and adjust carburetor                                                      |
| b. Fuel pipe dirty or restricted             | Clean or replace fuel pipe                                                       |
| c. Air leak at carburetor or intake manifold | Tighten carburetor attaching bolts or manifold attaching bolts or replace gasket |

**3. Valves**

- |                              |                          |
|------------------------------|--------------------------|
| a. Incorrect valve clearance | Adjust valve clearance   |
| b. Valves sticky             | Repair or replace valves |
| c. Weak valve springs        | Replace springs          |

**4. Cylinder head**

- |                                               |                              |
|-----------------------------------------------|------------------------------|
| a. Carbon deposits in combustion chambers     | Remove carbon                |
| b. Cylinder head water tube partially clogged | Clean or replace water tubes |
| c. Cylinder head gasket defective             | Replace gasket               |

**Rough Engine Idling****1. Carburetor**

- |                                                       |                             |
|-------------------------------------------------------|-----------------------------|
| a. Incorrect idling adjustment                        | Adjust idling               |
| b. Carburetor float needle valve not seating properly | Clean and adjust or replace |

**2. Air leaks**

- |                                                       |                                                                                         |
|-------------------------------------------------------|-----------------------------------------------------------------------------------------|
| a. Leaking heat insulator, and intake manifold gasket | Tighten carburetor attaching bolts or replace heat insulator and intake manifold gasket |
| b. Cracked intake manifold                            | Replace manifold                                                                        |

## 3. Valves

- |                                                                   |                               |
|-------------------------------------------------------------------|-------------------------------|
| a. Incorrect valve clearance                                      | Adjust valve clearance        |
| b. Valve not seated properly                                      | Lap valves                    |
| c. Excessive clearance between valve stem and valve guide bushing | Replace valve and valve guide |

## 4. Cylinder head

- |                               |                |
|-------------------------------|----------------|
| a. Leaky cylinder head gasket | Replace gasket |
|-------------------------------|----------------|

**Engine Misses at Acceleration**

## 1. Carburetor

- |                                |                                |
|--------------------------------|--------------------------------|
| a. Clogged accelerating system | Disassemble and clean          |
| b. Lean fuel mixture           | Overhaul and repair carburetor |

## 2. Ignition system

- |                                            |                              |
|--------------------------------------------|------------------------------|
| a. Defective spark plugs                   | Clean or replace spark plugs |
| b. Defective ignition wires                | Replace wires                |
| c. Incorrectly adjusted distributor points | Adjust or replace points     |
| d. Defective ignition coil                 | Replace ignition coil        |

## 3. Engine

- |                                         |                                     |
|-----------------------------------------|-------------------------------------|
| a. Burnt or incorrectly adjusted valves | Adjust or replace valves            |
| b. Poor compression                     | Overhaul and repair engine          |
| c. Leaky cylinder head gasket           | Replace gasket                      |
| d. Leaky manifold gaskets               | Tighten manifold or replace gaskets |

**Noisy Engine**

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

## 1. Crankshaft bearing

- |                               |                                               |
|-------------------------------|-----------------------------------------------|
| a. Worn bearings              | Replace bearings or grind crankshaft          |
| b. Worn crankshaft journals   | Grind or replace crankshaft                   |
| c. Melted crankshaft bearings | Replace bearings and check lubricating system |

## 2. Connecting rod &amp; connecting rod bearings

- |                                 |                                               |
|---------------------------------|-----------------------------------------------|
| a. Worn connecting rod bearings | Replace bearings or grind crankshaft          |
| b. Worn crankpin journals       | Grind or replace crankshaft                   |
| c. Bent connecting rod          | Correct or replace connecting rod             |
| d. Melted bearings              | Replace bearings and check lubricating system |
| e. Worn connecting rod bushing  | Replace bushing                               |

## 3. Piston, piston pin &amp; piston rings

- |                            |                                                            |
|----------------------------|------------------------------------------------------------|
| a. Excessive cylinder wear | Bore and hone cylinders, and install new pistons and rings |
|----------------------------|------------------------------------------------------------|

- |                                        |                               |
|----------------------------------------|-------------------------------|
| b. Worn piston or piston pin           | Replace piston and pin        |
| c. Burnt piston                        | Replace piston                |
| d. Defective piston rings              | Replace rings                 |
| <br>4. Other components                |                               |
| a. Excessive camshaft thrust clearance | Replace camshaft thrust plate |
| b. Worn crankshaft thrust washer       | Replace thrust washer         |
| c. Worn timing gear                    | Replace timing gear           |
| d. Worn valve lifters                  | Replace valve lifters         |
| e. Excessive valve clearance           | Adjust clearance              |

## MAJOR SERVICE

### Removal - On RH & RY series

- |                                                                                                         |                                                                                                                |
|---------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|
| 1. Drain the coolant from the cooling system.                                                           | lead wire from the distributor terminal.                                                                       |
| 2. Disconnect the battery ground cable from the battery terminal.                                       |                                                                                                                |
| 3. Lift the center seat, and remove the carburetor air inlet.                                           | 12. Jack up the vehicle, and support it with stands.                                                           |
| 4. Remove the throttle and choke wires from the carburetor and the clamp on the rocker arm cover.       | 13. Remove the propeller shaft.                                                                                |
|                                                                                                         | 14. Disconnect the speedometer cable from the transmission.                                                    |
| 5. Remove the radiator inlet hose, and disconnect the coolant temperature sender gauge lead wire.       | 15. Disconnect the back-up light switch lead wires from the switch.                                            |
| 6. Remove the alternator retaining bolts and the lead wires, and remove the alternator assembly upward. | 16. Remove the cross-shaft and the gear shifting rod No. 3.                                                    |
| 7. Remove the radiator outlet hose.                                                                     | 17. Remove the engine under cover LH, and disconnect the oil pressure switch lead wire from the switch.        |
| 8. Disconnect the high tension wire from the ignition coil.                                             | 18. Remove the front exhaust pipe.                                                                             |
| 9. Disconnect the fuel pump inlet hose from the fuel pump.                                              | 19. Remove the clutch release cylinder together with the clutch flexible hose set plate from the transmission. |
| 10. Disconnect the battery to starter cable and the lead wires from the starter terminals.              | 20. Place an engine holder onto the jack, and support the engine with the jack.                                |
| 11. Disconnect the distributor primary                                                                  | 21. Remove the engine under cover RH, and remove the engine front mounting insulator RH.                       |
|                                                                                                         | 22. Remove the engine front mounting                                                                           |

bracket LH together with the mounting insulator.

23. Remove the engine rear mounting retaining bolts.
24. Lower the jack gradually, and carefully remove the engine with the transmission from underneath the vehicle.  
Take care not to damage the radiator or the other components.

#### Removal - On RT & RN series

1. Drain the coolant from the cooling system.
2. Remove the hood support, and remove the hood.
3. Disconnect the battery ground cable from the battery terminal.
4. Remove the radiator grille. (RT)
5. Remove the radiator upper baffle. (RT)
6. Remove the radiator inlet and outlet hoses.
7. Remove the radiator.
8. Remove the air cleaner, and disconnect the heater water hoses from the engine if installed.
9. Disconnect the high tension wire from the ignition coil.
10. Disconnect the fuel pump inlet hose from the fuel pump.
11. Disconnect the battery to starter cable and the lead wires from the starter terminals.
12. Disconnect the distributor primary lead wire.
13. Disconnect the clutch release cylinder to flexible hose tube from the flexible hose, and remove the flexible hose clip from the flexible hose bracket.  
To prevent the clutch fluid from flowing out, plug the air vent hole located at the reservoir cap.
14. Disconnect the alternator lead wires.
15. Disconnect the coolant temperature sender gauge lead wire from the gauge.
16. Remove the accelerator wire clamp, and disconnect the wire from the accelerator wire lever bracket.
17. Disconnect the oil pressure switch lead wire from the switch.
18. Remove the exhaust pipe flange retaining nuts.
19. Jack up the car, and support it with stands.
20. Remove the exhaust pipe clamp, and disconnect the exhaust pipe front from the manifold.
21. Remove the equalizer support bracket and the tension spring, and then disconnect the parking brake cable No. 1.
22. Remove the propeller shaft.  
To prevent the oil leak from the transmission rear, insert any available universal joint sleeve yoke.
23. Disconnect the speedometer cable from the transmission.
24. Disconnect the low speed connecting rod from the shift outer lever.
25. Disconnect the high speed connecting rod from the cross-shaft.
26. Remove the gear shift rod from the

cross-shaft.

27. Remove the cross-shaft assembly.
28. Support the transmission with the jack, and remove the engine rear support member from the bracket.
29. Remove the engine rear mounting insulator from the engine mounting support.
30. Remove the engine mounting front insulator retaining bolts.
31. Install a lifting hook onto the engine hangers, and carefully remove the engine with the transmission frontward and upward using a suitable hoist.  
Take care not to damage the other components.

#### Disassembly

1. Remove the stiffener plate on RT series if installed.
2. Remove the flywheel housing under cover.
3. Remove the transmission from the engine.
4. Stamp the mating marks onto the clutch cover and the flywheel to relocate the original positions upon assembly, then remove the clutch cover and the clutch disc.  
Do not dirty the clutch disc with oil.
5. If the input shaft front bearing must be replaced, remove the bearing using the Input Shaft Front Bearing Puller 09303 - 35010.
6. Install the engine onto a work stand, and drain the engine oil.
7. Remove the oil level gauge.



Fig. 3-1 Removing Bearing

V3111

8. Remove the carburetor fuel pipe and the vacuum pipe.
9. Loosen the distributor clamp, and remove the distributor together with the spark plug and the ignition coil cords.
10. Remove the starter assembly.
11. Remove the spark plugs using the spark plug wrench.
12. Remove the fuel pump.
13. Remove the engine front mounting bracket RH.
14. Remove the water hose through joint if necessary.
15. Remove the fan, pulley and the fan belt.
16. Remove the alternator assembly only on RT series.
17. Remove the engine front mounting bracket LH only on RT series.
18. Remove the oil filter assembly.
19. Remove the automatic choke stove pipes only on RT series.
20. Remove the carburetor assembly and the heat insulator.

21. Remove the manifold assemblies.
22. Remove the water outlet, and remove the thermostat.
23. Remove the water pump by-pass hose, and remove the water pump assembly.
24. Remove the coolant temperature sender gauge and the oil pressure switch.
25. Remove the cylinder head cover.
26. Remove the valve rocker shaft assembly, and remove the push rods. The push rods should be arranged in the order of the cylinder number to re-install into the original positions upon assembly.
27. Remove the cylinder head bolts, and remove the cylinder head and the gasket. When loosening the cylinder head bolts, follow the order in accordance with the numbers shown in figure 3-2 in three progressive steps.

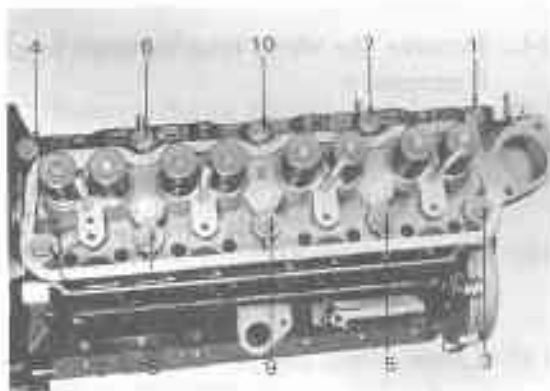


Fig 3-2 Head Bolts Loosening Order V3115

28. Remove the valve lifter cover, and remove the valve lifters. The valve lifters should be arranged in the order of the cylinder numbers.
29. Turn the engine, and position the

bottom side of the engine upward, then remove the oil pan.

30. Loosen the oil pipe union nuts (1), and remove the oil pump (2) with the strainer.



Fig. 3-3 Oil Pump Removal V3117

31. Remove the crankshaft pulley retaining bolt, and remove the crankshaft pulley using the Crankshaft Pulley & Gear Puller 09213-60014 or the Timing Gear Tool Set 09210-31011.



Fig. 3-4 Crankshaft Pulley Removal V3118

32. Remove the timing gear cover.
33. Inspect the timing gear backlash using a dial gauge. The backlash limit is 0.3 mm or 0.012". If the backlash exceeds the limit, replace the camshaft timing gear and/or the crankshaft timing gear referring to the camshaft timing gear and the crankshaft timing gear of Inspection & Repair in this section.



Fig. 3-5 Measuring Backlash

V3119

34. Remove the camshaft thrust plate retaining bolts (1), and remove the camshaft with the timing gear without damaging the camshaft bearings.



Fig. 3-6 Camshaft Removal

V3120

35. Remove the timing gear oil nozzle and the end plate (2).
36. Remove the connecting rod caps together with the bearings, and remove the pistons with the connecting rods from the top of the cylinder. At this time, do not mix the mated parts of the con-rod, cap and the bearings with the others.
37. Remove the flywheel.



Fig. 3-7 Piston Removal

V3123

38. Remove the crankshaft bearing caps together with the bearings. When loosening the cap bolts, follow the order of the numbers as shown in figure 3-8 in three progressive steps.

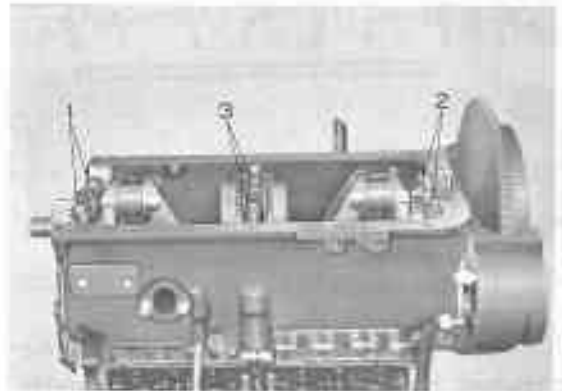


Fig. 3-8 Cap Bolts Loosening Order

V3124

39. Remove the crankshaft, and remove the crankshaft upper bearings.



Fig. 3-9 Valve Removal

V3125



40. Remove the ventilation tube assembly.
41. Mark the valves, and remove the valves using a valve spring compressor.
42. Remove the valve rocker shaft lock springs (1), and remove the tension springs (3), exhaust valve rocker arms (4), valve rocker supports (5), intake valve rocker arms (6) and the compression springs (7) from the valve rocker shaft (2).

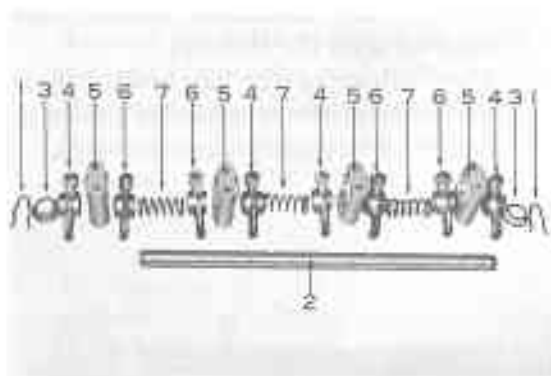


Fig. 3-10 Rocker Arm Disassembly V3126

43. Using a suitable piston ring expander, remove the piston rings. The removed piston rings should be laid in accordance with the cylinder numbers.



Fig. 3-11 Piston Ring Removal V3127

44. Remove the piston pin hole snap rings, and heat the piston to 40 to 50°C (104 ~ 122°F) with a piston heater, then remove the piston pin.

Do not mix the mated parts of the piston, piston pin and the connecting rod with the others.

### 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 for traces of water leak before washing;

Blow all passages with compressed air, and remove the deposits.

Check that the passages are not clogged.

Remove the carbon deposits from the top of the pistons, combustion chambers in the cylinder head, and also remove from the valves without damaging the parts.

Do not mix the mated parts with the others.

### Cylinder Head

1. Check the cylinder head for crack, and inspect the gasket surface for burrs and nicks.

Replace the cylinder head if defective.

2. Check for water leak from the cylinder head by applying water pressure of 4.0 ~ 4.5 kg/cm<sup>2</sup> or 57 ~ 64 psi., and water temperature of 40°C (104°F).

If defective, repair or replace the cylinder head.

Limit 0.05mm (0.002")

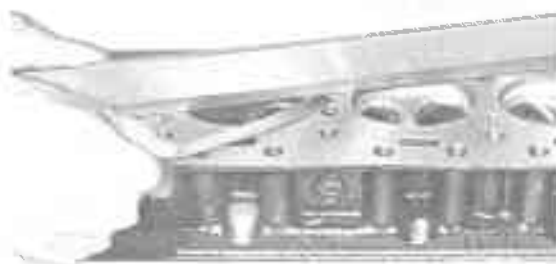


Fig. 3-12 Measuring Head Warpage

V3128

3. Check the flatness of the cylinder head gasket surface with a straight edge and a feeler gauge.

If the warpage exceeds 0.05 mm (0.002"), grind the gasket surface with a surface grinder.

The measuring points of flatness are as shown in figure 3-13.



Fig. 3-13 Measuring Points for Warpage V3129

### Valve Seat

1. Check the valve seat for damage and wear.

If necessary to reface the valve seat, first check the valve guide bushings for wear, and replace the bushings if these are worn.

Next, reface the valve seat with a valve seat grinder or other cutter.

The valve seat should be finished as shown in figure 3-14.



Fig. 3-14 Valve Seat Dimension

G0826

2. To reface the valve seat with the valve seat cutters, it is most common to follow the following procedures.

- a. First, grind the seat contact face of the valve using a valve refacer, and check the contact of the valve with the seat for valve seat cutting reference.

- b. Cut the seat surface roughly using the 15° cutter.

Next, cut the seat surface to approximate contact width using the 75° cutter.

Finally, cut the seat contact face to correct width of 1.2~1.6 mm (0.047~0.063") using the 45° cutter.

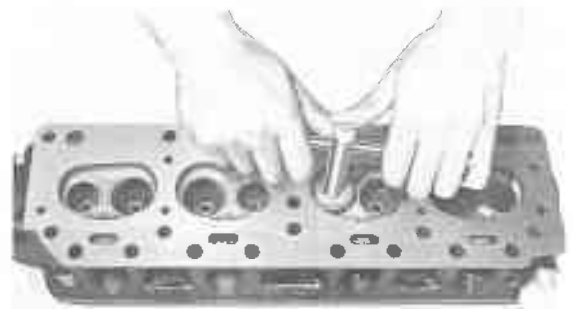


Fig. 3-15 Refacing Valve Seat

V3130

- c. After cutting the seat, the valve should contact the valve seat exactly at the center.

Therefore, when cutting the seat using the 15° and the 75° cutters, cut the seat checking the valve contact.

To check the contact, apply a thin coat of red lead onto the seat, and insert the valve.

Apply a light pressure onto the valve to check the contact.

If the seating is too high, use the 15° and the 45° cutters, and if the seating is too low, use the 75° and the 45° cutters.

3. Lap the valve and the seat with a lapping compound to match the seat.

After lapping, clean the valves and the valve seats thoroughly.

### Valve Guide Bushing

1. Check the clearance between the valve stem and the valve guide bushing. If the clearance exceeds 0.1 mm (0.004"), replace the valve/s and the valve guide bushing/s with the Valve Guide Bushing Remover & Replacer 09201 - 60010.

The specified clearances are as follows:

Intake side: 0.025 ~ 0.060 mm  
(0.0010 ~ 0.0024")

Exhaust side: 0.035 ~ 0.070 mm  
(0.0014 ~ 0.0028")

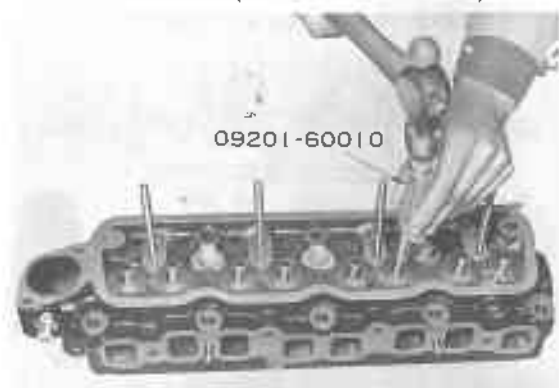


Fig. 3-16 Guide Bushing Replacement V3134

2. To check the clearance easily, insert the valve into the guide bushing, and position a dial gauge as shown in figure 3-17. At this time, the plunger of the dial gauge should be placed near the upper end of the guide bushing.

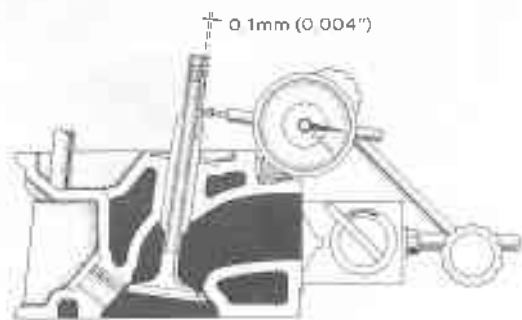


Fig. 3-17 Easy Method

G0829

Move the valve stem toward the left and right in parallel with the rocker arm.

Measure the clearance turning the valve slightly to obtain the maximum worn portion.

If the movement of the valve stem exceeds 0.1 mm (0.004"), the clearance may exceed 0.1 mm or 0.004"

3. Install the guide bushing into the cylinder head with the Valve Guide Remover & Replacer 09201-60010 so that the protrusion of the guide bushing will be within the specified dimension.

Protrusion dimension:

Intake: 25.0 ~ 26.0 mm  
(1.00 ~ 1.02") - 2R

Exhaust: 22.0 ~ 23.0 mm  
(0.87 ~ 0.91") - 2R

Intake & Exhaust: 18 mm (0.71") - 12R

25.0 ~ 26.0 mm - 2R 22.0 ~ 23.0 mm - 2R  
18 mm - 12R 18 mm - 12R

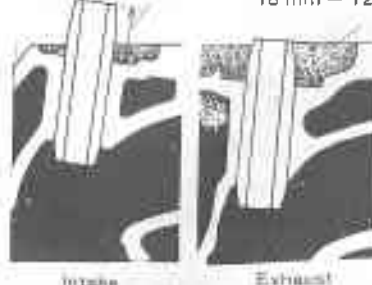


Fig. 3-18 Valve Guide Bushing Protrusion G0828

4. After installing the guide bushing, ream the guide bushing until the specified clearances are obtained.

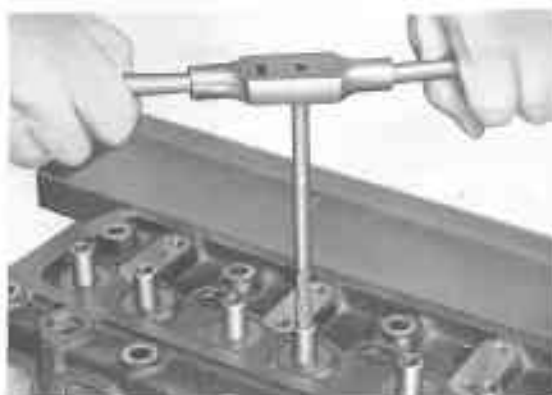


Fig. 3-19 Reaming Valve Guide Bushing V3150

## Valve

1. Check the valve face and the valve head edge for pits, grooves, scores and other defects.  
Replace if necessary.
2. Check the valve stem for bent, and check the stem end for grooves and scores.  
Replace if necessary.
3. Check the valve head for burns or erosion, warpage and cracks.  
Defects, such as minor pits, grooves, etc., may be removed by refacing.  
Replace the valves which are excessively damaged.
4. If refacing is necessary, grind the valve with a valve refacer to obtain a smooth and correct angle.  
Grind the valve to  $45^\circ$ , removing only sufficient stock to correct the run-out, and to remove the pits and grooves.

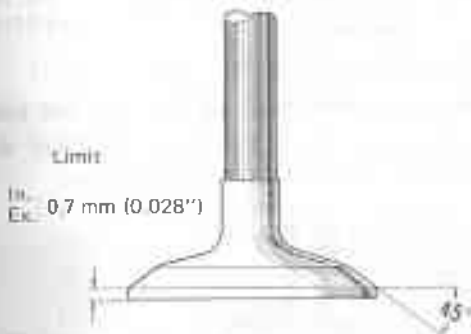


Fig. 3-20 Valve Head Edge G0830

If the thickness of the valve head edge is less than 0.7 mm (0.028") for the intake and less than 0.7 mm (0.028") for the exhaust after grinding, replace the valve.

5. Remove all grooves and scores from the end of the valve stem, then chamfer as necessary.  
Do not grind the valve stem end more than 0.5 mm (0.02").  
The overall length of both intake and exhaust valves are 115.8 mm (4.56") for 2R or 109.0 mm (4.29") for 12R.



Fig. 3-21 Grinding Valve V0716



Fig. 3-22 Grinding Valve Stem End V0717

6. Lap the valves slightly with a lapping compound for proper seating.  
Clean all compound thoroughly from the valve and the seat after lapping.

## Valve Spring

1. Measure the installed length of the valve spring as shown in figure 3-23.  
If the installed length exceeds approximately 2 mm (0.08"), check the valve seat depth, and check the valve spring retainer and the retainer locks for wear.  
If worn, replace them.  
The limit of the valve seat depth is 2 mm (0.08").
2. Measure the spring tension at the installed height of the valve spring with a spring tester.  
Replace it if the tension is less than the limit.



Fig. 3-23 Measuring Spring Installed Length G0831

- Inspect the valve spring squareness using a steel square and the surface plate. Place the spring against the square edge, and rotate the spring slowly. The space between the top coil of the spring and the square edge should be within the limit. If it exceeds the limit, replace the spring.

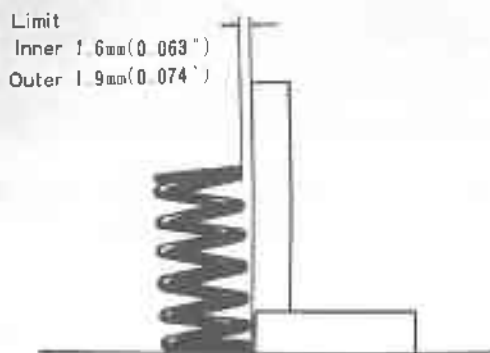


Fig. 3-24 Checking Spring Squareness G0832

#### Valve spring specification:

|                          | 2R              | 12R             |
|--------------------------|-----------------|-----------------|
| Free length              |                 |                 |
| Inner                    | 46mm (1.81")    | 39.7mm(1.56")   |
| Outer                    | 52.6mm(2.07")   | 45.5mm(1.79")   |
| Installed length:        |                 |                 |
| Inner                    | 40.4mm(1.59")   | 34.2mm(1.35")   |
| Outer                    | 46.4mm(1.83")   | 40.0mm(1.57")   |
| Installed tension:       |                 |                 |
| Inner                    | 5.6kg (12.3 lb) | 6.4kg (14.1 lb) |
| Outer                    | 26.0kg(57.3 lb) | 23.3kg(51.3 lb) |
| Installed tension limit: |                 |                 |
| Inner                    | 3.6kg ( 7.9 lb) | 5.1kg (11.2 lb) |
| Outer                    | 22.6kg(49.8 lb) | 19.0kg(41.8 lb) |
| Squareness limit:        |                 |                 |
| Inner                    | 1.6mm(0.063")   | 1.6mm(0.063")   |
| Outer                    | 1.9mm(0.075")   | 1.9mm(0.075")   |

#### Valve Rocker Arm & Rocker Shaft

- Check the valve rocker arm and the shaft for wear.

If excessively worn, replace the rocker arm bushing or the shaft.

The specified clearance between the shaft and the bushing should be 0.017 ~ 0.051 mm (0.0007 ~ 0.0020") for 2R or 0.020 ~ 0.035 mm (0.0008 ~ 0.0014") for 12R.

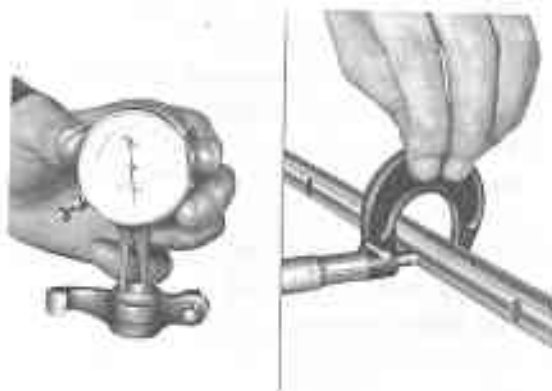


Fig. 3-25 Measuring Bushing & Shaft Clearance V0718  
V0719

- To replace the bushing for 2R, use the Connecting Rod Bushing Remover & Replacer 09222-30010 and a press.



Fig. 3-26 Bushing Replacement V3135

- To install the bushing for 2R, apply oil between the valve rocker arm and the bushing and install the bushing onto the rocker arm aligning the bushing oil hole with the rocker arm oil hole.

After installing, finish the bushing with an adjustable reamer or a pin hole grinder to obtain the specified clearance.

4. If the valve rocker arm shows excessive wear at the valve stem contact face, replace the rocker arm.  
If the wear is little, and the rocker arm is still serviceable, reface the rocker arm with a valve refacer.

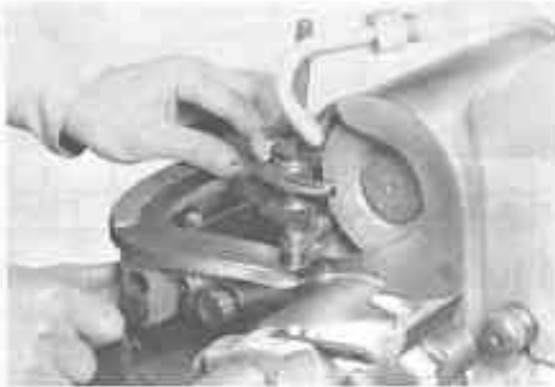


Fig. 3-27 Refacing Rocker Arm

V3136

### Valve Lifter

1. Check the valve lifters for wear and pitting, and if necessary, replace the lifter.
2. Inspect the clearance between the valve lifter and the lifter bore.  
If the clearance exceeds 0.1 mm (0.004"), replace with an oversize valve lifters reaming the bores to obtain the clearance of 0.015 to 0.029 mm (0.0006 ~ 0.0020").

Valve lifter specification:

#### Mark 1

Lifter diameter:

22.178 ~ 22.185 mm  
(0.8731 ~ 0.8734")

Bore finished diameter:

22.200 ~ 22.207 mm  
(0.8740 ~ 0.8743")

#### Mark 2

Lifter diameter:

22.185 ~ 22.192 mm  
(0.8734 ~ 0.8737")

Bore finished diameter:

22.207 ~ 22.214 mm  
(0.8743 ~ 0.8746")

#### Mark 3

Lifter diameter:

22.192 ~ 22.199 mm  
(0.8737 ~ 0.8740")

Bore finished diameter:

22.214 ~ 22.221 mm  
(0.8746 ~ 0.8748")



Fig. 3-28 Measuring Lifter Bore

V3137

### Push Rod

Check the push rods for bend and damage.  
If defective, replace the push rod.

### Cylinder Block

1. Check the cylinder block for cracks and damage.  
Minute cracks not visible to the naked eyes may be detected with an equipment if available.  
Replace the block if not serviceable.
2. Inspect the water leak from the cylinder block by applying water pressure of 4.0~4.5 kg/cm<sup>2</sup> (57~64 psi), and water temperature of 40°C (104°F).
3. Inspect the flatness of the cylinder block gasket surface following the procedure recommended for the cylinder head.  
If the warpage exceeds 0.05 mm (0.002"), grind the gasket surface with a suitable surface grinder.

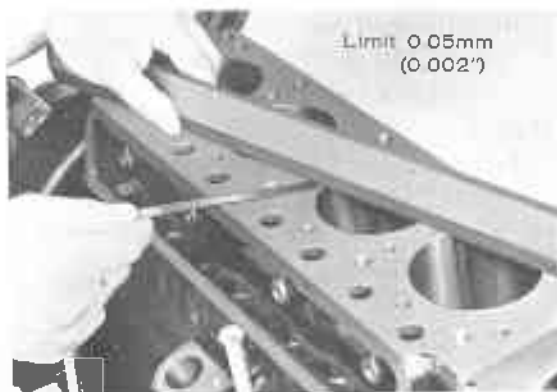


Fig. 3-29 Measuring Cylinder Block Flatness V3138

### Cylinder Bore

1. Measure the cylinder bore for out-of-round and taper with a cylinder bore gauge.

The measurement of each cylinder bore should be performed at the top, middle and the bottom of the thrust direction and of the axial direction placing the gauge at right angle.

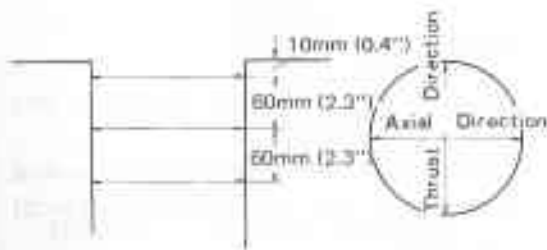


Fig. 3-30 Measuring Points of Cylinder Bore G0833

2. If the cylinders are scored badly, burned and/or worn out-of-round or tapered more than 0.2 mm or 0.008", bore the cylinder, and use proper oversize pistons. If one cylinder bore requires boring, the rest also require boring.

Standard cylinder bore:

78.00 ~ 78.03 mm (3.071 ~ 3.072") – 2R

80.50 ~ 80.55 mm (3.170 ~ 3.171") – 12R

Wear & taper limit: 0.2 mm (0.008")



Fig. 3-31 Measuring Cylinder Bore V3139

3. If the cylinder walls have minor surface defects, but the out-of-round and the taper are within the limit, remove the ridge with a ridge reamer, and hone the cylinder walls.

Next, select and install the pistons of larger diameter among the same size pistons shown in the following table of the next paragraph 4.



Fig. 3-32 Reaming Top of Bore V0725

4. To bore the cylinder, select the cylinder with the most wear first to determine the oversize piston to be used, and select the proper oversize piston in the following table.

**Note:**

The mark of each size piston and the piston diameter are marked on the piston package, and also the diameter of the standard size pistons installed onto the engine is marked with the "indent" on the piston head to indicate the piston diameter.

**Piston Diameter**

| Ident mark | 2R mm (in)                         | 12R mm (in)     |
|------------|------------------------------------|-----------------|
| 1          | 77.965 (3.0695)                    | 80.455 (3.1675) |
| 2          | 77.975 (3.0699)                    | 80.465 (3.1679) |
| 3          | 77.985 (3.0703)                    | 80.475 (3.1683) |
| 4          |                                    | 80.485 (3.1687) |
| 5          |                                    | 80.495 (3.1691) |
| O/S        | 0.25, 0.50, 0.75, 1.00, 1.25, 1.50 |                 |

- Measure the selected piston 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 the piston diameter.

After measuring the piston, bore the cylinders with a boring machine according to the piston diameter.

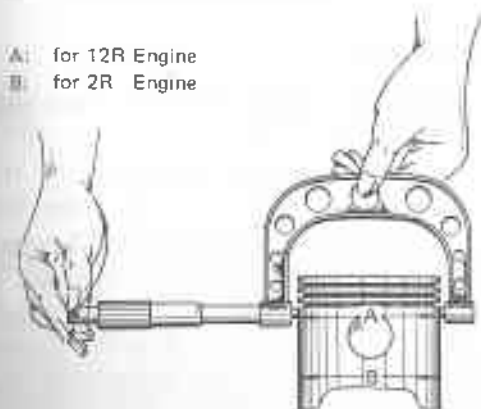


Fig. 3-33 Measuring Piston Diameter V3140

- After boring, check the cylinder bore for taper, out-of-round and difference of bore diameter between each cylinder. The taper and the out-of-round should be less than 0.02 mm or 0.008", and the difference of bore diameter should be less than 0.05 mm (0.002").

The measurement should be performed when the temperature of the cylinder is about 20° C (68° F).

- Inspect the clearance between the cylinder bore and the piston.

The clearance should be within 0.03 ~ 0.05 (0.0012 ~ 0.0020").

To check the clearance, position the feeler gauge of 0.03 mm or 0.0012" thickness and of 12 ~ 15 mm (0.5 ~ 0.6") wide into the cylinder extending the entire length of the piston at 90° from the piston pin boss location.

Invert the piston, and install into the cylinder bore with the piston pin parallel to the crank shaft axis.

Attach a pull-scale, and pull up straightward reading the pull-scale.

The correct reading should be within 1.0 ~ 2.5 kg (2.2 ~ 5.5 lb).

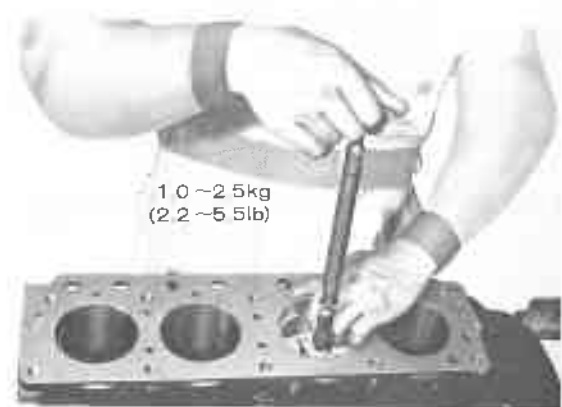


Fig. 3-34 Measuring Piston Fit

V3143

**Cylinder sleeve**

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

Cylinder sleeve outer diameter

| O/S        | 2R                                  | 12R                                 |
|------------|-------------------------------------|-------------------------------------|
| O/S - 4.00 | 82.091~82.126mm<br>(3.2319~3.2333") | 84.590~84.650mm<br>(3.3303~3.3327") |
| O/S - 4.50 | 82.591~82.626mm<br>(3.2516~3.2530") | 85.090~85.150mm<br>(3.3500~3.3524") |
| O/S - 5.00 | 83.091~83.126mm<br>(3.2713~3.2727") | 85.590~85.650mm<br>(3.3697~3.3720") |



2. To remove the sleeve, press out the sleeve toward the cylinder head with a press.

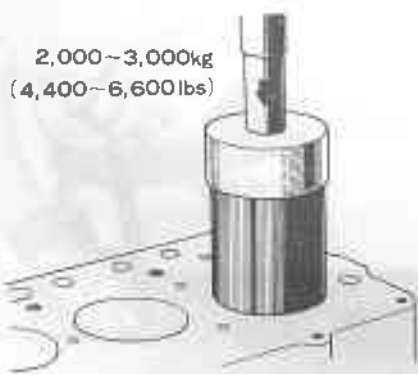
If the removal is difficult with the press, bore the sleeve to facilitate the removal with the boring machine.

3. To install the sleeve, bore the cylinder in accordance with the oversize sleeve to be installed.

The fitting tolerance between the cylinder block and the sleeve should be 0.056 ~ 0.126 mm (0.0022 to 0.0050").

4. The installing pressure required is 2,000 ~ 3,000 kg (4,400 ~ 6,600 lbs), and the sleeve must be installed so that the top of the sleeve is flush with the cylinder block gasket surface.

If the pressure required is less, select the next oversize sleeve.



*Fig. 3-35 Installing Cylinder Sleeve* G0834

5. After installing the sleeves, bore and hone the sleeves to fit the standard size pistons.

### **Piston & Piston Pin**

1. Inspect the piston and the piston ring grooves for wear, burrs or nicks, and if necessary, replace the pistons.

#### **Note:**

The standard size piston installed into the engine is marked with an "indent" indicating the piston pin size, piston diameter and the front mark on the piston head.

For the piston diameter, refer to the Cylinder Bore of the Inspection & Repair in this section.

2. Measure the ring grooves for wear by referring to the Piston Ring in the next paragraph.



*Fig. 3-36 Piston Marks on Head*

V3144

3. Check the piston pin fitness by pressing in the pin with the thumb with the piston heated to 40 ~ 60°C (104 ~ 140°F).

If the fitness is loose, replace both pin and the piston as a set.

### **Piston Ring**

1. Check the rings for wear and other defects.

If the pistons are replaced, the rings should be replaced at the same time. The ring size must be selected to correspond the size of the piston.

The rings are provided with the marks as shown in figure 3-37, but the standard size piston rings do not have the STD mark.

Face these marks upward upon installation.

2. Install each ring individually into the cylinder bore, and check the end gap of the ring with a feeler gauge. The end gaps should be within the specified clearances.

If only the rings are replaced without refinishing the cylinder bores, inspect the ring end gap by placing the ring at the lower position in the cylinder bore where the wear is minimum.

Specified end gap:

Compression ring No. 1:  
0.2 ~ 0.4 mm  
(0.008 ~ 0.016")

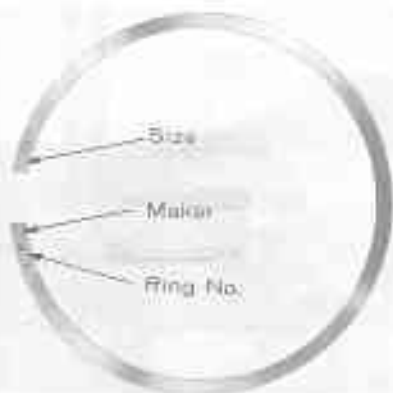


Fig. 3-37 Piston Ring Marks

V3145

Compression ring No. 2:  
0.1 ~ 0.3 mm  
(0.004 ~ 0.012")

Oil ring:  
0.1 ~ 0.3 mm  
(0.004 ~ 0.012")



Fig. 3-38 Measuring Ring End Gap

V3146

3. Inspect the ring to piston ring groove clearance with a feeler gauge by inserting between the ring and its lower land. The clearance should be within the specified clearance

Replace the pistons if necessary.  
Specified clearances:

Compression ring No. 1:  
0.03 ~ 0.07 mm  
(0.0012 ~ 0.0027")

Compression ring No. 2:  
0.030 ~ 0.070 mm  
(0.0012 ~ 0.0024")

Oil ring:  
0.025 ~ 0.070 mm  
(0.0010 ~ 0.0028")



Fig. 3-39 Measuring Groove Clearance

V3147

### Connecting Rod

1. Check the connecting rod for damage at the thrust surfaces on both sides.  
Replace the connecting rods if necessary. If replaced, the cylinder number should be marked on the camshaft side on the connecting rod.
2. Inspect the connecting rod for bend and twist with a Connecting Rod Aligner. The allowance of the bend and twist is 0.05 mm (0.002") per 100 mm (3.94"). If it exceeds the limit, correct it so that the three points on the "V" block contact with the face plate evenly, or replace the connecting rod.

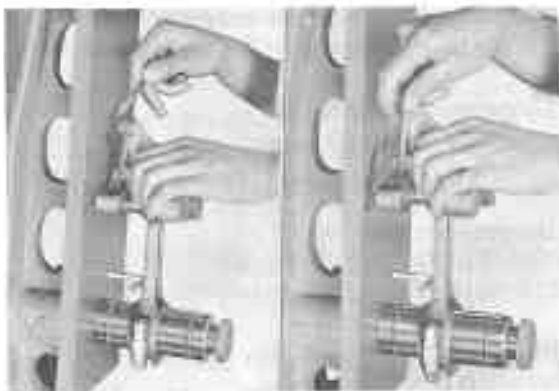


Fig. 3-40 Checking Bend &amp; Twist

V3148  
V3149

3. Install the connecting rod onto the crankshaft, and measure the thrust clearance.

The thrust clearance should be 0.08 ~ 0.24 mm (0.003 ~ 0.010") and the limit is 0.3 mm (0.012").

Replace the connecting rod if necessary.



Fig. 3-41 Measuring Thrust Clearance

V3122

4. Check the connecting rod bushing for wear, burrs or nicks.

If defective, replace the bushing with the Connecting Rod Bushing Remover & Replacer 09222 - 30010 and a press. When installing the bushing, align the oil hole of the bushing with that of the connecting rod.

After installing the bushing, hone the bushing with a pin hole honing machine

or a reamer to obtain the proper fitness with the piston pin.

The piston pin fitness can be determined by pushing in the pin into the bushing with the thumb applying engine oil onto the piston pin at normal temperature of 20°C or 68°F.



Fig. 3-42 Bushing Replacement

V3162

### Connecting Rod Bearing

The connecting rod bearings are of insert type, micro-precision finished with high quality and close tolerance.

Do not scrape or insert any shim, and also do not file or lap the bearing cap or bearing to obtain the specified clearance.

1. Check the bearing for poor contact, worn thin, partially melted or heavily scored.

If necessary, replace the bearings.

2. Check the oil clearance in the following manner with a Plastigage.

Clean the crankpin journal and the connecting rod bearings.

Place a piece of the Plastigage onto the crankpin journal at full width of the bearing, and parallel to the crankshaft, avoiding the oil hole in the journal. Install the connecting rod bearing and the cap, and tighten the nuts to 4.0 ~ 5.0 m·kg (29.0 ~ 36.0 ft·lb) torque with a torque wrench.

Do not turn the crankshaft while the Plastigage is in place.

Remove the cap, and check the width of the Plastigage with the Plastigage scale printed on the cover.

Read the widest point in order to obtain the minimum clearance.

Oil clearance:

0.016 ~ 0.040 mm (0.0006 ~ 0.0016")

— 2R

0.024 ~ 0.048 mm (0.0009 ~ 0.0020")

— 12R

Oil clearance limit: 0.1 mm (0.004")

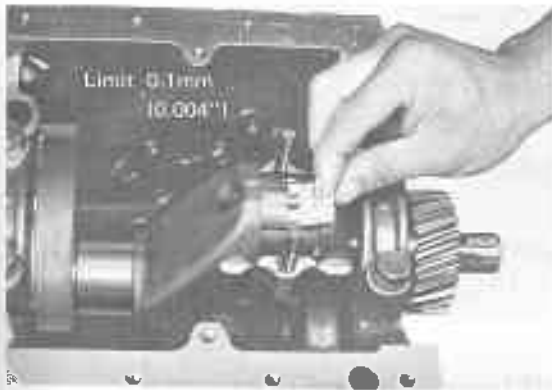


Fig. 3-43 Measuring Oil Clearance V3161

3. If the clearance exceeds the limit, replace the bearings selecting the proper undersize bearings with the following procedures.

If a new crankshaft is to be used, always use the standard size bearings.

When the oil clearance exceeds with the standard bearings, use U/S-0.05 bearings.

If the clearance exceeds with the U/S-0.05 bearings, grind the crankpin journals, and use U/S-0.25 or U/S-0.50 bearings.

Even after grinding the crankpin journals to the regular dimension, always check the oil clearance upon assembly.

Connecting rod bearings:

#### STD

Bearing thickness:

1.494 ~ 1.500 mm

(0.0588 ~ 0.0591")

Crankpin finished diameter:

49.985 ~ 50.000 mm

(1.9679 ~ 1.9685")

#### U/S-0.05

Bearing thickness:

1.511 ~ 1.517 mm

(0.0595 ~ 0.0597")

Crankpin finished diameter:

49.985 ~ 50.000 mm

(1.9679 ~ 1.9685")

#### U/S-0.25

Bearing thickness:

1.611 ~ 1.617 mm

(0.0634 ~ 0.0637")

Crankpin finished diameter:

49.756 ~ 49.766 mm

(1.9589 ~ 1.9593")

#### U/S-0.50

Bearing thickness:

1.736 ~ 1.742 mm

(0.0684 ~ 0.0686")

Crankpin finished diameter:

49.506 ~ 49.516 mm

(1.9491 ~ 1.9495")

#### U/S-0.75

Bearing thickness:

1.861 ~ 1.867 mm

(0.0733 ~ 0.0735")

Crankpin finished diameter:

49.256 ~ 49.266 mm

(1.9392 ~ 1.9396")

#### U/S-1.00

Bearing thickness:

1.986 ~ 1.992 mm

(0.0782 ~ 0.0784")

Crankpin finished diameter:

49.006 ~ 49.016 mm

(1.9294 ~ 1.9298")

## Crankshaft

### 1. Check the crankshaft for bend.

If the run-out exceeds 0.05 mm (0.002"), correct or replace the crankshaft.

To measure the bend, place a dial gauge onto the crankshaft center journal, and rotate the crankshaft one complete turn slowly to read the maximum and minimum values.

The bend is one-half of the difference between the maximum value and minimum value.

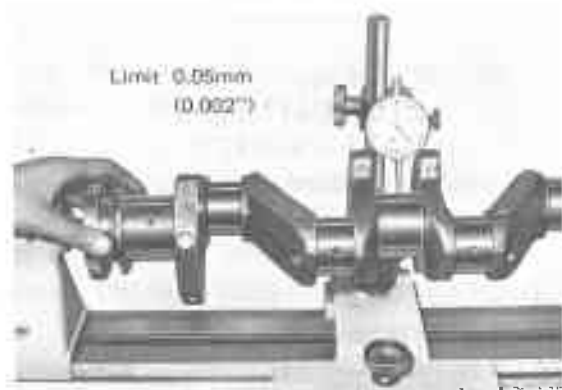


Fig. 3-44 Measuring Crankshaft Run-out V3164

2. Check the crankpin journals and the crankshaft journals for wear and scores, and if the out-of-round or taper exceeds 0.01 mm (0.0004"), grind the crankpin journals and/or the crankshaft journals referring to the connecting rod bearing and crankshaft bearing of Inspection & Repair in this section.



Fig. 3-45 Measuring Journal

V3165

3. Check the crankshaft thrust clearance at the thrust bearing.

The specified clearance should be within 0 ~ 0.18 mm (0 ~ 0.007"), and the limit is 0.3 mm (0.012").

If the clearance exceeds the limit, adjust the thrust clearance selecting the proper bearings listed in the following table. Thrust bearings:

STD:

Thickness: 2.950 ~ 3.000 mm  
(0.1161 ~ 0.1181")

O/-0.125:

Thickness: 3.013 ~ 3.063 mm  
(0.1186 ~ 0.1206")

O/S-0.25:

Thickness: 3.075 ~ 3.125 mm  
(0.1211 ~ 0.1230")

O/S-0.50:

Thickness: 3.200 ~ 3.250 mm  
(0.1260 ~ 0.1280")

When installing the thrust bearings, the side with the oil grooves must be positioned toward the crankshaft thrust surfaces.

## Crankshaft Bearing

The crankshaft bearings are also of the insert type and selective fit with micro-precision finished. Therefore, the same procedures of inspection and oil clearance check should be performed as the connecting rod bearings.

1. Check the bearing for poor contact, worn thin, partially melted or heavily scored.

If necessary, replace the bearings.

2. Measure the oil clearance with the Plastigage.

The tightening torque of the crankshaft bearing cap bolts is 9.8 to 11.2 m·kg (70.6 ~ 80.6 ft·lb).

Specified oil clearance:

0.020 ~ 0.044 mm (0.0008 ~ 0.0017")  
- 2R

0.028 ~ 0.052 mm (0.0011 ~ 0.0022")  
- 12R

Oil clearance limit: 0.1 mm (0.004")

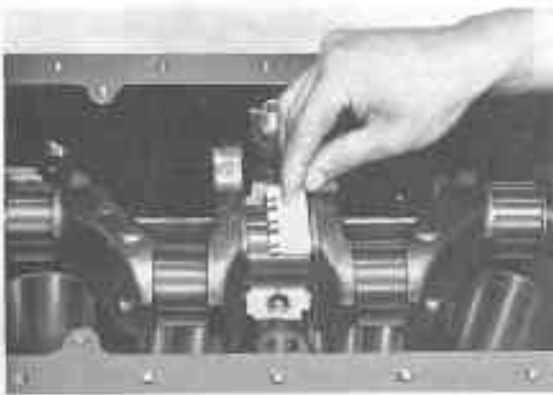


Fig. 3-46 Measuring Oil Clearance

V3167

3. If the clearance exceeds the limit, replace the bearings, selecting the proper undersize bearings with the following methods.

If a new crankshaft is to be used, always use the standard size bearings.

When the oil clearance exceeds with the standard bearings, use U/S-0.05 bearings. If the clearance exceeds with the U/S-0.05 bearings, grind the crankshaft journals, and use U/S-0.25 or U/S-0.50 bearings.

Even after grinding the crankshaft journals to the regular dimension, always check the oil clearance upon assembly.

Crankshaft bearings:

STD

Bearing thickness:

1.789 ~ 1.795 mm  
(0.0704 ~ 0.0707")

Journal finished diameter:

57.976 ~ 58.000 mm  
(2.2825 ~ 2.2835")

U/S-0.05

Bearing thickness:

1.809 ~ 1.815 mm  
(0.0712 ~ 0.0716")

Journal finished diameter:

57.976 ~ 58.000 mm  
(2.2825 ~ 2.2835")

U/S-0.25

Bearing thickness:

1.909 ~ 1.915 mm  
(0.0752 ~ 0.0754")

Journal finished diameter:

57.750 ~ 57.760 mm  
(2.2736 ~ 2.2740")

U/S-0.50

Bearing thickness:

2.034 ~ 2.040 mm  
(0.0801 ~ 0.0803")

Journal finished diameter:

57.500 ~ 57.510 mm  
(2.2638 ~ 2.2642")

U/S-0.75

Bearing thickness:

2.159 ~ 2.165 mm  
(0.0850 ~ 0.0852")

Journal finished diameter:

57.250 ~ 57.260 mm  
(2.2539 ~ 2.2543")

U/S-1.00

Bearing thickness:

2.284 ~ 2.290 mm  
(0.0899 ~ 0.0902")

Journal finished diameter:

57.000 ~ 57.010 mm  
(2.2441 ~ 2.2445")

### Crankshaft Timing Gear

The crankshaft timing gear should be only removed when it is to be replaced, and the timing gear replacement can be performed on the car by using the Timing Gear Tool Set 09210-31011.

1. Check the crankshaft timing gear for wear, damage and chipped teeth.

If defective, replace the timing gear.

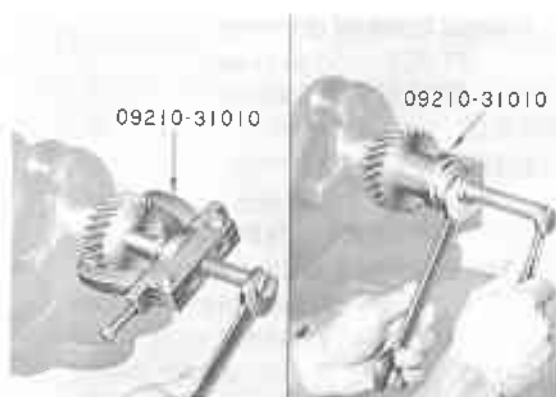


Fig. 3-47 Replacing Timing Gear B0276 B0278

2. To remove and install the timing gear, use the Timing Gear Tool Set 09210-31010 as shown in figure 3-47.

### Camshaft

1. Inspect the camshaft for bend with a dial gauge.

To measure the bend, place the dial gauge onto the center journal, and rotate the camshaft one complete turn slowly to read the maximum and minimum values.

The bend is one-half of the difference between the maximum value and the minimum value.

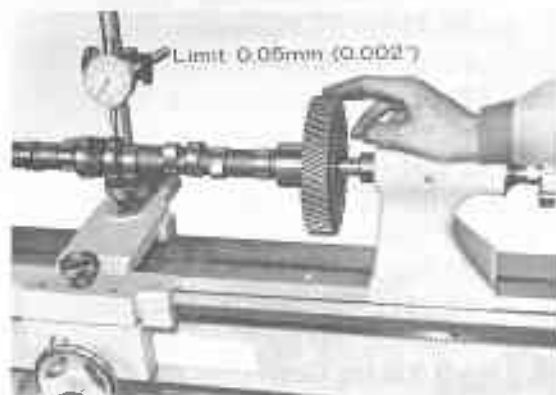


Fig. 3-48 Measuring Bend of Camshaft V3170

2. Inspect the camshaft thrust clearance, and if the clearance exceeds 0.3 mm (0.012'') for 2R or 0.2 mm (0.008'') for 12R, replace the thrust plate referring to the Camshaft Timing Gear of Inspection & Repair in this section. The specified clearance should be within 0.06 ~ 0.122 mm (0.0024 to 0.0048'').

3. Check the camshaft cam lobes for pits, scores and abnormal wear.

If defective, replace the camshaft.

If the cam lobes are pitted or scored slightly, and the pitting or scoring is not detrimental to the operation of the camshaft, the lobes may be dressed with an oil stone.

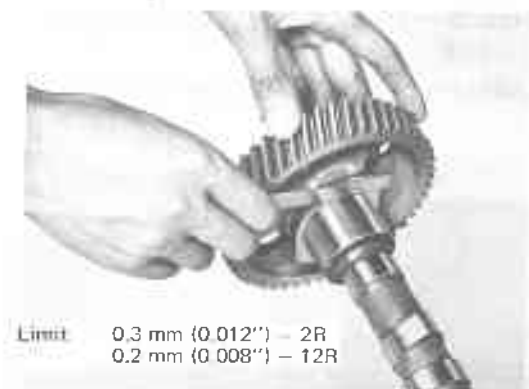


Fig. 3-49 Measuring Thrust Clearance V3171

4. Inspect the cam lobe height, and if the cam lobe height is less than the 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: 38.29 mm (1.508'')

Exhaust: 38.19 mm (1.504'')

5. Check the distributor drive gear on the camshaft for wear or damage. If defective, replace the camshaft.
6. Inspect the camshaft journals for pits and abnormal wear.  
If the out-of-round or taper exceeds 0.05 mm (0.002''), grind the camshaft journals, and the undersize bearings must be installed. Refer to the Camshaft Bearing of Inspection & Repair in this section.

### Camshaft Timing Gear

The camshaft timing gear should be also removed only for replacement, and the replacement of the timing gear can be per-

formed on the car by using the Timing Gear Tool Set 09210-31011 same as the crankshaft timing gear.

1. Check the timing gear for cracks, damage, wear and chipped teeth.  
If defective, replace the timing gear.
2. Inspect the timing gear for runout, and if it exceeds 0.25 mm (0.01"), replace the timing gear.

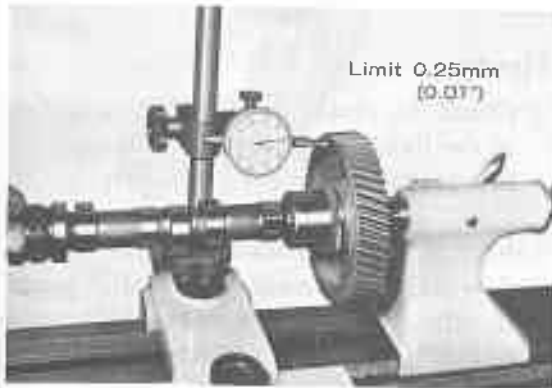


Fig. 3-50 Measuring Timing Gear Run-out V3172

3. Inspect the backlash between the crankshaft timing gear and the crankshaft timing gear if necessary.  
For the details on the backlash measurement, refer to the Disassembly in this section.  
If the backlash exceeds 0.3 mm (0.012"), replace the camshaft timing gear and/or the crankshaft timing gear. The backlash should be 0.02 to 0.13 mm (0.0008 ~ 0.0052") for 2R or 0.068 ~ 0.170 mm (0.0027 ~ 0.0067").

4. To remove the camshaft timing gear, remove the gear retaining bolt and the washers, then remove the timing gear using the Timing Gear Tool Set 09210-31011.

To assemble the camshaft timing gear, install the thrust plate and the key, then install the timing gear onto the camshaft, using the Timing Gear Tool Set 09210-31011.

After installation, install the washers and the retaining bolt, then check the camshaft thrust clearance.

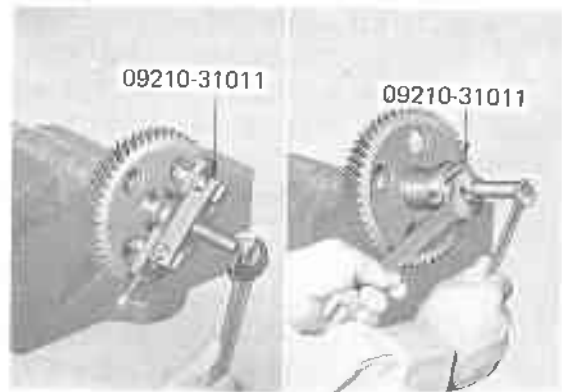


Fig. 3-51 Replacing Timing Gear

B0281  
B0283

### Camshaft Bearing

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

2. Inspect the oil clearance by measuring the difference between the camshaft journal diameter and the bearing inner diameter.

The oil clearance should be within 0.025 ~ 0.066 mm (0.0010 to 0.0026"), and the limit is 0.1 mm (0.004").

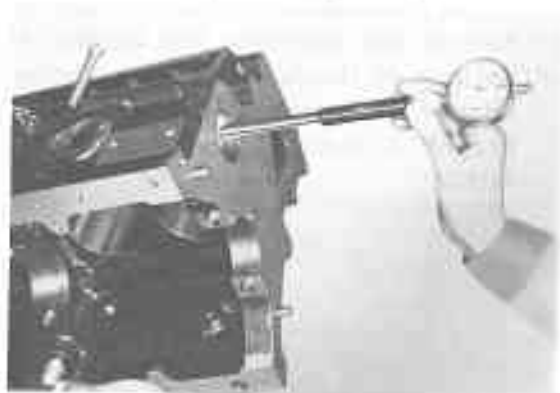


Fig. 3-52 Measuring Oil Clearance

V3173

3. If the oil clearance exceeds the limit, grind the camshaft journals according to the size as in the following table for selection of the undersize bearings.

Camshaft journal finished diameter:

Bearing size: STD

|              |                                          |
|--------------|------------------------------------------|
| No.1 journal | 46.459 ~ 46.475 mm<br>(1.8291 ~ 1.8297") |
|--------------|------------------------------------------|



No.2 journal 46.209 ~ 46.225 mm  
(1.8193 ~ 1.8199")

No.3 journal 45.959 ~ 45.975 mm  
(1.8094 ~ 1.8100")

Bearing size: U/S-0.125

No.1 journal 46.335 ~ 46.345 mm  
(1.8242 ~ 1.8246")

No.2 journal 46.085 ~ 46.095 mm  
(1.8144 ~ 1.8148")

No.3 journal 45.835 ~ 45.845 mm  
(1.8045 ~ 1.8049")

Bearing size: U/S-0.250

No.1 journal 46.210 ~ 46.220 mm  
(1.8193 ~ 1.8197")

No.2 journal 45.960 ~ 45.970 mm  
(1.8095 ~ 1.8098")

No.3 journal 45.710 ~ 45.720 mm  
(1.7996 ~ 1.8000")

Bearing size: U/S-0.500

No.1 journal 45.960 ~ 45.970 mm  
(1.8095 ~ 1.8098")

No.2 journal 45.710 ~ 45.720 mm  
(1.7996 ~ 1.8000")

No.3 journal 45.460 ~ 45.470 mm  
(1.7898 ~ 1.7902")

- 4 Replace the bearings adhering the following procedures.

Remove the expansion plug installed at the rear of the camshaft No.3 bearing. Remove the bearings with the Camshaft Bearing Remover & Replacer 09215-31010.

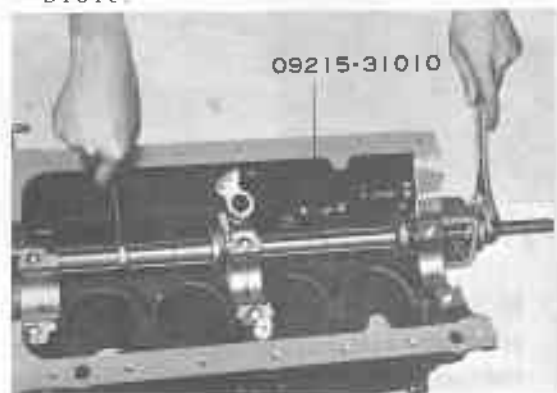


Fig. 3-53 Camshaft Bearing Removal V3174

5. Install the new selected bearings with the Camshaft Bearing Remover & Replacer 09215-31010 aligning the bearing oil

holes.

The bearings should be installed one at a time individually.

After installing the bearings, ream the bearings with a line reamer to obtain the specified oil clearance.

If the bearings are correctly installed, only a slight reaming is required.

Install the new expansion plug applied with liquid sealer into the cylinder block.

### Flywheel

1. Check the clutch disc contacting surface of the flywheel for wear and damage. If defective, replace the flywheel.
2. Inspect the contacting surface of the flywheel for run-out with a dial gauge. If the run-out exceeds 0.20 mm (0.008"), replace the flywheel.

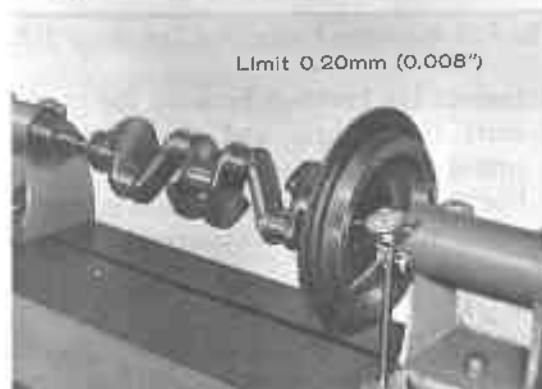


Fig. 3-54 Measuring Flywheel Run-out V3175

3. Check the ring gear for chipped teeth, cracks and wear.

If defective, replace the ring gear.

To remove the ring gear, heat the ring gear to about 150 ~ 200°C (300 to 390°F) evenly, and remove the ring gear by tapping lightly.

To install, heat the ring gear to about 200°C (390°F), and install the ring gear while still hot.

### Crankshaft Oil Retainer

It is recommended that the oil retainer should be replaced whenever the engine is

overhauled.

To remove the retainer from the timing gear cover, pry out the retainer toward the front.

To install, use the Crankshaft Pulley & Gear Replacer 09214-60010.



Fig. 3-55 Installing Oil Retainer

V3176

### Assembly

Before assembling, thoroughly clean the disassembled parts especially the oil passages, bearings, bearing holes and the cylinder walls.

Apply engine oil onto the sliding or rotating portion of the cylinder walls, pistons, bearings, gears and etc. It is recommended that all gaskets, packings and seals be replaced with new ones.

Recheck the oil clearance, backlash and thrust clearance upon assembly.

1. Heat the piston to about 40 ~ 60°C (104 ~ 140°F), and install the connecting rod, piston and the hole snap rings.



Fig. 3-56 Piston Front Mark

V3144



Fig. 3-57 Assembling Piston & Connecting Rod

V3177

The front mark of the piston is indicated with the "indent", and that of the connecting rod is indicated with the "T" mark.

When assembling the piston with the connecting rod, align both front marks. At this time, the oil hole provided at the shoulder of the connecting rod large end will face toward the camshaft side.

2. Install the piston rings onto the piston. The piston rings are provided with the marks as shown in figure 3-58. When installing the rings, face the marks upward and install the rings so that the ring numbers will be in order from the piston head side.

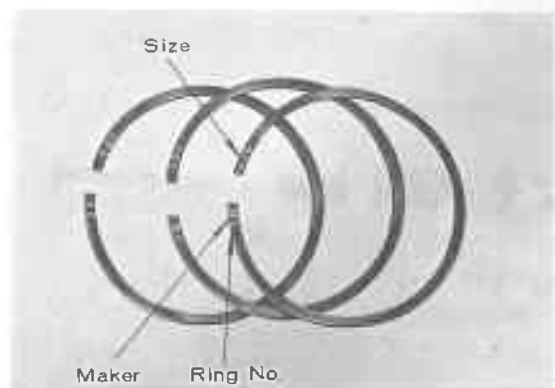


Fig. 3-58 Piston Rings

V2062

3. Clean the bearing fitting portion of the connecting rod and the bearings. Install the bearings and the caps, and tighten the nuts lightly.

4. Assemble the rocker arm components installing the compression springs, rocker arms, rocker supports, tension springs and the lock springs onto the rocker shaft.

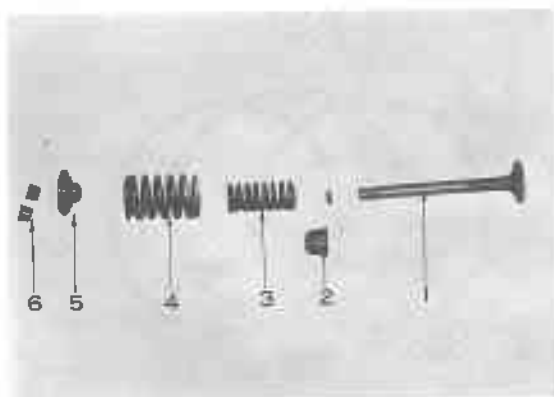
The "F" mark of the valve rocker supports should be faced toward the engine front, and the oil hole provided on the rocker shaft should be placed toward the engine rear.



*Fig. 3-59 Assembling Rocker Arm Components V3179*

5. Place the valve (1) into the valve guide after applying engine oil, and install the oil seal (2), inner spring (3), outer spring (4) and the spring retainer (5) into the position.

Compress the valve springs with a spring compressor, and install the retainer locks (6) onto the valve stem.



*Fig. 3-60 Assembling Valve Components V3180*

The side painted "yellow" of the inner and the outer valve springs should be faced toward the cylinder head side.

After installing the retainer locks, check

if the retainer locks are properly installed into the valve stem grooves.

6. Install the oil seal into the groove located at the rear end of the cylinder block and the rear bearing cap using a cylindrical tool.

Cut the protruding portion of the seal ends.



*Fig. 3-61 Installing Oil Seal V3181*

7. Install the upper halves of the crankshaft No. 1, No. 2 and No. 3 bearings onto the cylinder block.

8. Install the crankshaft, and insert the upper halves of the crankshaft thrust bearings.

The grooves side of the thrust bearings must be faced toward the crankshaft thrust surface.



*Fig. 3-62 Inserting Thrust Washer V3182*

9. Install the lower halves of the crankshaft bearings and the thrust bearings onto the

bearing caps, and then install the bearing caps onto the cylinder block.

When installing the bearing caps, the "Arrow" mark on the bearing caps must be faced toward the front of the cylinder block.

Tighten the cap bolts following the order of the numbers in three progressive steps, and finally secure the bolts to 9.8 ~ 11.2 m·kg or 70.6 ~ 80.6 ft·lb torque.

After tightening, check if the thrust clearance is proper.

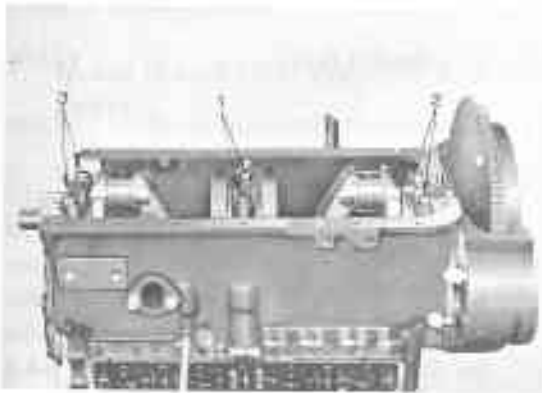


Fig. 3-63 Tightening Cap Bolts V3124

10. Drive in the side packings of the rear bearing cap into the grooves after applying the liquid sealer.
11. Install the flywheel onto the crankshaft, and tighten the bolts to 5.8 to 6.6 m·kg (41.7 ~ 47.5 ft·lb) torque, and then lock the lock plates securely.
12. Install the piston into the cylinder block using a piston ring compressor facing the piston front mark toward the front of the cylinder block.  
When installing the piston, it is advisable to insert vinyl tubes onto each connecting rod cap bolt to prevent scoring the cylinder wall or the crankpin journal.  
Make sure that the end of each ring is not directed to the thrust face of the piston, and also that each ring is not

coincided with the other ring end gap as shown in figure 3-64.

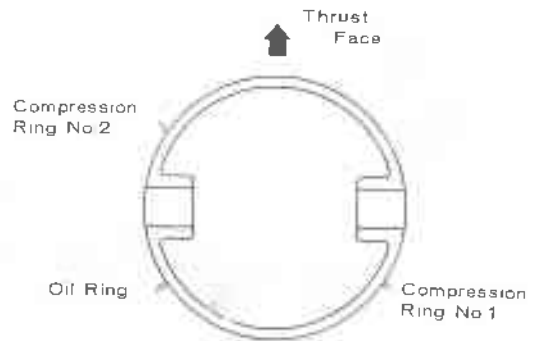


Fig. 3-64 Positioning Ring End Gap G0839



Fig. 3-65 Installing Piston V3184

13. Install the connecting rod bearing caps aligning the mating marks of the connecting rod and of the cap, and tighten the nuts to 4.2 ~ 4.8 m·kg (30.0 ~ 34.5 ft·lb) torque.
14. Install the front end plate with the gasket.
15. Install the camshaft assembly aligning the mating marks on the camshaft and the crankshaft timing gears, and tighten the thrust plate retaining bolts to 1.4 ~ 2.0 m·kg (10.0 ~ 14.5 ft·lb) torque.  
After installing the camshaft, recheck the timing gear backlash.
16. Screw in the timing gear oil nozzle onto the cylinder block, and lock the oil nozzle in place by punching at two

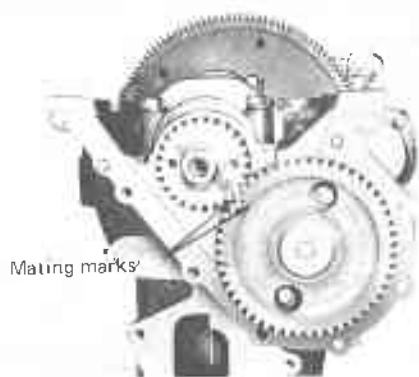


Fig. 3-66 Aligning Timing Marks

V3185

places to prevent it from loosening. When installing the oil nozzle, position the oil supply hole of the oil nozzle to discharge the oil onto the timing gears.



Fig. 3-67 Positioning Oil Nozzle

G0840

17. Install the timing gear cover with the gasket, and tighten the bolts to 1.0 ~ 1.6 m·kg (7.0 ~ 12.0 ft·lb) torque.
18. Install the crankshaft pulley using the Crankshaft Pulley & Gear Replacer 09214-60010 or the Timing Gear Tool Set 09210-31011, and tighten the bolt with the washer to 4.1 ~ 5.5 m·kg (29.7 ~ 39.8 ft·lb) torque.
19. Install the oil pump together with the oil pump outlet pipe, and tighten the securing bolt to 1.4 ~ 2.0 m·kg (10.1 ~ 14.5 ft·lb) torque.

20. Install the oil pan with the gasket, and tighten the bolts to 0.4 ~ 0.8 m·kg (2.9 ~ 5.8 ft·lb) torque. Check if the engine oil drain plug is secure.

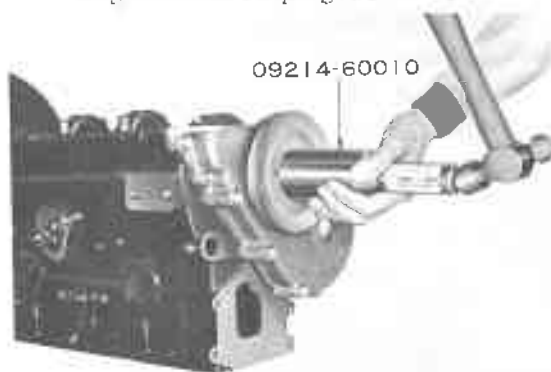


Fig. 3-68 Installing Pulley

V3186

21. Turn the engine, and position the top side up. Install the cylinder head with the gasket, and tighten the cylinder head bolts following the order of the numbers as shown in figure 3-69, in three progressive steps, and secure the bolts to 10.3 to 11.7 m·kg (74.5 ~ 84.6 ft·lb) torque finally.

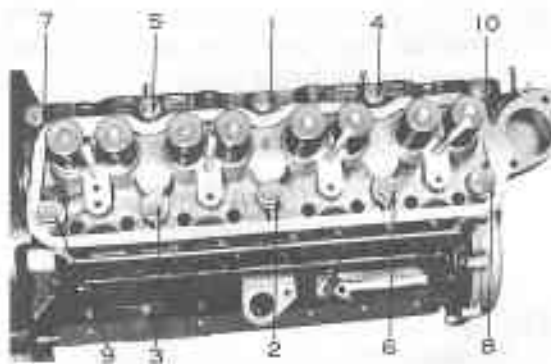


Fig. 3-69 Tightening Order

V3115

22. Install the valve lifters and the push rods, and install the valve rocker shaft assembly onto the cylinder head facing the "F" mark on the rocker support toward the front of the cylinder block. Tighten the retaining bolts to 1.75 to 2.45 m·kg (12.7 ~ 17.7 ft·lb) torque.

23. Install the push rod cover, oil pressure switch and the ventilation tube.
24. Install the manifolds with the gaskets, and tighten the retaining bolts to 2.8 ~ 3.5 m·kg (20.3 ~ 25.3 ft·lb) torque.
25. Install the carburetor assembly with the heat insulator.  
After installing the carburetor, cover the carburetor air horn with a clean cloth to prevent entry of dust or dirt.
26. Install the automatic choke stove inlet and outlet pipes on RT series.
27. Install the oil filter assembly with the gasket.
28. Install the engine front bracket LH. As the rear bolt hole for the engine bracket is drilled through the cylinder block, apply liquid sealer onto the bolt.
29. Install the alternator assembly.
30. Install the water pump assembly with the packing and with the fan belt adjusting bar.
31. Install the water pump by-pass hose and the coolant temperature sender gauge.
32. Install the fan belt, and adjust the belt tension.
33. Install the engine front bracket RH with the same procedures prescribed on the assembling of the front bracket LH.
34. Install the fuel pump with the gasket and the insulator, and install the fuel pipe and the vacuum pipe.
35. Install the thermostat and the water outlet with the gasket, and tighten the

bolts together with the fuel and vacuum pipe support.

36. Install the distributor clamp, and install the distributor referring to the Distributor in the Ignition System.
37. Install the starter assembly.
38. Install the spark plugs and the oil level gauge.
39. Install the input shaft front bearing if it was removed.  
To install, pack the bearing with multipurpose grease into the bearing, and install the bearing using the Input Shaft Front Bearing Replacer 09304-30012.



Fig. 3-70 Installing Bearing B1011 V4700

40. Install the clutch disc and the clutch cover assembly, aligning the mating marks and using the Clutch Guide



Fig. 3-71 Installing Clutch Cover B1013 V4701

Tool 09301-36010, and tighten the bolts to 1.0 ~ 1.6 m·kg (7.2 to 11.6 ft·lb) torque.

41. Install the transmission assembly and the flywheel under cover.
42. Install the stiffener plates on RT series if installed.

### Installation

To install, follow the removal procedures in the reverse order, and after installation, perform the following operations.

1. Bleed the air from the clutch hydraulic system referring to the Chassis Repair Manual.
2. Refill the engine with the engine oil marked SC, SD (API service classification) and the coolant.

Each capacity is as follows.

Engine oil:

4.2 liters (4.5 US qts, 3.7 Imp. qts)

Coolant: RT, RY, RN series

7.0 liters (7.4 US qts, 6.2 Imp. qts)

Coolant: RH series

6.7 liters (7.1 US qts, 5.9 Imp. qts)

3. Check the transmission gear lubricant level.

If necessary, refill the case up to the level with gear lubricant with the viscosity of SAE-90, and with the grade of GL-4 (API service classification).

4. Tune up the engine by referring to the Engine Tune-up section.
5. After performing the engine tune-up, recheck if the oil level is correct, and check for water and oil leaks.

\*\*\*\*\*

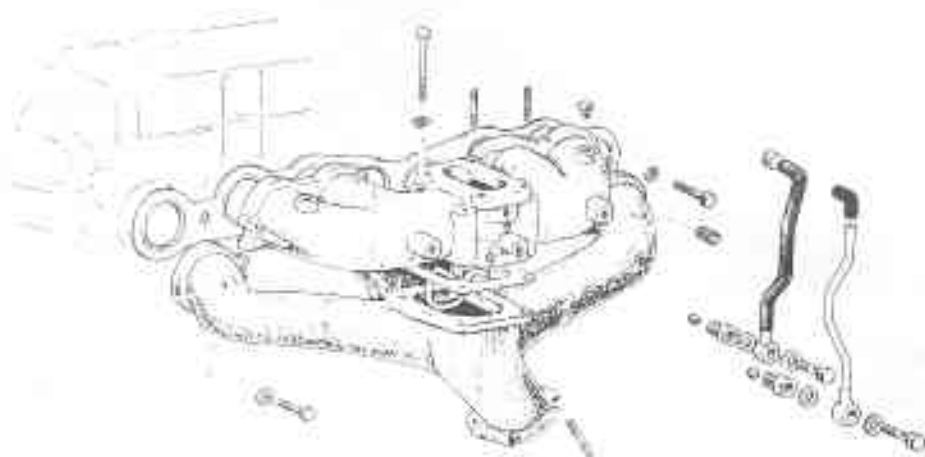
## INTAKE & EXHAUST MANIFOLDS

|                                                      |     |
|------------------------------------------------------|-----|
| INTAKE & EXHAUST MANIFOLDS .....                     | 4-1 |
| Description .....                                    | 4-1 |
| Removal .....                                        | 4-2 |
| Inspection & Repair .....                            | 4-2 |
| EXHAUST PIPE .....                                   | 4-3 |
| POSITIVE CRANKCASE VENTILATION SYSTEM (Optional) . . | 4-5 |
| Ventilation Valve .....                              | 4-5 |
| Inspection .....                                     | 4-5 |
| MEMORANDUM .....                                     | 4-6 |



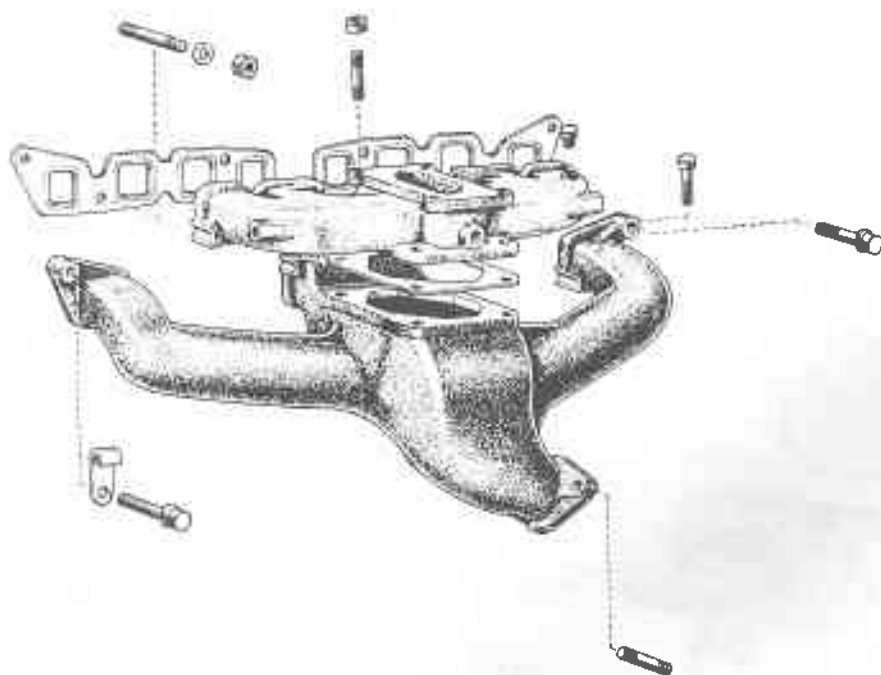
# INTAKE & EXHAUST MANIFOLDS

## Description



*Fig. 4-1 Sectional View of Manifold on RT Series*

Y5506



*Fig. 4-2 Manifolds Components on Light-Truck series*

The intake manifold is of aluminum alloy which has superior heat conductance, and the exhaust manifold is of cast iron.

Each manifold is arranged in parallel as shown in the above illustration and the flange bottom side of the intake manifold is directly exposed to the heat of the exhaust gas to warm the air-fuel mixture drawn in from the carburetor.

On RT series, the intake manifold is provided with the automatic choke stove pipe. This pipe is also exposed to the heat of the exhaust gas. This warms the air entering from the air cleaner through the automatic choke stove inlet pipe, and the warmed air enters the thermostat case to control the choke valve automatically through the bi-metal coil.

On Light-Truck series, since the carburetor is equipped with a manual choke, the intake manifold is not provided with the automatic choke stove pipe and the related parts.

### Removal

1. Remove the air cleaner on RT & RN series, and the intake air connector on RH & RN series.
2. Remove the carburetor and the heat insulator.
3. Remove the exhaust pipe retaining nuts, and disconnect the exhaust pipe flange from the exhaust manifold.
4. Remove the manifolds retaining bolts, and remove the manifold assemblies and the gaskets.
5. Remove the automatic choke stove inlet and the outlet pipes on RT series.
6. Remove the intake manifold from the exhaust manifold if necessary.

### Inspection & Repair

1. Check the manifold for corrosion, cracks or other damage.  
If defective, repair or replace as necessary.
2. Inspect the distortion of the manifold

gasket surface with a straight edge and a feeler gauge.

If the distortion exceeds 0.4 mm (0.016"), grind the manifolds with a surface grinder, or replace the manifolds.

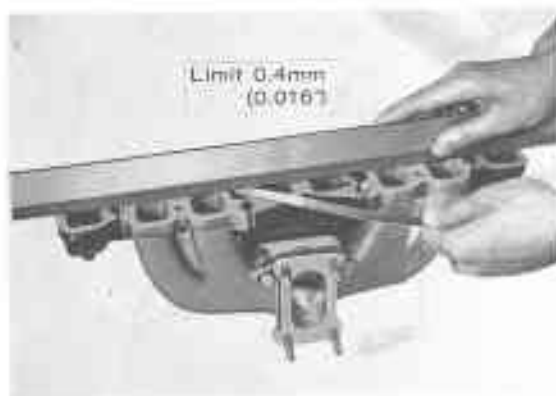


Fig. 4-3 Measuring Manifold Distortion V3187

### Installation

Follow the removal procedures in the reverse order, and follow the following precautions.

1. Always replace the gaskets upon installation.
2. Tighten the manifolds retaining bolts to 2.8 ~ 3.5 m·kg (20 ~ 25 ft·lb) torque.

EXHAUST PIPE

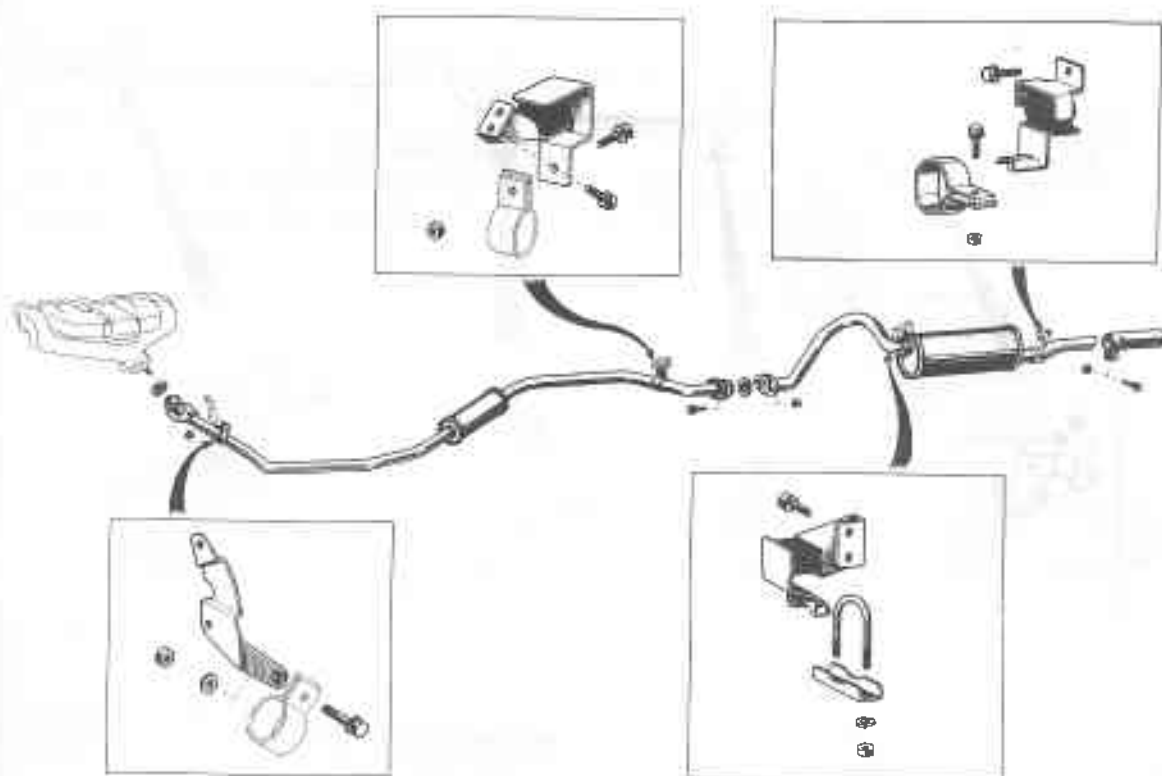


Fig. 4-4 Exhaust System Components on RT Series

Y5509

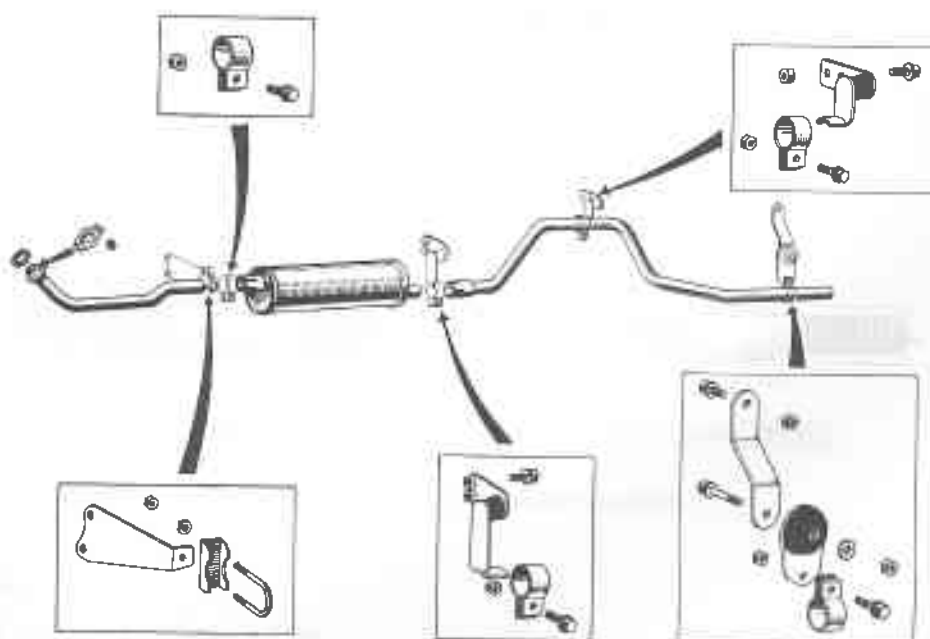


Fig. 4-5 Exhaust System Components on RY Series

G3803

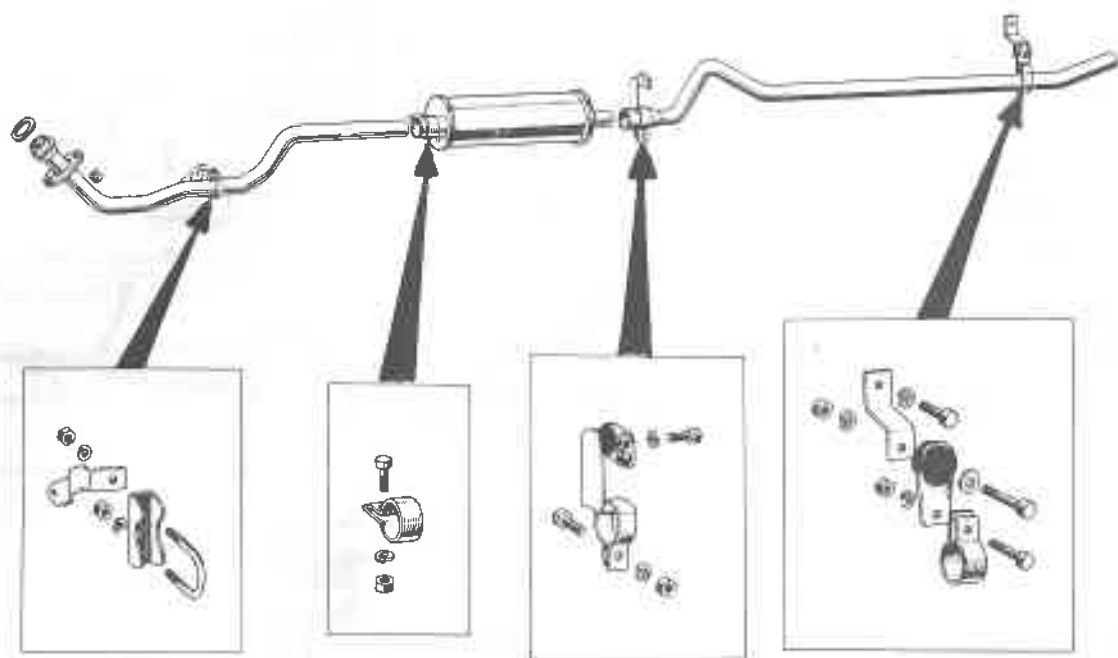


Fig 4-6 Exhaust System Components on RH Series

G3804

## POSITIVE CRANKCASE VENTILATION SYSTEM. (Optional)

The positive crankcase ventilation system is optional as previous, and the system is of a valve type.

This is of an excellent type which draws in the blow-by gas by force into the intake manifold through the ventilation valve to dispose with the fuel mixture.

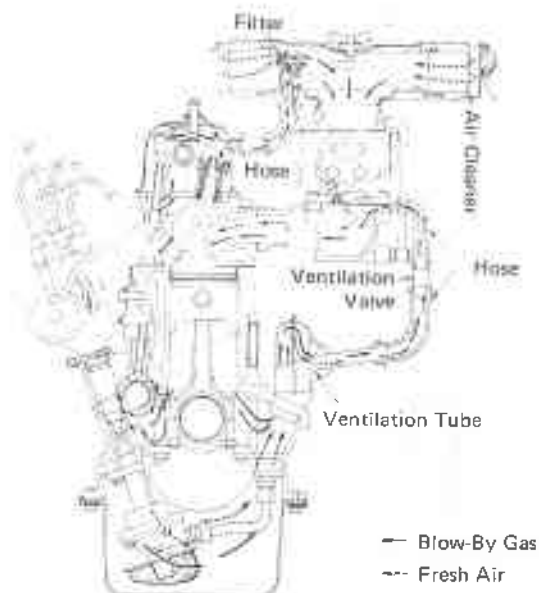


Fig. 4-7 Positive Crankcase Ventilation System

### Ventilation Valve

Normally, the blow-by gas created volume is affected by the manifold vacuum (engine load) due to engine revolution, and by simply connecting the cylinder head cover and intake manifold with an orifice, deficiency will be encountered as blow-by gas creating volume will be less during light load when the manifold vacuum is high due to high efficiency of suction, but during full load, the creating volume will be high due to the lowering of suction efficiency.

For this reason, the ventilation valve (PCV) is provided intermediately to counteract the variation of flow area by the manifold vacuum.

Further, when the blow-by creating volume overcomes the ventilation valve suction efficiency (in full load), the blow-by gas is drawn in from the air cleaner by the tube connecting the cylinder head cover and air cleaner.

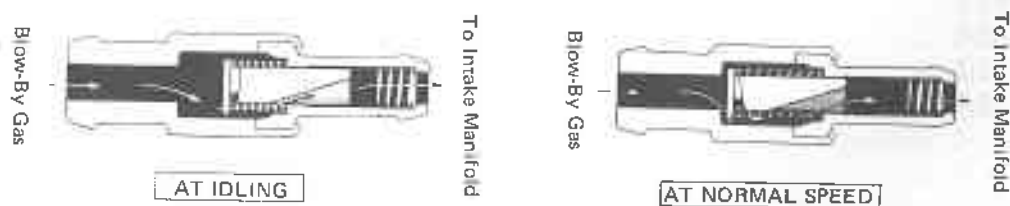


Fig. 4-8 Ventilation Valve Operation

### Inspection

1. Replace worn or defective hose.
2. With the engine idling, press the hose several times. If noise emits when pressed, the PCV operation is satisfactory.

## FUEL SYSTEM

|                                              |      |
|----------------------------------------------|------|
| DESCRIPTION .....                            | 5- 1 |
| TROUBLE SHOOTING .....                       | 5- 2 |
| CARBURETOR .....                             | 5- 4 |
| Description .....                            | 5- 4 |
| Construction & Operation .....               | 5- 5 |
| Float chamber & air vent system .....        | 5- 5 |
| Idling & low speed system .....              | 5- 6 |
| Primary high speed system .....              | 5- 7 |
| Secondary high speed system .....            | 5- 8 |
| Power system .....                           | 5- 9 |
| Accelerating system .....                    | 5- 9 |
| Automatic choke system (RT) .....            | 5-10 |
| Fast idle (RT) .....                         | 5-11 |
| Unloader (RT) .....                          | 5-11 |
| Thermostatic valve .....                     | 5-12 |
| Carburetor Adjustment .....                  | 5-12 |
| Float level .....                            | 5-12 |
| Secondary throttle valve opening angle ..... | 5-13 |
| High speed valve .....                       | 5-13 |
| Fast idle .....                              | 5-13 |
| Unloader .....                               | 5-14 |
| Automatic choke .....                        | 5-14 |
| High speed valve stopper lever .....         | 5-14 |
| Idle adjusting screw .....                   | 5-14 |
| CARBURETOR on RT Series .....                | 5-14 |
| Removal .....                                | 5-14 |
| Disassembly .....                            | 5-15 |
| Main body group .....                        | 5-15 |
| Flange group .....                           | 5-19 |
| Air horn group .....                         | 5-19 |
| Inspection .....                             | 5-20 |
| Air horn group .....                         | 5-21 |
| Main body group .....                        | 5-21 |
| Flange group .....                           | 5-21 |
| Assembly .....                               | 5-22 |
| Air horn group .....                         | 5-22 |
| Main body group .....                        | 5-23 |
| Flange group .....                           | 5-24 |
| Installation .....                           | 5-25 |
| CARBURETOR on Light Truck .....              | 5-25 |
| Removal .....                                | 5-25 |
| Disassembly .....                            | 5-25 |
| Main body group .....                        | 5-28 |

|                                        |             |
|----------------------------------------|-------------|
| Flange group .....                     | 5-29        |
| Air horn group .....                   | 5-30        |
| Inspection .....                       | 5-30        |
| Assembly .....                         | 5-30        |
| Air horn group .....                   | 5-30        |
| Main body group .....                  | 5-31        |
| Flange group .....                     | 5-32        |
| Installation .....                     | 5-33        |
| <b>SOLENOID VALVE .....</b>            | <b>5-33</b> |
| <b>FUEL FILTER (2R) .....</b>          | <b>5-35</b> |
| Description .....                      | 5-35        |
| Removal .....                          | 5-35        |
| Disassembly .....                      | 5-35        |
| Inspection .....                       | 5-35        |
| Assembly .....                         | 5-35        |
| Installation .....                     | 5-35        |
| <b>FUEL PUMP .....</b>                 | <b>5-35</b> |
| Description .....                      | 5-36        |
| Removal .....                          | 5-37        |
| Disassembly .....                      | 5-37        |
| Inspection .....                       | 5-37        |
| Assembly .....                         | 5-37        |
| Installation .....                     | 5-38        |
| Performance Test .....                 | 5-38        |
| <b>FUEL TANK &amp; FUEL PIPE .....</b> | <b>5-39</b> |
| Fuel Tank Removal .....                | 5-41        |
| Inspection .....                       | 5-41        |
| Installation .....                     | 5-41        |
| <b>AIR CLEANER .....</b>               | <b>5-42</b> |
| <b>ACCELERATOR LINKAGE .....</b>       | <b>5-44</b> |
| Description .....                      | 5-45        |
| <b>MEMORANDUM .....</b>                | <b>5-46</b> |

## DESCRIPTION

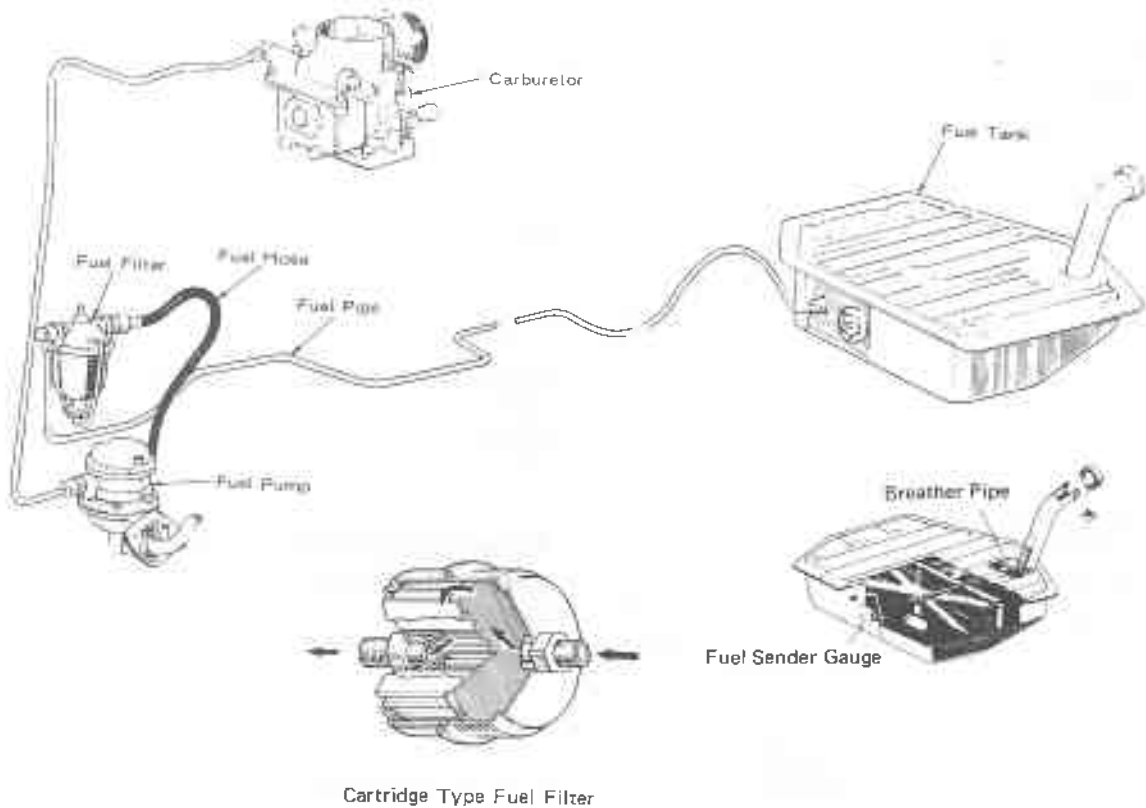


Fig. 5-1 Fuel System on Corona Sedan Series

Y5766, Y5767

The fuel system consists of the fuel tank, fuel filter, fuel pump, carburetor and the pipes which connect the components, and the fuel sender gauge.

The fuel tank on RT series is installed onto the luggage compartment floor, and the upper panel of the fuel tank acts as a floor of the car.

That on RT wagon series is installed onto the floor member of the rear floor end. On RH, RY, RN series, the fuel tank is installed onto the left side of the rear deck with two retaining bands, while the RH11V, B, G and RH16B-B series is provided under the rear floor with six retaining bolts.

The fuel in the fuel tank is drawn into the fuel filter by the suction of the fuel pump through the fuel pipe. The fuel passes the filter element from the outside to the inside of the element, and the fuel is filtered to remove dirt or water if contained within the fuel.

The fuel pump produces a constant controlled fuel pressure, and supplies the filtered fuel into the carburetor through the fuel pipe which is required for engine operation.

The carburetor mixes adequately the fuel delivered from the fuel pump through the fuel filter with the air drawn in from the air cleaner for various operating conditions of the engine.



## TROUBLE SHOOTING

## Fuel Pump

## Symptoms &amp; Probable Causes

## Remedies

- |                                                          |                                                    |
|----------------------------------------------------------|----------------------------------------------------|
| 1. Fuel leaks from fuel pump                             |                                                    |
| a. Loose pump cover screws                               | Tighten screws                                     |
| b. Defective or deteriorated diaphragm                   | Replace diaphragm                                  |
| c. Defective threads of union fitting or cracked fitting | Replace fitting/s                                  |
| 2. Oil leaks from fuel pump                              |                                                    |
| a. Loose fitting of rocker arm pin                       | Replace pump body and pin or replace pump assembly |
| b. Loose 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 valves                                      | Replace valves                                     |
| d. Cracked or broken fuel pipes                          | Replace fuel pipes                                 |
| 4. Noisy fuel pump                                       |                                                    |
| a. Loose fuel pump mounting                              | Tighten mounting bolts                             |
| b. Worn or defective rocker arm                          | Replace rocker arm                                 |
| c. Broken or weak rocker arm spring                      | Replace spring                                     |
| 5. Excessive fuel delivery                               |                                                    |
| a. Improper diaphragm spring                             | Replace with a proper spring                       |

## Carburetor

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

## Symptoms &amp; Probable Causes

## Remedies

- |                                                            |                                            |
|------------------------------------------------------------|--------------------------------------------|
| 1. Flooding                                                |                                            |
| a. Improper seating or damaged float needle valve and seat | Dress or replace the needle valve and seat |
| b. Incorrect float level                                   | Adjust float level                         |
| c. Worn float tab                                          | Replace float                              |
| d. Worn float pin & related parts                          | Replace float pin & related parts          |
| e. Defective air-horn gasket or loose attaching screws     | Replace gasket & tighten screws            |
| f. Fuel pump excessive pressure                            | Check fuel pump                            |
| 2. Rough idling                                            |                                            |
| a. Incorrect idle adjustment                               | Adjust idling                              |
| b. Defective idle adjusting screw                          | Replace idle adjusting screw               |
| c. Plugged idle passage & idle port                        | Clean passage & port                       |

- |                                                                   |                                                               |
|-------------------------------------------------------------------|---------------------------------------------------------------|
| d. Plugged low speed jet                                          | Clean jet                                                     |
| e. Improper low speed jet seating                                 | Tighten or replace jet                                        |
| f. Worn throttle shaft                                            | Replace shaft                                                 |
| g. Loose vacuum pipe union                                        | Tighten union                                                 |
| h. Plugged economizer jet                                         | Clean jet                                                     |
| i. Improper low speed system passage seal                         | Tighten plug or replace seal                                  |
| j. Defective body flange gasket                                   | Replace gasket                                                |
| k. Improper operation of thermostatic valve                       | Replace thermostatic valve                                    |
| <br>                                                              |                                                               |
| 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                                              | Replace plug or jet                                           |
| d. Defective gaskets                                              | Replace gaskets                                               |
| e. Vacuum leaks from power piston vacuum passage                  | Check vacuum passage                                          |
| f. Check valve opens improperly                                   | Check & repair automatic choke, choke linkage & related parts |
| g. Clutch slippage                                                | Adjust or replace clutch                                      |
| h. Dragging brake                                                 | Adjust brakes                                                 |
| i. Incorrect tire inflation                                       | Correct tire inflation                                        |
| <br>                                                              |                                                               |
| 4. Poor acceleration (Lack of rich fuel mixture for acceleration) |                                                               |
| a. Defective accelerating pump                                    | Replace plunger                                               |
| b. Plugged pump jet                                               | Clean pump 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 spring                                   |
| f. Defective power valve                                          | Replace power valve                                           |
| g. Plugged power jet                                              | Clean or replace jet                                          |
| h. Float level too low                                            | Adjust float level                                            |
| i. Incorrect throttle opening                                     | Adjust throttle linkage                                       |
| <br>                                                              |                                                               |
| 5. Stalling (Lack of fuel mixture at high speed)                  |                                                               |
| a. Plugged main jet                                               | Clean main jet                                                |
| b. Incorrect float level                                          | Adjust float level                                            |
| c. Defective operation of power piston                            | Replace power piston spring                                   |
| d. Defective power valve                                          | Replace power valve                                           |
| e. Worn throttle valve shaft                                      | Replace throttle valve shaft                                  |
| f. Defective gaskets                                              | Replace gaskets                                               |
| g. Incorrect throttle opening                                     | Adjust throttle linkage                                       |
| h. Defective operation of high speed valve                        | Repair high speed valve operation                             |
| <br>                                                              |                                                               |
| 6. Poor cold weather operation                                    |                                                               |
| a. Improper choke operation                                       | Check related parts or replace choke assembly                 |
| b. Incorrect fast idle                                            | Adjust fast idle                                              |
| c. Improper unloader                                              | Adjust unloader                                               |

## CARBURETOR

## Description

The carburetor installed on the 2R or 12R engine is a two-barrel type to insure efficient performances of the carburetor under various operations. It is similar to two single barrel carburetors built into one single unit with special features. The primary system incorporates a double type venturi while the secondary system is provided with a triple type venturi. Each system consists of the air horn, main nozzle and throttle valve. One set forms the primary while the other set forms the secondary side. The primary system composes of the low speed, high speed, power valve, accelerating and choke systems, and is able to supply the air-fuel mixture for normal operation. When the throttle valve is opened wide for full load or for acceleration, the secondary system also operates to supply the air-fuel mixture together with the primary system. The throttle valves of both the primary and the secondary systems are operated with linkage, and are interlocked enabling both the throttle valves to open fully simultaneously.

The high speed valve installed in the secondary system together with the power valve enables the performances extremely smooth.

The carburetor equipped on RT series is incorporated with the automatic choke system, while the Light-Truck series is provided with the manual choke system.

Therefore, the construction and the operation of each carburetor is the same with the exception of the choke system.

## Specification:

| Vehicle                 |         | RT                                    | RY, RH                        | RN                            |
|-------------------------|---------|---------------------------------------|-------------------------------|-------------------------------|
| Type                    |         | Down-draft, two-barrel                |                               |                               |
| Air hone outer diameter | mm (in) | 63.0 (2.48)                           | ←                             | ←                             |
| Venturi diameter        | mm (in) |                                       |                               |                               |
| Primary — Main          |         | 23.0 (0.91)                           | ←                             | ←                             |
| — Small                 |         | 8.0 (0.32)                            | ←                             | ←                             |
| Secondary — Main        |         | 2R- 27.0 (1.06)<br>12R- 28.0 (1.12)   | ←                             | ←                             |
| — Small                 |         | 2R- 7.0 (0.28)<br>12R- 9.0 (0.36)     | ←                             | ←                             |
| Throttle bore diameter  | mm (in) |                                       |                               |                               |
| Primary                 |         | 30.0 (1.18)                           | ←                             | ←                             |
| Secondary               |         | 2R- 32.0 (1.26)<br>12R- 34.0 (1.34)   | ←                             | ←                             |
| Main jet diameter       | mm (in) |                                       |                               |                               |
| Primary                 |         | 2R- 1.08 (0.143)<br>12R- 1.03 (0.041) | 1.06 (0.042)<br>1.03 (0.041)  | 1.11 (0.044)<br>1.03 (0.041)  |
| Secondary               |         | 2R- 1.40 (0.055)<br>12R- 1.62 (0.064) | 1.60 (0.063)<br>1.56 (0.061)  | 1.47 (0.058)<br>1.65 (0.065)  |
| Slow jet diameter       | mm (in) | 2R- 0.55 (0.022)<br>12R- 0.50 (0.020) | 0.435 (0.019)<br>0.47 (0.019) | 0.525 (0.021)<br>0.47 (0.019) |
| Power jet diameter      | mm (in) | 2R- 0.75 (0.030)<br>12R- 0.50 (0.020) | 0.60 (0.024)<br>0.58 (0.023)  | 0.70 (0.028)<br>0.60 (0.024)  |
| Pump jet diameter       | mm (in) | 0.50 (0.020)                          | 0.47 (0.019)<br>0.50 (0.020)  | 0.50 (0.020)                  |
| Economizer jet diameter | mm (in) | 2R- 0.80 (0.031)<br>12R- 1.00 (0.040) | 0.80 (0.031)                  | 0.80 (0.031)<br>1.00 (0.040)  |

|                                                                                                                          |         |                                                                                                        |                          |                          |
|--------------------------------------------------------------------------------------------------------------------------|---------|--------------------------------------------------------------------------------------------------------|--------------------------|--------------------------|
| Main air bleed diameter                                                                                                  | mm (in) |                                                                                                        |                          |                          |
| Primary                                                                                                                  |         | 2R- 0.70 (0.028)                                                                                       | 0.50 (0.020)             | 0.70 (0.028)             |
|                                                                                                                          |         | 12R- 0.50 (0.020)                                                                                      | —                        | 0.50 (0.020)             |
| Secondary                                                                                                                |         | 2R- 0.70 (0.028)                                                                                       | 0.50 (0.020)             | 0.70 (0.028)             |
|                                                                                                                          |         | 12R- 0.50 (0.020)                                                                                      | —                        | 0.50 (0.020)             |
| Power piston operating vacuum                                                                                            | mm (in) | 2R- 110 ~ 130<br>(4.3 ~ 5.1)                                                                           | 70 ~ 90<br>(2.8 ~ 3.5)   | 110 ~ 130<br>(4.3 ~ 5.1) |
|                                                                                                                          |         | 12R- 120 ~ 140<br>(4.7 ~ 5.5)                                                                          | 120 ~ 140<br>(4.7 ~ 5.5) | 120 ~ 140<br>(4.7 ~ 5.5) |
| Float level                                                                                                              | mm (in) |                                                                                                        |                          |                          |
| Raised position (from air horn fitting surface)                                                                          |         | 3.5 (0.140)                                                                                            | ←                        | ←                        |
| Lowered position (between needle valve push pin and float tab)                                                           |         | 0.9 (0.035)                                                                                            | ←                        | ←                        |
| Idle mixture adjusting screw preset position                                                                             |         |                                                                                                        |                          |                          |
| for 2R                                                                                                                   |         | Screw out about 2-1/2 turns after slightly seating.<br>Screw out about 2 turns after slightly seating. |                          |                          |
| for 12R                                                                                                                  |         |                                                                                                        |                          |                          |
| Throttle valve fully closed angle:                                                                                       |         |                                                                                                        |                          |                          |
| Primary                                                                                                                  |         | 7°                                                                                                     | ←                        | ←                        |
| Secondary                                                                                                                |         | 20°                                                                                                    | ←                        | ←                        |
| Fast idle: Primary throttle valve should open at Right degree from closed position when the choke valve is fully closed. |         | 2R - 12°<br>12R - 13°                                                                                  | 12°<br>17°               | 13°<br>17°               |
| Unloader                                                                                                                 |         | 2R - 30°<br>12R - 27°                                                                                  | —<br>—                   | —<br>—                   |
| Thermostatic valve operating temperature                                                                                 |         | Fully closed at 60°C (140°F)<br>Fully opened at 75°C (167°F)                                           |                          |                          |

## Construction & Operation

The carburetor is of a three group construction consisting of the air horn group, main body group and the flange group.

Each group composes the primary and the secondary bores.

The primary bore provided with a double venturi consists of the slow system, high speed system, accelerating system, choke system and the thermostatic valve system enabling the air-fuel mixture to be supplied to the engine as required for normal driving conditions. The secondary bore provided with a triple venturi consists only of the high speed system to meet the requirement for high speed and for sudden acceleration.

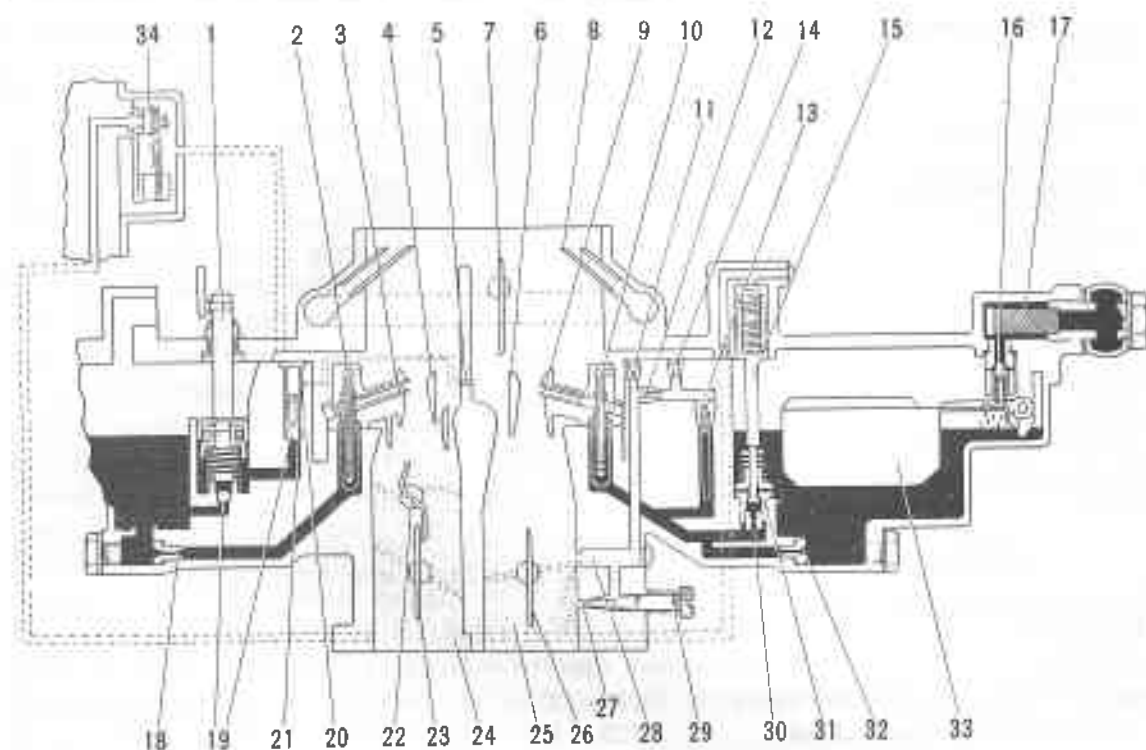
### 1. Float chamber & air vent system

The float chamber serves as a constant level fuel reservoir.

It is necessary to maintain the fuel level at a constant height regardless of whether small or large amount of fuel is being withdrawn.

The level gauge glass is installed at the float chamber as a cover for visual inspection of the fuel level.

The fuel forced out from the fuel pump enters into the float chamber through the strainer (1) and the needle valve (2).



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

Fig. 5-2 Cross Sectional View of Carburetor

Y5447

and the fuel level is regulated at constant height causing to the opening and closing of the needle valve by the buoyance of the float (3).

Since the flux of the fuel from each jet is determined under the condition that the fuel level is the specified height, the improper fuel level influences the performances of the carburetor remarkably. The air horn is provided with the vent tubes (4), and these tubes are connected with the float chamber to maintain the same air pressure in the air horn and the float chamber.

This type compensates the out-of-

balance of the air-fuel mixture causing to the clogging of the air cleaner.

## 2. Idling & low speed system

The idling and the low speed system supplies the air-fuel mixture to the engine when the primary throttle valve is slightly opened or fully closed, viz; the engine is operated at idling speed or light load and slow speed.

The fuel from the float chamber flows through the primary main jet to the slow jet (1), and the fuel is controlled to the minimum quantity by the slow jet.

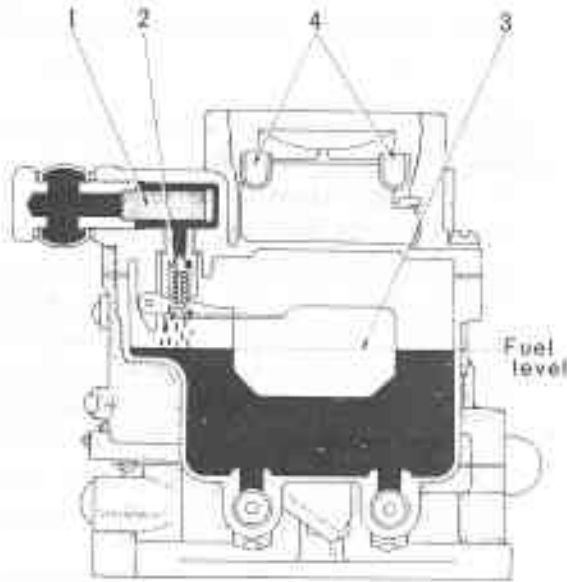


Fig. 5-3 Float Chamber & Air Vent G1352

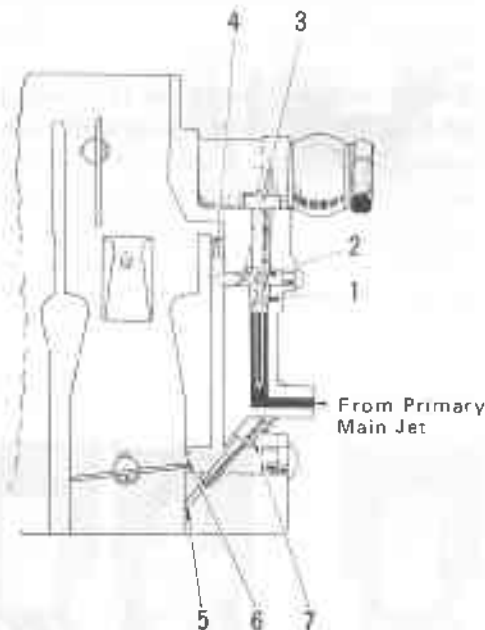


Fig. 5-4 Idle & Low Speed System G1353

The controlled fuel mixes with the air from the slow air bleeder No. 1 (2), and after passing the economizer jet (3), mixes with the air from the slow air bleeder No. 2 (4) extensively, and flows down into the slow port (5) and the idle

port (6) to be discharged in spray form into the intake manifold

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 to discharge the air-fuel mixture same as the idle port.

The amount of air-fuel mixture discharged from the idle port is regulated by adjusting the idle adjusting screw (7).

### 3. Primary high speed system

This system is provided to supply the air-fuel mixture for intermediate throttle opening or part-load operating requirements, and the fuel consumption is mainly controlled by this system.

The fuel is controlled by the primary main jet (1) located at the bottom of the float chamber, and is mixed with the air from the primary main air bleeder (2). The mixture is withdrawn from the primary main nozzle (3) to the primary small venturi (4) in accordance with the air stream flowing through the venturi.

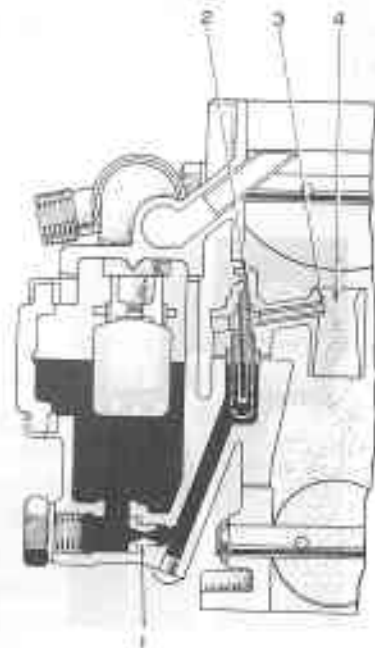


Fig. 5-5 Primary High Speed System G1354

## 4. Secondary high speed system

The fuel system of the secondary high speed is separated from that of the primary high speed system completely, but the construction is very similar to the primary high speed system.

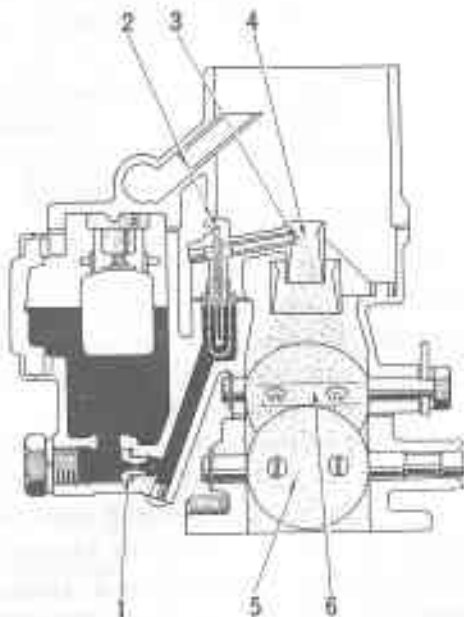


Fig. 5-6 Secondary High Speed System G1355

The fuel is controlled by the secondary main jet (1), and is mixed with the air from the secondary main air bleeder (2),

and is withdrawn from the secondary main nozzle (3) to the secondary small venturi (4).

Whenever more engine power is required, and as the accelerator pedal is depressed, the primary throttle valve is opened approximately 50°, the secondary throttle valve (5) is started to open by the linkage, and also both valves are fully opened at the same time. However, while the engine revolution is not high enough, the high speed valve (6) remains at closed position even though both valves are fully opened, therefore, the secondary high speed system remains inactive.

At this time, the mixture required to the engine is only supplied by the primary high speed system. This causes the air flow through the primary venturi to quicken accomplishing a complete atomization of the air-fuel mixture to the cylinders.

As the engine revolution 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 the mixture starts to be withdrawn from the secondary main nozzle.

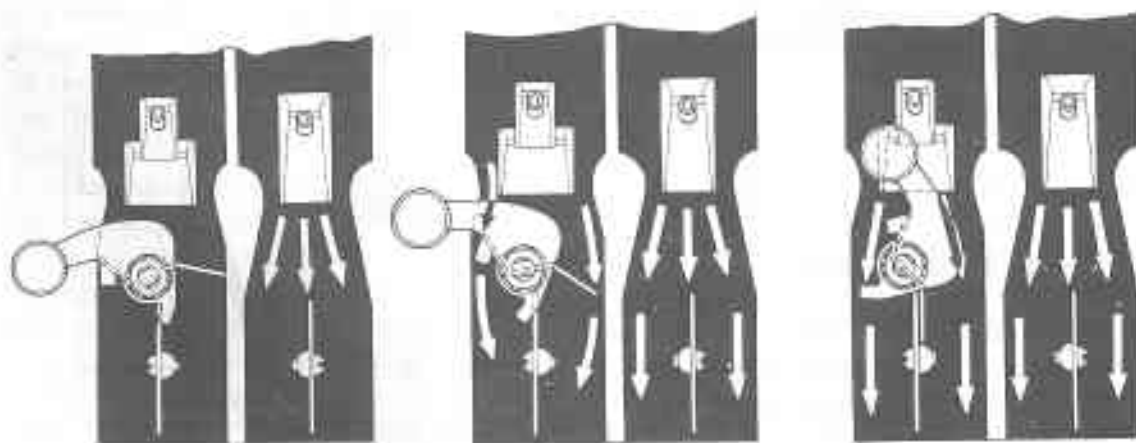


Fig. 5-7 High Speed Valve Operation

G1356, G1357, G1358

### 5. Power system

The primary and the secondary high speed systems are designed to deliver the most economical air-fuel mixture. However, when full engine power is desired, it is necessary to supply the rich mixture.

To obtain this rich mixture, the power system is incorporated in the carburetor. When the throttle valve is partially opened, and when the manifold vacuum is high, the manifold vacuum pulls up the power piston (1) to close the power valve (3).

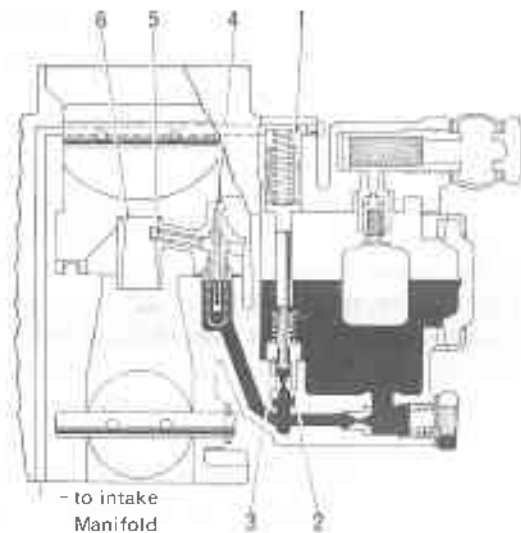


Fig. 5-8 Power System

G1359

As the primary throttle valve is fully opened, 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 through the power jet (2), and joins with the fuel from the primary main jet.

Thus, extra fuel is discharged from the primary main nozzle (5) to the small venturi (6) after mixing with the air from the primary main air bleeder (4).

### 6. Accelerating system

The carburetor is provided with the accelerating system to obtain the rich mixture momentarily in accordance with the depression of the accelerator pedal when rapid engine revolution is required. When the accelerator pedal is suddenly depressed for quick acceleration, the plunger (1) connected to the throttle valve is pushed down into the pump cylinder. Thus, the inlet side steel ball (5) is closed, and the fuel pushes the outlet side steel ball (2) and the discharge weight (3), then the fuel is discharged

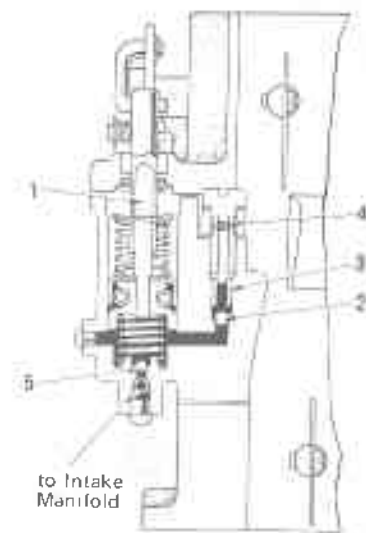


Fig. 5-9 Accelerating System

G1360

from the pump jet (4) into the venturi to supply rich mixture necessary for acceleration.

When the throttle valve is closed, the pump plunger is pulled upwards and the outlet side steel ball is closed by the discharge weight, and at the same time, the inlet side port is opened to refill the pump cylinder with fuel from the float chamber.

Also when the accelerator pedal is fully depressed, and as the manifold vacuum drops, the power valve is opened, and the fuel is also supplied from the power system.



## 7. Automatic choke system (RT)

The automatic choke system consists of the coil housing installed with the thermostatic bimetal coil, thermostat case provided with the vacuum piston, choke shaft, fast idle cam, etc., and the automatic choke stove pipe which is connected with the air cleaner and the coil housing.

The air from the air cleaner is warmed up while passing the stove pipe (2) installed on the intake manifold (1) by the heat within the exhaust manifold (3), and passes the coil housing (4), then the air is drawn into the intake manifold pushing down the vacuum piston (5).

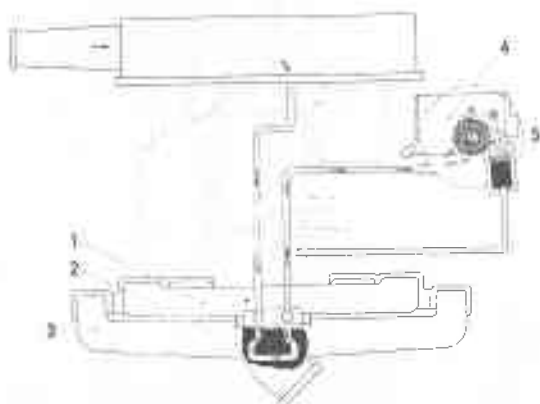


Fig. 5-10 Automatic Choke System

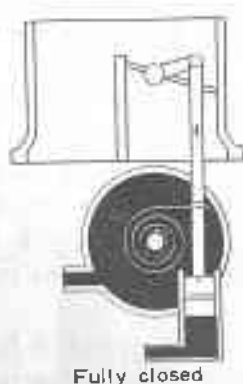
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The choke valve is opened fully when the vacuum piston is pushed down all the way, and also since the choke valve is installed eccentrically against the choke shaft, the choke valve is opened according to the air intake pressure created when the air is drawn into the cylinders.

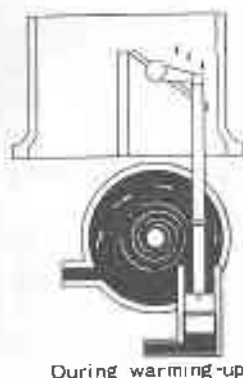
The thermostatic bimetal coil is adjusted to close the choke valve fully at 25°C (77°F), therefore, below this temperature, the choke valve will be closed completely.

When starting the engine in cold weather, as the choke valve is closed, high vacuum is created within the intake manifold, and the vacuum piston is pulled downward to open the choke valve in opposition to the expansibility of the bimetal coil, in addition, as the air intake pressure is also applied onto the choke valve, the choke valve tends to open slightly.

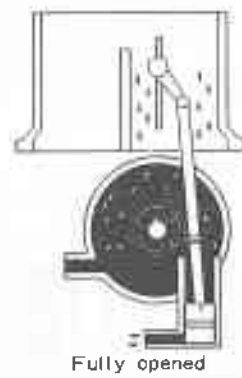
For these reasons, the choke valve allows the draw in of necessary air for starting the engine. Since the bimetal coil expansibility increases in accordance with the temperature decrease, the opening angle of the choke valve becomes smaller, and resultantly the mixture becomes rich to facilitate the starting of the engine in cold weather.



Fully closed



During warming-up



Fully opened

Fig. 5-11 Automatic Choke Operation

G1361, G1362, G1363

After starting the engine, as the vacuum applying onto the vacuum piston and the air intake pressure exerted on the choke valve increase, and the choke valve is opened further (approx.  $15^\circ$ ) balancing with the bimetal coil expansibility until proper engine revolution is obtained.

As the engine warms up, and since the air entering into the thermostat case is heated by the exhaust manifold, the expansibility of the bimetal coil will decrease gradually, and finally the choke valve is opened completely.

If the throttle valve is opened suddenly during the engine warm-up, the choke valve will close momentarily due to decrease of vacuum within the intake manifold to maintain a smooth acceleration of the engine.

#### 8. Fast Idle (RT)

The fast idle is to maintain higher revolution of the engine than the idling speed while the engine is started, and is for warming up. When the carburetor is in choked position, the fast idle cam

follower (2) installed on the sliding rod (1) which is connected to the throttle valve shaft contacts against the fast idle cam (3), and the throttle valve is opened slightly.

For this reason, the idling revolution becomes slightly higher. As the fast idle cam is of the four steps type, the revolution is obtained in accordance with the choke valve opening angle.

Even after the engine is warmed up, and the choke valve is fully opened, the fast idle is still in operation.

To obtain a normal idling, depress the accelerator pedal slightly to return the cam to its original position.

Also when starting a cold engine, as the fast idle cam is obstructed by the cam follower, the choke valve is not closed. Consequently, it is necessary to depress the accelerator pedal one time and all the way to close the choke valve.

#### 9. Unloader (RT)

When starting to drive with a cold engine without warming up the engine, and

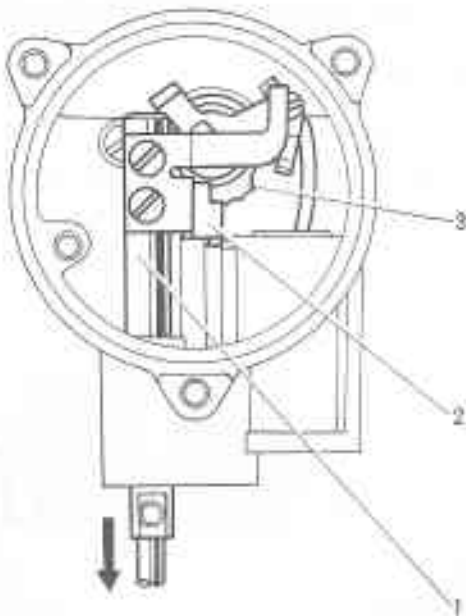


Fig. 5-12 Fast Idle Operation

G1364

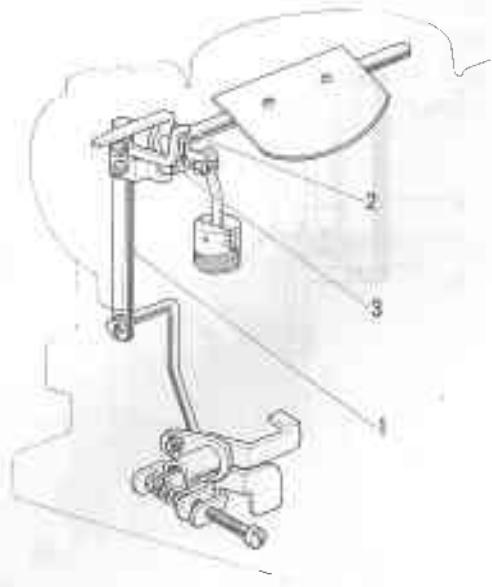


Fig. 5-13 Under Operation

G1365

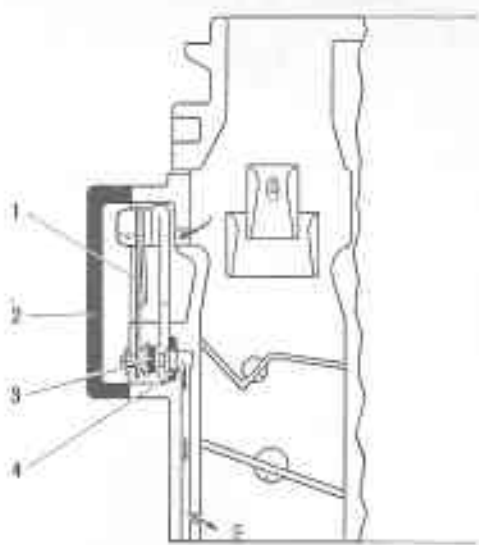
trying to accelerate, the choke valve has to open to a certain position, otherwise, the engine will stall.

To avoid engine from stalling, the accelerator is provided with the unloader. The choke valve is so designed that it will open approximately 25° mechanically from the fully closed position when the throttle valve is fully opened.

As the accelerator pedal is depressed, the choke shaft (3) is rotated by the cam follower (2) installed on the sliding rod (1) to open the choke valve forcibly.

#### 10. Thermostatic valve

When the temperature around the carburetor rises as in summer season with slow cruising speed, the fuel will evaporate rapidly.



- 1 Thermostatic valve
- 2 Thermostatic valve cover
- 3 Valve
- 4 "O" ring

Fig. 5-14 Thermostatic Valve

G0221

Consequently, engine stalling, rough idling and hard starting of the engine may result.

This thermostatic valve eliminates these deficiencies.

The thermostatic valve starts to open at 60°C (140°F), and is fully opened at 75°C (167°F), and allows the air flow into the intake manifold directly through the port installed on the flange to dilute the over rich mixture with air.

#### Carburetor Adjustment

##### Float Level

The float level adjustment is performed by bending the float tabs, but it should be checked by the level line on the level gauge glass while the engine is operated at idling speed.

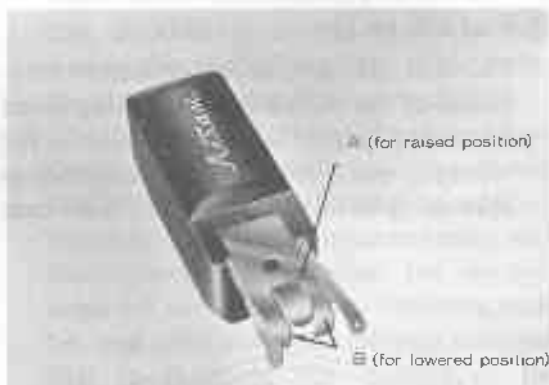


Fig. 5-15 Float Tabs

V2178

##### 1. Raised position

Inspect the distance between the end of

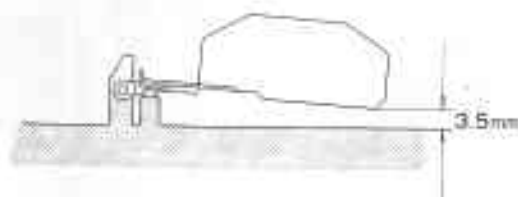


Fig. 5-16 Checking Raised Position

V2841

the float and the air horn gasket surface with the Gauge 09240-31020 when the float is lowered by inverting the air horn. This distance should be 3.5 mm (0.14"), and to obtain a correct distance, bend the tab "A" as shown in figure 5-15.

## 2. Lowered position

Lift up the float and check the gap between the needle valve bushing pin and the float lip with the wire gauge 09240-00010.

Standard gap 1.2 mm (0.047")

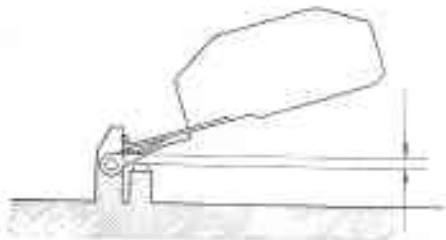


Fig. 5-17 Checking Lowered Position V3993

## Secondary Throttle Valve Opening Angle

Hold the primary throttle valve at the fully opened position, and inspect if the

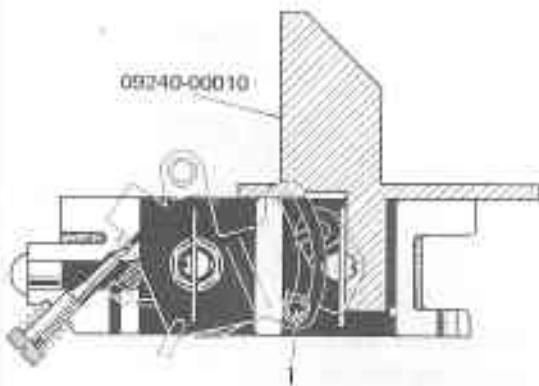


Fig. 5-18 Checking Valve Opening Angle G1366

secondary throttle valve is vertically against the flange surface with the Gauge 09240-31020 as shown in figure 5-18.

If necessary, adjust the opening angle by bending the throttle shaft link (1). After adjusting the link, check if the link motion is smooth.

## High Speed Valve

Inspect the clearance between the high speed valve and the bore when the high speed valve is at fully closed position.

The clearance should be within 0.10 to 0.25 mm (0.004 ~ 0.01").

If necessary, adjust the installation position of the high speed valve by loosening the valve retaining screws. After adjusting the clearance, check if the valve operation is smooth, and then calk the retaining screw ends to prevent them from loosening.

Note:

The following adjustments should be performed after assembling the carburetor.

## Fast Idle

On RT series:

Position the choke valve at fully closed position, and adjust the clearance between the primary throttle valve (1) and the bore to be 0.75 mm (0.03") with the fast idle adjusting screw (2) using the Wire Gauge 09240-00010.



Fig. 5-19 Adjusting Fast Idle

V3994

**On Light Truck series**

Disconnect the fast idle connecting link when the idle adjustment is performed after installing the carburetor onto the engine.

Bend the fast idle connecting link so that it will be connected freely after performing the idle adjustment.

**Unloader**

Hold the throttle valves at fully opened position, and apply the 45° angle Gauge 09240-00010 onto the choke valve.

Adjust the opening angle of the choke valve (1) so that it will open 30° for 2R and 27° for 12R from the closed position by bending the fast idle cam follower (2) or the lip (3) of the choke shaft.



Fig. 5-20 Adjusting Unloader

G1367

**Automatic Choke**

The automatic choke should be adjusted to supply adequate air-fuel mixture for engine starting in accordance with the climatic condition, but generally, align the groove on the coil housing with the center line located on the thermostat case.

At this time, the choke valve will be closed fully at 25°C (77°F).

The variation of one graduation on the thermostat case is equal to 5°C (9°F).

To adjust the choking effect, turn the coil housing counterclockwise to richen the mixture, and turn the coil housing clockwise to lean the mixture after checking if the choke valve is closed from fully opened

position when the coil housing is turned counterclockwise.

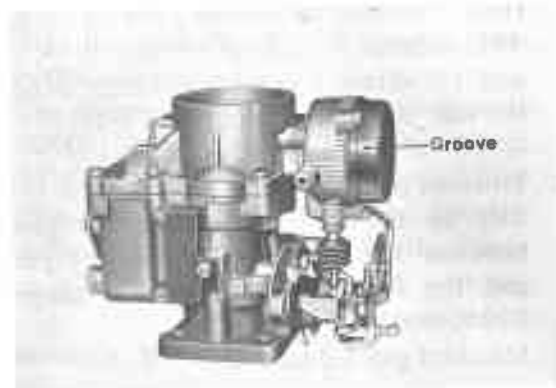


Fig. 5-21 Automatic Choke Adjustment B0107

**High Speed Valve Stopper Lever**

Adjust the unlocking motion of the stopper lever by the bending the lip of the stopper lever so that the secondary throttle valve is unlocked at the same time when the secondary throttle valve starts to open.

**Idle Adjusting Screw**

The idle adjusting screw should be correctly adjusted after the carburetor is installed onto the engine, but for pre-adjustment, screw in the idle adjusting screw until it seats slightly, then screw it out about two and one-half of a turn.

Do not screw in the screw securely. If the tapered end of the adjusting screw is damaged, a smooth idling operation and the vacuum are not obtainable.

**CARBURETOR on RT series****Removal**

1. Remove the air cleaner.
2. Disconnect the automatic choke stove outlet pipe from the carburetor.
3. Disconnect the accelerator link connecting rod from the carburetor.
4. Disconnect the vacuum pipe and the fuel pipe from the carburetor.
5. Remove the carburetor retaining nuts, and remove the carburetor and the accelerator bell-crank.

6. Remove the heat insulator from the manifold if necessary.

### Disassembly

For disassembling and assembling the carburetor, the Carburetor Adjust Kit 09240-00010 together with the Carburetor Screwdriver Set 09860-11010 should always be utilized.

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

The removed parts should be kept in a clean container to facilitate the assembly.

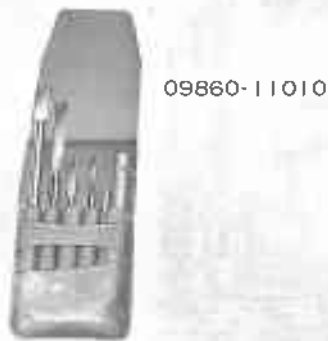


Fig. 5-22 Carburetor Screwdriver Set B0108

1. Remove the pump arm retaining screw (1), and remove the pump connecting link (3) together with the pump lever (2).
2. Remove the fast idle connecting link (4).

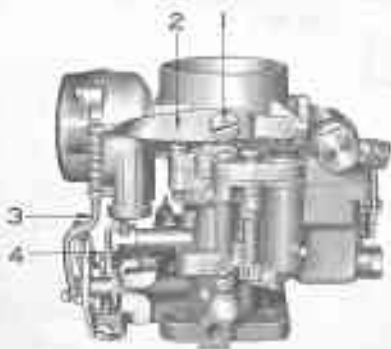


Fig. 5-23 Connecting Links Removal B0109

3. Remove the slow passage plug, and remove the air horn straight upward by removing the six retaining screws.

4. Remove the pump damping spring.

5. Invert the carburetor, and take out the stopper (1), discharge weight (2) and the steel ball (3).

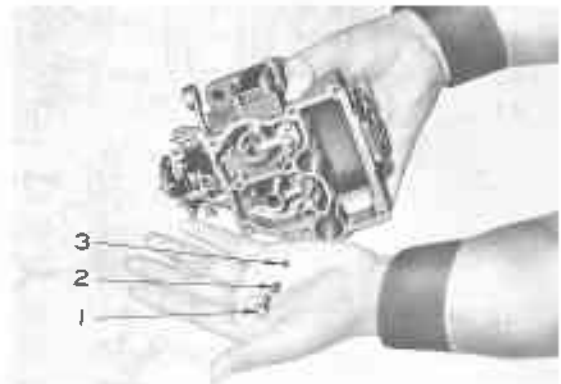


Fig. 5-24 Steel Ball Removal

B0110

6. Remove the four flange retaining screws, and separate the main body from the flange.

### Main Body Group

7. Remove the stopper lever retaining screw, and remove the stopper lever (1) together with the stopper lever spring.
8. Remove the high speed valve arm retaining nut, then remove the valve arm (2) from the high speed valve shaft.



Fig. 5-25 Lever & Arm Removal

B0111

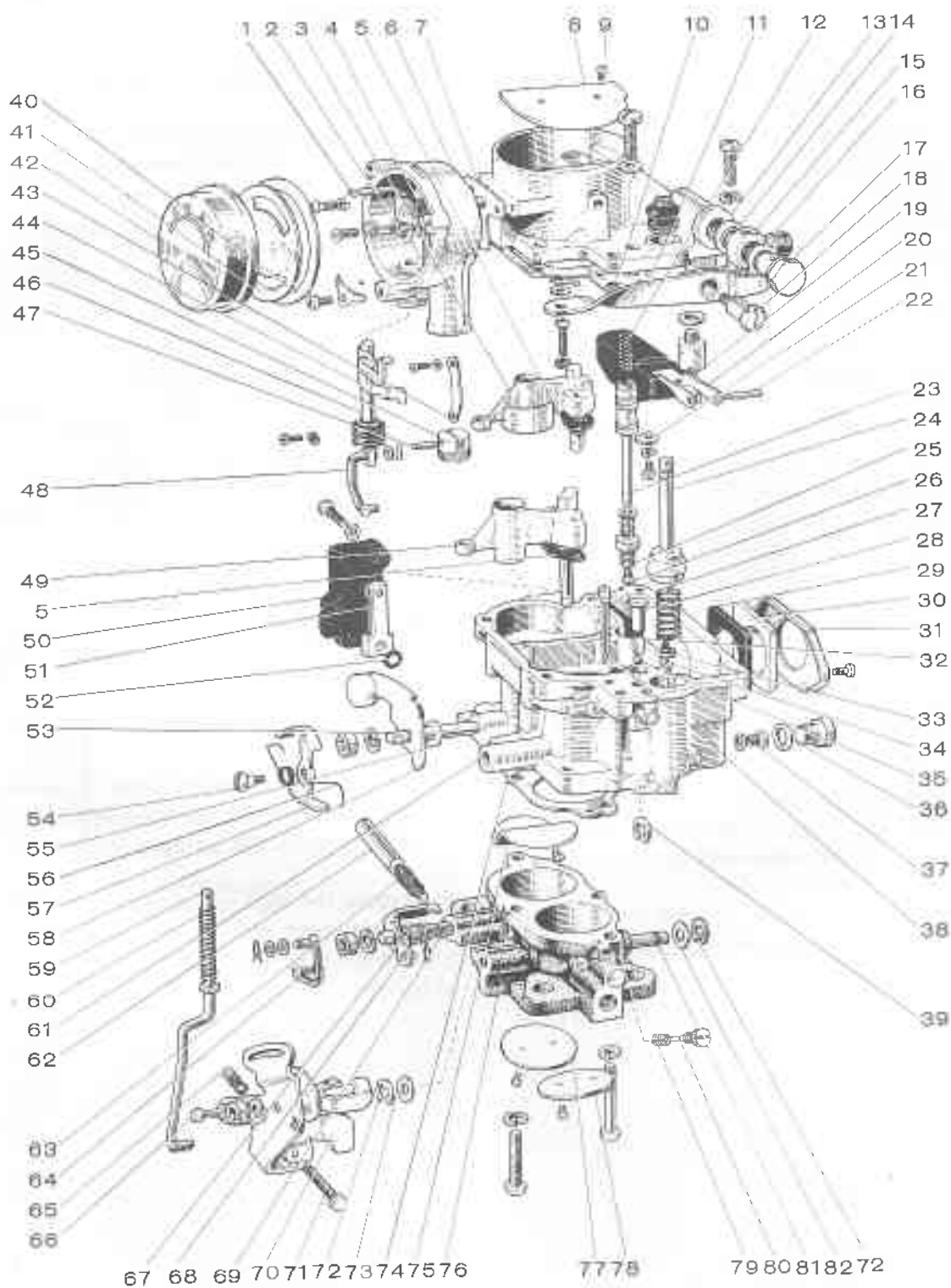


Fig. 5-26 Carburetor Components for RT Series

- |    |                          |    |                                  |
|----|--------------------------|----|----------------------------------|
| 1  | Choke shaft              | 42 | Coil housing                     |
| 2  | Fast idle cam            | 43 | Piston connector                 |
| 3  | Secondary small venturi  | 44 | Fast idle cam follower           |
| 4  | Fast idle cam spring     | 45 | Vacuum piston                    |
| 5  | Venturi gasket           | 46 | Sliding rod                      |
| 6  | Thermostat case          | 47 | Piston pin                       |
| 7  | Case gasket              | 48 | Fast idle connecting link        |
| 8  | Choke valve              | 49 | Primary small venturi            |
| 9  | Valve retaining screw    | 50 | Thermostatic valve cover         |
| 10 | Air horn gasket          | 51 | Thermostatic valve               |
| 11 | Pump lever               | 52 | "O" ring                         |
| 12 | Power piston spring      | 53 | High speed shaft                 |
| 13 | Air horn                 | 54 | Retaining screw                  |
| 14 | Union gasket             | 55 | Shim                             |
| 15 | Union fitting            | 56 | Stopper lever spring             |
| 16 | Union gasket             | 57 | High speed valve stopper lever   |
| 17 | Union bolt with strainer | 58 | High speed valve shaft arm       |
| 18 | Pump arm retaining screw | 59 | Pump connecting link             |
| 19 | Needle valve             | 60 | Pump arm push spring             |
| 20 | Float                    | 61 | Main body                        |
| 21 | Power piston stopper     | 62 | Throttle adjusting screw         |
| 22 | Float lever pin          | 63 | Adjusting screw spring           |
| 23 | Power piston             | 64 | Throttle shaft link              |
| 24 | Pump plunger             | 65 | Adjusting screw spring           |
| 25 | Power valve              | 66 | Primary throttle shaft arm       |
| 26 | Power jet                | 67 | Secondary throttle lever         |
| 27 | Pump damping spring      | 68 | Secondary throttle return spring |
| 28 | Weight stopper           | 69 | Secondary throttle shaft         |
| 29 | Level gauge gasket       | 70 | Fast idle lever                  |
| 30 | Level gauge glass        | 71 | Fast idle adjusting screw        |
| 31 | Level gauge clamp        | 72 | Retainer ring                    |
| 32 | Pump discharge weight    | 73 | Shim                             |
| 33 | Ball check retainer      | 74 | Body flange gasket               |
| 34 | Steel ball (inlet)       | 75 | High speed valve                 |
| 35 | Steel ball (outlet)      | 76 | Flange                           |
| 36 | Main passage plug        | 77 | Secondary throttle valve         |
| 37 | Main jet                 | 78 | Primary throttle valve           |
| 38 | Slow jet                 | 79 | Adjusting screw spring           |
| 39 | Retainer ring            | 80 | Idle adjusting screw             |
| 40 | Coil housing plate       | 81 | Primary throttle shaft           |
| 41 | Coil housing gasket      | 82 | Shim                             |



9. Remove the small venturi retaining screws (1), and remove the primary small venturi (2) and the secondary small venturi (3).

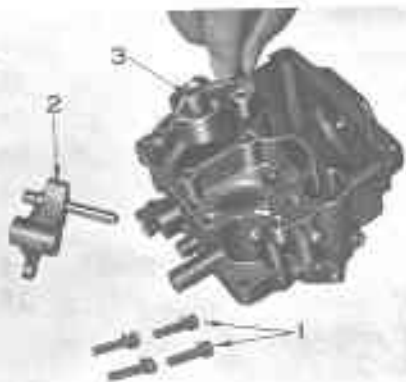


Fig. 5-27 Venturi Removal

B0112

10. Remove the check ball retainer (1) located at the bottom of the pump cylinder, and remove the steel ball (2) by inverting the main body.

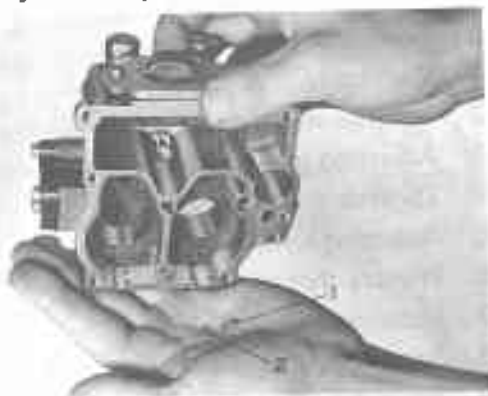


Fig. 5-28 Steel Ball Removal

V1860

11. Remove the slow jet. This slow jet can be removed without removing the air horn if necessary.
12. Remove the power valve using the Power Valve Wrench, and remove the power jet from the power valve.
13. Remove the level gauge clamp (1), glass (2) and the gasket (3) by removing the two retaining screws.
14. Remove the three thermostatic valve cover retaining screws, and remove the



Fig. 5-29 Power Valve Removal

B0113

valve cover, thermostatic valve (4) and the "O" ring (5).

Do not disassemble the thermostatic valve.

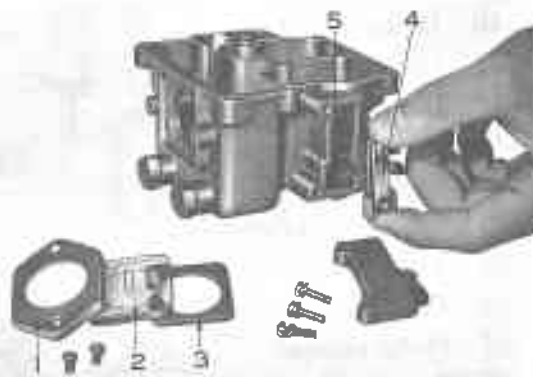


Fig. 5-30 Thermostatic Valve Removal

B0114

15. Remove the primary and the secondary main passage plugs (1), and remove the primary main jet (2) and the secondary main jet with the gaskets.

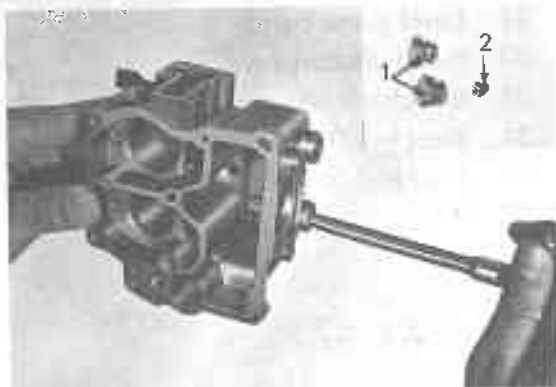


Fig. 5-31 Main Jet Removal

B0115  
B0116

16. Remove the high speed valve retaining screws, then remove the high speed valve.

Since the ends of the retaining screws are calked, file off the calked portion of the screw ends slightly before removing.

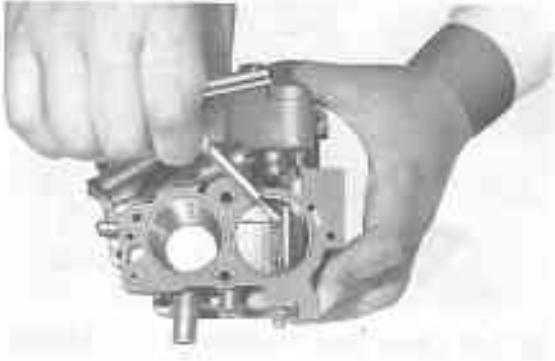


Fig. 5-32 High Speed Valve Removal B0117

17. Remove the retainer ring, and remove the high speed shaft.

#### Flange Group

18. Remove the idle adjusting screw (1) and the throttle adjusting screw (2) together with the screw springs.
19. Remove the snap ring on the throttle shaft link and the arm retaining nut, then remove the throttle shaft arm (3).
20. Remove the lever retaining nut, and remove the secondary throttle lever (4) with the return spring.

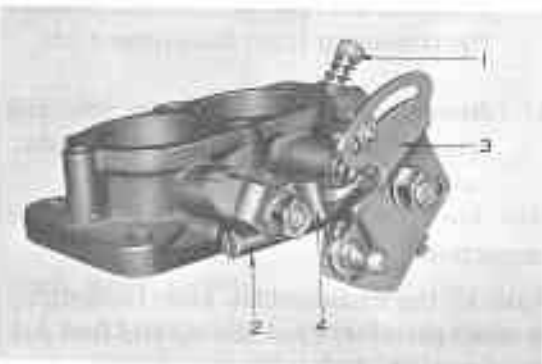


Fig. 5-33 Screw & Lever Removal B0118

21. Remove the primary throttle valve (1) and the retainer rings (2), and then remove the primary throttle shaft (3).

As the ends of the throttle valve retaining screws are calked, remove them after filing off the calked portions of the screws.

Also since the adjusting shims are installed onto both shaft ends for adjustment of the primary throttle shaft thrust play, do not lose the shims.

22. Remove the secondary throttle valve (4) in the same manner as the primary side, and remove the secondary throttle shaft (5).

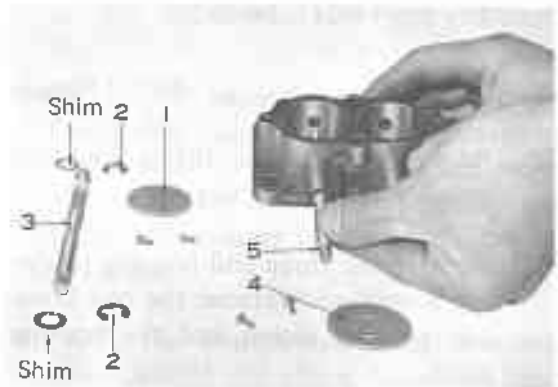


Fig. 5-34 Throttle Shaft Valves Removal

V1876

#### Air Horn Group

23. Remove the pump plunger and the boot.
24. Pull out the float lever pin (1), and remove the float (2), valve push pin

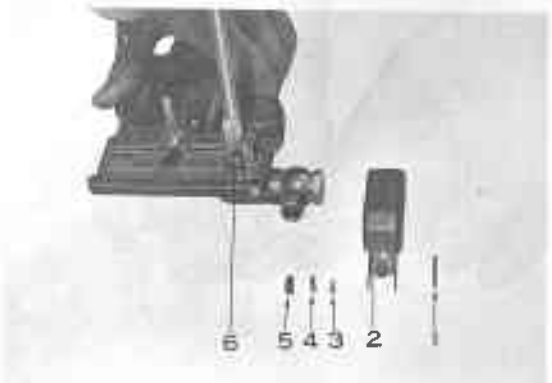
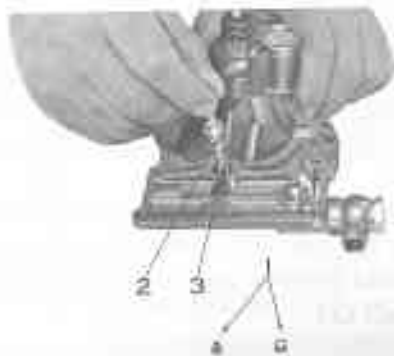


Fig. 5-35 Needle Valve Removal

V3997

- (3), needle valve push spring (4) and the needle valve (5), then remove the needle valve seat (6).
25. Remove the power piston stopper (1), and remove the power piston (2) and the piston spring (3).



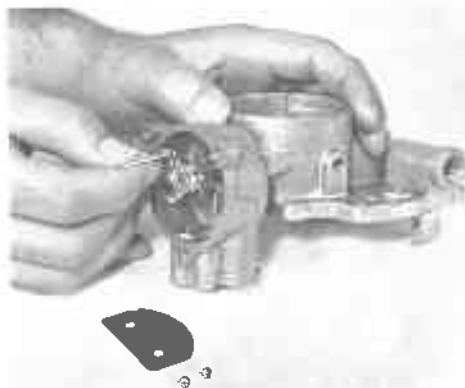
**Fig. 5-36 Power Piston Removal** V3998

26. Remove the union fitting and the union bolt with the strainer.
27. Remove the three coil housing retaining screws, and remove the coil housing, housing gasket and the housing plate.  
When removing the coil housing, do not deform the thermostatic bimetal coil.
28. Remove the fast idle cam follower retaining screws, and remove the fast idle cam follower (1) and the sliding rod (2).



**Fig. 5-37 Sliding Rod Removal** V3999

29. Remove the vacuum piston connector retaining screw, and the choke valve in the same manner as the primary throttle valve removal and remove the choke shaft.



**Fig. 5-38 Choke Shaft Removal** V4000

30. Remove the fast idle cam with the cam spring from the choke valve shaft.
31. Take out the vacuum piston with the connector.



**Fig. 5-39 Vacuum Piston Removal** V4001

32. Pull out the piston pin, and remove the connector from the piston.
33. Remove the thermostat case retaining screws, and remove the thermostat case and the gasket.

### Inspection

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

Wash the die-cast parts with a soft brush, and wash and clean the carbon deposits around the throttle valve. Never use a wire for cleaning the jets.

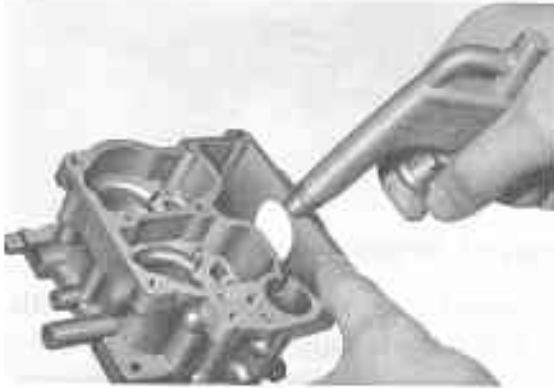


Fig. 5-40 Cleaning Passages

V4002

Inspect the following items, and if defective, repair or replace the defective part/s.

#### Air Horn Group

1. Check the air horn for cracks, scores, damaged threads and worn shaft bore.
2. Check the choke valve for deformation, and the choke shaft for bend and wear.
3. Check the power piston for wear, and for proper operation in the housing bore. Also check the power piston spring for weakness and deformation.
4. Check the float for deformation and defective tabs, and also check for wear of the float lever pin hole, bracket and the lever pin.
5. Check the needle valve and the seat for proper seating.
6. Check the strainer for clog and rust.

#### Main Body Group

1. Check the body for cracks, damage on the fitting surfaces, defective threads and the jet fitting surfaces.

2. Check the jets for defective threads and slot.
3. Check the power valve for proper operation, defective threads and other defects.
4. Check the pump plunger for wear of the sliding surface, defective leather and weak spring.
5. Check the pump damping spring for weakness and deformation.
6. Check the discharge check ball for rust and proper seating.
7. Check the high speed valve for deformation, and the shaft for bend and wear.

#### Flange Group

1. Check the flange for cracks, damage of fitting surfaces and defective and wear. Also check for wear of the throttle shaft bores and damage of the idle adjusting screw seat.
2. Check the throttle valves for wear and deformation, and check for wear, bend of the shafts and proper operation in the flange shaft bores.
3. Check the idle adjusting screw for damage of the threads and tapered portion.

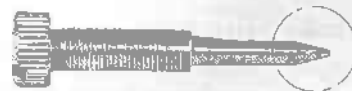


Fig. 5-41 Checking Idle Adjusting Screw

V1873

### Assembly

Before assembling, clean each part with gasoline, and always replace the gaskets and the packings upon assembly. All sliding or rotating portions should be coated with engine oil, and be sure to check for proper operation after assembly.

### Air Horn Group

1. Install the thermostat case with the gasket onto the air horn.

Two crown head and one flat head screws are utilized for installation of the thermostat case, and the flat head screw is installed above the vacuum piston bore.

2. Assemble the piston connector (2) onto the piston (1) with the piston pin (3), and install the vacuum piston into the cylinder of the thermostat case.

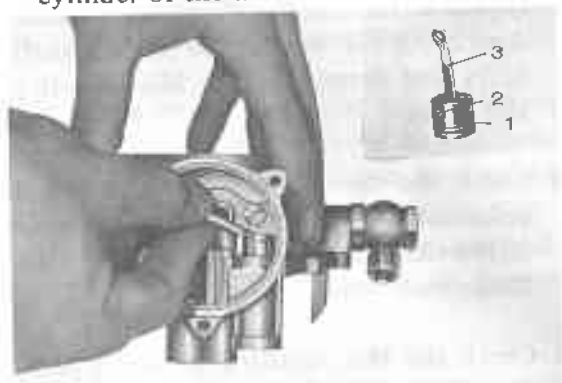


Fig. 5-42 Assembling Vacuum Piston

V4003  
V4004

3. Assemble the fast idle cam (2) and the fast idle cam spring (3) onto the choke shaft (1).

4. Install the choke valve onto the choke shaft, and after checking for proper operation, calk the retaining screw ends.

5. Connect the piston connector onto the choke shaft with the connector retaining screw.

6. Install the sliding rod into the ther-

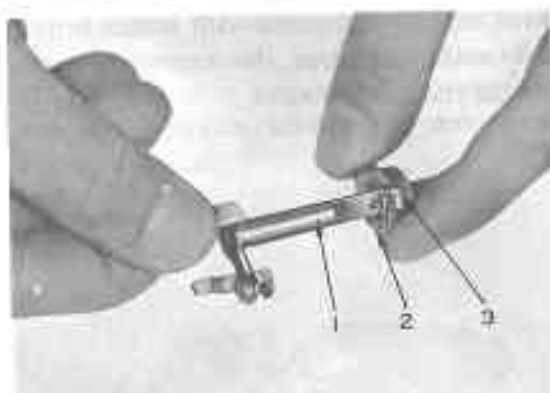


Fig. 5-43 Assembling Choke Shaft

V4005

mostat case, and assemble the fast idle cam follower onto the sliding rod.

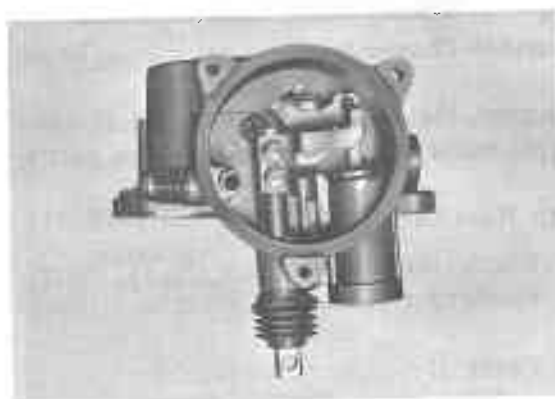


Fig. 5-44 Assembling Inside of  
Thermostat Case

V4006

7. Assemble the coil housing plate, gasket and the coil housing onto the thermostat case without damaging the thermostat bimetal coil.

Check if the choke valve operation is satisfactory before tightening the coil housing retaining screws. The choke valve must be closed from the fully opened position when the coil housing is turned counterclockwise.

For the setting position of the coil housing, refer to the Carburetor Adjustment in this section.

8. Install the union fitting (2) and the gaskets (1) with the union bolt (3) together with the strainer.

9. Install the power piston spring (4) and



Fig. 5-45 Assembling Coil Housing V4007

the power piston (5) into the power piston cylinder, and retain them with the stopper (6).

After installing, check if the power piston movement is smooth.

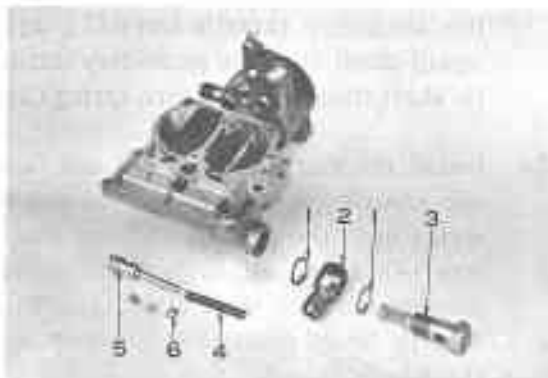


Fig. 5-46 Fitting & Power Piston Assembly V4008

10. Install the needle valve seat (6) with the gasket, and assemble the needle valve (5), valve spring (4) and the push

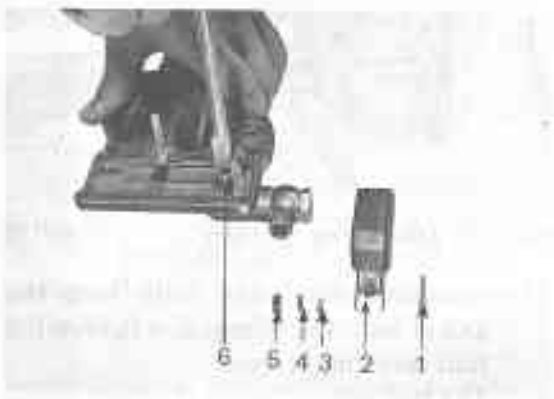


Fig. 5-47 Float Assembly V3997

pin (3), then install the float (2) with the float lever pin (1).

### Main Body Group

11. Install the high speed shaft, and install the retainer ring onto the shaft end. Next, install the high speed valve adjusting the installation position of the valve referring to the Carburetor Adjustment in this section.  
After tightening the valve retaining screws, check the high speed valve for proper operation, then calk the valve retaining screw ends.
12. Assemble the gasket, fuel level gauge glass and the glass clamp in order, and tighten the retaining screws evenly.
13. Install the "C" ring, thermostatic valve and the valve cover.
14. Install the high speed valve shaft arm (1) onto the high speed shaft, and install the high speed valve stopper lever (2) and the spring (3).

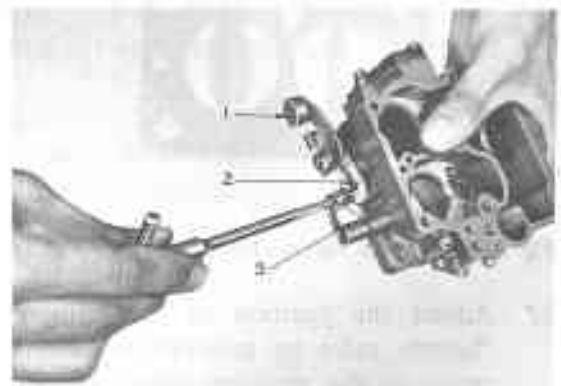


Fig. 5-48 Shaft Arm & Stopper Lever Assembly B0119

15. Install the primary and the secondary main jets and the gaskets, and install each passage plug.  
The primary main jet diameter is 1.08 mm (0.043"), and the secondary main jet diameter is 1.40 mm (0.055").
16. Install the power jet into the power

valve, and install them onto the body using the Power Valve Wrench.

17. Install the slow jet.
18. Install both primary and the secondary small venturies with the gaskets.
19. Install smaller steel ball compared with the other into the bottom of the pump cylinder, and retain it with the check ball retainer.

### Flange Group

20. Install both primary and the secondary throttle shafts onto the flange, and install each throttle valve onto the shafts.

The primary throttle valve is thinner than the secondary throttle valve, and both valves should be installed under the shafts.

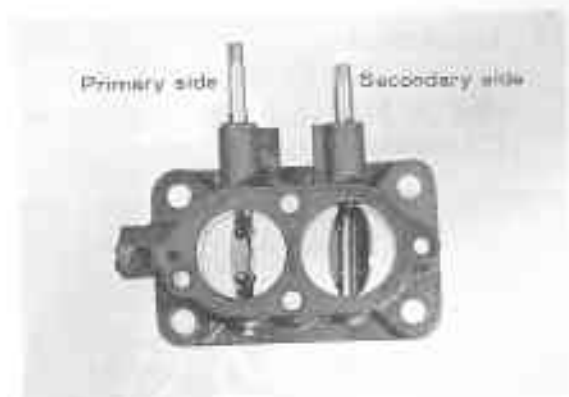


Fig. 5-49 Throttle Valves Assembly V4009

21. Adjust the position of the primary throttle valve by inserting the shims between the retainer rings of both shaft ends and both ends of the shaft bore.

When inserting the shims, insert the thick shim to the throttle shaft arm side, and the thin shim to the other side.

After installing both valves, check if the valve will contact against the throttle bore completely when the valves are fully closed, then calk the retaining screw ends.

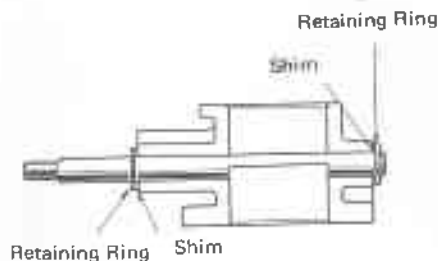


Fig. 5-50 Shaft Shim Assembly

G0147

22. Install the idle adjusting and the throttle adjusting screws with the screw springs onto each position.
23. Install the throttle shaft link (2) onto the secondary throttle lever (1), and install them onto the secondary throttle shaft through the return spring (3).
24. Install the fast idle lever (5) and fast idle adjusting screw (6) with the screw spring onto the primary throttle shaft arm (4), then install them onto the primary throttle shaft connecting the throttle shaft link with the primary throttle shaft arm.

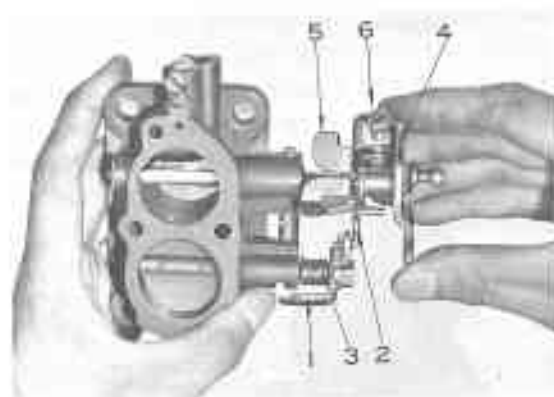


Fig. 5-51 Link & Arm Assembly

B0120

25. Assemble the main body with the gasket onto the flange, and tighten the four retaining screws.
- The two screws among the four retaining screws provided with the vacuum

passages for the power piston and the vacuum piston.

26. Insert the steel ball, discharge weight and the stopper under the pump jet.
27. Install the pump damping spring and the pump plunger without deforming the plunger leather, and hold the plunger in its position.
28. Assemble the air horn onto the main body.
29. Install the slow passage plug with the gasket and the plunger boot.
30. Connect the pump connecting link (1) onto the throttle shaft arm (2) and the pump lever (3), and install the pump lever onto the air horn.

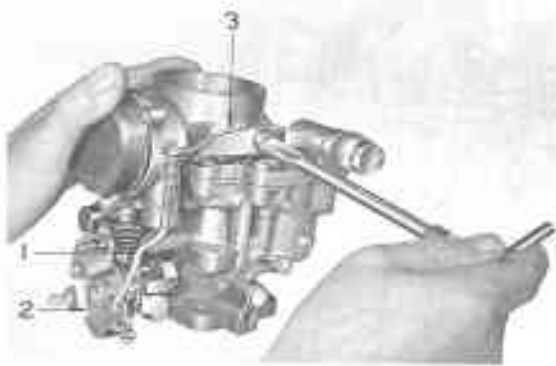


Fig. 5-52 Pump Lever & Link Assembly B0121

31. Install the fast idle connecting link.

### Installation

1. Follow the removal procedures in the reverse order.
2. After the engine is warmed up, check the fuel level and the fuel leaks, then perform the idle adjustment referring to the Engine Tune-Up section.

## CARBURETOR on Light Truck

### Removal

1. Remove the intake air connector from the air horn.
2. Remove the accelerator and the choke wires from the carburetor.
3. Disconnect the fuel pipe and the vacuum pipe from the carburetor.
4. Remove the carburetor retaining nuts, and remove the carburetor.

### Disassembly

For disassembling and assembling the carburetor, use the Carburetor Adjust Kit 09240-00010 together with the Carburetor Screwdriver Set 09860-11010 which are utilized on the carburetor on RT series. Also the same procedures and precautions prescribed for the RT series should be adhered.

1. Remove the pump arm retaining screw (1), and remove the pump connecting link (3) with the pump lever (2).
2. Remove the fast idle connector (4), primary throttle return spring (5), throttle connecting link (6), accelerator lever rod (7) and the accelerator link support (8).

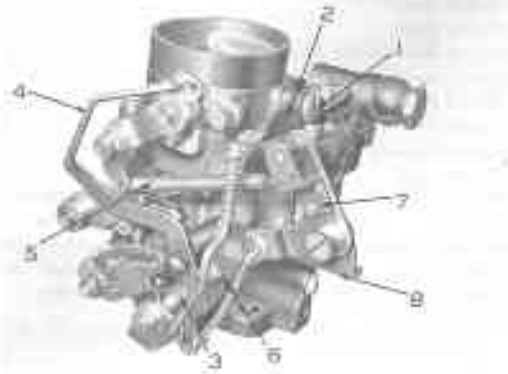
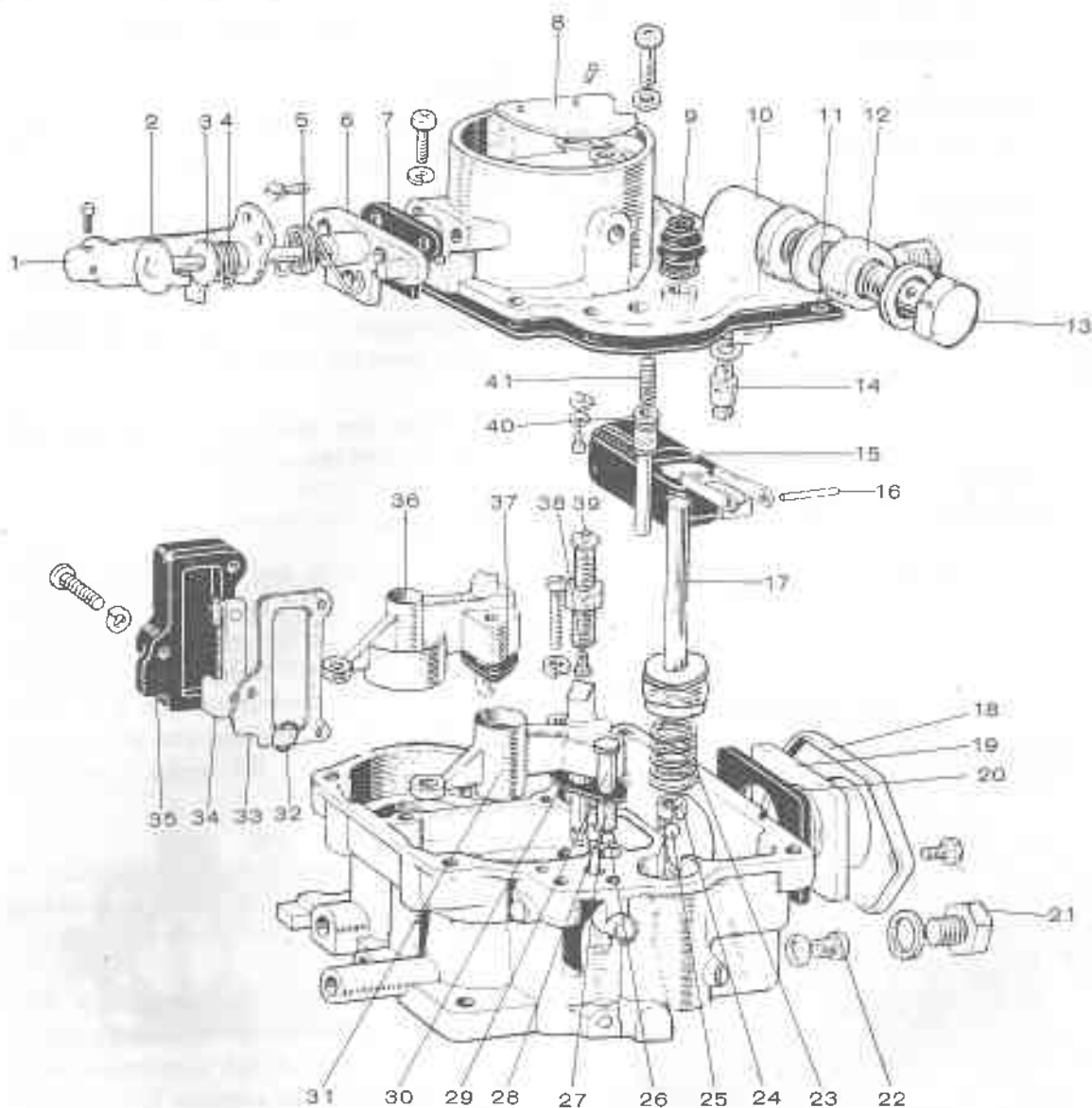


Fig. 5-53 Connecting Links Removal B0954



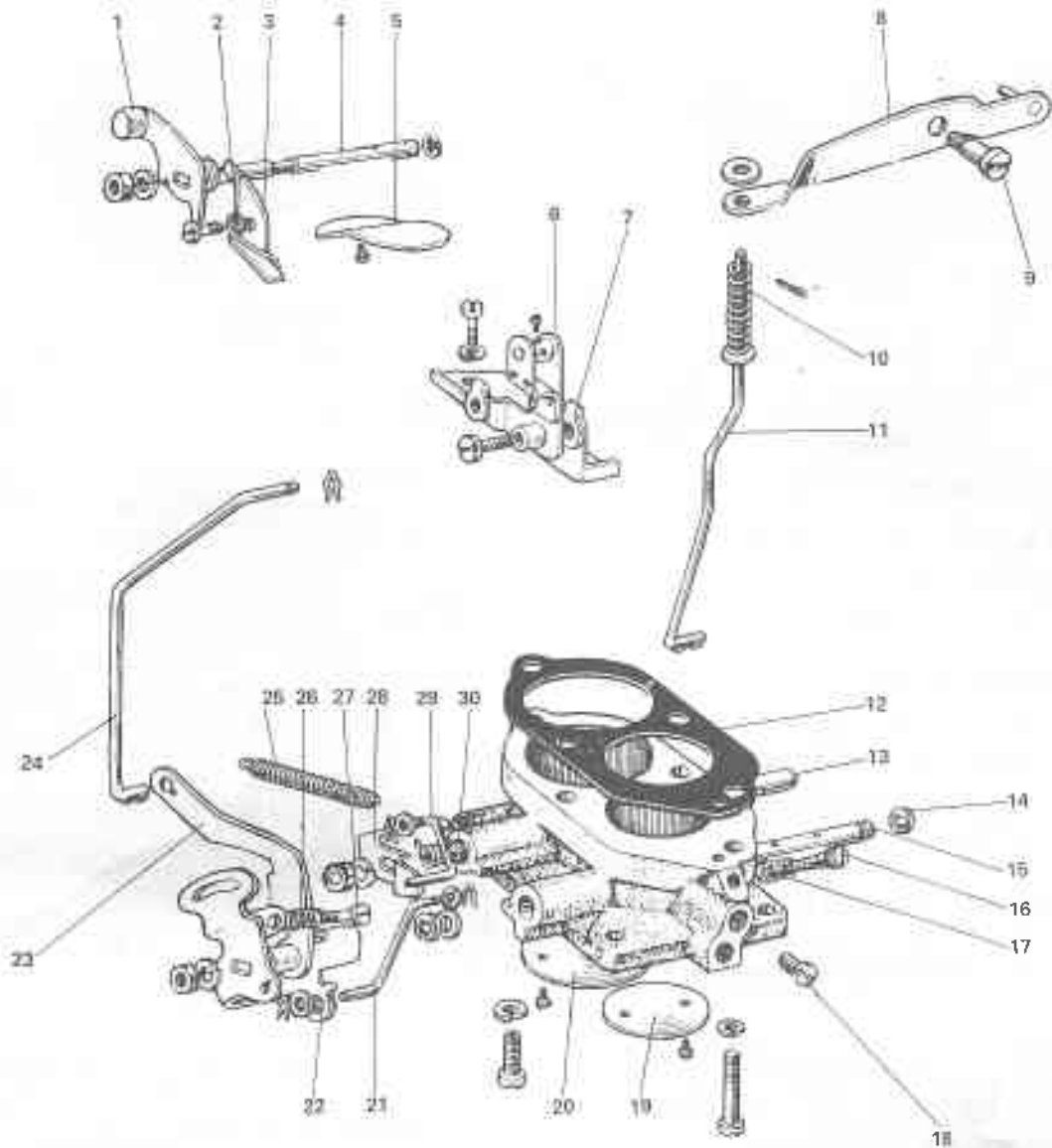


- 1 Choke lever
- 2 Choke shaft
- 3 Choke lever spring guide
- 4 Choke valve relief spring
- 5 Choke valve return spring
- 6 Choke shaft adapter
- 7 Adapter gasket
- 8 Choke valve
- 9 Boot
- 10 Air horn
- 11 Air horn gasket
- 12 Union fitting
- 13 Union bolt w/strainer
- 14 Needle valve

- 15 Float
- 16 Float lever pin
- 17 Pump plunger
- 18 Level gauge clamp
- 19 Level gauge glass
- 20 Level gauge gasket
- 21 Main passage plug
- 22 Primary main jet
- 23 Pump damping spring
- 24 Check ball retainer
- 25 Steel ball (inlet)
- 26 Steel ball (outlet)
- 27 Slow jet

- 28 Pump discharge weight
- 29 Discharge weight stopper
- 30 Venturi gasket
- 31 Primary small venturi
- 32 "O" ring
- 33 Gasket
- 34 Thermostatic valve
- 35 Thermostatic valve cover
- 36 Secondary small venturi
- 37 Venturi gasket
- 38 Power jet
- 39 Power valve
- 40 Power piston

Fig. 5-54 Carburetor Components No. 1 on RH Series



- |                                  |                                |                                     |
|----------------------------------|--------------------------------|-------------------------------------|
| 1 High speed valve arm           | 11 Pump connecting link        | 21 Throttle connecting link         |
| 2 Stopper lever spring           | 12 Body flange gasket          | 22 Primary throttle shaft arm       |
| 3 High speed valve stopper lever | 13 Secondary throttle shaft    | 23 Fast idle lever                  |
| 4 High speed valve shaft         | 14 Retainer ring               | 24 Fast idle connecting link        |
| 5 High speed valve               | 15 Primary throttle shaft      | 25 Primary throttle return spring   |
| 6 Accelerator lever rod          | 16 Idle adjusting screw        | 26 Throttle adjusting screw spring  |
| 7 Accelerator link support       | 17 Idle adjusting screw spring | 27 Throttle adjusting screw         |
| 8 Pump lever                     | 18 Slow port plug              | 28 Secondary throttle lever         |
| 9 Pump arm set screw             | 19 Primary throttle valve      | 29 Throttle shaft link              |
| 10 Pump arm spring               | 20 Secondary throttle valve    | 30 Secondary throttle return spring |

Fig. 5-55 Carburetor Components No. 2 on RH Series

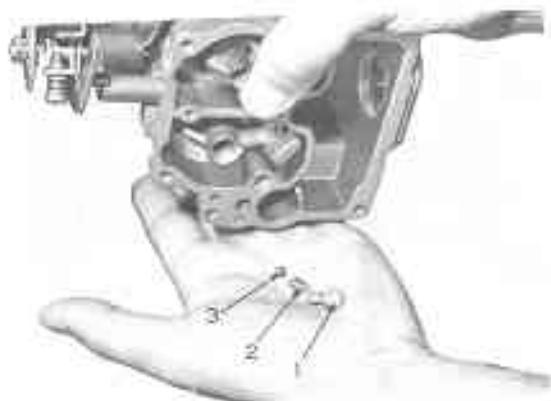
Y6960

3. Remove the slow passage plug, and remove the air horn straight upward by removing the six retaining screws.

4. Remove the pump damping spring.

5. Invert the carburetor, and take out the

stopper (1), discharge weight (2) and the steel ball (3).



*Fig. 5-56 Steel Ball Removal* **B0951**

6. Remove the four flange retaining screws, and separate the main body from the flange.

### Main Body Group

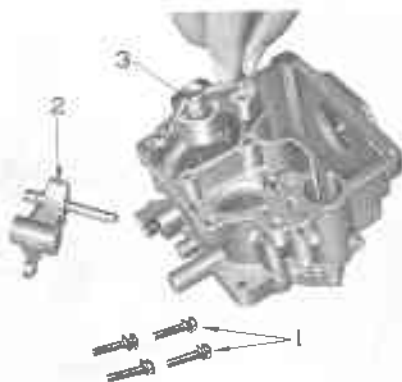
7. Remove the stopper lever retaining screw, and remove the stopper lever (1) together with the stopper lever spring.
8. Remove the high speed valve retaining nut, then remove the valve arm (2) from high speed valve shaft.



*Fig. 5-57 Lever & Arm Removal* **B0111**

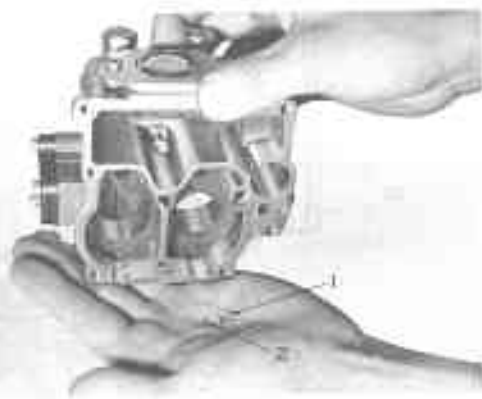
9. Remove the small venturi retaining screws (1), and remove the primary small venturi (2) and the secondary small venturi (3).

10. Remove the check ball retainer (1)



*Fig. 5-58 Venturi Removal* **B0112**

located at the bottom of the pump cylinder, and remove the steel ball (2) by inverting the main body.



*Fig. 5-59 Steel Ball Removal* **V1860**

11. Remove the slow jet. This slow jet can be removed without removing the air horn if necessary.

12. Remove the power valve using the



*Fig. 5-60 Power Valve Removal* **B0113**

Power Valve Wrench, and remove the power jet from the power valve.

13. Remove the level gauge clamp (1), glass (2) and the gasket (3) by removing the two retaining screws.
14. Remove the three thermostatic cover retaining screws, and remove the valve cover, thermostatic valve (4) and the "O" ring (5).  
Do not disassemble the thermostatic valve.



Fig. 5-61 Thermostatic Valve Removal B0114

15. Remove the primary and the secondary main passage plugs (1), and remove the primary main jet (2) and the secondary main jet together with the gaskets.

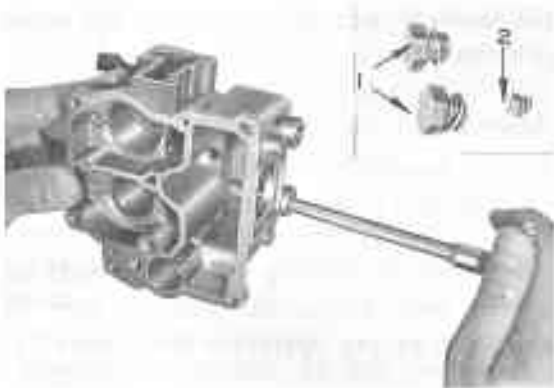


Fig. 5-62 Main Jet Removal B0115  
B0116

16. Remove the high speed valve retaining screws, then remove the high speed valve.  
Since the ends of the retaining screws

are caked, file off the caked portions of the screw ends slightly before removing.

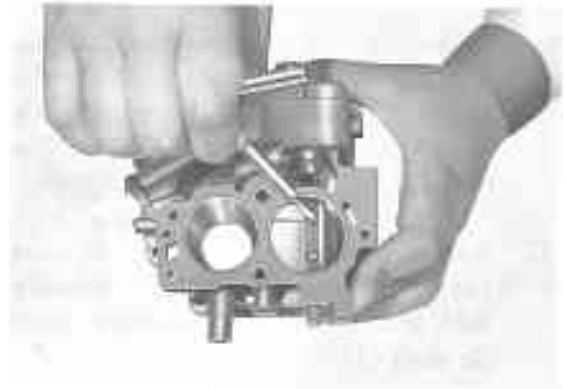


Fig. 5-63 High Speed Valve Removal B0117

17. Remove the retainer ring, and remove the high speed shaft.

#### Flange Group

18. Remove the idle adjusting screw (1) and the throttle adjusting screw (2) with the screw springs.
19. Remove the snap ring on the throttle shaft link and the arm retaining nut, then remove the throttle shaft arm (3) and the fast idle lever (4).
20. Remove the lever retaining nut, and remove the secondary throttle lever (5) with the return spring.



Fig. 5-64 Screws & Levers Removal B0955

21. Remove the primary throttle valve (1) and the retainer rings (2), and then remove the primary throttle shaft (3).

As the ends of the throttle valve retaining screws are caked, remove them after filing off slightly the caked portions of the screws.

Also since the adjusting shims are installed onto both shaft ends for the adjustment of the primary throttle shaft thrust play, do not lose the shims.

22. Remove the secondary throttle valve (4) in the same manner as the primary side, and remove the secondary throttle shaft (5).

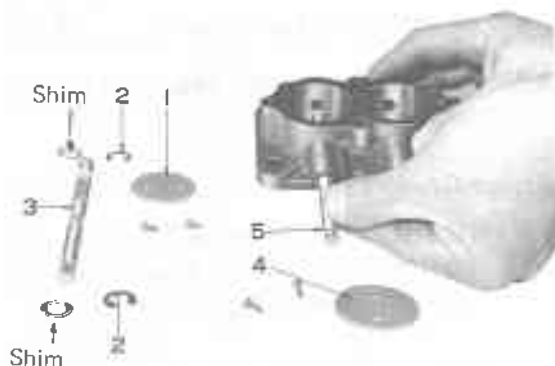


Fig. 5-65 Throttle Shafts & Valves Removal

V1876

### Air horn Group

23. Remove the pump plunger and the boot.
24. Pull out the float lever pin (1), and remove the float (2), valve push pin (3), needle valve push spring (4) and the

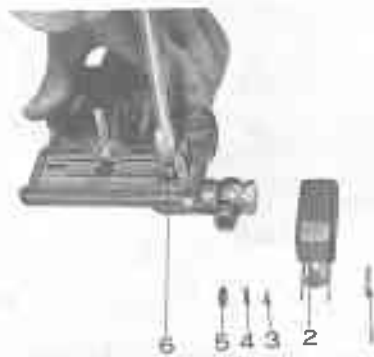


Fig. 5-66 Needle Valve Removal

V3997

needle valve (5), then remove the needle valve seat (6).

25. Remove the power piston stopper (1), and remove the power piston (2) and the piston spring (3).

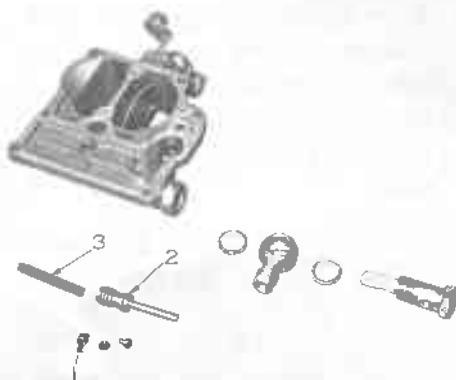


Fig. 5-67 Power Piston Removal

B0956

26. Remove the union fitting and the union bolt with the strainer.
27. Remove the choke valve in the same manner as the primary throttle valve removal, and remove the choke shaft.

### Inspection

Inspect all disassembled parts according to the Inspection procedures on the RT series in this section.

### Assembly

Before assembling, clean each part with gasoline, and always replace the gaskets and the packings upon assembly.

All sliding or rotating portions should be coated with engine oil, and be sure to check for proper operation after assembly.

### Air Horn Group

1. Install the choke shaft and the choke valve, and after checking the valve for proper operation, calk the retaining screw ends to prevent them from loosening.

2. Install the union fitting, gaskets and the union bolt with the strainer.
3. Install the power piston spring and the power piston into the power piston cylinder, and retain them with the stopper.  
After installing, check if the power piston movement is smooth.
4. Install the needle valve seat (6) and the gasket, and assemble the needle valve (5), valve spring (4) and the push pin (3), then install the float (2) with the float lever pin (1).



Fig. 5-68 Float Assembly

V3997



Fig. 5-69 Gauge Glass &amp; Thermostatic Valve Assembly

B0114

10. Install the high speed valve shaft arm (1) onto the high speed shaft, and install the high speed valve stopper lever (2) and the return spring (3).

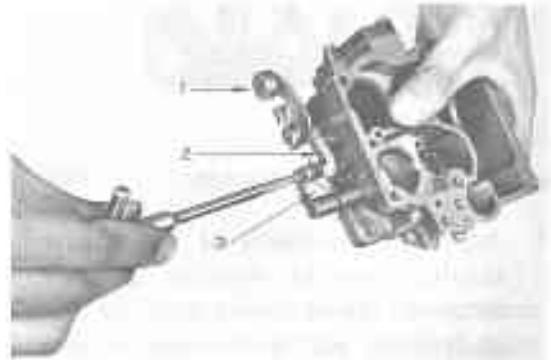


Fig. 5-70 Shaft Arm &amp; Stopper Lever Assembly

B0119

### Main Body Group

7. Install the high speed shaft, and install the retainer ring onto the shaft end. Next, install the high speed valve adjusting the installation position of the high speed valve referring to the Carburetor Adjustment in this section.  
After tightening the valve retaining screws, check the valve for proper operation, then calk the valve retaining screw ends.
8. Assemble the gasket (1), fuel level gauge glass (2) and the clamp (3) in order, and tighten the retaining screws evenly.
9. Install the "O" ring (5), thermostatic valve (4) and the thermostatic valve cover.
11. Install the primary and the secondary main jets with the gaskets, and install each passage plug.
12. Install the power jet onto the power valve, and install them onto the body using the Power Valve Wrench.
13. Install the slow jet.
14. Install both primary and the secondary small venturies with the gaskets.
15. Install the smaller steel ball of the two steel balls into the bottom of the

pump cylinder, and retain it with the check ball retainer.

### Flange Group

16. Install both primary and the secondary shafts onto the flange, and install each throttle valve onto the shafts. The primary throttle valve is thinner than the secondary throttle valve, and both valves should be installed under the shafts.

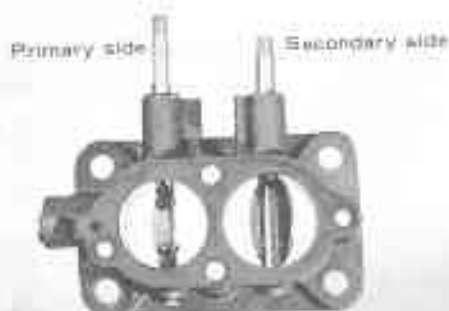


Fig. 5-71 Throttle Valves Assembly V4009

17. Adjust the position of the primary throttle valve by inserting the shims between the retaining rings of both shaft ends and both ends of shaft bores.

When inserting the shims, insert the thick shim to the throttle shaft arm side, and the thin shim to the other side.

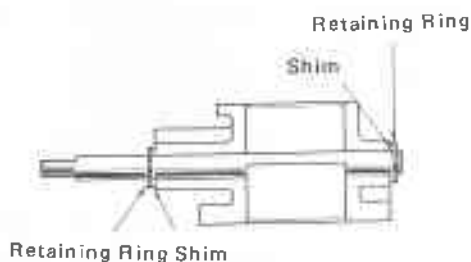


Fig. 5-72 Shaft Shims Assembly G0147

After installing both valves, check if the valve will contact against the throttle bore completely, when the valves are fully closed, and calk the retaining screw ends.

18. Install the idle adjust screw with the screw spring.
19. Install the throttle shaft link (2) onto the secondary throttle lever (1), and install them onto the secondary throttle shaft through the return spring (3).
20. Install the fast idle lever (5) and the throttle adjusting screw (6) with the screw spring onto the primary throttle shaft arm (4), then install them onto the primary throttle shaft connecting the throttle shaft link with the primary throttle shaft arm.

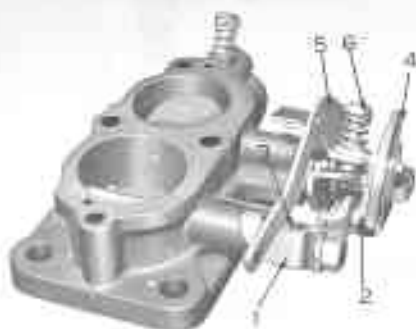


Fig. 5-73 Link & Arm Assembly B0955

21. Assemble the main body with the gasket onto the flange, and tighten the four retaining screws.
22. Insert the steel ball discharge weight and the stopper under the pump jet.
23. Install the pump damping spring and the pump plunger without deforming the plunger leather, and hold the plunger in its position.
24. Assemble the air horn onto the main body.

25. Install the slow passage plug with the gasket and the plunger boot.
26. Install the fast idle connector (1), accelerator lever rod (2), accelerator link support (3), primary throttle return spring (4) and the throttle connecting link (5).

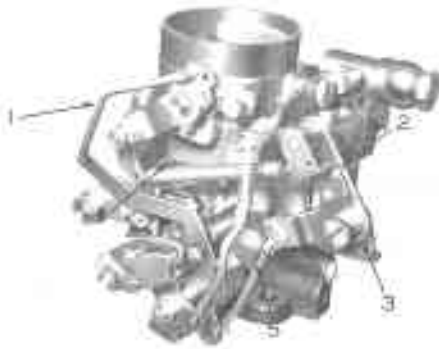


Fig. 5-74 Links Assembly B0954

27. Connect the pump connecting link (1) onto the throttle shaft arm (2) and the pump lever (3), then install the pump lever onto the air horn.

### Solenoid Valve

To prevent engine running on, the solenoid valve has been installed onto the carburetor, so as to further close the throttle valve

against idling position when the ignition switch is turned off and the solenoid valve rod returns.

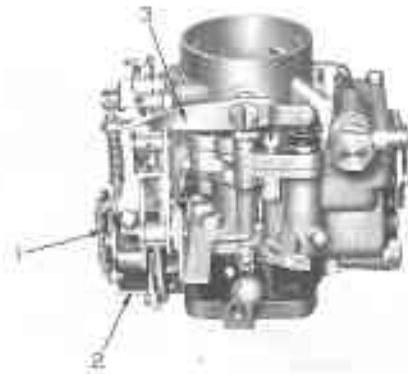
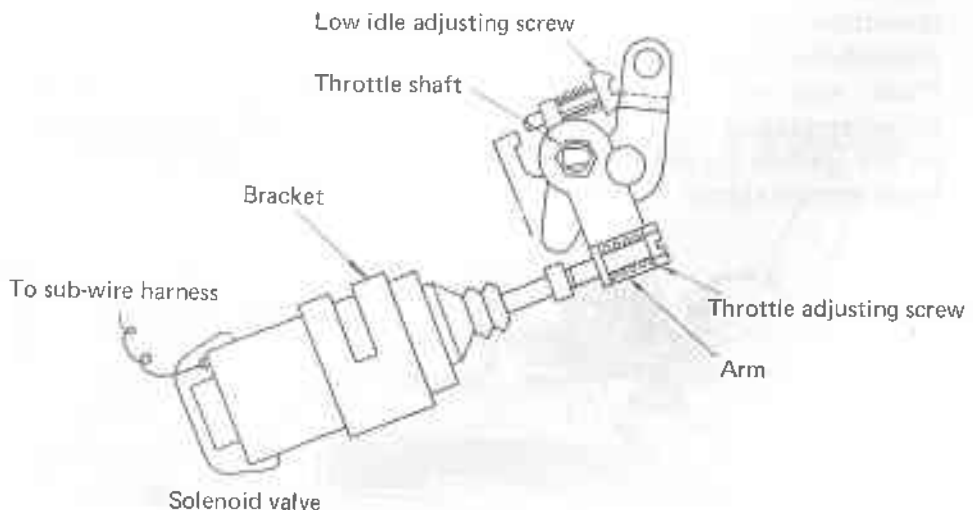


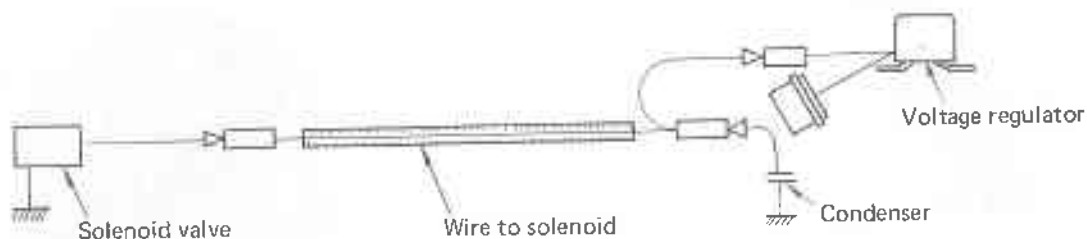
Fig. 5-75 Pump Lever & Link Assembly B0957

### Installation

1. Follow the removal procedures in the reverse order.
2. After the engine is warmed up, check the fuel level and the fuel leaks, then perform the idle adjustment referring to the Engine Tune-Up section.



## IDLE ADJUSTMENT PROCEDURES

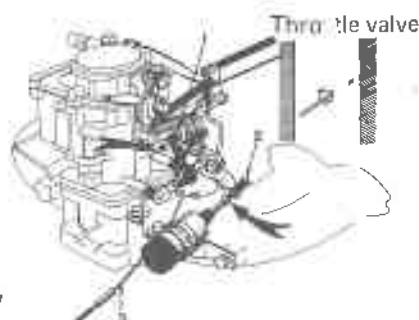
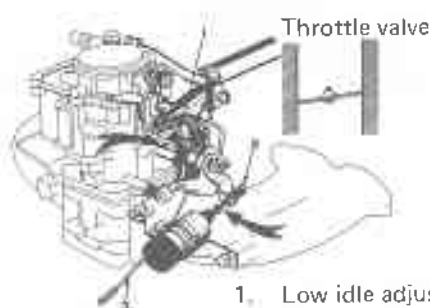


1. Warm up the engine sufficiently.
2. Adjust the engine idling revolution to  $550 \pm 50$  r.p.m. by throttle adjust screw (Newly installed part).
3. Disconnect the wire harness terminal of solenoid valve and check if the idling revolution falls below 400 r.p.m. or the engine stops. Adjust the low idle adjusting screw, if necessary, as follows. Another method is to turn low idle adjusting screw clockwise, until the engine idle revolution increases, and then turn back the low idle adjusting screw to  $1/2$  turn.

| Ignition switch                                | Throttle adjusting screw | Low idle adjusting screw | Throttle valve | Engine rpm                                         |
|------------------------------------------------|--------------------------|--------------------------|----------------|----------------------------------------------------|
| ON                                             |                          |                          |                | $550 \pm 50$                                       |
| ON<br>(Disconnect solenoid valve wire harness) |                          |                          |                | * Below 400 (Also possible when engine is at stop) |

## NOTE:

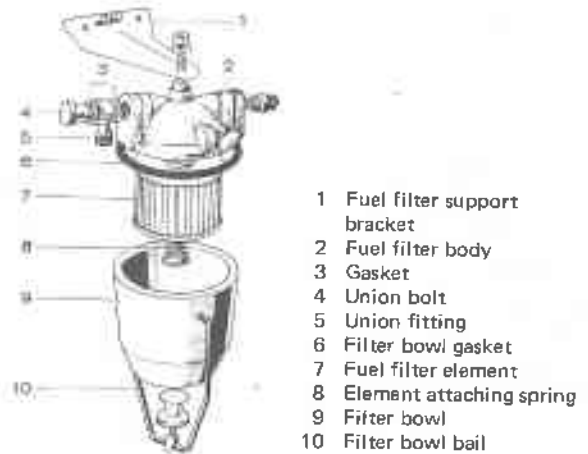
1. The throttle adjusting screw is a newly installed part, which controls the engine idling revolution, also, the low idle adjust screw is the former throttle adjust screw, which prevents the throttle valve from closing completely.
2. Please note that there is some change in former engine starting and also avoid misinterpretation of poor engine starting from the user. To start the engine, please turn on the ignition key, while stepping gradually on the accelerator pedal to run the starter. When run the starter, it is unnecessary to step on the accelerator pedal.



3. Solenoid valve wire harness

**FUEL FILTER (2R)****Removal**

1. Disconnect the inlet and the outlet hoses from the union fitting of the filter.
2. Remove the fuel filter assembly from the support by removing the filter retaining nut.

*Fig. 5-77 Fuel Filter Components*

Y7686

**Disassembly**

Loosen the filter bowl bail nut, and remove the filter bowl, spring, element and the gasket.

**Inspection**

Wash all the parts with clean gasoline.

1. If the element is defective or excessively dirty, replace the element.
2. Check the body and the bowl for cracks, damage and deformation.  
If defective, replace as necessary.

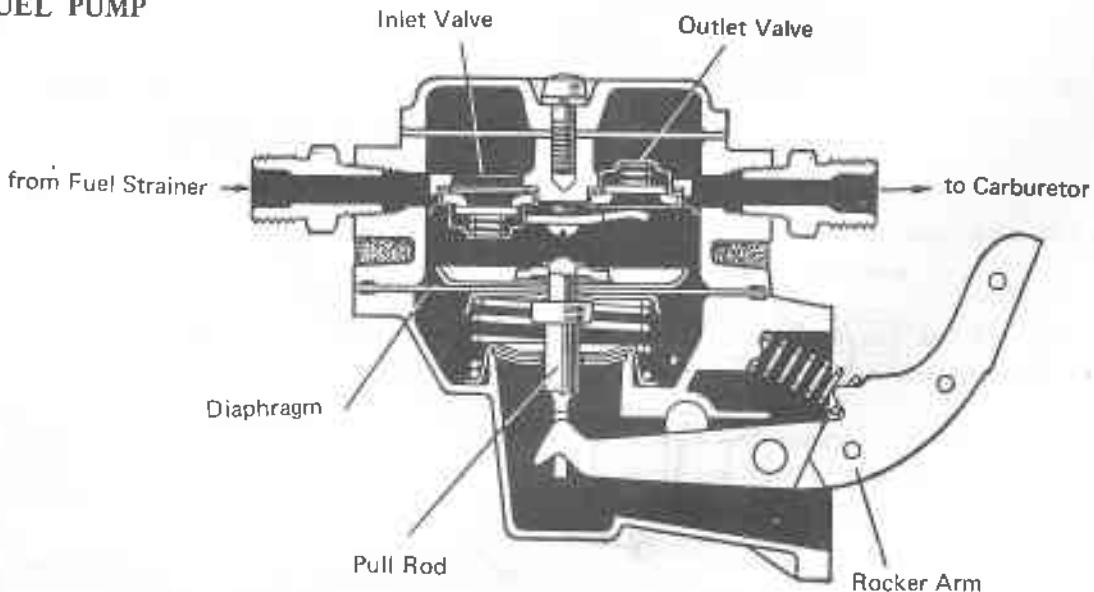
**Assembly**

Position the new gasket, element and the spring correctly, and assemble the bowl and the bowl bail, then tighten the bail nut securely.

**Installation**

Follow the removal procedures in the reverse order.

After installation, operate the engine and check for fuel leak.

**FUEL PUMP***Fig. 5-78 Cross Sectional View of Fuel Pump*

G1774

### Description

The fuel pump is of a diaphragm type, and is composed of the inlet and outlet valves, diaphragm, rocker arm, upper and lower bodies.

The rotational motion of the camshaft actuates the rocker arm which in turn converts into the reciprocation of the diaphragm.

This diaphragm movement draws the fuel into the pump, and also delivers out the fuel with specified pressure and volume to meet the requirement of the engine through the carburetor.

### Specification:

|                   |                                                                                 |
|-------------------|---------------------------------------------------------------------------------|
| Type              | Diaphragm                                                                       |
| Delivery capacity | Over 1.0 liter/min (1.06 US qts/min 0.88 Imp. qts/min) at 1,000 rpm of camshaft |
| Delivery pressure | 0.22 ~ 0.32 kg/cm <sup>2</sup> (3.1 ~ 4.5 psi)                                  |
| Vacuum            | Over -400 mmHg (15.7 inHg)                                                      |

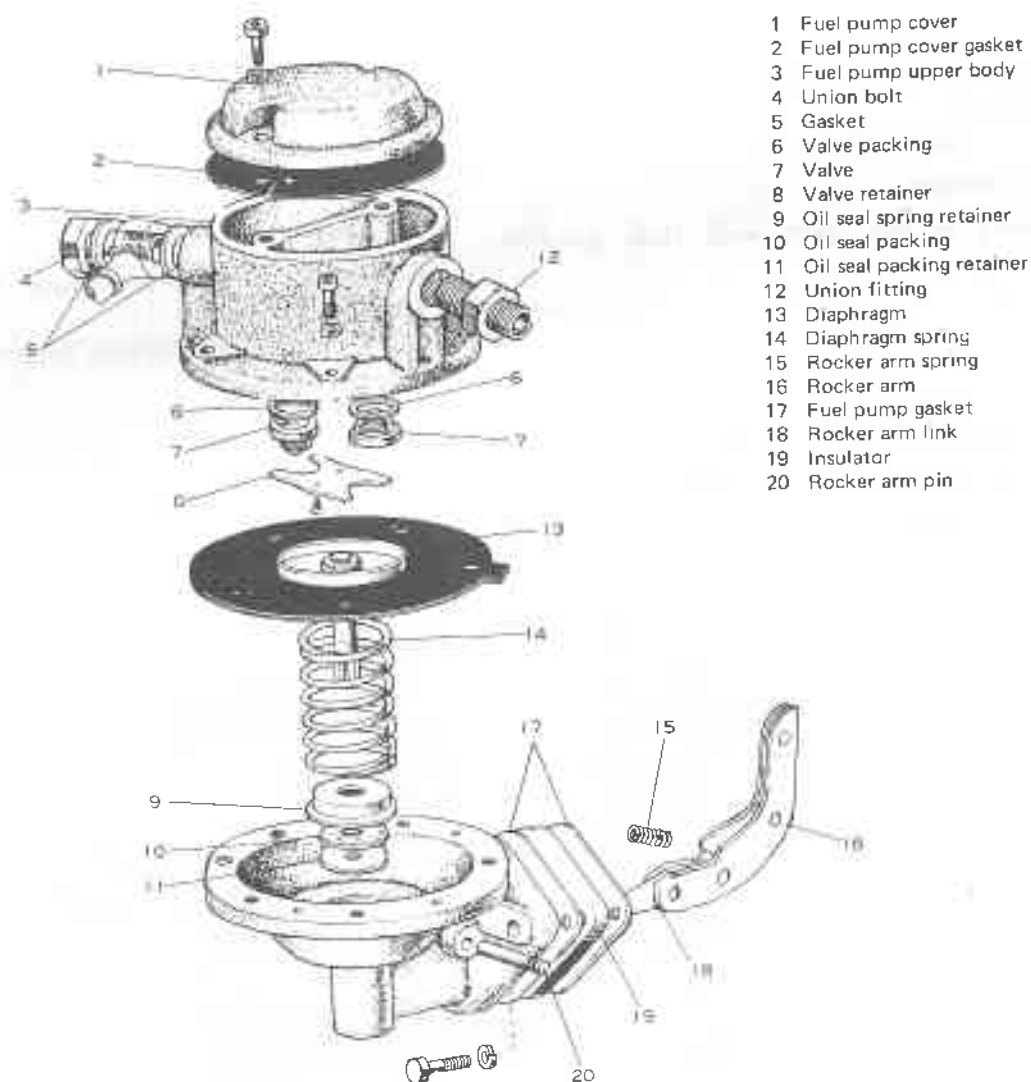


Fig. 5-79 Fuel Pump Components

**Removal**

1. Remove the engine under cover on RH series.
2. Disconnect the inlet hose and outlet pipe from the pump.
3. Remove the pump retaining bolts, and remove the pump assembly.

**Disassembly**

1. Remove the upper body retaining screws, and remove the upper body from the lower body.
2. Remove the valve retainer retaining screws, and remove the retainer, valves and the packings.



*Fig. 5-80 Valves Removal* V3990

3. Remove the pump cover retaining screws, and remove the pump cover and the gasket from the upper body.
4. Press down the diaphragm into the pump lower body, and unhook the diaphragm rod from the rocker arm link, then remove the diaphragm from the lower body.
5. Remove the diaphragm spring, oil seal spring retainer, oil seal packing and the oil seal packing retainer.
6. Drive out the rocker arm pin towards the serration using a blunt punch, then re-

move the rocker arm, link and the rocker arm spring.



*Fig. 5-81 Direction of Pin Removal* V3991

**Inspection**

Wash all the parts in clean gasoline, and blow the passages with compressed air. Check the following items, and if defective, replace as necessary.

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

**Assembly**

Always replace the gaskets with the new gaskets upon assembly.

1. Place the rocker arm and the link into the lower body, and hold them in place.
2. Install the rocker arm pin from non-serration side of the pin, and install the rocker arm spring onto the rocker arm locator on the rocker arm.
3. Install the oil seal packing retainer, oil

seal packing, oil seal spring retainer and the diaphragm spring onto the lower body.

4. Install the diaphragm, and hold it in the pump lower body, then hook the diaphragm rod onto the rocker arm link.



Fig. 5-82 Diaphragm Assembly

V3992

5. Install the cover with the gasket onto the upper body.



Fig. 5-83 Positioning Inlet & Outlet Valves

V4768

6. Install the packing and the valves correctly into the upper body as shown in figure 5-83, and secure the valves with the valve retainer and the screws.
7. Assemble the upper body onto the lower body insuring that all securing screws pass through the holes in the diaphragm without tearing the fabric, then tighten the screws evenly and securely.
8. Check the pump for proper operation.

### Installation

Follow the removal procedures in the reverse order.

Always replace the gaskets with the new gaskets.

After installation, operate the engine and check for fuel and oil leaks.

### Performance Test

1. Disconnect the fuel pump outlet pipe and connect a pressure gauge onto the pump outlet fitting.
2. Operate the engine, and measure the pump delivery pressure. If the pressure does not meet the specified pressure, replace the diaphragm spring.

Delivery pressure:

0.22 ~ 0.32 kg/cm<sup>2</sup>  
(3.1 ~ 4.5 psi)

\*\*\*\*\*

## FUEL TANK &amp; FUEL PIPE

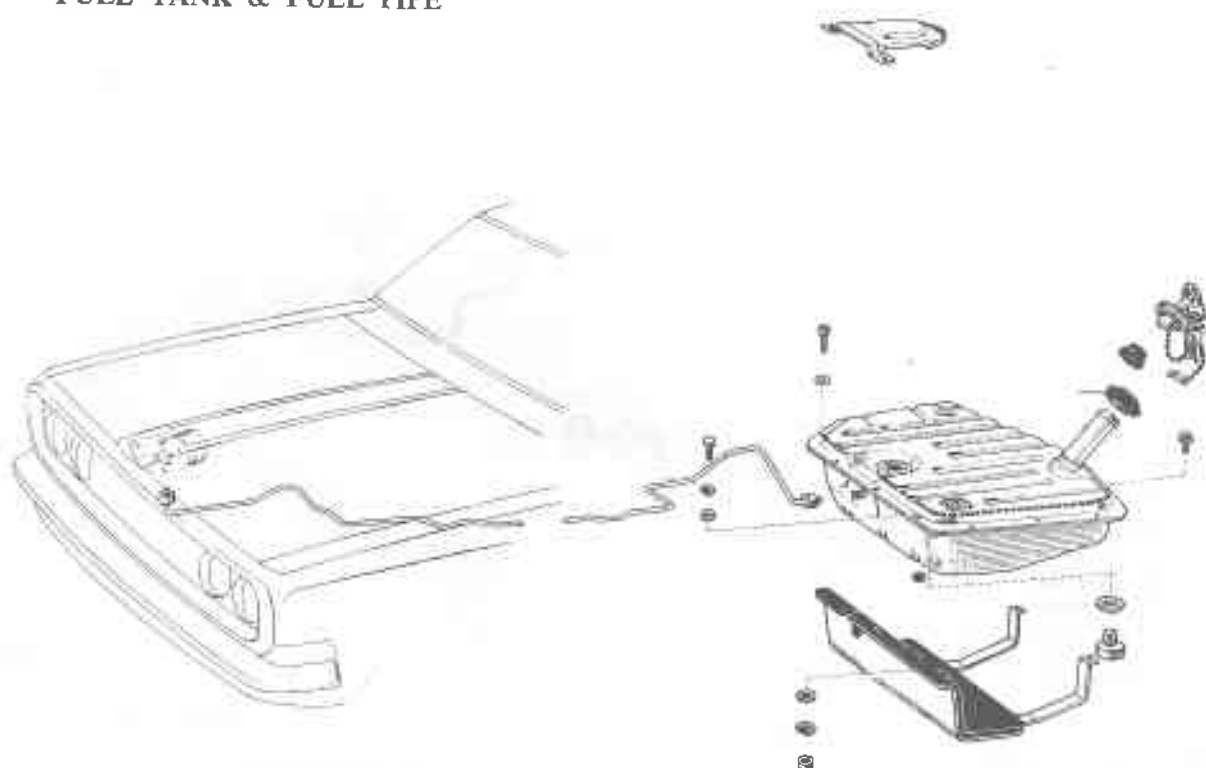


Fig. 5-84 Fuel Tank &amp; Pipe Components on 81 Series

Y7292

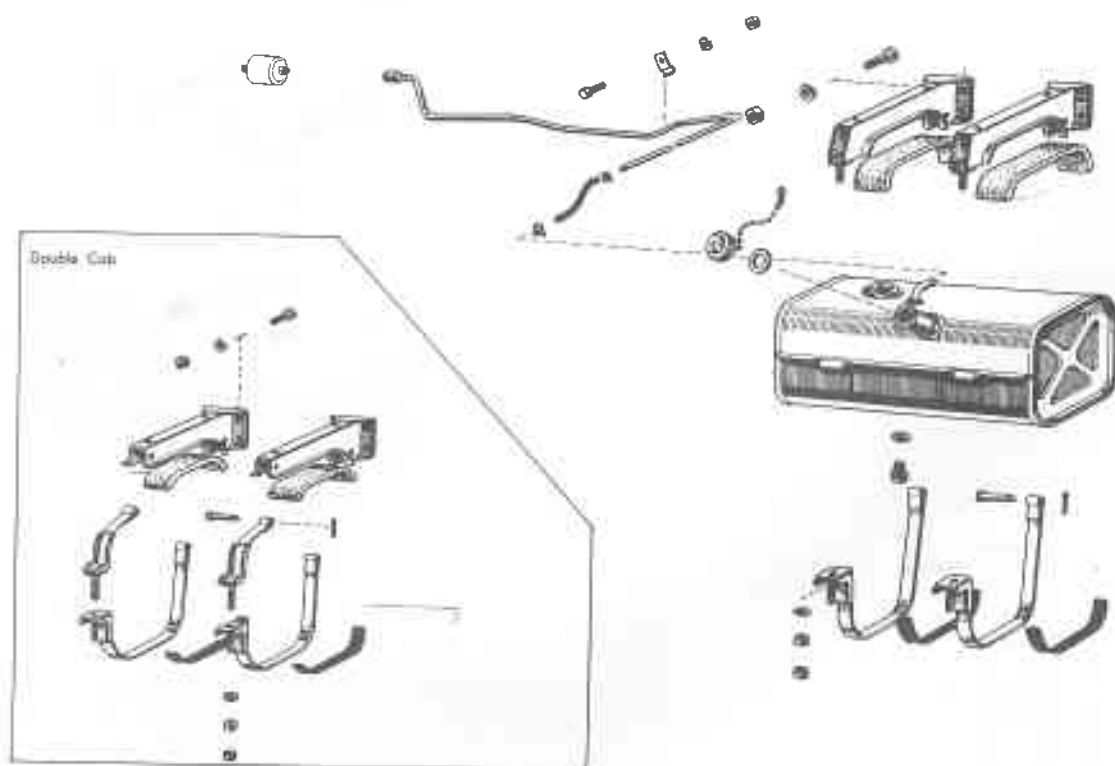


Fig. 5-85 Fuel Tank &amp; Pipe Components on RY Series

G3803

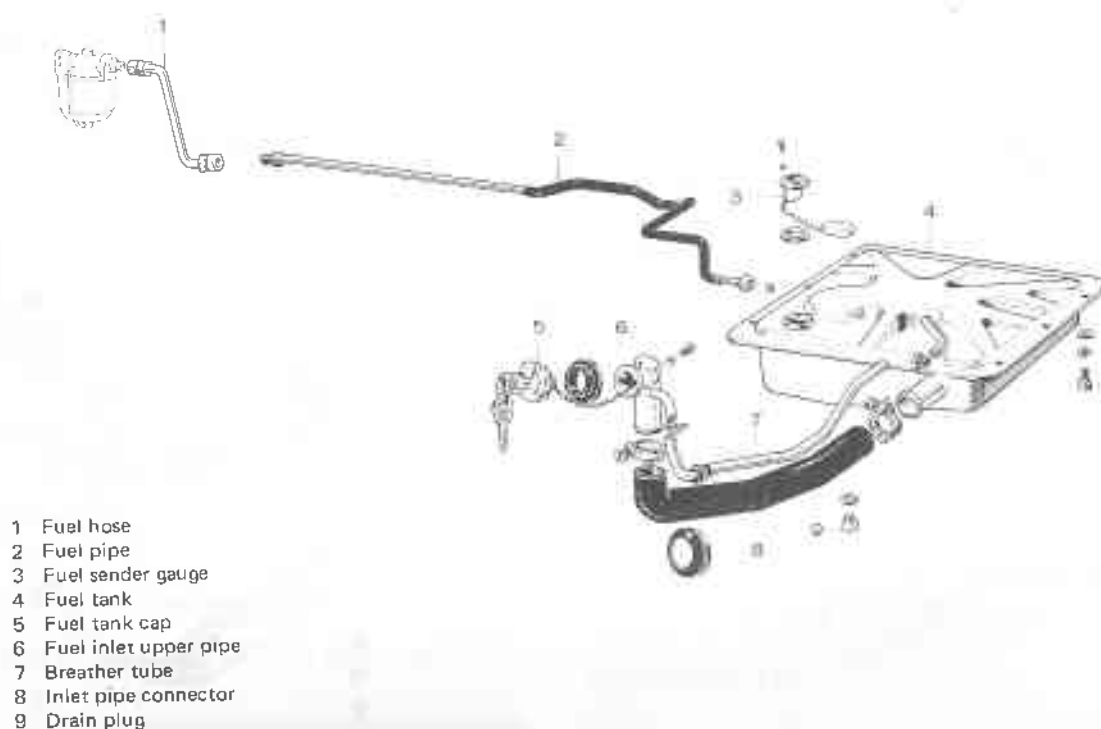


Fig. 5-86 Fuel Tank &amp; Pipe Components on RH10V, B, G &amp; 15B-B Series

G3806

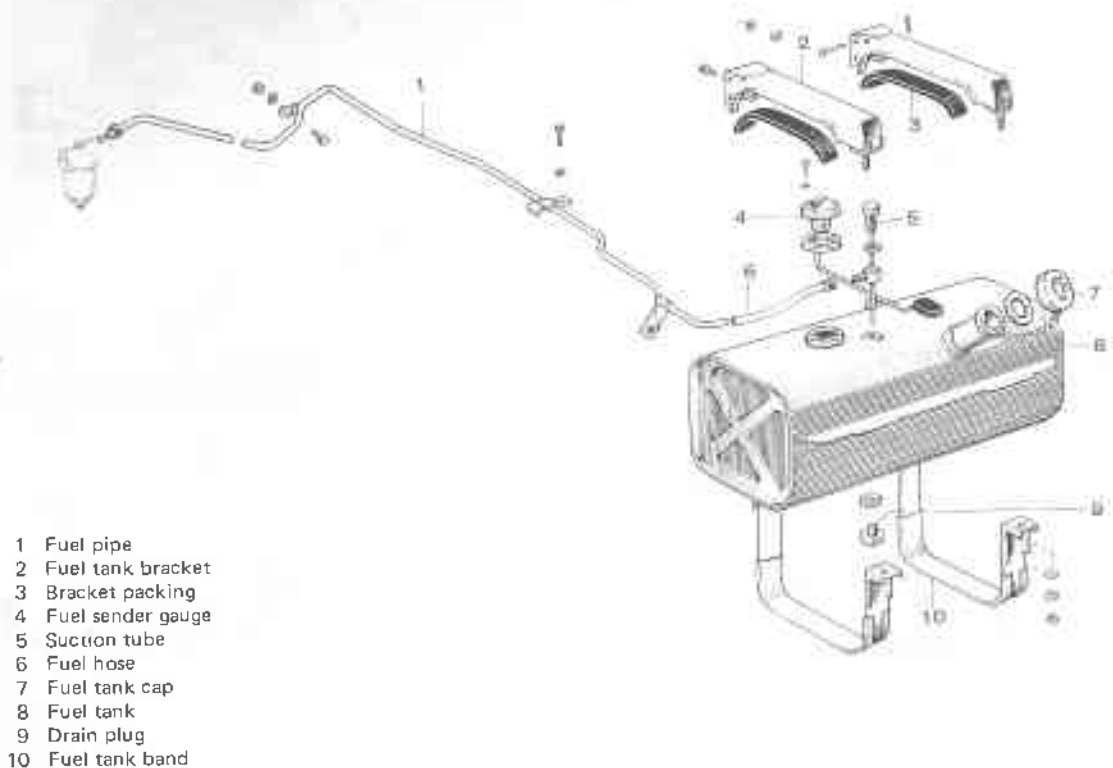


Fig. 5-87 Fuel Tank &amp; Pipe Components on RH10 Series

G3807

### Fuel Tank Removal

1. Drain the fuel, and disconnect the fuel pipe from the fuel tank.
2. Remove the fuel sender gauge cover, and disconnect the gauge wire.
3. Remove the tank cap, and remove the inlet pipe shield from the tank inlet pipe.
4. Remove the fuel tank retaining bolts, and remove the fuel tank assembly.

Note:

The fuel tank upper panel acts as a floor of the car. Therefore, when installing, use a sealer with water resistance and non-drying qualities between the body and the installing surface of the tank to prevent water or dust entering into the compartment.

5. Remove 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 or pipe and unions, and if defective, replace as necessary.
3. Water and dust accumulation in the fuel tank will cause malfunction of the carburetor, fuel filter or the fuel pump.  
If the accumulation of sediment in the fuel tank and the fuel filter is excessive, the fuel tank should be removed and flushed, and the fuel pipe should be blown out.

### Installation

Follow the removal procedures in the reverse order.

Fuel lines must be securely fastened in position with the clamps, and all connections should be tightened securely.

To prevent fuel leak, use a liquid sealer with fuel-proof qualities for the installing surface of the sender gauge if necessary.



## AIR CLEANER

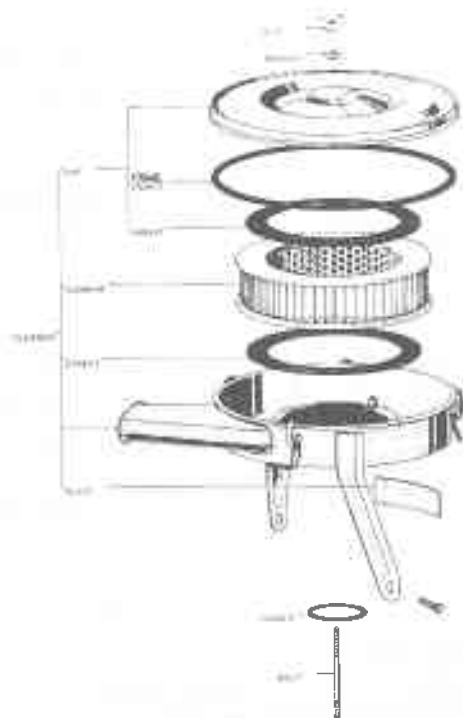


Fig. 5-88 Air Cleaner Components on RT &amp; RN Series

G3128

- 1 Wing nut
- 2 Seal washer
- 3 Air cleaner cap
- 4 Element gasket
- 5 Cap gasket
- 6 Filter element
- 7 Air cleaner case
- 8 Intake air connector
- 9 Connector hose

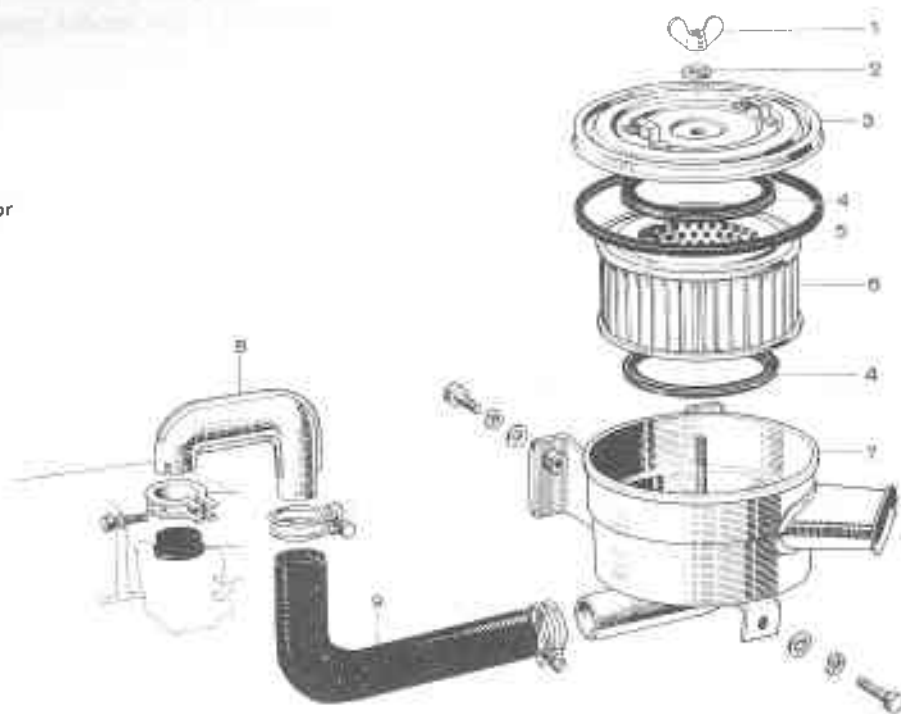
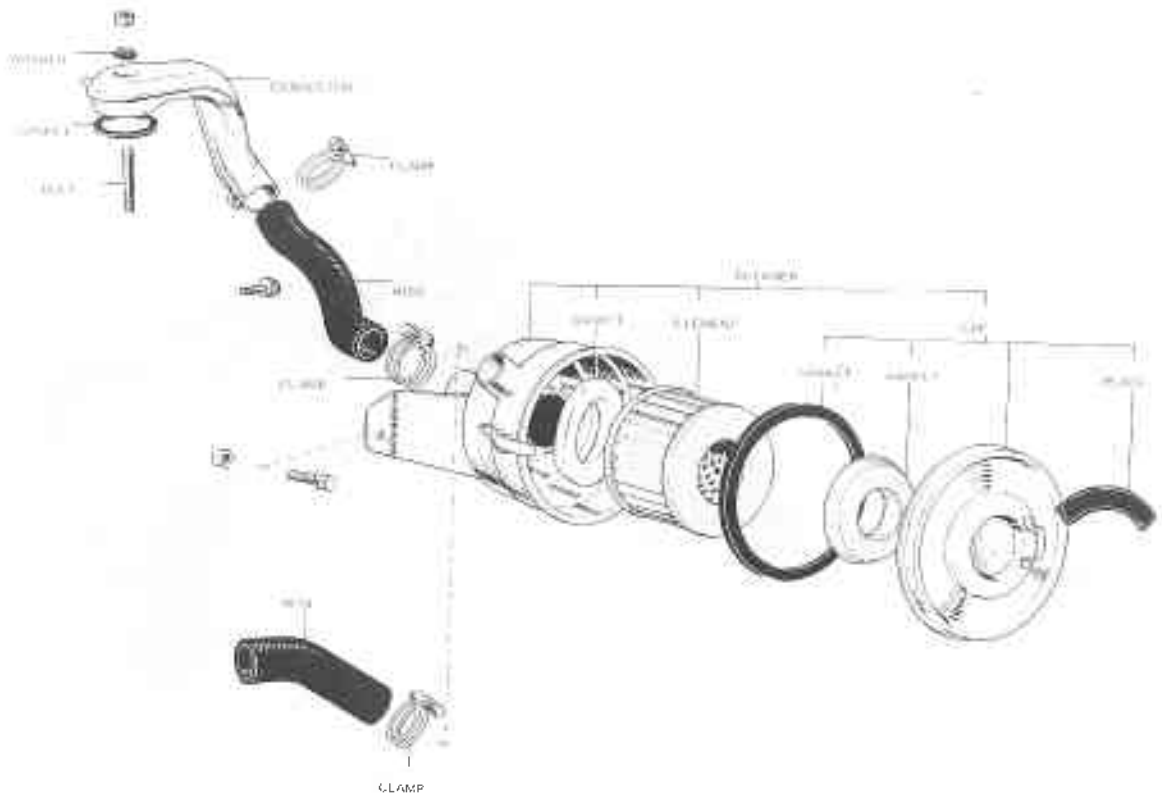


Fig. 5-89 Air Cleaner Components on RH Series

G3808



*Fig. 5-90 Air Cleaner Components on RY Series*

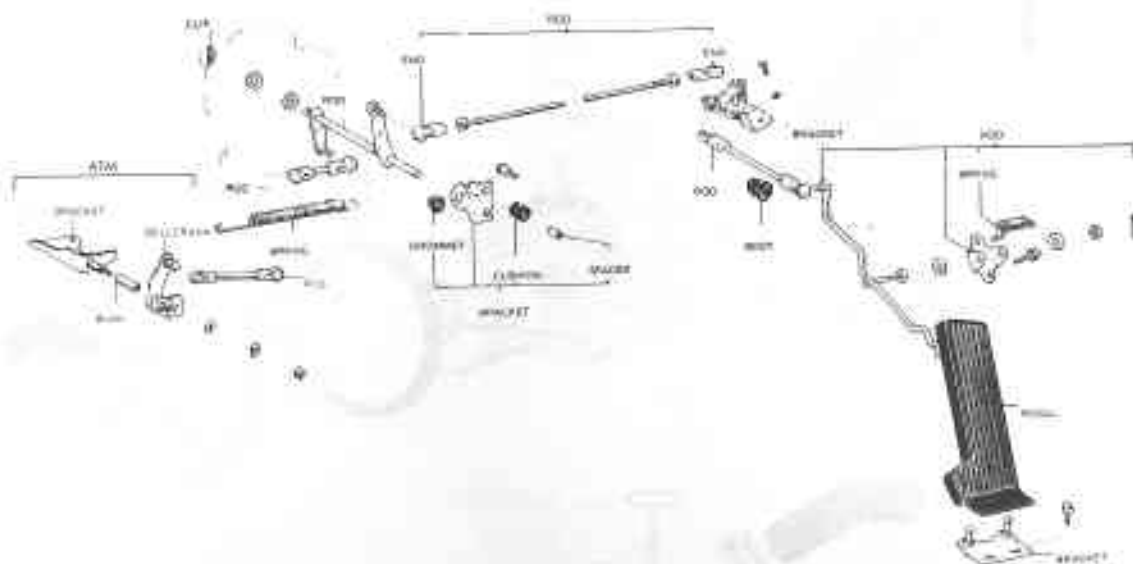
#### **Instruction Tips on Felt Element:**

1. For cleaning the element with compressed air, blow out from the inside toward the outside with low pressure air.
2. If the element is spoiled with oil or fat, wash with a soft soap or clean gasoline, and dry it thoroughly.  
It is recommended that the washing of the element should be performed only thrice.
3. Never wash the element with a cleaning solvent except with clean gasoline or water with soft soap.
4. If the element is washed, it may discolor, but the filtration efficiency will not be affected.

#### **Instruction Tips on Paper Element:**

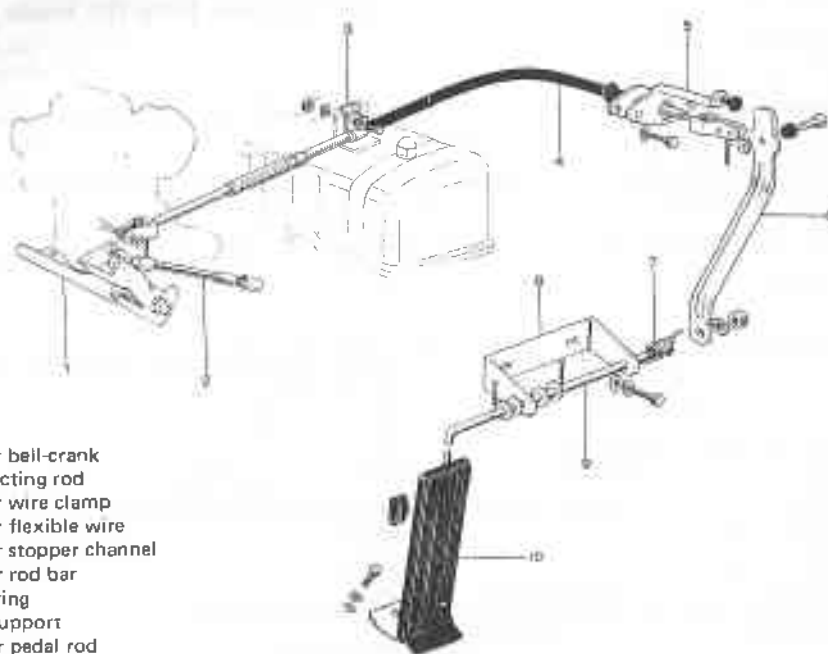
1. For cleaning the element with compressed air, follow the same procedures on the felt element type as prescribed above.
2. Do not wash the element with any solvent or soap and water.  
If the element is excessively dirty, replace the element.

## ACCELERATOR LINKAGE



*Fig. 5-91 Accelerator Linkage Components on RT Series for RHD*

**G3809**



- 1 Accelerator bell-crank
- 2 Link connecting rod
- 3 Accelerator wire clamp
- 4 Accelerator flexible wire
- 5 Accelerator stopper channel
- 6 Accelerator rod bar
- 7 Torsion spring
- 8 Pedal rod support
- 9 Accelerator pedal rod
- 10 Accelerator pedal

*Fig. 5-92 Accelerator Linkage Components on RT Series for LHD*

G3810

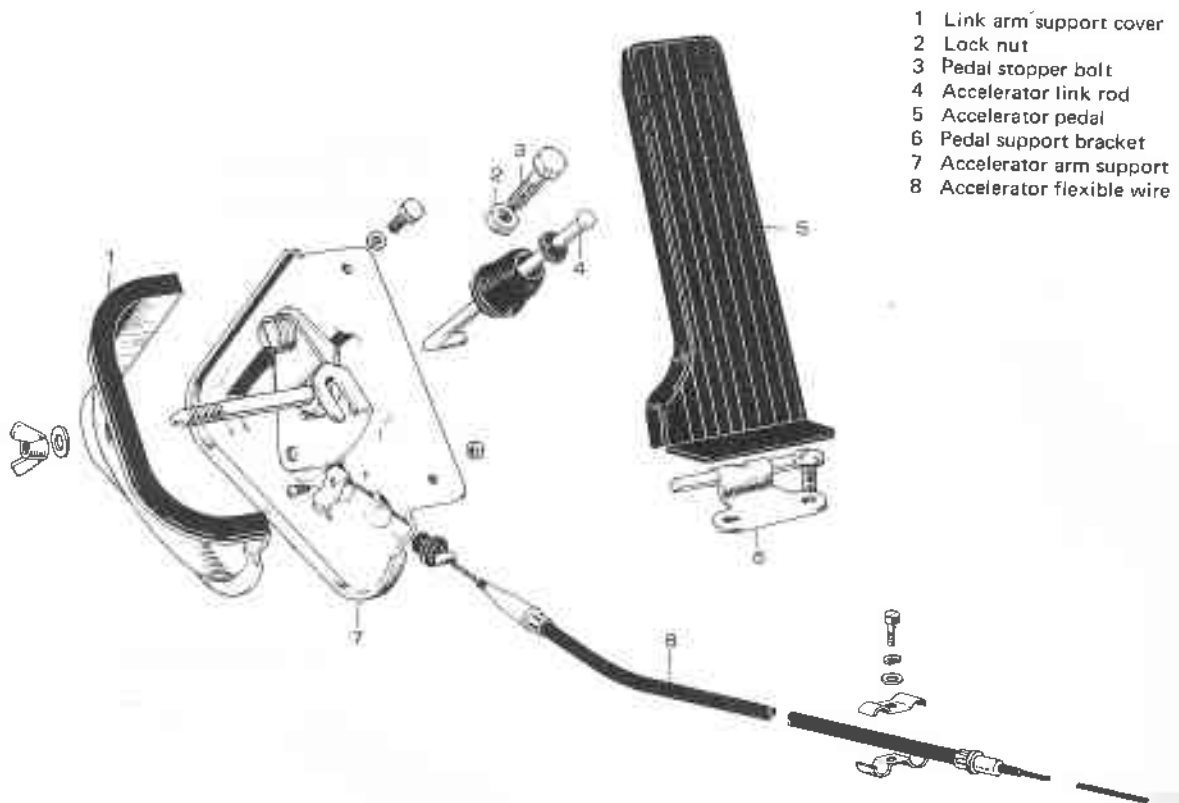


Fig. 5-93 Accelerator Linkage Components on RH Seires for RHD

G3812

### Description

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, and check if the throttle valves are just sufficiently fully opened when the accelerator pedal is depressed all the way. This is very essential to obtain the full performance of the engine.

If necessary, adjust the pedal stroke by adjusting the installation position of the wire clamp located on the rocker arm cover on RT series, and the pedal stopper bolt on RH series.

## LUBRICATING SYSTEM

|                                      |     |
|--------------------------------------|-----|
| DESCRIPTION .....                    | 6-1 |
| OIL PUMP .....                       | 6-2 |
| Description .....                    | 6-2 |
| Removal .....                        | 6-2 |
| Disassembly .....                    | 6-2 |
| Inspection & Repair .....            | 6-3 |
| Assembly .....                       | 6-4 |
| Installation .....                   | 6-5 |
| OIL FILTER .....                     | 6-5 |
| Description .....                    | 6-5 |
| Removal .....                        | 6-5 |
| Disassembly .....                    | 6-5 |
| Inspection .....                     | 6-5 |
| Assembly .....                       | 6-6 |
| Installation .....                   | 6-6 |
| Oil Filter Element Replacement ..... | 6-6 |
| MEMORANDUM .....                     | 6-7 |

## DESCRIPTION

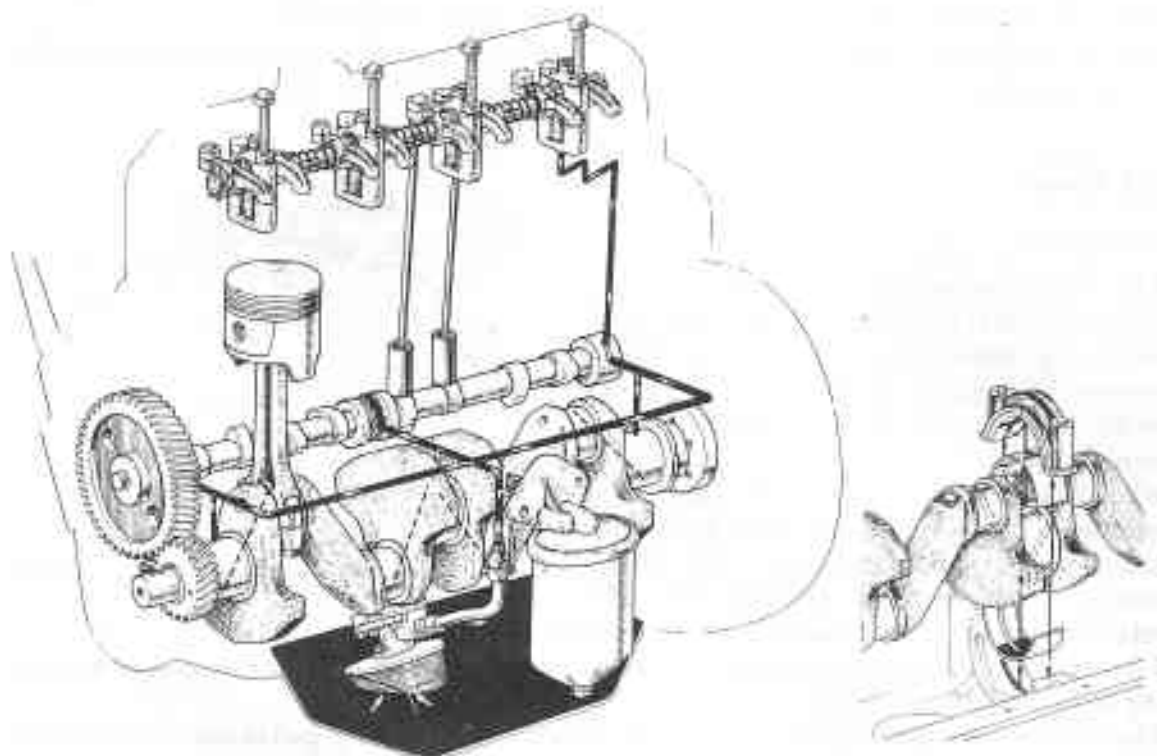


Fig. 6-1 2R-Engine Lubricating System

Y5512, G0842

The lubricating system utilized on the 2R, 12R engine is of an all forced-feed and partial-flow filtering type insuring positive lubrication, and the lubricating circuit is as shown in the above illustration.

The oil discharged from the oil pump divides into two flowing circuits; one enters into the cylinder block oil hole, while the other enters into the oil filter which returns to the oil pan through the check valve after filtration.

As the oil filter is of the partial-flow filtering type, the filter cap is provided with the check valve to prevent the oil pressure in the engine internal components from decreasing less than the specified pressure when the engine is operating at low revolution. Therefore, the oil pressure is regulated by the relief valve provided in the oil pump to the specified pressure.

The oil reaching the cylinder block oil divides into three different directions; engine front, center and the rear sections. The oil reaching the front section lubricates the camshaft No. 1 bearing and the crankshaft front bearings. After lubricating the crankshaft bearings, it lubricates the connecting rod No. 1 bearings through the oil passage provided within the crankshaft, and also sprays from the oil nozzle to the timing gears for lubrication. The center section oil lubricates the camshaft No. 2 bearing, distributor drive gear and the crankshaft center bearings, and after lubricating the crankshaft center bearings, the oil lubricates the connecting rod No. 2 and the No. 3 bearings. The rear section oil lubricates the camshaft No. 3 bearing and the crankshaft rear bearings, and after lubricating the crankshaft rear bearings, the oil lubricates the connecting rod No. 4 bearings. A part of the oil

which lubricated the camshaft No. 3 bearing, travels intermittently through the oil hole in the cylinder block and the cylinder head to the valve rocker support No. 4, and this lubricates the valve rocker shaft, and then flows out of the rocker arms.

The oil which lubricated each of the connecting rods sprays onto the cylinder walls and the piston pins from the holes located at the connecting rod larger end upper.

## OIL PUMP

### Description

The oil pump is of a trochoid type, and is driven by the distributor shaft which is engaged with the camshaft. Therefore, the delivery quantity of the oil pump will increase in proportion to the engine revolution.

When the engine is operated at high revolution, the oil pressure will increase above the specified pressure. For this reason, the oil pump is provided with a relief valve within the oil pump cover to regulate the oil pressure.

The oil drawn in from the strainer is delivered to the oil filter and the cylinder oil hole by the arrow mark shown in the figure 6 - 2.

The delivery pressure becomes to  $3.7 \sim 4.3 \text{ kg/cm}^2$  ( $52.5 \sim 61.2 \text{ psi}$ ) in relation to the increase of the engine revolution, which opens the relief valve, and the oil will be by-passed from the outlet side into the inlet side to regulate the above specified pressure.

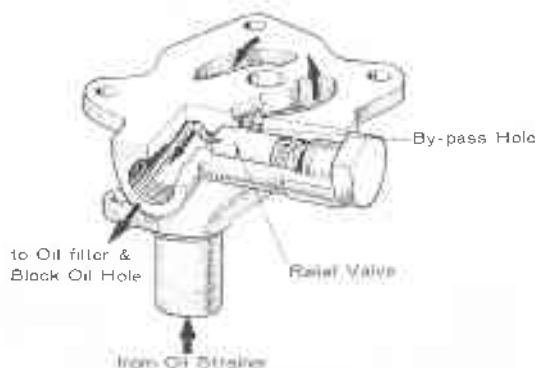


Fig. 6-2 Relief Valve Operation

G0843

### Specification:

#### Type

Trochoid

Delivery quantity: at oil temperature  
 $100^{\circ}\text{C}$  ( $212^{\circ}\text{F}$ )  
Using oil - SAE30

Over 1.7 liters (1.8 US qts., 1.5 Imp. qts)  
per minute at 300 rpm & at oil pressure of  
 $2 \text{ kg/cm}^2$  (28.4 psi)

Over 19 liters (20.1 US qts., 16.7 Imp. qts)  
per minute at 2,500 rpm & at oil pressure  
of  $3 \text{ kg/cm}^2$  (42.7 psi)

Relief valve operating pressure:  
at oil temperature  $100^{\circ}\text{C}$  ( $212^{\circ}\text{F}$ )  
at 2,500 rpm

Starts to open at  $3.7 \sim 4.3 \text{ kg/cm}^2$   
(52.6 ~ 61.2 Psi)

### Removal

1. Drain the engine oil.
2. Remove the oil pan.
3. Remove the oil pump outlet pipe.
4. Remove the oil pump with the strainer.

### Disassembly

1. Remove the oil strainer.
2. Remove the relief valve plug from the oil pump cover, then take out the relief valve spring and the relief valve.
3. Remove the pump cover, and remove the cover packing, drive rotor and the driven rotor.

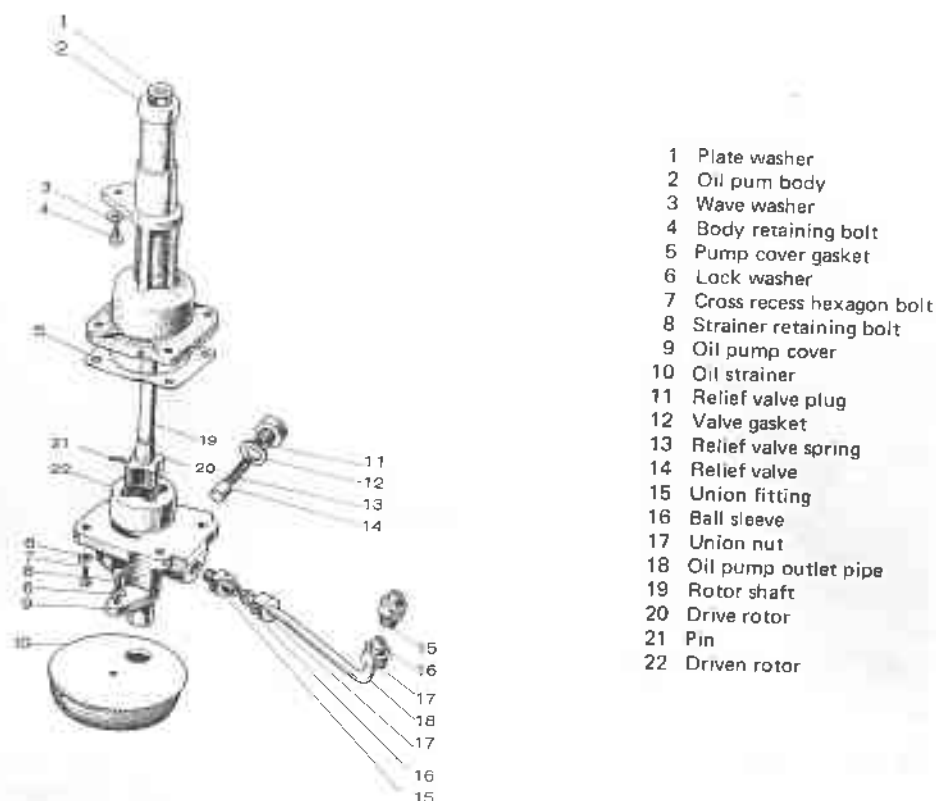


Fig. 6-3 Oil Pump Components

Y5513

**Inspection & Repair**

Wash all the parts in cleaning solvent, and check the following items.

1. Check the oil pump rotor shaft for excessive wear and scores.  
If necessary, replace the shaft.



Fig. 6-4 Checking Rotor Shaft

V3188

2. Inspect the drive rotor and the driven rotor for excessive wear and scores. If defective, replace the rotors as a set.

Drive rotor diameter is 29.70 to 29.74 mm (1.170 ~ 1.172").

Driven rotor diameter is 40.53 to 40.56 mm (1.597 ~ 1.598").

3. Inspect the tip clearance between the drive rotor and the driven rotor.  
The clearance should be within 0.07 ~ 0.12 mm (0.003 ~ 0.005"), and if the clearance exceeds 0.2 mm (0.008"), replace the rotors as a set.

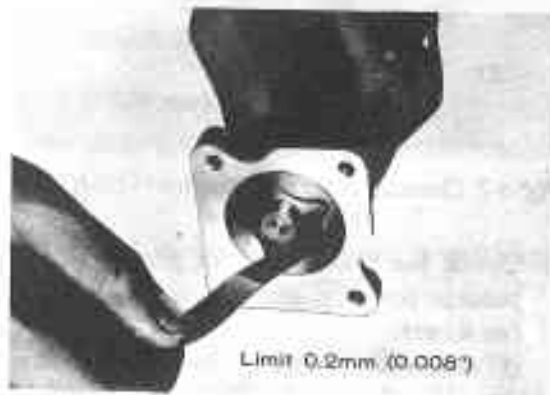


Fig. 6-5 Checking Tip Clearance

V3189



4. Inspect the side clearance between the rotor and the installing surface of the pump cover.

The clearance should be within 0.03 ~ 0.09 mm or 0.0012 to 0.0035".

If the clearance exceeds 0.15 mm (0.006"), replace the rotor and/or the pump cover.



Fig. 6-6 Checking Side Clearance V3190

5. Inspect the body clearance between the driven rotor and the body. The clearance should be within 0.10 ~ 0.16 mm (0.004 ~ 0.006"). If the clearance exceeds 0.2 mm (0.008"), replace the body or the rotor set.



Fig. 6-7 Checking Body Clearance V3191

6. Check the relief valve for proper fit, oil passage for clog and the sliding surface for scores.

If defective, replace the relief valve. Also check the valve spring for weakness and damage, and replace as necessary.

#### Relief valve spring specification:

|                   |                                     |
|-------------------|-------------------------------------|
| Free length       | 47.0 mm<br>(1.85")                  |
| Installed length  | 36.8 mm<br>(1.45")                  |
| Installed tension | 5.99 ~ 6.59 kg<br>(13.2 ~ 14.5 lbs) |



Fig. 6-8 Checking Relief Valve V3192

7. Check the pipe and other parts for cracks and damages, and check the strainer for clog and damage. Replace if defective.

#### Assembly

Follow the disassembly procedures in the reverse order, and after assembling, perform the delivery test of the oil pump according to the following easy method.

Submerge the oil pump inlet pipe into the engine oil, and rotate the rotor shaft with a screwdriver until the oil is pumped out from the outlet port.



Fig. 6-9 Oil Pump Test V3193

At this time, the rotor shaft should rotate smoothly and lightly.

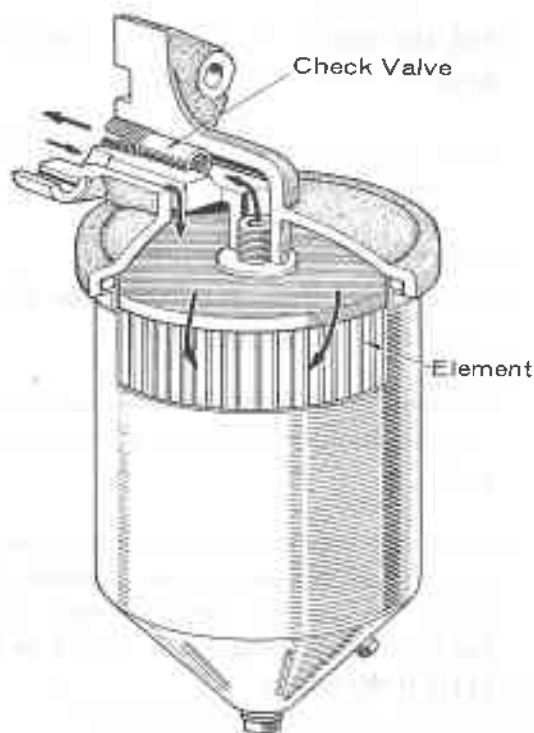
Next, plug the outlet port with the finger, and rotate the shaft continuously. If the oil is pumped out counteracting to the pressure of the finger, the oil pump is satisfactory.

### Installation

1. Install the oil pump and the outlet pipe, and tighten the oil pump retaining bolt to 1.7 ~ 2.3 m·kg (12.3 ~ 16.6 ft·lb) torque.
2. Install the oil pan with the new gasket, and tighten the bolts to 0.4 ~ 0.7 m·kg (2.9 ~ 5.0 ft·lb) torque.
3. Fill the engine oil to specified level.

## OIL FILTER

### Description



The oil filter element is of a paper type which is treated with a special resin.

Since the oil filter is of the partial-flow filtering type, when the engine is operated at high revolution comparatively, the oil delivered from the pump flows to the cylinder block oil hole for lubricating and to the oil filter for filtration.

But, at low revolution, the passage to the oil filter is closed by the check valve incorporated within the oil filter cap in order to maintain sufficient pressure of oil flow to the engine internal components.

Namely, when the delivery pressure of the oil pump becomes less than 0.6 to 0.8 kg/cm<sup>2</sup> (8.5 ~ 11.4 psi), the check valve closes, and all the quantity of oil from the oil pump is delivered to the engine internal components to maintain the specified pressure.

### Specification

|                                |                                                      |
|--------------------------------|------------------------------------------------------|
| Filtration type                | Partial-flow                                         |
| Element material               | Paper                                                |
| Case capacity                  | Approx. 0.8 liter<br>(0.85 US qt.,<br>0.70 Imp. qt.) |
| Check valve operating pressure | 0.8 ~ 1.2 kg/cm <sup>2</sup><br>(11.4 ~ 17.0 psi)    |

### Removal

Remove the oil filter retaining bolts, and remove the oil filter assembly from the cylinder block.

### Disassembly

1. Remove the drain plug, and drain the oil.
2. Remove the cartridge guide, then disassemble the filter cap, filter element and the filter case.
3. Remove the check valve from the filter cap.

### Inspection

Wash the disassembled parts with the cleaning solvent.

Fig. 6-10 Cross Sectional View of Oil Filter G0728

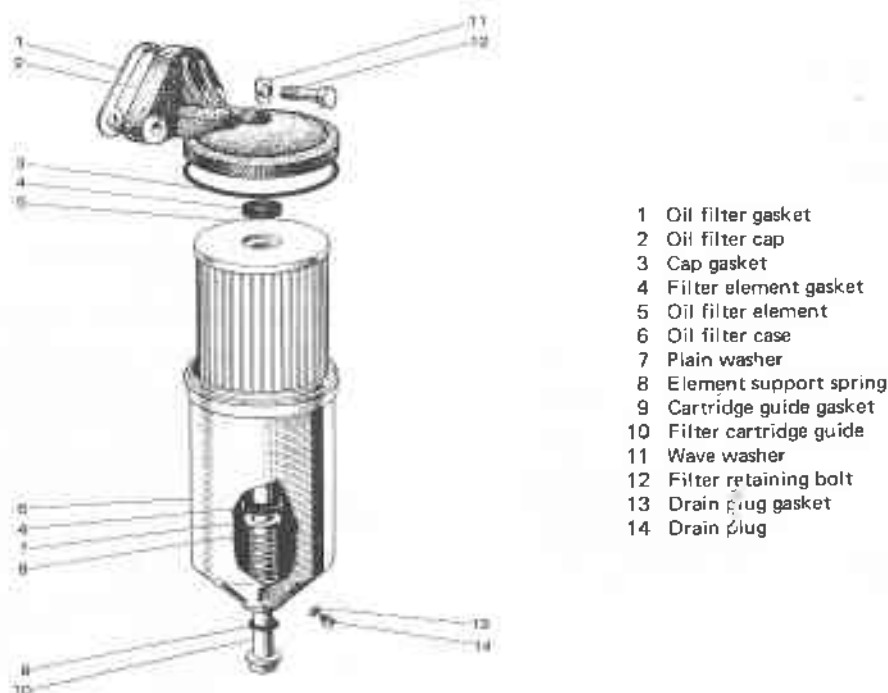


Fig. 6-11 Oil Filter Components

Y5515

1. Check the element, and replace it with the Element Kit, if it is excessively dirty or damaged.
2. Check the filter cap and the case. If these are distorted or damaged, replace as necessary.
3. Check the check valve for fitting condition and scores on the sliding surface. Replace if damaged.

### Assembly

Follow the disassembly procedures in the reverse order adhering the following precautions.

1. Always replace the gaskets upon assembly.
2. Tighten the oil filter cartridge guide to specified torque of 1.6 m-k<sub>g</sub> (11.5 ft-lb) torque.

### Installation

1. Install the oil filter assembly with the

new gasket onto the cylinder block, and tighten the bolts.

2. Fill the engine oil up to the specified level.
3. Start the engine, and check for oil leak from the oil filter.

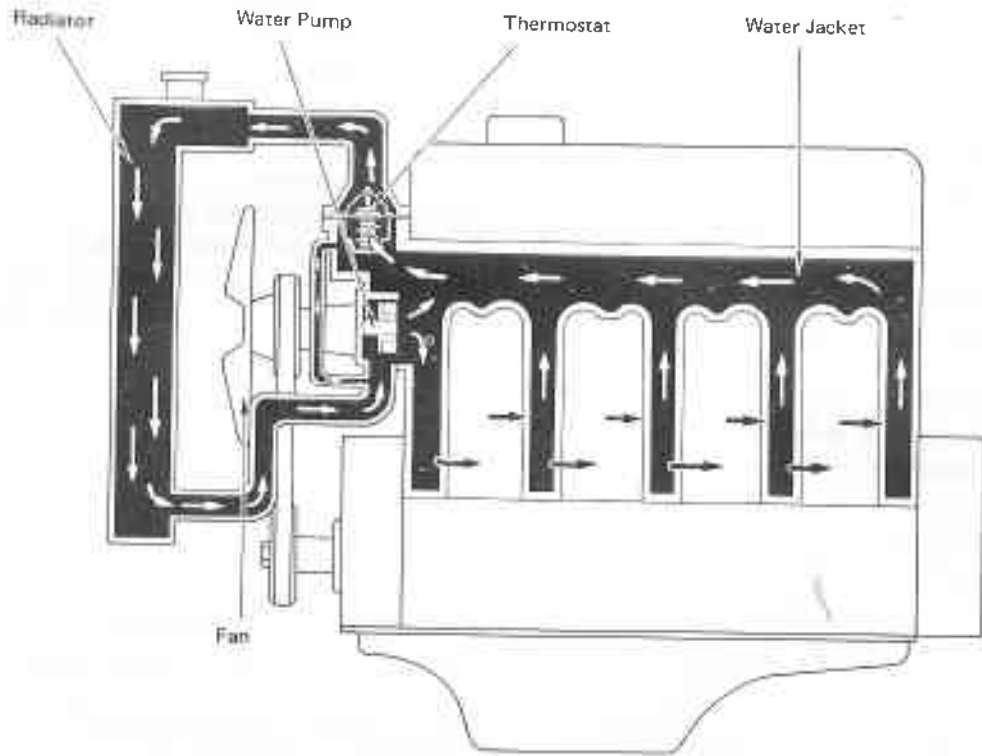
### Oil Filter Element Replacement

1. Remove the drain plug from the filter case, and drain the engine oil.
2. Loosen the oil filter cartridge guide and remove the filter case with the cartridge guide.
3. Clean the case and the cartridge guide, and install the new element with the gasket in correct position, and then tighten the cartridge guide to 1.6 m-k<sub>g</sub> (11.5 ft-lb) torque.
4. Replenish the engine oil and check for oil leak after operating engine.

## COOLING SYSTEM

|                           |      |
|---------------------------|------|
| DESCRIPTION .....         | 7- 1 |
| TROUBLE SHOOTING .....    | 7- 2 |
| WATER PUMP .....          | 7- 2 |
| Description .....         | 7- 2 |
| Removal .....             | 7- 3 |
| Disassembly .....         | 7- 3 |
| Inspection & Repair ..... | 7- 4 |
| Assembly .....            | 7- 4 |
| Installation .....        | 7- 5 |
| THERMOSTAT .....          | 7- 5 |
| Description .....         | 7- 5 |
| Removal .....             | 7- 6 |
| Inspection .....          | 7- 6 |
| Installation .....        | 7- 6 |
| RADIATOR .....            | 7- 6 |
| Description .....         | 7- 6 |
| Removal .....             | 7- 7 |
| Inspection & Repair ..... | 7- 7 |
| Installation .....        | 7- 7 |

## DESCRIPTION

*Fig. 7-1 Engine Cooling System*

Y5516

The cooling system on the 2R or 12R engine is of a pressure forced-circulation type insuring positive cooling efficiency.

The construction of the cooling system and the circulation of the coolant are as shown in the above illustration.

The radiator is a corrugated fin type which is comparatively light, and has excellent radiation efficiency.

The water pump is a direct driven type having the four blades fan for positive cooling efficiency under excessive heavy load operation, and the thermostat is of a wax type utilized within the cooling system.

The coolant is pumped out from the lower tank of the radiator by the water pump, and is forcedly circulated from the cylinder walls to the cylinder head within the water jackets provided in the engine. The coolant which has been heated is returned into the upper tank of the radiator through the thermostat housing, and flows into the lower tank to be cooled while passing the radiator tubes by the air.

If the coolant temperature is low, and as the thermostat is closed, the coolant is pumped out from the thermostat housing through the by-pass hose, and is circulated within the water jackets to warm-up the engine quickly.

## TROUBLE SHOOTING

## Symptoms &amp; Probable Causes

## Remedies

- |                                                    |                                     |
|----------------------------------------------------|-------------------------------------|
| 1. Overheating                                     |                                     |
| a. Lack of coolant                                 | Replenish and check for leak/s      |
| b. Loose fan belt                                  | Adjust fan belt tension             |
| c. Oil soaked or defective fan belt                | Replace fan belt                    |
| d. Defective thermostat                            | Replace thermostat                  |
| e. Water pump inoperative                          | Repair or replace water pump        |
| f. Clogged cooling system                          | Clean radiator and water jackets    |
| g. Incorrect ignition timing                       | Adjust ignition timing              |
| h. Brakes dragging                                 | Adjust brakes                       |
| 2. Overcooling                                     |                                     |
| a. Thermostat defective                            | 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. Loose heater hose connections or defective hose | Tighten connections or replace hose |
| e. Leak at cylinder head gasket                    | Tighten bolts or replace gasket     |
| f. Cracked cylinder head or block                  | Repair or replace                   |
| 4. Noisy cooling system                            |                                     |
| a. Defective water pump bearing                    | Replace bearing assembly            |
| b. Loose or bent fan blades                        | Tighten, repair or replace blades   |
| c. Defective fan belt                              | Replace fan belt                    |

## WATER PUMP

## Description

The water pump is of the direct driven fan type for stable cooling effect under excessive heavy load operation, and consists of a fan, pulley, pulley seat, water pump bearing, shaft seal set, pump rotor and the pump body. The water pump body is of aluminum alloy, and is provided with the by-pass port which is connected with the thermostat housing.

The pump rotor is of a centrifugal type having six blades, and this type has the following advantages; it is compact, the delivery quantity is large, and even though the outlet port is made smaller, the pressure will

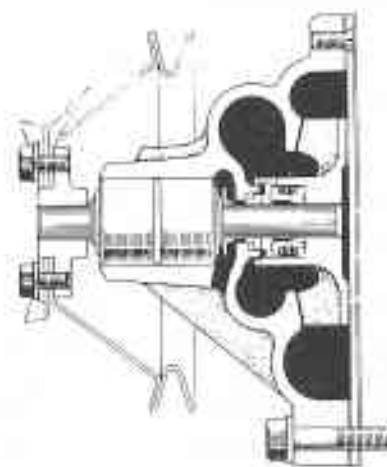


Fig. 7-2 Water Pump Section

G3203

even though the outlet port is made smaller, the pressure will

not increase, therefore, it is quite convenient to perform the temperature adjustment. The water pump bearing is of dual ball bearings with grease sealed type, and the water seal method is of a mechanical seal type.

#### Specification:

|                                  |                                                                                                                                       |
|----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| Water pump type                  | Centrifugal with six blades                                                                                                           |
| Delivery quantity                | 120 liters (31.7 US gals., 26.4 Imp. gals) per minute at 3,500 rpm, at delivery pressure of approx. 0.4 kg/cm <sup>2</sup> (5.7 psi). |
| Water seal method                | Mechanical seal                                                                                                                       |
| Bearing type                     | Dual ball bearings with grease sealed                                                                                                 |
| Rotational ratio with crankshaft | 13 to 11                                                                                                                              |

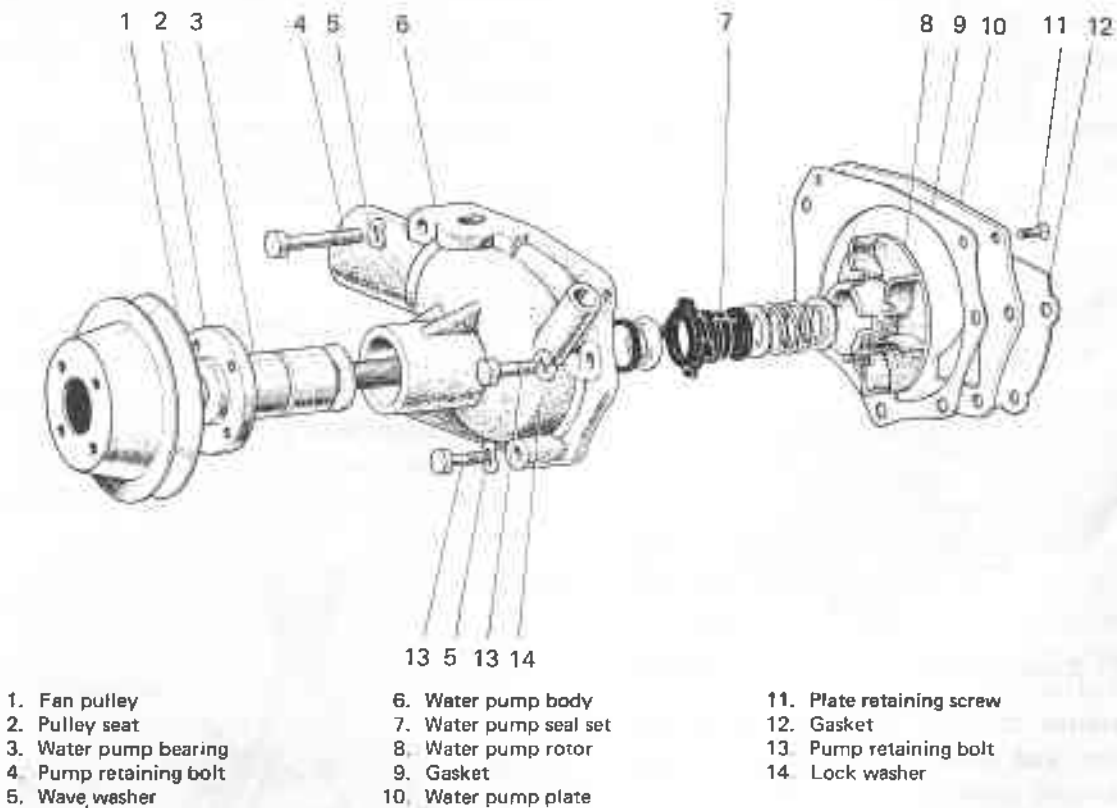


Fig. 7-3 Water Pump Components

Y5518

#### Removal

1. Drain the coolant.
2. Remove the radiator inlet and outlet hoses and the by-pass hose. Disconnect the heater hose if the car is equipped with the heater.
3. Remove the fan belt, fan and the fan pulley.

4. Remove the pump retaining bolts, then remove the water pump assembly.

#### Disassembly

1. Remove the pulley seat with the Water Pump Pulley Seat Puller 09235-20011.



Fig. 7-4 Pulley Seat Removal V3194

2. Remove the water pump plate and the gasket.
3. Remove the water pump rotor from the bearing shaft with the Water Pump Rotor Puller 09239-31011.



Fig. 7-5 Rotor Removal V3195

4. Remove the hold snap ring from the rotor, and remove the water pump seal set.



Fig. 7-6 Bearing Removal V3196

5. Heat the pump body to 75 ~ 85°C (167 ~ 185 °F), and remove the water pump bearing toward the pulley side using the Water Pump Bearing Remover & Replacer 09238-40010 and a press. Do not remove the bearing unless for replacement.

6. Remove the floating seat and the gasket from the pump body.

### Inspection & Repair

Wash all the parts with the exception of the water pump bearing, and check each part for cracks, wear, corrosion, and other damage.

If defective, replace as necessary. The water seal set is advisable to be replaced when the water pump is disassembled.

### Assembly

1. Heat the water pump body to 75 to 85°C (167 ~ 185°F), and press in the water pump bearing until the bearing end is flush with the upper end of the pump body using the Water Pump Bearing Remover & Replacer 09238-40010 and a press.



Fig. 7-7 Installing Bearing V3197

2. Press in the pulley seat onto the bearing shaft with the press.
3. Install the gasket and the floating seat onto the pump body. When installing the floating seat, insert it after wetting with water.



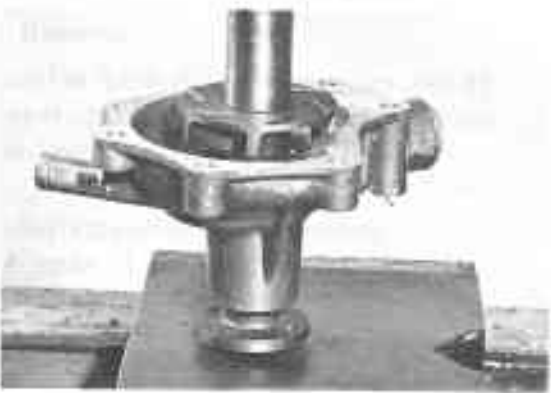
4. Assemble the water seal set onto the rotor.



**Fig. 7-8 Installing Pulley Seat** V3198

5. Coat silicone oil or engine oil onto the contacting surface of the floating seat and the thrust washer, and then press in the rotor onto the bearing shaft until the rotor end surface and the bearing shaft end surface are flush.

At this time, the clearance between the rotor and the body should be 0.3 ~ 0.7 mm (0.012 ~ 0.030").



**Fig. 7-9 Installing Rotor** V3199

6. Install the water pump plate with the new gasket onto the water pump body.

### Installation

Follow the removal procedures in the reverse order adhering the following described precautions.

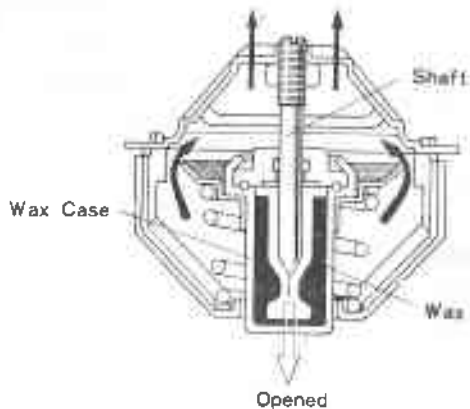
1. Always replace the gasket.
2. Adjust the fan belt deflection to 8 ~ 12 mm (0.31 ~ 0.47") when depressed at

the midway of the fan belt with 10 kg (22 lbs) pressure.

3. Start the engine after installing, and check if the cooling system for water leak.

### THERMOSTAT

#### Description



**Fig. 7-10 Thermostat Section** G1500

The thermostat equipped on RT & RH series is of the wax type, and is installed within the thermostat housing of the cylinder head, which restricts the coolant flow into the radiator. Thus, the engine warm-up period is minimized, and maintains engine economical operating temperature. The wax type thermostat has the following excellent features.

1. As it is not affected by water pressure, it ensure positive operation, and water leak is slight when the valve is closed.
2. As the water flow resistance is small on the thermostat, the water flow into the radiator is large.
3. The construction is very durable, and the life of the thermostat is prolonged due to no valve vibration.
4. It is heat-proof, cold-proof and pressure-proof.

For the operation of the thermostat, the wax inflates in the wax case according to the increase of water temperature, and tends to push out the shaft through the rubber seal, but as the shaft is fixed, the wax case will be pushed down relatively thereby opening the water valve. The wax type thermostat will rest in the closed condition if the temperature sensing unit becomes inoperative.

#### Specification:

|                 |                                                                             |
|-----------------|-----------------------------------------------------------------------------|
| Thermostat type | Wax                                                                         |
| Starts to open  | at 80.5 ~ 83.5°C (177 ~ 182°F) – 2R<br>at 73.5 ~ 76.5°C (164 ~ 170°F) – 12R |
| Fulley opens    | at 95°C (203°F) – 2R at 85°C (185°F) – 12R                                  |
| Valve lift      | 8 mm (0.315")                                                               |

#### Removal

Remove the water outlet after draining coolant and then take out the thermostat.

#### Inspection

1. Check the thermostat valve for closed condition at normal temperature. Replace the thermostat if the valve is opened or improperly seated.
2. Inspect the opening operation of the thermostat valve as follows.
  - a. Prepare hot water of 95 ~ 100°C (203 ~ 212°F), and submerge the thermostat over 4 minutes.
  - b. Hold the thermostat with pliers and check the valve opening travel between the valve and the flange using a suitable gauge of 4.0 mm (0.16") as shown in figure 7-11.

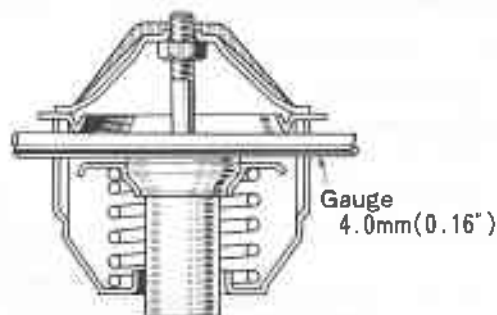


Fig. 7-11 Checking Thermostat

10134

If the gauge can be inserted or the valve opening travel is more than 4.0 mm (0.16"), the thermostat is satisfactory.

- c. Also submerge the thermostat into hot water of 78°C (172°F) over 4 minutes. If the valve does not open, the thermostat is satisfactory.

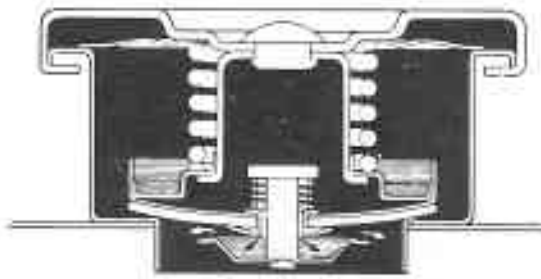
## RADIATOR

#### Description

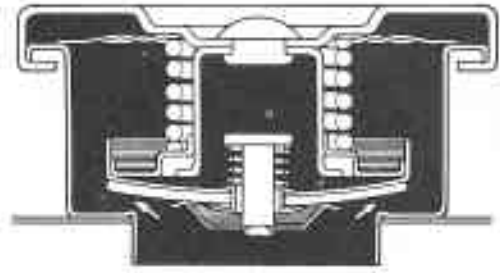
The radiator is of the corrugated fin and tube type designed with large cooling area and smooth passages for high efficiency.

As the radiator is of the pressure type, the radiator cap is provided with relief valves to maintain the pressure of approximately 0.3 kg/cm<sup>2</sup> (4 psi) above the atmospheric pressure within the cooling system.

When the pressure within the radiator increases above 0.3 kg/cm<sup>2</sup> (4 psi), the pressure relief valve allows the pressure to escape through the over-flow pipe. When the pressure decreases less than the atmospheric pressure, and as the coolant is cooled, the vacuum relief valve allows the outside air to enter preventing the formation of vacuum within the radiator.



Vacuum Relief Valve Operation



Pressure Relief Valve Operation

Fig. 7-12 Cross Sectional View of Radiator Cap

G1110, G1111

On the pressure type radiator, the coolant will not boil even though the coolant temperature reaches 100°C (212°F), therefore, to maintain this excellent cooling efficiency, it is essential that the relief valves operate properly.

#### Specification:

|                        |                                       |
|------------------------|---------------------------------------|
| Type                   | Pressure cooling                      |
| Core type              | Corrugated fin & tube                 |
| Valve opening pressure | 0.5 kg/cm <sup>2</sup> ( 7 psi) - 2R  |
|                        | 0.9 kg/cm <sup>2</sup> (13 psi) - 12R |

#### Removal

##### On RT & RN series

1. Drain the coolant, and remove the radiator inlet and outlet hoses.
2. Remove the radiator grille.
3. Remove the radiator retaining bolts, then remove the radiator.

##### On RH & RY series

1. Jack up the vehicle, and support with stands.
2. Drain the coolant, and remove the radiator inlet and the outlet hoses.
3. Remove the radiator brace rod.
4. Remove the engine under cover air guide.
5. Remove the radiator retaining bolts, then remove the radiator from under-

neath the vehicle.

#### Inspection & Repair

1. Inspect the radiator for leaks from the upper tank, lower tank and the core. Repair or replace if defective.
2. Check the radiator core fin for clogging the air passages.  
If necessary, repair the fins.
3. If the clog of the radiator core exceeds 20 percent of the entire area, replace the radiator assembly.
4. Check the radiator cap pressure relief valve and the vacuum relief valve springs for proper tensions, and also check the packing for damage. Replace if necessary.
5. Check the radiator inlet and the outlet hoses for cracks or other defects. Replace as necessary.

## CHARGING SYSTEM

|                                          |      |
|------------------------------------------|------|
| DESCRIPTION .....                        | 8- 1 |
| TROUBLE SHOOTING .....                   | 8- 2 |
| ALTERNATOR & REGULATOR .....             | 8- 3 |
| Construction .....                       | 8- 3 |
| Operation .....                          | 8- 4 |
| Inspection in Car .....                  | 8- 5 |
| ALTERNATOR .....                         | 8- 7 |
| Removal .....                            | 8- 7 |
| Disassembly .....                        | 8- 7 |
| Inspection & Repair .....                | 8- 9 |
| Bearing .....                            | 8- 9 |
| Rotor .....                              | 8- 9 |
| Stator .....                             | 8-10 |
| Brush & brush holder .....               | 8-10 |
| Rectifier .....                          | 8-11 |
| Assembly .....                           | 8-11 |
| Alternator Output Test .....             | 8-13 |
| Installation .....                       | 8-13 |
| ALTERNATOR REGULATOR .....               | 8-13 |
| Removal .....                            | 8-13 |
| Electrical Adjustment .....              | 8-13 |
| Voltage relay .....                      | 8-13 |
| Voltage regulator .....                  | 8-14 |
| Regulator Circuit Test .....             | 8-14 |
| Inspection & Mechanical Adjustment ..... | 8-15 |
| Voltage relay .....                      | 8-15 |
| Voltage regulator .....                  | 8-16 |
| Installation .....                       | 8-17 |
| MEMORANDUM .....                         | 8-18 |



## TROUBLE SHOOTING

| Symptoms & Probable Causes                                                                        | Remedies                                                  |
|---------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| 1. Battery discharges                                                                             |                                                           |
| a. Loose or worn fan belt                                                                         | Adjust or replace fan belt                                |
| b. Shorted or opened stator coil                                                                  | Replace stator                                            |
| c. Opened rotor coil                                                                              | Replace rotor                                             |
| d. Poor contact between brushes and slip rings                                                    | Clean or replace brushes                                  |
| e. Defective rectifier/s                                                                          | Replace rectifier/s                                       |
| f. Regulator voltage adjusted too low                                                             | Adjust regulator                                          |
| g. Burnt or poor contact of regulator low speed points                                            | Dress points or replace regulator                         |
| h. Melted regulator high speed points                                                             | Replace                                                   |
| i. Lack or insufficient electrolyte                                                               | Replenish with distilled water or adjust specific gravity |
| j. Shorted battery plates                                                                         | Replace battery                                           |
| k. Poor connection of battery terminals                                                           | Clean and tighten terminals                               |
| l. Opened or poor connection of wiring between ignition switch and regulator "IG" terminal        | Repair or replace wiring                                  |
| m. Burnt or poor contact of fuse                                                                  | Replace fuse or clean fuse holder                         |
| n. Opened or poor connection of wiring between regulator "F" terminal and alternator "F" terminal | Repair or replace wiring                                  |
| o. Excessive current load                                                                         | Recheck current draw                                      |
| 2. Battery over charges                                                                           |                                                           |
| a. Poor contact of regulator "E" terminal                                                         | Repair contact                                            |
| b. Opened pressure coil of voltage regulator                                                      | Replace regulator                                         |
| c. Melted regulator low speed points                                                              | Replace regulator                                         |
| d. Poor contact of regulator high speed points                                                    | Dress points                                              |
| e. Regulator voltage adjusted too high                                                            | Adjust regulator                                          |
| f. Opened or poor connection of wiring between alternator "N" terminal and regulator "N" terminal | Repair or replace wiring                                  |
| 3. Defective actuation of charge warning light                                                    |                                                           |
| a. Loose fan belt                                                                                 | Adjust fan belt tension                                   |
| b. Loose wiring connections                                                                       | Tighten or repair connections                             |
| c. Defective regulator operation                                                                  | Adjust or replace regulator                               |
| 4. Alternator noisy                                                                               |                                                           |
| a. Defective bearing/s                                                                            | Replace bearing/s                                         |
| b. Malfunction of rectifier/s                                                                     | Replace rectifier/s                                       |
| c. Grounded or shorted stator coil                                                                | Replace stator                                            |

## ALTERNATOR & REGULATOR

### Construction

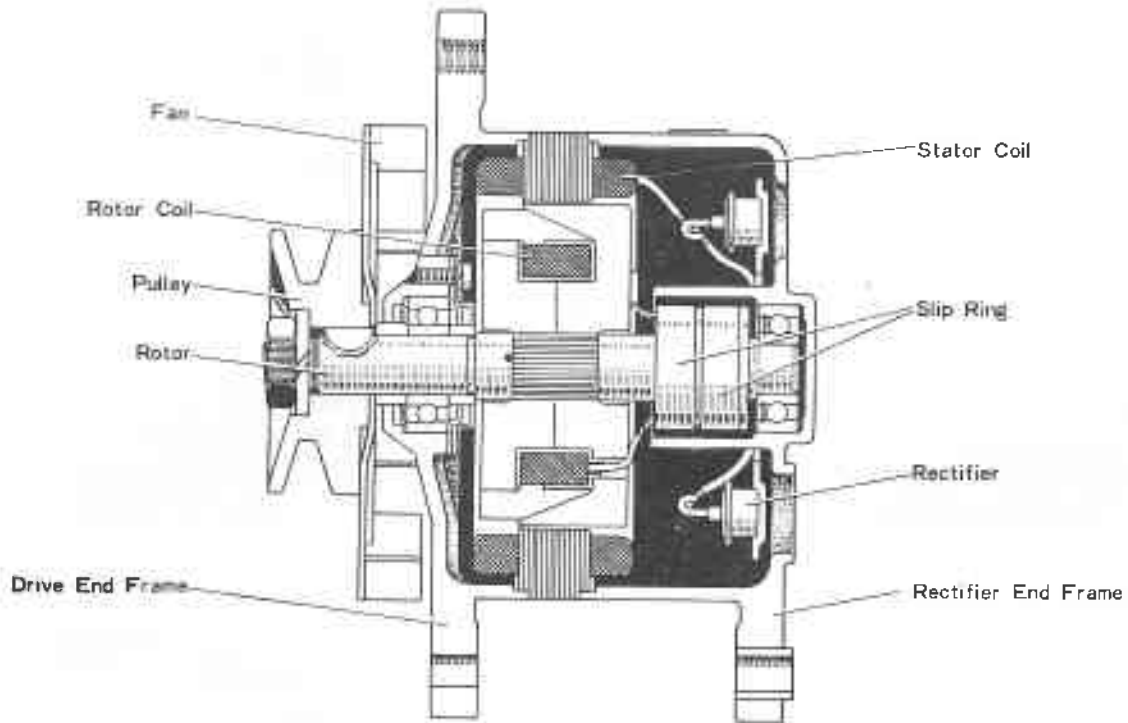


Fig. 8-2 Cross Sectional View of Alternator

Y5118

The components and the specifications of the alternator for RT and RH series are slightly different, but the construction and operation are same.

The main components of the alternator are composed of the rotor, stator, rectifiers and the frames.

The rotor consists of two six-fingered, cup-shaped halves, which when assembled become a 12-pole rotor.

A rotor coil wound in the shape of a doughnut is connected to the two slip rings which are actuated by an exciting current from the two brushes, and the rotor is mounted onto the bearings located at the end frames, and revolves within the stator.

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 stator coil is of a three-phase "Y" type. An alternating current generated at the stator coil is converted to a direct current by the six rectifiers which are mounted at the rectifier holders.

The rectifier is of a silicone diode which has a very high resistance to a flow of current in one direction, but it has a very low resistance in the other direction. Therefore, with a proper polarity, the low resistance allows the current to flow from the stator coil to the battery, and the high resistance prevents a reverse current from the battery. Moreover, the stator coil has a self-limiting characteristic in limiting the current flow in its coil to a pre-set value even the revolution increases exceedingly. For these reasons, a current control such as a cut-out relay and a current limiter are not required for the alternator.

The alternator regulator is composed of the voltage regulator and the voltage relay. The function of the voltage regulator in the charging system is to regulate the generating voltage of the stator coil to a pre-set value by controlling the exciting current of the rotor coil.

The voltage relay is provided to prevent the flickering of the headlights and the irregular vibration of the ammeter needle when the engine is operated at idle revolution.

### Specification:

|                                                 |                                               |                                                |
|-------------------------------------------------|-----------------------------------------------|------------------------------------------------|
|                                                 | RT series                                     | Light Truck                                    |
| Voltage                                         | 12volts                                       | same                                           |
| Max. output current                             | 40 amperes                                    | 30 amperes                                     |
| Ground                                          | Negative                                      | same                                           |
| Direction of revolution                         | Clockwise as seen<br>from pulley              | same                                           |
| Stator coil connection                          | Three-phase "Y" type                          | same                                           |
| Rectifying method                               | All wave rectified by<br>six diodes           | same                                           |
| Pulley ratio                                    | 2.0                                           | 1.69                                           |
| No load characteristic at<br>normal temperature | 700 ~ 900 rpm at<br>14 volts, zero ampere     | 800 ~ 1000 rpm at<br>14 volts, zero ampere     |
| Output characteristic at<br>normal temperature  | Less than 3500 rpm at<br>14 volts, 40 amperes | Less than 4000 rpm at<br>14 volts, 30 amperes. |

### Operation

When the ignition switch is closed, the current flows from the battery to the voltage relay points "P0" and "P1", through the charge warning light, therefore, the charge warning light glows. At the same time, the exciting current from the battery flows to the rotor coil through the fuse for the turn signal, voltage regulator points "PL1", "PL0", brushes and the slip rings, causing the rotor to magnetize.

In these conditions, as the rotor is rotated, the three-phase alternating current is generated within the stator coil, and the alternating current is fully rectified into direct current by the six rectifiers. This direct current voltage is actuated between the "B" terminal and the "E" terminal. Also the output voltage of the stator coil neutral point becomes higher, the pull-in force of the pressure coil in the voltage relay increases, and the point "P0" contacts the point "P2" side, resulting the charge warning light to go out.

These points are closed when the neutral point voltage reaches to 4.5~5.8 volts, but the points are closed while the engine is operated normally.

If the alternator output voltage becomes higher than the voltage in the battery, the output current starts flowing to the battery or to the load. When the output voltage increases further, the pull-in force of the voltage coil in the voltage regulator increases. Due to this, the point "PL0" opens from the low speed point "PL1". As the point opens, the exciting current to the rotor coil has to pass the control resistance "Rf", and decreases, resulting to reduce the output voltage at "B" terminal.



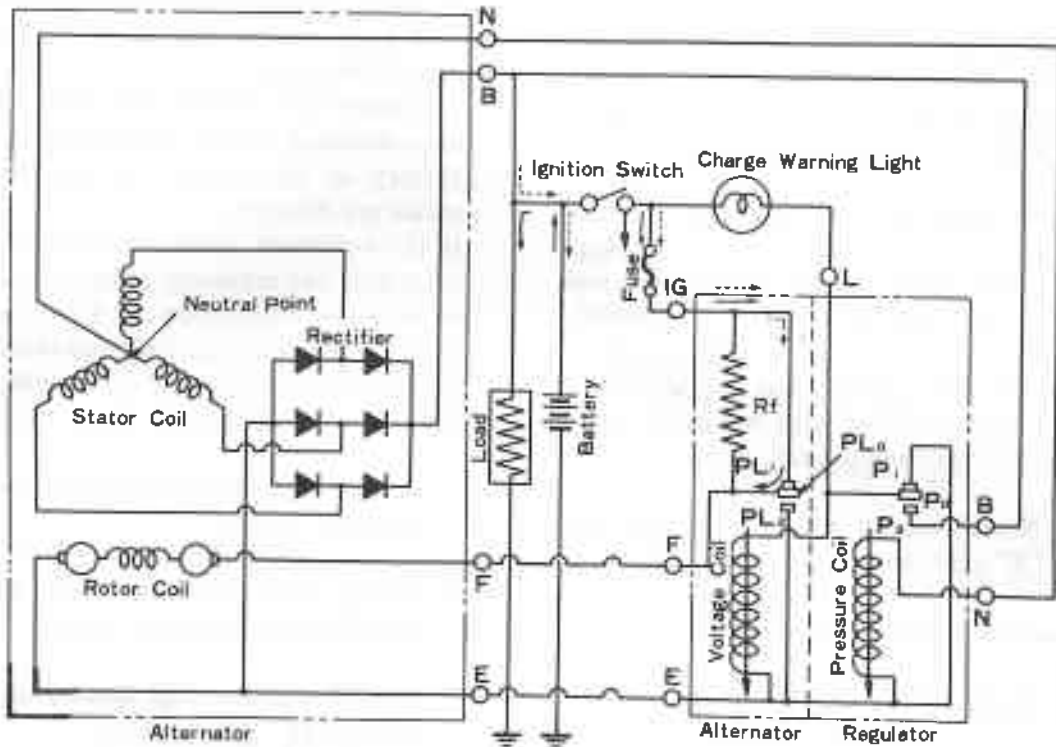


Fig. 8-3 Alternator Generating Circuit

G1553

Under light load at high revolution, the point "PL0" contacts the high speed point "PL2", and the exciting current is further decreased to control the "B" terminal voltage to the specified voltage.

As the output voltage is decreased, the pull-in force of the voltage coil decreases, and the point "PL0" returns to the point "PL1". Thus, the point "PL0" repeats the intermittent movement to control the alternator output voltage.

### Inspection In Car

#### 1. Precaution for operation with the alternator.

- a. Take care when connecting any equipment onto the alternator, as the alternator output "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. Always pay attention to the polarity of the battery, not to connect it onto the alternator oppositely. If connected oppositely, large current flows from the battery to the alter-

nator so that the rectifiers are damaged, and sometimes the flasher unit will burn.

- 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 disconnected, the voltage regulator cannot operate and the voltage of the

"N" terminal increases abnormally so that the voltage relay burns.

If it is necessary to open the "B" terminal, disconnect the connector plug for the "F" terminal at the same time.

- e. For adjustment of the regulator, make sure to disconnect the connector plug. If not, the points may be melted and the fuse may be burnt.
- f. Take care not to wet the alternator rectifier diodes with water or steam when washing the car.
- g. Never connect a condenser onto the "F" terminal.

## 2. Pre-check of this test.

- a. Loose installation of the alternator.
- b. Fan belt tension.
- c. Burnt-out fuse in the fuse block.
- d. Charging system wirings.

3. Disconnect the "B" terminal lead wire from the alternator, and connect the regulator tester.

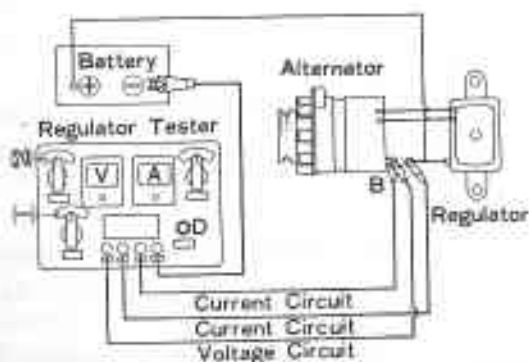


Fig. 8-4 Test Circuit

G0156

4. Check the voltage and amperage of the alternator 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 13.8~14.8 volts, and the current should be less than 10 amperes,

A current flow considerably higher than that specified above, indicates that 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. Voltage regulator low speed point gap too wide.
- b. Voltage regulator low speed points melted or high pressure contact.
- c. Voltage regulator high speed point gap is too wide.
- d. Poor contact of voltage regulator high speed point.
- e. Voltage regulator or relay coil circuit opened.
- f. Poor contact of voltage relay points.

5. Stop the engine, and turn the ignition switch to first position to the right. Check the voltage between the "F" and "E" terminals using the regulator tester.

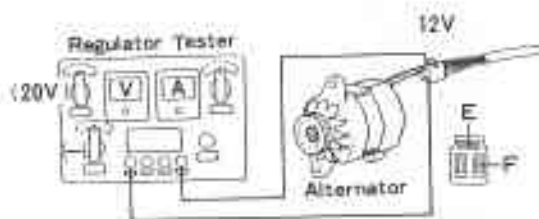


Fig. 8-5 Checking Voltage between "F" & "E"

G0162

The voltage should be 12 volts. If the reading of the voltmeter is zero voltage or low voltage than the specified voltage, it indicates the following symptoms.

- a. Opened or poor contact of fuse, regulator "IG" terminal wire or "F" terminal wire.
- b. Regulator high speed points melted.
6. Disconnect the regulator connector plug, and check the resistance between the regulator "IG" and "F" terminals with a circuit tester. There should be no resistance. If there is any resistance, it indicates that the voltage regulator low speed points contact poorly.

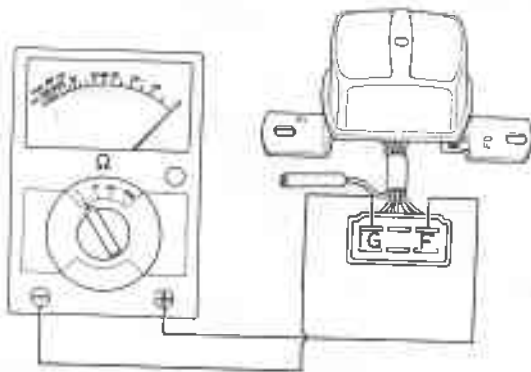


Fig. 8-6 Checking Resistance between "IG" & "F"

G0163

7. Perform the load test in the following manner.

Make the same connection as shown in figure 8-4, and start the engine, and run it at approximately 1,100 rpm with all lights and accessories turned on.

The ammeter should indicate more than 35 amperes on the RT series, and more than 25 amperes on the Light Truck series with the voltage of 13.5 to 14.5 volts.

than the specified amperage, the rectifier or stator coil is shorted or opened.

If the battery is in full charged state and the amperage reading is less than the specified amperage.

It is recommended to discharge the battery to perform the load test.

Disconnect the high tension lead from the ignition coil, and turn the starter for about 5-10 seconds to discharge the battery.

## ALTERNATOR

### Removal

1. Disconnect the battery to ground cable from the battery terminal.
2. Disconnect the wirings from the alternator.
3. Remove the fan belt adjusting bar bolt and the fan belt.
4. Remove the alternator retaining bolt, and remove the alternator assembly from the alternator bracket.

### Disassembly

1. Remove the three drive end frame retaining bolts.
2. Insert a screwdriver into the notches in the drive end frame, and pry with the screwdriver to separate with drive end frame from the stator.

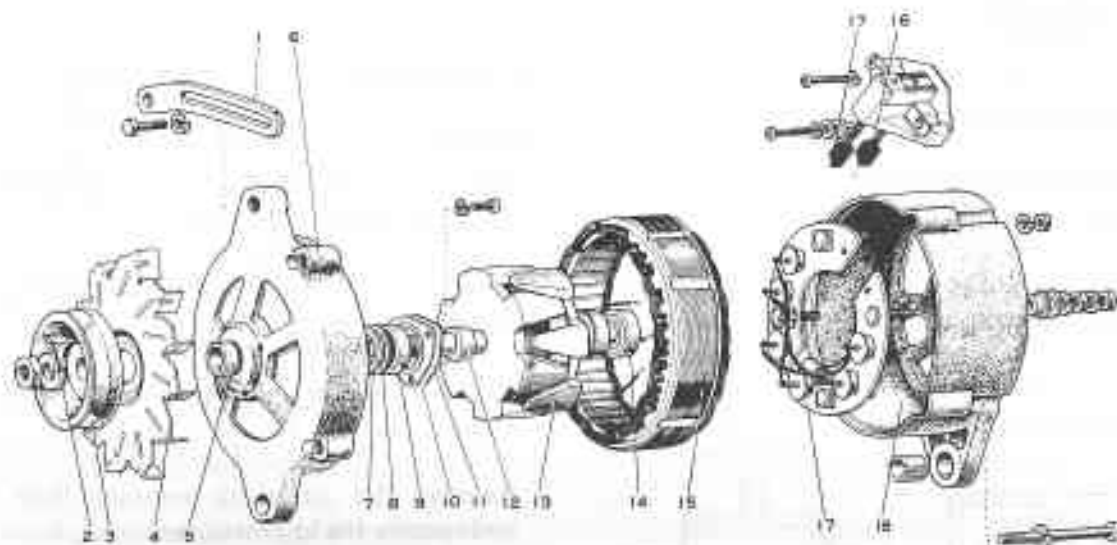
If necessary, tap lightly on the drive end frame with a mallet toward the pulley, and then remove the drive end frame with the rotor.



Fig. 8-7 Drive End Frame Removal

V2195

3. Remove the pulley retaining nut, and remove the pulley, fan, key and the space collar.
4. Remove the rotor from the drive end frame using a press as shown in figure 8-9.



- |                           |                            |                         |
|---------------------------|----------------------------|-------------------------|
| 1. Fan belt adjusting bar | 7. Felt ring               | 13. Rotor               |
| 2. Key                    | 8. Felt ring cover         | 14. Bearing             |
| 3. Alternator pulley      | 9. Bearing                 | 15. Stator              |
| 4. Alternator fan         | 10. Bearing retainer plate | 16. Brush spring        |
| 5. Space collar           | 11. Felt cover             | 17. Rectifier holder    |
| 6. Drive end frame        | 12. Space ring             | 18. Rectifier end frame |

Fig. 8-8 Alternator Components on RH Series

Y6841



Fig. 8-9 Rotor Removal

B0038



Fig. 8-10 Rear Bearing Removal

V1139

5. Remove the rear bearing from the rotor shaft with the Injection Pump Spline Shaft Puller 09286-46011.
6. Remove the bearing retainer retaining

screws, and remove the felt cover (except RT series), bearing retainer, front bearing, felt ring cover and the felt ring from the drive end frame.

7. Remove the rectifier holder retaining nuts, "B" terminal retaining nut and the brush holder retaining screws, then remove the stator with the rectifier holders from the rectifier end frame.



**Fig. 8-11 Stator with Rectifier Holder Removal**

B0039

8. Remove the brush holder assembly from the stator coil "N" terminal in accordance with the following order using a small screwdriver.
  - a. Pull out the brush lead terminal from the holder by sliding the terminal.
  - b. Remove one terminal insulator.
  - c. Remove the stator coil "N" terminal from the holder by sliding out the "N" terminal.

When removing the brush holder assembly, do not remove it by cutting the "N" terminal lead or melting the solder.



**Fig. 8-12 Brush Holder Removal**

B0040

## Inspection & Repair

### Bearing

Check the bearings for scores, roughness, abnormal noise or damage.

If defective, 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 4.1 ~ 4.3 ohms.

If there is little or no resistance, the coil or slip rings have a short or ground, and considerably higher resistance than that specified above, indicates an opened coil or connection defect.

If the test shows that the rotor coil is shorted or opened, and the slip rings are defective, the rotor assembly should be replaced.



**Fig. 8-13 Testing Rotor Coil for Open & Short Circuit**

V2196



**Fig. 8-14 Testing Rotor Coil for Ground**

V2197

2. Connect the tester from the slip ring to the rotor to rotor shaft, and check the insulation between them as shown in figure 8-14.

If the tester needle moves, the rotor coil or slip rings are defective.

The rotor assembly should be replaced.

### 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 the coil or replace the stator assembly.



Fig. 8-15 Testing Stator Coil for Insulation

B0041

2. Check the stator coil for open circuit.

In order to perform this test, the stator coil leads must be disconnected from the rectifier leads.

To disconnect the leads, hold the rectifier lead with a nose pliers to prevent



Fig. 8-16 Melting Solder

G3364

the rectifier from heating, and melt the soldered portions using an electric soldering iron of 100~200 watts for 2 seconds.



Fig. 8-17 Testing Stator Coil for Open Circuit

V1145

Check the four leads of the stator coil for conductance between them.

If the tester needle does not move, the stator coil is opened, and must be replaced.

### Brush & Brush Holder

1. Check the brush for crack and wear.

If the brush is worn beyond 8.5mm (0.335"), replace the brushes.

The brush should slide smoothly.

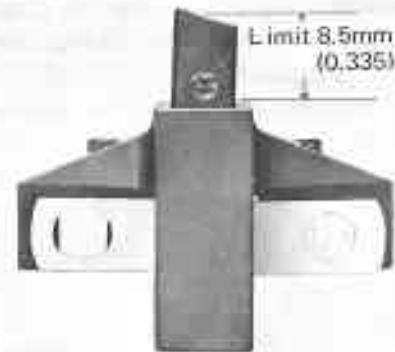


Fig. 8-18 Brush Length

V1143

2. If replacing the brush, install the new brush and the brush spring into the brush holder, then solder the brush lead wire keeping the protruded brush length to 13 mm (0.51").

After soldering the brush lead, check if the brush movement is smooth.

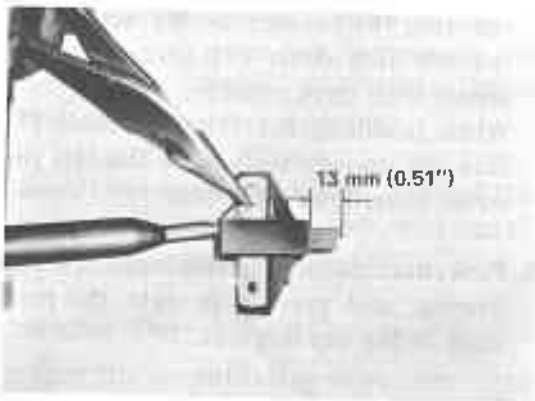


Fig. 8-19 Replacing Brush

V0216

### Rectifier

Good or defective rectifier is classified by the resistance value between the rectifier holder and the rectifier lead.

To perform this test, the rectifier holder must be separated from the stator.

Refer to paragraph 2 of the Stator in the Inspection & Repair on page 8-10.

#### 1. Rectifier holder positive side.

Connect the tester (+) lead onto the rectifier holder and the (-) lead onto the rectifier lead as shown in figure 8-20, and check the resistance.

Good rectifier will indicate no resistance, and if it indicates a high resistance, the rectifier is opened.

Next, turn the polarity of the tester and check again. If the tester needle moves in either polarity, the rectifier is shorted. If the needle does not move in either polarity, the rectifier is opened, and

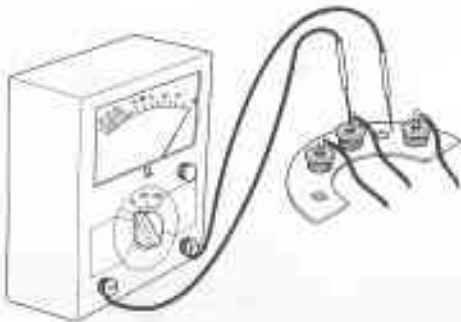


Fig. 8-20 Rectifier Test

G0172

should be replaced with the holder assembly.

#### 2. Rectifier holder negative side.

Connect the tester (-) lead onto the rectifier holder and (+) lead onto the rectifier lead as shown in figure 8-21, and check the resistance.

Good rectifier will indicate no resistance, and if it indicates high resistance, the rectifier is opened.

Next, 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 polarity, the rectifier is opened, and should be replaced.

If any one of the negative side rectifier is found defective, always replace the negative side rectifiers with the holder assembly.



Fig. 8-21 Rectifier Test

G0173

### Assembly

1. Install the stator coil "N" terminal onto the brush holder in the following manner.

a. Insert the stator coil "N" terminal onto the brush holder.

b. Install the terminal insulator.

c. Insert the brush terminal onto the holder at correct position.



Fig. 8-22 Assembling Brush Holder B0043

2. Install the insulator washers to the retaining bolts of the positive side rectifier holder, and install the stator with the rectifier holders onto the rectifier end frame.  
Install the "B" terminal insulator, then tighten the retaining nuts.

3. Install the brush holder onto the rectifier holders through the insulation plate and the insulators.  
The brush holder retaining bolts must be tightened through the insulators.

4. Install the felt ring (2) and the felt ring cover (3) onto the drive end frame (1) so that the convex surface of the felt ring cover will face toward the pulley side.  
Pack multipurpose grease into the bearing (4), and install the bearing.  
Next, install the bearing retainer (5),

felt ring (6) (except on RT series) and the felt ring cover (7) (except on RT series) with three retaining screws.  
When installing the felt ring cover (7), face the convex surface of the felt ring cover toward the rotor side.

5. Pack multipurpose grease into the rear bearing, and press it in onto the rotor shaft of the slip ring side.
6. Install the drive end frame onto the rotor shaft bearing through the space collar with the Transmission Oil Plug 09325-12010 and a press.



Fig. 8-24 Installing Drive End Frame B0045

7. Press in the brushes against the brush spring tension into the brush holder.  
Next, insert a wire through the access hole in the rectifier end frame, and also into the hole provided in the brush holder to prevent the brushes from falling.

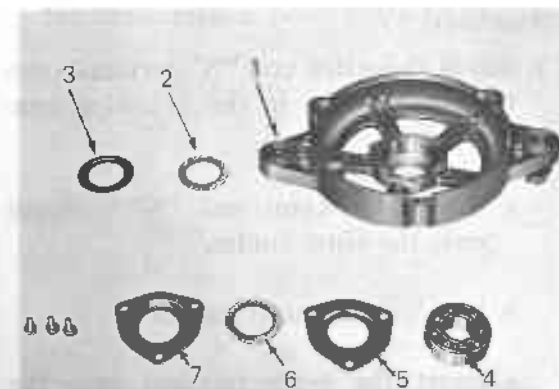


Fig. 8-23 Drive End Frame Assembly V1149

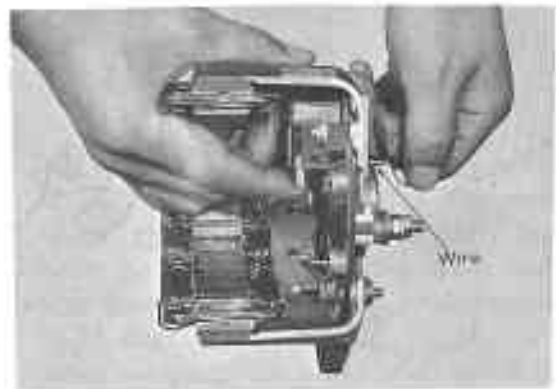


Fig. 8-25 Installing Wire V0218



With the brushes positioned as above, assemble the drive end frame onto the rectifier end frame, and tighten them with the three retaining bolts.

8. Install the space collar, key, fan and the pulley onto the rotor shaft, and install the retaining nut.

### Alternator Output Test

Perform the output test in accordance with the circuit shown in the following illustration.

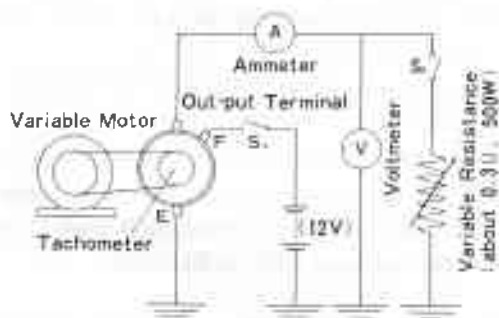


Fig. 8-26 Output Test Circuit

Y5120

1. Turn on the switch "S1" only, then increase the alternator revolution gradually with a variable motor until the voltage reading reaches 14 volts, and read the alternator revolution at that time, which should be 700 ~ 1000 rpm.

2. Turn on the switch "S1", and "S2" further holding the output voltage at 14 volts with a variable resistance, increase the alternator revolution to less than 3,500 rpm for RT series, and to less than 4,000 rpm for RH series, and read the ammeter at that time.

The ammeter should be 40 amperes on RT series, and on RH series this should be 30 amperes.

### Installation

Follow the removal procedures in the reverse order. Adjust the fan belt deflec-

tion to 8~13 mm (0.31 to 0.51") with the fan belt pushed with 10 kg (22 lbs).

## ALTERNATOR REGULATOR

### Removal

1. Disconnect the battery to ground cable from the battery terminal.
2. Disconnect the regulator wiring harness connector plug.
3. Remove the regulator retaining bolts, and remove the regulator assembly.

### Electrical Adjustment

If the alternator regulator does not actuate properly in accordance with the electrical adjustment, check the resistance of the regulator circuits.

If defective, repair the defective portion, and repeat the electrical adjustment after performing the mechanical adjustment.

Always use a fully charged battery to perform the electrical adjustment.

### Voltage Relay

Make the test circuit as shown in figure 8-27.

Operate the variable motor, and turn on the switch "S".

Next, increase the alternator revolution gradually, and read the voltage when the test lamp goes out.

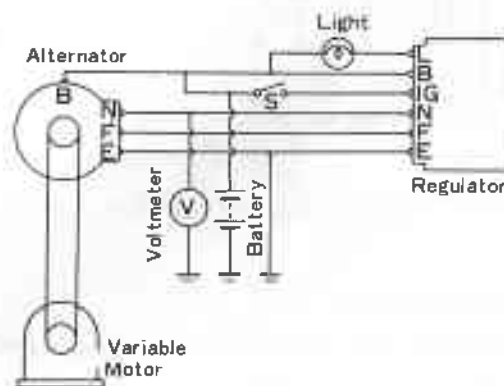


Fig. 8-27 Voltage Relay Test Circuit

G0176

The voltage relay operating voltage should be 4.5 ~ 5.8 volts.

If the voltage is not within the specified voltage, adjust it by bending the adjusting arm of the voltage relay.

Refer to figure 8-30.

### Voltage Regulator

Make the test circuit as shown in figure 8-28.

Operate the variable motor, and turn on the switch "S". Check the voltage and amperage by varying the alternator revolution gradually at the time when the ammeter needle registers maximum.

Increase the alternator revolution, and read the voltage at the time when the ammeter needle registers one-half of maximum amperage reading.

Also increase the revolution reaches 3,000 rpm, and read the voltage.

The regulating voltage should be within 13.8~14.8 volts when the ammeter needle registers at one-half of maximum amperage, and also when the alternator revolution is at 3,000 rpm.

If the regulating voltage is not within the specified voltage, adjust it by bending the adjusting arm of the voltage regulator. Refer to figure 8-31.

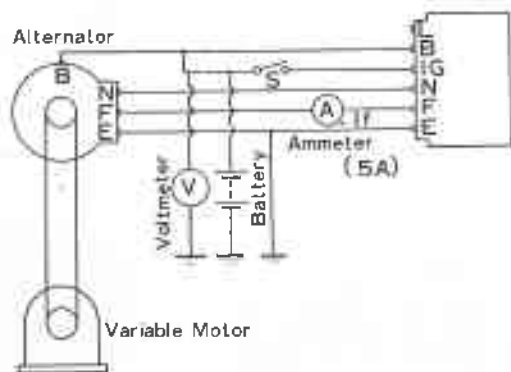


Fig. 8-28 Voltage Regulator Test Circuit G0177

### Regulator Circuit Test

1. Connect the circuit tester between the "IG" and "F" terminals.  
The resistance should be zero.

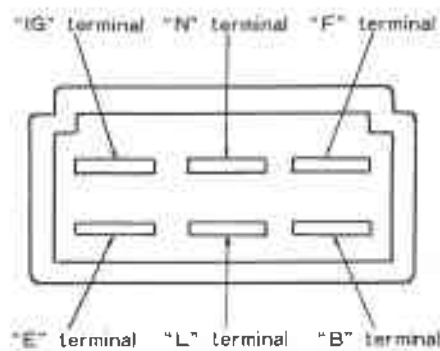


Fig. 8-29 Regulator Wiring Harness Connector Plug

G3456

If there is any resistance, the contact of the voltage regulator points "PL1" and "PL0" is poor.

Press down the armature of the voltage regulator, and check the resistance.

The resistance should be about 10 ohms. If the resistance is considerably higher than the specified resistance value, the control resistor (Rf) is defective.

2. Connect the circuit tester between the "L" and "E" terminals.

The resistance should be zero.

If there is any resistance, the contact of the voltage relay points "P1" and "P0" is poor.

Press down the armature of the regulator relay, and check the resistance.

The resistance should be about 100 ohms.

If the resistance is considerably higher than 100 ohms, the voltage coil is opened.

If the resistance is extremely lower than the above, the voltage relay points "P1" and "P0" are melted or the voltage coil is shorted.

3. Connect the circuit tester between the "N" and "E" terminals.

The resistance should be about 23 ohms. If the resistance is considerably higher than 23 ohms, the voltage relay coil is opened.

If the resistance is extremely lower than

the above, the voltage relay coil is shorted.

4. Connect the circuit tester between the "L" and "B" terminals, and press down the armature of the voltage relay, then check the resistance.

The resistance should be zero.

If there is any resistance, the contact of the voltage relay points "P0" and "P2" is poor.

5. Connect the circuit tester between the "B" and "E" terminals.

The resistance should be infinite.

If there is any resistance the voltage relay points "P0" and "P2" are melted.

Press the armature of the voltage relay, and check the resistance.

The resistance should be about 100 ohms.

If the resistance is considerably higher than 100 ohms, the voltage coil is opened.

If the resistance is extremely lower than the above, the voltage coil is shorted.

6. Connect the circuit tester between the "F" and "E" terminals.

The resistance should be infinite.

If there is any resistance, the voltage regulator points "PL0" and "PL2" are melted.

Press the armature of the voltage regulator, and check the resistance.

The resistance should be zero.

If there is any resistance, the contact of the regulator points "PL0" and "PL2" is poor.

### Inspection & Mechanical Adjustment

This mechanical adjustment described here should be performed when the specified values are not obtained in the electrical adjustment.

Dirty contact points should be dressed with a suitable paper or a suitable fine emery cloth.

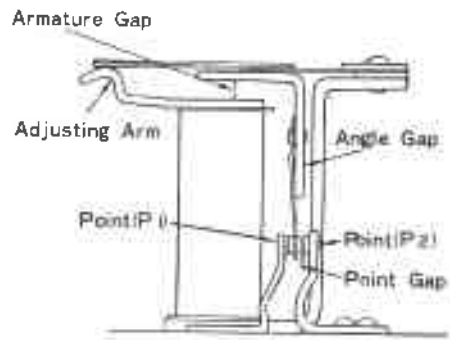


Fig. 8-30 Nomenclature of Voltage Relay G0175

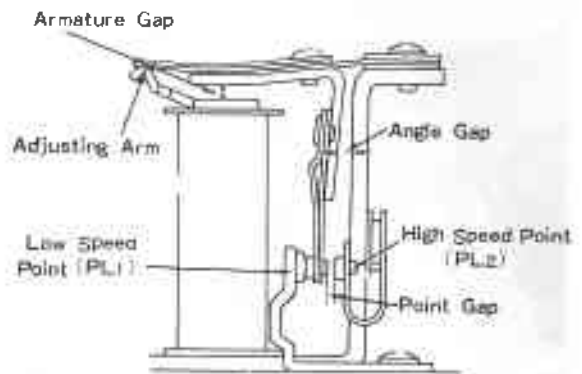


Fig. 8-31 Nomenclature of Voltage Regulator G0174

After dressing the points, wash them thoroughly with cleaning solvent.

If any of the points is burnt or pitted excessively, replace the regulator assembly.

### Voltage Relay

1. Press down the armature, and check the

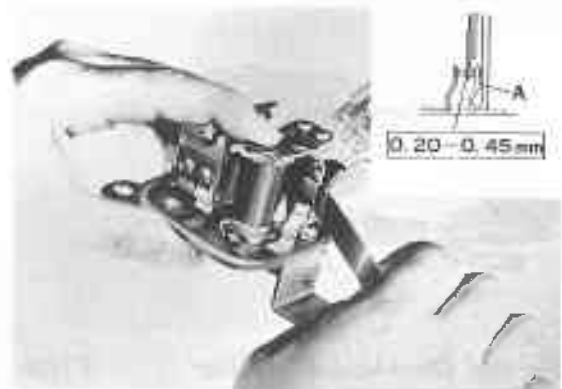


Fig. 8-32 Checking Spring Deflection

V2198  
G0180

contact spring deflection with the feeler gauge.

This deflection should be 0.20 to 0.45 mm (0.008 ~ 0.018").

If necessary, adjust it by bending the point holder "A".

2. Check the point gap with the feeler gauge.

This point gap should be 0.4 to 1.2 mm (0.016 ~ 0.047").

If necessary, adjust the gap by bending the point holder "B".

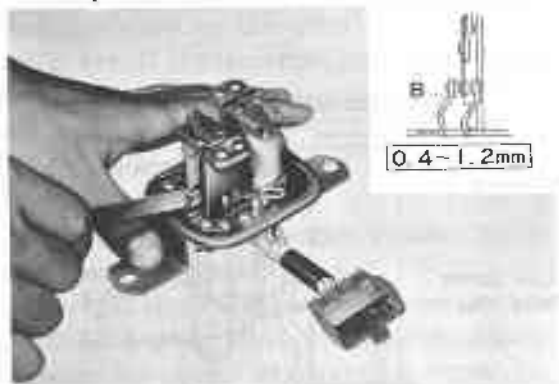


Fig. 8-33 Checking Point Gap

V1185  
G0181

### Voltage Regulator

1. Check the armature gap with the feeler gauge.

This point gap should be 0.6 to 0.8 mm (0.024 ~ 0.032").

If necessary, adjust the gap by bending the low speed point holder "A".

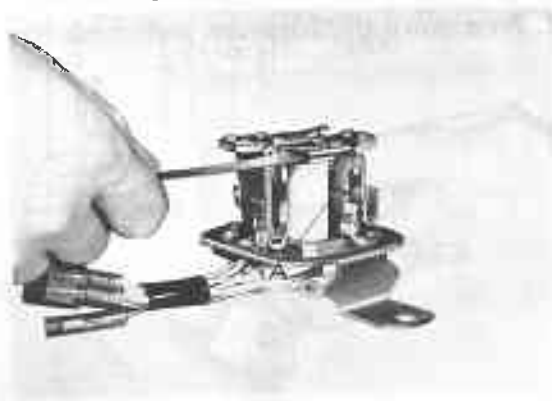


Fig. 8-34 Checking Armature Gap

V1186

2. Check the point gap with the feeler gauge.

This point gap should be 0.25 to 0.45 mm (0.010 ~ 0.018").

If necessary, adjust the gap by bending the high speed point holder "B" as shown in figure 8-35.

3. Press the armature, and check the contact spring deflection with the feeler gauge. Fig. 8-36.

This deflection should be 0.2~0.6 mm (0.008 ~ 0.024").

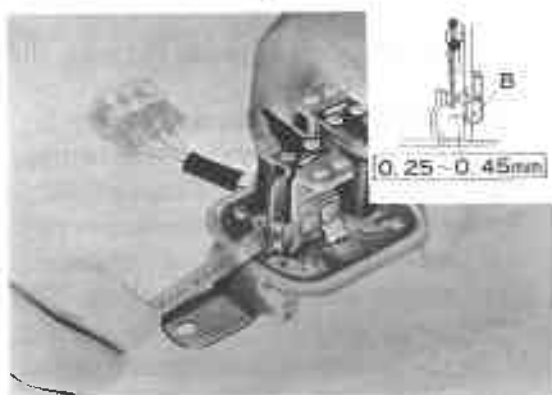


Fig. 8-35 Checking Point Gap

V2155, G0182

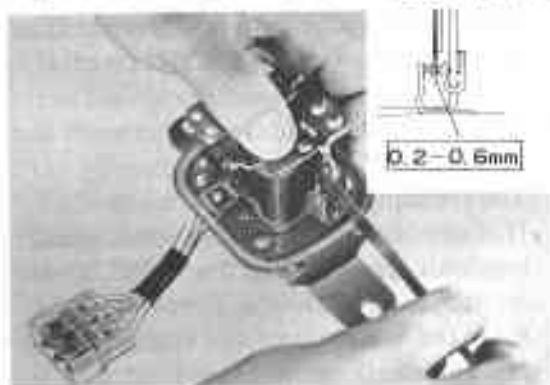


Fig. 8-36 Checking Spring Deflection

V3105  
G0183



Fig. 8-37 Checking Angle Gap

V2199

4. Press the armature, and check the angle gap with the feeler gauge.

This gap should be more than 0.2 mm (0.008").

If not, replace the regulator assembly.

#### Installation

Follow the removal procedures in the reverse order.

\* \* \* \* \*

## STARTING SYSTEM

|                               |      |
|-------------------------------|------|
| DESCRIPTION .....             | 9- 1 |
| TROUBLE SHOOTING .....        | 9- 2 |
| STARTER .....                 | 9- 3 |
| Construction .....            | 9- 3 |
| Operation .....               | 9- 4 |
| Removal .....                 | 9- 6 |
| Disassembly .....             | 9- 6 |
| Inspection & Repair .....     | 9- 7 |
| Armature .....                | 9- 7 |
| Field coil .....              | 9- 8 |
| Magnetic switch .....         | 9- 8 |
| Brush holder & brush .....    | 9- 9 |
| Starter clutch .....          | 9-10 |
| Assembly .....                | 9-10 |
| Testing After Assembly .....  | 9-12 |
| Installation .....            | 9-12 |
| BATTERY .....                 | 9-12 |
| Inspection & Adjustment ..... | 9-12 |
| Charging .....                | 9-12 |
| MEMORANDUM .....              | 9-14 |

## DESCRIPTION

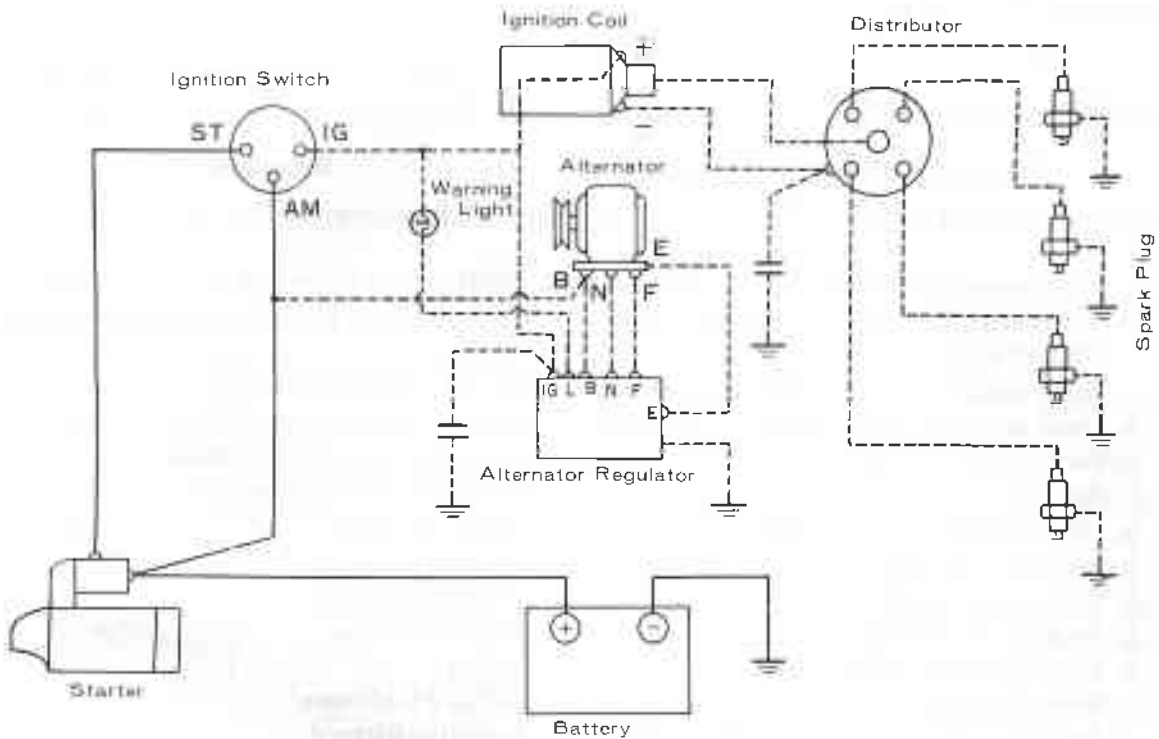


Fig. 9-1 Starting System Wiring Diagram

G3814

The purpose of the starting system is to crank the engine to draw in the combustible air-fuel mixture for starting the engine. The starting system is composed of the starter and the battery, and its wiring diagram is as shown in the above illustration.

The battery stores the energy in a chemical form, and when the connection is made from the battery to the starter motor, a chemical action takes place inside the battery. This chemical action actuates the starter motor to convert the electrical energy to mechanical energy.

The starter motor is incorporated with newly improved mechanism within the starter clutch, magnetic switch, pinion drive lever, brake and etc., and has the following excellent features. It is compact and light. The output is large, and the end frames are of a sealed type to prevent the entry of dirt and dust.

Since the idle rotational torque of the starter clutch is very little, the armature is difficult to be over-run.

The pinion drive lever is operated through the drive lever spring, and the drive lever spring acts as a cushion when meshing the gears. Therefore, the smooth gear meshing is obtained without damaging the gears.

Since the armature brake is designed to contact the commutator side face with the brush holder ring plate, the brake is actuated only when the starter clutch is returned in its original position. For this reason, the starter motor does not lose the braking application during the starting operation.

The shape of the magnetic switch moving stud end is modified to a hook type, which facilitate the disassembly and the assembly of the magnetic switch.

The magnetic switch contact plates are also modified into a tapered shape to increase the durability.

## TROUBLE SHOOTING

| Symptoms & Probable Causes                                                | Remedies                                       |
|---------------------------------------------------------------------------|------------------------------------------------|
| 1. Starter does not turn or starter spins, but does not crank the engine. |                                                |
| a. Poor contact of starter switch contact points                          | Replace ignition switch                        |
| b. Burnt or poor contact of magnetic switch contact plate                 | Clean contact plate or replace magnetic switch |
| c. Open magnetic switch pull-in coil circuit                              | Replace magnetic switch                        |
| d. Open magnetic switch hold-in coil circuit                              | Replace magnetic switch                        |
| e. Poor contact of brush                                                  | Dress commutator and brush                     |
| f. Burnt commutator                                                       | Lathe cut the commutator                       |
| g. Commutator mica too high                                               | Under cut mica                                 |
| h. Shorted field coil                                                     | Replace field coil                             |
| i. Shorted armature                                                       | Replace armature                               |
| j. Weak brush spring tension                                              | Replace springs                                |
| k. Poor soldering of field coil                                           | Solder                                         |
| l. Worn bushing/s                                                         | Replace bushing/s                              |
| m. Weak battery                                                           | Recharge battery                               |
| n. Shorted battery cell/s                                                 | Replace battery                                |
| o. Poor contact of battery terminal/s                                     | Clean and tighten terminal/s                   |
| p. Open circuit between starter switch and magnetic switch                | Repair                                         |
| q. Poor battery ground cable connection                                   | Clean and tighten                              |
| 2. Starter turns, but pinion does not mesh with ring gear.                |                                                |
| a. Starter clutch pinion gear worn                                        | Replace starter clutch                         |
| b. Defective starter clutch                                               | Replace starter clutch                         |
| c. Defective drive spring                                                 | Replace drive spring                           |
| d. Poor movement of clutch on splines                                     | Clean and correct                              |
| e. Worn starter clutch bushing                                            | Replace starter clutch                         |
| f. Poor starter clutch pinion travel                                      | Adjust magnetic switch stud                    |
| g. Drive lever set bolt missing                                           | Correct                                        |
| h. Worn starter bushing/s                                                 | Replace bushing/s                              |
| i. Ring gear worn                                                         | Replace ring gear                              |
| 3. Starter motor keeps running.                                           |                                                |
| a. Shorted magnetic switch coil                                           | Replace coil                                   |
| b. Melted magnetic switch contact plate                                   | Replace magnetic switch                        |
| c. Starter switch returns poorly                                          | Replace ignition switch                        |



The voltage should be 12 volts. If the reading of the voltmeter is zero voltage or low voltage than the specified voltage, it indicates the following symptoms.

- a. Opened or poor contact of fuse, regulator "IG" terminal wire or "F" terminal wire.
  - b. Regulator high speed points melted.
6. Disconnect the regulator connector plug, and check the resistance between the regulator "IG" and "F" terminals with a circuit tester.
- There should be no resistance. If there is any resistance, it indicates that the voltage regulator low speed points contact poorly.

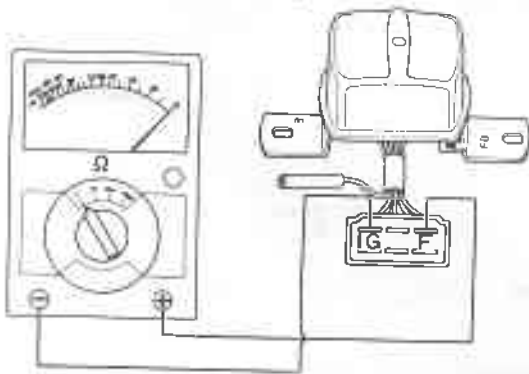


Fig. 8-6 Checking Resistance between "IG" & "F"

G0163

7. Perform the load test in the following manner.
- Make the same connection as shown in figure 8-4, and start the engine, and run it at approximately 1,100 rpm with all lights and accessories turned on.
- The ammeter should indicate more than 35 amperes on the RT series, and more than 25 amperes on the Light Truck series with the voltage of 13.5 to 14.5 volts.
- than the specified amperage, the rectifier or stator coil is shorted or opened.
- If the battery is in full charged state and the amperage reading is less than the specified amperage.

It is recommended to discharge the battery to perform the load test.

Disconnect the high tension lead from the ignition coil, and turn the starter for about 5~10 seconds to discharge the battery.

## ALTERNATOR

### Removal

1. Disconnect the battery to ground cable from the battery terminal.
2. Disconnect the wirings from the alternator.
3. Remove the fan belt adjusting bar bolt and the fan belt.
4. Remove the alternator retaining bolt, and remove the alternator assembly from the alternator bracket.

### Disassembly

1. Remove the three drive end frame retaining bolts.
  2. Insert a screwdriver into the notches in the drive end frame, and pry with the screwdriver to separate with drive end frame from the stator.
- If necessary, tap lightly on the drive end frame with a mallet toward the pulley, and then remove the drive end frame with the rotor.

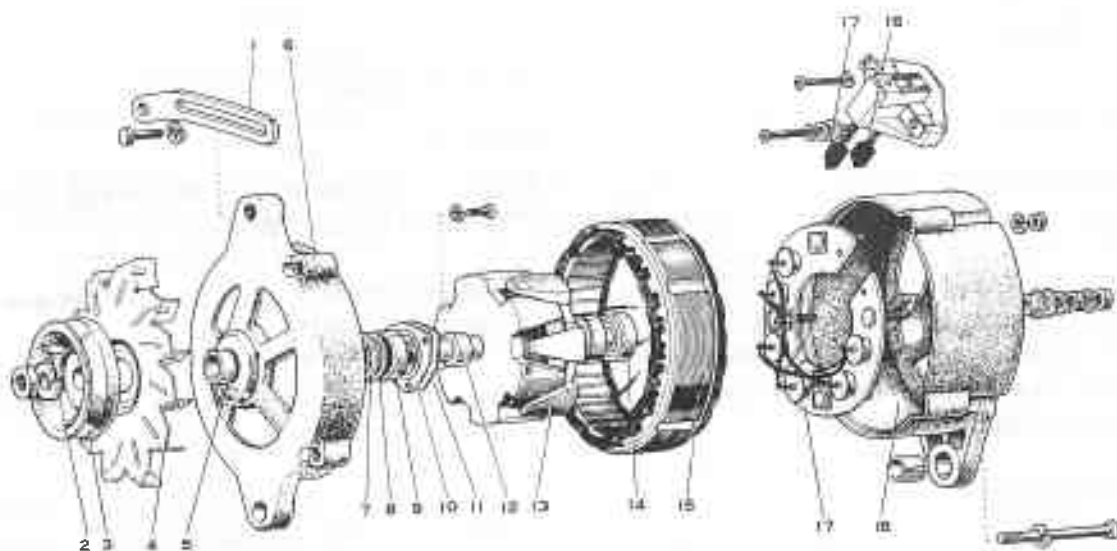


Fig. 8-7 Drive End Frame Removal

V2195

3. Remove the pulley retaining nut, and remove the pulley, fan, key and the space collar.

4. Remove the rotor from the drive end frame using a press as shown in figure 8-9.



1. Fan belt adjusting bar
2. Key
3. Alternator pulley
4. Alternator fan
5. Space collar
6. Drive end frame

7. Felt ring
8. Felt ring cover
9. Bearing
10. Bearing retainer plate
11. Felt cover
12. Space ring

13. Rotor
14. Bearing
15. Stator
16. Brush spring
17. Rectifier holder
18. Rectifier end frame

Fig. 8-8 Alternator Components on RH Series

Y6841



Fig. 8-9 Rotor Removal

B0038



Fig. 8-10 Rear Bearing Removal

V1139

5. Remove the rear bearing from the rotor shaft with the Injection Pump Spline Shaft Puller 09286-46011.

6. Remove the bearing retainer retaining

screws, and remove the felt cover (except RT series), bearing retainer, front bearing, felt ring cover and the felt ring from the drive end frame.

7. Remove the rectifier holder retaining nuts, "B" terminal retaining nut and the brush holder retaining screws, then remove the stator with the rectifier holders from the rectifier end frame.



**Fig. 8-11 Stator with Rectifier Holder Removal** B0039

8. Remove the brush holder assembly from the stator coil "N" terminal in accordance with the following order using a small screwdriver.
  - a. Pull out the brush lead terminal from the holder by sliding the terminal.
  - b. Remove one terminal insulator.
  - c. Remove the stator coil "N" terminal from the holder by sliding out the "N" terminal.
 When removing the brush holder assembly, do not remove it by cutting the "N" terminal lead or melting the solder.



**Fig. 8-12 Brush Holder Removal** B0040

## Inspection & Repair

### Bearing

Check the bearings for scores, roughness, abnormal noise or damage.

If defective, 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 4.1 ~ 4.3 ohms.

If there is little or no resistance, the coil or slip rings have a short or ground, and considerably higher resistance than that specified above, indicates an opened coil or connection defect.

If the test shows that the rotor coil is shorted or opened, and the slip rings are defective, the rotor assembly should be replaced.



**Fig. 8-13 Testing Rotor Coil for Open & Short Circuit** V2196



**Fig. 8-14 Testing Rotor Coil for Ground** V2197

2. Connect the tester from the slip ring to the rotor to rotor shaft, and check the insulation between them as shown in figure 8-14.

If the tester needle moves, the rotor coil or slip rings are defective.

The rotor assembly should be replaced.

### 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 the coil or replace the stator assembly.



Fig. 8-15 Testing Stator Coil for Insulation B0041

2. Check the stator coil for open circuit.  
In order to perform this test, the stator coil leads must be disconnected from the rectifier leads.  
To disconnect the leads, hold the rectifier lead with a nose pliers to prevent



Fig. 8-16 Melting Solder

G3364

the rectifier from heating, and melt the soldered portions using an electric soldering iron of 100~200 watts for 2 seconds.



Fig. 8-17 Testing Stator Coil for Open Circuit V1145

Check the four leads of the stator coil for conductance between them.

If the tester needle does not move, the stator coil is opened, and must be replaced.

### Brush & Brush Holder

1. Check the brush for crack and wear.  
If the brush is worn beyond 8.5mm (0.335"), replace the brushes.  
The brush should slide smoothly.



Fig. 8-18 Brush Length V1143

2. If replacing the brush, install the new brush and the brush spring into the brush holder, then solder the brush lead wire keeping the protruded brush length to 13 mm (0.51").  
After soldering the brush lead, check if the brush movement is smooth.

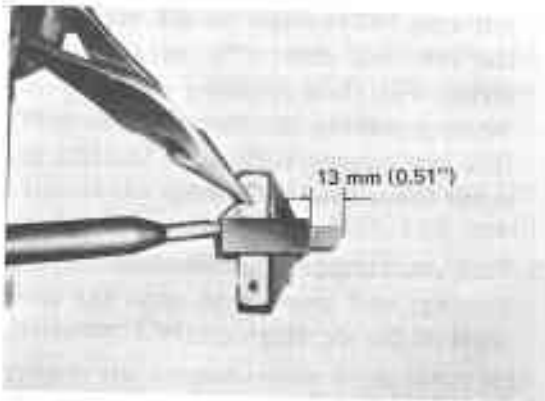


Fig. 8-19 Replacing Brush

V0216

### Rectifier

Good or defective rectifier is classified by the resistance value between the rectifier holder and the rectifier lead.

To perform this test, the rectifier holder must be separated from the stator.

Refer to paragraph 2 of the Stator in the Inspection & Repair on page 8-10.

#### 1. Rectifier holder positive side.

Connect the tester (+) lead onto the rectifier holder and the (-) lead onto the rectifier lead as shown in figure 8-20, and check the resistance.

Good rectifier will indicate no resistance, and if it indicates a high resistance, the rectifier is opened.

Next, turn the polarity of the tester and check again. If the tester needle moves in either polarity, the rectifier is shorted. If the needle does not move in either polarity, the rectifier is opened, and

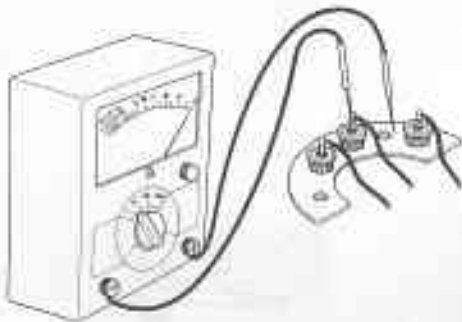


Fig. 8-20 Rectifier Test

G0172

should be replaced with the holder assembly.

#### 2. Rectifier holder negative side.

Connect the tester (-) lead onto the rectifier holder and (+) lead onto the rectifier lead as shown in figure 8-21, and check the resistance.

Good rectifier will indicate no resistance, and if it indicates high resistance, the rectifier is opened.

Next, 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 polarity, the rectifier is opened, and should be replaced.

If any one of the negative side rectifier is found defective, always replace the negative side rectifiers with the holder assembly.

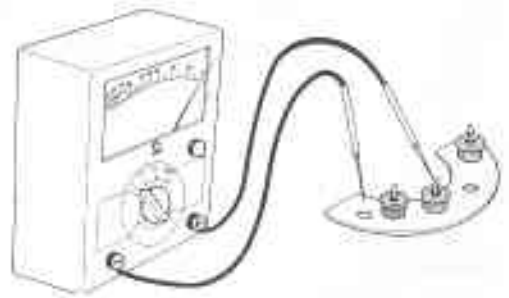


Fig. 8-21 Rectifier Test

G0173

### Assembly

1. Install the stator coil "N" terminal onto the brush holder in the following manner.

- a. Insert the stator coil "N" terminal onto the brush holder.
- b. Install the terminal insulator.
- c. Insert the brush terminal onto the holder at correct position.



Fig. 8-22 Assembling Brush Holder

B0043

2. Install the insulator washers to the retaining bolts of the positive side rectifier holder, and install the stator with the rectifier holders onto the rectifier end frame.

Install the "B" terminal insulator, then tighten the retaining nuts.

3. Install the brush holder onto the rectifier holders through the insulation plate and the insulators.

The brush holder retaining bolts must be tightened through the insulators.

4. Install the felt ring (2) and the felt ring cover (3) onto the drive end frame (1) so that the convex surface of the felt ring cover will face toward the pulley side.

Pack multipurpose grease into the bearing (4), and install the bearing.

Next, install the bearing retainer (5),

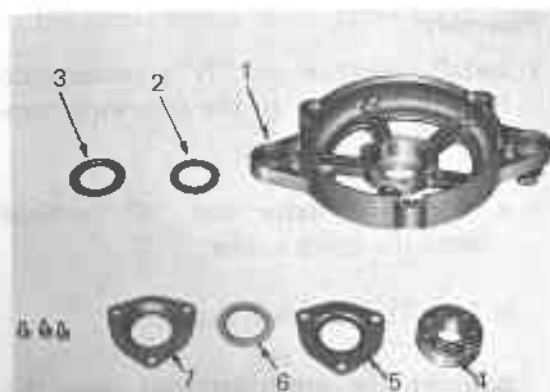


Fig. 8-23 Drive End Frame Assembly

V1149

felt ring (6) (except on RT series) and the felt ring cover (7) (except on RT series) with three retaining screws.

When installing the felt ring cover (7), face the convex surface of the felt ring cover toward the rotor side.

5. Pack multipurpose grease into the rear bearing, and press it in onto the rotor shaft of the slip ring side.

6. Install the drive end frame onto the rotor shaft bearing through the space collar with the Transmission Oil Plug 09325-12010 and a press.

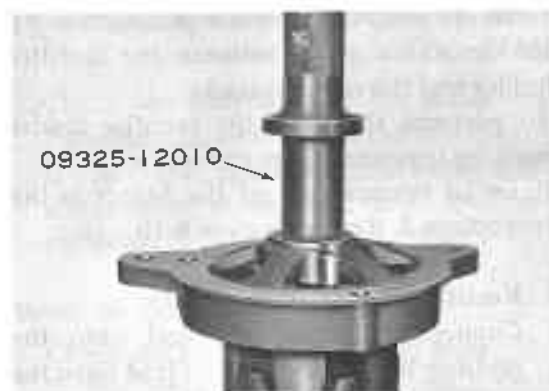


Fig. 8-24 Installing Drive End Frame

B0045

7. Press in the brushes against the brush spring tension into the brush holder.

Next, insert a wire through the access hole in the rectifier end frame, and also into the hole provided in the brush holder to prevent the brushes from falling.

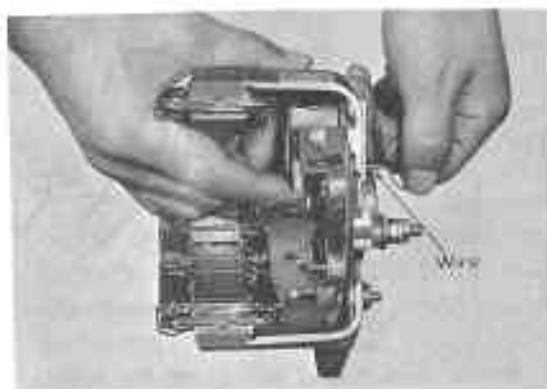


Fig. 8-25 Installing Wire

V0218

With the brushes positioned as above, assemble the drive end frame onto the rectifier end frame, and tighten them with the three retaining bolts.

8. Install the space collar, key, fan and the pulley onto the rotor shaft, and install the retaining nut.

### Alternator Output Test

Perform the output test in accordance with the circuit shown in the following illustration.

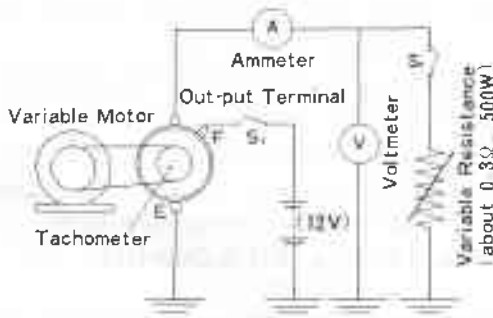


Fig. 8-26 Output Test Circuit

Y5120

1. Turn on the switch "S1" only, then increase the alternator revolution gradually with a variable motor until the voltage reading reaches 14 volts, and read the alternator revolution at that time, which should be 700 ~ 1000 rpm.
2. Turn on the switch "S1", and "S2" further holding the output voltage at 14 volts with a variable resistance, increase the alternator revolution to less than 3,500 rpm for RT series, and to less than 4,000 rpm for RH series, and read the ammeter at that time.  
The ammeter should be 40 amperes on RT series, and on RH series this should be 30 amperes.

### Installation

Follow the removal procedures in the reverse order. Adjust the fan belt deflec-

tion to 8~13 mm (0.31 to 0.51") with the fan belt pushed with 10 kg (22 lbs).

## ALTERNATOR REGULATOR

### Removal

1. Disconnect the battery to ground cable from the battery terminal.
2. Disconnect the regulator wiring harness connector plug.
3. Remove the regulator retaining bolts, and remove the regulator assembly.

### Electrical Adjustment

If the alternator regulator does not actuate properly in accordance with the electrical adjustment, check the resistance of the regulator circuits.

If defective, repair the defective portion, and repeat the electrical adjustment after performing the mechanical adjustment.

Always use a fully charged battery to perform the electrical adjustment.

### Voltage Relay

Make the test circuit as shown in figure 8-27.

Operate the variable motor, and turn on the switch "S".

Next, increase the alternator revolution gradually, and read the voltage when the test lamp goes out.

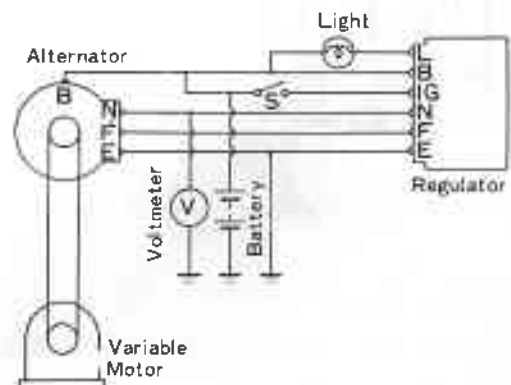


Fig. 8-27 Voltage Relay Test Circuit

G0176

The voltage relay operating voltage should be 4.5 ~ 5.8 volts.

If the voltage is not within the specified voltage, adjust it by bending the adjusting arm of the voltage relay.

Refer to figure 8-30.

## Voltage Regulator

Make the test circuit as shown in figure 8-28.

Operate the variable motor, and turn on the switch "S". Check the voltage and amperage by varying the alternator revolution gradually at the time when the ammeter needle registers maximum.

Increase the alternator revolution, and read the voltage at the time when the ammeter needle registers one-half of maximum amperage reading.

Also increase the revolution reaches 3,000 rpm, and read the voltage.

The regulating voltage should be within 13.8~14.8 volts when the ammeter needle registers at one-half of maximum amperage, and also when the alternator revolution is at 3,000 rpm.

If the regulating voltage is not within the specified voltage, adjust it by bending the adjusting arm of the voltage regulator. Refer to figure 8-31.

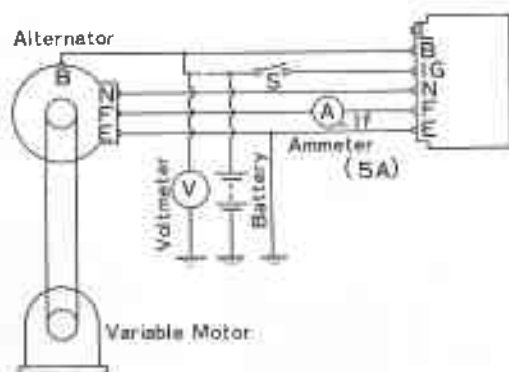
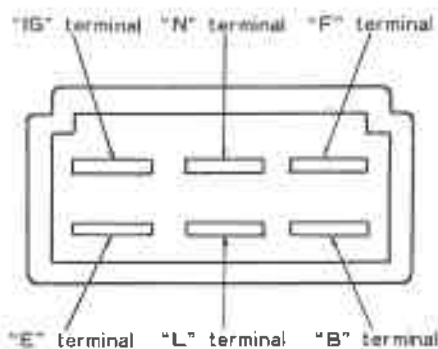


Fig. 8-28 Voltage Regulator Test Circuit G0177

### Regulator Circuit Test

1. Connect the circuit tester between the "IG" and "F" terminals.  
The resistance should be zero.



*Fig. 8-29 Regulator Wiring Harness Connector Plug*

G3456

If there is any resistance, the contact of the voltage regulator points "PL1" and "PL0" is poor.

Press down the armature of the voltage regulator, and check the resistance.

The resistance should be about 10 ohms.

If the resistance is considerably higher than the specified resistance value, the control resistor ( $R_f$ ) is defective.

2. Connect the circuit tester between the "L" and "E" terminals.

The resistance should be zero.

If there is any resistance, the contact of the voltage relay points "P1" and "P0" is poor.

Press down the armature of the regulator relay, and check the resistance.

The resistance should be about 100 ohms.

If the resistance is considerably higher than 100 ohms, the voltage coil is opened.

If the resistance is extremely lower than the above, the voltage relay points "P1" and "P0" are melted or the voltage coil is shorted.

3. Connect the circuit tester between the "N" and "E" terminals.

The resistance should be about 23 ohms.

If the resistance is considerably higher than 23 ohms, the voltage relay coil is opened.

If the resistance is extremely lower than



the above, the voltage relay coil is shorted.

4. Connect the circuit tester between the "L" and "B" terminals, and press down the armature of the voltage relay, then check the resistance.

The resistance should be zero.

If there is any resistance, the contact of the voltage relay points "P0" and "P2" is poor.

5. Connect the circuit tester between the "B" and "E" terminals.

The resistance should be infinite.

If there is any resistance the voltage relay points "P0" and "P2" are melted.

Press the armature of the voltage relay, and check the resistance.

The resistance should be about 100 ohms.

If the resistance is considerably higher than 100 ohms, the voltage coil is opened.

If the resistance is extremely lower than the above, the voltage coil is shorted.

6. Connect the circuit tester between the "F" and "E" terminals.

The resistance should be infinite.

If there is any resistance, the voltage regulator points "PL0" and "PL2" are melted.

Press the armature of the voltage regulator, and check the resistance.

The resistance should be zero.

If there is any resistance, the contact of the regulator points "PL0" and "PL2" is poor.

### Inspection & Mechanical Adjustment

This mechanical adjustment described here should be performed when the specified values are not obtained in the electrical adjustment.

Dirty contact points should be dressed with a suitable paper or a suitable fine emery cloth.

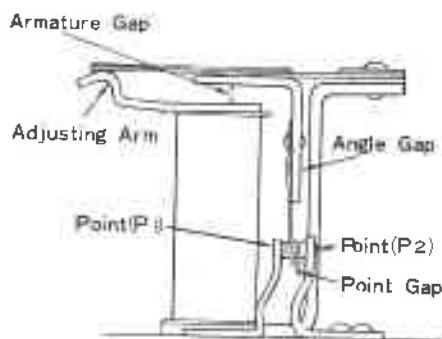


Fig. 8-30 Nomenclature of Voltage Relay G0175

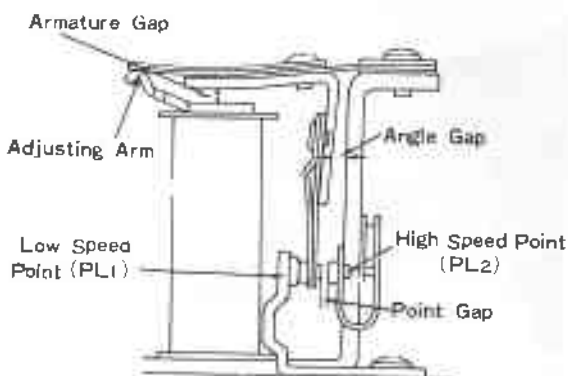


Fig. 8-31 Nomenclature of Voltage Regulator

G0174

After dressing the points, wash them thoroughly with cleaning solvent.

If any of the points is burnt or pitted excessively, replace the regulator assembly.

### Voltage Relay

1. Press down the armature, and check the

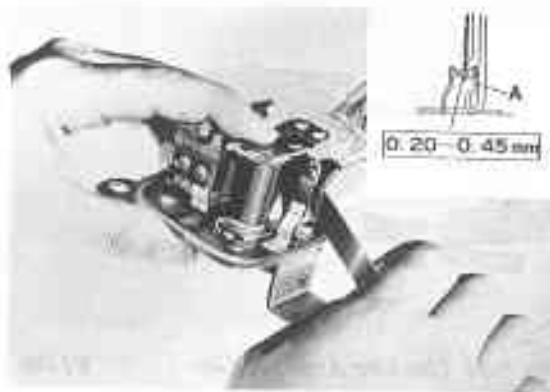


Fig. 8-32 Checking Spring Deflection

V2198  
G0180

contact spring deflection with the feeler gauge.

This deflection should be 0.20 to 0.45 mm (0.008 ~ 0.018").

If necessary, adjust it by bending the point holder "A".

2. Check the point gap with the feeler gauge.

This point gap should be 0.4 to 1.2 mm (0.016 ~ 0.047").

If necessary, adjust the gap by bending the point holder "B".

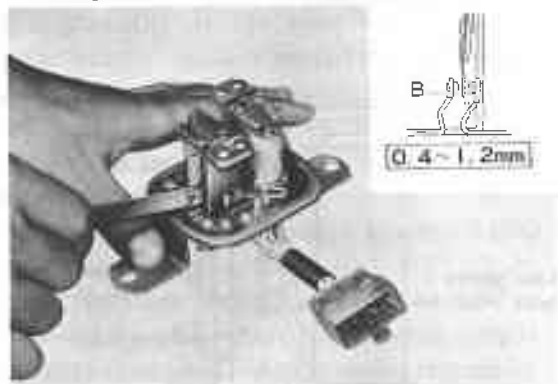


Fig. 8-33 Checking Point Gap

V1185  
G0181

### Voltage Regulator

1. Check the armature gap with the feeler gauge.

This point gap should be 0.6 to 0.8 mm (0.024 ~ 0.032").

If necessary, adjust the gap by bending the low speed point holder "A".

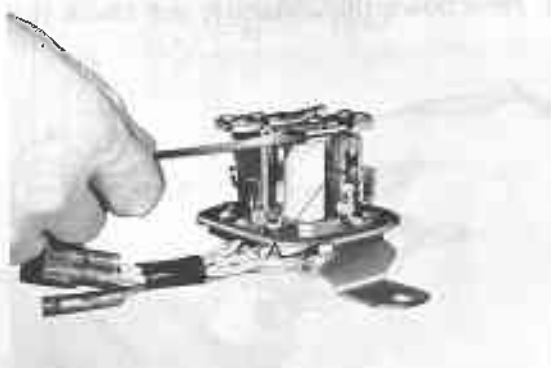


Fig. 8-34 Checking Armature Gap

V1186

2. Check the point gap with the feeler gauge.

This point gap should be 0.25 to 0.45 mm (0.010 ~ 0.018").

If necessary, adjust the gap by bending the high speed point holder "B" as shown in figure 8-35.

3. Press the armature, and check the contact spring deflection with the feeler gauge. Fig. 8-36.

This deflection should be 0.2~0.6 mm (0.008 ~ 0.024").

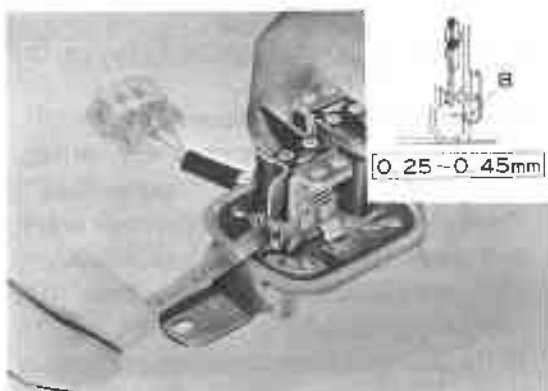


Fig. 8-35 Checking Point Gap

V2155, G0182

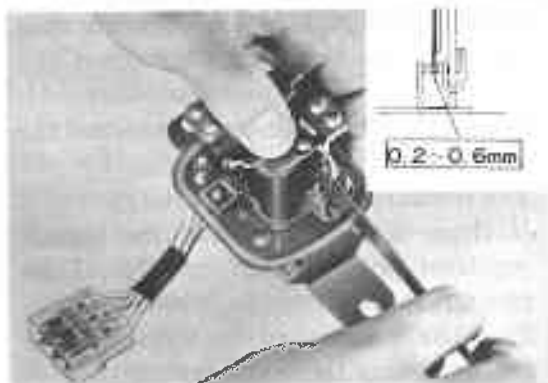


Fig. 8-36 Checking Spring Deflection

V3105  
G0183



Fig. 8-37 Checking Angle Gap

V2199

4. Press the armature, and check the angle gap with the feeler gauge.

This gap should be more than 0.2 mm (0.008").

If not, replace the regulator assembly.

#### Installation

Follow the removal procedures in the reverse order.

\* \* \* \* \*

## STARTING SYSTEM

|                               |      |
|-------------------------------|------|
| DESCRIPTION .....             | 9- 1 |
| TROUBLE SHOOTING .....        | 9- 2 |
| STARTER .....                 | 9- 3 |
| Construction .....            | 9- 3 |
| Operation .....               | 9- 4 |
| Removal .....                 | 9- 6 |
| Disassembly .....             | 9- 6 |
| Inspection & Repair .....     | 9- 7 |
| Armature .....                | 9- 7 |
| Field coil .....              | 9- 8 |
| Magnetic switch .....         | 9- 8 |
| Brush holder & brush .....    | 9- 9 |
| Starter clutch .....          | 9-10 |
| Assembly .....                | 9-10 |
| Testing After Assembly .....  | 9-12 |
| Installation .....            | 9-12 |
| BATTERY .....                 | 9-12 |
| Inspection & Adjustment ..... | 9-12 |
| Charging .....                | 9-12 |
| MEMORANDUM .....              | 9-14 |

## DESCRIPTION

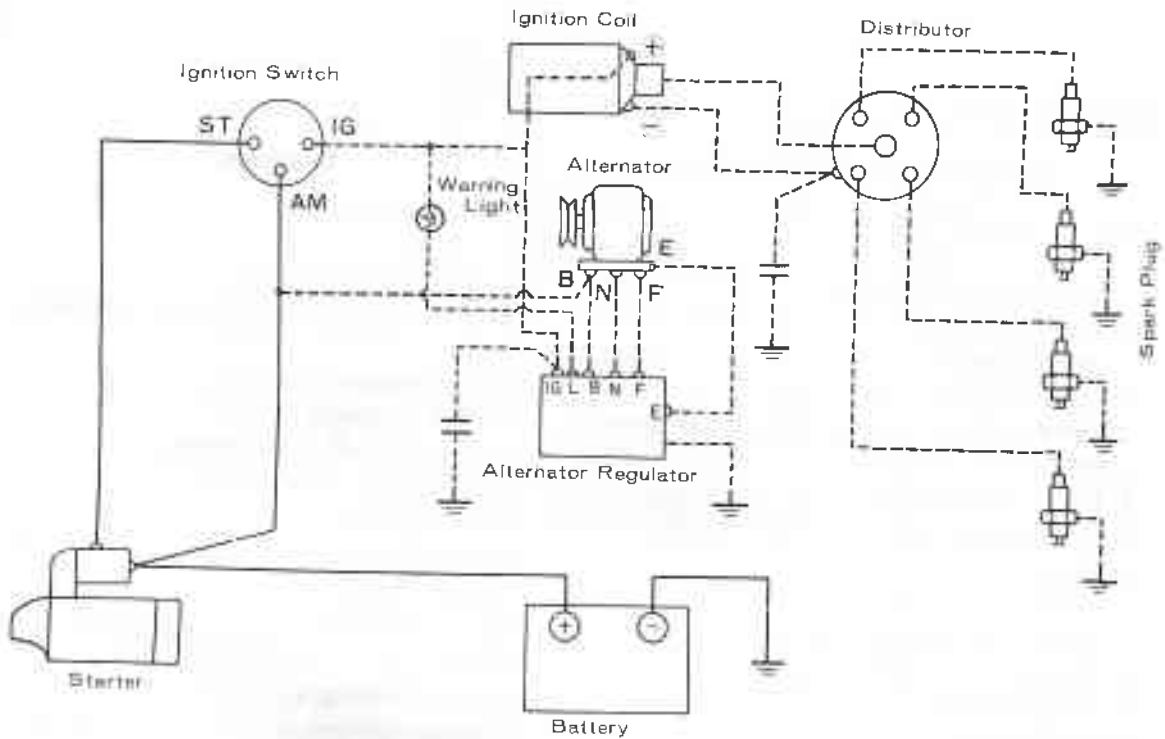


Fig. 9-1 Starting System Wiring Diagram

G3814

The purpose of the starting system is to crank the engine to draw in the combustible air-fuel mixture for starting the engine. The starting system is composed of the starter and the battery, and its wiring diagram is as shown in the above illustration.

The battery stores the energy in a chemical form, and when the connection is made from the battery to the starter motor, a chemical action takes place inside the battery. This chemical action actuates the starter motor to convert the electrical energy to mechanical energy.

The starter motor is incorporated with newly improved mechanism within the starter clutch, magnetic switch, pinion drive lever, brake and etc., and has the following excellent features. It is compact and light. The output is large, and the end frames are of a sealed type to prevent the entry of dirt and dust.

Since the idle rotational torque of the starter clutch is very little, the armature is difficult to be over-run.

The pinion drive lever is operated through the drive lever spring, and the drive lever spring acts as a cushion when meshing the gears. Therefore, the smooth gear meshing is obtained without damaging the gears.

Since the armature brake is designed to contact the commutator side face with the brush holder ring plate, the brake is actuated only when the starter clutch is returned in its original position. For this reason, the starter motor does not lose the braking application during the starting operation.

The shape of the magnetic switch moving stud end is modified to a hook type, which facilitate the disassembly and the assembly of the magnetic switch.

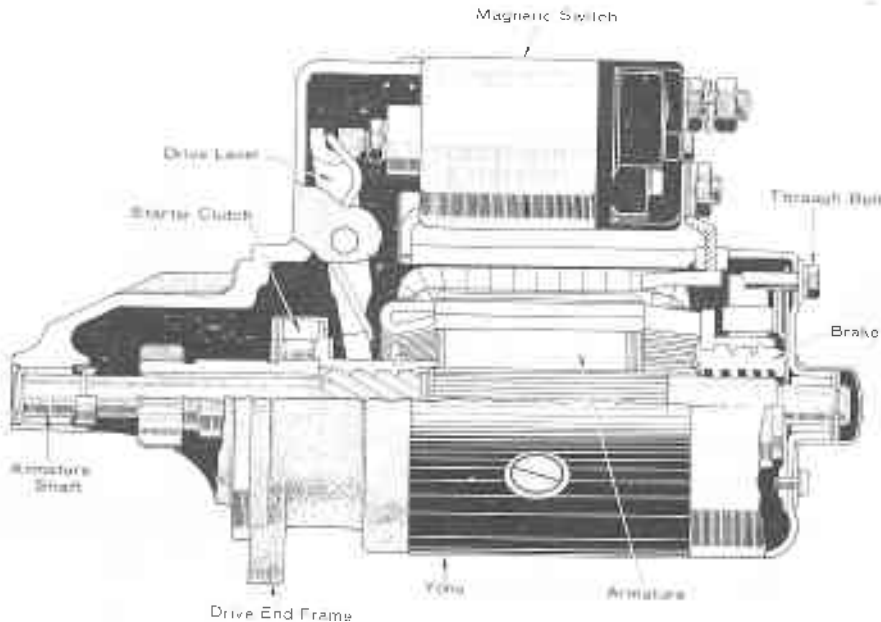
The magnetic switch contact plates are also modified into a tapered shape to increase the durability.

## **TROUBLE SHOOTING**

| <b>Symptoms &amp; Probable Causes</b>                                            | <b>Remedies</b>                                |
|----------------------------------------------------------------------------------|------------------------------------------------|
| <b>1. Starter does not turn or starter spins, but does not crank the engine.</b> |                                                |
| a. Poor contact of starter switch contact points                                 | Replace ignition switch                        |
| b. Burnt or poor contact of magnetic switch contact plate                        | Clean contact plate or replace magnetic switch |
| c. Open magnetic switch pull-in coil circuit                                     | Replace magnetic switch                        |
| d. Open magnetic switch hold-in coil circuit                                     | Replace magnetic switch                        |
| e. Poor contact of brush                                                         | Dress commutator and brush                     |
| f. Burnt commutator                                                              | Lathe cut the commutator                       |
| g. Commutator mica too high                                                      | Under cut mica                                 |
| h. Shorted field coil                                                            | Replace field coil                             |
| i. Shorted armature                                                              | Replace armature                               |
| j. Weak brush spring tension                                                     | Replace springs                                |
| k. Poor soldering of field coil                                                  | Solder                                         |
| l. Worn bushing/s                                                                | Replace bushing/s                              |
| m. Weak battery                                                                  | Recharge battery                               |
| n. Shorted battery cell/s                                                        | Replace battery                                |
| o. Poor contact of battery terminal/s                                            | Clean and tighten terminal/s                   |
| p. Open circuit between starter switch and magnetic switch                       | Repair                                         |
| q. Poor battery ground cable connection                                          | Clean and tighten                              |
| <b>2. Starter turns, but pinion does not mesh with ring gear.</b>                |                                                |
| a. Starter clutch pinion gear worn                                               | Replace starter clutch                         |
| b. Defective starter clutch                                                      | Replace starter clutch                         |
| c. Defective drive spring                                                        | Replace drive spring                           |
| d. Poor movement of clutch on splines                                            | Clean and correct                              |
| e. Worn starter clutch bushing                                                   | Replace starter clutch                         |
| f. Poor starter clutch pinion travel                                             | Adjust magnetic switch stud                    |
| g. Drive lever set bolt missing                                                  | Correct                                        |
| h. Worn starter bushing/s                                                        | Replace bushing/s                              |
| i. Ring gear worn                                                                | Replace ring gear                              |
| <b>3. Starter motor keeps running.</b>                                           |                                                |
| a. Shorted magnetic switch coil                                                  | Replace coil                                   |
| b. Melted magnetic switch contact plate                                          | Replace magnetic switch                        |
| c. Starter switch returns poorly                                                 | Replace ignition switch                        |

## STARTER

### Construction



*Fig. 9-2 Cross Sectional View of Starter*

Y5115

The principle components of the starter consist of the armature, starter clutch, field coil, drive end frame, yoke, commutator end frame, brushes and the magnetic switch.

The field coil is connected with the armature coil through the brushes and the commutator segments in series. The windings of the field coil and the armature coil are of a heavy copper wire to withstand the large current encountered during the starting operation.

The starter clutch is engaged to the armature shaft with the helical splines. As the starter clutch is pushed out by the pinion drive spring, the turning of the pinion occurs due to the helical splines, and this enables a smooth engagement of the pinion with the ring gear.

Also as the starter clutch pinion is engaged with the ring gear, the turning force of the armature pushes the starter clutch pinion into a complete mesh without further force of the pinion drive spring.

For these reasons, the pulling force of the magnetic switch is not required to be strong, the magnetic switch, therefore, is designed very small compared with the unit used on the conventional push-in type starter.

The starter clutch has an one-way clutch, and it transmits the turning force of the armature to the ring gear, but the armature is not turned by the ring gear as soon as the engine is started.

The drive lever is provided with the pinion drive spring, and as the upper end of this spring is hooked directly onto the magnetic switch joint, the drive spring acts as a cushion in the pushing motion of the pinion drive lever for meshing with the ring gear. An armature brake is provided at the commutator end, and it is designed to use friction between the commutator side surface and the brush holder plate. The brake is affected by the magnetic switch return spring through the drive lever when the starter clutch is returned in its original position.

## Operation

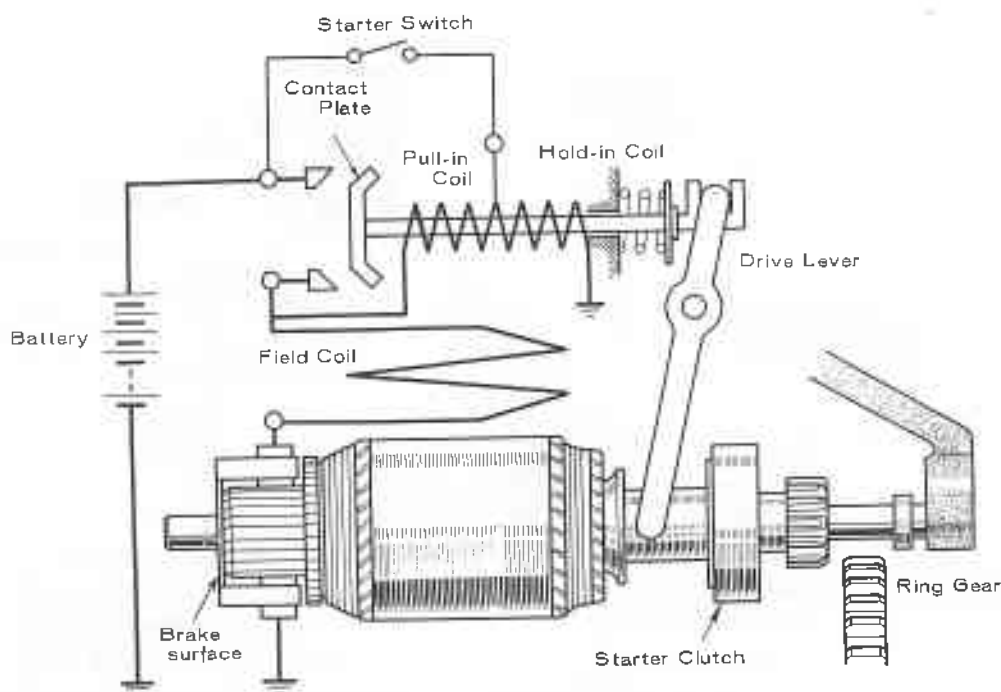


Fig. 9-3 Starter Circuit

G3136

On closing the starter switch, the battery current flows into the hold-in coil and also to the armature coil through the pull-in coil, field coil and the brushes.

Then the moving core of the magnetic switch is pulled in by means of the magnetic force, and the starter clutch is slid on the armature shaft by the drive spring and the drive lever to engage the starter pinion with the ring gear.

At this time, the pinion is partially engaged with the ring gear smoothly before the magnetic switch contact plate is closed.

When the magnetic switch is closed, the battery current flows directly into the field coil and to the armature through the contact plate, and energizes the armature to spin creating a large torque.

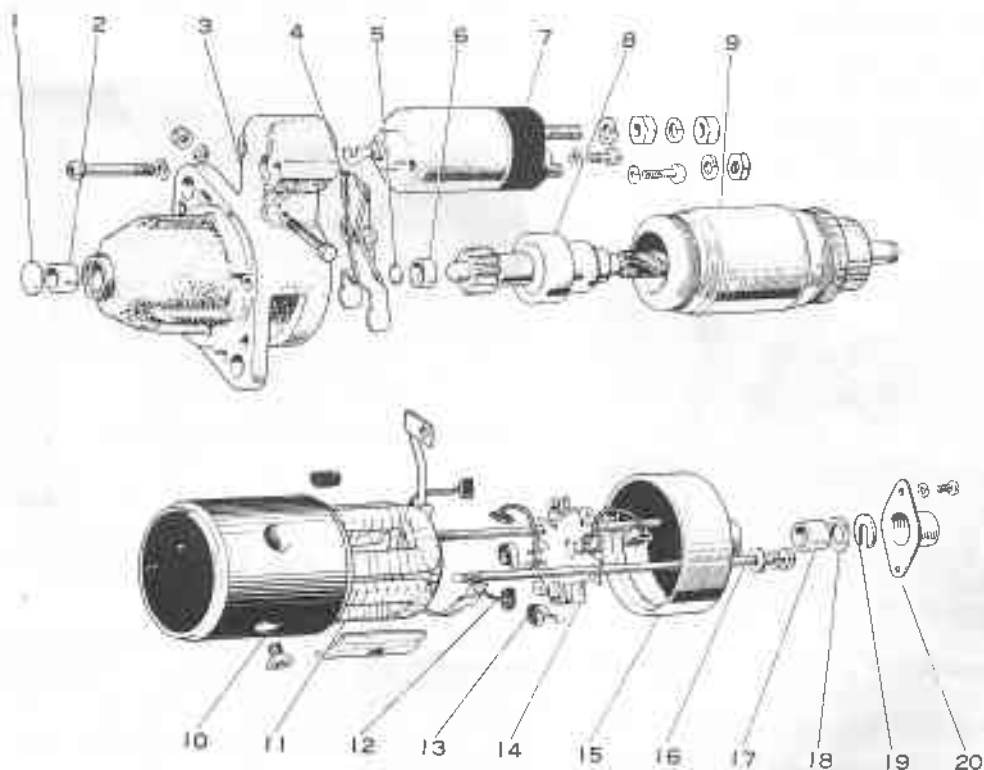
This moves the starter clutch pinion further to completely engage with the ring gear, and brings the starter into the engine cranking condition. As the magnetic switch is closed, the current does not flow to the pull-in coil, and the contact plate is retained at the closed position by the hold-in coil until the engine starts to operate.

With the starter switch off after the engine starting, the current flows from the magnetic switch contact plate to the pull-in coil and the hold-in coil. As these coils are wound to have their attractive forces act in opposite directions, these attractive forces cancel each other, and the plunger return spring retracts the plunger moving core to open the magnetic switch. At the same time, the starter clutch is returned to its original position, and the armature is pushed towards the commutator end frame side by the plunger return spring to effect the armature brake. Then, the armature quickly stops, and becomes ready for the starter re-operation.



# Specification:

|                                 |                                    |
|---------------------------------|------------------------------------|
| Type                            | Series wound motor                 |
| Rated voltage                   | 12 volts                           |
| Rated output power              | 0.8 KW                             |
| Rating                          | 30 seconds                         |
| Direction of revolution         | Clockwise as seen from pinion side |
| Number of poles                 | 4                                  |
| Number of pinion teeth          | 9                                  |
| Suitable battery capacity       | 35 ~ 60 AH                         |
| No-load output characteristics: |                                    |
| Voltage at                      | 11 volts                           |
| Amperage                        | Less than 50 amperes               |
| Revolution                      | Over 5,000 rpm                     |
| Locked output characteristics:  |                                    |
| Voltage at                      | 7.7 volts                          |
| Amperage                        | Less than 470 amperes              |
| Torque                          | Over 1.2 m-kg (8.6 ft-lb)          |



- |                                |                   |                                  |
|--------------------------------|-------------------|----------------------------------|
| 1. Cover                       | 8. Starter clutch | 15. Commutator end frame         |
| 2. Drive end frame bushing     | 9. Armature       | 16. Through bolt                 |
| 3. Drive end frame             | 10. Yoke          | 17. Commutator end frame bushing |
| 4. Pinion drive lever w/spring | 11. Field coil    | 18. Plate washer                 |
| 5. Snap ring                   | 12. Brush         | 19. Lock plate                   |
| 6. Pinion stopper collar       | 13. Brush spring  | 20. Bearing cover                |
| 7. Magnetic switch             | 14. Brush holder  |                                  |

Fig. 9-4 Starter Components

Y5660

## Removal

1. Disconnect the battery ground cable from the battery terminal.
2. Disconnect the battery to starter cable and the wires from the starter.
3. Remove the engine under cover on RH & RY series.
4. Remove the starter retaining nuts, and remove the starter.

## Disassembly

1. Disconnect the field coil wire from the lower side main terminal of the magnetic switch.
2. Remove the two magnetic switch retaining screws, and disconnect the moving stud from the drive lever by lowering the front end of the magnetic switch as shown in arrow mark, then remove the magnetic switch.



Fig. 9-5 Magnetic Switch Removal V1806

3. Remove the bearing cap from the commutator end frame, and pull out the lock plate and the washer.
4. Remove the two through bolts, and remove the commutator end frame.
5. Take out the brushes from the brush holder, and remove the brush holder from the armature shaft.



Fig. 9-6 Brush Holder Removal V1808

6. Remove the yoke from the drive end frame.
7. Remove the drive lever retaining bolt, and remove the armature, together with the starter clutch and the drive lever from the drive end frame.



Fig. 9-7 Armature Removal B0033

8. Remove the snap ring and the pinion

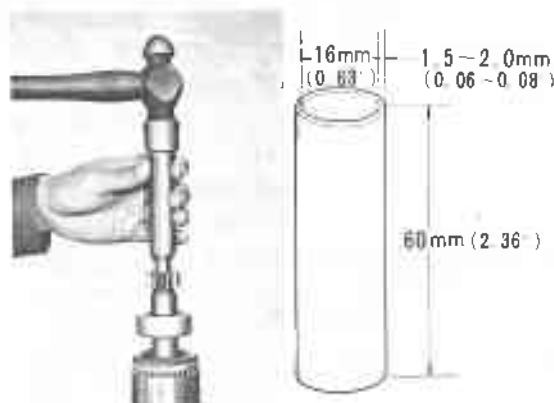


Fig. 9-8 Starter Clutch Removal B0034  
G1249

stopper collar from the armature shaft end, then remove the starter clutch.

To remove the snap ring, make a tool similar to the one as shown in the illustration.

Drive out the pinion stopper collar toward the starter clutch side first using the tool to remove the snap ring.

Next, remove the stopper collar and the starter clutch after removing the snap ring.

## Inspection & Repair

### Armature

1. Inspect the clearance between the armature shaft and the bushing.

The specified clearance should be less than 0.1 mm (0.004"), and if the clearance exceeds 0.2 mm (0.008"), select the proper size bushing in the following table to obtain the specified clearance.

Armature shaft diameter:

12.425 ~ 12.440 mm (0.4892 ~ 0.4898")

Bushing inner diameter:

STD: 12.535 ~ 12.560 mm  
(0.4935 ~ 0.4945")

U/S-0.30: 12.235 ~ 12.260 mm  
(0.4817 ~ 0.4827")

U/S-0.50: 12.035 ~ 12.060 mm  
(0.4738 ~ 0.4748")

The under size bushings are marked with the identification line of 3 mm (0.12") width. The U/S-0.30 bushing is marked with a single line, and the U/S-0.50 is marked with double lines.

2. Check the commutator for roughness, burnt or scored surface.

If necessary, dress or cut with a lathe just enough to remove stock to clean the surface.

If the out-of-round of the commutator is more than 0.3 mm (0.012"), cut the commutator on a lathe.

The out-of-round should be less than 0.1 mm (0.004").

The serviceable limit of the commutator is 36.8 mm (1.45") for 2R, 30.7 mm

(1.21") for 12R, and if the limit exceeds, replace the armature.

The specified commutator diameter is 38.8 mm (1.53") for 2R, 32.7 mm (1.31") for 12R.

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").

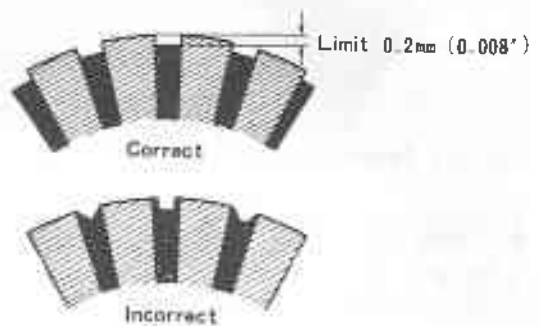


Fig. 9-9 Mica Depth

G0151

4. Check the armature coil for ground using a growler.

Connect one test prod on the commutator, and the other test prod on the armature core or shaft.

If the test lamp lights, the armature coil is grounded.

Repair or replace the armature.



Fig. 9-10 Testing Armature Coil for Ground

V2186

5. Check the armature coil for internal short by placing the armature on the growler, and hold a hacksaw blade over the armature core while rotating the

armature.

If the hacksaw blade vibrates, the armature coil is shorted.

Repair or replace the armature.



Fig. 9-11 Testing Armature Coil for Short

V2187

6. Check the armature coil for open circuit by placing the armature on the growler, and connect the two commutator segments with the test prods, and check the reading.

Repeat the test for all adjacent segments moving one segment at a time.

If there is inconsistent reading, it indicates an open circuit.

Repair or replace the armature.



Fig. 9-12 Testing Armature Coil for Open Circuit

V2188

### Field Coil

1. Check the field coil for open circuit using a circuit tester.

Connect one test prod onto the field coil lead and the other prod onto the other field coil lead.

If the tester needle does not move, the

field coil has an open circuit.

Repair or replace the field coil.



Fig. 9-13 Testing Field Coil for Open Circuit

B0035

2. Check the field coil for ground. Connect one test prod onto the field coil lead and the other lead on the yoke.

If the tester needle moves, the field coil has a ground circuit.

Repair or replace the field coil.



Fig. 9-14 Testing Field Coil for Ground

B0036

### Magnetic Switch

The following magnetic switch tests described in paragraphs 1 through 3 should be performed with the condition that the starter is assembled, and with the specified voltage application, to prevent the contact plate of the magnetic switch from deforming.

In testing, disconnect the field coil lead from the magnetic switch terminal "F"

1. Test the pull-in coil motion of the magnetic switch.

Connect the test leads onto the "50" terminal and the "F" terminal as shown in figure 9-15.

The magnetic switch should pull in the plunger strongly with 8 volts.

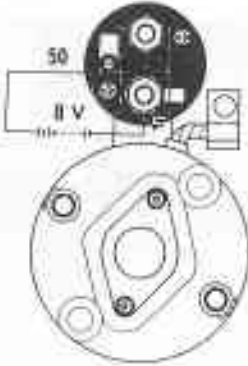


Fig. 9-15 Pull-in Coil Test

G1265

2. With the magnetic switch in pull-in condition, connect the battery negative lead onto the magnetic switch body. Next, disconnect the test lead of the battery negative side from the "F" terminal.

The plunger must be pulled in, and held in this position with 8 volts.

If held, the hold-in coil is satisfactory.

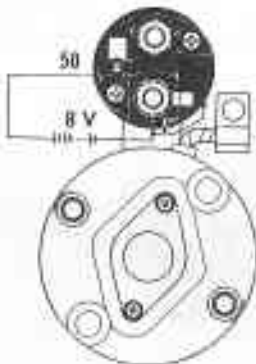


Fig. 9-16 Hold-in Coil Test

G1266

3. Check the plunger return motion by connecting the battery positive lead onto the "F" terminal, and the negative lead onto the magnetic switch body. After pulling out the pinion until it reaches to the pinion stopper collar with the hand, release the hand from the pinion.

At this time, if the plunger returns with 12 volts, the magnetic switch is satisfactory.

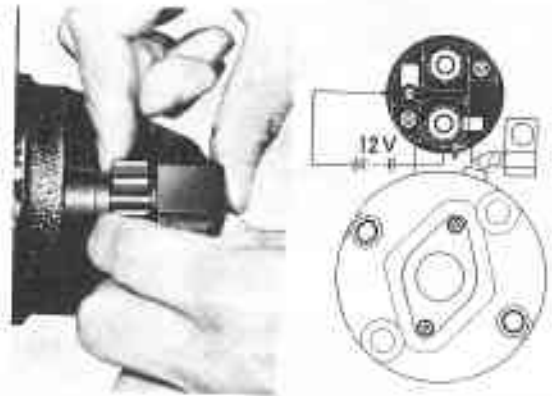


Fig. 9-17 Plunger Return Test

V1812

G1267

4. Inspect the length of the magnetic switch moving stud.

The length is approximately 34 mm (1.34") from the installation surface of the magnetic switch to the extreme end of the moving stud joint hook.

If necessary, adjust the moving stud length by loosening the lock nut to obtain the correct position of the pinion travel.



Fig. 9-18 Checking Moving Stud Length

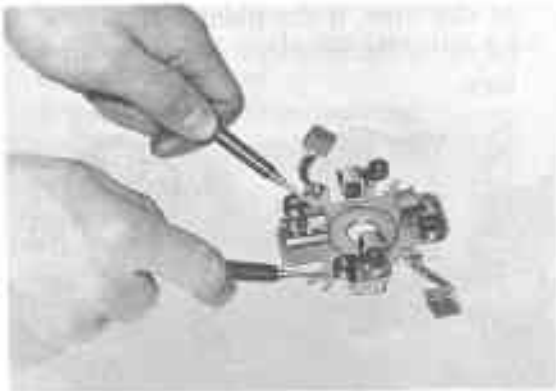
V1813

### Brush Holder & Brush

1. Inspect the brush holder for insulation using a circuit tester.

Connect the test prods onto the positive side brush holder, and onto the negative side brush holder.

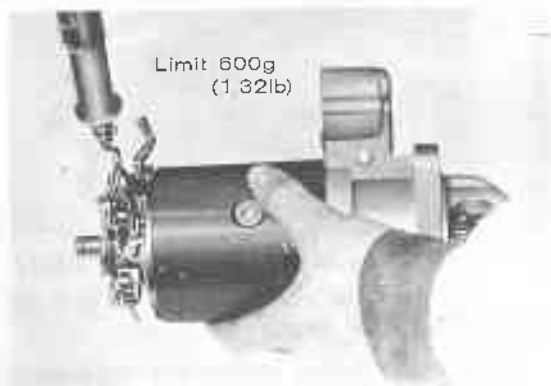
If the tester needle moves, the brush holder insulator is defective, and should be repaired or replaced.



**Fig. 9-19 Checking Brush Holder Insulation** VI814

2. Check the brush length, and if the length is less than 12 mm (0.48"), replace the brushes.  
The specified brush length is 19 mm (0.75").

3. Check the brush spring tension with a pull-scale.  
The reading of the tension should be made when the spring just comes off the brush.  
The specified spring tension should be 1,050 ~ 1,350 grams (2.3 to 3.0 lbs) when the new brushes are installed.  
If the tension is less than 600 g (1.32 lbs), replace the spring/s and/or the brush/es.



**Fig. 9-20 Checking Spring Tension** VI816

### **Starter Clutch**

1. Check the pinion teeth for wear and damage.  
If defective, replace the starter clutch assembly.

2. Check the starter clutch for damage, sticky against the free-wheel movement, and slippage in opposite direction to the free-wheel movement.  
If defective, replace the starter clutch assembly.



**Fig. 9-21 Checking Starter Clutch** VI817

### **Assembly**

When assembling each part, coat with multipurpose grease onto the sliding surface or moving portion of the armature shaft splines, starter clutch bushing, end frame bushings, drive lever and the moving stud.

1. Install the starter clutch, pinion stopper collar and the snap ring onto the armature shaft, and then lock the stopper collar in place by calking at two points.



**Fig. 9-22 Calking Stopper Collar** B0037

2. Install the drive lever (2) onto the starter clutch (1) as follows.  
Always install the drive lever as in the illustrated position.  
If the installation is incorrect, the pinion

meshing with the ring gear will be improper.

Also the steel washer (3) must always be installed towards the clutch side.



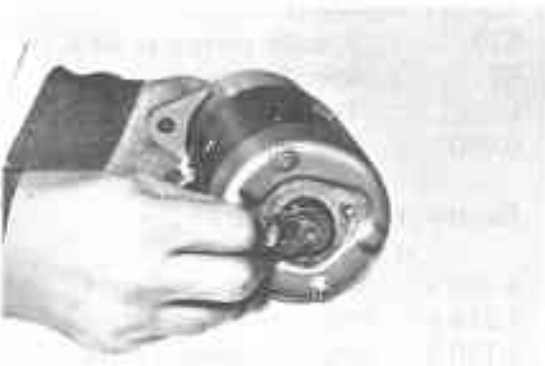
*Fig. 9-23 Direction of Drive Lever Installation* V1818

3. Install the armature onto the drive end frame, and tighten the drive lever retaining bolt.

4. Install the yoke onto the drive end frame.

5. Install the brush holder onto the armature, and install the brushes into the brush holders.

Align the cut provided on the brush holder with the thread holes for the through bolts on the drive end frame.



*Fig. 9-24 Installing Lock Plate* V1820

6. Install the commutator end frame, and tighten the through bolts.

7. Install the thrust washer and the lock plate onto the armature shaft end as shown in figure 9-24.

The armature shaft thrust play should be 0.05 -- 0.35 mm (0.002 to 0.13"), and the thrust play limit is 0.8 mm (0.03")

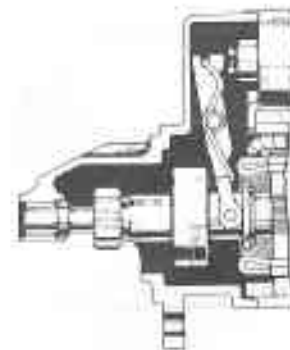
8. Pack multipurpose grease into the bearing cover, and install it onto the end frame.



*Fig. 9-25 Installing Bearing Cover* V1821

9. Install the magnetic switch onto the drive end frame.

Always hook the moving stud joint onto the drive spring from the underneath of the spring as illustrated.



*Fig. 9-26 Installing Magnetic Switch* G0152

10. Check the clearance between the starter clutch pinion and the pinion stopper collar. The clearance should be 1 ~ 4 mm or 0.04 to 0.16" when the starter is operated under no load. If necessary, adjust the clearance by adjusting the moving stud length.

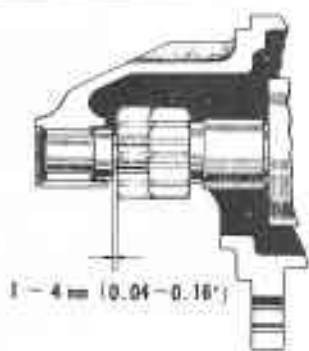


Fig. 9-27 Clutch Pinion Clearance

G0153

### Testing After Assembly

The following tests should be performed after assembling the starter.

If suitable equipment is not available, at least the no-load test should be made.

Use a fully charged battery for the tests.

To perform the no-load test, connect the test leads as shown in figure 9-28.

The starter motor should rotate smoothly at a constant speed of more than 5,000 rpm at 11 volts with the current draw of 50 amperes or less.

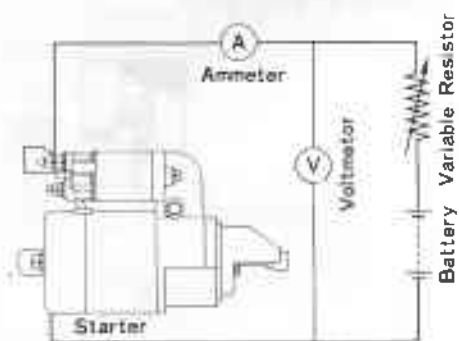


Fig. 9-28 Testing Circuit

G0154

To perform the lock test, follow the instruction and procedures outlined in the instruction manual of the tester furnished by the manufacturer.

With the armature locked, the current draw should be less than 470 amperes at 7.7 volts producing a torque of 1.2 m-kG (8.6 ft-lb) or more.

### Installation

Follow the removal procedures in the reverse order.

## BATTERY

### Inspection & Adjustment

1. Check the electrolyte level in each cell. Add sufficient electrolyte to level line. 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 temperature. It is necessary before adjusting the specific gravity that it is converted accordingly to standard temperature reading at 20°C (68°F).

For conversion of temperature pertaining to acid specific gravity, the following equation should be used.

$$S_{20} = ST + 0.0007(t - 20)$$

$S_{20}$  . . . . . Specific gravity at 20°C

$ST$  . . . . . Specific gravity at  $t^{\circ}C$

$t$  . . . . . 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 charging operation. This gas mixture can explode if flames or sparks are brought 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 alternator rectifiers will be damaged.

\*\*\*\*\*

## IGNITION SYSTEM

|                                        |       |
|----------------------------------------|-------|
| DESCRIPTION .....                      | 10- 1 |
| TROUBLE SHOOTING .....                 | 10- 2 |
| DISTRIBUTOR .....                      | 10- 2 |
| Description .....                      | 10- 2 |
| Removal .....                          | 10- 6 |
| Disassembly .....                      | 10- 6 |
| Inspection .....                       | 10- 7 |
| Distributor shaft .....                | 10- 7 |
| Distributor cap .....                  | 10- 7 |
| Breaker plate & stationary plate ..... | 10- 8 |
| Other item .....                       | 10- 8 |
| Assembly .....                         | 10- 8 |
| Performance Test & Adjustment .....    | 10-10 |
| Breaker point gap .....                | 10-10 |
| Breaker arm spring tension .....       | 10-10 |
| Cam dwell angle .....                  | 10-10 |
| Condenser .....                        | 10-11 |
| Advance characteristics .....          | 10-11 |
| Installation .....                     | 10-12 |
| IGNITION COIL .....                    | 10-13 |
| Description .....                      | 10-13 |
| Inspection .....                       | 10-13 |
| HIGH TENSION WIRES .....               | 10-14 |
| Description .....                      | 10-14 |
| Removal .....                          | 10-14 |
| Inspection .....                       | 10-14 |
| Installation .....                     | 10-14 |
| SPARK PLUG .....                       | 10-15 |
| Description .....                      | 10-15 |
| Removal .....                          | 10-16 |
| Inspection & Adjustment .....          | 10-16 |
| Installation .....                     | 10-16 |
| MEMORANDUM .....                       | 10-17 |

## DESCRIPTION

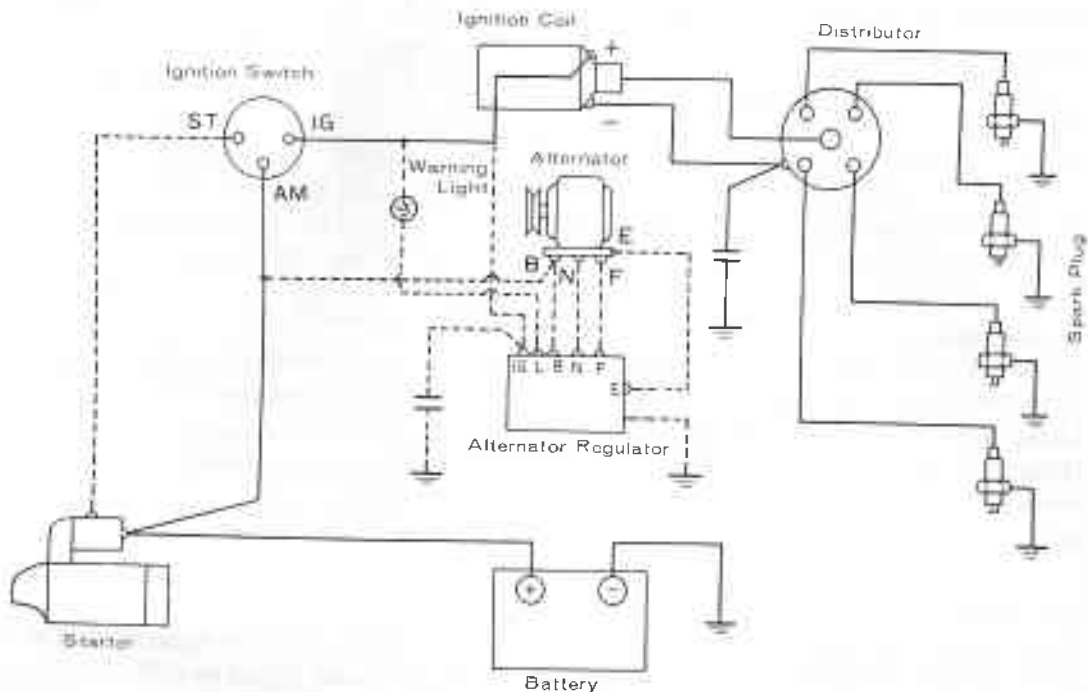


Fig. 10-1 Ignition System Wiring Diagram

G3815

The ignition system is provided to control the ignition of the air-fuel mixture within the engine combustion chambers.

The function of this system is very essential in the performances of the engine, and special attention should be maintained in the servicing of the engine, so that it is always in perfect operating condition.

The ignition system produces high-voltage surges of up-to 20,000 volts, and delivers them to the spark plugs in "time" with the engine.

Each high-voltage surge jumps across the spark plug gap and ignites the compressed air-fuel mixture.

The ignition system is composed of the primary (low-voltage) circuit and the secondary (high-voltage) circuit, and the wiring diagram is as shown in the above illustration.

The primary circuit consists of the battery, distributor breaker points, condenser and the ignition coil primary windings.

The secondary circuit consists of the ignition coil secondary windings, distributor cap, rotor, high-tension wirings and the spark plugs.

When the breaker points are closed, the primary current flows from the battery through the ignition switch to the primary windings in the coil, then to ground through the closed breaker points.

When the breaker points open, the magnetic field built up in the ignition coil primary windings moves through the secondary windings of the coil producing high voltage surge.

The high voltage surge is produced each time the breaker points open. The high voltage flows through the coil high tension wiring to the distributor cap where the rotor distributes it to one of the spark plug terminals in the distributor cap.

**TROUBLE SHOOTING**

| Symptoms & Probable Causes                                   | Remedies                          |
|--------------------------------------------------------------|-----------------------------------|
| 1. Starter turns, but engine will not start.                 |                                   |
| a. Weak battery                                              | Recharge battery                  |
| b. Excessive moisture on spark plugs or high tension wirings | 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. Burnt or improperly adjusted breaker points               | Adjust or replace points          |
| f. Defective condenser                                       | Replace condenser                 |
| 2. Hard starting                                             |                                   |
| a. Defective spark plug/s                                    | Clean, adjust or replace plug/s   |
| b. Defective breaker points                                  | Replace points                    |
| c. Loose connection in primary circuit                       | Tighten or repair                 |
| d. Defective condenser                                       | Replace condenser                 |
| e. Defective coil                                            | Replace coil                      |
| f. Defective cap or rotor                                    | Replace cap or rotor              |
| 3. Engine misses.                                            |                                   |
| a. Dirty or defective spark plug/s                           | Clean, adjust or replace plug/s   |
| b. Loose ignition wire/s or defective insulation             | Tighten, repair or replace wire/s |
| c. Cracked distributor cap                                   | Replace cap                       |
| d. Improper breaker points adjustment                        | Adjust breaker points             |

**DISTRIBUTOR****Description**

The distributor construction is as shown in the figure 10-2, and the distributor shaft is driven by the gear on the camshaft in time with the engine.

The distributor cap is connected with the high tension wirings to the ignition coil and the spark plugs, and distributes the high voltage surge induced in the secondary windings of the ignition coil to each spark plug in turn according to the rotation of the rotor mounted on the distributor cam upper end.

The construction of the breaker components is also as shown in the figure 10-2, and consists of the cam with four lobes, breaker arm and the contact point. And as the cam is rotated, each cam lobe passes under the breaker arm rubbing block, the breaker points separate, therefore, this turns off the primary current.

The condenser installed on the distributor housing absorbs the primary current which tends to continue flowing when the breaker points starts opening, and this reduces the arcing at the breaker points to prolong the points life.

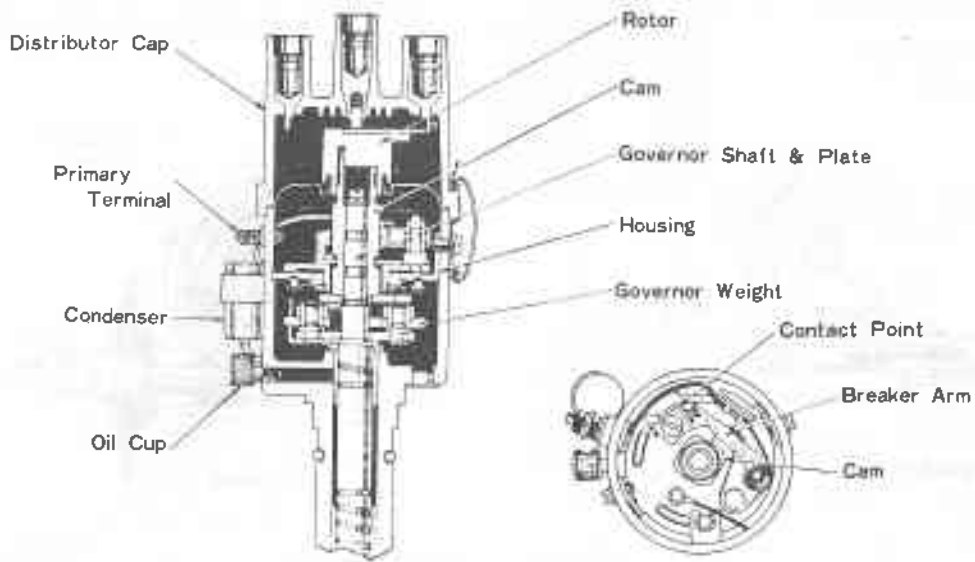


Fig. 10-2 Sectional View of Distributor

Y5662

As it is necessary to vary the spark timing in order to obtain efficient operation of the engine according to the range of speed and operating conditions, the automatic spark advance mechanism is incorporated within the distributor.

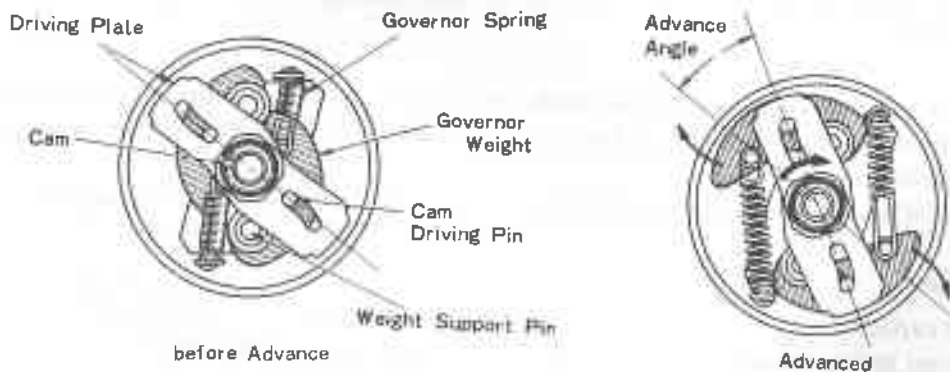


Fig. 10-3 Operation of Governor Advancer

G0185, G0186

The combustion speed of the mixture is almost constant, consequently, at higher engine revolution, there is a shorter interval of time for the mixture to ignite and expand. Therefore, in order to obtain the maximum amount of power at higher speeds, it is necessary to have the spark timing slightly earlier in the engine cycle. This is accomplished by means of the centrifugal advance mechanism.

The distributor shaft is provided with the governor weights which are designed to expand outward with one end supported at the weight support pins, and the governor springs are installed onto the end of the governor weights, and also the cam with the driving plate is installed onto the distributor shaft through the cam driving pins above the weights and springs.

As the distributor shaft is rotated, the governor weights are expanded outward by the centrifugal force against the tension of the governor springs. At this time, the cam with the driving plate is rotated to the rotating direction of the shaft by the driving pins in respect to the distributor drive shaft to advance the spark timing.

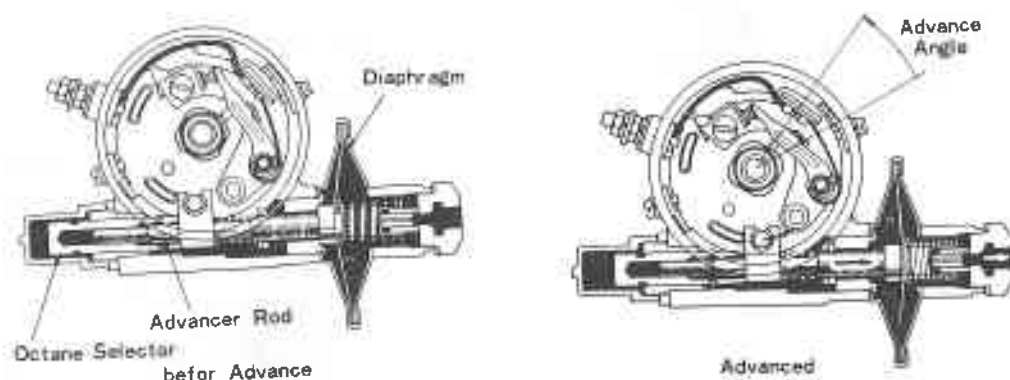


Fig. 10-4 Operation of Vacuum Advancer

G1273, G1274

Under light load, it is economical to have the spark timing earlier than that under heavy load, and more than that obtained by the centrifugal advance mechanism even though the engine is at same revolution. This additional advance is obtained by means of the vacuum advance mechanism.

This vacuum advance mechanism utilizes the increase of the vacuum within the intake manifold when the throttle valve is opened slightly under light load. As the vacuum increases within the intake manifold, the diaphragm pulls the advancer rod against the diaphragm spring tension toward the diaphragm side. The advancer rod when pulled, rotates the breaker plate to the opposite direction of the distributor shaft to advance the spark timing further.

Also the vacuum advancer is provided with the octane selector to obtain full advantage of fuel for the engine performances, and it is necessary to adjust the spark timing in accordance with the quality of fuel.

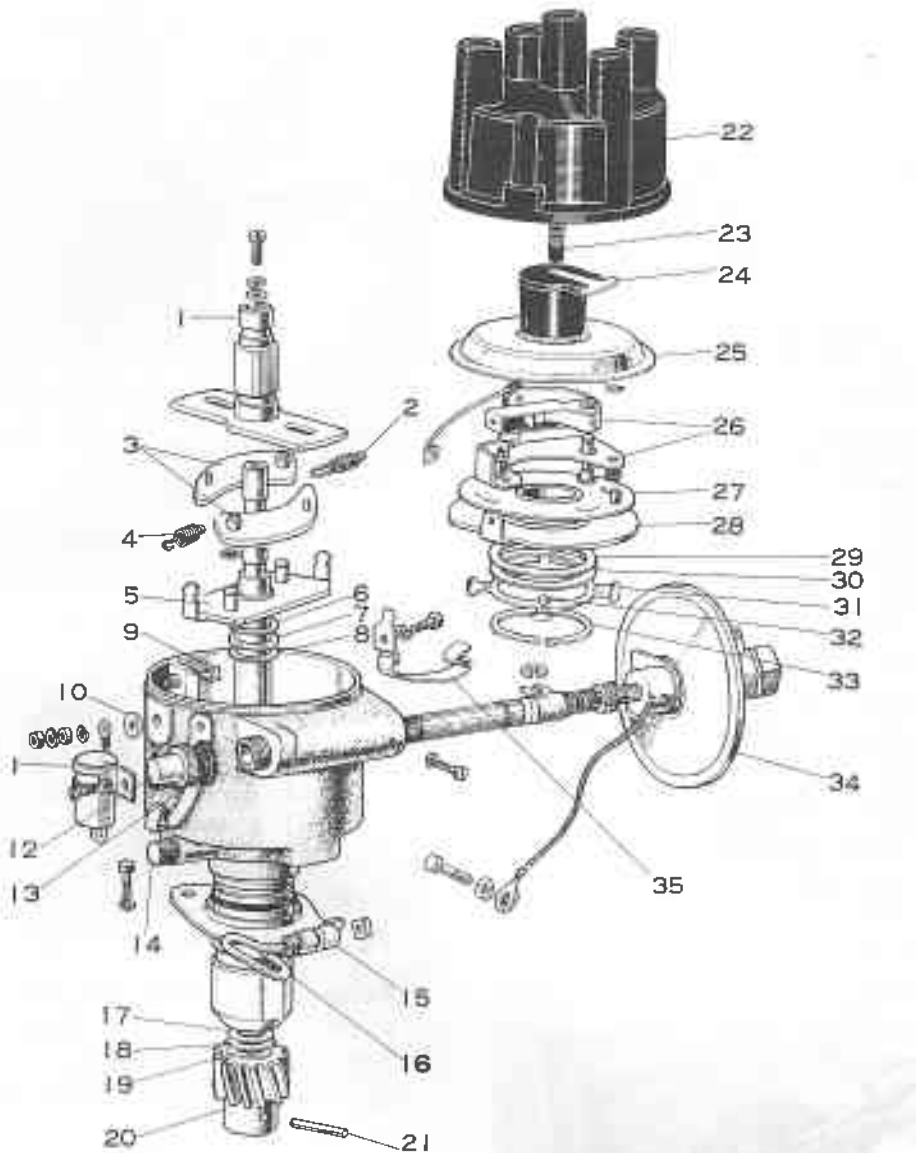
This octane selector has no relation with the characteristics of the vacuum advancer.

#### Specification:

|                                 |                                     |
|---------------------------------|-------------------------------------|
| Condenser capacity              | 0.20 ~ 0.24 microfarad              |
| Breaker point spring tension    | 400 ~ 550 grams (14.1 ~ 19.4 oz)    |
| Breaker point gap               | 0.45 mm (0.018")                    |
| Dwell angle                     | 50 ~ 54°                            |
| Vacuum advance characteristics: |                                     |
| Advance begins                  | at 110 ~ 130 mm Hg (4.3 ~ 5.0 inHg) |
| Timing advances                 | 5.5 ~ 7.5° at 200 mmHg ( 7.9 inHg)  |
|                                 | 10 ~ 12° at 280 mmHg (11.0 inHg)    |

#### Governor advance characteristics:

|                 |                          |
|-----------------|--------------------------|
| Advance begins  | at 400 ~ 600 rpm         |
| Timing advances | 8.5 ~ 10.5° at 1,400 rpm |
|                 | 15 ~ 17° at 2,500 rpm    |



- |                     |                      |                             |
|---------------------|----------------------|-----------------------------|
| 1 Distributor cam   | 13 Rubber washer     | 25 Dust proof cover         |
| 2 Governor spring B | 14 Oil cap           | 26 Breaker point kit        |
| 3 Governor weight   | 15 Distributor clamp | 27 Breaker plate            |
| 4 Governor spring A | 16 Clamp bolt        | 28 Stationary plate         |
| 5 Distributor shaft | 17 Steel washer      | 29 Adjusting washer         |
| 6 Steel washer      | 18 Bakelite washer   | 30 Adjusting washer         |
| 7 Bakelite washer   | 19 Steel washer      | 31 Breaker plate set spring |
| 8 Steel washer      | 20 Spiral gear       | 32 Steel ball               |
| 9 Terminal bolt     | 21 Pin               | 33 Snap ring                |
| 10 Insulator        | 22 Distributor cap   | 34 Vacuum advancer          |
| 11 Condenser        | 23 Cap center piece  | 35 Housing cap spring       |
| 12 Adjuster cap     | 24 Rotor             |                             |

Fig. 10-5 Distributor Components

**Removal**

1. Disconnect the high tension wires from the spark plugs and the ignition coil.  
As the high tension wires are of an internal resistance type (Resistive cord), care must be taken that the wires are removed by pulling on the cord insulating fittings rather than the wire insulation.
2. Disconnect the primary wire from the distributor.
3. Remove the vacuum pipe from the vacuum advancer.
4. Loosen the distributor clamp bolt, and remove the distributor.

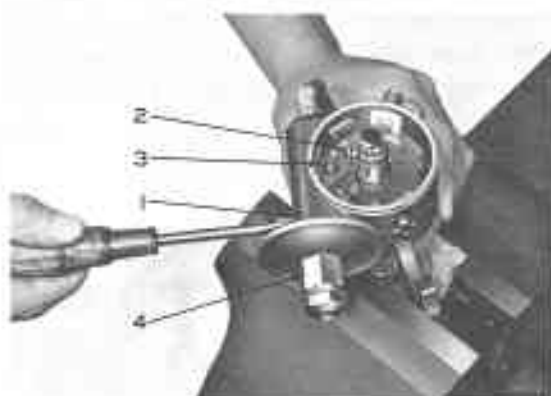
**Disassembly**

1. Remove the distributor cap, rotor, dust proof cover and the adjuster cap.
2. Remove the breaker arm snap ring (1), contact point retaining screw and the breaker arm lead wire, then remove the breaker arm (2) with the contact point (3) from the breaker plate.



**Fig. 10-6 Removing Breaker Point** V3675

3. Remove the vacuum advancer retaining screw (1), advancer lead wire retaining screw (2) and the snap ring (3), and then remove the vacuum advancer (4).
4. Remove the housing cap springs, and remove the condenser and the terminal insulators.



**Fig. 10-7 Removing Vacuum Advancer V3637**

5. Remove the breaker plate with the stationary plate.



**Fig. 10-8 Removing Breaker Plate** V3677

6. Remove the distributor cam retaining screw, and remove the distributor cam. The retaining screw is installed onto the upper end of the distributor shaft.



**Fig. 10-9 Removing Distributor Cam** V3678

7. Remove the governor springs and the governor weights.



8. Remove the pin, and then remove the spiral gear and the distributor shaft. To remove the pin, drill the rivetted pin end.

Take care of the 3~7 washers installed on the distributor shaft at both sides of the Distributor housing.



Fig. 10-10 Removing Distributor Shaft

V3680

### Inspection

Wash all the parts with the exception of the vacuum advancer and the condenser in cleaning solvent.

Inspect the following items, and repair or replace any defective part/s.

### Distributor Shaft

1. Check the shaft for wear, and check the fitness with the Distributor housing.
2. Inspect the shaft for bend which should not exceed 0.05 mm or 0.002".
3. Check the fitting portions of the governor weights with the support pins for

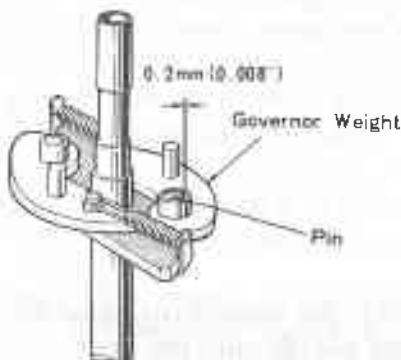


Fig. 10-11 Checking Pin Clearance

G0190

binding, and check the governor spring fitting surfaces for wear.

The governor weight to the pin clearance limit is 0.2 mm or 0.008"

4. Install the distributor shaft, washers, spiral gear and the pin onto the distributor housing, and then inspect the thrust clearance with a dial gauge or feeler guage.

The clearance should be less than 0.4 mm (0.16").

If the clearance exceeds 0.4 mm (0.16"), adjust the clearance with the adjusting steel washer.



Fig. 10-12 Checking Thrust Clearance

V3681

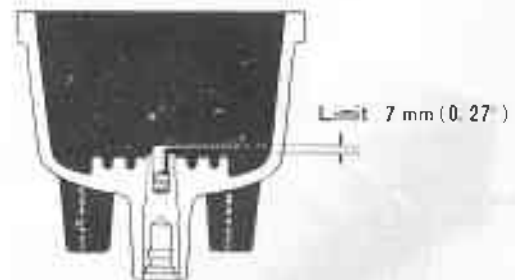


Fig. 10-13 Checking Carbon Center Piece

G1275

### Distributor Cap

Check the cap for cracks, carbon tracks, and for burnt or corroded terminals, and also check the center carbon piece for wear. Refer to figure 10-13.

The piece length is 9 mm (0.35"), and the limit is 7 mm (0.27").

**Breaker Plate & Stationary Plate**

1. Remove the snap ring (1), and remove the washer (2), set spring (3), balls (4), washers (5), stationary plate (6) and the breaker plate (7).

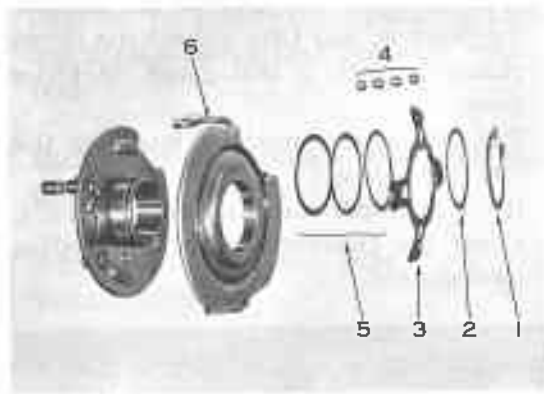


Fig. 10-14. Disassembling Stationary & Breaker Plates V3682

2. Coat multipurpose grease onto the sliding surface of the stationary plate with the breaker plate after washing, and assemble the disassembled parts.
3. Inspect the breaker plate operating resistance.  
The resistance should be less than 500 grams (17.7 oz).

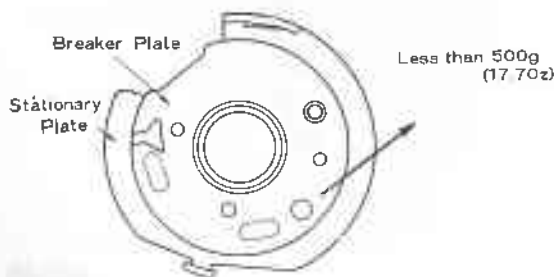


Fig. 10-15 Checking Operating Resistance G0335

4. Insert two screwdrivers between the breaker plate and the stationary plate as shown in the figure 10-16, and pry the screwdrivers.

At this time, the clearance between both plates should be less than 0.2 mm (0.008").

If the clearance exceeds, adjust the clearance with the washer.

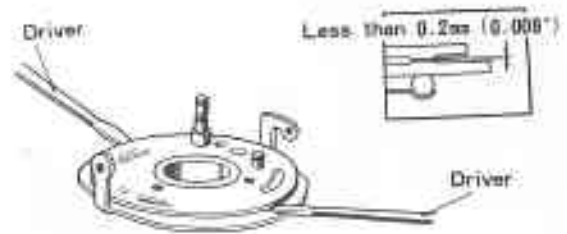


Fig. 10-16 Checking Clearance between Stationary & Breaker Plates G0349

**Other Items**

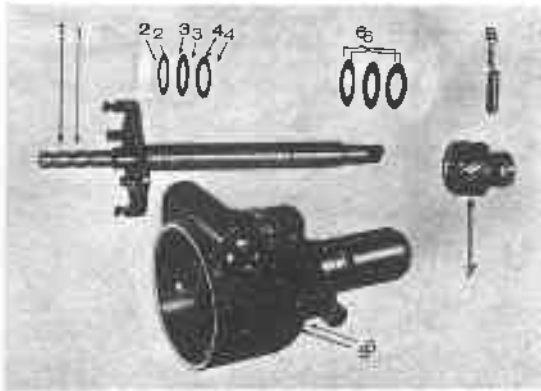
1. Check the breaker points for burnt or pitted condition, and if necessary, dress with a point file.
2. Inspect the distributor cam lobes for scores and wear.
3. Inspect the condenser for capacity and defects.
4. Check the diaphragm of the vacuum advancer for damage.
5. Check the spiral gear for wear.

**Assembly**

1. Insert the thrust washers (2), (3) and (4) onto the distributor shaft (1), and then install the shaft onto the housing (5) after lubricating the shaft with engine oil.

The bakelite washer should be installed between the steel washers.

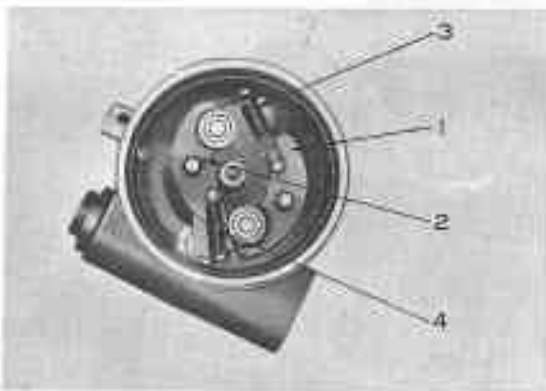
2. Assemble the washers (6), spiral gear (7) and the pin (8) onto the shaft, and then rivet both pin ends.



*Fig. 10-17 Assembling Distributor Shaft* V3683

3. Assemble the governor weights (1) and (2) and the governor springs (3) and (4). Take care on the assembling direction of the governor springs as shown in figure 10-18.

Also lubricate the connections and the pins with engine oil, and check for smooth operation.



*Fig. 10-18 Assembling Governor* V3684

4. Coat the distributor shaft with multipurpose grease, and install the cam onto the shaft.

Tighten the cam retaining screw, and fill the hollow portion at the top of the cam with grease.

5. Install the breaker plate assembly onto the housing, and secure it with the retaining screw together with the cap springs.



*Fig. 10-19 Assembling Cam* V3678



*Fig. 10-20 Assembling Breaker Plate* V3677

As the shape of the cap spring is different from each other, install the cap springs as shown in figure 10-21.



*Fig. 10-21 Installing Cap Springs* V3685

6. Install the vacuum advancer and the condenser.

7. Install the terminal bolt and the insulators, and tighten the nut finger tight together with the condenser lead wire.

8. Install the contact point and the breaker arm onto the breaker plate with the snap ring and the retaining screw.

Connect the breaker arm lead wire onto the terminal, and tighten the nut.  
Coat the cam lobes with the Distributor Grease.

Do not allow any oil or grease on the point surfaces.

9. Adjust the octane selector to the normal position as follows.

The setting line should be flush with the housing thread end.

Also align the center line with the setting mark.

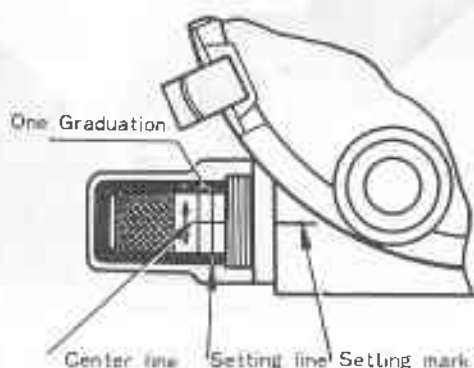


Fig. 10-22 Octane Selector Normal Position

G1701

10. Install the adjuster cap, and adjust the point gap referring to the Performance Test in the following paragraph.

## Performance Test & Adjustment

### Breaker Point Gap

Rotate the distributor shaft until the breaker arm rubbing block is at the top of the cam lobe.

Check the point gap with a feeler gauge, and adjust the gap to 0.45 or 0.018".

To adjust the gap, loosen the contact point retaining screw, and insert a slot type screwdriver into the cut portion of the contact point plate.

Next, pry the screwdriver to obtain the correct clearance.

After adjusting the gap, tighten the retaining screw securely.

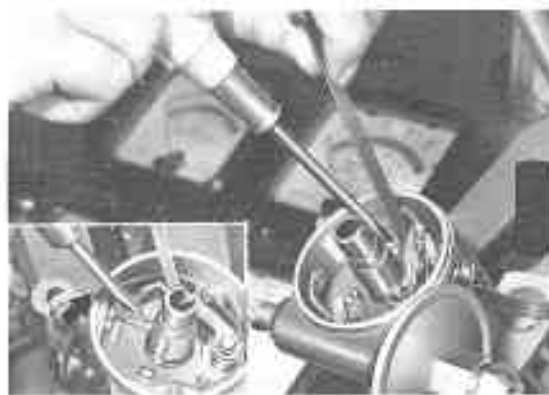


Fig. 10-23 Adjusting Point Gap

V3686

V3687

### Breaker Arm Spring Tension

Inspect the breaker arm spring tension with a spring tension tester by pulling at right angle of the breaker arm point. Read the tester just when the points start to open.

The specified tension should be 200 to 500 grams (7 ~ 18 oz).

If the tension is low, replace the breaker point assembly.



Fig. 10-24 Checking Spring Tension

V3688

### Cam Dwell Angle

Check the cam dwell angle with the distributor tester.

The angle should be within 50~54°.

The adjustment can be made by adjusting the breaker point gap.

If the gap is wide, the angle will be small, and if the gap is narrow, the angle will be large.



Fig. 10-25 Checking Cam Dwell Angle V3689

### Condenser

Check the condenser for minimum series resistance, maximum insulation resistance and the capacity with the distributor tester. The series and the insulation resistances should be within the permissible range on the tester.

Also the capacity should be 0.20 to 0.24 microfarad.

If defective, replace the condenser.

### Advance Characteristics

Check the governor advance and the vacuum advance with the distributor tester.

When the tests are performed, test the governor advance first as the vacuum advance is influenced by the governor.

#### 1. Governor advancer.

Operate the distributor in the direction of rotation, and adjust the speed to the initial rpm setting listed in the specification.

Move the protruded scale so that one of the flashes aligns with the zero degree mark.

Slowly increase the rpm to setting specification for the first advance reading listed in the specification.

If the correct advance is not indicated at this rpm, replace the governor springs.

Operate the distributor both forward and reverse in the rpm ranges.

Governor advance specification:

| Distributor rpm | Advance angle  |
|-----------------|----------------|
| 400 ~ 600       | Advance begins |
| 1,400           | 8.5 ~ 10.5°    |
| 2,500           | 15.0 ~ 17.0°   |

#### 2. Vacuum advancer.

Connect the test set vacuum line onto the fitting on the vacuum advancer.

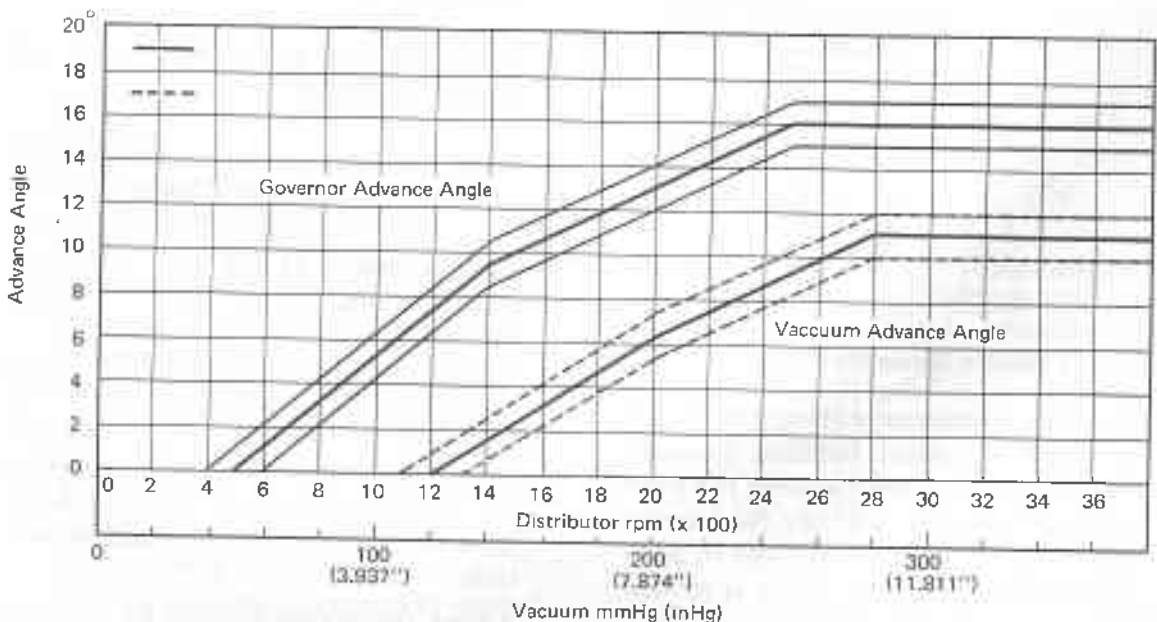


Fig. 10-26 Distributor Advance Characteristics

Set the tester to 0° advance, zero vacuum at the distributor 1,000 rpm. Check the advance at the first vacuum setting specification in the specification. If necessary, replace the advancer.

Vacuum advance specification:

| Vacuum reading<br>(mmHg or inHg) | Advance angle  |
|----------------------------------|----------------|
| 110 ~ 130 (4.3 ~ 5.0)            | Advance begins |
| 200 ( 7.9)                       | 5.5 ~ 7.5°     |
| 280 (11.0)                       | 10 ~ 12°       |

### Installation

1. Position the No. 1 piston at TDC of the compression stroke.

At this time, be sure to check if the push rods of the No.1 cylinder are movable with the fingers.

Next, align the timing pointer on the timing gear cover with the timing ball installed on the crankshaft pulley.

This will set the timing at BTDC 8 degrees.

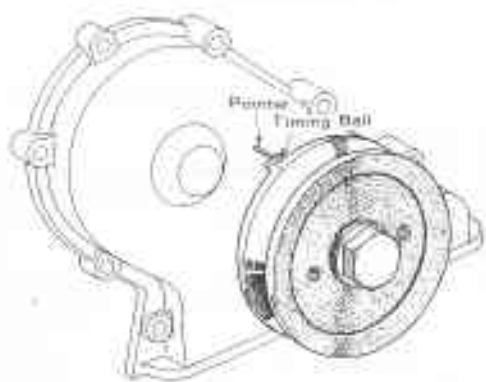


Fig. 10-27 Ignition Timing Marks

G0853

2. Hold the distributor without the distributor cap at correct installing position, and position the rotor so that the rotor terminal will align with the No.1 terminal of the distributor cap, and in addition to that the cam, which is rotated clockwise, will start the breaker point to separate from the contact point.

3. With the above positions, align the slot of the oil pump drive shaft upper end with the distributor shaft end using a screwdriver.

Next, rotate the rotor beforehand to 30° (about one tooth on the spiral gear) clockwise, then insert the distributor onto the cylinder block.



Fig. 10-28 Distributor Installing Position V3692

4. Adjust the ignition timing by rotating the distributor housing so that the breaker point starts to separate from the contact point by the cam, then tighten the distributor clamp bolt.
5. Connect the primary wire and the vacuum pipe.
6. Install the dust proof cover, rotor and the distributor cap.
7. Insert the high tension wires securely with the firing order of 1-2-4-3.
8. Run the engine at 550 rpm, and check if the timing pointer aligns with the timing ball using the timing light. If necessary, adjust the ignition timing by rotating the distributor housing. Do not align the ignition timing with the octane selector, and also when checking the ignition timing, the octane selector must be positioned at the standard position.
9. Adjust the octane selector by referring to the Engine Tune-Up section.

## IGNITION COIL

### Description

The ignition coil is utilized to transform the battery voltage to the high voltage sufficient to spark across the spark plugs gap.

It is composed of the primary and secondary windings, and the latter is wound to thousands of windings of very fine wire. By this windings, the voltage is increased to about 20,000 volts which is sufficient to spark across the spark plug gap without any difficulty.

The voltage induced in the secondary winding is strongest when the primary circuit is opened because of the difference of speed of movement of the magnetic lines of force. When the breaker points are closed, the current flows through the primary windings causing magnetic lines of force to move away from the soft iron core. Because of their attraction to the core, they move relatively slow. When the primary circuit is opened, the magnetic line of force snap back to the core because of their attraction to it.

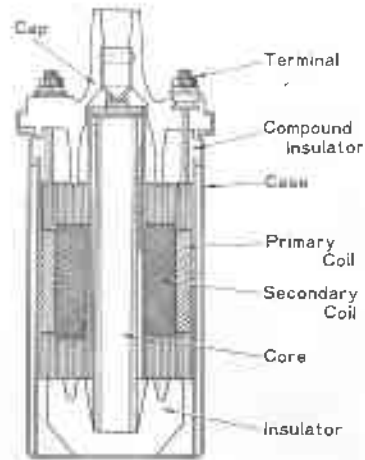


Fig. 10-29 Ignition Coil Section

G0194

### Specification:

|                      |                                                                                                                                                                                                                                                                                                         |
|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Primary voltage      | 12 volts                                                                                                                                                                                                                                                                                                |
| Primary resistance   | 3.3 ~ 4.3 ohms                                                                                                                                                                                                                                                                                          |
| Secondary resistance | 7,500 ~ 10,000 ohms                                                                                                                                                                                                                                                                                     |
| Secondary voltage    | Sparkling distance from center to three negative electrodes should be more than 8 mm (0.276") at distributor revolution of 75 rpm with 12 volts.<br>Sparkling distance from center to three negative electrodes should be more than 6 mm (0.236") at distributor revolution of 3,000 rpm with 12 volts. |

### Inspection

Before testing the coil, always heat the coil to normal operating temperature.

1. Check the primary resistance with a tester.  
The reading should be within 3.3 to 4.3 ohms.
2. Check the secondary resistance.  
The resistance should be within 7,500~10,000 ohms.  
If the reading is not within the specified resistance, the coil is opened or shorted.

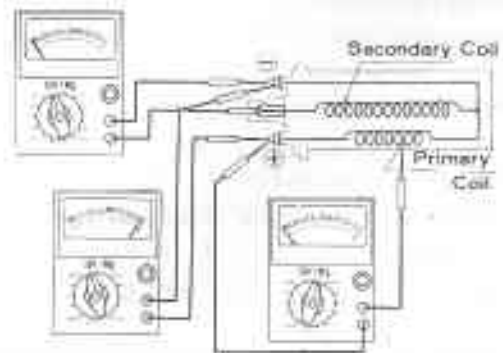


Fig. 10-30 Checking Coil Resistance

G1278

3. Check the insulation resistance between the case and the terminal with a 500 volts megohm meter.  
The insulation resistance should be more than 50 megohms.



Fig 10-31 Insulation Test

V2203

4. Check the secondary voltage with a coil tester following the instruction manual of the tester furnished by the manufacturer.

The sparking distance from the center to the three negative electrodes should be more than 8 mm (0.276") at distributor revolution of 75 rpm with 12 volts.

Also the sparking should be more than 6 mm (0.236") at distributor revolution of 3,000 rpm with 12 volts.

## HIGH TENSION WIRES

### Description

Internal resistance type spark plugs and ignition coil wires are installed on the engine high tension circuit. These wires are of a radio resistance type which the core is carbon-impregnated linen. These wires are designed to eliminate the high frequency electrical impulses that are the source of ignition noise interference, but are also superior in resistance to cross-fire. The resistive wires, however, are more easily damaged by careless handling than copper cored wires. For this reason, care must be taken that the wires are removed by pulling on the wire insulating fittings rather than on the wire insulation.

### Removal

To disconnect the high tension wires, pull only on the end insulating fitting.

Do not pull or jerk the wire, because pulling on the wire might cause damage of the conducting core of the wire.

### Inspection

1. Check the resistance value of each wire between both ends.  
The resistance value should be less than 25,000 ohms, and if it exceeds the specified value, replace the wire.
2. Wipe the high tension wires with a cloth moistened with cleaning solvent, and wipe them dry.

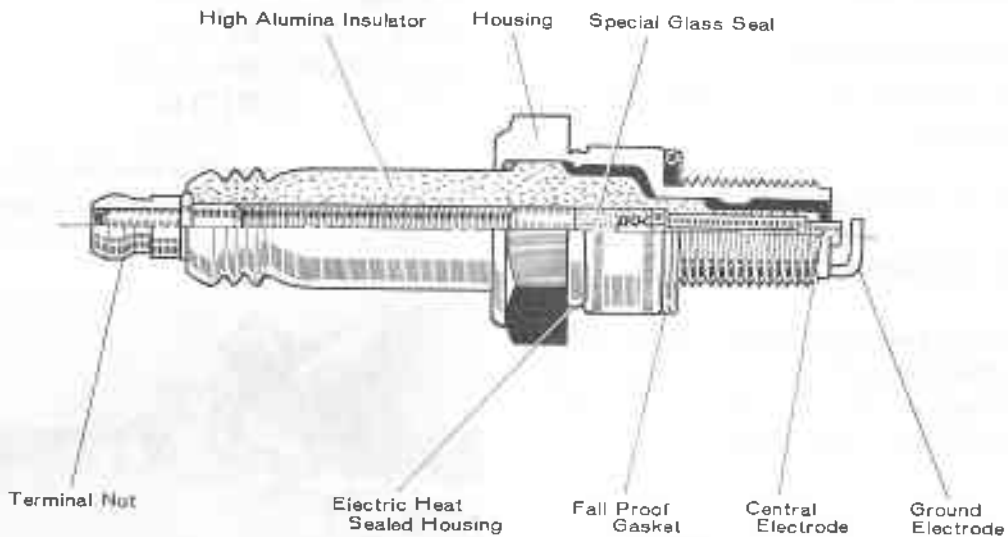
Bend the wires to check for brittle and cracks or loose connection.

3. Check the condition of the wire terminal.  
If any terminal is corroded, clean it, and if it is broken or distorted, replace the wire.  
Never try to alter the length of the wire, and do not make a sharp bend in the wire.

### Installation

Insert the wire securely as it was installed before, and do not allow the wire to contact any metal surface.



**SPARK PLUG***Fig. 10-32 Spark Plug Section (Denso W17ES)*

G1279

**Description**

The temperature of the electrode portion must be within the specific range (it is called "Self-Cleaning Temperature") to obtain the engine performances sufficiently.

If the temperature is maintained under 500°C (930°F), such as the engine is operated for long period in slow speed at part throttle opening, the plug tends to foul that the insulator tip and the electrodes will become covered with carbon and other products of combustion, and this will result missing or roughness because of their lower resistance.

On the other hand, if the temperature exceeds 500°C (930°F), the carbon or other products is burnt and dispersed.

However, it is not necessarily good condition that the temperature of the electrodes exceed over 500°C (930°F).

If it exceeds 870°C (1,600°F), for instance, the engine is operated for long period under approximately at full load conditions, the mixture will occur preignition and detonation, and the engine performances decrease.

It is, therefore, advisable to always maintain the temperature of the electrodes within 500~870°C (930~1,600°F) by utilizing the proper plug with heat range based on average driving conditions.

**Specification:**

|                   |                                |
|-------------------|--------------------------------|
| Type              | DENSO W20ES or NGK BP6-ES      |
| Plug size & reach | 14 mm x 19 mm (0.551 x 0.748") |
| Plug gap          | 0.7 ~ 0.8 mm (0.027 ~ 0.031")  |

## SPECIFICATIONS

|                                                |       |
|------------------------------------------------|-------|
| GENERAL SPECIFICATION .....                    | 11- 1 |
| ENGINE SPECIFIED PARTS TIGHTENING TORQUE ..... | 11- 2 |
| ENGINE TUNE-UP .....                           | 11- 3 |
| Battery .....                                  | 11- 3 |
| Engine Oil .....                               | 11- 3 |
| Coolant .....                                  | 11- 3 |
| Spark plug .....                               | 11- 3 |
| Fan Belt .....                                 | 11- 3 |
| Distributor .....                              | 11- 3 |
| Valve .....                                    | 11- 4 |
| Carburetor .....                               | 11- 4 |
| Compression Pressure .....                     | 11- 4 |
| ENGINE .....                                   | 11- 5 |
| Cylinder Head .....                            | 11- 5 |
| Valve Guide Bushings .....                     | 11- 5 |
| Valve .....                                    | 11- 5 |
| Valve Springs .....                            | 11- 5 |
| Valve Rocker Arms & Rocker Shaft .....         | 11- 6 |
| Valve Lifters .....                            | 11- 6 |
| Cylinder Block .....                           | 11- 6 |
| Cylinder Sleeves .....                         | 11- 6 |
| Pistons .....                                  | 11- 7 |
| Piston Rings .....                             | 11- 7 |
| Connecting Rods .....                          | 11- 7 |
| Connecting Rod Bearings .....                  | 11- 8 |
| Crankshaft .....                               | 11- 8 |
| Crankshaft Bearings .....                      | 11- 8 |
| Timing Gears .....                             | 11- 8 |
| Camshaft .....                                 | 11- 9 |
| Flywheel .....                                 | 11- 9 |
| Manifolds .....                                | 11- 9 |
| FUEL SYSTEM .....                              | 11-10 |
| Carburetor .....                               | 11-10 |
| Fuel Pump .....                                | 11-11 |
| LUBRICATING SYSTEM .....                       | 11-11 |
| Oil Pump .....                                 | 11-11 |
| Oil Filter .....                               | 11-12 |
| COOLING SYSTEM .....                           | 11-12 |
| Water Pump .....                               | 11-12 |
| Thermostat .....                               | 11-12 |
| Radiator .....                                 | 11-12 |

|                                   |       |
|-----------------------------------|-------|
| CHARGING SYSTEM .....             | 11-13 |
| Alternator .....                  | 11-13 |
| Alternator Regulator .....        | 11-14 |
| STARTING SYSTEM .....             | 11-14 |
| Starter .....                     | 11-14 |
| Battery .....                     | 11-15 |
| IGNITION SYSTEM .....             | 11-16 |
| Distributor .....                 | 11-16 |
| Ignition Coil .....               | 11-16 |
| High Tension Wires .....          | 11-16 |
| Spark Plugs .....                 | 11-17 |
| SST (SPECIAL SERVICE TOOLS) ..... | 11-18 |
| MEMORUNDUM .....                  | 11-20 |

## GENERAL SPECIFICATION

Vehicle Model: RT series, RN series, RH series, RY series.

| ITEMS                   | 2R ENGINE                                    | 12R ENGINE                          |
|-------------------------|----------------------------------------------|-------------------------------------|
| Type                    | 4 cylinder in line, 4-cycle O.H.V.           | Same                                |
| Bore x Stroke           | 78 x 78 mm (3.07 x 3.07")                    | 80.5 x 78 mm<br>(3.17 x 3.07")      |
| Piston displacement     | 1490 cc (90.9 cu.in.)                        | 1587 cc (96.8 cu.in.)               |
| Compression ratio       | 8.3 to 1                                     | 8.5 to 1                            |
| Compression pressure    | 11.0 kg/cm <sup>2</sup> (155 psi) at 250 rpm | Same                                |
| Max. horse-power (SAE)  | 82 HP at 5200 rpm                            | 90 HP at 5400 rpm                   |
| Max. torque (SAE)       | 12.4 m-k (90 ft-lb) at 2800 rpm              | 13.5 m-k (98 ft-lb)<br>at 3,000 rpm |
| Number of piston rings: |                                              |                                     |
| Compression             | Two                                          | Same                                |
| Oil                     | One                                          | Same                                |
| Valve clearance         |                                              |                                     |
| Intake (hot)            | 0.203 mm (0.008")                            | Same                                |
| Exhaust (hot)           | 0.356 mm (0.014")                            | Same                                |
| Ignition timing         | 8° B.T.D.C. at 550 rpm                       | Same                                |
| Firing order            | 1-3-4-2                                      | Same                                |
| Spark plug size         | 14 x 19 mm (0.55 x 0.75")                    | Same                                |
| Spark plug gap          | 0.8 mm (0.031")                              | Same                                |
| Air cleaner type        | Felt element (RT), Paper element (RH, RN RY) | Same                                |
| Carburetor type         | Down-draft, two barrel                       | Same                                |
| Fuel pump type          | Diaphragm                                    | Same                                |
| Fuel filter type        | Glass ball type (Old), Cartredge type (New)  | Same                                |
| Oil pump type           | Trochoid                                     | Same                                |
| Oil filter element      | Paper                                        | Same                                |
| Oil capacity            |                                              |                                     |
| Crank case              | 3.5 liter (3.7 US qts., 3.1 Imp. qts.)       | Same.                               |
| Oil filter              | 0.8 liter (0.85 US qts., 0.70 Imp. qts.)     | Same                                |
| Radiator type           | Corrugated fin and tube                      | Same                                |
| Water pump type         | Centrifugal                                  | Same                                |
| Thermostat type         | Wax                                          | Same                                |
| Battery                 | 12 volt, 35 ~ 50 AH                          | Same                                |
| Alternator              | 12 volt, 0.48 kW                             | Same                                |
| Starter                 | 12 volt, 1.1 ps                              | Same                                |
| Coolant capacity:       |                                              |                                     |
| RT & RY                 | 7.0 liters (7.4 US qts., 6.2 Imp. qts.)      |                                     |
| RH                      | 6.7 liters (7.1 US qts., 5.9 Imp. qts.)      |                                     |
| RN                      | 6.5 liters (6.9 US qts., 5.7 Imp. qts.)      |                                     |
| Fuel tank capacity:     |                                              |                                     |
| RT, RH                  | 45 liters (11.9 US gal., 9.9 Imp. gal.)      |                                     |
| RN                      | 46 liters (12.1 US gal., 10.1 Imp. gal.)     |                                     |
| RY                      | 50 liters (13.2 US gal., 11.0 Imp. gal.)     |                                     |

## ENGINE SPECIFIED PARTS TIGHTENING TORQUE

| Tightening Parts                         | Tightening Torque |           |
|------------------------------------------|-------------------|-----------|
|                                          | m-kg              | (ft-lb)   |
| Crankshaft bearing cap to cylinder block | 9.8 - 11.2        | (71 - 81) |
| Flywheel to crankshaft                   | 5.8 - 6.6         | (42 - 48) |
| Connecting rod cap to connecting rod     | 4.0 - 5.0         | (29 - 36) |
| Camshaft thrust plate to cylinder block  | 1.4 - 2.0         | (10 - 14) |
| Timing gear cover to cylinder block      | 1.4 - 2.0         | (10 - 14) |
| Crankshaft pulley to crankshaft          | 4.1 - 5.5         | (30 - 40) |
| Oil pump to cylinder block               | 1.4 - 2.0         | (10 - 14) |
| Oil pan to cylinder block                | 0.4 - 0.8         | ( 3 - 6)  |
| Oil pan drain plug to oil pan            | 3.5 - 4.5         | (25 - 33) |
| Cylinder head to cylinder block          | 10.3 - 11.7       | (75 - 85) |
| Valve rocker support to cylinder head    | 1.8 - 2.5         | (13 - 18) |
| Manifolds to cylinder head               | 2.8 - 3.5         | (20 - 25) |
| Spark plug to cylinder head              | 1.5 - 2.1         | (11 - 15) |
| Oil filter to cartridge guide            | 1.4 - 2.0         | (10 - 14) |
| Cylinder head cover to cylinder head     | 0.2 - 0.4         | ( 1 - 3)  |
| Clutch cover to flywheel                 | 1.0 - 1.6         | ( 7 - 12) |

**ENGINE TUNE-UP****Battery**

Battery electrolyte specific  
gravity at 20°C (68°F)

1.250 – 1.270

Battery charged condition at 20°C or 68°F (reference):

Over 1.230

Over 75% charged, requiring no charging

Between 1.190 – 1.230

50 – 75% charged, can be charged with

Quick Charger

Below 1.190

Below 50% charged, requires Bench Charge

Battery electrolyte level

Over 10 mm (0.4") above plates

**Engine Oil**

Engine oil capacity: Crankcase  
Oil filter

3.5 liters (3.7 US qts., 3.1 Imp. qts)

Approx. 0.8 liter (0.85 US qts.,

0.70 Imp. qts)

**Coolant**

Cooling system capacity:

RT & RY series

7.0 liters (7.4 US qts., 6.2 Imp. qts)

RH series

6.7 liters (7.1 US qts., 5.9 Imp. qts)

RN series

6.5 liters (6.9 US qts., 5.7 Imp. qts)

**Spark Plug**

Spark plug gap

0.7 – 0.8 mm (0.028 – 0.031")

Recommended spark plugs:

NIPPONDENSO W20ES

NGK BP-6ES

BOSCH W200T27

CHAMPION N10-Y

**Fan Belt**

Fan belt slack

8 – 13 mm (0.31 – 0.51") with 10 kg  
(22 lbs) depressed pressure

**Distributor**

Breaker point gap

0.4 – 0.5 mm (0.016 – 0.020")

Cam dwell angle

50 – 54°

Breaker point spring tension

400 – 550 grams (14 – 19 oz)

Condenser capacity

0.20 – 0.24 micro-farad

Ignition timing

8° B.T.D.C at 550 rpm

**Valve**

|                                              |         |                                  |
|----------------------------------------------|---------|----------------------------------|
| Valve clearance (hot):                       | Intake  | 0.203 mm (0.008")                |
|                                              | Exhaust | 0.360 mm (0.014")                |
| Cylinder head bolts tightening torque        |         | 10.3 - 11.7 m·kg (74 - 86 ft·lb) |
| Rocker shaft support bolts tightening torque |         | 1.8 - 2.5 m·kg (13 - 18 ft·lb)   |

**Carburetor**

|                           |                           |
|---------------------------|---------------------------|
| Engine idling speed       | 550 rpm                   |
| Manifold vacuum at idling | Over 430 mm Hg (17 in Hg) |

**Compression Pressure**

|                                          |                                           |
|------------------------------------------|-------------------------------------------|
| Compression pressure at 250 rpm          | Over 11.0 kg/cm <sup>2</sup> (156 psi)    |
| Compression pressure limit               | 8.0 kg/cm <sup>2</sup> (115 psi)          |
| Difference of pressure between cylinders | Less than 0.7 kg/cm <sup>2</sup> (10 psi) |

**ENGINE****Cylinder Head**

|                                                   |                                            |
|---------------------------------------------------|--------------------------------------------|
| Cylinder head water leak testing pressure         | 4.0 - 4.5 kg/cm <sup>2</sup> (57 - 64 psi) |
| Cylinder head installing surface<br>warpage limit | 0.05 mm (0.002")                           |
| Valve seat refacing angle                         | 15°, 45°, 75°                              |
| Valve seat contacting width                       | 1.2 - 1.6 mm (0.05 - 0.06")                |

**Valve Guide Bushings**

|                                    |                                       |
|------------------------------------|---------------------------------------|
| Valve guide bushing inner diameter | 8.01 - 8.03 mm (0.315 - 0.316")       |
| Valve guide bushing outer diameter | 14.023 - 14.041 mm (0.5521 - 0.5528") |
| Valve guide bushing protrusion:    |                                       |
| Intake - 2R                        | 25.0 - 26.0 mm (1.0 - 1.02")          |
| Exhaust - 2R                       | 22.0 - 23.0 mm (0.87 - 0.91")         |
| Intake & Exhaust - 12R             | 18 mm (0.71")                         |

**Valves**

|                                            |         |                                               |
|--------------------------------------------|---------|-----------------------------------------------|
| Valve head diameter:                       | Intake  | 39 mm (1.54") - 2R, 40 mm (1.57") - 12R       |
|                                            | Exhaust | 33 mm (1.30") - 2R, 34 mm (1.34") - 12R       |
| Valve overall length                       |         | 115.8 mm (4.56") - 2R, 109.0 mm (4.29") - 12R |
| Valve overall length limit                 |         | 115.3 mm (4.54") - 2R, 108.5 mm (4.27") - 12R |
| Valve stem diameter:                       | Intake  | 7.970 - 7.985 mm (0.3138 - 0.3144")           |
|                                            | Exhaust | 7.960 - 7.975 mm (0.3134 - 0.3140")           |
| Valve stem to bushing oil clearance:       |         |                                               |
|                                            | Intake  | 0.025 - 0.060 mm (0.0010 - 0.024")            |
|                                            | Exhaust | 0.035 - 0.070 mm (0.0014 - 0.0028")           |
| Valve stem to bushing oil clearance limit: |         |                                               |
|                                            | Intake  | 0.08 mm (0.003")                              |
|                                            | Exhaust | 0.10 mm (0.004")                              |
| Valve head edge thickness limit:           |         |                                               |
|                                            | Intake  | 0.7 mm (0.028")                               |
|                                            | Exhaust | 0.7 mm (0.028")                               |
| Valve head contacting face angle           |         | 45°                                           |

**Valve Springs**

|                    |       | 2R                | 12R               |
|--------------------|-------|-------------------|-------------------|
| Free length:       | Inner | 46 mm (1.81")     | 39.7 mm (1.56")   |
|                    | Outer | 52.6 mm (2.07")   | 34.5 mm (1.79")   |
| Installed length:  | Inner | 40.4 mm (1.59")   | 34.2 mm (1.35")   |
|                    | Outer | 46.4 mm (1.83")   | 40.0 mm (1.57")   |
| Installed tension: | Inner | 5.6 kg (12.3 lb)  | 6.4 kg (14.1 lb)  |
|                    | Outer | 26.0 kg (57.3 lb) | 23.3 kg (51.3 lb) |



|                          |       |                   |                   |
|--------------------------|-------|-------------------|-------------------|
| Installed tension limit: | Inner | 3.6 kg (7.9 lb)   | 5.1 kg (11.2 lb)  |
|                          | Outer | 22.6 kg (49.8 lb) | 19.0 kg (41.8 lb) |
| Squareness limit:        | Inner | 1.6 mm (0.063")   | 1.6 mm (0.063")   |
|                          | Outer | 1.9 mm (0.075")   | 1.9 mm (0.075")   |

**Valve Rocker Arms & Rocker Shaft**

|                                                 |                                       |
|-------------------------------------------------|---------------------------------------|
| Rocker arm bushing outer diameter - 2R          | 21.075 - 21.115 mm (0.8297 - 0.8313") |
| Rocker arm bushing inner diameter - 2R          | 18.500 - 18.521 mm (0.7283 - 0.7292") |
| Rocker shaft diameter - 2R                      | 18.470 - 18.483 mm (0.7272 - 0.7277") |
| Rocker shaft diameter - 12R                     | 18.474 - 18.487 mm (0.7273 - 0.7278") |
| Rocker shaft to bushing oil clearance - 2R      | 0.017 - 0.051 mm (0.0007 - 0.0020")   |
| Rocker shaft to rocker arm bore clearance - 12R | 0.020 - 0.035 mm (0.0008 - 0.0014")   |

**Valve Lifters**

|                                          |           |                                       |
|------------------------------------------|-----------|---------------------------------------|
| Valve lifter diameter:                   | STD       | 22.178 - 22.185 mm (0.8731 - 0.8734") |
|                                          | O/S-0.075 | 22.185 - 22.192 mm (0.8734 - 0.8737") |
|                                          | O/S-0.125 | 22.192 - 22.199 mm (0.8737 - 0.8740") |
| Lifter bore finished diameter:           | STD       | 22.200 - 22.207 mm (0.8740 - 0.8743") |
|                                          | O/S-0.075 | 22.207 - 22.214 mm (0.8743 - 0.8746") |
|                                          | O/S-0.125 | 22.214 - 22.221 mm (0.8746 - 0.8748") |
| Valve lifter to bore oil clearance       |           | 0.015 - 0.029 mm (0.0006 - 0.0011")   |
| Valve lifter to bore oil clearance limit |           | 0.1 mm (0.004")                       |

**Cylinder Block**

|                                            |                                            |
|--------------------------------------------|--------------------------------------------|
| Cylinder block upper surface warpage limit | 0.05 mm (0.002")                           |
| Cylinder block water leak testing pressure | 4.0 - 4.5 kg/cm <sup>2</sup> (57 - 64 psi) |
| Cylinder bore diameter (STD) - 2R          | 78.00 - 78.03 mm (3.071 - 3.072")          |
| Cylinder bore diameter (STD) - 12R         | 80.50 - 80.55 mm (3.170 - 3.171")          |
| Cylinder bore wear limit                   | 0.2 mm (0.008")                            |
| Difference of bore between cylinders       | Less than 0.05 mm (0.002")                 |
| Cylinder bore taper & out-of-round limit   | 0.02 mm (0.0008")                          |

**Cylinder Sleeves**

|                          |                |                                       |
|--------------------------|----------------|---------------------------------------|
| Sleeve outer diameter:   | O/S 4.00 - 2R  | 82.091 - 82.126 mm (3.2319 - 3.2333") |
|                          | O/S 4.00 - 12R | 84.590 - 84.650 mm (3.3303 - 3.3327") |
|                          | O/S 4.50 - 2R  | 82.591 - 82.626 mm (3.2516 - 3.2530") |
|                          | O/S 4.50 - 12R | 85.090 - 85.150 mm (3.3500 - 3.3524") |
|                          | O/S 5.00 - 2R  | 83.091 - 83.126 mm (3.2713 - 3.2727") |
|                          | O/S 5.00 - 12R | 85.590 - 85.650 mm (3.3697 - 3.3720") |
| Sleeve fitting tolerance |                | 0.056 - 0.126 mm (0.0022 - 0.0050")   |

Sleeve installing pressure

2,000 - 3,000 kg (4,400 - 6,600 lb)

**Pistons**

Piston diameter at 20°C (68°F)

| Ident mark | 2R mm (in)                       | 12R mm (in)     |
|------------|----------------------------------|-----------------|
| 1          | 77.965 (3.0695)                  | 80.455 (3.1675) |
| 2          | 77.975 (3.0699)                  | 80.465 (3.1679) |
| 3          | 77.985 (3.0703)                  | 80.475 (3.1683) |
| 4          | —                                | 80.485 (3.1687) |
| 5          | —                                | 80.495 (3.1691) |
| O/S        | 0.25, 0.50, 0.75, 100, 1.25, 150 |                 |

**Piston Rings**

Piston ring end gap:

Compression ring No.1 0.2 - 0.4 mm (0.008 - 0.016")

Compression ring No.2 0.1 - 0.3 mm (0.004 - 0.012")

Oil ring 0.1 - 0.3 mm (0.004 - 0.012")

Piston ring to ring groove clearance:

Compression ring No.1 0.03 - 0.07 mm (0.0012 - 0.0027")

Compression ring No.2 0.03 - 0.07 mm (0.0012 - 0.0027")

Oil ring 0.025 - 0.07 mm (0.0010 - 0.0027")

**Connecting Rods**

Connecting rod bend and twist limit 0.05 mm (0.002") per 100 mm (3.94")

Connecting rod thrust clearance 0.08 - 0.24 mm (0.003 - 0.010")

Connecting rod thrust clearance limit 0.3 mm (0.012")

Piston pin to bushing oil clearance 0.006 - 0.010 mm (0.0002 - 0.0004")

Piston pin to bushing oil clearance limit 0.015 mm (0.0006")

**Connecting Rod Bearings**

Crankpin journal finished diameter:

|                   |                                       |
|-------------------|---------------------------------------|
| STD bearings      | 49.985 - 50.000 mm (1.9679 - 1.9685") |
| U/S-0.05 bearings | 49.985 - 50.000 mm (1.9679 - 1.9685") |
| U/S-0.25 bearings | 49.756 - 49.766 mm (1.9589 - 1.9593") |
| U/S-0.50 bearings | 49.506 - 49.516 mm (1.9491 - 1.9495") |
| U/S-0.75 bearings | 49.256 - 49.266 mm (1.9392 - 1.9396") |
| U/S-1.00 bearings | 49.006 - 49.016 mm (1.9294 - 1.9298") |

Connecting rod bearing oil clearance - 2R 0.016 - 0.040 mm (0.0006 - 0.0016")

Connecting rod bearing oil clearance - 12R 0.024 - 0.048 mm (0.0009 - 0.0020")

Connecting rod bearing oil clearance limit 0.10 mm (0.004")

**Crankshaft**

Crankshaft bend limit 0.05 mm (0.002")

Crankshaft thrust clearance 0 - 0.18 mm (0 - 0.007")

Crankshaft thrust clearance limit 0.3 mm (0.012")

Crankshaft journal taper and out-of-round limit 0.05 mm (0.002")

Crankpin journal taper and out-of-round limit 0.05 mm (0.002")

Crankshaft thrust bearing thickness:

|                    |                                     |
|--------------------|-------------------------------------|
| STD bearings       | 2.950 - 3.000 mm (0.1161 - 0.1181") |
| O/S-0.125 bearings | 3.013 - 3.063 mm (0.1186 - 0.1206") |
| O/S-0.250 bearings | 3.075 - 3.125 mm (0.1211 - 0.1230") |
| O/S-0.500 bearings | 3.200 - 3.250 mm (0.1260 - 0.1280") |

**Crankshaft Bearings**

Crankshaft journal finished diameter:

|                   |                                       |
|-------------------|---------------------------------------|
| STD bearings      | 57.976 - 58.000 (2.2825 - 2.2835")    |
| U/S-0.05 bearings | 57.976 - 58.000 (2.2825 - 2.2835")    |
| U/S-0.25 bearings | 57.750 - 57.760 mm (2.2736 - 2.2740") |
| U/S-0.50 bearings | 57.500 - 57.510 mm (2.2638 - 2.2642") |
| U/S-0.75 bearings | 57.250 - 57.260 mm (2.2539 - 2.2543") |
| U/S-1.00 bearings | 57.000 - 57.010 mm (2.2441 - 2.2445") |

Crankshaft bearing oil clearance 0.020 - 0.044

Crankshaft bearing oil clearance limit 0.1 mm (0.004")

**Timing Gears**Timing gear backlash 0.020 - 0.130 mm (0.0008 - 0.0052") - 2R  
0.068 - 0.170 mm (0.0027 - 0.0067") - 12R

Timing gear backlash limit 0.3 mm (0.012")

Camshaft timing gear run-out limit 0.25 mm (0.01")

**Camshaft**

|                                 |                                                                                     |
|---------------------------------|-------------------------------------------------------------------------------------|
| Camshaft bend limit             | 0.05 mm (0.002")                                                                    |
| Camshaft thrust clearance       | 0.06 - 0.122 mm (0.0024 - 0.0048") - 2R<br>0.05 - 0.130 mm (0.0020 - 0.0052") - 12R |
| Camshaft thrust clearance limit | 0.3 mm (0.012") - 2R<br>0.2 mm (0.008") - 12R                                       |
| 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   | 38.29 mm (1.508")                                                                   |
| Exhaust                         | 38.18 mm (1.503")                                                                   |
| Cam lift: Intake                | 6.34 - 6.44 mm (0.250 - 0.254")                                                     |
| Exhaust                         | 6.45 - 6.55 mm (0.254 - 0.258")                                                     |

**Camshaft Bearings**

|                                      |                                       |
|--------------------------------------|---------------------------------------|
| Camshaft journal finished diameter:  |                                       |
| STD bearings: No.1 journal           | 46.459 - 46.475 mm (1.8291 - 1.8297") |
| No.2 journal                         | 46.209 - 46.225 mm (1.8193 - 1.8199") |
| No.3 journal                         | 45.959 - 45.975 mm (1.8094 - 1.8100") |
| U/S-0.125 bearings:                  |                                       |
| No.1 journal                         | 46.335 - 46.345 mm (1.8242 - 1.8246") |
| No.2 journal                         | 46.085 - 46.095 mm (1.8144 - 1.8148") |
| No.3 journal                         | 45.835 - 45.845 mm (1.8045 - 1.8049") |
| U/S-0.250 bearings:                  |                                       |
| No.1 journal                         | 46.210 - 46.220 mm (1.8193 - 1.8197") |
| No.2 journal                         | 45.960 - 45.970 mm (1.8095 - 1.8098") |
| No.3 journal                         | 45.710 - 45.720 mm (1.7996 - 1.8000") |
| U/S-0.500 bearings:                  |                                       |
| No.1 journal                         | 45.960 - 45.970 mm (1.8095 - 1.8098") |
| No.2 journal                         | 45.710 - 45.720 mm (1.7996 - 1.8000") |
| No.3 journal                         | 45.460 - 45.470 mm (1.7898 - 1.7902") |
| Camshaft bearing oil clearance       | 0.025 - 0.066 mm (0.0010 - 0.0026")   |
| Camshaft bearing oil clearance limit | 0.1 mm (0.004")                       |

**Flywheel**

|                        |                 |
|------------------------|-----------------|
| Flywheel run-out limit | 0.2 mm (0.008") |
|------------------------|-----------------|

**Manifolds**

|                                        |                 |
|----------------------------------------|-----------------|
| Manifold fitting surface warpage limit | 0.4 mm (0.016") |
|----------------------------------------|-----------------|

## FUEL SYSTEM

## Carburetor

| Vehicle                                                        |         | RT                                                                                                    | RY, RH                   | RN                       |
|----------------------------------------------------------------|---------|-------------------------------------------------------------------------------------------------------|--------------------------|--------------------------|
| Type                                                           |         | Down-draft, two-barrel                                                                                |                          |                          |
| Air hone outer diameter                                        | mm (in) | 63.0 (2.48)                                                                                           | ←                        | ←                        |
| Venturi diameter                                               | mm (in) |                                                                                                       |                          |                          |
| Primary - Main                                                 |         | 23.0 (0.91)                                                                                           | ←                        | ←                        |
| - Small                                                        |         | 8.0 (0.32)                                                                                            | ←                        | ←                        |
| Secondary - Main                                               |         | 2R- 27.0 (1.06)                                                                                       | ←                        | ←                        |
|                                                                |         | 12R- 28.0 ( )                                                                                         |                          |                          |
| - Small                                                        |         | 2R- 7.0 (0.28)                                                                                        | ←                        | ←                        |
|                                                                |         | 12R- 9.0 (0.36)                                                                                       |                          |                          |
| Throttle bore diameter                                         | mm (in) |                                                                                                       |                          |                          |
| Primary                                                        |         | 30.0 (1.18)                                                                                           | ←                        | ←                        |
| Secondary                                                      |         | 2R- 32.0 (1.26)                                                                                       | ←                        | ←                        |
|                                                                |         | 12R- 34.0 (1.34)                                                                                      |                          |                          |
| Main jet diameter                                              | mm (in) |                                                                                                       |                          |                          |
| Primary                                                        |         | 2R- 1.08 (0.143)                                                                                      | 1.06 (0.042)             | 1.11 (0.044)             |
|                                                                |         | 12R- 1.05 (0.041)                                                                                     | 1.03 (0.041)             | 1.03 (0.041)             |
| Secondary                                                      |         | 2R- 1.40 (0.055)                                                                                      | 1.60 (0.063)             | 1.47 (0.058)             |
|                                                                |         | 12R- 1.62 (0.064)                                                                                     | 1.56 (0.061)             | 1.65 (0.065)             |
| Slow jet diameter                                              | mm (in) | 2R- 0.55 (0.022)                                                                                      | 0.435 (0.017)            | 0.525 (0.021)            |
|                                                                |         | 12R- 0.50 (0.020)                                                                                     | 0.47 (0.019)             | 0.47 (0.019)             |
| Power jet diameter                                             | mm (in) | 2R- 0.75 (0.030)                                                                                      | 0.60 (0.024)             | 0.70 (0.028)             |
|                                                                |         | 12R- 0.50 (0.020)                                                                                     | 0.58 (0.023)             | 0.60 (0.024)             |
| Pump jet diameter                                              | mm (in) | 0.50 (0.020)                                                                                          | 0.47 (0.019)             | 0.50 (0.020)             |
|                                                                |         |                                                                                                       | 0.50 (0.020)             |                          |
| Economizer jet diameter                                        | mm (in) | 2R- 0.80 (0.031)                                                                                      | 0.80 (0.031)             | 0.80 (0.031)             |
|                                                                |         | 12R- 1.00 (0.040)                                                                                     |                          | 1.00 (0.040)             |
| Main air bleed diameter                                        | mm (in) |                                                                                                       |                          |                          |
| Primary                                                        |         | 2R- 0.70 (0.028)                                                                                      | 0.50 (0.020)             | 0.70 (0.028)             |
|                                                                |         | 12R- 0.50 (0.020)                                                                                     |                          | 0.50 (0.020)             |
| Secondary                                                      |         | 2R- 0.70 (0.028)                                                                                      | 0.50 (0.020)             | 0.70 (0.028)             |
|                                                                |         | 12R- 0.50 (0.020)                                                                                     |                          | 0.50 (0.020)             |
| Power piston operating vacuum                                  | mm (in) | 2R- 110 ~ 130<br>(4.3 ~ 5.1)                                                                          | 70 ~ 90<br>(2.8 ~ 3.5)   | 110 ~ 130<br>(4.3 ~ 5.1) |
|                                                                |         | 12R- 120 ~ 140<br>(4.7 ~ 5.5)                                                                         | 120 ~ 140<br>(4.7 ~ 5.5) | 120 ~ 140<br>(4.7 ~ 5.5) |
| Float level                                                    | mm (in) |                                                                                                       |                          |                          |
| Raised position (from air horn fitting surface)                |         | 3.5 (0.140)                                                                                           | ←                        | ←                        |
| Lowered position (between needle valve push pin and float tab) |         | 0.9 (0.035)                                                                                           | ←                        | ←                        |
| Idle mixture adjusting screw preset position                   |         | Screw out about 2-1/2 turns after slightly seating.<br>Screw out about 2 turns after slightly seating |                          |                          |
| for 2R                                                         |         |                                                                                                       |                          |                          |
| for 12R                                                        |         |                                                                                                       |                          |                          |

|                                                                                                                         |                                                              |            |            |
|-------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|------------|------------|
| Throttle valve fully closed angle                                                                                       |                                                              |            |            |
| Primary                                                                                                                 | 7°                                                           | ←          | ←          |
| Secondary                                                                                                               | 20°                                                          | ←          | ←          |
| Fast idle: Primary throttle valve should open at Right degree from closed position when the choke valve is fully closed | 2R - 12°<br>12R - 13°                                        | 12°<br>17° | 13°<br>17° |
| Unloader                                                                                                                | 2R - 30°<br>12R - 27°                                        | —<br>—     | —<br>—     |
| Thermostatic valve operating temperature                                                                                | Fully closed at 60°C (140°F)<br>Fully opened at 75°C (167°F) |            |            |

## Fuel Pump

|                   |                                                                                     |
|-------------------|-------------------------------------------------------------------------------------|
| Type              | Mechanical diaphragm                                                                |
| Delivery capacity | Over 1,000 cc (1.06 US qts., 0.88 Imp. qts)<br>per minute at 1,000 rpm of camshaft. |
| Delivery pressure | 0.22 - 0.32 kg/cm <sup>2</sup> (3.1 - 4.5 psi)                                      |
| Suction vacuum    | Over 400 mm Hg (15.7 in Hg)                                                         |

## LUBRICATING SYSTEM

### Oil Pump

|                                  |                                                                                                                                                               |
|----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Type                             | Trochoid                                                                                                                                                      |
| Delivery capacity                | Over 17 liters (18 US qts., 15 Imp. qts)<br>per minute at pump; 3,000 rpm,<br>oil temperature; 100°C (212°F),<br>oil pressure; 3.2 kg/cm <sup>2</sup> (45.5") |
| Relief valve operating pressure  | 3.7 - 4.3 kg/cm <sup>2</sup> (52.6 - 61.2 psi) at<br>pump; 2,500 rpm, oil temperature; 100°C<br>(212°F)                                                       |
| Pump shaft to body oil clearance | 0.013 - 0.050 mm (0.0005 - 0.0020")                                                                                                                           |
| Tip clearance                    | 0.07 - 0.12 mm (0.003 - 0.005")                                                                                                                               |
| Tip clearance limit              | 0.2 mm (0.008")                                                                                                                                               |
| Side clearance                   | 0.03 - 0.09 mm (0.001 - 0.004")                                                                                                                               |
| Side clearance limit             | 0.15 mm (0.006")                                                                                                                                              |

|                      |                                 |
|----------------------|---------------------------------|
| Body clearance       | 0.10 - 0.16 mm (0.004 - 0.006") |
| Body clearance limit | 0.2 mm (0.008")                 |

**Oil Filter**

|                                  |                                                 |
|----------------------------------|-------------------------------------------------|
| Filtration type                  | Full-flow                                       |
| Element material                 | Paper                                           |
| Case capacity                    | Approx. 0.8 liter (0.85 US qts., 0.70 Imp. qts) |
| By-pass valve operating pressure | 0.8 - 1.2 kg/cm <sup>2</sup> (11.4 - 17.0 psi)  |

**COOLING SYSTEM****Water Pump**

|                                        |                                                                                                                                            |
|----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| Water pump type                        | Centrifugal pump                                                                                                                           |
| Delivery capacity                      | Over 120 liters (31.7 US gals., 26.4 Imp. gals) per minute at pump; 3,500 rpm, delivery pressure; approx. 0.4 kg/cm <sup>2</sup> (5.7 psi) |
| Water seal method                      | Mechanical seal                                                                                                                            |
| Bearing type                           | Dual ball bearings with grease sealed                                                                                                      |
| Rotational ratio to crank pulley       | 13 to 11                                                                                                                                   |
| Water pump bearing fitting temperature | Water pump body should be heated to 75 - 85°C (167 - 185°F) for bearing replacement.                                                       |
| Water pump rotor to body clearance     | 0.3 - 0.7 mm (0.012 - 0.030")                                                                                                              |

**Thermostat**

|                            |                                   |
|----------------------------|-----------------------------------|
| Type                       | Wax                               |
| Valve opening temperature: |                                   |
| Starts to open at          | 80.5 - 83.5°C (177 - 182°F) - 2R  |
|                            | 73.5 - 76.5°C (164 - 170°F) - 12R |
| Full opens at              | 75°C (203°F) - 2R                 |
|                            | 85°C (185°F) - 12R                |
| Valve opening travel       | Over 8 mm (0.315")                |

**Radiator**

|                               |                                       |
|-------------------------------|---------------------------------------|
| Type                          | Pressurized corrugated fin and tube   |
| Radiator cap opening pressure | 0.5 kg/cm <sup>2</sup> (7 psi) - 2R   |
|                               | 0.9 kg/cm <sup>2</sup> (13 psi) - 12R |

**CHARGING SYSTEM****Alternator**

|                                                                                                                                                                  |                                                                                                                                                                             |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Nominal voltage                                                                                                                                                  | 12 volts                                                                                                                                                                    |
| Nominal output current: RT series                                                                                                                                | 40 amperes                                                                                                                                                                  |
| Light Truck                                                                                                                                                      | 30 amperes                                                                                                                                                                  |
| Ground                                                                                                                                                           | Negative                                                                                                                                                                    |
| Direction of revolution                                                                                                                                          | Clockwise as seen from pulley                                                                                                                                               |
| Stator coil connection                                                                                                                                           | Three-phase, "Y" shape                                                                                                                                                      |
| Rectification                                                                                                                                                    | Full wave rectification by six integral<br>silicone diodes                                                                                                                  |
| Pulley ratio: RT series                                                                                                                                          | 2.0                                                                                                                                                                         |
| Light Truck                                                                                                                                                      | 1.69                                                                                                                                                                        |
| No-load characteristics at normal<br>temperature: RT series                                                                                                      | 700 - 900 rpm at 14 volts, zero ampere                                                                                                                                      |
| Light Truck                                                                                                                                                      | 800 - 1000 rpm at 14 volts, zero ampere                                                                                                                                     |
| Load characteristics at normal<br>temperature: RT40 series                                                                                                       | Less than 3500 rpm at 14 volts, 40 amperes                                                                                                                                  |
| Light Truck                                                                                                                                                      | Less than 4000 rpm at 14 volts, 30 amperes                                                                                                                                  |
| Slip ring diameter                                                                                                                                               | 32 mm (1.259")                                                                                                                                                              |
| Slip ring diameter limit                                                                                                                                         | 31.6 mm (1.243")                                                                                                                                                            |
| Brush protruded length                                                                                                                                           | 12.5 mm (0.50")                                                                                                                                                             |
| Brush protruded length limit                                                                                                                                     | 8.5 mm (0.34")                                                                                                                                                              |
| Brush spring tension                                                                                                                                             | 450 - 550 grams (15.9 - 19.4 oz)                                                                                                                                            |
| Brush spring tension limit                                                                                                                                       | 350 grams (12.3 oz)                                                                                                                                                         |
| Rotor shaft bend limit                                                                                                                                           | 0.1 mm (0.004")                                                                                                                                                             |
| Rotor coil resistance                                                                                                                                            | 4.1 - 4.3 ohms                                                                                                                                                              |
| Stator coil resistance                                                                                                                                           | Approximately 0.24 ohm                                                                                                                                                      |
| Pulley retaining nut tightening torque                                                                                                                           | 0.35 - 0.50 m-kp (2.5 - 3.6 ft-lb)                                                                                                                                          |
| Rectifier characteristics:                                                                                                                                       |                                                                                                                                                                             |
| Correct direction characteristic                                                                                                                                 | At normal temperature, when direct current of<br>22 amperes is applied, the voltage difference<br>between the rectifier lead and the body<br>should be less than 1.2 volts. |
| Reverse direction characteristic                                                                                                                                 | At normal temperature, when direct current<br>voltage of 100 volts is actuated, the reverse<br>current should be less than 1.5 milliamperes.                                |
| Note: The correct direction can be defined with direction in which positive<br>voltage is actuated at rectifier body side, and negative voltage at lead<br>side. |                                                                                                                                                                             |



**Alternator Regulator**

|                                                 |                                 |
|-------------------------------------------------|---------------------------------|
| Voltage regulator regulating voltage            | 13.8 – 14.8 volts               |
| Voltage relay operating voltage                 | 4.5 – 5.8 volts                 |
| Regulator circuit resistance values:            |                                 |
| Between IG terminal & F terminal (actuated)     | Approximately 10 ohms           |
| Between IG terminal & F terminal (not actuated) | Zero ohm                        |
| Between L terminal & E terminal (actuated)      | Approximately 100 ohms          |
| Between L terminal & E terminal (not actuated)  | Zero ohm                        |
| Between N terminal & E terminal (not actuated)  | Approximately 23 ohms           |
| Between B terminal & L terminal (actuated)      | Zero ohm                        |
| Between B terminal & E terminal (not actuated)  | Infinite                        |
| Between B terminal & E terminal (actuated)      | Approximately 100 ohms          |
| Between F terminal & E terminal (not actuated)  | Infinite                        |
| Between F terminal & E terminal (actuated)      | Zero ohm                        |
| Voltage regulator mechanical adjusting values:  |                                 |
| Angle gap (actuated)                            | Over 0.2 mm (0.008")            |
| Point gap (not actuated)                        | 0.25 – 0.45 mm (0.010 – 0.018") |
| Contact spring deflection (actuated)            | Over 0.2 mm (0.008")            |
| Armature gap (not actuated)                     | 0.6 – 0.8 mm (0.024 – 0.031")   |
| Voltage relay mechanical adjusting values:      |                                 |
| Point gap (not actuated)                        | 0.4 – 1.2 mm (0.016 – 0.047")   |
| Contact spring deflection (actuated)            | 0.20 – 0.45 mm (0.008 – 0.018") |

**STARTING SYSTEM****Starter**

|                                |                                                |
|--------------------------------|------------------------------------------------|
| Motor type                     | Direct current, series wound w/magnetic switch |
| Nominal voltage & output power | 12 volts, 0.8 kW (1.1 ps)                      |
| Rating time                    | 30 seconds                                     |
| Direction of revolution        | Clockwise as seen from pinion side             |
| Number of poles                | Four                                           |
| Number of pinion teeth         | Nine                                           |
| Suitable battery               | 12 volts 40 – 60 AH                            |
| No-load characteristic:        | Voltage At 11.0 volts                          |
|                                | Amperage Less than 45 amperes                  |
|                                | Revolution More than 5,000 rpm                 |
| Locked characteristic:         | Voltage At 7.7 volts                           |
|                                | Amperage Less than 470 amperes                 |
|                                | Torque More than 1.2 m-kG (8.6 ft-lb)          |
| Armature shaft diameter        | 12.50 mm (0.472")                              |

|                                        |                                                                                                           |
|----------------------------------------|-----------------------------------------------------------------------------------------------------------|
| Armature shaft bushing inner diameter: |                                                                                                           |
| STD                                    | 12.535 - 12.560 mm (0.4935 - 0.4945")                                                                     |
| U/S-0.30                               | 12.235 - 12.260 mm (0.4817 - 0.4827")                                                                     |
| U/S-0.50                               | 12.035 - 12.060 mm (0.4738 - 0.4748")                                                                     |
| Shaft to bushing clearance             | 0.1 mm (0.004")                                                                                           |
| Shaft to bushing clearance limit       | 0.2 mm (0.008")                                                                                           |
| Shaft thrust clearance                 | 0.05 - 0.35 mm (0.002 - 0.13")                                                                            |
| Shaft thrust clearance limit           | 0.8 mm (0.03")                                                                                            |
| Commutator diameter                    | 38.8 mm (1.53") - 2R, 32.7 mm (1.31") - 12R                                                               |
| Commutator diameter limit              | 36.8 mm (1.45") - 2R, 30.7 mm (1.21") - 12R                                                               |
| Commutator out-of-round                | 0.1 mm (0.004")                                                                                           |
| Commutator out-of-round limit          | 0.3 mm (0.012")                                                                                           |
| Commutator mica depth                  | 0.5 - 0.8 mm (0.02 - 0.03")                                                                               |
| Commutator mica depth limit            | 0.2 mm (0.008")                                                                                           |
| Brush length                           | 19 mm (0.75")                                                                                             |
| Brush length limit                     | 12 mm (0.47")                                                                                             |
| Brush spring tension                   | 1,050 - 1,350 grams (2.3 - 3.0 lbs)                                                                       |
| Brush spring tension limit             | 600 grams (1.3 lbs)                                                                                       |
| Magnetic switch moving stud length     | Approximate 34 mm (1.34")                                                                                 |
| Pinion to stop collar clearance        | 1 - 4 mm (0.04 - 0.16") w/pinion pushed out.                                                              |
| Magnetic switch pull-in test           | Plunger should be fully pulled in with 8 volts at pull-in coil.                                           |
| Magnetic switch holding test           | Plunger should be held by holding coil with 8 volts after being pulled-in.                                |
| Magnetic switch return test            | With holding coil and pull in coil connected in series, the plunger should be return fully with 12 volts. |

## Battery

Electrolyte specific gravity at 20°C (68°F):

|               |                        |
|---------------|------------------------|
| 1,250 - 1,270 | 100% charged state     |
| 1,210         | 75% charged state      |
| 1,160         | 50% charged state      |
| 1,110         | 25% charged state      |
| 1,060         | Fully discharged state |

Battery capacity at 20 H.R.

|                          |
|--------------------------|
| Hi power 40 - 35 ~ 38 AH |
| N40 - 40 AH              |
| N50 - 50 AH              |
| N50Z - 60 AH             |

**IGNITION SYSTEM****Distributor**

|                              |                               |
|------------------------------|-------------------------------|
| Condenser capacity           | 0.20 - 0.24 micro-farad       |
| Breaker point spring tension | 400 - 550 grams (14 - 19 oz)  |
| Breaker point gap            | 0.4 - 0.5 mm (0.016 - 0.020") |
| Dwell angle                  | 50 - 54°                      |

**Governor advance characteristics:**

|                           |                |
|---------------------------|----------------|
| Distributor 400 - 600 rpm | Advance begins |
| 1400 rpm                  | 8.5 - 10.5°    |
| 2500 rpm                  | 15.0 - 17.0°   |

**Vacuum advance characteristics:**

|                                     |                |
|-------------------------------------|----------------|
| Vacuum 110-130 mmHg (4.3-5.0 in Hg) | Advance begins |
| 200 mmHg (7.9 in Hg)                | 5.5 - 7.5°     |
| 280 mmHg (11.0 inHg)                | 10 - 12°       |

|                              |                  |
|------------------------------|------------------|
| Distributor shaft bend limit | 0.07 mm (0.003") |
|------------------------------|------------------|

**Governor weight to support pin clearance limit**

0.2 mm (0.008")

|                                          |                 |
|------------------------------------------|-----------------|
| Distributor shaft thrust clearance limit | 0.4 mm (0.016") |
|------------------------------------------|-----------------|

|                                     |              |
|-------------------------------------|--------------|
| Distributor cap carbon piece length | 9 mm (0.35") |
|-------------------------------------|--------------|

|                                           |              |
|-------------------------------------------|--------------|
| Distributor cap carbon piece length limit | 7 mm (0.28") |
|-------------------------------------------|--------------|

|                                    |                             |
|------------------------------------|-----------------------------|
| Breaker plate operating resistance | 200 - 500 grams (7 - 18 oz) |
|------------------------------------|-----------------------------|

|                                             |                           |
|---------------------------------------------|---------------------------|
| Breaker plate to stationary plate clearance | Less than 0.2 mm (0.008") |
|---------------------------------------------|---------------------------|

**Ignition Coil**

|                 |          |
|-----------------|----------|
| Primary voltage | 12 volts |
|-----------------|----------|

|                   |                                                                                                                                                                                        |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Secondary voltage | Sparking distance from center to three negative electrodes should be more than 8 mm (0.32") at distributor revolution of 75 rpm and more than 6 mm (0.34") at 3,000 rpm with 12 volts. |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                         |                |
|-------------------------|----------------|
| Primary coil resistance | 3.3 - 4.3 ohms |
|-------------------------|----------------|

|                           |                     |
|---------------------------|---------------------|
| Secondary coil resistance | 7,500 - 10,000 ohms |
|---------------------------|---------------------|

|                       |                                    |
|-----------------------|------------------------------------|
| Insulation resistance | 50 megohms w/500 volt Megohm Meter |
|-----------------------|------------------------------------|

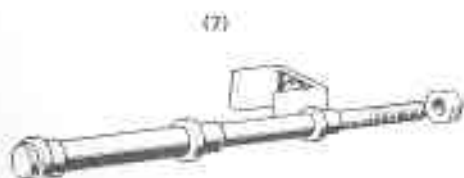
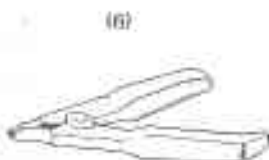
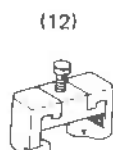
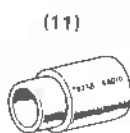
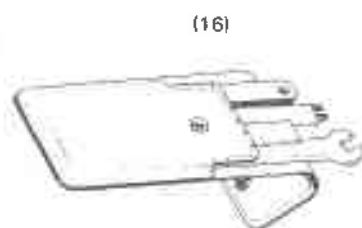
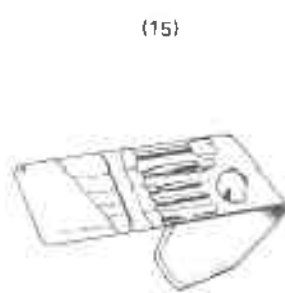
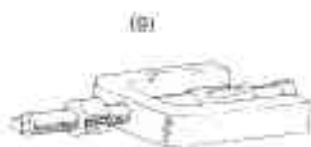
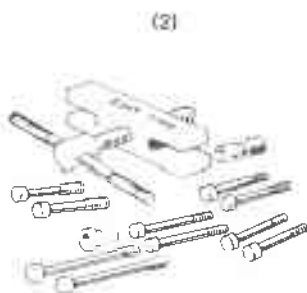
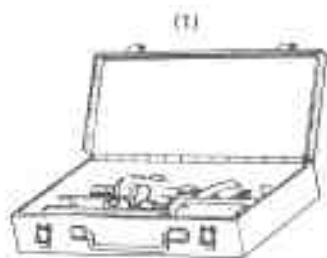
**High Tension Wires**

|                                  |                      |
|----------------------------------|----------------------|
| Wire end to end resistance limit | 25,000 ohms per unit |
|----------------------------------|----------------------|

**Spark Plugs**

|                        |                                |
|------------------------|--------------------------------|
| Plug gap               | 0.7 - 0.8 mm (0.027 - 0.031")  |
| Plug size              | 14 mm x 19 mm (0.551 x 0.748") |
| Recommend spark plug:  |                                |
| NIPPONDENSO            | W20ES                          |
| NGK                    | BP-6ES                         |
| CHAMPION               | N10Y                           |
| BOSCH                  | W200T27                        |
| Plug tightening torque | 1.5 - 2.1 m-kp (11 - 15 ft-lb) |

SST (SPECIAL SERVICE TOOLS)



|      |             |                                           |
|------|-------------|-------------------------------------------|
| (1)  | 09310-31011 | Timing Gear Tool Set                      |
| (2)  | 09213-60014 | Crankshaft Pulley & Gear Puller           |
| (3)  | 09214-60010 | Crankshaft Pulley & Gear Replacer         |
| (4)  | 09201-60010 | Valve Stem Guide Remover & Replacer       |
| (5)  | 09222-30010 | Connecting Rod Bushing Remover & Replacer |
| (6)  | 09905-00010 | Snap Ring Expander No.1                   |
| (7)  | 09215-31010 | Camshaft Bearing Remover & Replacer       |
| (8)  | 09301-36010 | Clutch Guide Tool                         |
| (9)  | 09303-35010 | Input Shaft Front Bearing Puller          |
| (10) | 09304-30012 | Input Shaft Front Bearing Replacer        |
| (11) | 09238-40010 | Water Pump Bearing Remover & Replacer     |
| (12) | 09239-31010 | Water Pump Rotor Puller                   |
| (13) | 09235-20011 | Water Pump Pulley Seat Puller             |
| (14) | 09240-00010 | Carburetor Adjust Kit                     |
| (15) | 09860-11010 | Carburetor Screwdriver Set                |
| (16) | 09850-00030 | Engine Adjust Kit                         |
| (17) | 09286-46011 | Injection Pump Spline Shaft Puller        |
| (18) | 09325-12010 | Transmission Oil Plug                     |

**Note:** a. It is recommended that the removal and installation of the crankshaft pulley and the timing gears be performed utilizing the Timing Gear Tool Set 09210-31011 instead of the Crankshaft Pulley & Gear Puller 09213-60014 and the Crankshaft Pulley & Gear Replacer 09214-60010.

This Tool Set is designed also for On-Car service.

b. The Injection Pump Spline Shaft Puller 09286-46011 is for the removal of the alternator rear bearing and the Transmission Oil Plug 09325-12010 is for the assembly of the alternator drive end frame.