TOYOTA

12R ENGINE

REPAIR MANUAL

INCLUDES 2R

TOYOTA MOTOR SALES CO., LTD.

SECTION INDEX

GENERAL

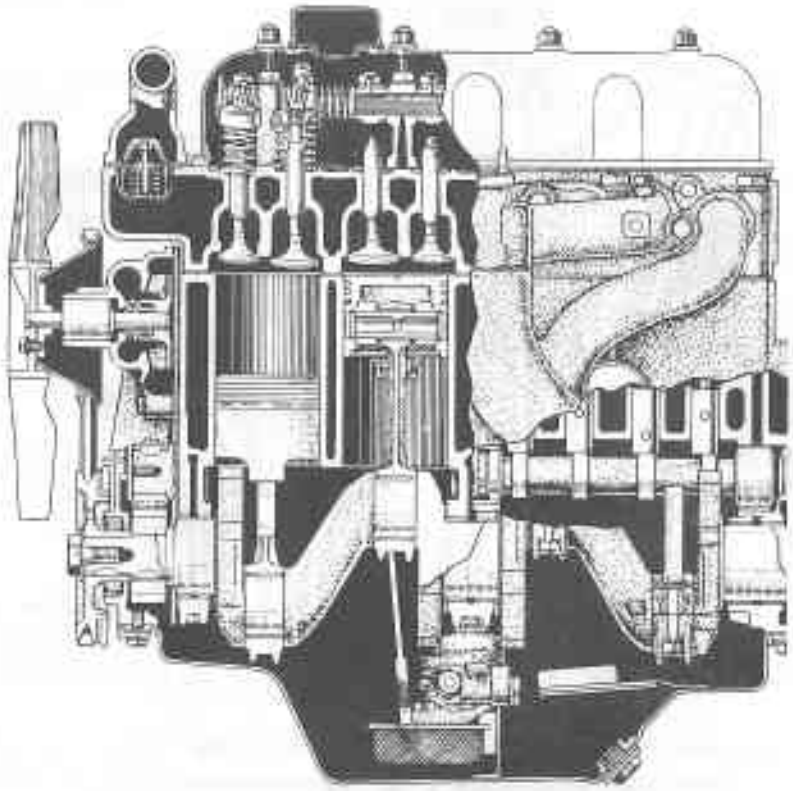


Fig. 1-1 Cross Sectional Side View *Y5500*

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.

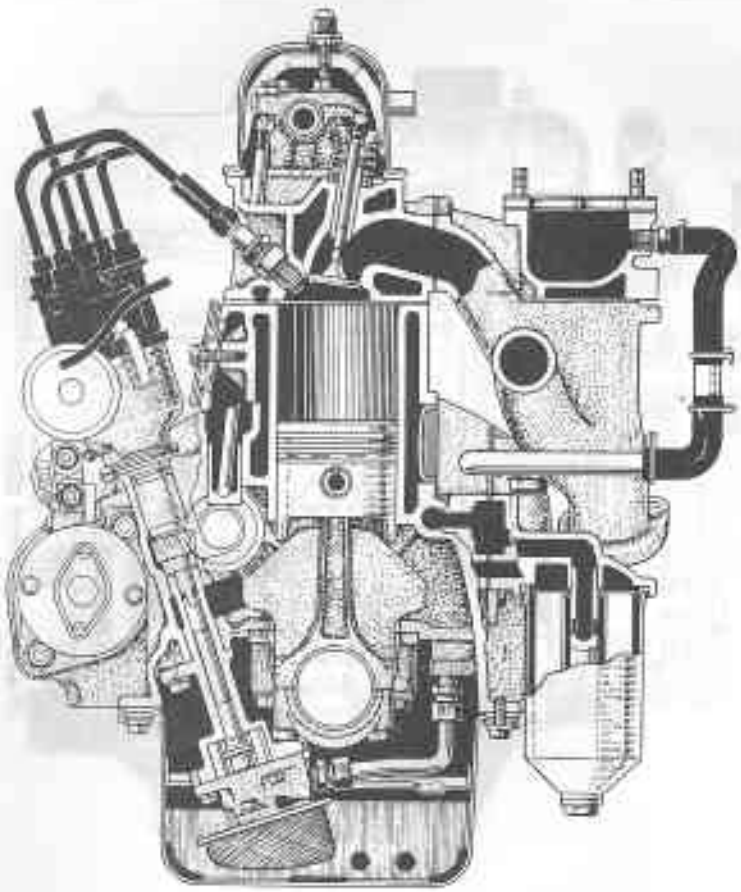


Fig. 1-2 Cross Sectional Front View *Y5501*

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 shoped 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/cm² (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-kg (90 ft-lb) at 2800 rpm	13.5 m-kg (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), 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), 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 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

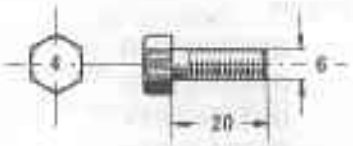
09235-20011	Water Pump Pulley Seat Puller
09239-31010	Water Pump Rotor Puller
09238-40010	Water Pump Bearing Remover & Replacer

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/mm²)	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/mm²)	more than 30	more than 45	more than 60

Specified Torque for Standard Bolt

Class	Basic Dia.	Pitch	Standard Torque 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 defficiency 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).

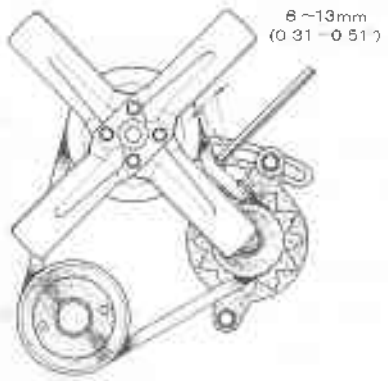


Fig. 2-1 Checking Fan Belt Tension *G0850*

Fuel Filter (Glass bowl type)

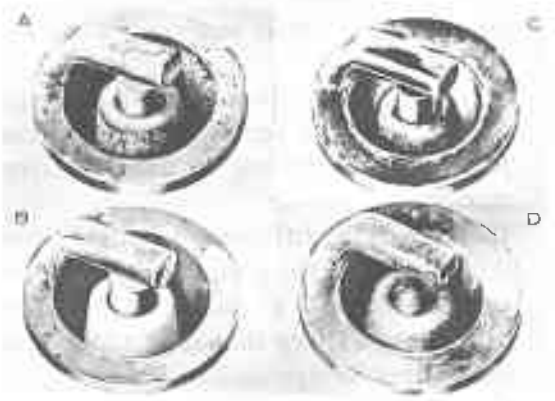
1. Check the fuel filter bowl for crack, and check the body for deformation.
   Replace as necessary.
2. Clean the element if excessively dirty, and check for damage.
   Replace the element with the Kit if necessary.

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° BTDC at 550 rpm.

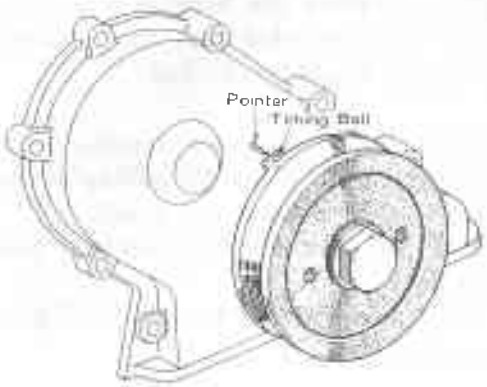


Fig. 2-6 Ignition Timing Mark *G0853*

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° of the crankshaft angle.
b. The octane selector has no relation with the characteristic of the vacuum advancer.

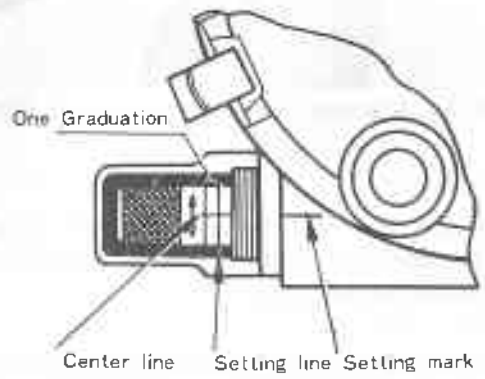


Fig. 2-7 Octane Selector *G0340*

Valve Clearance

1. Warm up the engine till the coolant temperature reaches 75~85°C (167 ~ 185°F).

2. Tighten the cylinder head bolts and the rocker shaft support bolts to specified torque.
   Specified torque:
   Cylinder head bolts:
   10.3 ~ 11.7 m-kg (74.1 ~ 84.2 ft-lb)
   Rocker shaft support bolts:
   1.8 ~ 2.5 m-kg (13 ~ 18 ft-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.

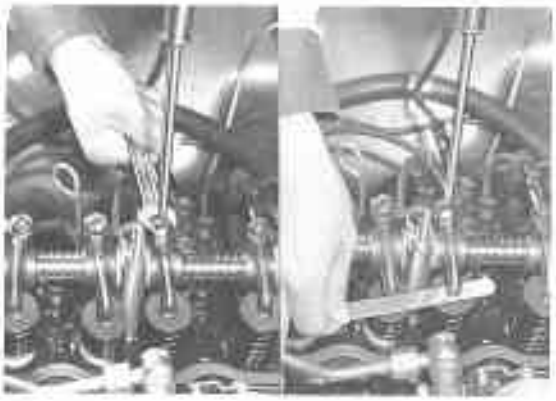


Fig. 2-8 Adjusting Valve Clearance *V3214 V3215*

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 kg/cm^2 (156 psi) at 250 rpm, and the limit is 8.0 kg/cm^2 (115 psi).

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

* *

ENGINE

TROUBLE SHOOTING

The possible faults, and their remedies are listed in the following table. When the symptoms of troubles are detected, proper care must be taken immediately before proceeding to the next probable 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	
a. Insufficient coolant	Replenish coolant
b. Loose fan belt	Adjust fan belt
c. 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 & 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 & 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
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.
2. Disconnect the battery ground cable from the battery terminal.
3. Lift the center seat, and remove the carburetor air inlet.
4. Remove the throttle and choke wires from the carburetor and the clamp on the rocker arm cover.
5. Remove the radiator inlet hose, and disconnect the coolant temperature sender gauge lead wire.
6. Remove the alternator retaining bolts and the lead wires, and remove the alternator assembly upward.
7. Remove the radiator outlet hose.
8. Disconnect the high tension wire from the ignition coil.
9. Disconnect the fuel pump inlet hose from the fuel pump.
10. Disconnect the battery to starter cable and the lead wires from the starter terminals.
11. Disconnect the distributor primary lead wire from the distributor terminal.
12. Jack up the vehicle, and support it with stands.
13. Remove the propeller shaft.
14. Disconnect the speedometer cable from the transmission.
15. Disconnect the back-up light switch lead wires from the switch.
16. Remove the cross-shaft and the gear shifting rod No. 3.
17. Remove the engine under cover LH, and disconnect the oil pressure switch lead wire from the switch.
18. Remove the front exhaust pipe.
19. Remove the clutch release cylinder together with the clutch flexible hose set plate from the transmission.
20. Place an engine holder onto the jack, and support the engine with the jack.
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 mainfold 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.

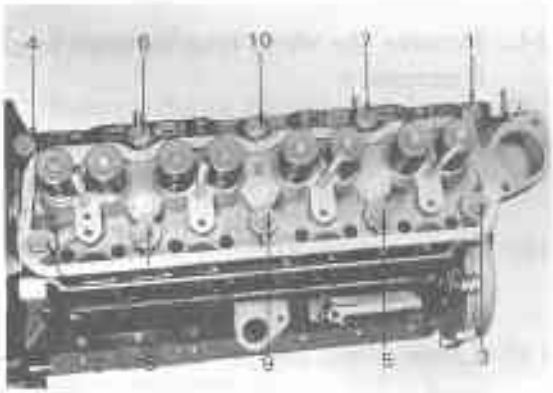


Fig. 3-2 Head Bolts Loosening Order *V3115*

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.

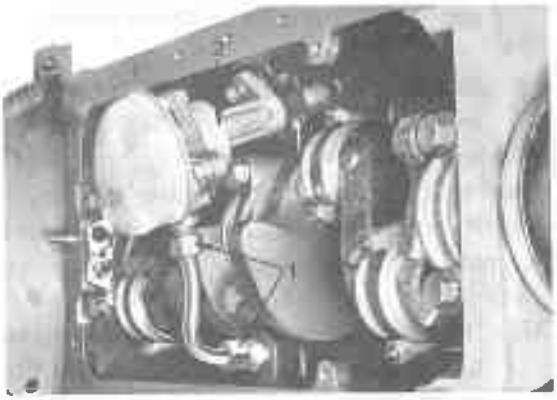


Fig. 3-3 Oil Pump Removal *V3117*

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.

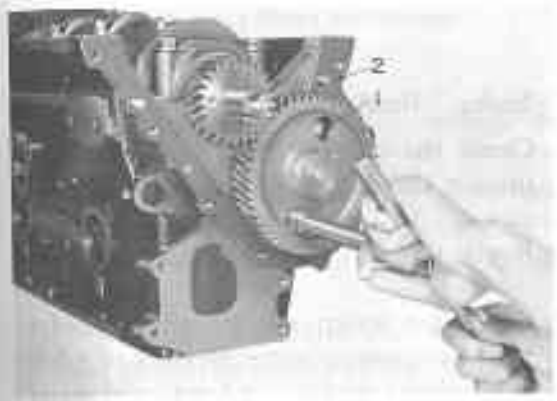


Fig. 3-6 Camshaft Removal *V3120*

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).

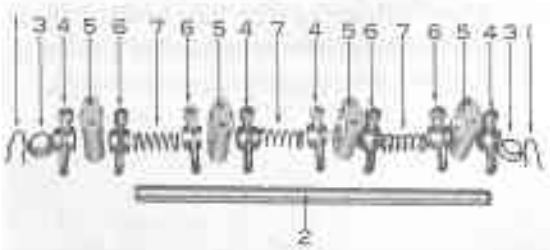


Fig. 3-10 Rocker Arm Disassembly *V3126*

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/cm² or 57 ~ 64 psi., and water temperature of 40° C (104° F).
If defective, repair or replace the cylinder head.

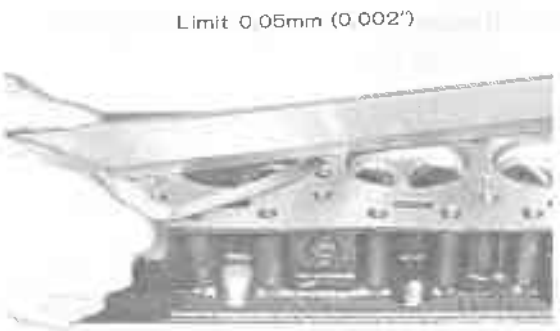


Fig. 3-12 Measuring Head Warpage *V3128*

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.

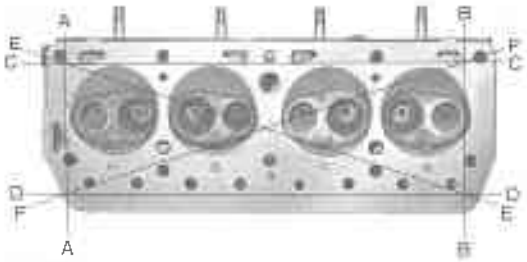


Fig. 3-13 Measuring Points for Warpage V3129

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.

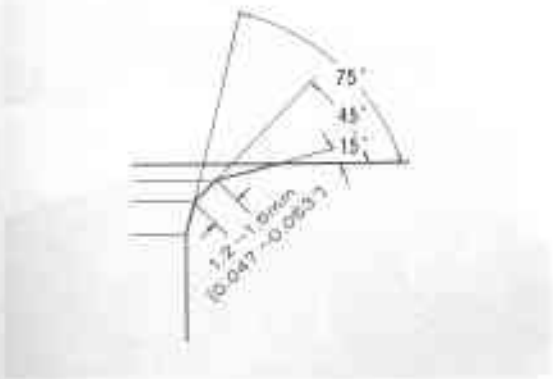


Fig. 3-14 Valve Seat Dimension G0826

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.

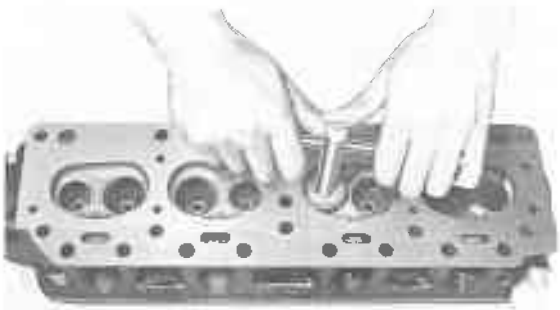


Fig. 3-15 Refacing Valve Seat V3130

   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")

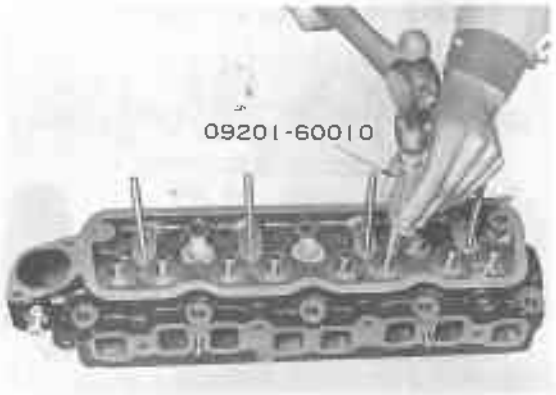


Fig. 3-16 Cuide Bushing Replacement V3134

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.

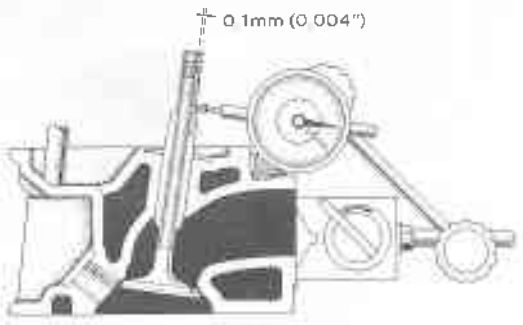


Fig. 3-17 Easy Method G0829

   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

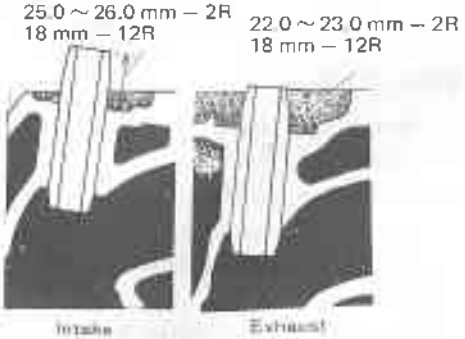


Fig. 3-18 Valve Guide Bushing Protrusion G0828

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

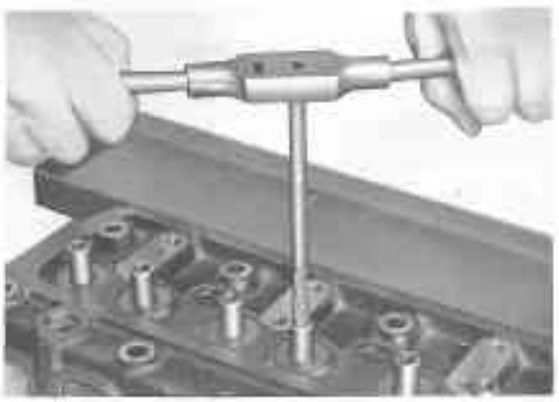


Fig. 3-19 Reaming Valve Guide Bushing V3150

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°, removing only sufficient stock to correct the run-out, and to remove the pits and grooves.

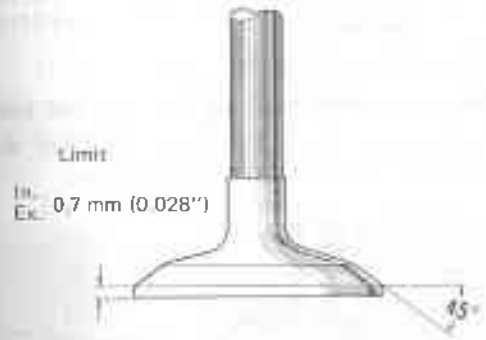


Fig. 3-20 Valve Head Edge *G0830*

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.

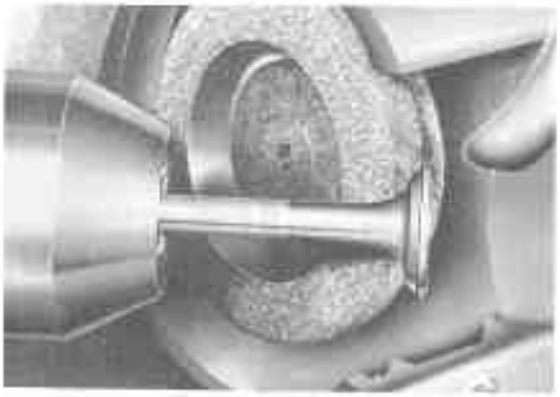


Fig. 3-21 Grinding Valve *V0716*

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*

3. 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.

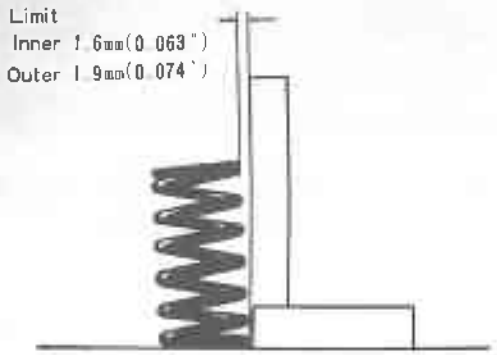


Fig. 3-24 Checking Spring Squareness *G0832*

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

1. 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.

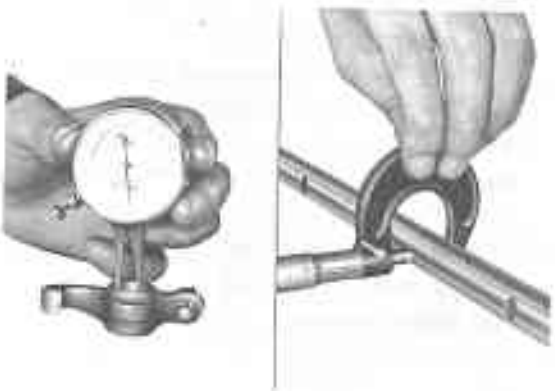


Fig. 3-25 Measuring Bushing & Shaft Clearance *V0718* *V0719*

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

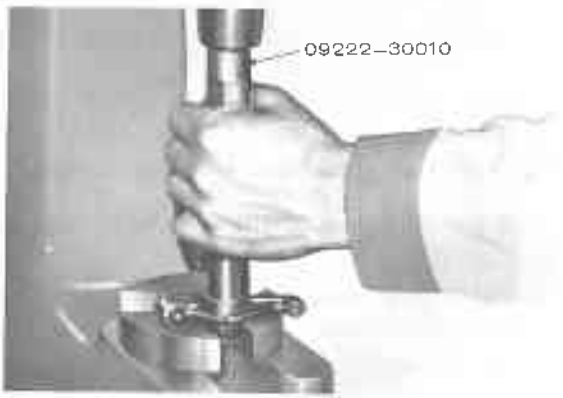


Fig. 3-26 Bushing Replacement *V3135*

3. To intall 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 ^{2} (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.

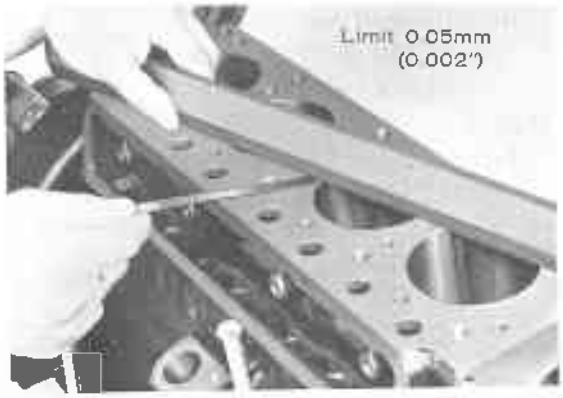


Fig. 3-29 Measuring Cylinder Block Flatness *V3138*

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.

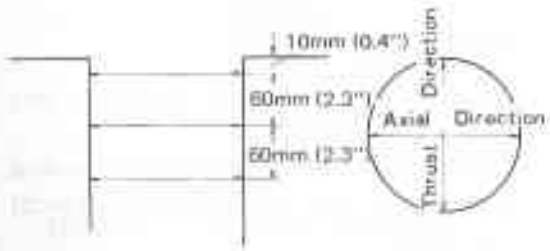


Fig. 3-30 Measuring Points of Cylinder Bore *G0833*

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, 100, 125, 1.50	

5. 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.

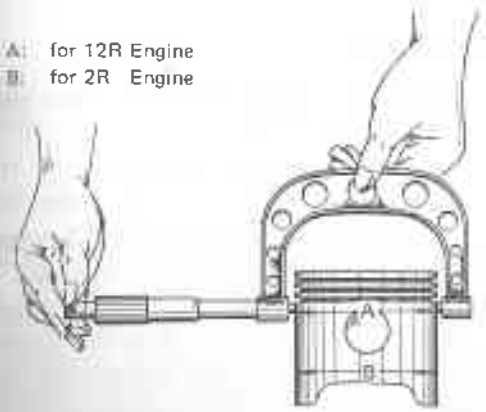


Fig. 3-33 Measuring Piston Diameter *V3140*

6. 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).

7. 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).

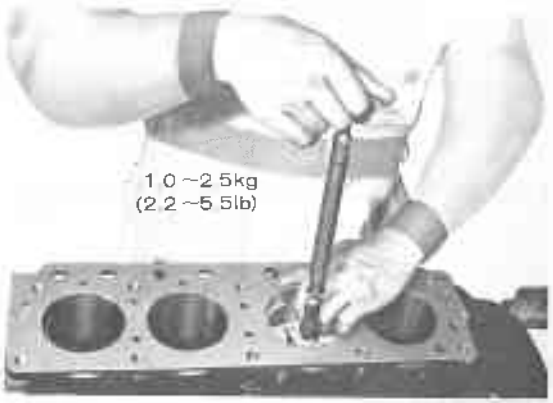


Fig. 3-34 Measuring Piston Fit *V3143*

Cylinder sleeve

1. 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 (3.2319~3.2333")	84.590~84.650mm (3.3303~3.3327")
O/S - 4.50	82.591~82.626mm (3.2516~3.2530")	85.090~85.150mm (3.3500~3.3524")
O/S - 5.00	83.091~83.126mm (3.2713~3.2727")	85.590~85.650mm (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.

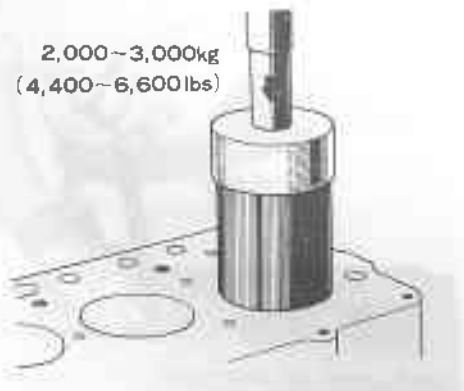


Fig. 3-35 Installing Cylinder Sleeve *G0834*

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")

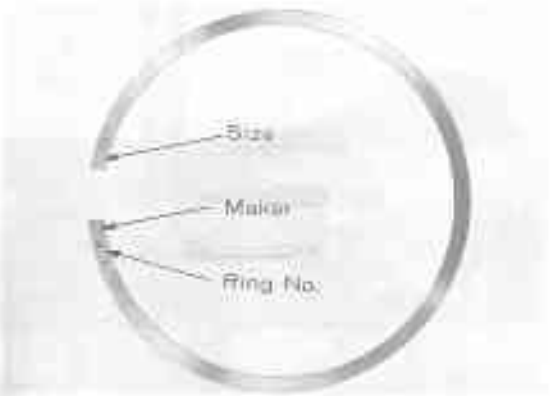


Fig. 3-37 Piston Ring Marks *V3145*

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 & 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.

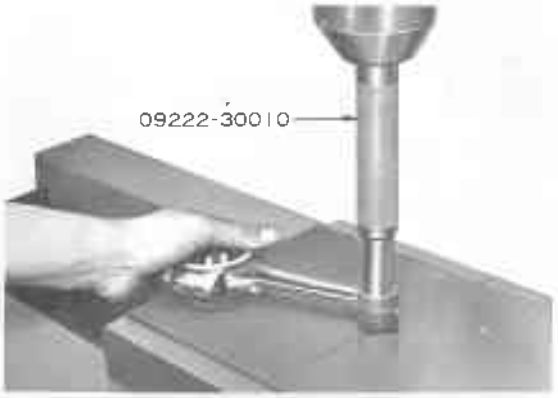


Fig. 3-42 Bushing Replacement *V3162*

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")

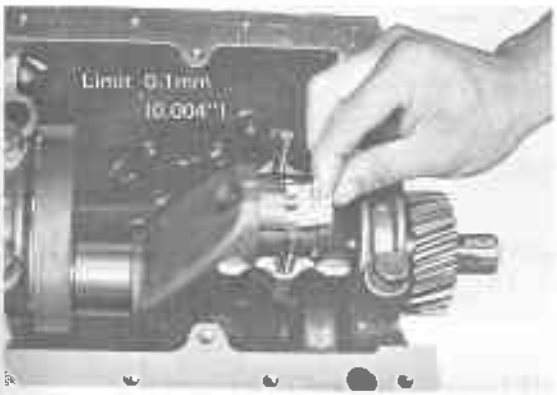


Fig. 3-43 Measuring Oil Clearance *V3161*

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 ~ 0.9735")
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.

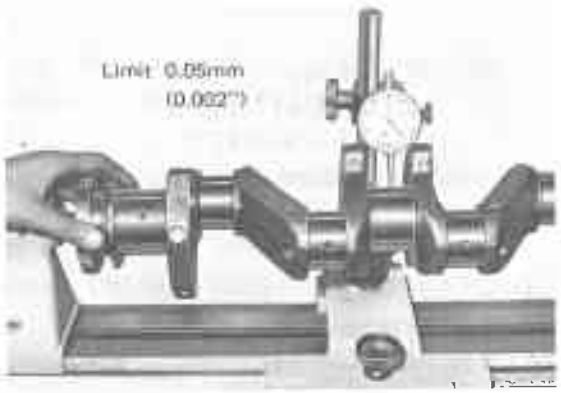


Fig. 3-44 Measuring Crankshaft Run-out V3164

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")

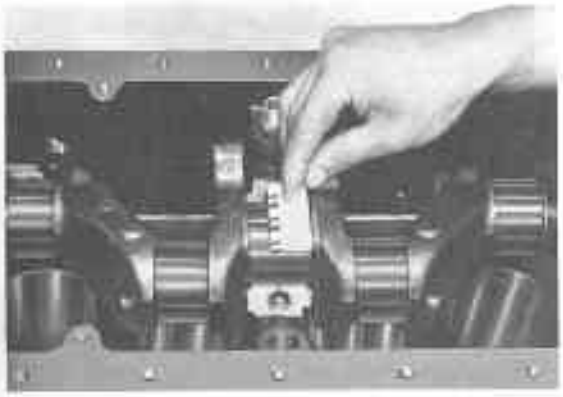


Fig. 3-46 Measuring Oil Clearance *V3167*

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.

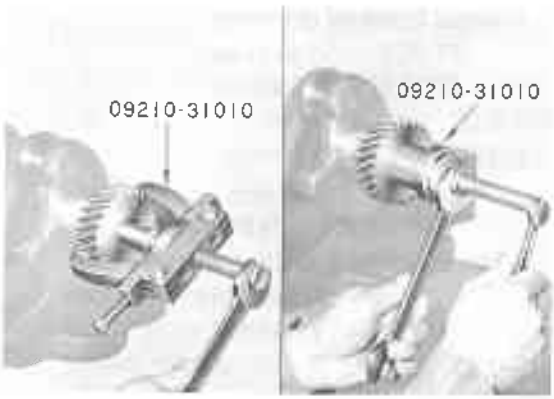


Fig. 3-47 Replacing Timing Gear B0276 B0278

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.

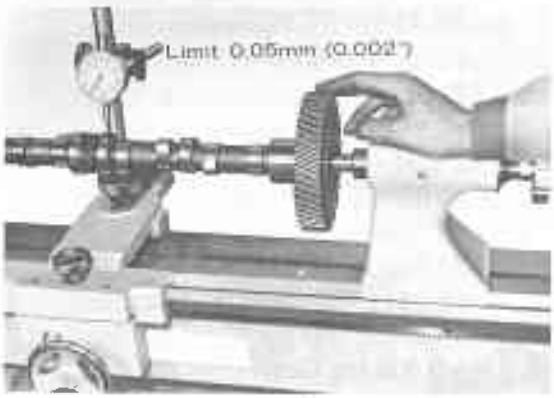


Fig. 3-48 Measuring Bend of Camshaft V3170

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.

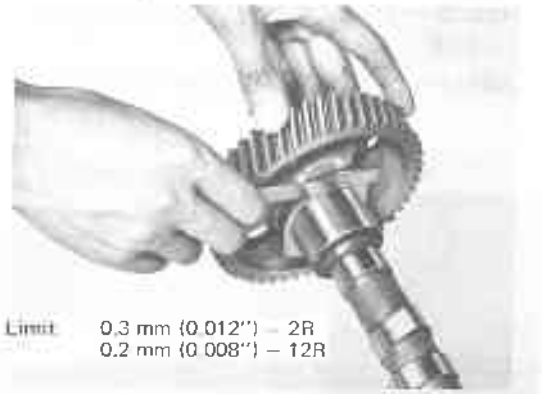


Fig. 3-49 Measuring Thrust Clearance V3171

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.

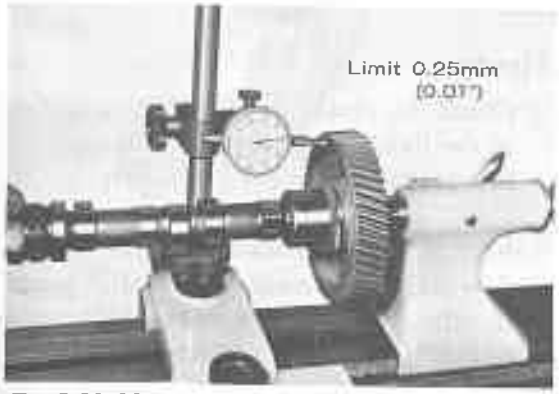


Fig. 3-50 Measuring Timing Gear Run-out V3172

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.

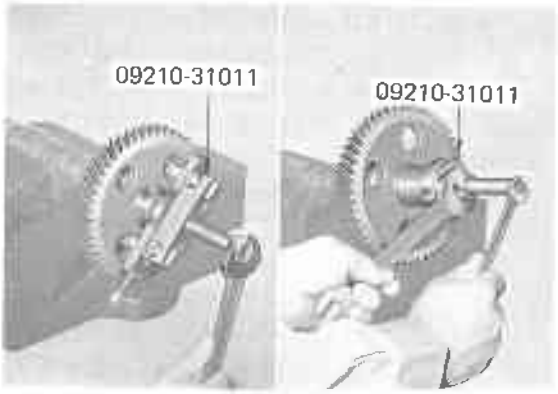


Fig. 3-51 Replacing Timing Gear B0281 B0283

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").

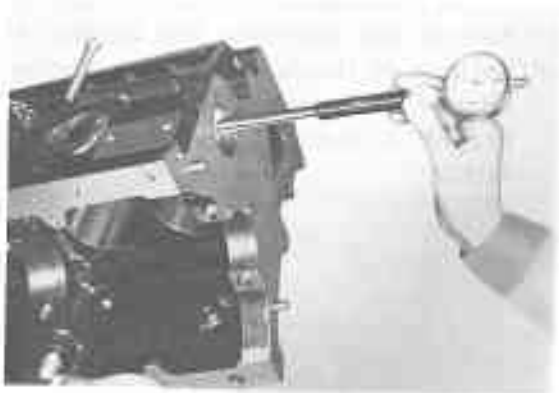


Fig. 3-52 Measuring Oil Clearance V3173

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 (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.

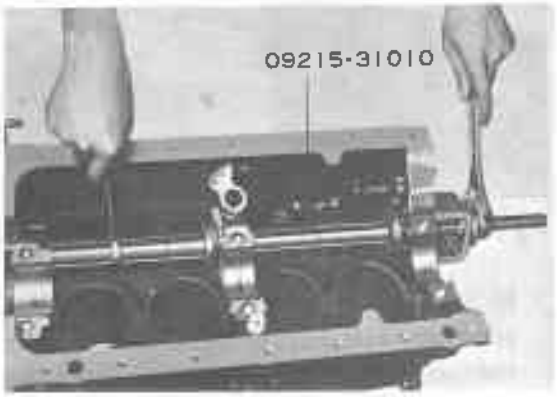


Fig. 3-53 Camshaft Bearing Removal V3174

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.

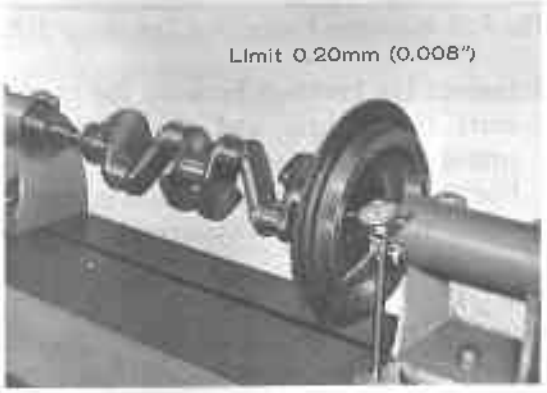


Fig. 3-54 Measuring Flywheel Run-out V3175

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 Assemblint 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 "I" 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.

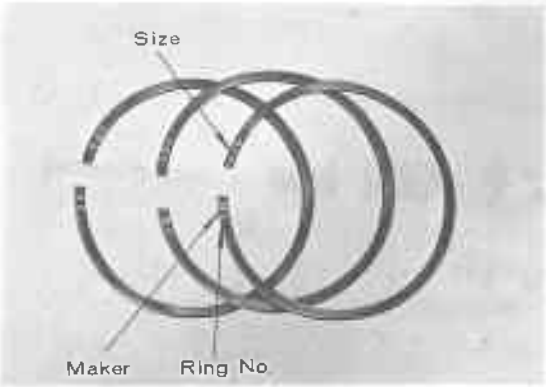


Fig. 3-58 Piston Rings *V2062*

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.

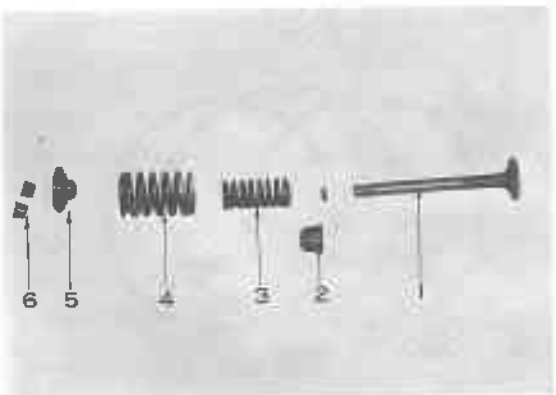


Fig. 3-60 Assembling Valve Components *V3180*

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

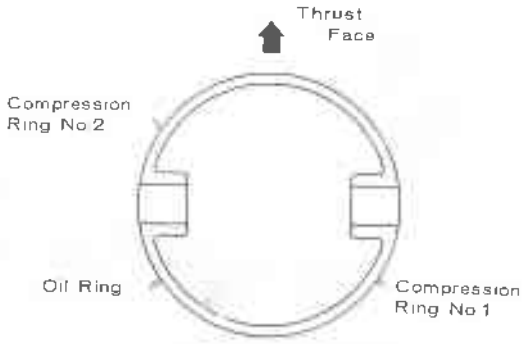


Fig. 3-64 Positioning Ring End Gap *G0839*

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

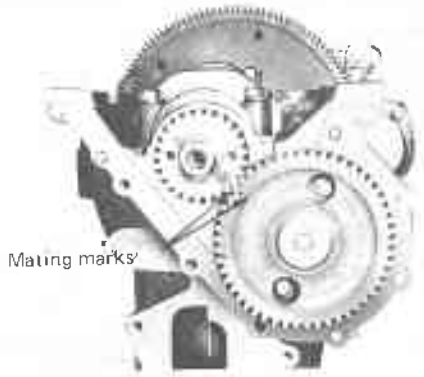


Fig. 3-66 Aligning Timing Marks *V3185*

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.

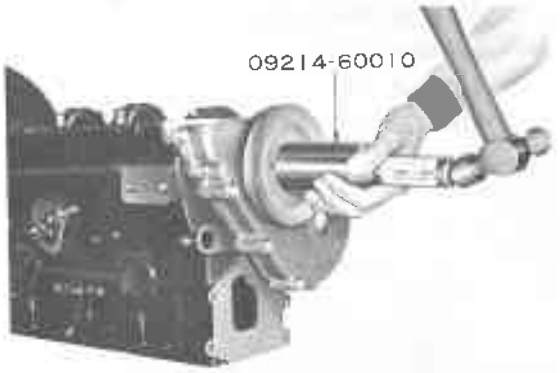


Fig. 3-68 Installing Pulley *V3186*

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.

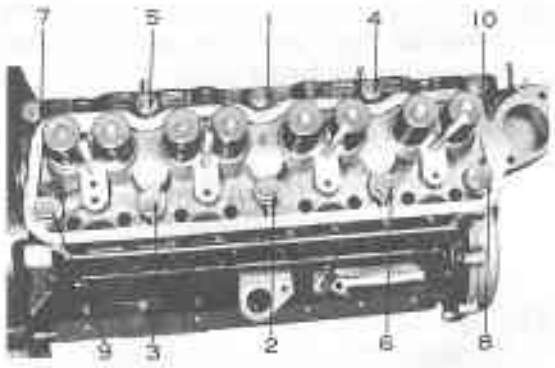


Fig. 3-69 Tightening Order *V3115*

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.

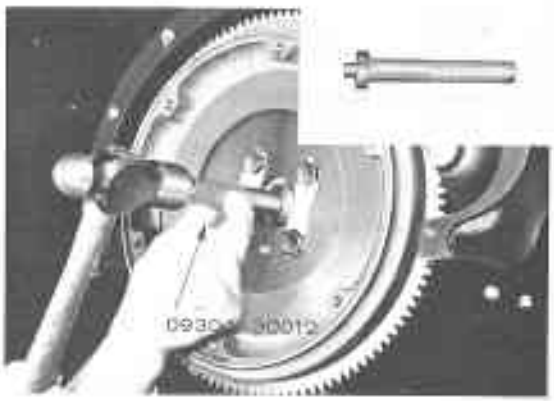


Fig. 3-70 Installing Bearing *B1011 V4700*

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

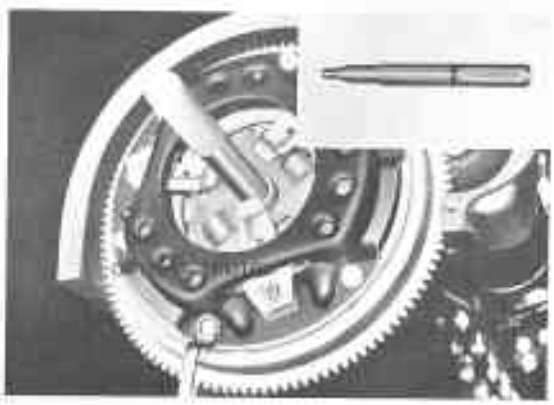


Fig. 3-71 Installing Clutch Cover *B1013 V4701*

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

Description

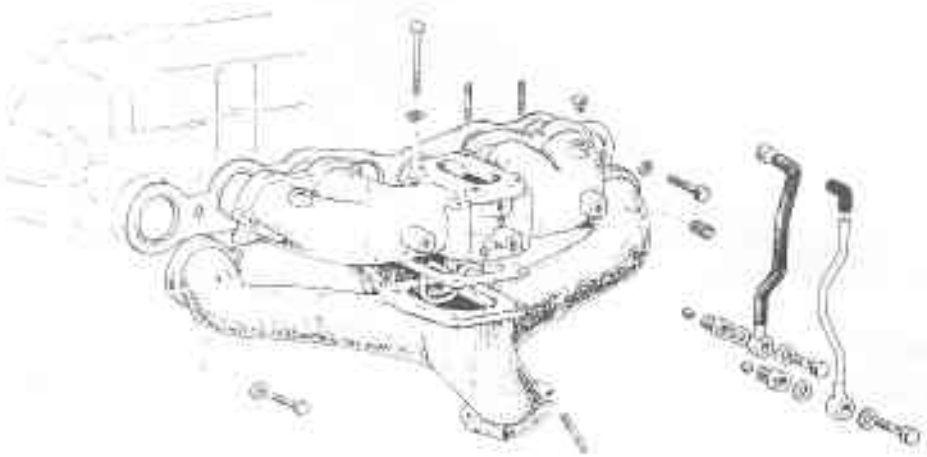


Fig. 4-1 Sectional View of Manifold on RT Series Y5506

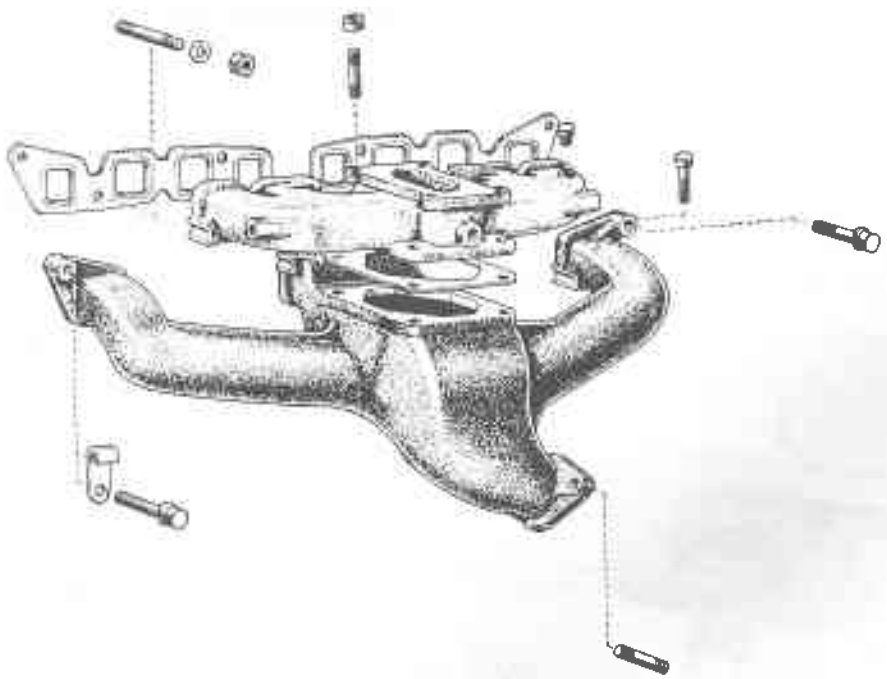


Fig. 4-2 Manifolds Components on Light-Truck series

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.

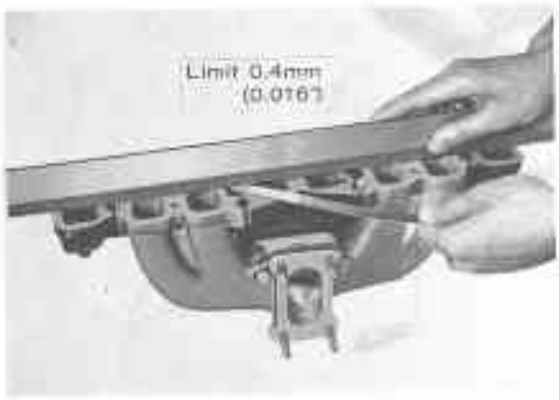


Fig. 4-3 Measuring Manifold Distortion V3187

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

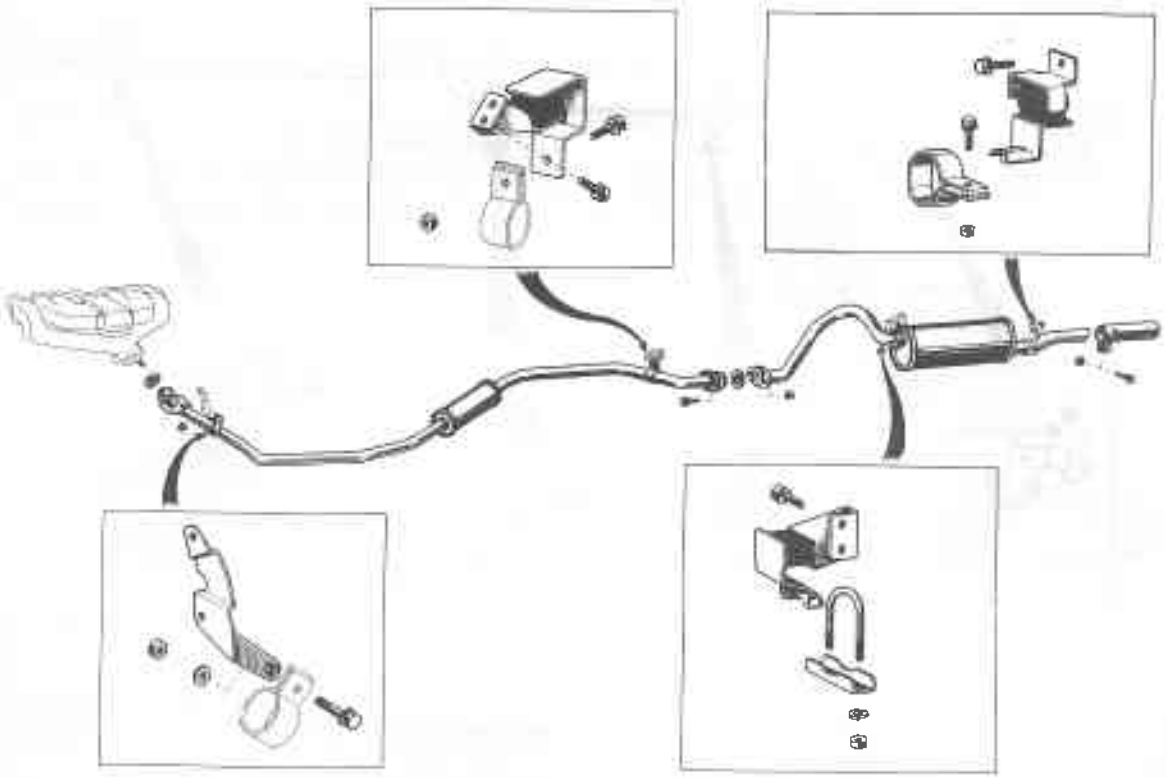


Fig. 4-4 Exhaust System Components on RT Series Y5509

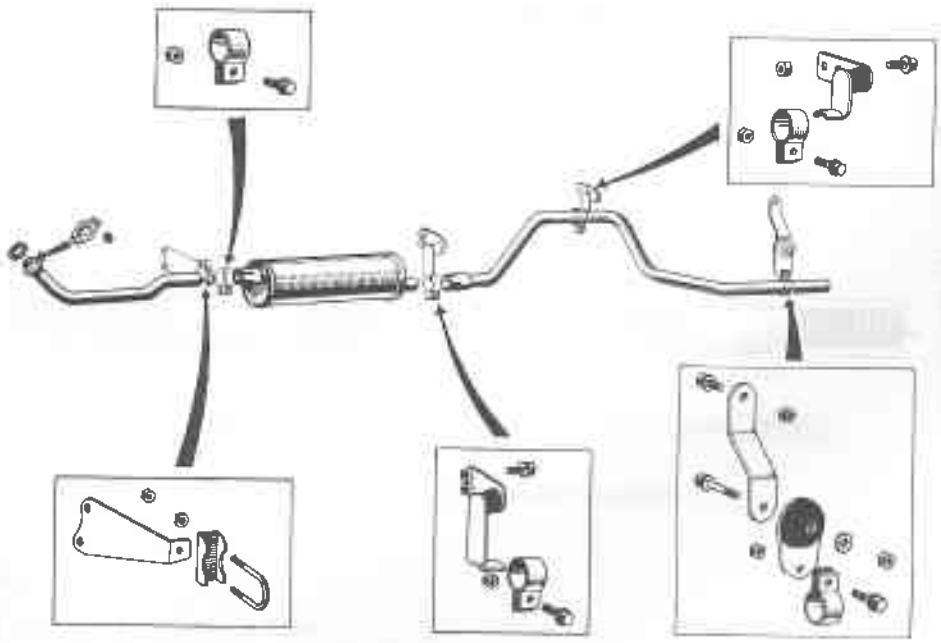


Fig. 4-5 Exhaust System Components on RY Series G3803

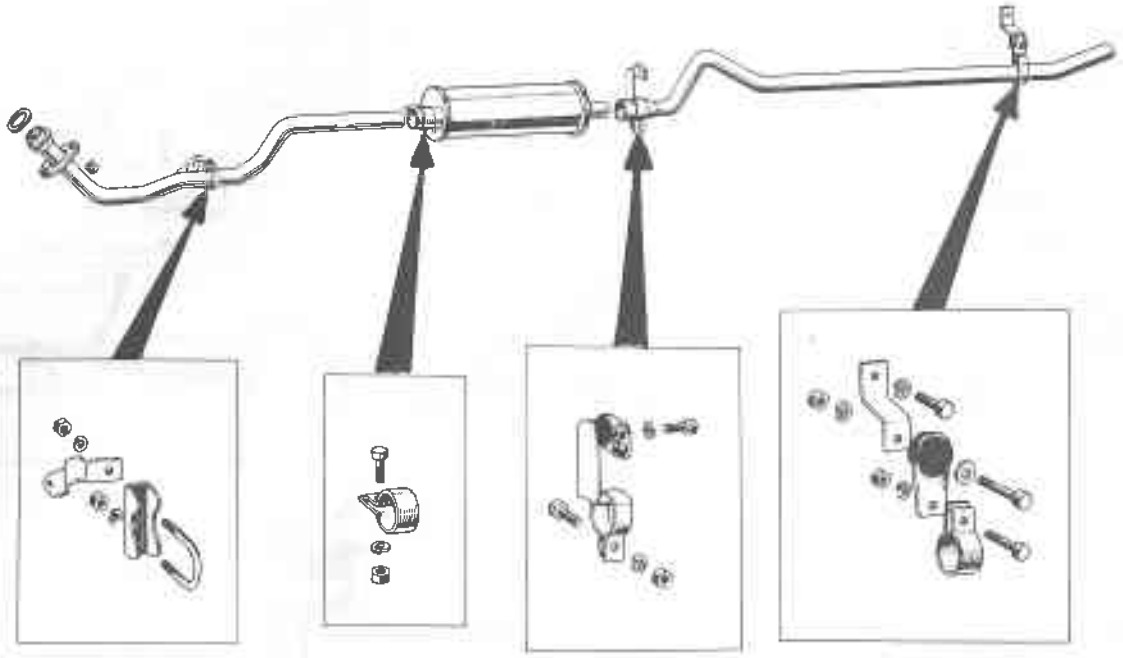


Fig. 4-6 Exhaust System Components on RH Series G3804

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.

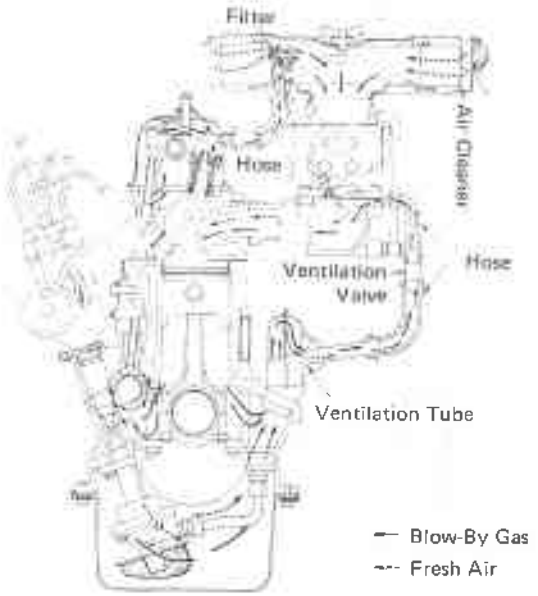


Fig. 4-7 Positive Crankcase Ventilation System

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.

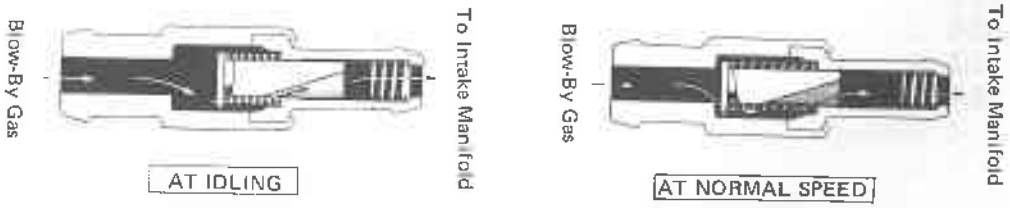


Fig. 4-8 Ventilation Valve Operation

Inspection

1. Replace worn of 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

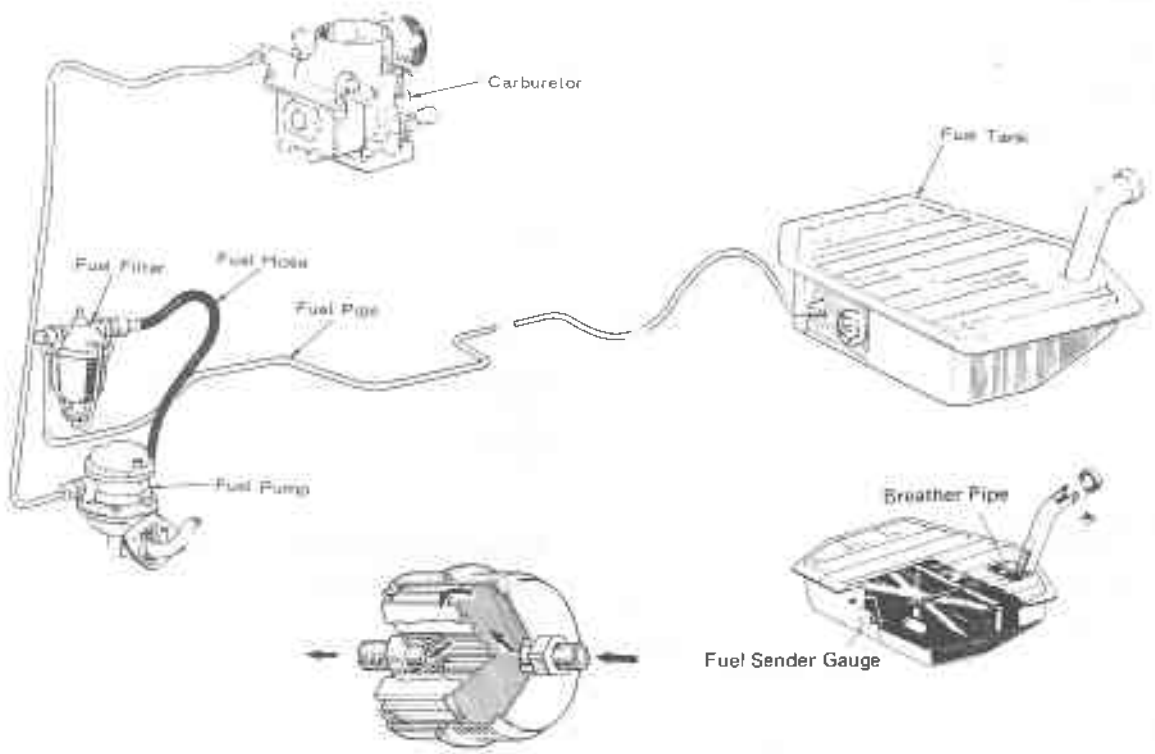


Fig. 5-1 Fuel System on Corona Sedan Series *Y5766, Y5767*

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 floow 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 & 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 & 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

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

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

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

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)	←	←
Primary – Small		8.0 (0.32)	←	←
Secondary – Main		2R- 27.0 (1.06) 12R- 28.0 (1.12)	←	←
Secondary – 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) 12R- 1.03 (0.041)	1.06 (0.042) 1.03 (0.041)	1.11 (0.044) 1.03 (0.041)
Secondary		2R- 1.40 (0.055) 12R- 1.62 (0.064)	1.60 (0.063) 1.56 (0.061)	1.47 (0.058) 1.65 (0.065)
Slow jet diameter	mm (in)	2R- 0.55 (0.022) 12R- 0.50 (0.020)	0.435 (0.019) 0.47 (0.019)	0.525 (0.021) 0.47 (0.019)
Power jet diameter	mm (in)	2R- 0.75 (0.030) 12R- 0.50 (0.020)	0.60 (0.024) 0.58 (0.023)	0.70 (0.028) 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) 12R- 1.00 (0.040)	0.80 (0.031) ———	0.80 (0.031) 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 (4.3 ~ 5.1)	70 ~ 90 (2.8 ~ 3.5)	110 ~ 130 (4.3 ~ 5.1)
	12R- 120 ~ 140 (4.7 ~ 5.5)	120 ~ 140 (4.7 ~ 5.5)	120 ~ 140 (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.		
for 12R	Screw out about 2 turns after slightly seating.		
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°	12°	13°
	12R – 13°	17°	17°
Unloader	2R – 30°	–	–
	12R – 27°	–	–
Thermostatic valve operating temperature	Fully closed at 60°C (140°F)		
	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.

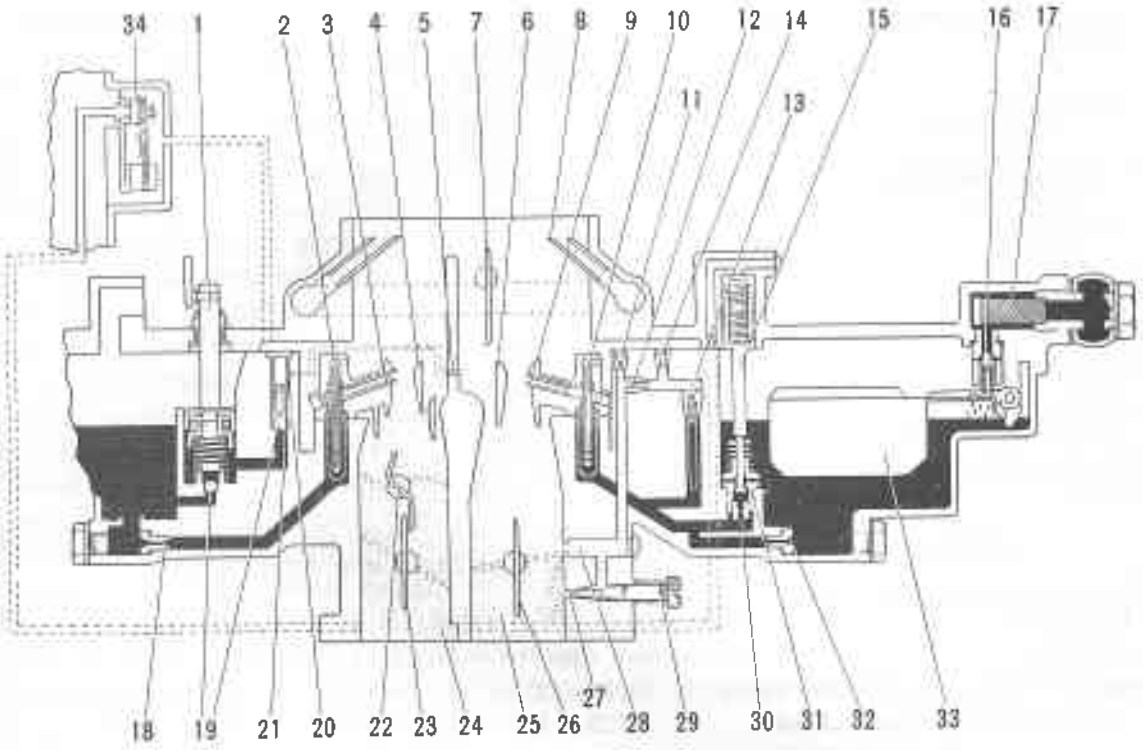
1. Float chamber & air vent system

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

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.

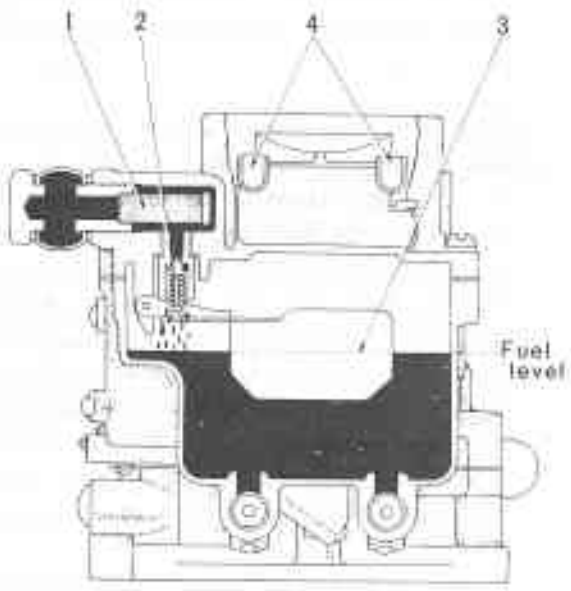


Fig. 5-3 Float Chamber & Air Vent *G1352*

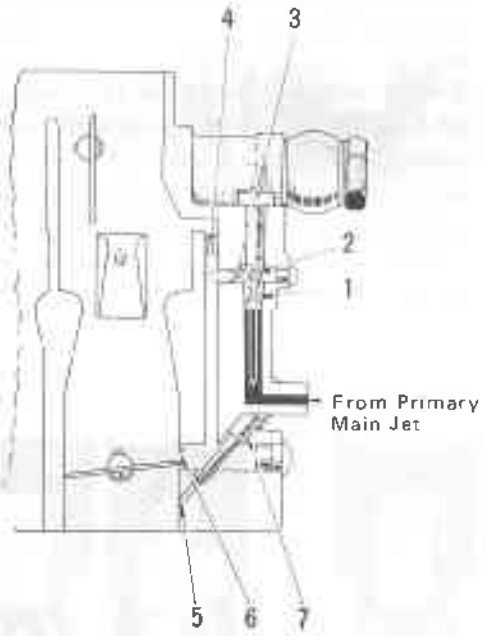


Fig. 5-4 Idle & Low Speed System *G1353*

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.

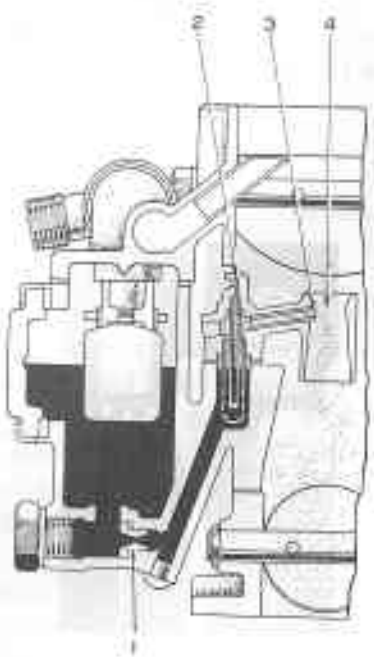


Fig. 5-5 Primary High Speed System *G1354*

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.

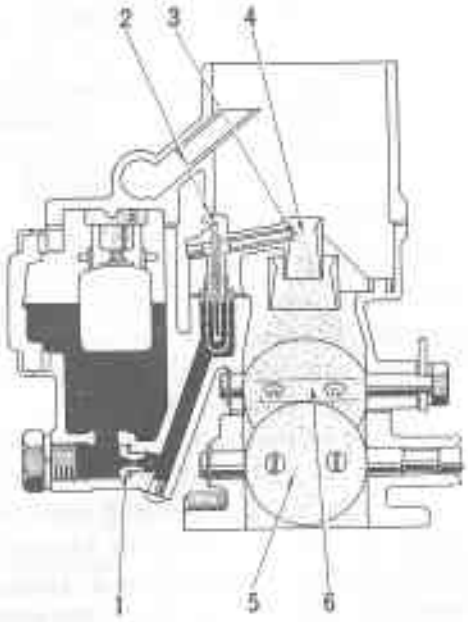


Fig. 5-6 Secondary High Speed System *G1355*

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.

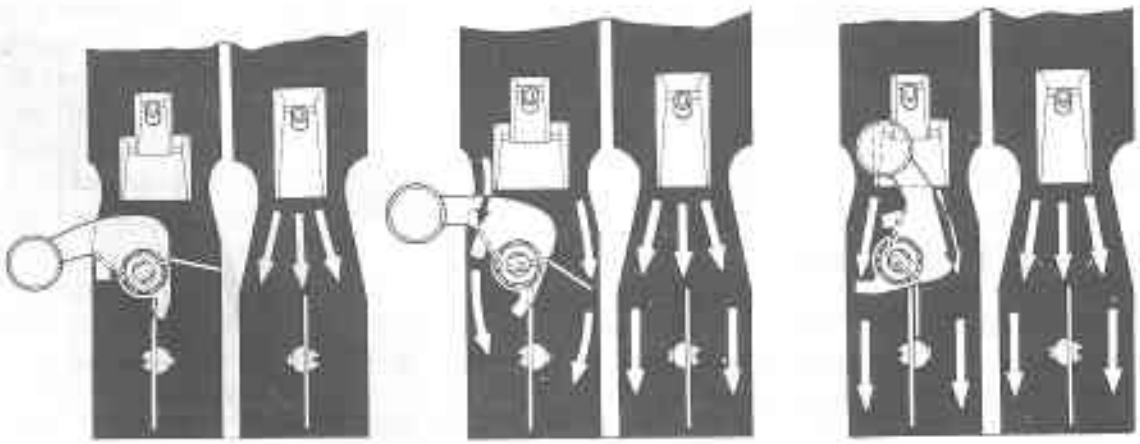


Fig. 5-7 High Speed Valve Operation *G1356, G1357, G1358*

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).

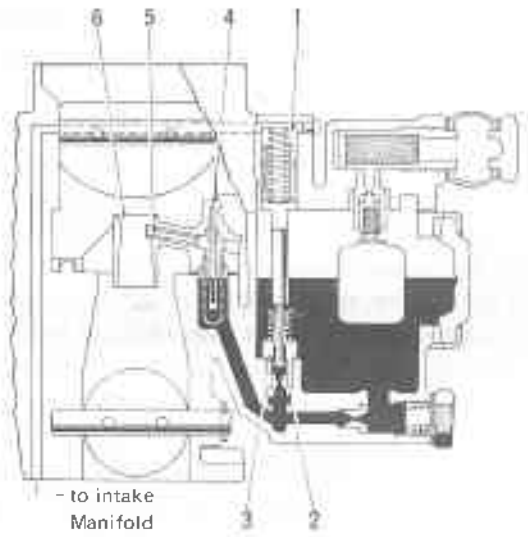


Fig. 5-8 Power System *G1359*

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

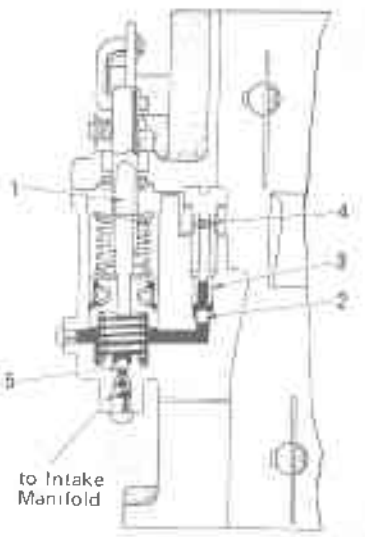


Fig. 5-9 Accelerating System *G1360*

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).

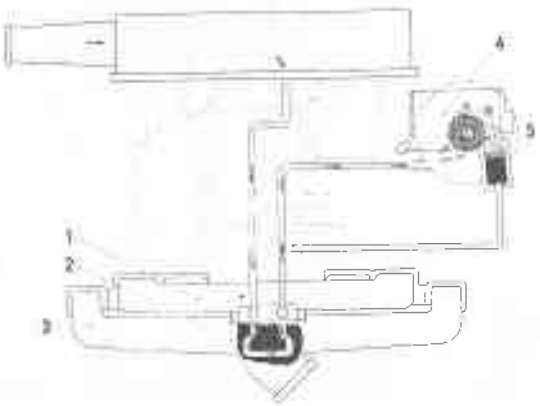


Fig. 5-10 Automatic Choke System *Y5771*

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.

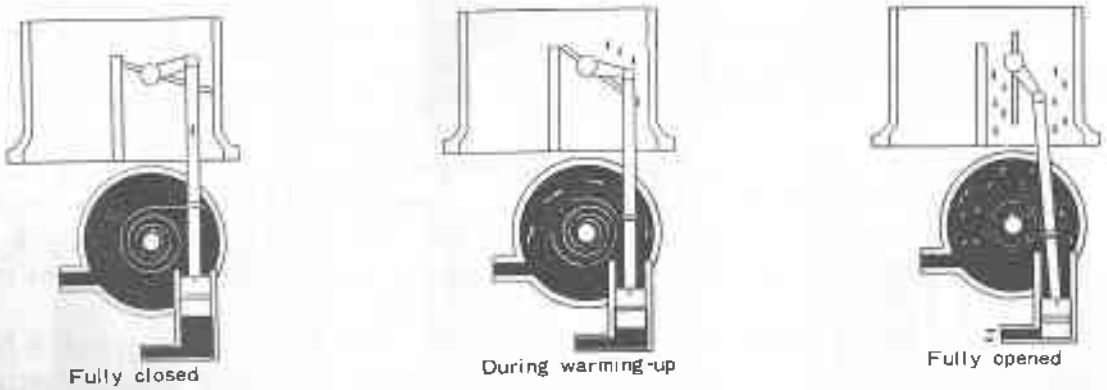


Fig. 5-11 Automatic Choke Operation *G1361, G1362, G1363*

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°) 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

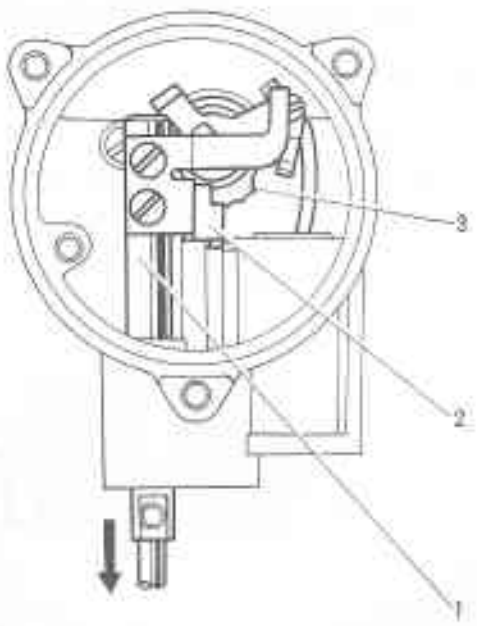


Fig. 5-12 Fast Idle Operation *G1364*

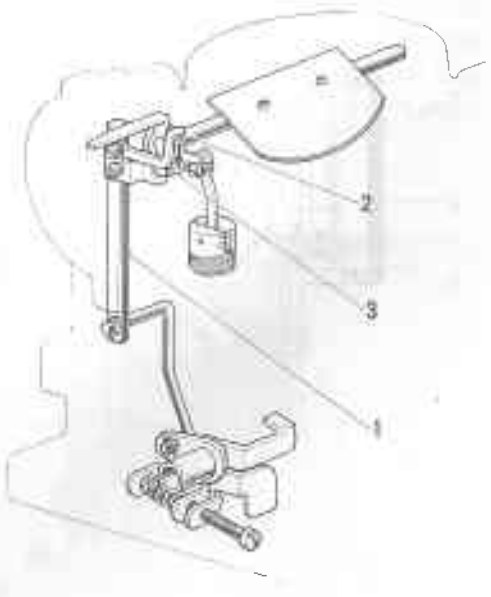


Fig. 5-13 Under Operation *G1365*

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.

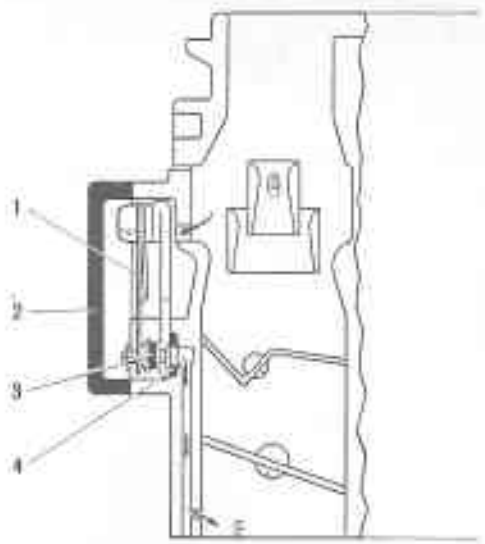
As the accelerator pedal is depressed, the choke shaft (3) is rotated by the cam follower (2) installed on the sliding rod (1) to open the choke valve forcibly.

10. Thermostatic valve

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



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

Fig. 5-14 Thermostatic Valve *G0221*

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.

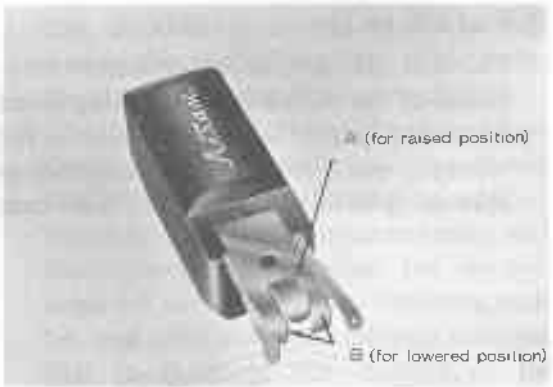


Fig. 5-15 Float Tabs *V2178*

1. Raised position

Inspect the distance between the end of

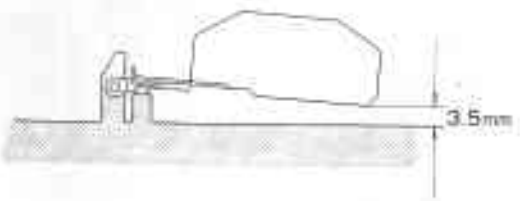


Fig. 5-16 Checking Raised Position *V2841*

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")

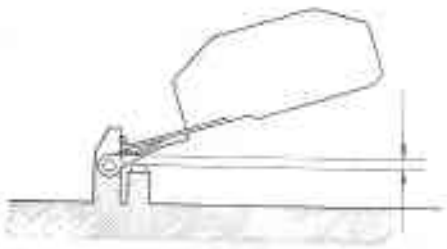


Fig. 5-17 Checking Lowered Position V3993

Secondary Throttle Valve Opening Angle

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

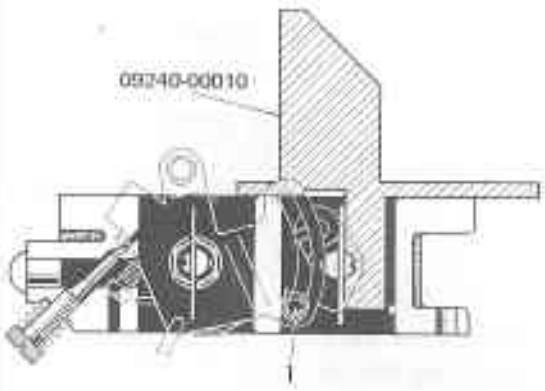


Fig. 5-18 Checking Valve Opening Angle G1366

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

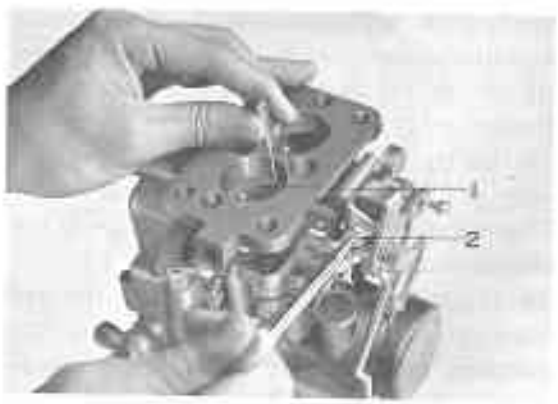


Fig. 5-19 Adjusting Fast Idle V3994

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.

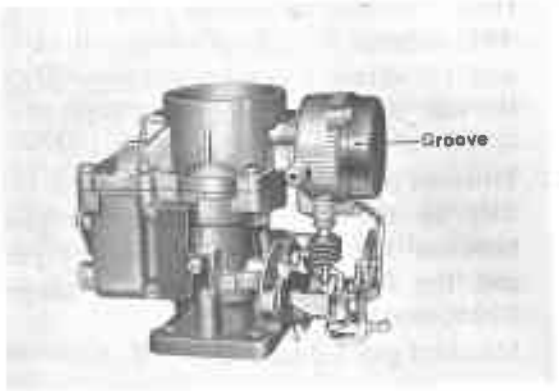


Fig. 5-21 Automatic Choke Adjustment *B0107*

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 wiht clean gasoline or carburetor cleaning solvent.

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

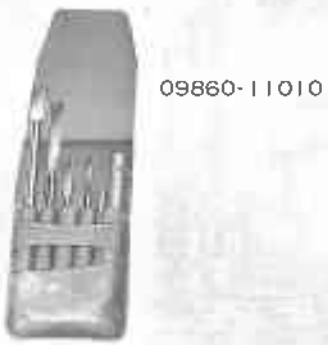


Fig. 5-22 Carburetor Screwdriver Set *B0108*

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).

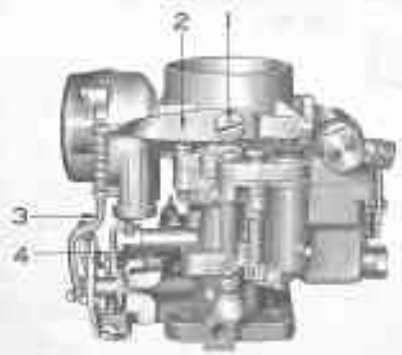


Fig. 5-23 Connecting Links Removal *B0109*

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).

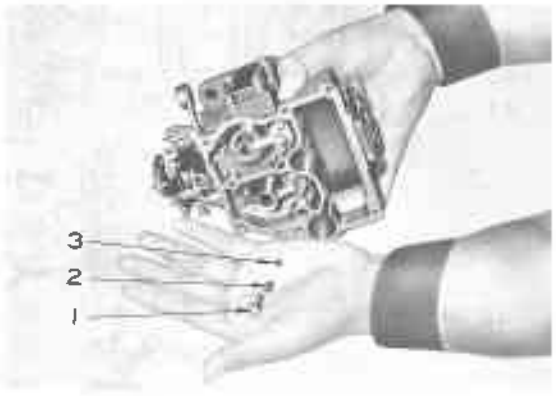


Fig. 5-24 Steel Ball Removal *B0110*

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.

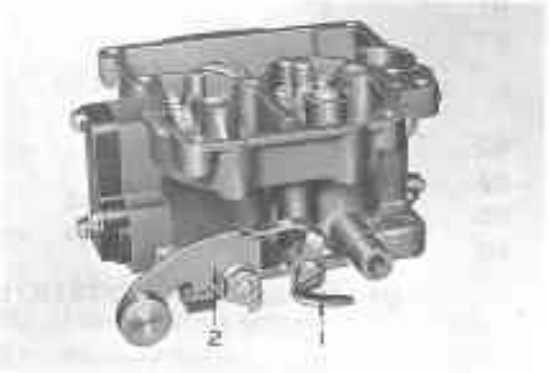


Fig. 5-25 Lever & Arm Removal *B0111*

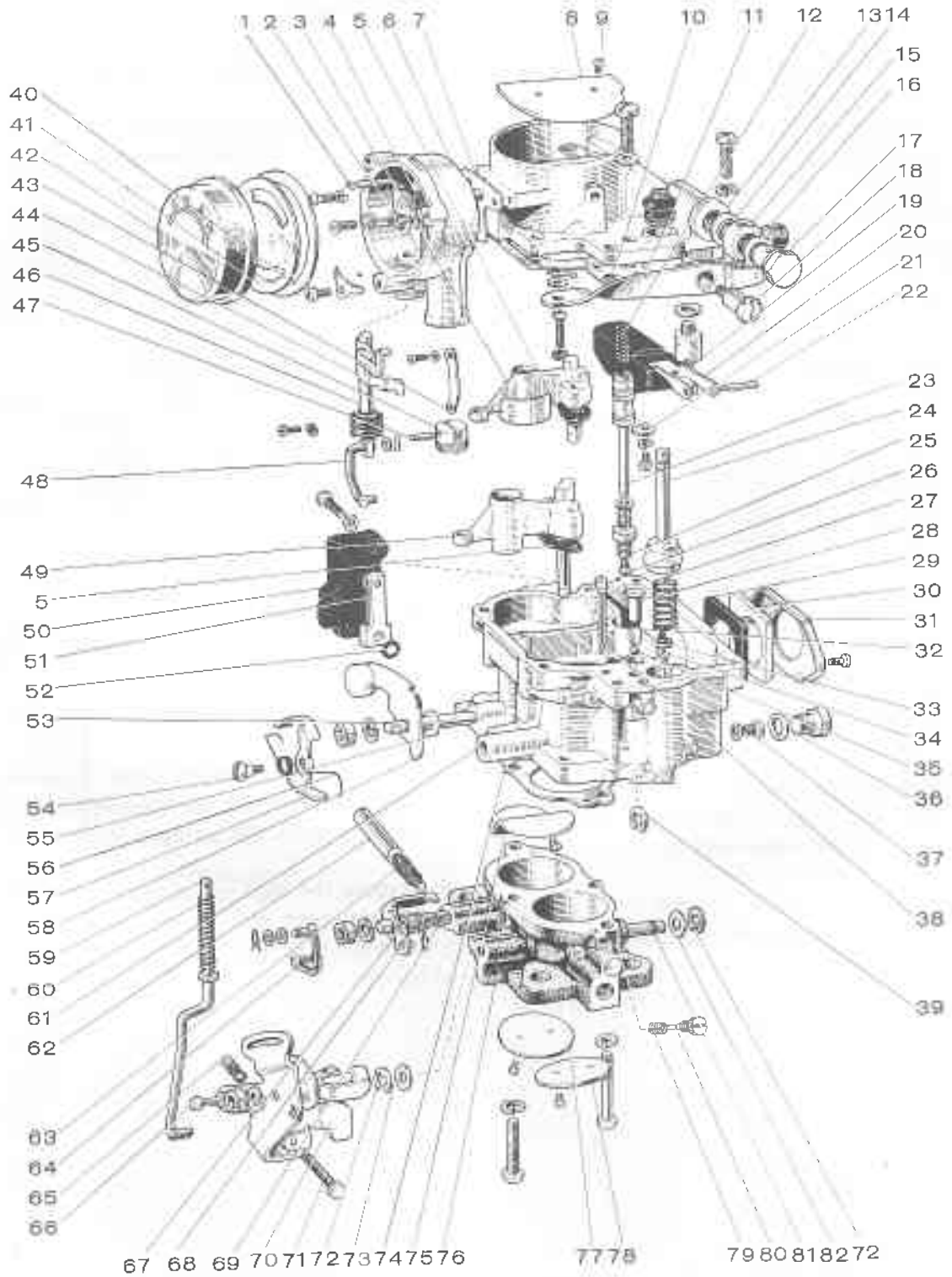


Fig. 5-26 Carburetor Components for RT Series Y5772

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

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

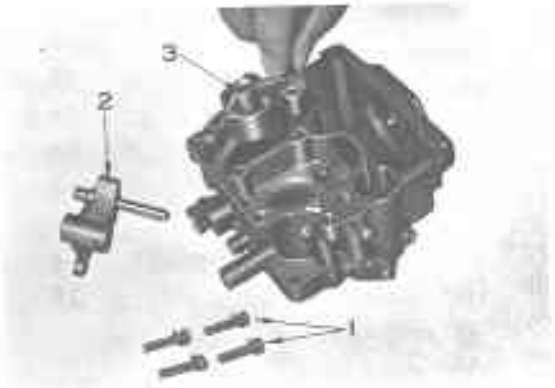


Fig. 5-27 Venturi Removal B0112

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.

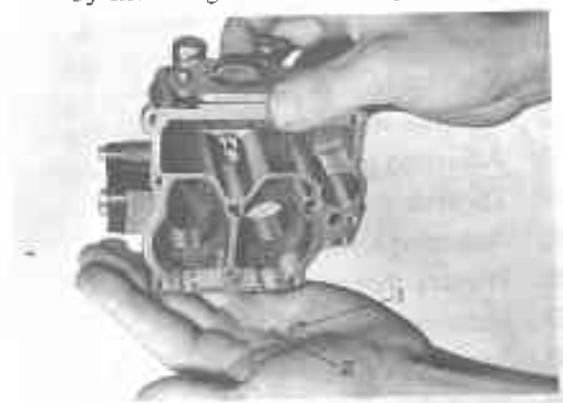


Fig. 5-28 Steel Ball Removal V1860

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 valve cover, thermostatic valve (4) and the "O" ring (5).
Do not disassemble the thermostatic valve.

Fig. 5-29 Power Valve Removal B0113

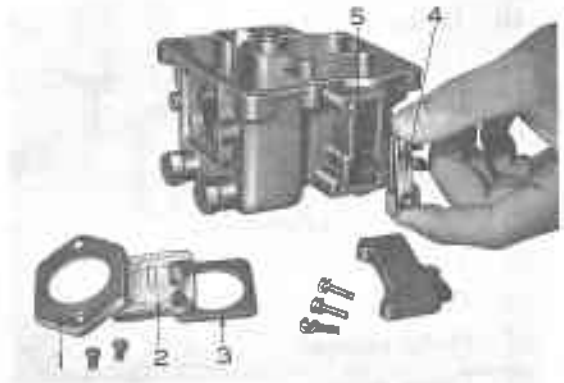


Fig. 5-30 Thermostatic Valve Removal B0114

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.

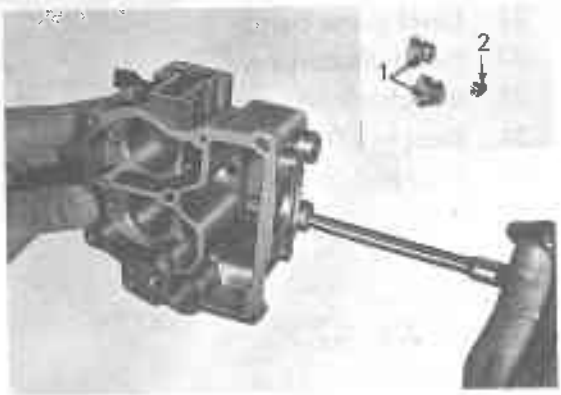


Fig. 5-31 Main Jet Removal B0115 B0116

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.

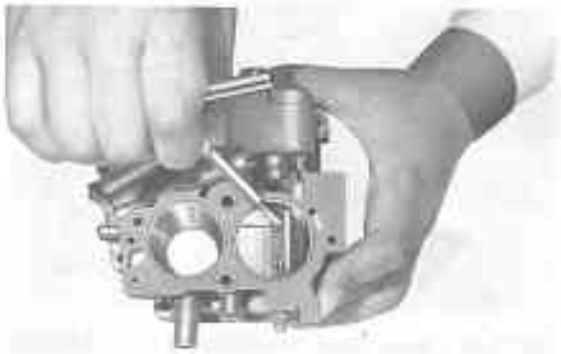


Fig. 5-32 High Speed Valve Removal *B0117*

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.

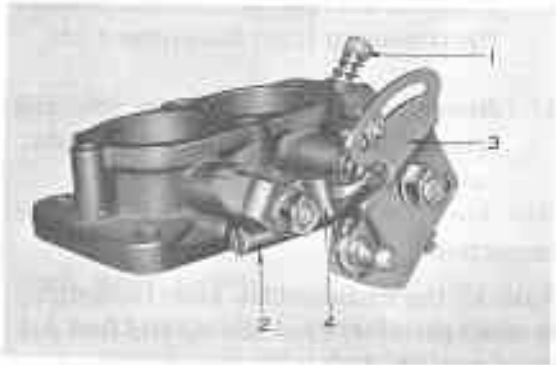


Fig. 5-33 Screw & Lever Removal *B0118*

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).

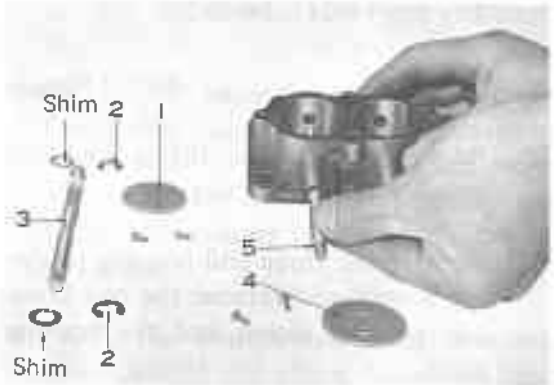


Fig. 5-34 Throttle Shaft Valves Removal *V1876*

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).

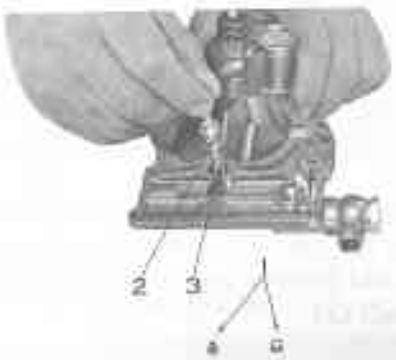


Fig. 5-36 Power Piston Removal *V3998*

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.

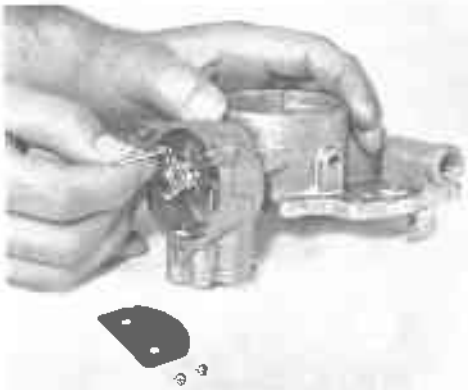


Fig. 5-38 Choke Shaft Removal *V4000*

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.

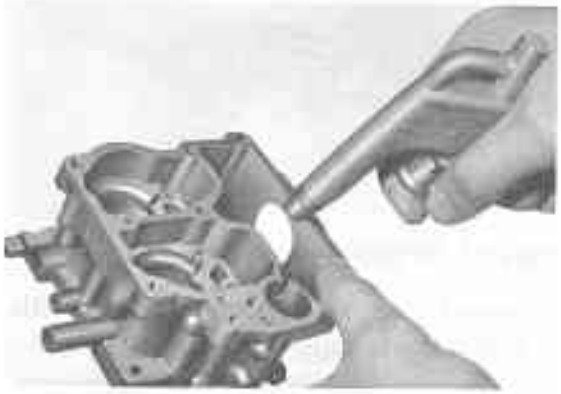


Fig. 5-40 Cleaning Passages V4002

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 leahter 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.

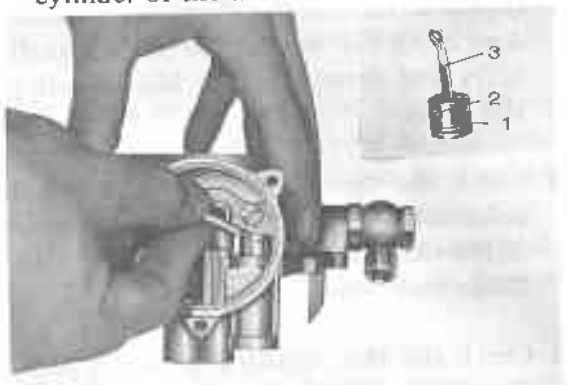


Fig. 5-42 Assembling Vacuum Piston *V4003 V4004*

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

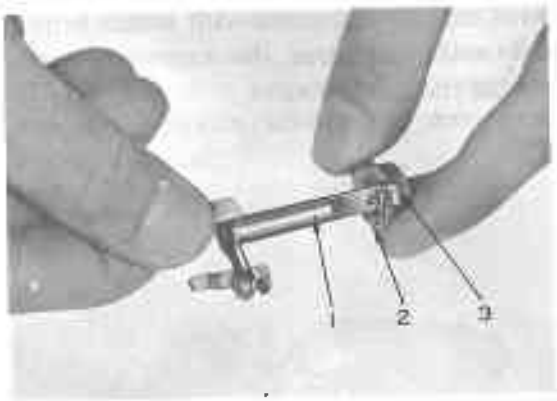


Fig. 5-43 Assembling Choke Shaft *V4005*

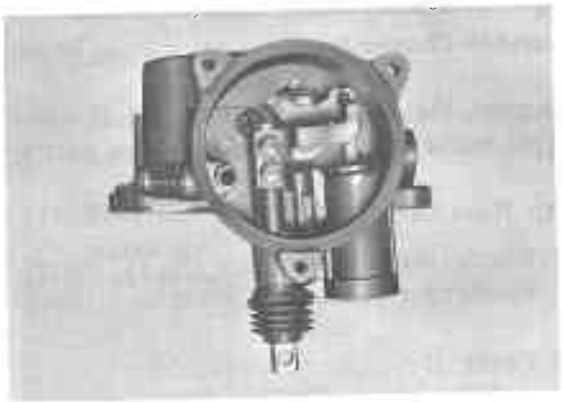


Fig. 5-44 Assembling Inside of Thermostat Case *V4006*

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.

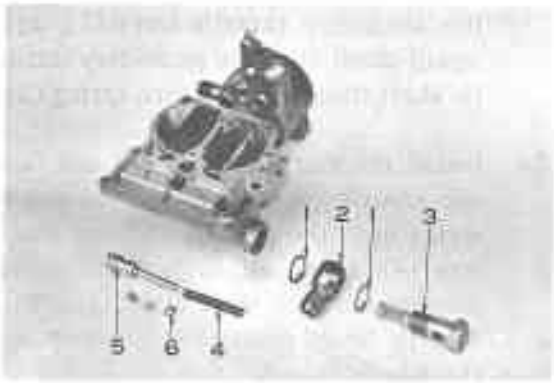


Fig. 5-46 Fitting & Power Piston Assembly *V4008*

10. Install the needle valve seat (6) with the gasket, and assemble the needle valve (5), valve spring (4) and the push pin (3), then install the float (2) with the float lever pin (1).

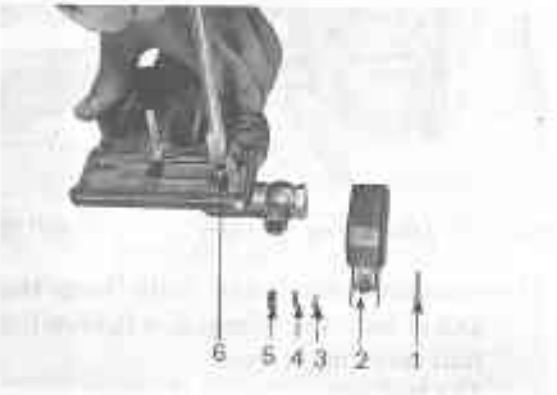


Fig. 5-47 Float Assembly *V3997*

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).

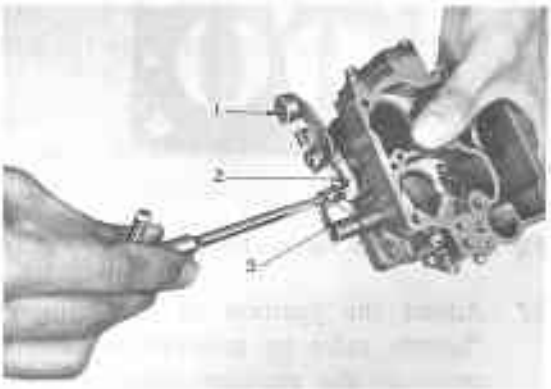


Fig. 5-48 Shaft Arm & Stopper Lever Assembly *B0119*

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.

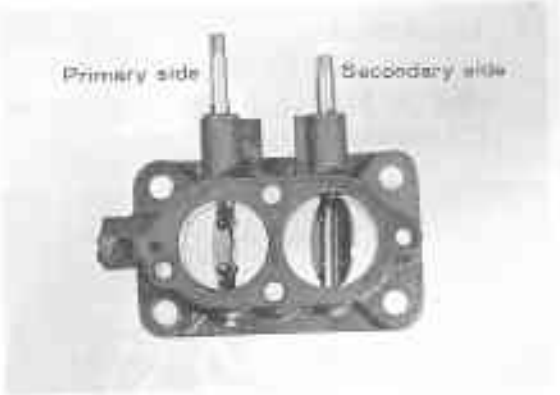


Fig. 5-49 Throttle Valves Assembly *V4009*

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.

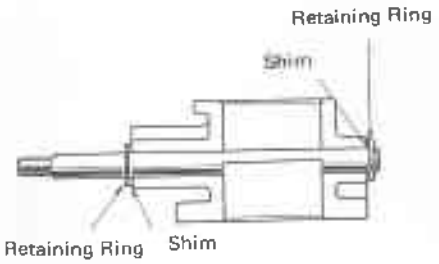


Fig. 5-50 Shaft Shim Assembly *G0147*

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.

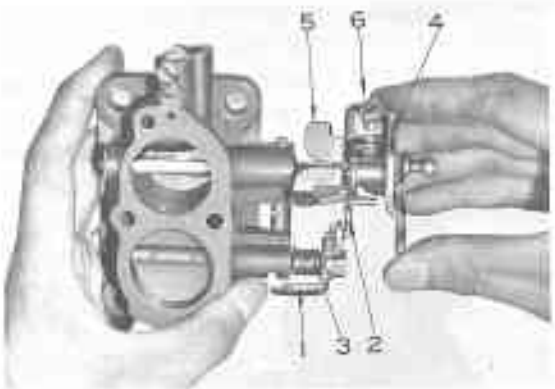


Fig. 5-51 Link & Arm Assembly *B0120*

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.

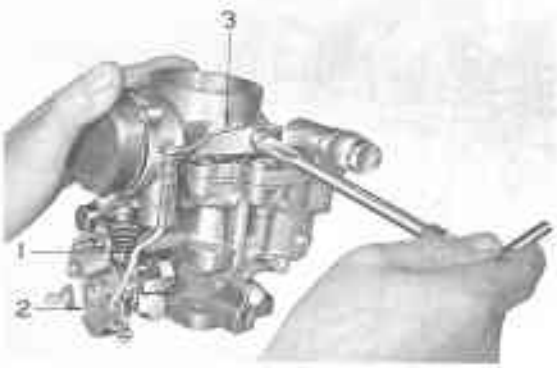


Fig. 5-52 Pump Lever & Link Assembly *B0121*

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 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).

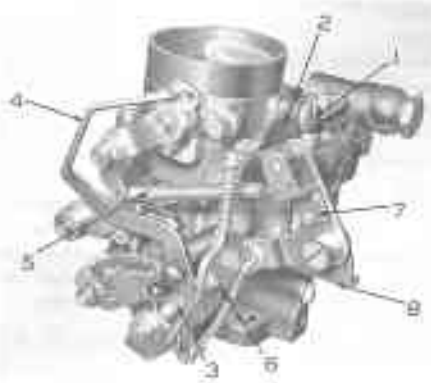
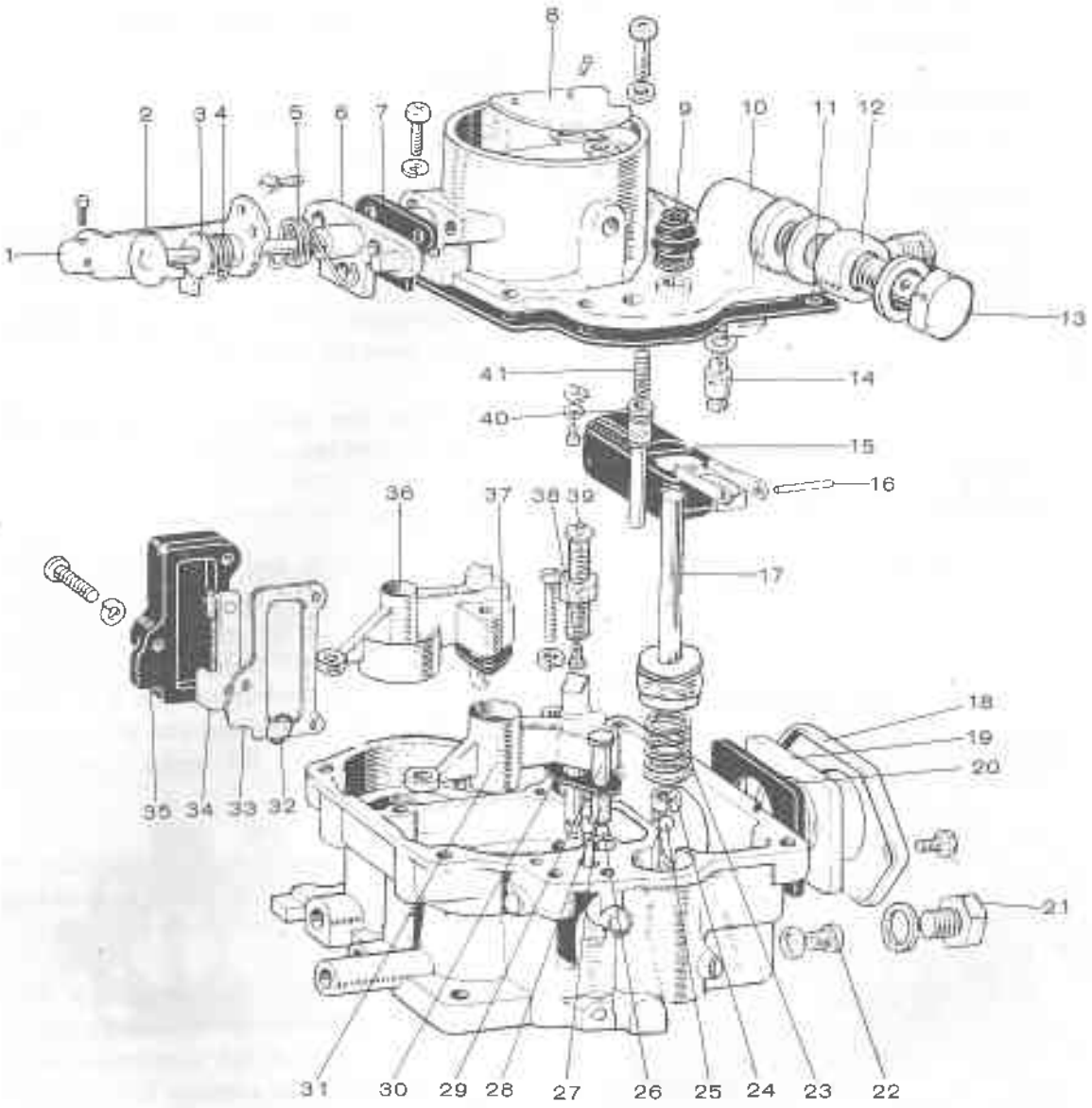
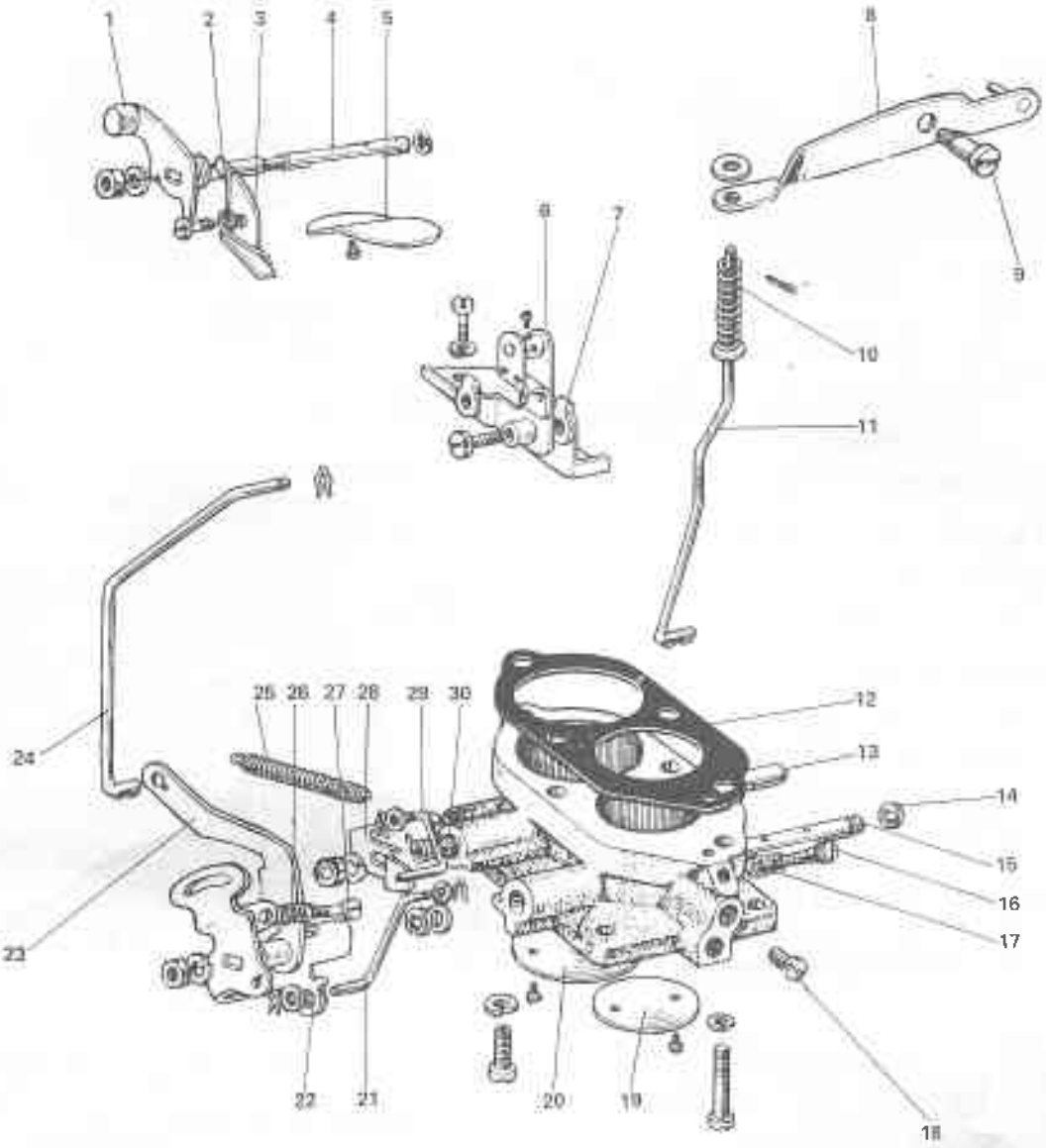


Fig. 5-53 Connecting Links Removal *B0954*



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 Y6959



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).

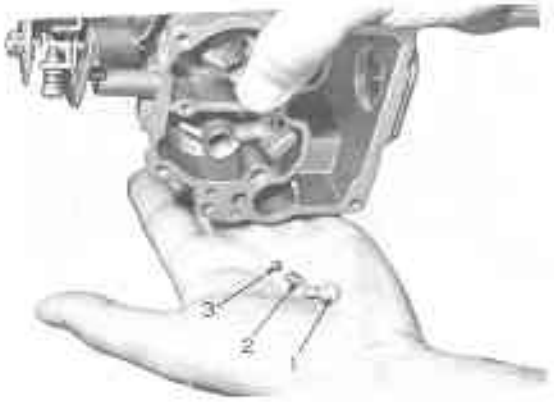


Fig. 5-56 Steel Ball Removal *B0951*

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

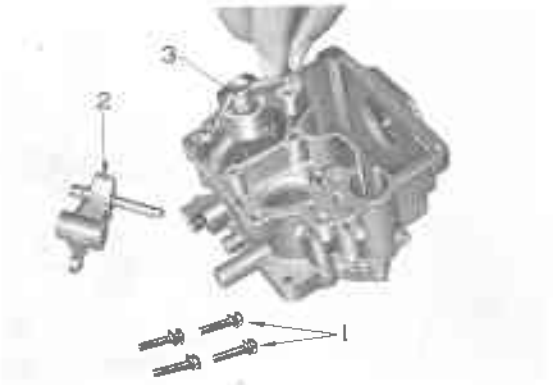


Fig. 5-58 Venturi Removal *B0112*

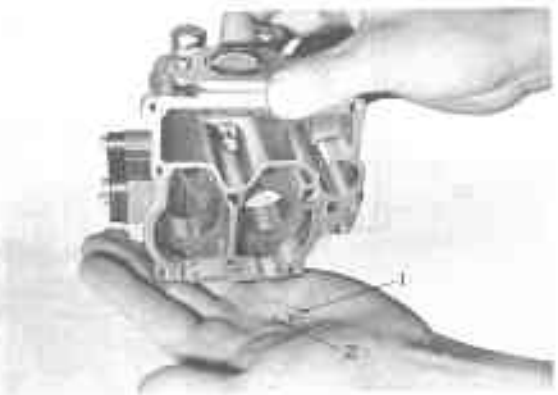


Fig. 5-59 Steel Ball Removal *V1860*

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.

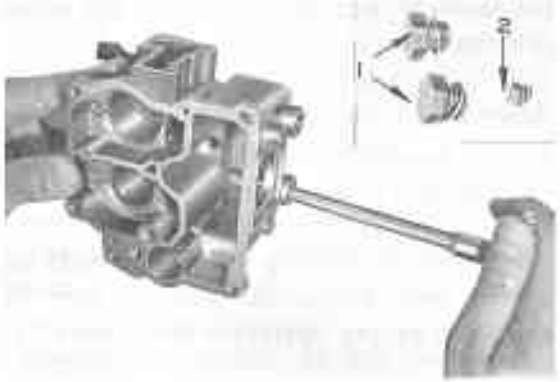


Fig. 5-62 Main Jet Removal *B0115*
B0116

16. Remove the high speed valve retaining screws, then remove the high speed valve.
Since the ends of the retaining screws are calked, file off the calked portions of the screw ends slightly before removing.

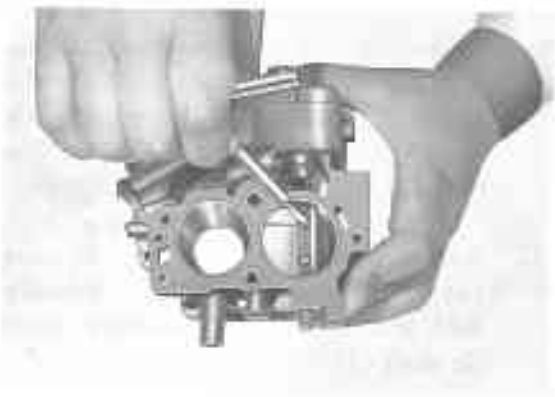


Fig. 5-63 High Speed Valve Removal *B0117*

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 calked, remove them after filing off slightly the calked 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).

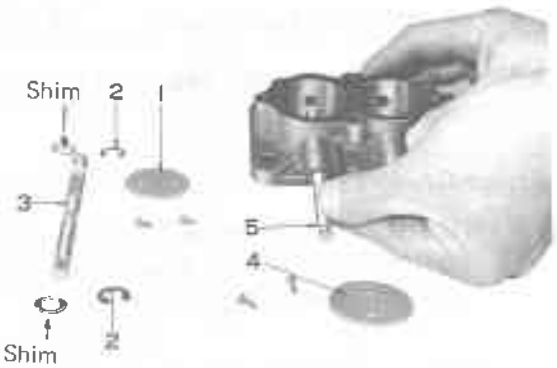


Fig. 5-65 Throttle Shafts & Valves Removal *V1876*

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

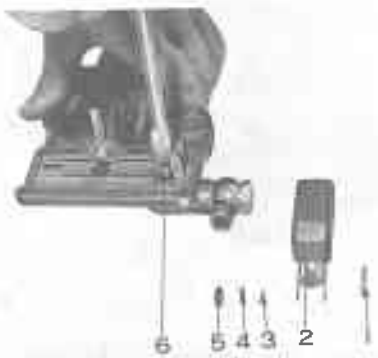


Fig. 5-66 Needle Valve Removal *V3997*

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

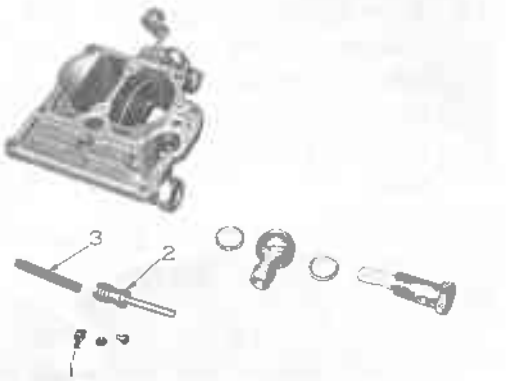


Fig. 5-67 Power Piston Removal *B0956*

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 cheking 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).

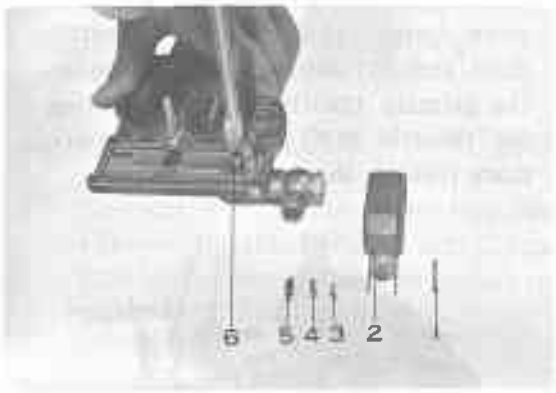


Fig. 5-68 Float Assembly *V3997*

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.

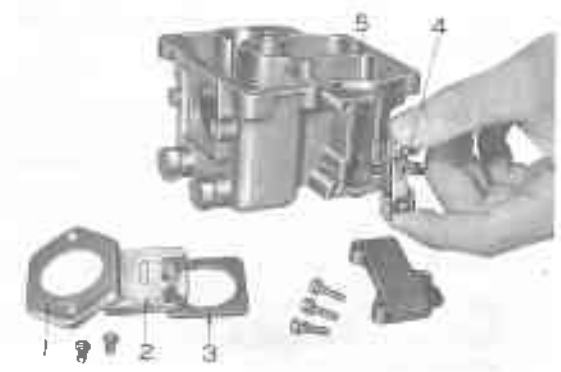


Fig. 5-69 Gauge Glass & Thermostatic Valve Assembly *B0114*

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 retutn spring (3).

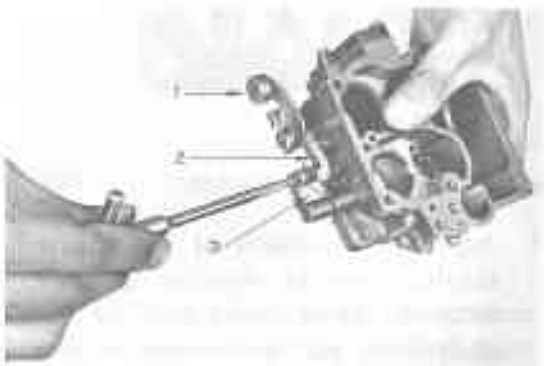


Fig. 5-70 Shaft Arm & Stopper Lever Assembly *B0119*

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.

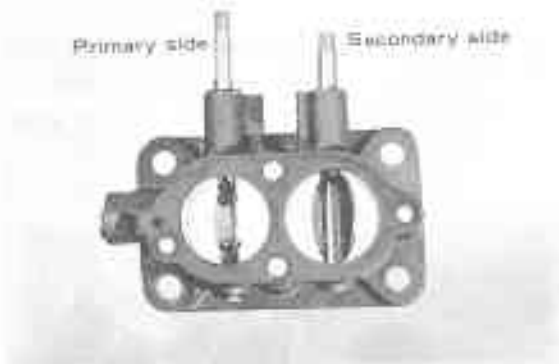


Fig. 5-71 Throttle Valves Assembly *V4009*

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.

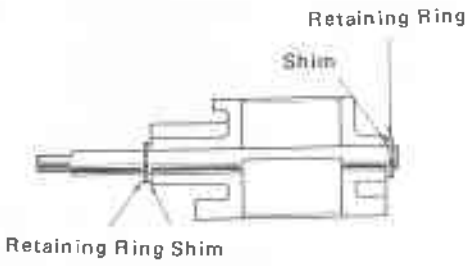


Fig. 5-72 Shaft Shims Assembly *G0147*

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).

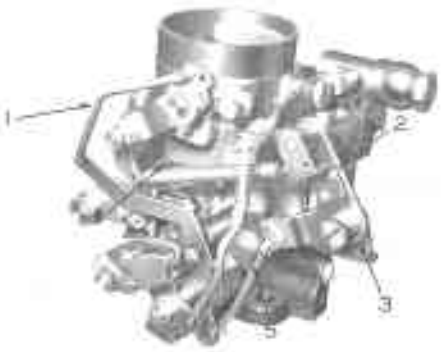


Fig. 5-74 Links Assembly *B0954*

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.

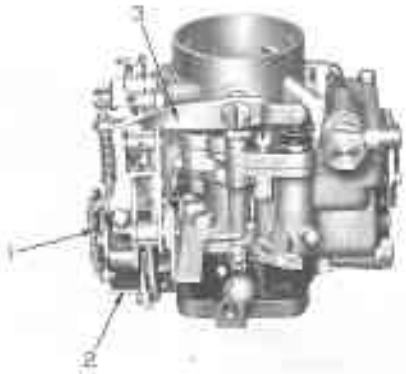


Fig. 5-75 Pump Lever & Link Assembly *B0957*

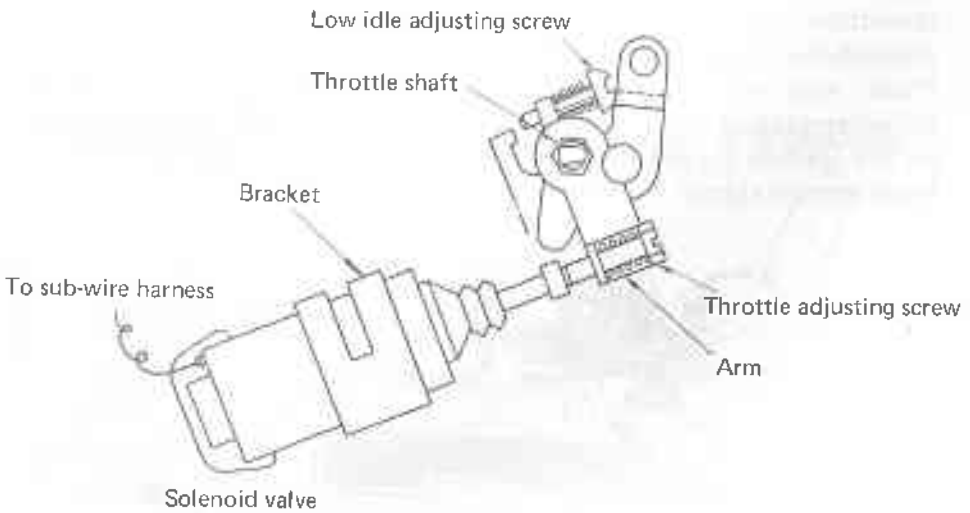
Installation

1. Follow the removal procedures in the reverse order.

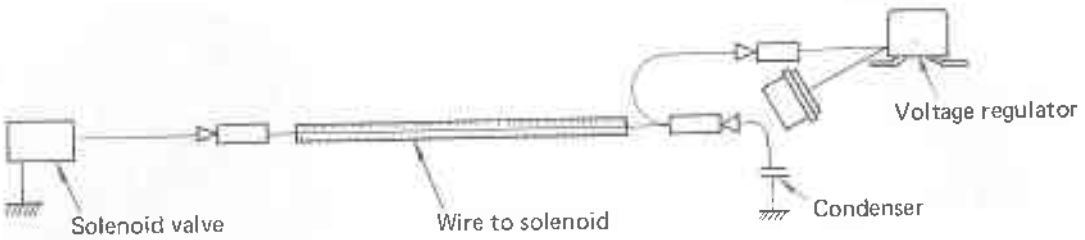
2. After the engine is warmed up, check the fuel level and the fuel leaks, then perform the idle adjustment referring to the Engine Tune-Up section.

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.

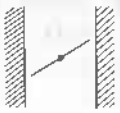
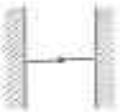


IDLE ADJUSTMENT PROCEDURES

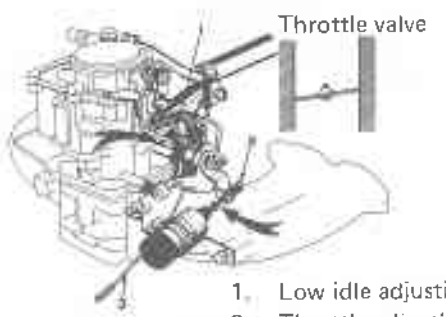


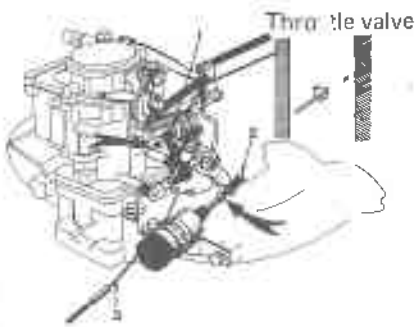
1. Warm up the engine sufficiently.
2. Adjust the engine idling revolution to 550 ± 50 r.p.m. by throttle adjust screw (Newly installed part).

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 ± 50
ON (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.





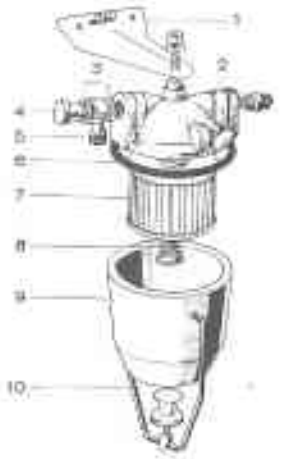
1. Low idle adjusting screw
2. Throttle adjusting screw
3. Solenoid valve wire harness

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.



1 Fuel filter support bracket
2 Fuel filter body
3 Gasket
4 Union bolt
5 Union fitting
6 Filter bowl gasket
7 Fuel filter element
8 Element attaching spring
9 Filter bowl
10 Filter bowl bail

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

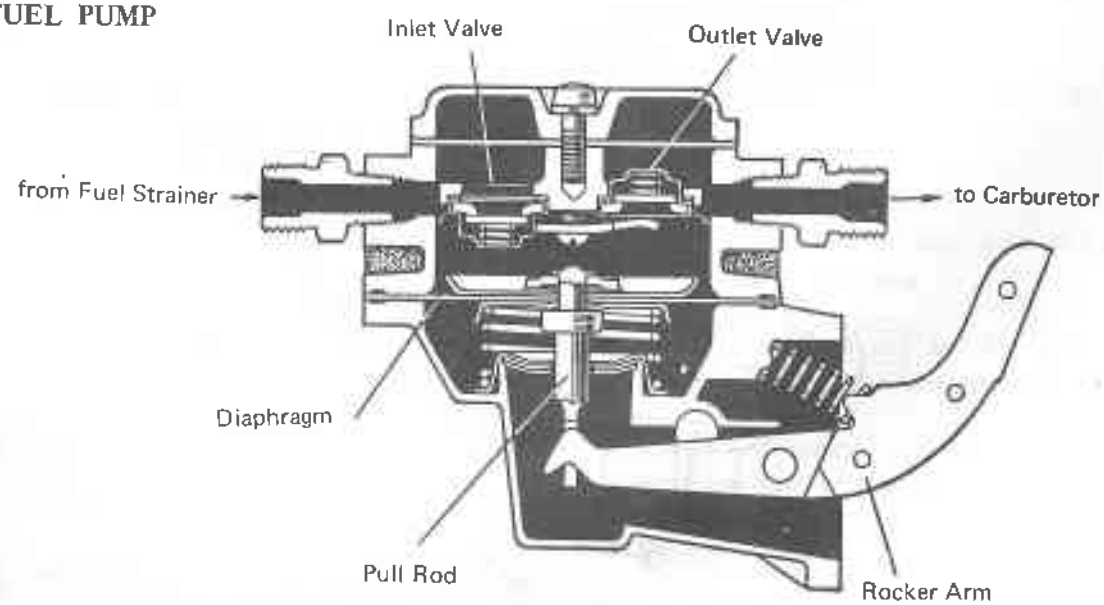


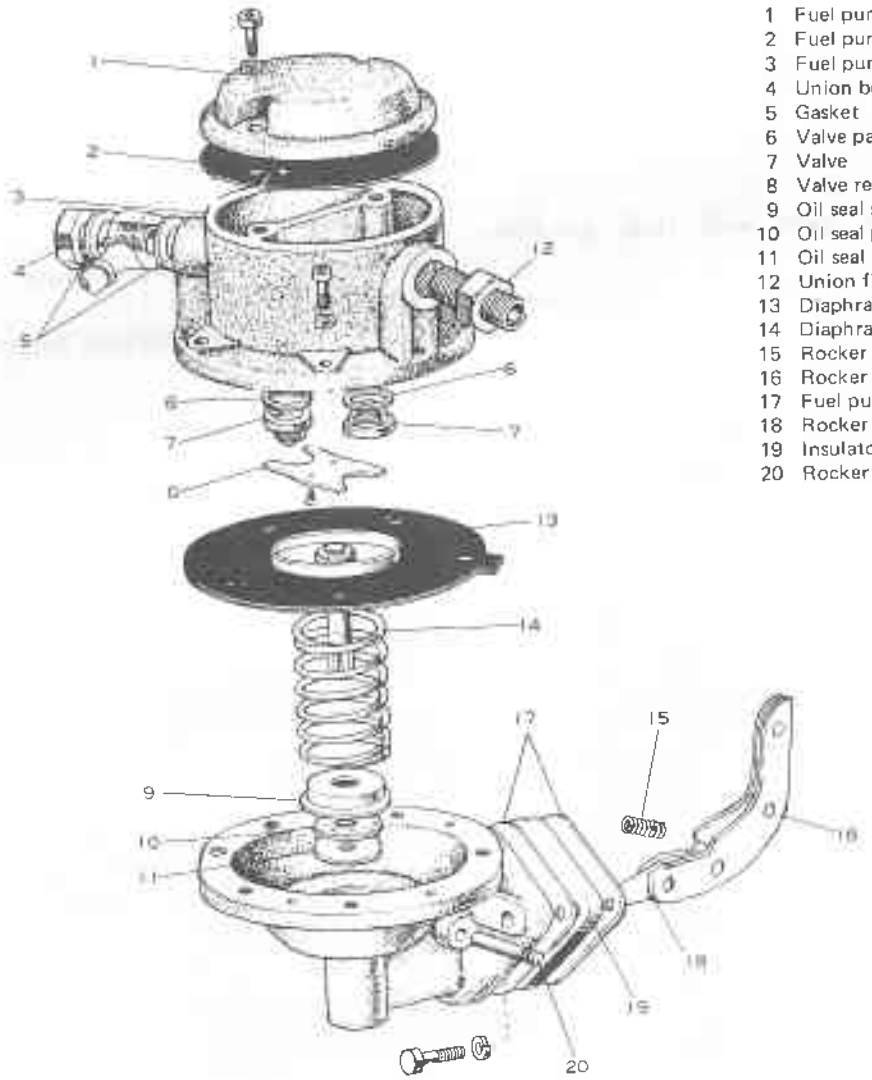
Fig. 5-78 Cross Sectional View of Fuel Pump *G1774*

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/cm² (3.1 ~ 4.5 psi)
Vacuum	Over −400 mmHg (15.7 inHg)



1 Fuel pump cover
2 Fuel pump cover gasket
3 Fuel pump upper body
4 Union bolt
5 Gasket
6 Valve packing
7 Valve
8 Valve retainer
9 Oil seal spring retainer
10 Oil seal packing
11 Oil seal packing retainer
12 Union fitting
13 Diaphragm
14 Diaphragm spring
15 Rocker arm spring
16 Rocker arm
17 Fuel pump gasket
18 Rocker arm link
19 Insulator
20 Rocker arm pin

Fig. 5-79 Fuel Pump Components G2038

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 remove 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 none-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^2
   (3.1 ~ 4.5 psi)

* *

FUEL TANK & FUEL PIPE

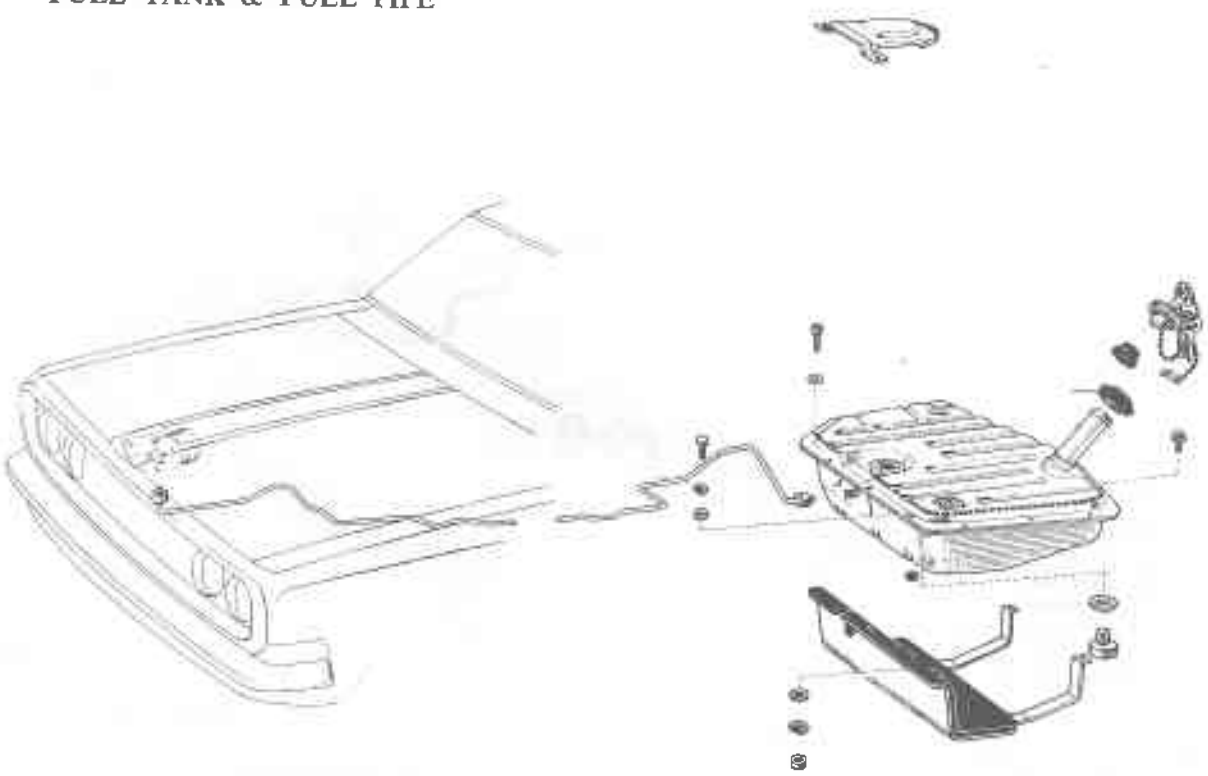


Fig. 5-84 Fuel Tank & Pipe Components on 81 Series Y7292

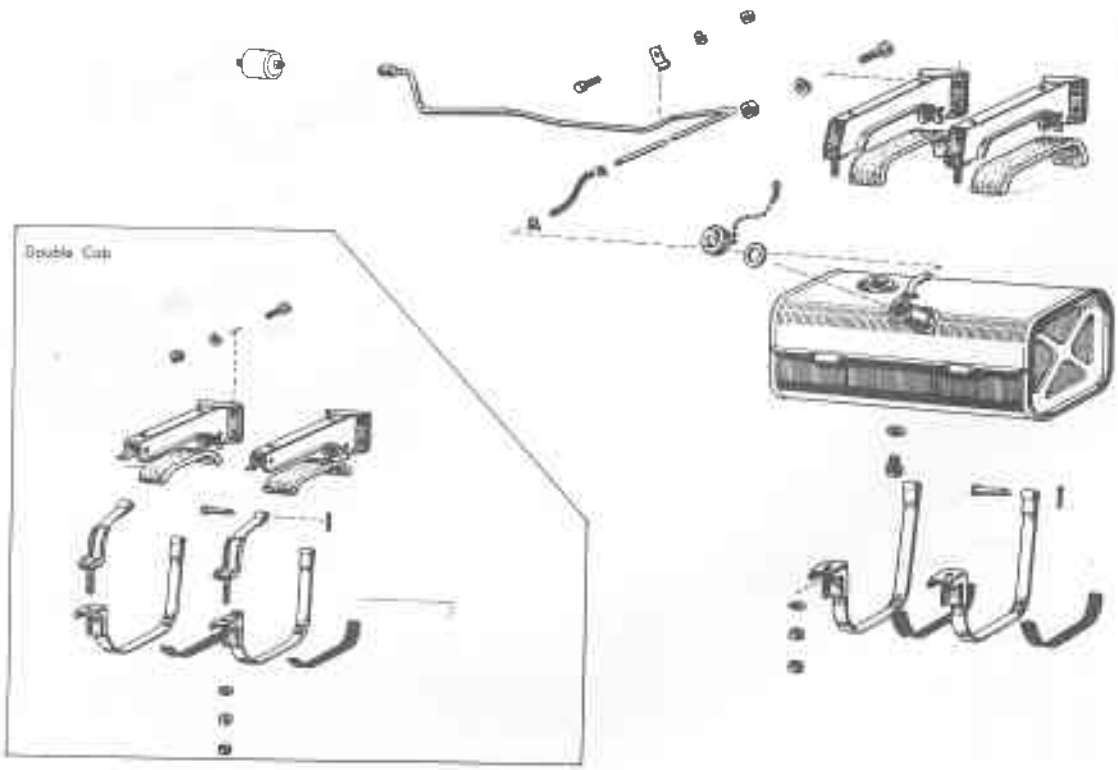
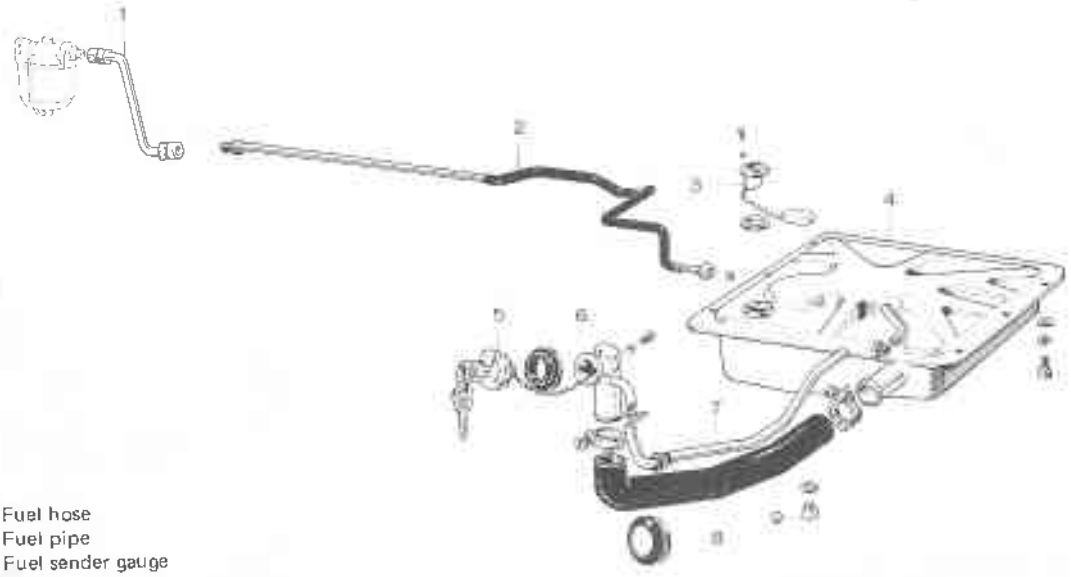
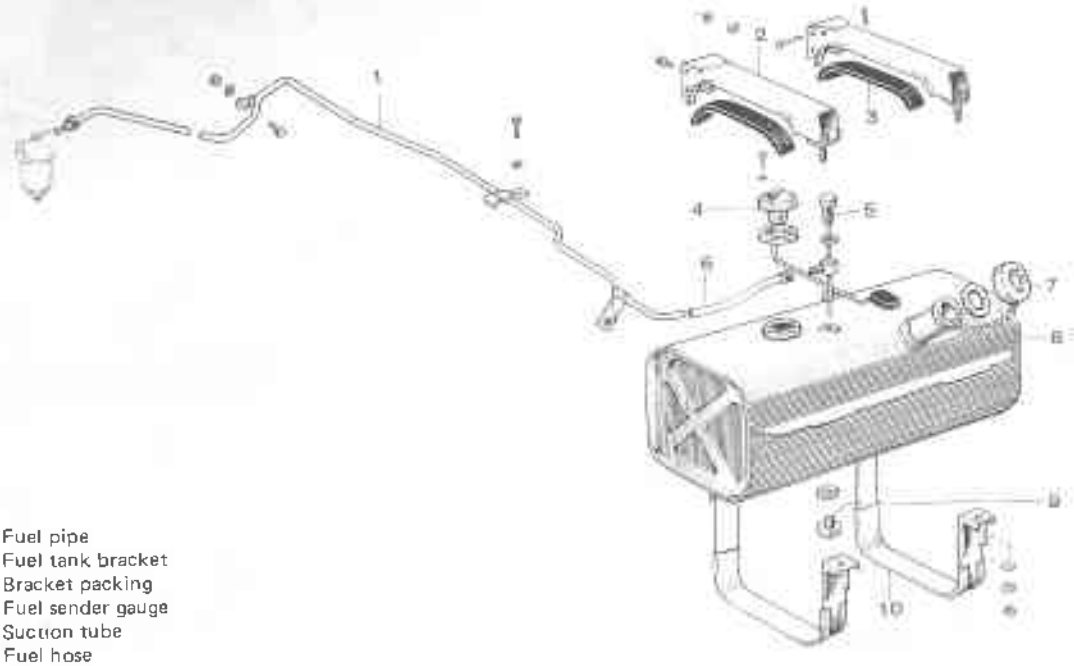


Fig. 5-85 Fuel Tank & Pipe Components on RY Series G3805



1 Fuel hose
2 Fuel pipe
3 Fuel sender gauge
4 Fuel tank
5 Fuel tank cap
6 Fuel inlet upper pipe
7 Breather tube
8 Inlet pipe connector
9 Drain plug

Fig. 5-86 Fuel Tank & Pipe Components on RH10V, B, G & 15B-B Series G3806



1 Fuel pipe
2 Fuel tank bracket
3 Bracket packing
4 Fuel sender gauge
5 Suction tube
6 Fuel hose
7 Fuel tank cap
8 Fuel tank
9 Drain plug
10 Fuel tank band

Fig. 5-87 Fuel Tank & 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

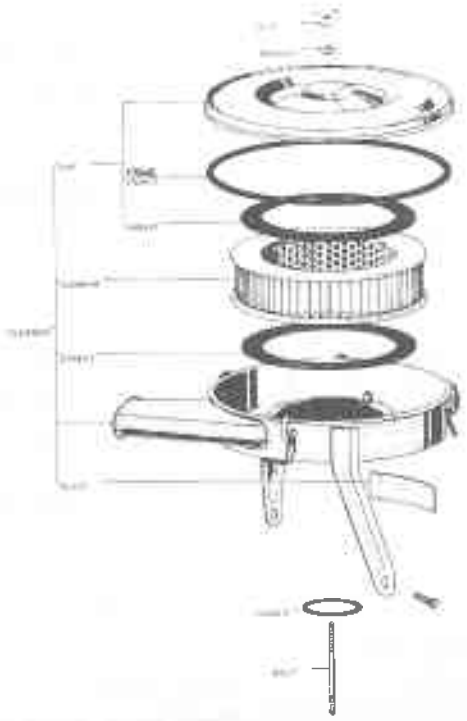


Fig. 5-88 Air Cleaner Components on RT & RN Series G3128

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

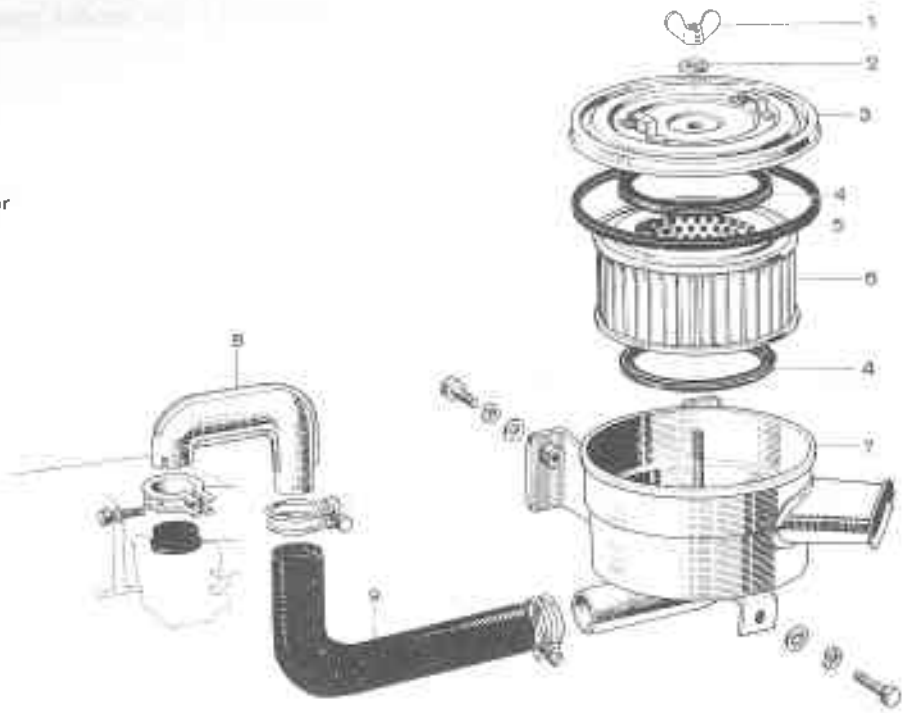


Fig. 5-89 Air Cleaner Components on RH Series G3808

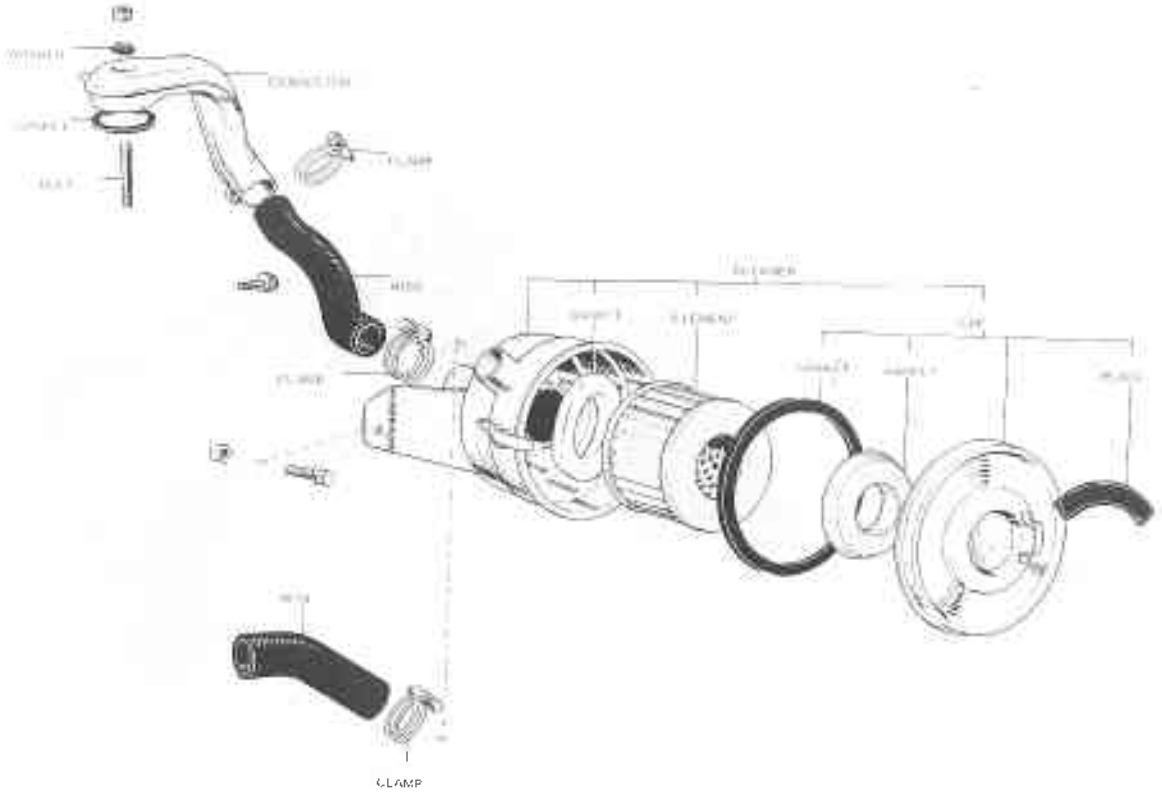


Fig. 5-90 Air Cleaner Components on RY Series

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

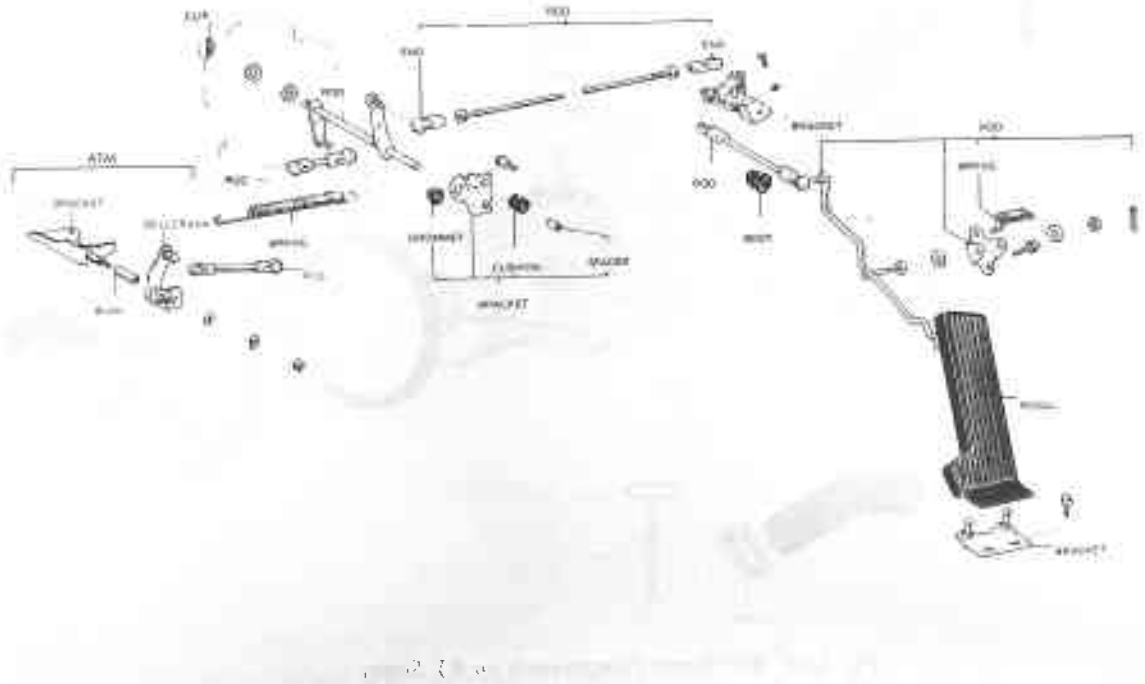
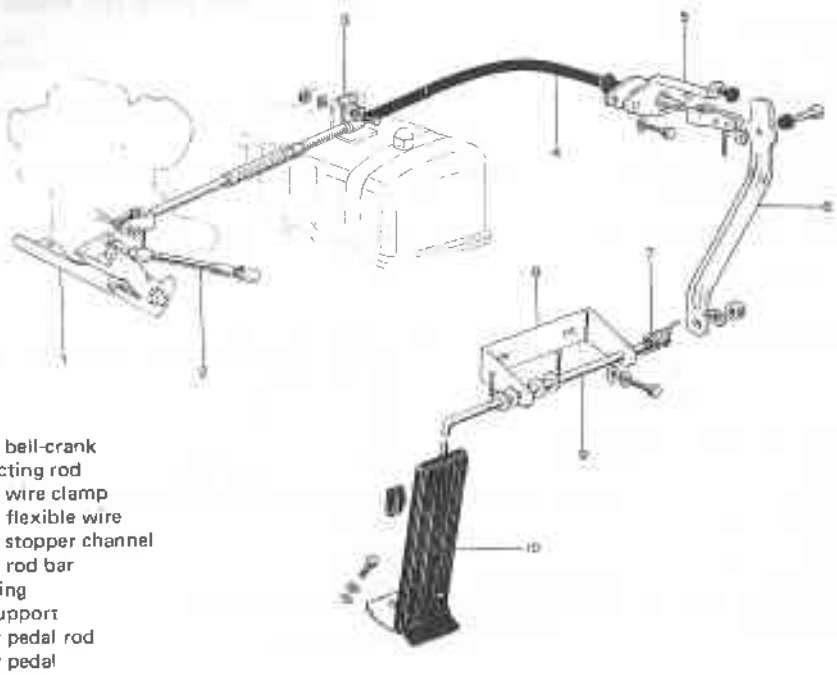


Fig. 5-91 Accelerator Linkage Components on RT Series for RHD G3809



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

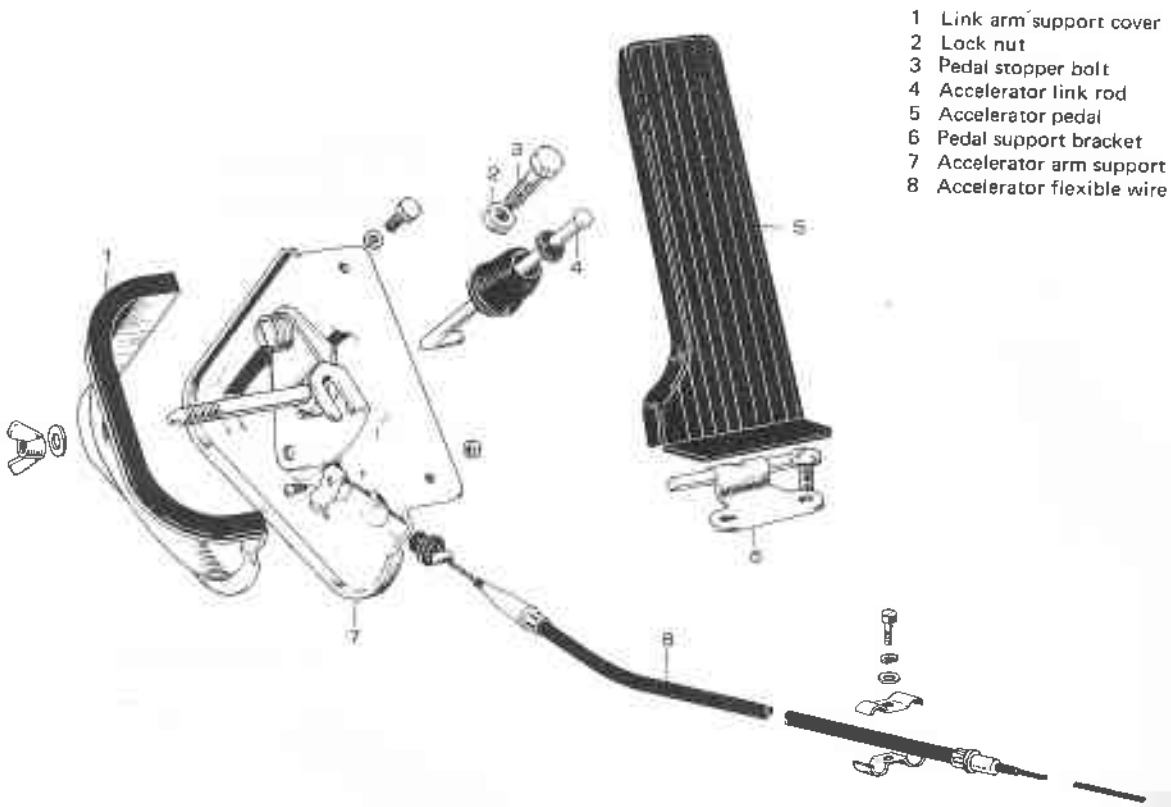


Fig. 5-93 Accelerator Linkage Components on RH Seires for RHD G3812

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

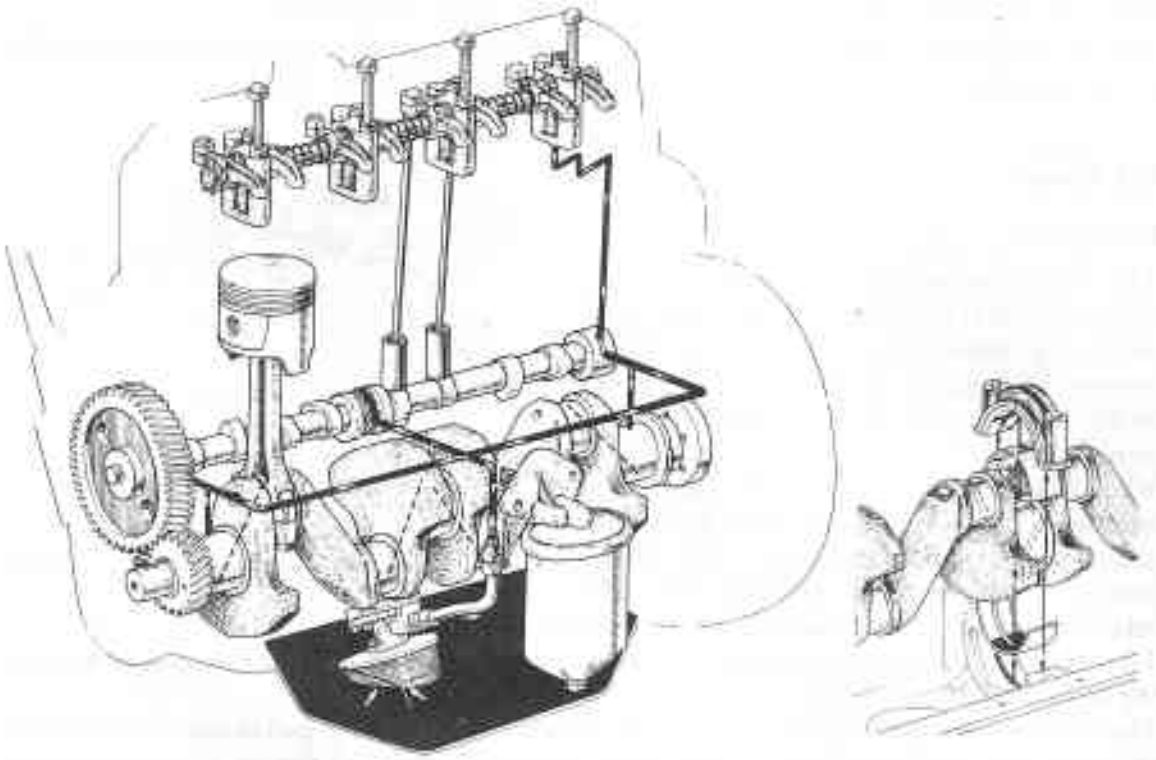


Fig. 6-1 2R-Engine Lubricating System *Y5512, G0842*

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.

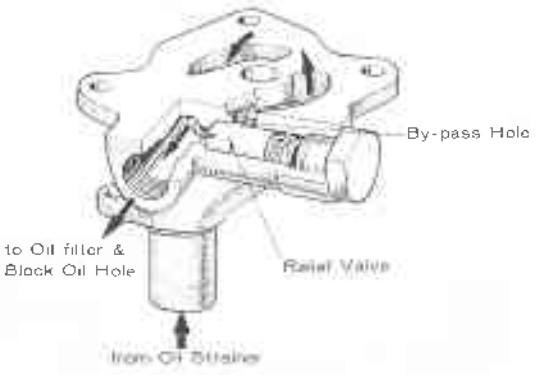


Fig. 6-2 Relief Valve Operation *G0843*

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 ~ 4.3 kg/cm² (52.5 ~ 61.2 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.

Specification:

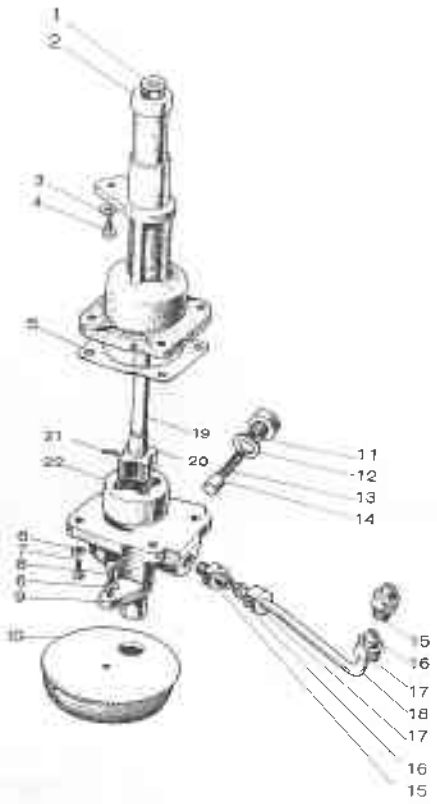
Type		Trochoid
Delivery quantity:	at oil temperature 100°C (212°F) Using oil - SAE30	Over 1.7 liters (1.8 US qts., 1.5 Imp. qts) per minute at 300 rpm & at oil pressure of 2 kg/cm² (28.4 psi) Over 19 liters (20.1 US qts., 16.7 Imp. qts) per minute at 2,500 rpm & at oil pressure of 3 kg/cm² (42.7 psi)
Relief valve operating pressure: at oil temperature 100° C (212° F) at 2,500 rpm		Starts to open at 3.7 ~ 4.3 kg/cm² (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.



1 Plate washer
2 Oil pum body
3 Wave washer
4 Body retaining bolt
5 Pump cover gasket
6 Lock washer
7 Cross recess hexagon bolt
8 Strainer retaining bolt
9 Oil pump cover
10 Oil strainer
11 Relief valve plug
12 Valve gasket
13 Relief valve spring
14 Relief valve
15 Union fitting
16 Ball sleeve
17 Union nut
18 Oil pump outlet pipe
19 Rotor shaft
20 Drive rotor
21 Pin
22 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.

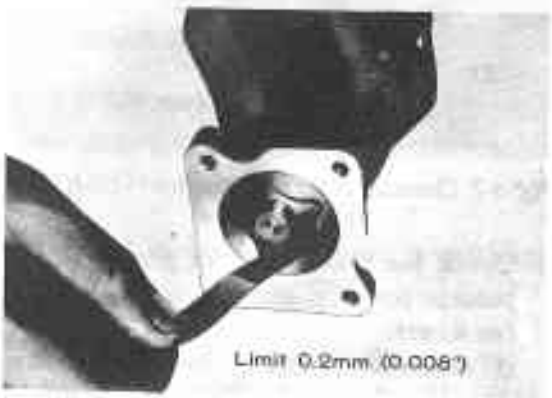


Fig. 6-5 Checking Tip Clearance *V3189*

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 (1.85")
Installed length	36.8 mm (1.45")
Installed tension	5.99 ~ 6.59 kg (13.2 ~ 14.5 lbs)

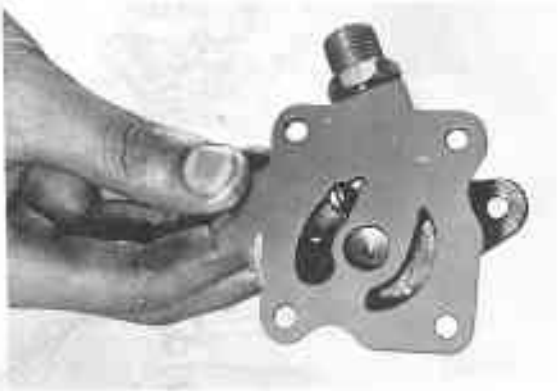


Fig. 6-8 Checking Relief Valve *V3192*

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

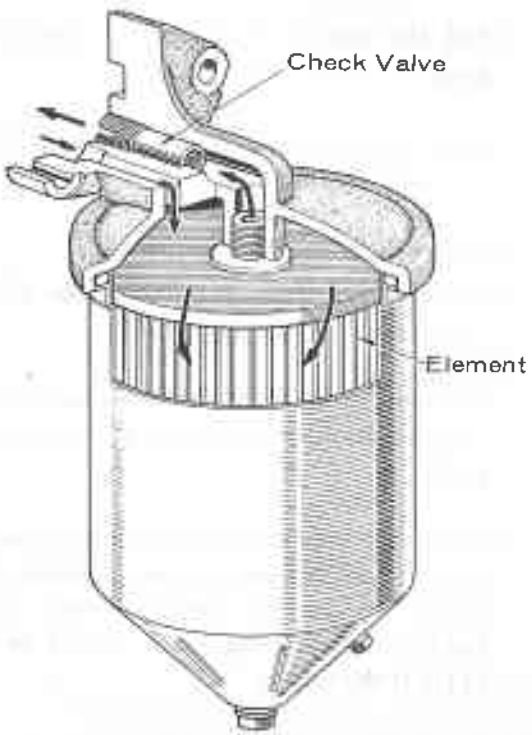


Fig. 6-10 Cross Sectional View of Oil Filter G0728

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/cm² (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 (0.85 US qt., 0.70 Imp. qt)
Check valve operating pressure	0.8 ~ 1.2 kg/cm² (11.4 ~ 17.0 psi)

Removal

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

Disassembly

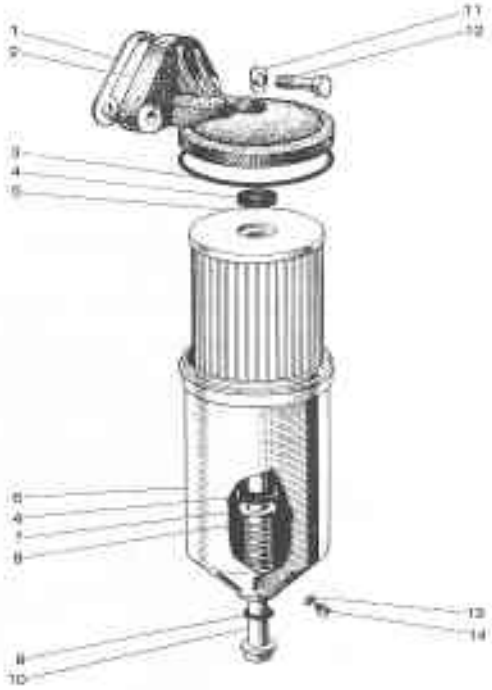
1. Remove the drain plug, and drain the oil.

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.



1 Oil filter gasket
2 Oil filter cap
3 Cap gasket
4 Filter element gasket
5 Oil filter element
6 Oil filter case
7 Plain washer
8 Element support spring
9 Cartridge guide gasket
10 Filter cartridge guide
11 Wave washer
12 Filter retaining bolt
13 Drain plug gasket
14 Drain plug

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-kg (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-kg (11.5 ft-lb) torque.

4. Replenish the engine oil and check for oil leak after operating engine.

COOLING SYSTEM

DESCRIPTION

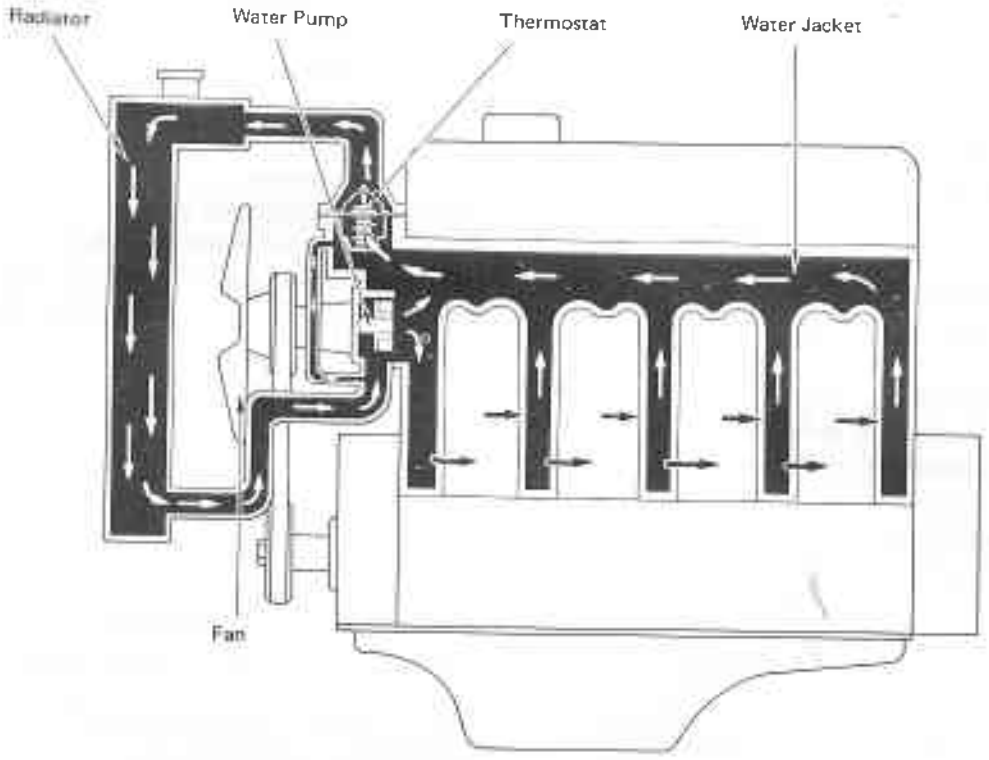


Fig. 7-1 Engine Cooling System *Y5516*

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 & 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 provived with the by-pass port which is connected with the thermostat housing.
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

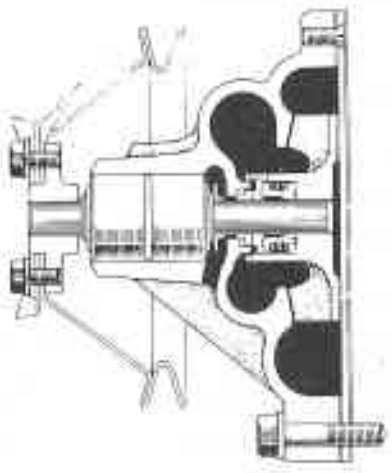
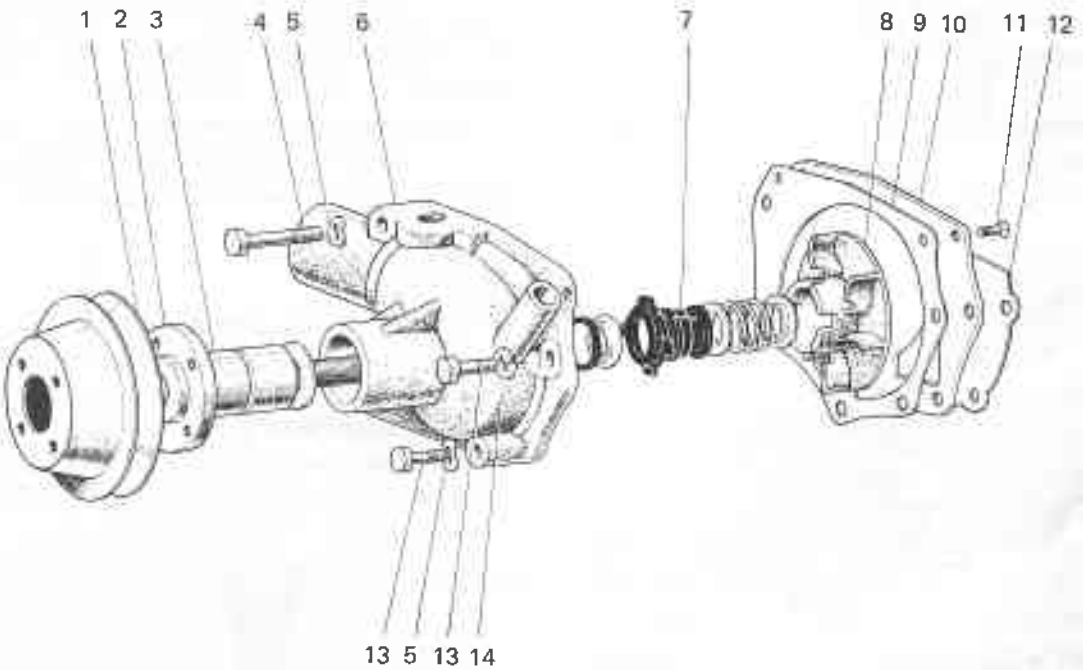


Fig. 7-2 Water Pump Section G3203

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/cm² (5.7 psi)
Water seal method	Mechanical seal
Bearing type	Dual ball bearings with grease sealed
Rotational ratio with crankshaft	13 to 11



1. Fan pulley
2. Pulley seat
3. Water pump bearing
4. Pump retaining bolt
5. Wave washer
6. Water pump body
7. Water pump seal set
8. Water pump rotor
9. Gasket
10. Water pump plate
11. Plate retaining screw
12. Gasket
13. Pump retaining bolt
14. Lock washer

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 hole 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.

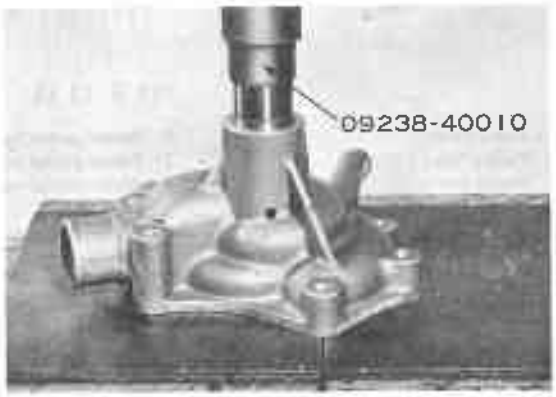


Fig. 7-7 Installing Bearing *V3197*

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

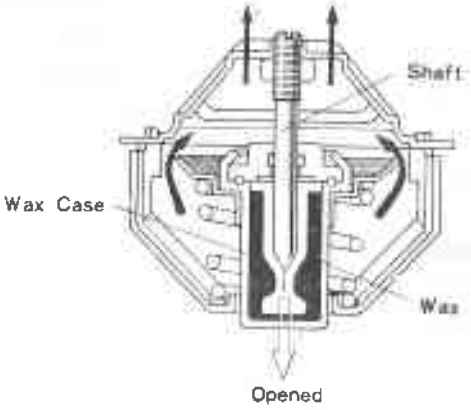


Fig. 7-10 Thermostat Section *G1500*

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
	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.

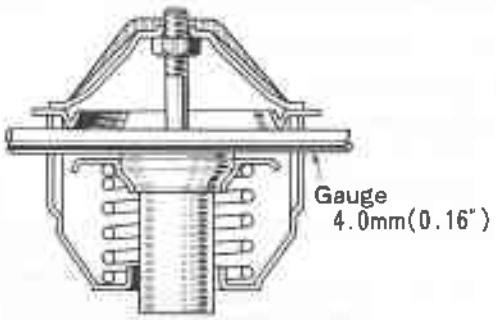


Fig. 7-11 Checking Thermostat *10134*

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.

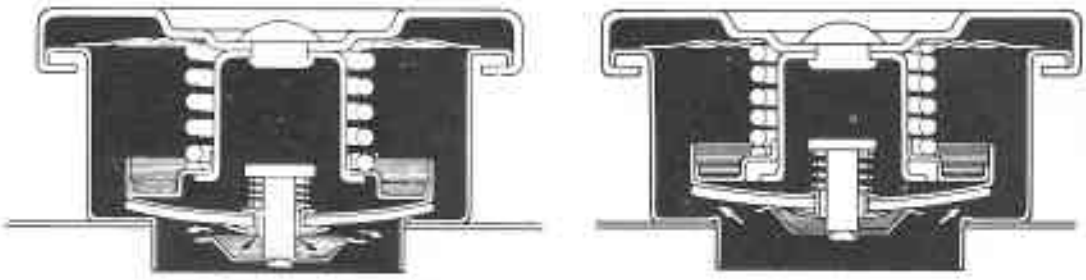
RADIATOR

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/cm² (4 psi) above the atmospheric pressure within the cooling system.

When the pressure within the radiator increases above 0.3 kg/cm² (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/cm² (7 psi) – 2R
	0.9 kg/cm² (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 underneath 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

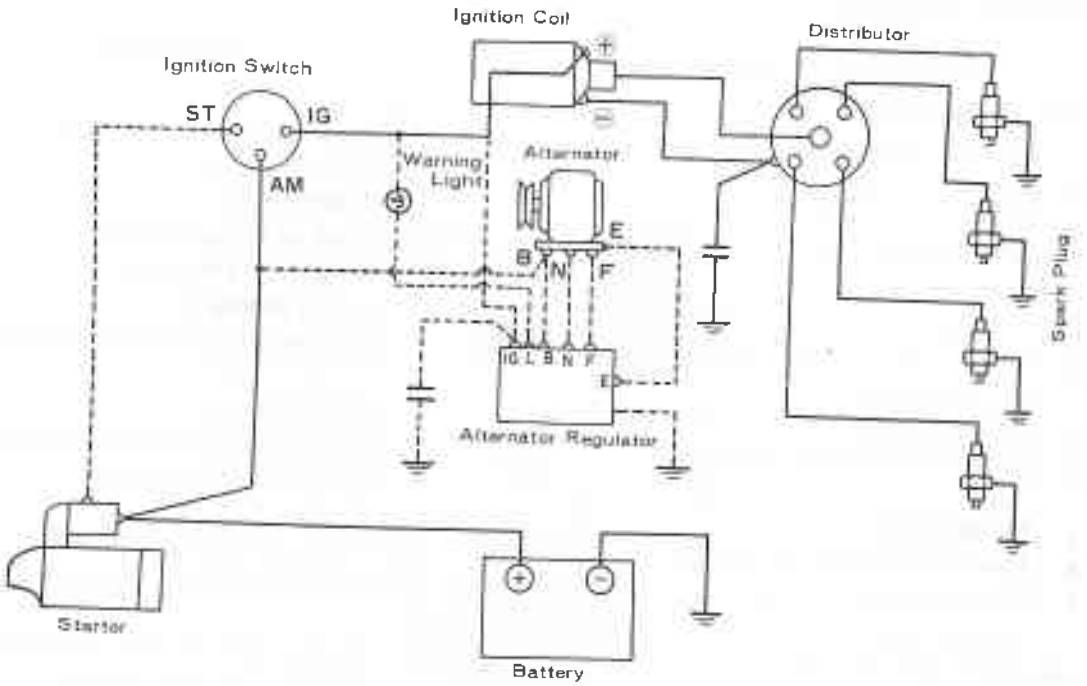


Fig. 8-1 Charging System Wiring Diagram G3813

The purpose of the charging system in a car is to adequately charge the battery which is the source of electric power, and also to supply electric power to other electrical equipment in place of the battery when the engine is operated.
The charging system consists of the alternator and the alternator regulator, and the wiring diagram is as shown in the above illustration. The proper operation of the charging system can be checked with the charge warning light.
The alternator has the following excellent features in comparision with the conventional DC generator.

1. It provides a very high output at cruising speeds and also at lower engine revolution.

2. Since the alternator uses the silicone diodes for rectification, there is no increase of temperature due to the rectification sparks compared with the DC generator. Also as the slip ring of the alternator is not used for rectification, the brush life is longer in the alternator.

3. The maximum revolution of the alternator is rather restricted by the mechanical conditions of the ball bearings, centrifugal force of the rotor and the fan belt than the electrical conditions. Therefore, the alternator can be operated at high revolution than the DC generator, and the rotational ratio to the engine can be designed more largely. For these reasons, the alternator can be designed compact and light.

4. As the alternator has a self-limiting characteristic in limiting the output, and by utilizing the diodes for rectification, a current control such as a cut-out relay and a current limiter are not required for the alternator.

The functioning of the alternator regulator in the charging system is to regulate the alternator output voltage to a pre-set value.

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

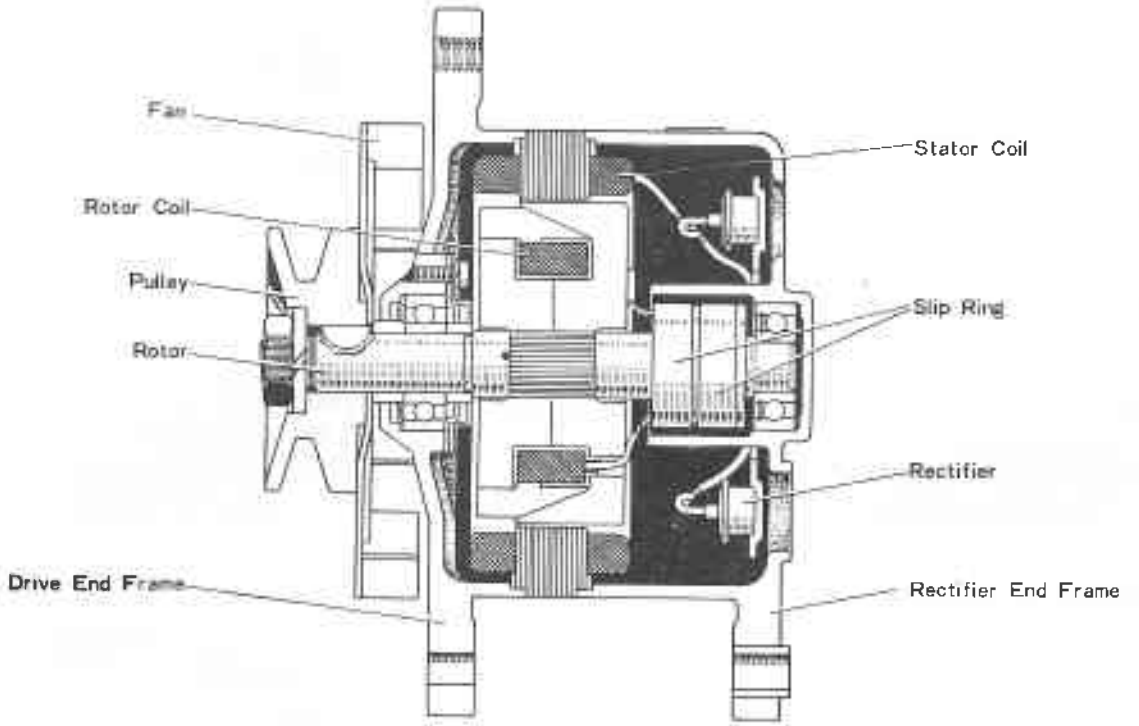


Fig. 8-2 Cross Sectional View of Alternator *Y5118*

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 threephase "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 from pulley	same
Stator coil connection	Three-phase "Y" type	same
Rectifying method	All wave rectified by six diodes	same
Pulley ratio	2.0	1.69
No load characteristic at normal temperature	700 ~ 900 rpm at 14 volts, zero ampere	800 ~ 1000 rpm at 14 volts, zero ampere
Output characteristic at normal temperature	Less than 3500 rpm at 14 volts, 40 amperes	Less than 4000 rpm at 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 magnitize.

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.

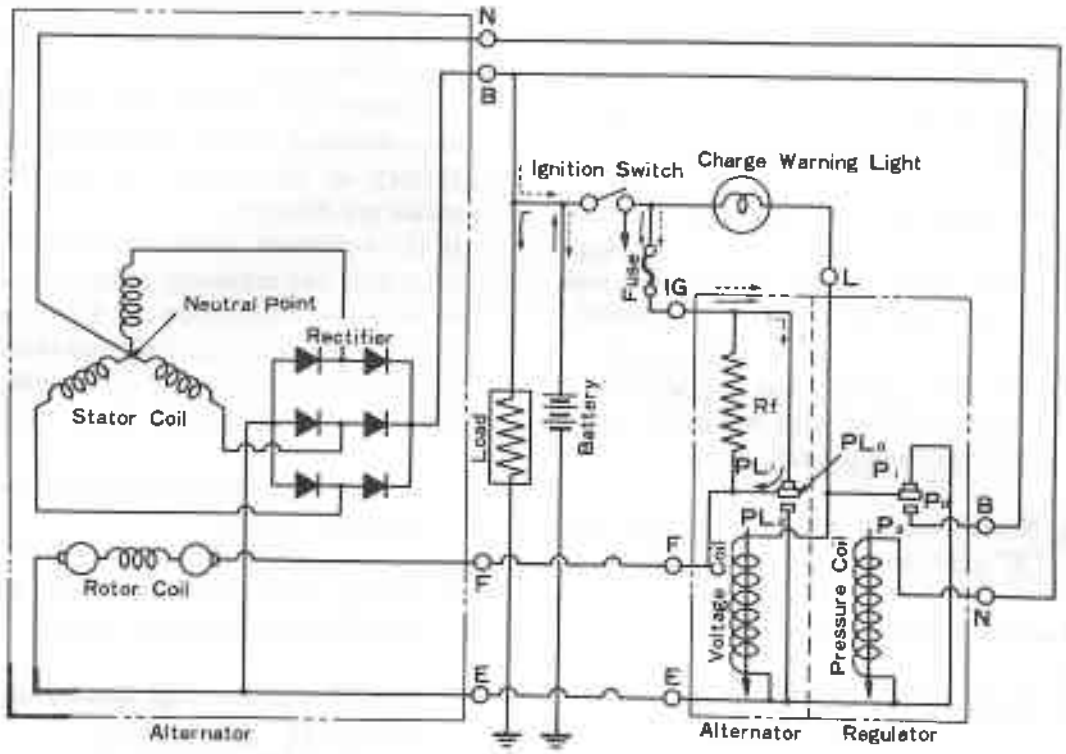


Fig. 8-3 Alternator Generating Circuit *G1553*

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 alternator 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.

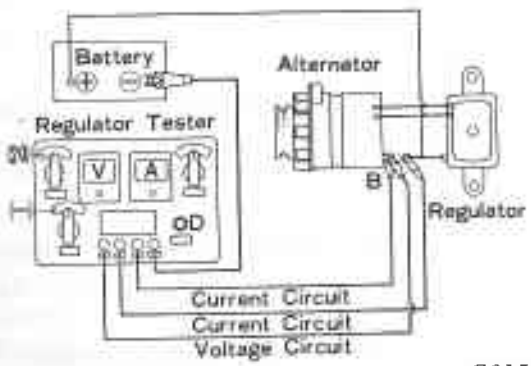


Fig. 8-4 Test Circuit *G0156*

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.

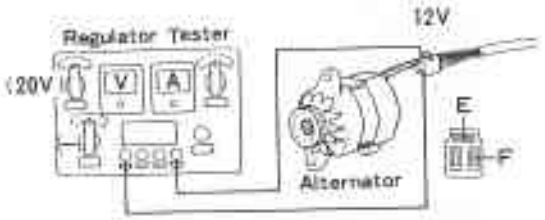


Fig. 8-5 Checking Voltage between "F" & "E" *G0162*

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.

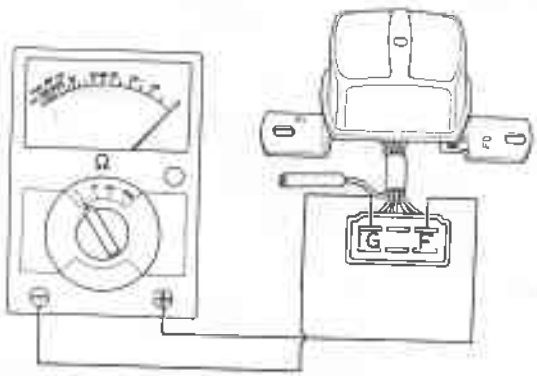


Fig. 8-6 Checking Resistance between "IG" & "F" G0163

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

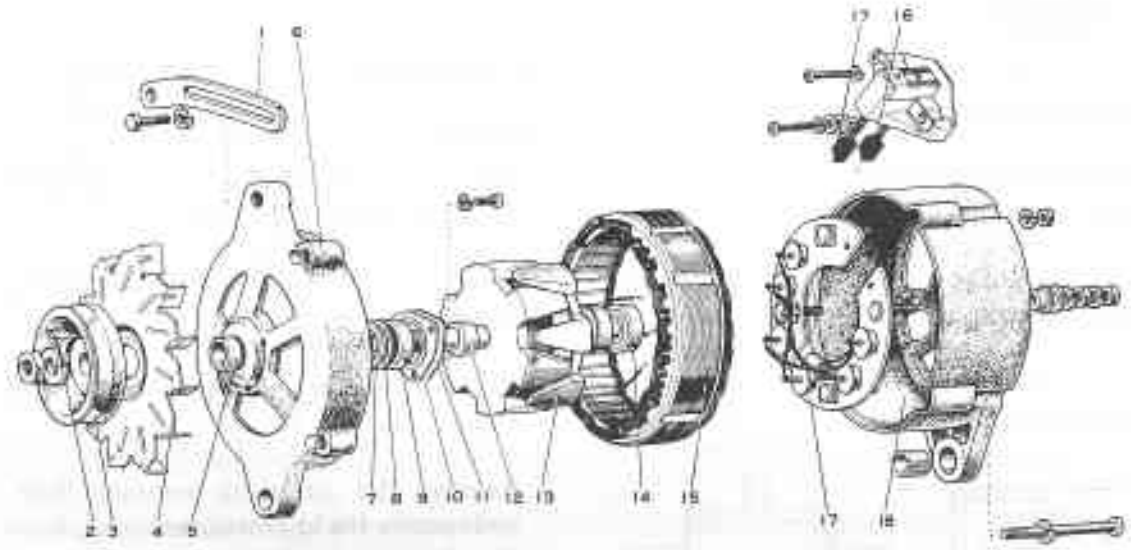
1. Remove the three drive end frame retaining bolts.

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 mellet 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 ro 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 the rectifier from heating, and melt the soldered portions using an electric soldering iron of 100~200 watts for 2 seconds.

Fig. 8-16 Melting Solder *G3364*

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.

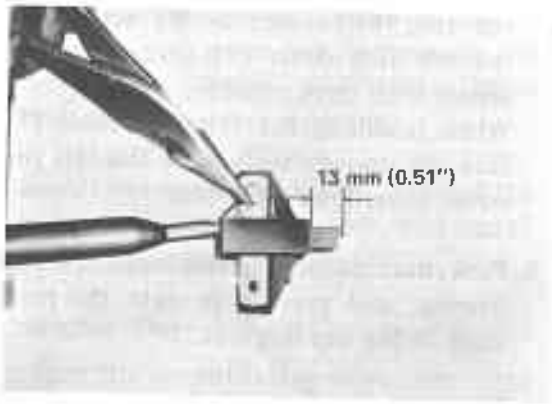


Fig. 8-19 Replacing Brush *V0216*

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 should be replaced with the holder assembly.

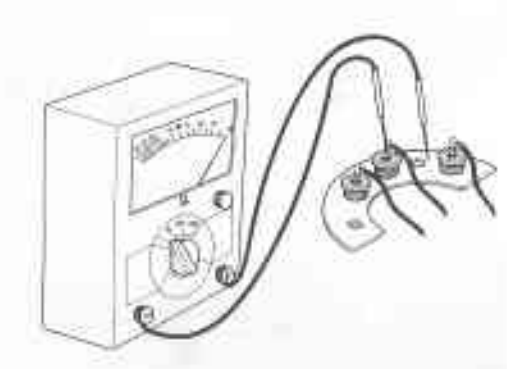


Fig. 8-20 Rectifier Test *G0172*

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.

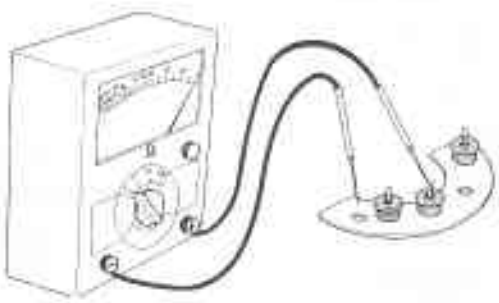


Fig. 8-21 Rectifier Test *G0173*

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.

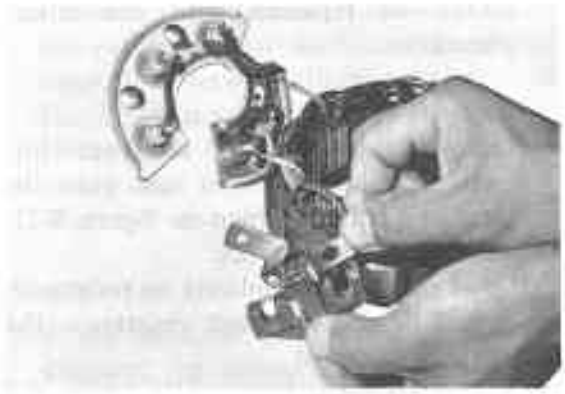


Fig. 8-22 Assembling Brush Holder *B0043*

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 tigten 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.

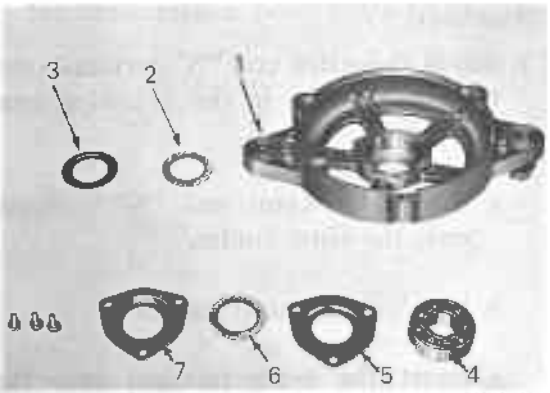


Fig. 8-23 Drive End Frame Assembly ***V1149***

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.

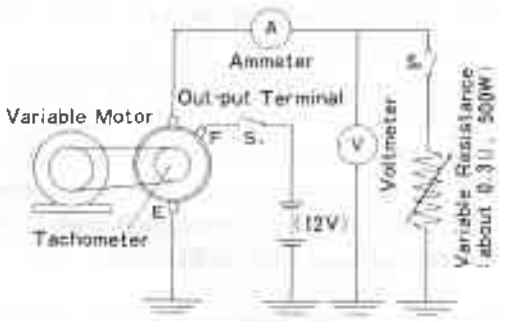


Fig. 8-26 Output Test Circuit *Y5120*

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 deflection 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.

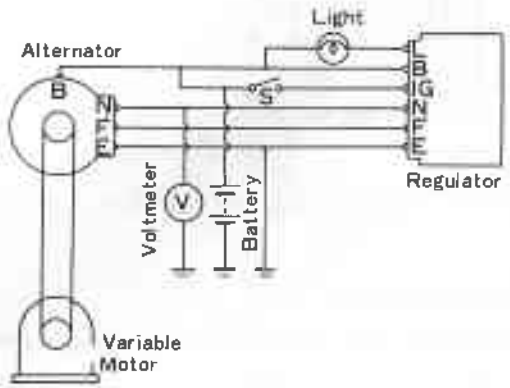


Fig. 8-27 Voltage Relay Test Circuit *G0176*

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 ameter 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.

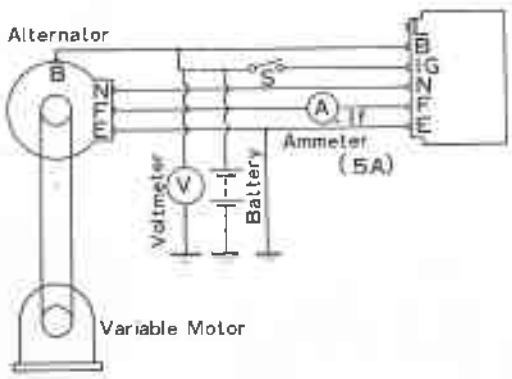


Fig. 8-28 Voltage Regulator Test Circuit G0177

Regulator Circuit Test

1. Connect the circuit tester between the "IG" and "F" terminals.
   The resistance should be zero.

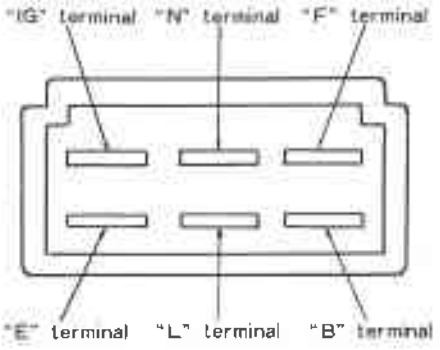


Fig. 8-29 Regulator Wiring Harness Connector Plug G3456

   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.

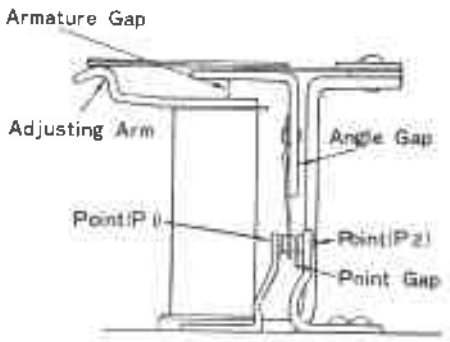


Fig. 8-30 Nomenclature of Voltage Relay G0175

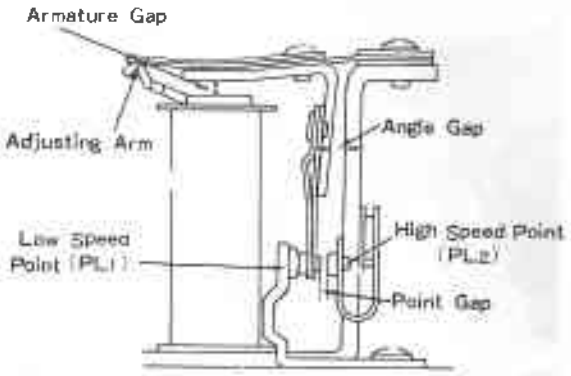


Fig. 8-31 Nomenclature of Voltage Regulator G0174

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

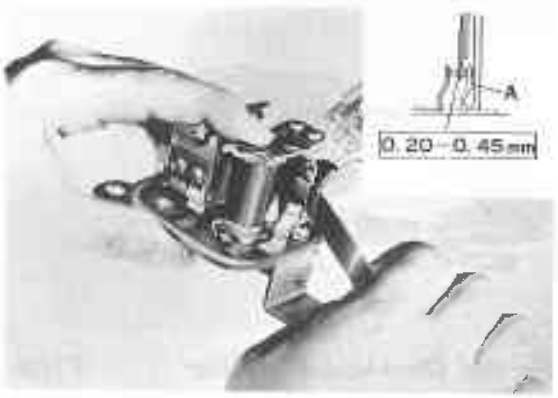


Fig. 8-32 Checking Spring Deflection V2198 G0180

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".

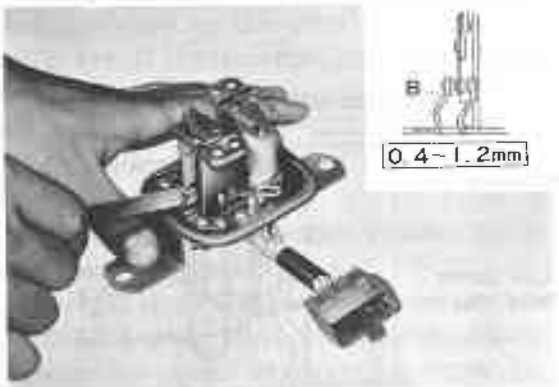


Fig. 8-33 Checking Point Gap *V1185 G0181*

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"

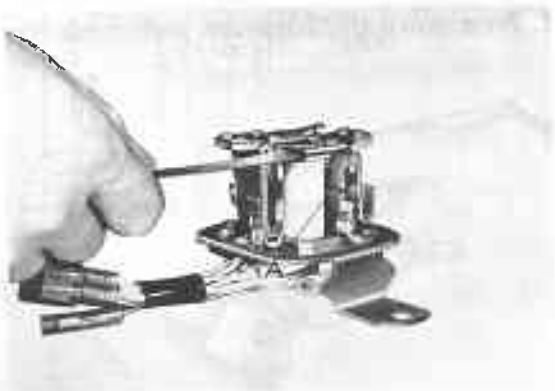


Fig. 8-34 Checking Armature Gap *V1186*

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").

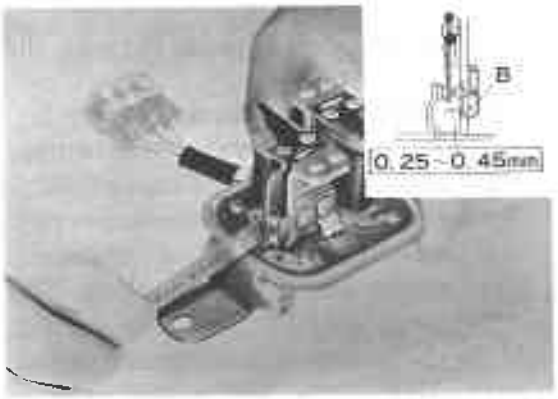


Fig. 8-35 Checking Point Gap *V2155, G0182*

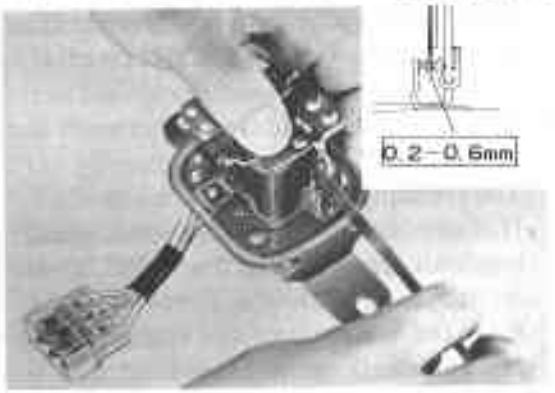


Fig. 8-36 Checking Spring Deflection *V3105 G0183*

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

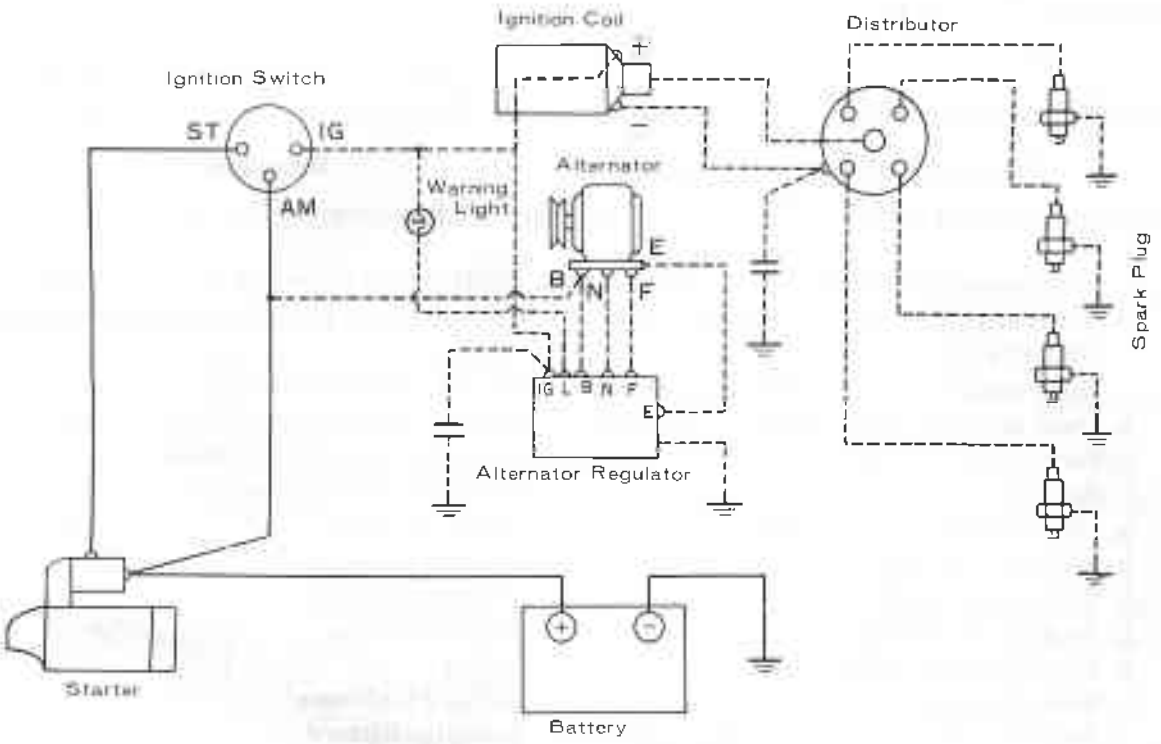


Fig. 9-1 Starting System Wiring Diagram G3814

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.

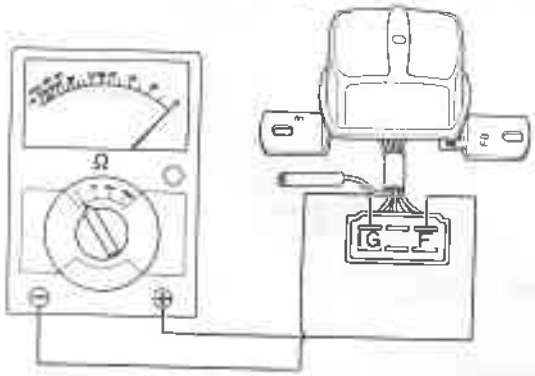


Fig. 8-6 Checking Resistance between "IG" & "F" G0163

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 tensión 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

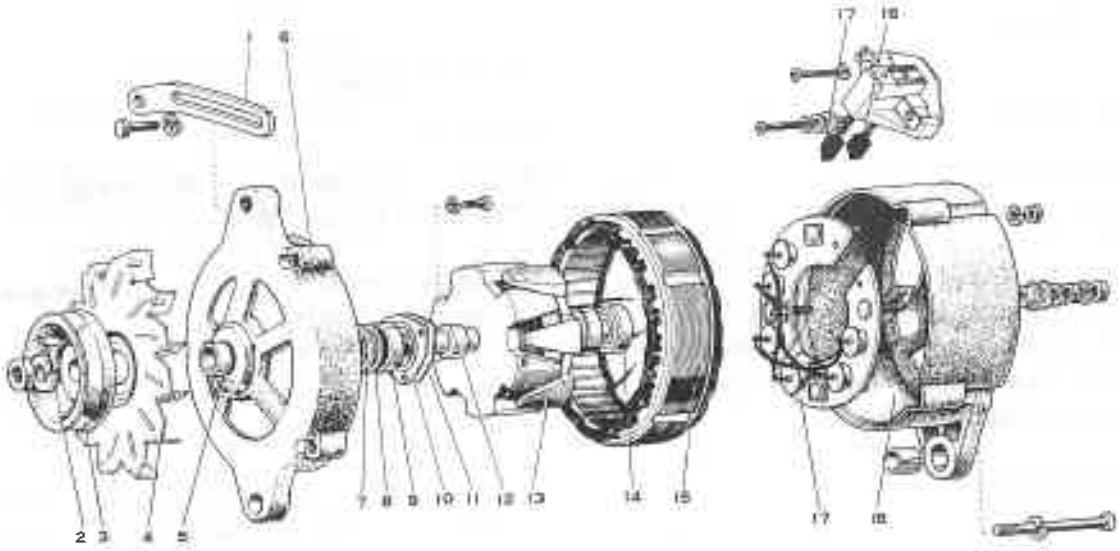
1. Remove the three drive end frame retaining bolts.

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 mellet 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 ro 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 the rectifier from heating, and melt the soldered portions using an electric soldering iron of 100~200 watts for 2 seconds.

Fig. 8-16 Melting Solder *G3364*

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.

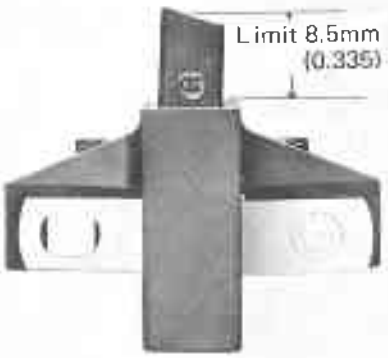


Fig. 8-18 Brush Length *V1143*

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.

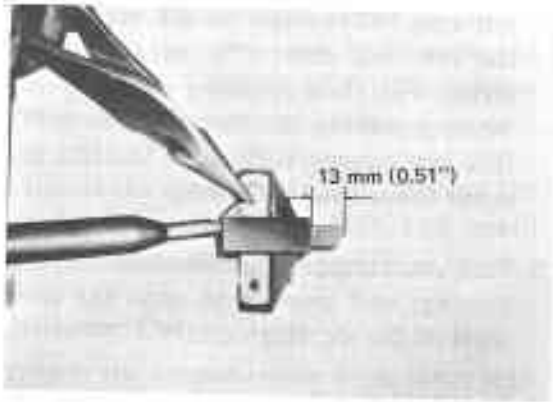


Fig. 8-19 Replacing Brush *V0216*

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 should be replaced with the holder assembly.

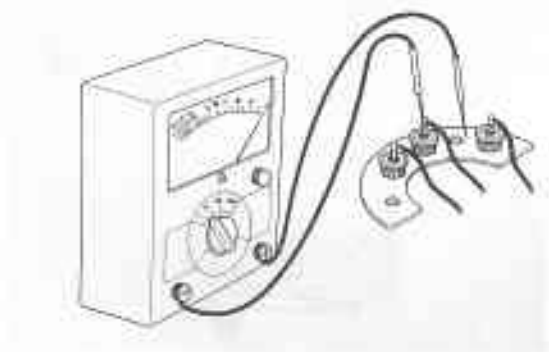


Fig. 8-20 Rectifier Test *G0172*

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.

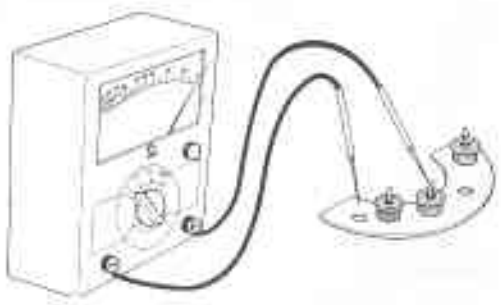


Fig. 8-21 Rectifier Test *G0173*

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 tigten 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.

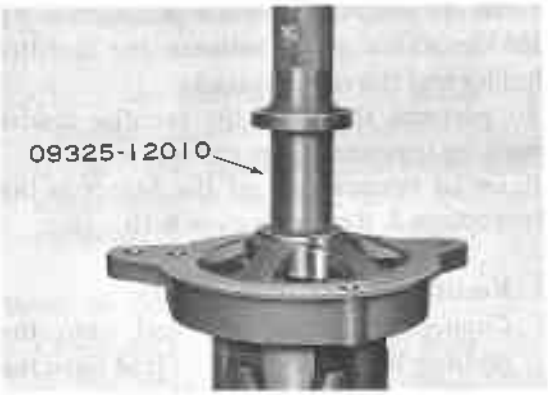


Fig. 8-24 Installing Drive End Frame *B0045*

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.

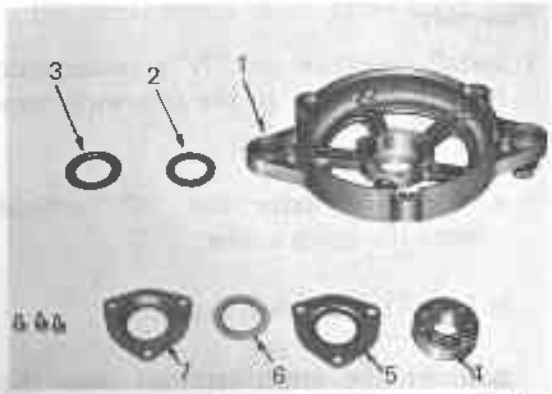


Fig. 8-23 Drive End Frame Assembly *V1149*

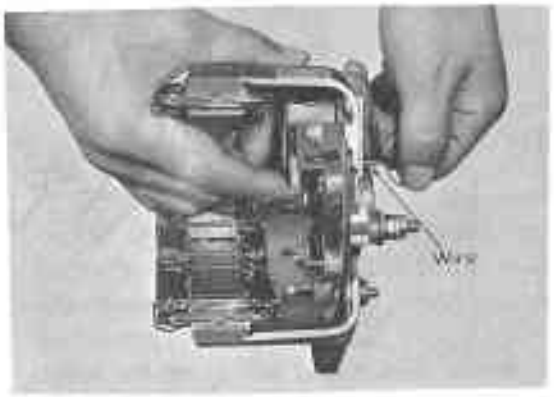


Fig. 8-25 Installing Wire *V0218*

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.

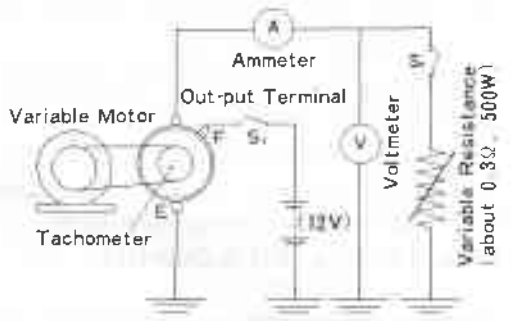


Fig. 8-26 Output Test Circuit *Y5120*

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 deflection 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.

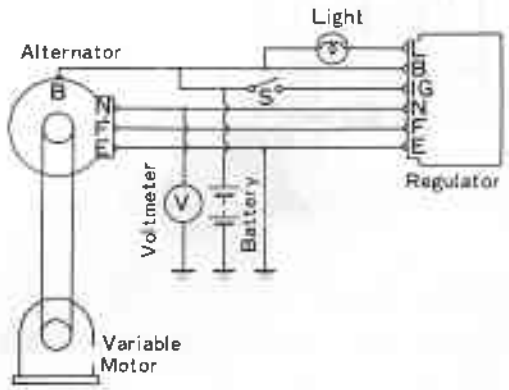


Fig. 8-27 Voltage Relay Test Circuit *G0176*

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 ameter 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.

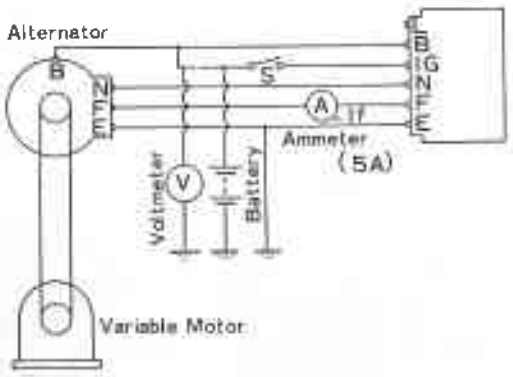


Fig. 8-28 Voltage Regulator Test Circuit G0177

Regulator Circuit Test

1. Connect the circuit tester between the "IG" and "F" terminals.
   The resistance should be zero.

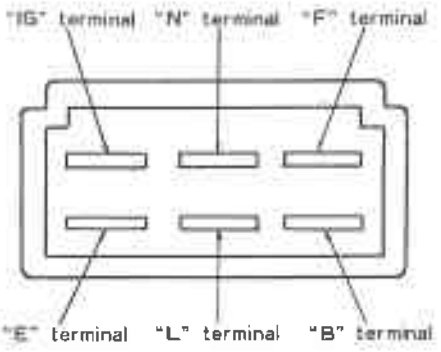


Fig. 8-29 Regulator Wiring Harness Connector Plug G3456

   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.

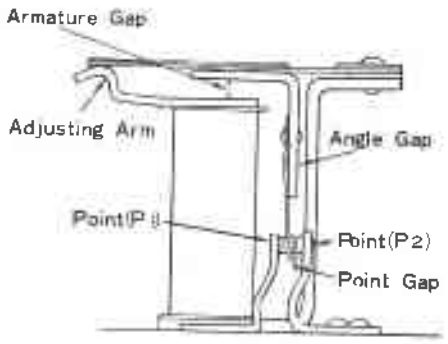


Fig. 8-30 Nomenclature of Voltage Relay G0175

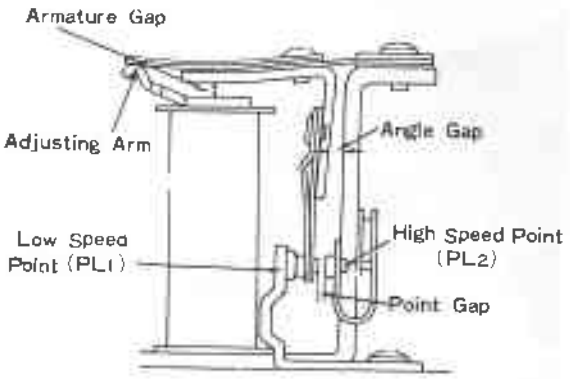


Fig. 8-31 Nomenclature of Voltage Regulator G0174

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

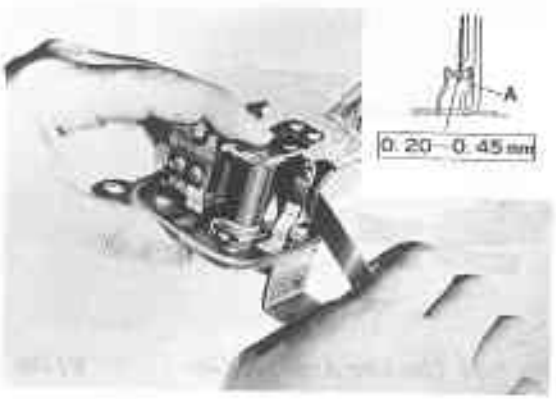


Fig. 8-32 Checking Spring Deflection V2198 G0180

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".

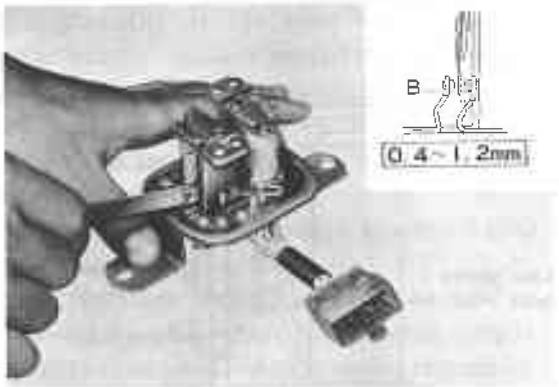


Fig. 8-33 Checking Point Gap *V1185 G0181*

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"

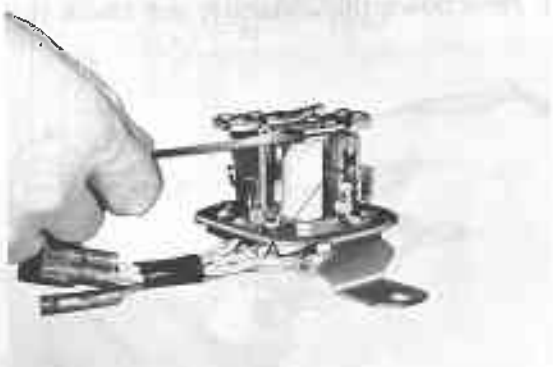


Fig. 8-34 Checking Armature Gap *V1186*

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").

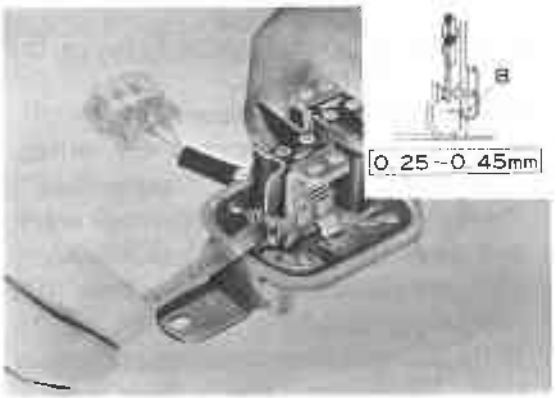


Fig. 8-35 Checking Point Gap *V2155, G0182*

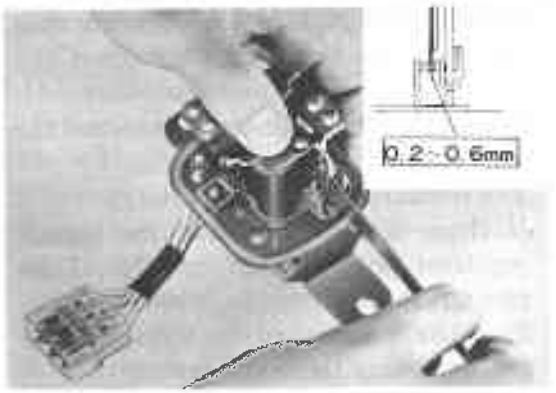


Fig. 8-36 Checking Spring Deflection *V3105 G0183*

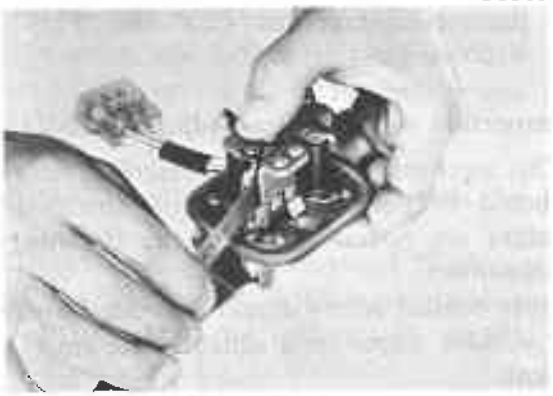


Fig. 8-37 Checking Angle Gap *V2199*

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

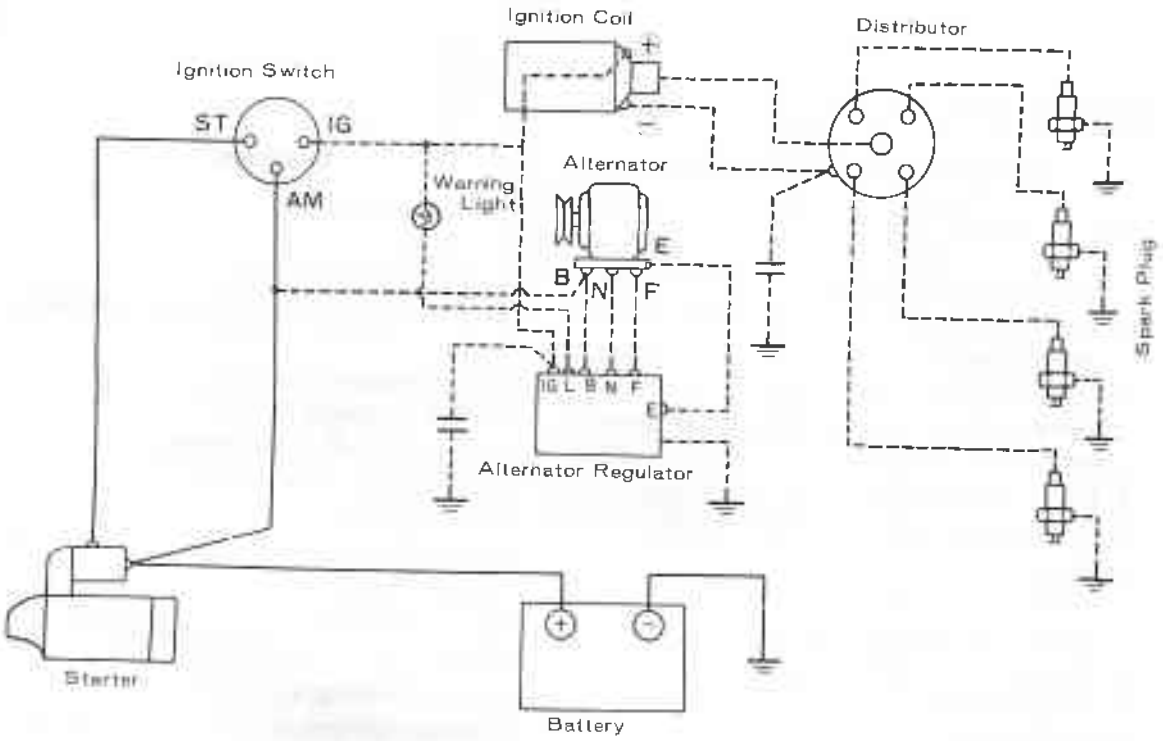


Fig. 9-1 Starting System Wiring Diagram G3814

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

STARTER

Construction

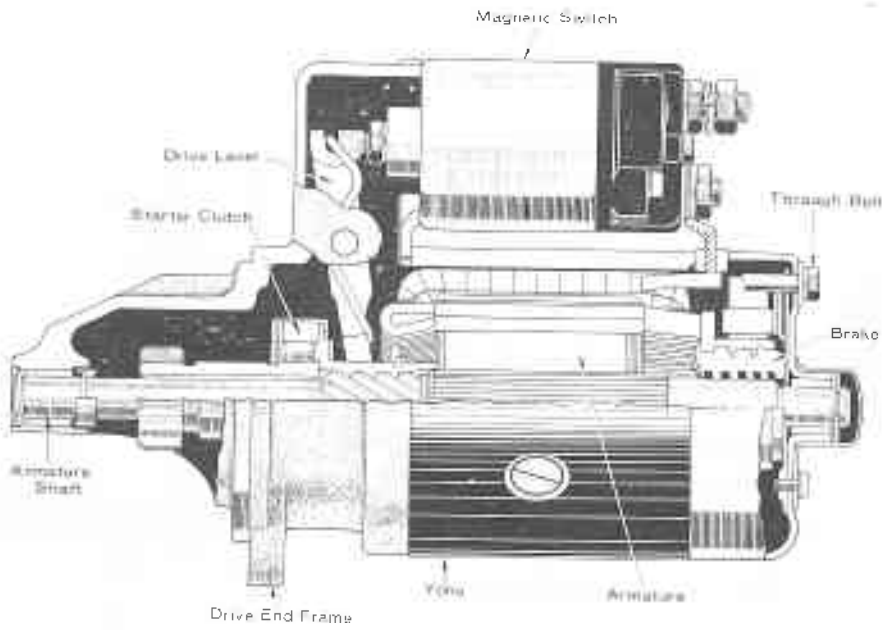


Fig. 9-2 Cross Sectional View of Starter *Y5115*

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

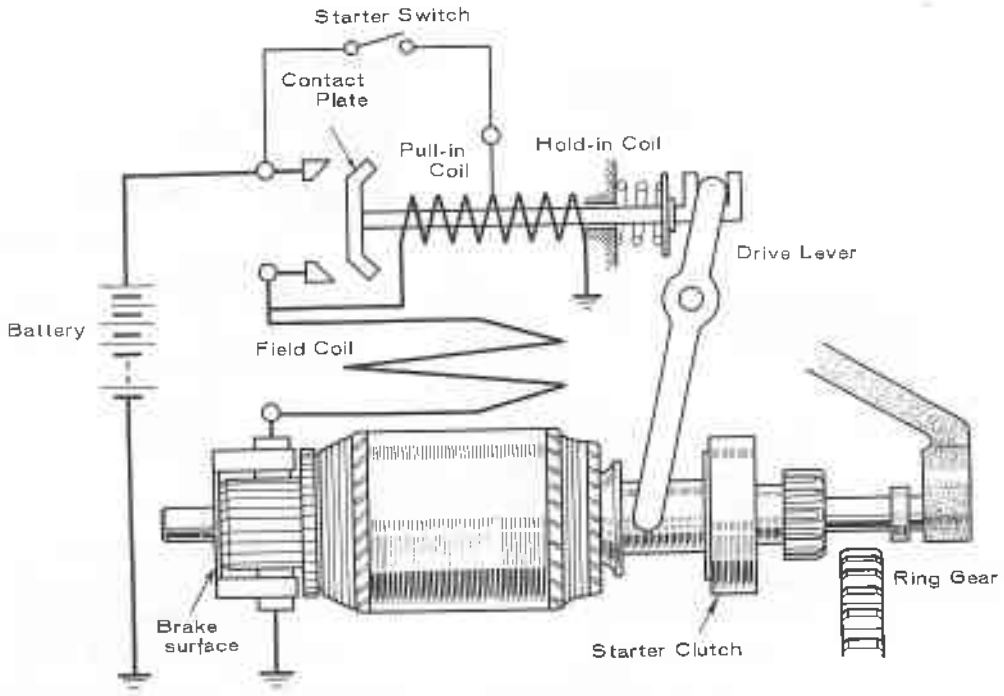


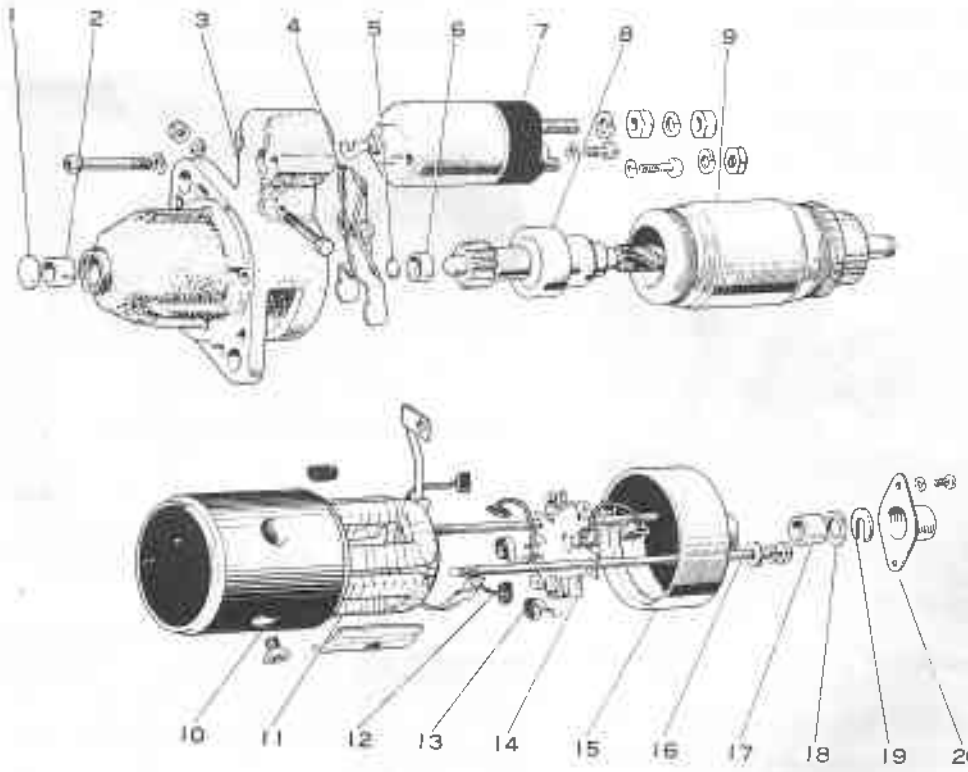
Fig. 9-3 Starter Circuit G3136

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 slided 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
2. Drive end frame bushing
3. Drive end frame
4. Pinion drive lever w/spring
5. Snap ring
6. Pinion stopper collar
7. Magnetic switch
8. Starter clutch
9. Armature
10. Yoke
11. Field coil
12. Brush
13. Brush spring
14. Brush holder
15. Commutator end frame
16. Through bolt
17. Commutator end frame bushing
18. Plate washer
19. Lock plate
20. Bearing cover

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

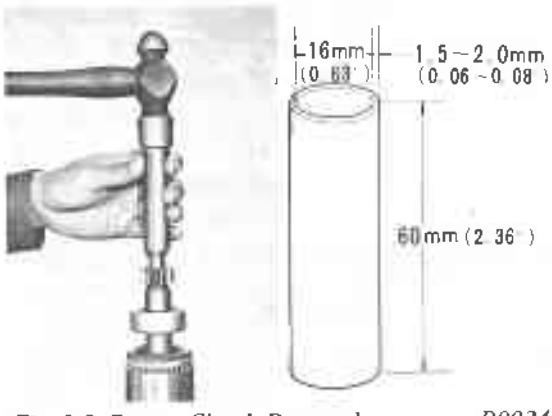


Fig. 9-8 Starter Clutch Removal *B0034 G1249*

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").

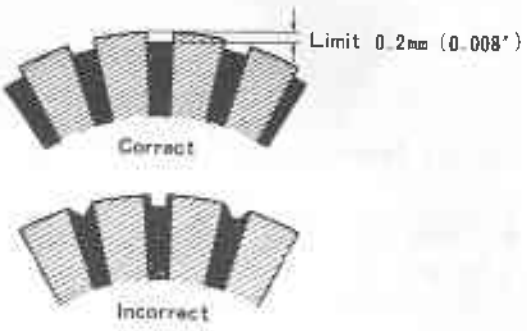


Fig. 9-9 Mica Depth *G0151*

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.

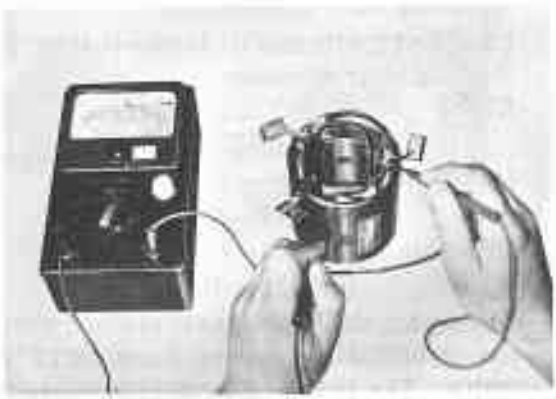


Fig. 9-14 Testing Field Coil for Ground *B0036*

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, desconnect 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.

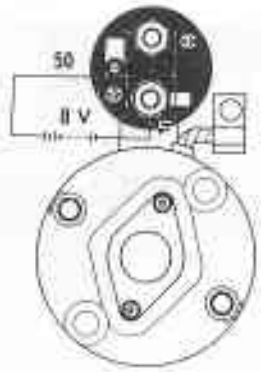


Fig. 9-15 Pull-in Coil Test *G1265*

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.

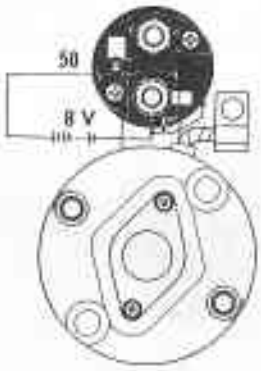


Fig. 9-16 Hold-in Coil Test *G1266*

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.

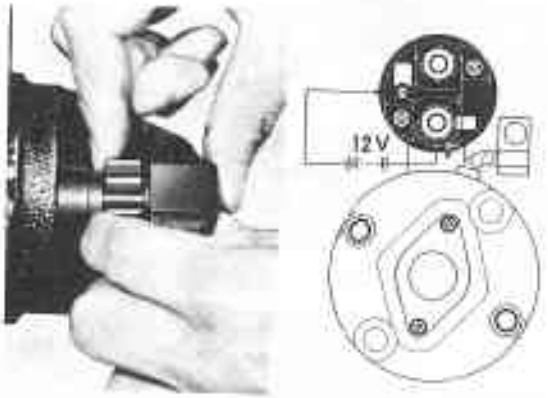


Fig. 9-17 Plunger Return Test *V1812 G1267*

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.

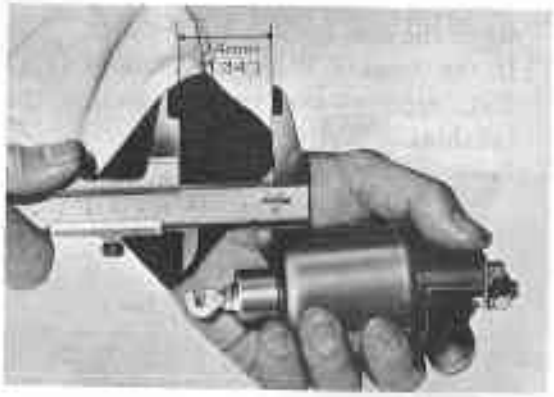


Fig. 9-18 Checking Moving Stud Length *V1813*

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.

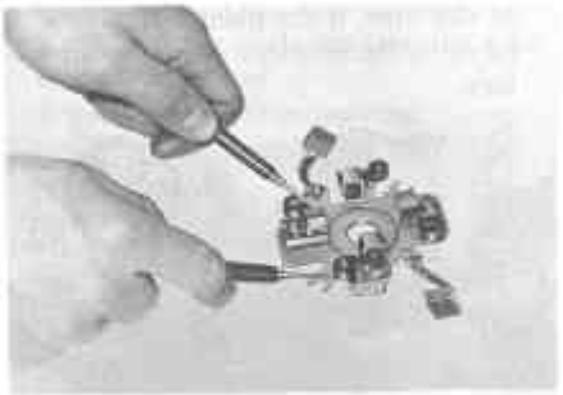


Fig. 9-19 Checking Brush Holder Insulation *V1814*

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.

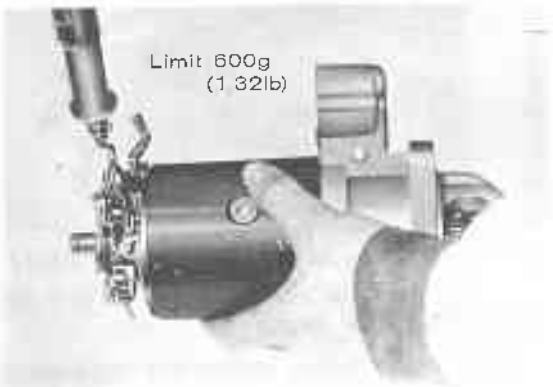


Fig. 9-20 Checking Spring Tension *V1816*

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 *V1817*

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.

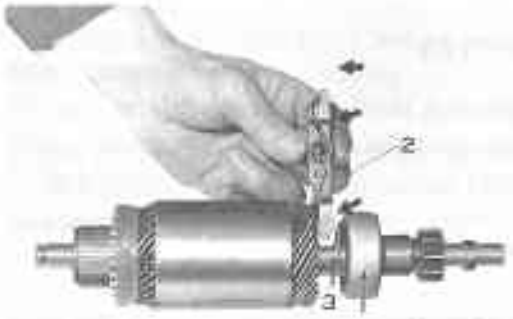


Fig. 9-23 Direction of Drive Lever Installation *V1818*

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.

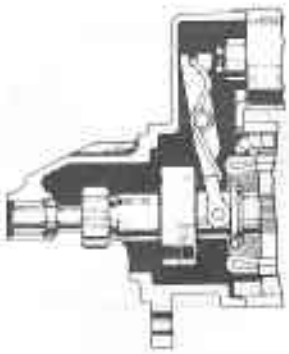


Fig. 9-26 Installing Magnetic Switch *G0152*

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.

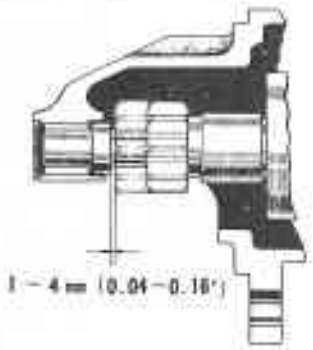


Fig. 9-27 Clutch Pinion Clearance *G0153*

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.

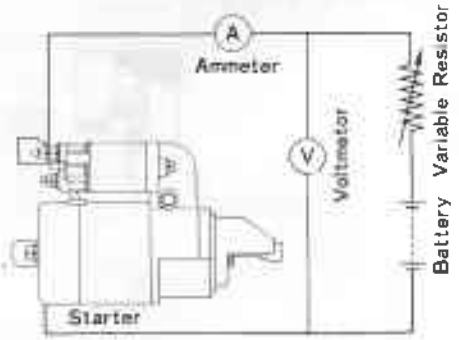


Fig. 9-28 Testing Circuit *G0154*

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.

   S20=ST+0.0007 (t−20)
   S20 . . . . . Specific gravity at 20°C
   ST . . . . . Specific gravity at t°C
   t . . . . . Temperature of electrolyte
   0.0007 . . . Temperature coefficient

   Electrolyte specific gravity
   at 20°C (68°F):
   1.260 is 100% fully charged state
   1.210 is 75% fully charged state
   1.160 is 50% fully charged state
   1.110 is 25% fully charged state
   1.060 is fully discharged state

Charging

Before placing the battery on the charger, clean the battery terminals, check the

electrolyte level, and replenish with distilled water as necessary. Remove all the filler caps while charging, and do not allow the battery electrolyte temperature to rise 45°C (113°F).

Hydrogen and oxygen gases are produced during normal battery 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

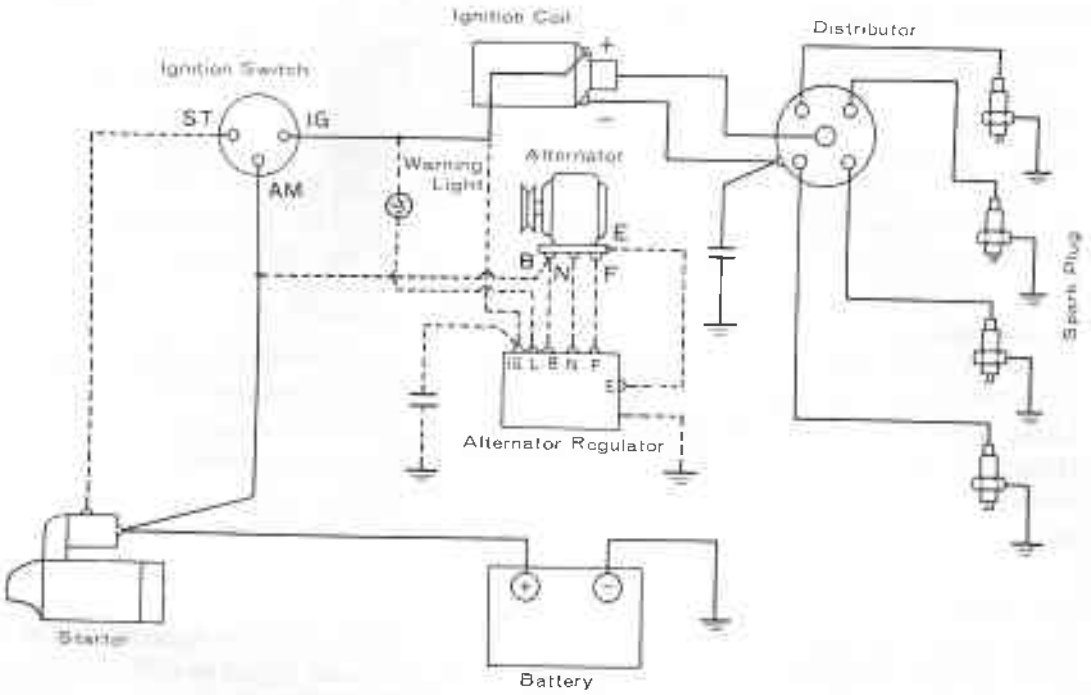


Fig. 10-1 Ignition System Wiring Diagram *G3815*

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 buit 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 absorbes 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.

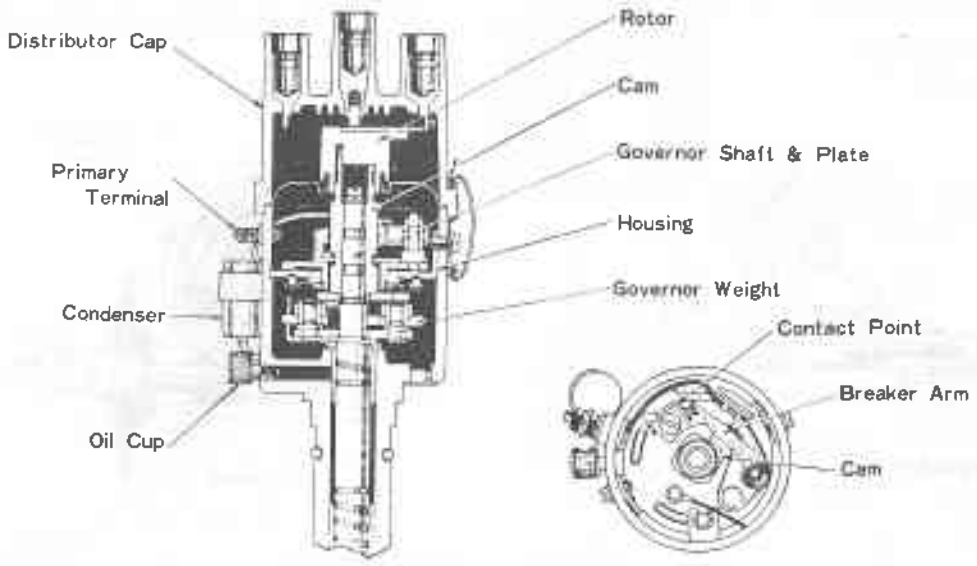


Fig. 10-2 Sectional View of Distributor *Y5662*

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.

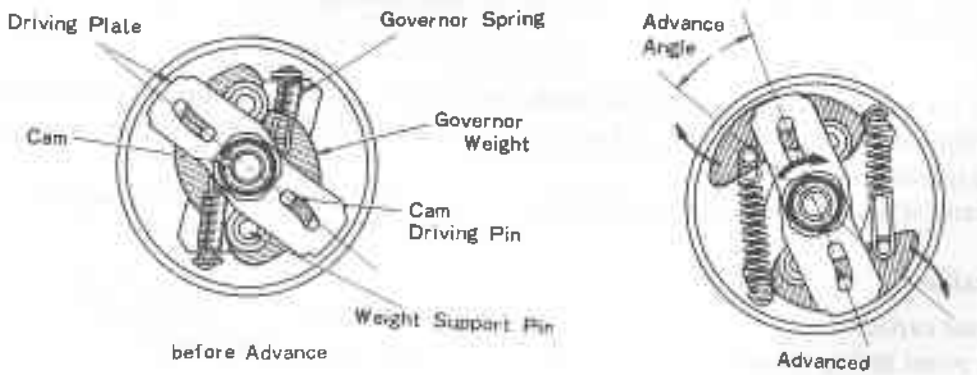


Fig. 10-3 Operation of Governor Advancer *G0185, G0186*

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 repect to the distributor drive shaft to advance the spark timing.

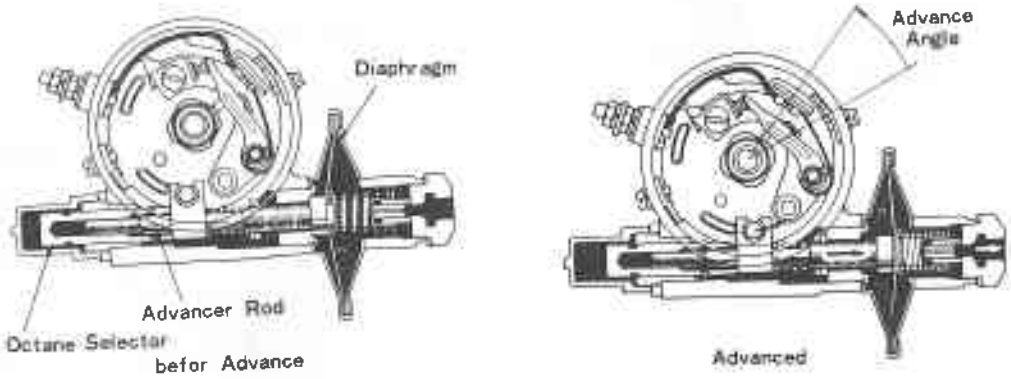


Fig. 10-4 Operation of Vacuum Advancer *G1273, G1274*

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.

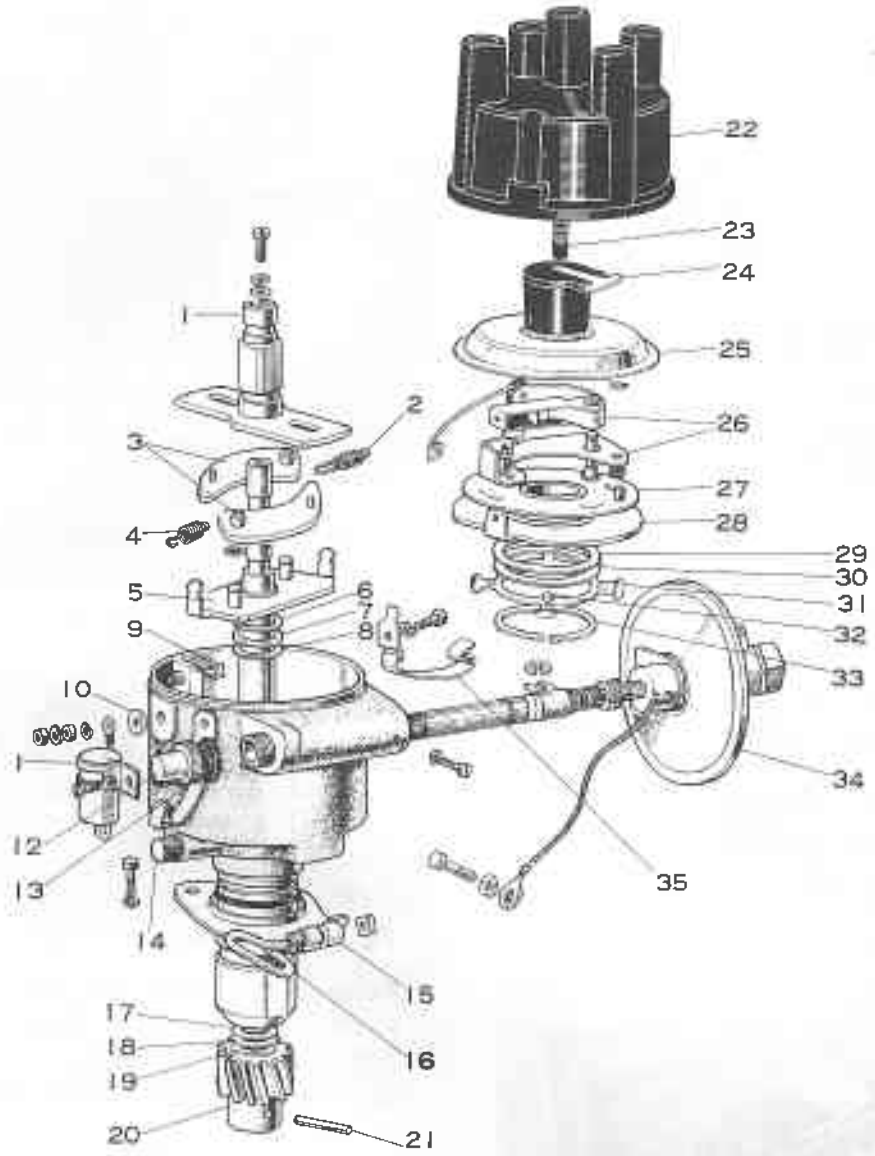
This vacuum advance mechanism utilizes the increase of the vacuum within the intake manifold when the throttle valve is opened slightly under light load. As the vacuum increases within the intake manifold, the diaphragm pulls the advancer rod against the diaphragm spring tension toward the diaphragm 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
2 Governor spring B
3 Governor weight
4 Governor spring A
5 Distributor shaft
6 Steel washer
7 Bakelite washer
8 Steel washer
9 Terminal bolt
10 Insulator
11 Condenser
12 Adjuster cap
13 Rubber washer
14 Oil cap
15 Distributor clamp
16 Clamp bolt
17 Steel washer
18 Bakelite washer
19 Steel washer
20 Spiral gear
21 Pin
22 Distributor cap
23 Cap center piece
24 Rotor
25 Dust proof cover
26 Breaker point kit
27 Breaker plate
28 Stationary plate
29 Adjusting washer
30 Adjusting washer
31 Breaker plate set spring
32 Steel ball
33 Snap ring
34 Vacuum advancer
35 Housing cap spring

Fig. 10-5 Distributor Components *Y6804*

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.

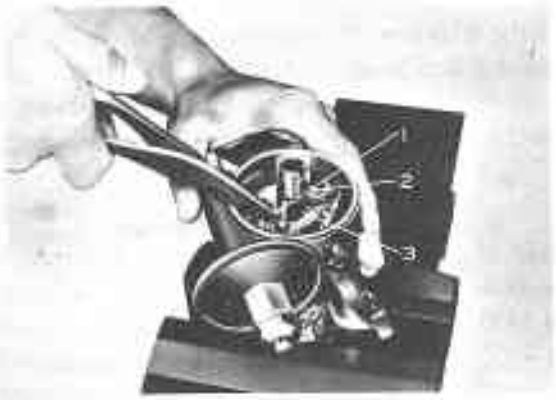


Fig. 10-6 Removing Breaker Point *V3675*

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.

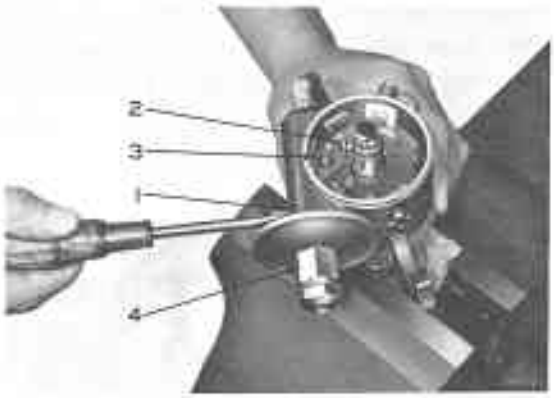


Fig. 10-7 Removing Vacuum Advancer *V3637*

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 grovernor 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.

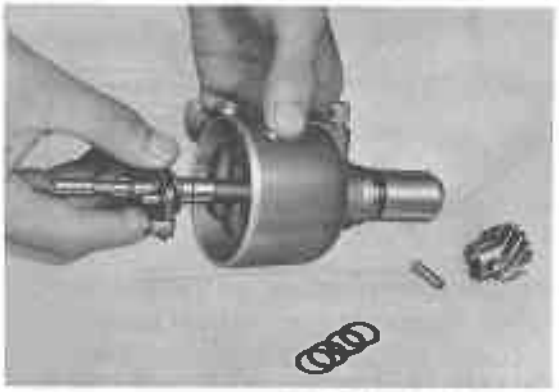


Fig. 10-10 Removing Distributor Shaft
V3680

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 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"

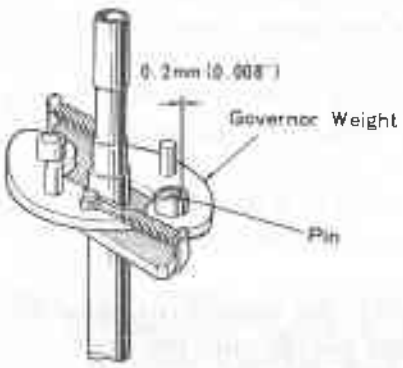


Fig. 10-11 Checking Pin Clearance G0190

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.

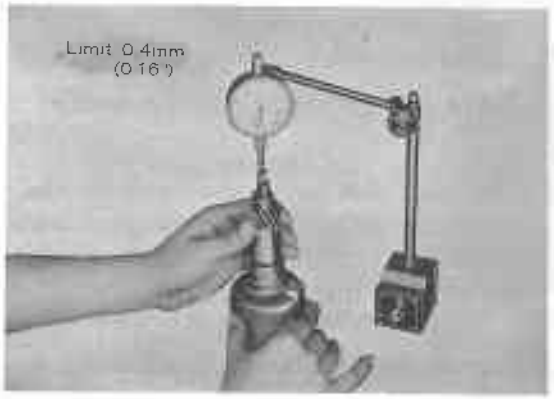


Fig. 10-12 Checking Thrust Clearance V3681

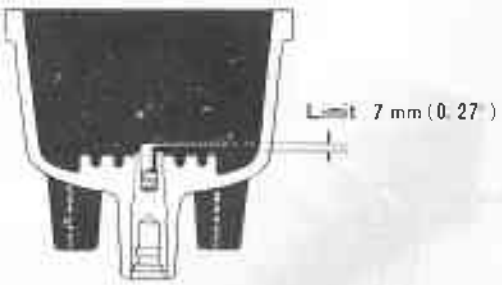


Fig. 10-13 Checking Carbon Center Piece
G1275

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).

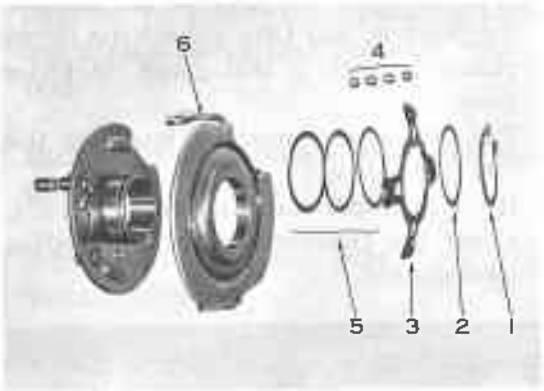


Fig. 10-14. Disassembling Stationary & Breaker Plates *V3682*

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).

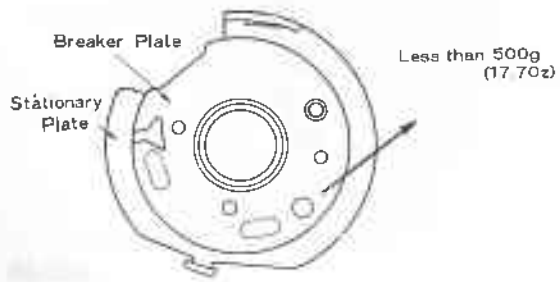


Fig. 10-15 Checking Operating Resistance *G0335*

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.

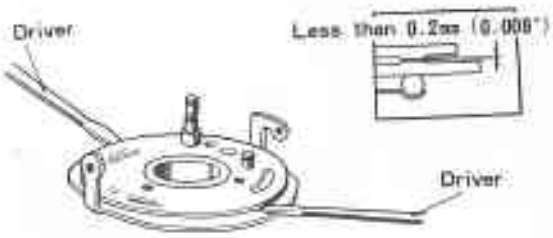


Fig. 10-16 Checking Clearance between Stationary & Breaker Plates *G0349*

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.

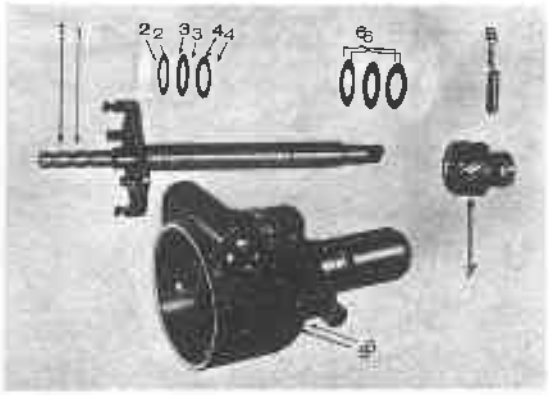


Fig. 10-17 Assembling Distributor Shaft *V3683*

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.

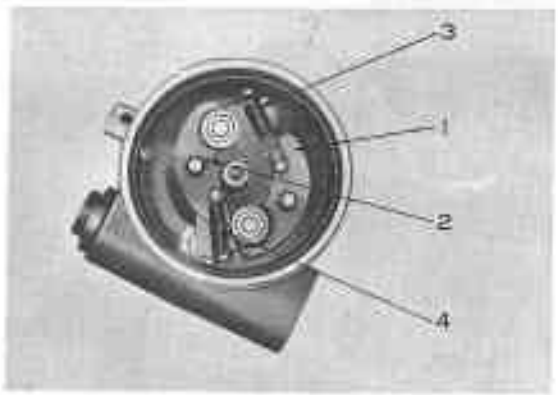


Fig. 10-18 Assembling Governor *V3684*

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.

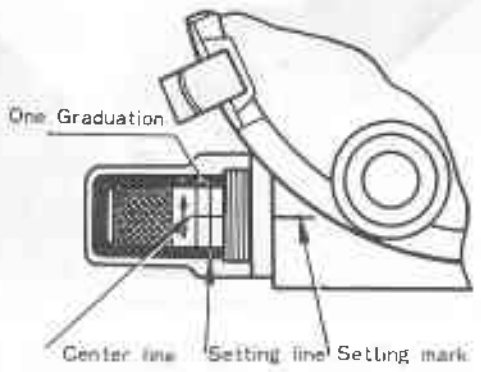


Fig. 10-22 Octane Selector Normal Position *G1701*

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.

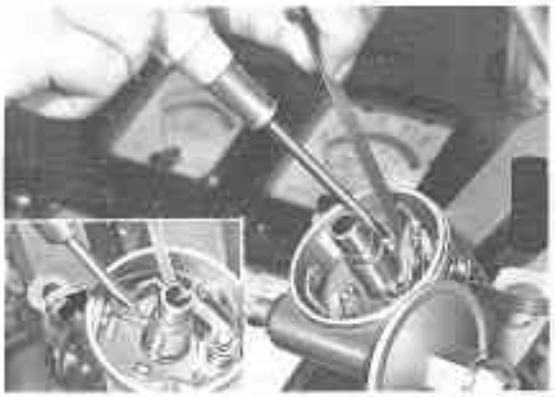


Fig. 10-23 Adjusting Point Gap *V3686 V3687*

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 advancer 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.

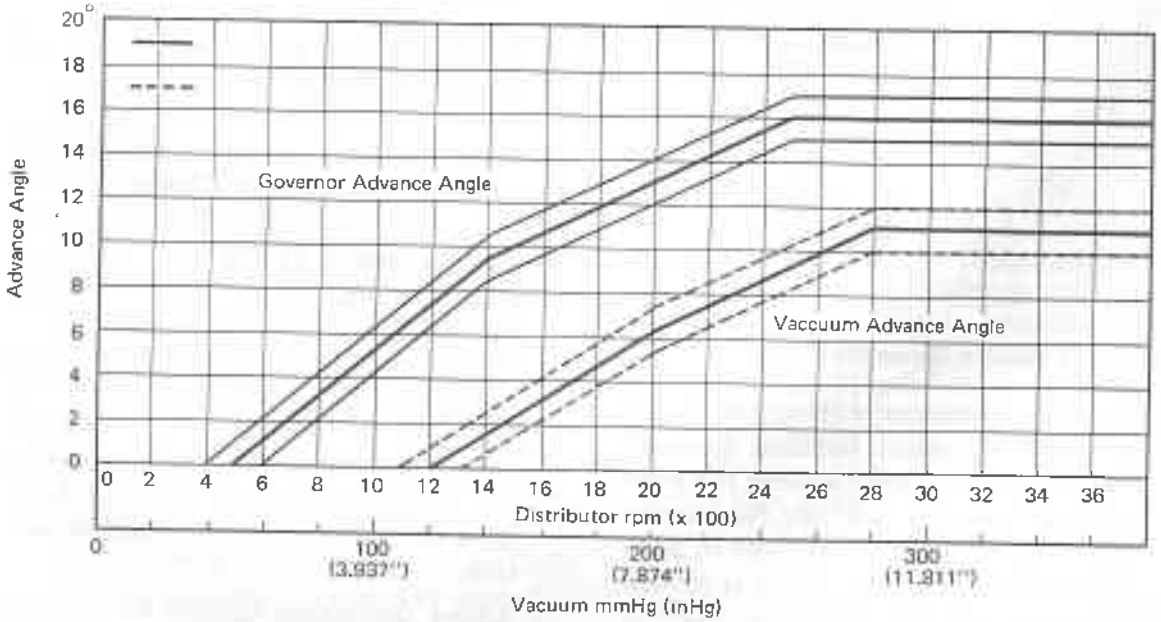


Fig. 10-26 Distributor Advance Characteristics G1276

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 (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.

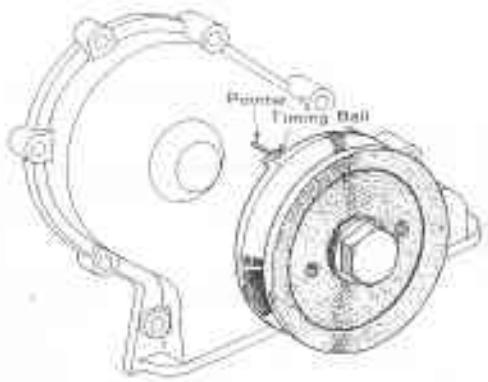


Fig. 10-27 Ignition Timing Marks *G0853*

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.

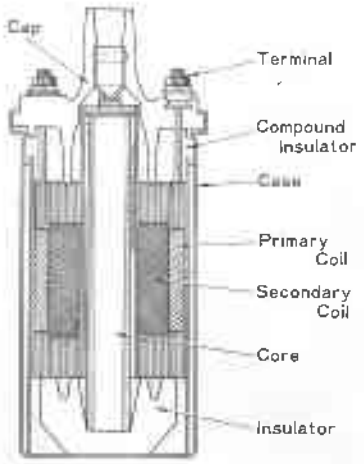


Fig. 10-29 Ignition Coil Section *G0194*

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 more relatively slow. When the primary circuit is opened, the magnetic line of force snap back to the core because of their attraction to it.

Specification:

Primary voltage	12 volts
Primary resistance	3.3 ~ 4.3 ohms
Secondary resistance	7,500 ~ 10,000 ohms
Secondary voltage	Sparking distance from center to three negative electrodes should be more than 8 mm (0.276") at distributor revolution of 75 rpm with 12 volts. Sparking 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.

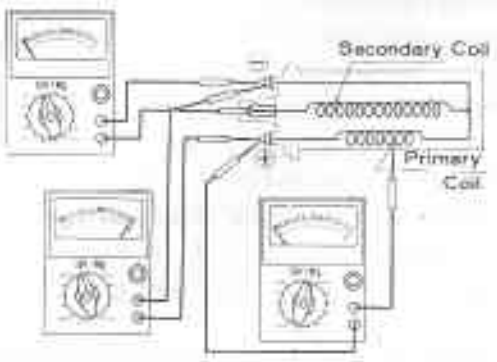


Fig. 10-30 Checking Coil Resistance *G1278*

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 secondaty 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

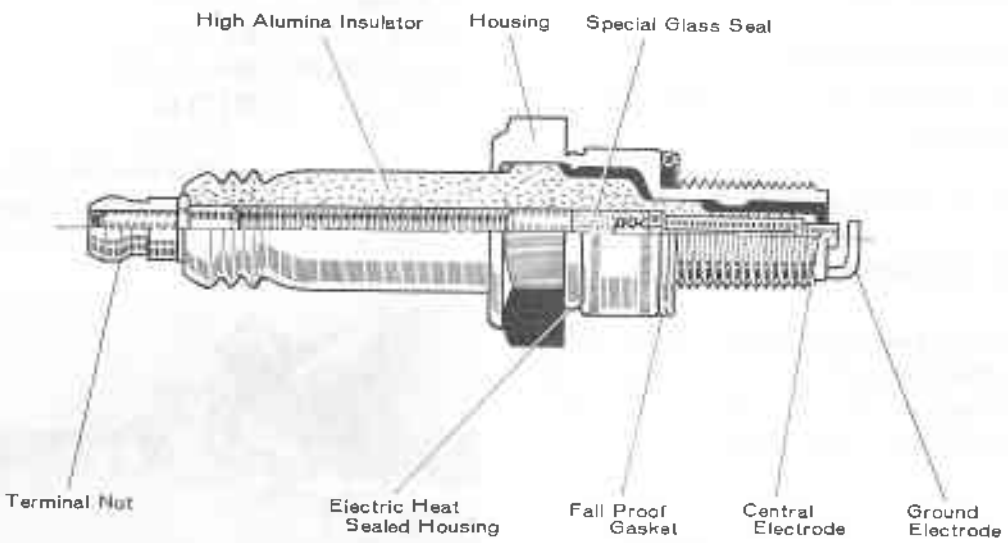


Fig. 10-32 Spark Plug Section (Denso W17ES) *G1279*

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

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 (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/cm² (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-kg (90 ft-lb) at 2800 rpm	13.5 m-kg (98 ft-lb) 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 fiter 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	3.5 liters (3.7 US qts., 3.1 Imp. qts)
	Oil filter	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^2 (156 psi)
Compression pressure limit	8.0 kg/cm^2 (115 psi)
Difference of pressure between cylinders	Less than 0.7 kg/cm^2 (10 psi)

ENGINE

Cylinder Head

Cylinder head water leak testing pressure	4.0 – 4.5 kg/cm^2 (57 – 64 psi)
Cylinder head installing surface 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 daimeter – 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^2 (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 diamter:	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 0.05 – 0.130 mm (0.0020 – 0.0052") – 12R
Camshaft thrust clearance limit	0.3 mm (0.012") – 2R 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) 12R- 1.05 (0.041)	1.06 (0.042) 1.03 (0.041)	1.11 (0.044) 1.03 (0.041)
Secondary		2R- 1.40 (0.055) 12R- 1.62 (0.064)	1.60 (0.063) 1.56 (0.061)	1.47 (0.058) 1.65 (0.065)
Slow jet diameter	mm (in)	2R- 0.55 (0.022) 12R- 0.50 (0.020)	0.435 (0.017) 0.47 (0.019)	0.525 (0.021) 0.47 (0.019)
Power jet diameter	mm (in)	2R- 0.75 (0.030) 12R- 0.50 (0.020)	0.60 (0.024) 0.58 (0.023)	0.70 (0.028) 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) 12R- 1.00 (0.040)	0.80 (0.031) ———	0.80 (0.031) 1.00 (0.040)
Main air bleed diameter	mm (in)			
Primary		2R- 0.70 (0.028) 12R- 0.50 (0.020)	0.50 (0.020)	0.70 (0.028) 0.50 (0.020)
Secondary		2R- 0.70 (0.028) 12R- 0.50 (0.020)	0.50 (0.020)	0.70 (0.028) 0.50 (0.020)
Power piston operating vacuum	mm (in)	2R- 110 ~ 130 (4.3 ~ 5.1) 12R- 120 ~ 140 (4.7 ~ 5.5)	70 ~ 90 (2.8 ~ 3.5) 120 ~ 140 (4.7 ~ 5.5)	110 ~ 130 (4.3 ~ 5.1) 120 ~ 140 (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.		
for 12R		Screw out about 2 turns after slightly seating.		

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° 12R - 13°	12° 17°	13° 17°
Unloader	2R – 30° 12R – 27°	– –	– –
Thermostatic valve operating temperature	Fully closed at 60°C (140°F) 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) per minute at 1,000 rpm of camshaft.
Delivery pressure	0.22 – 0.32 kg/cm^2 (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) per minute at pump; 3,000 rpm, oil temperature; 100°C (212°F), oil pressure; 3.2 kg/cm^2 (45.5")
Relief valve operating pressure	3.7 – 4.3 kg/cm^2 (52.6 – 61.2 psi) at pump; 2,500 rpm, oil temperature; 100°C (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^2 (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^2 (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^2 (7 psi) – 2R 0.9 kg/cm^2 (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 silicone diodes
Pulley ratio:	RT series	2.0
	Light Ruck	1.69
No-load characteristics at normal temperature:	RT series	700 – 900 rpm at 14 volts, zelo ampere
	Lfight Truck	800 – 1000 rpm at 14 volts, zero ampere
Load characteristics at normal 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-kg (2.5 – 3.6 ft-lb)
Rectifier characteristics:		
Correct direction characteristic		At normal temperature, when direct current of 22 amperes is applied, the voltage difference between the rectifier lead and the body should be less than 1.2 volts.
Reverse direction characteristic		At normal temperature, when direct current voltage of 100 volts is actuated, the reverse current should be less than 1.5 milliamperes.

Note: The correct direction can be defined with direction in which positive voltage is actuated at rectifier body side, and negative voltage at lead 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

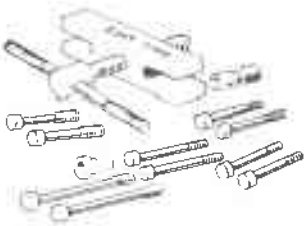
Spark Plugs

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-kg (11 – 15 ft-lb)

SST (SPECIAL SERVICE TOOLS)

(1)

(2)



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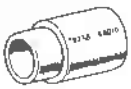

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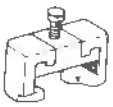

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Special Service Tool List for 2R Engine

(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.