# SERVICE MANUAL

## SUBARU 360 SERIES

## ENGINE SECTION

FUJI HEAVY INDUSTRIES LTD.
TOKYO JAPAN

# FOREWORD

This service manual has been prepared as reference for effective service and maintenance of the engine for Subaru 360 Sedan, Subaru 360 Custom, Subaru 360 Van and Subaru 360 Truck.

Please utilize this manual fully to ensure complete maintenance work for satisfying our customers by keeping their vehicles in the best condition.
(For information on the body, please refer to the "Service Manual - Body Section".)
When it is necessary to replace parts during maintenance, be sure to use genuine Subaru parts.

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FUJI HEAVY INDUSTRIES LTD.

# CONTENTS

# CHAPTER 1 : MAIN SPECIFICATIONS AND PERFORMANCE

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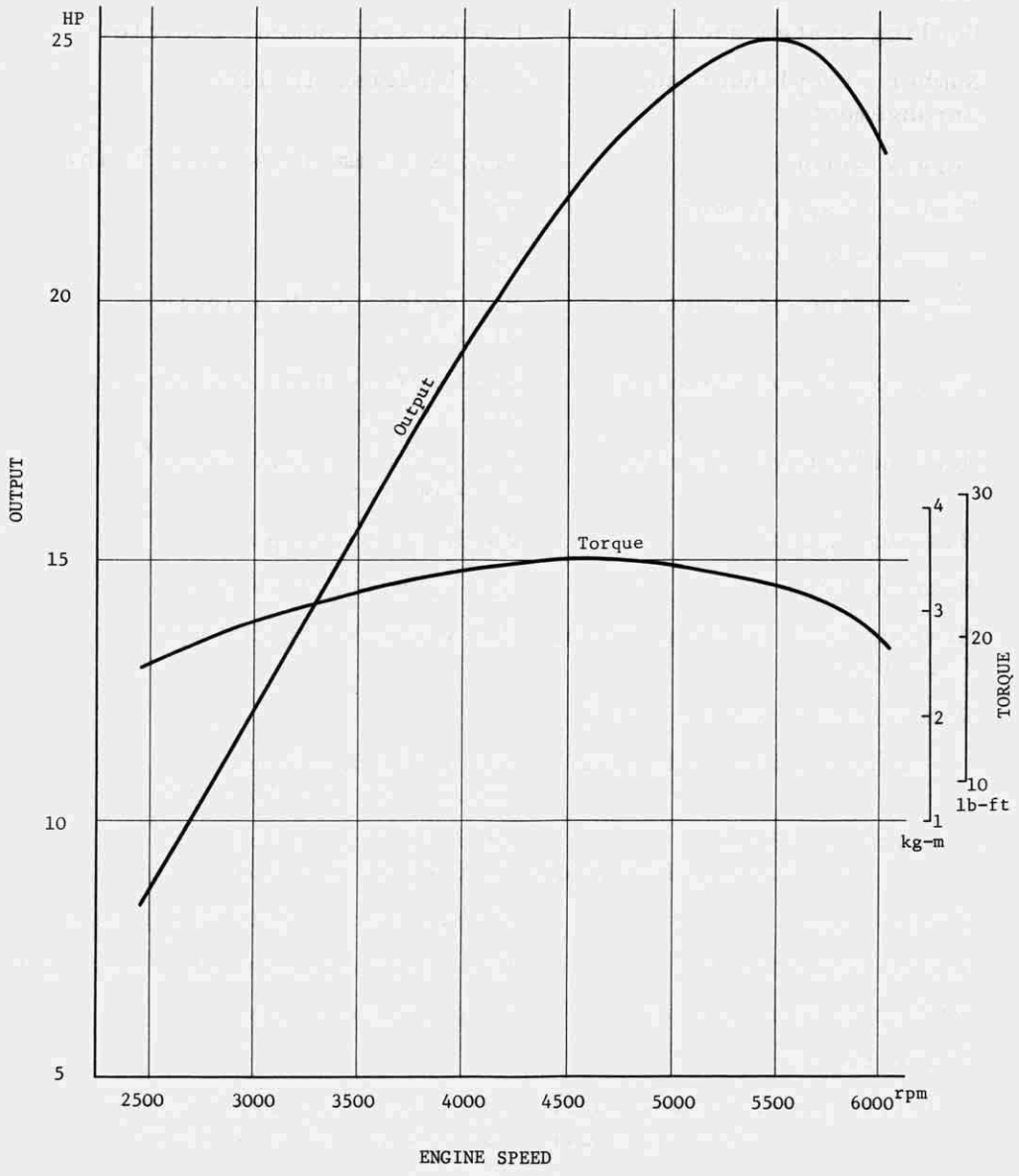
## 1 - 1 ENGINE PERFORMANCE CURVE



## 1 - 2 MAIN SPECIFICATIONS

ENGINE

| | |
|---|---|
| Model | EK32 |
| Type | Gasoline engine |
| Cooling system and cycle | Forced air-cooled; 2-cycle |
| Number of cylinder and arrangement | 2 cylinders, in line |
| Bore x stroke | 61.5 x 60 mm (2.42 x 2.36 in) |
| Piston displacement | 356 cc |
| Compression ratio | 6.7 |
| Compression pressure | 9.1 kg/cm$^2$ (129.4 lb/in$^2$) at 300 rpm |
| Max. explosion pressure | 25.0 kg/cm$^2$ (355.6 lb/in$^2$) at 1500 rpm |
| Mean effective pressure | 6.2 kg/cm$^2$ (88.2 lb/in$^2$) at 4500 rpm |
| Maximum output | 25 HP at 5500 rpm |
| Maximum torque | 3.5 kg-m (25.3 lb-ft) |
| Minimum fuel consumption at full load | 300 gr/hp-h at 5200 rpm |
| Dimensions & weight (dry) | |
| Length x width x height | 634 x 618 x 476 mm (25.0 x 24.3 x 18.7 in) |
| Weight : SEDAN: | 78.3 kg (172.3 lb) |
| CUSTOM,TRUCK,VAN: | 78.8 kg (173.4 lb) |
| Piston type | Single action cylinder piston |
| Piston material | High silicon aluminum alloy cast |
| Number of piston rings | 3 (pressure rings) |
| Valve timing | |
| Intake port: Opening angle | 53° before top dead center |
| Closing angle | 53° after top dead center |
| Exhaust port: Opening angle | 68° before bottom dead center |
| Closing angle | 68° after bottom dead center |

IGNITION SYSTEM

| | |
|---|---|
| Firing order | 1-2 |
| Ignition timing | 13° before top dead center at 2000 rpm |

| | |
|---|---|
| Ignition coil type | HITACHI 51504 - 1100 |
| Distributor | |
| Type : Sedan, Custom | NIPPON DENSO 29100-136 |
| Truck, Van | HITACHI D-203 |
| Firing angle advancer | Automatic centrifugal |
| Spark plug | |
| Type | NIPPON TOKUSHU TOGYO (NGK) B7H |
| Thread size | 14 mm |
| Spark gap | 0.7 mm (0.0276 in) |
| FUEL SYSTEM | |
| Carburetor | |
| Type and number | HITACHI Solex Type HAB28, 1 |
| Air flow-direction | Side draft |
| Air cleaner type and number | Oil wet type paper filter, 1 |
| Fuel tank capacity | |
| Sedan | 25 ℓ, 6.6 US gal, 5.5 Imp. gal |
| Custom | 20 ℓ, 5.3 US gal, 4.4 Imp. gal |
| Truck, Van | 30 ℓ, 8.0 US gal, 6.5 Imp. gal |
| LUBRICATION SYSTEM | |
| Lubrication method | Forced lubrication |
| Oil pump type | Plunger pump |
| Oil tank capacity | 2.5 ℓ (2.6 US qt, 2.2 Imp qt) |
| BATTERY | |
| Type and number | YUASA 12N24-3, 1 |
| Voltage and capacity | 12 V, 26 AH |
| Specific gravity | 1.280 (when fully charged) |
| GENERATOR | |
| Type | NIPPON DENSO 27000 - 116 |
| Generating method | Constant voltage |
| Voltage and capacity | 12 V, 200 W |
| STARTER MOTOR | |
| Type | HITACHI S108 |
| Voltage and output | 12 V, 600 W |

| | | |
|---|---|---|
| REGULATOR | | |
| Type | | NIPPON DENSO 26000 - 108 |
| POWER TRANSMISSION | | |
| Clutch | | |
| Type | | Dry single plate type |
| Clutch plate(outside dia. x inside dia. x thickness) | | 160 x 110 x 3.1 mm (6.30 x 4.33 x 0.12 in) |
| Facing area | | 212 $cm^2$ (32.86 $in^2$) |
| Primary reduction gear | | |
| Type | | Helical gear |
| Reduction ratio | | 1.605 |
| Transmission | | |
| Type | | 4-forward & 1-reverse, synchromesh on 2nd, 3rd & 4th(OT) |
| Gear ratio : | 4th (OT) | 0.806 |
| | 3rd | 1.000 |
| | 2nd | 1.601 |
| | 1st | 3.130 |
| | Reverse | 4.248 |
| Final reduction gear | | |
| Type | | Helical gear |
| Reduction ratio : | Sedan | 3.667 |
| | Custom | 3.667 |
| | Truck | 4.188 |
| | Van | 3.882 |
| Amount of gear oil | | 1.6 ℓ (3.4 US pt., 2.8 Imp. pt.) |
| DIFFERENTIAL | | |
| Differential case | | Separate type |
| Differential gear type and number | | Bevel gear, 2. |

# CHAPTER 2 : MOUNTING AND DISMOUNTING ENGINE

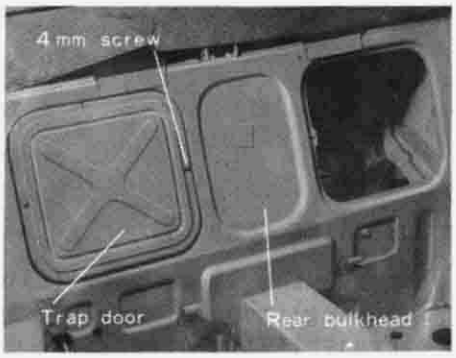
# 2 - 1 MOUNTING AND DISMOUNTING THE ENGINE FOR THE SUBARU 360 SEDAN & CUSTOM

## 1 : PREPARATION

A. SUPPORTING THE CAR BODY

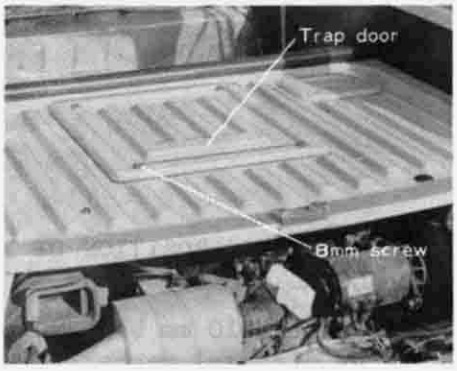
Support the car body by placing it on a sturdy block; raise the rear wheels off the ground.

B. REMOVING THE TRAP DOOR




(a) SEDAN

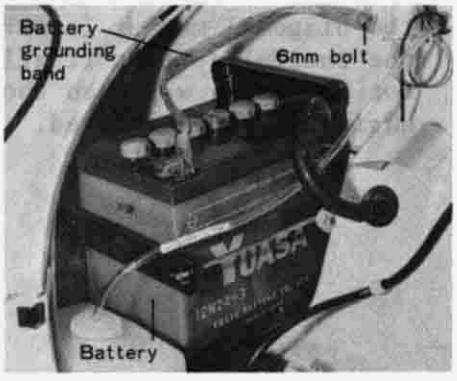
Remove the 4 mm screws and detach the trap doors on the rear bulkhead.




(b) CUSTOM

Remove the 8 mm screws and detach the trap door on the rear shelf.

C. REMOVING THE BATTERY GROUNDING BAND



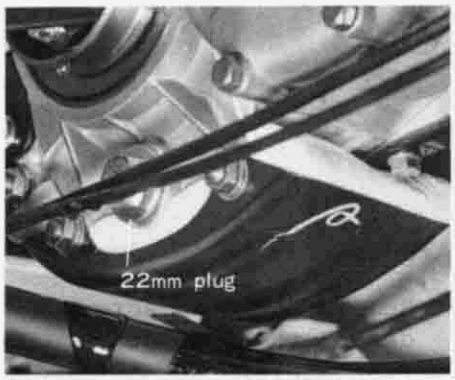

(a) Remove the 6 mm bolt to detach the battery grounding band.

(b) Bend the grounding band so that it will not touch the car body.

## 2 : DISMOUNTING THE ENGINE


A. REMOVING THE ENGINE ROOM UNDER COVER

Remove the four 6 mm bolts and one 10 mm bolt to detach the under cover.

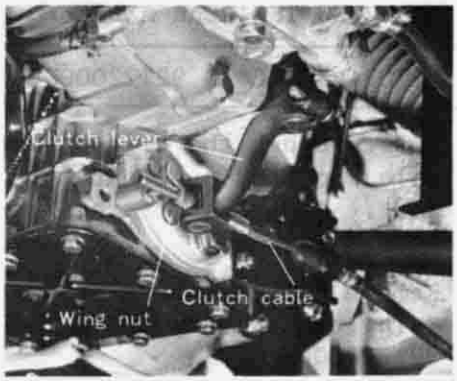



B. DRAINING GEAR OIL

Remove the 14 mm plug (clutch housing) and 22 mm plug (transmission case) and drain the gear oil.


C. SHIFTING THE POSITION OF THE DIAGONAL MEMBER.

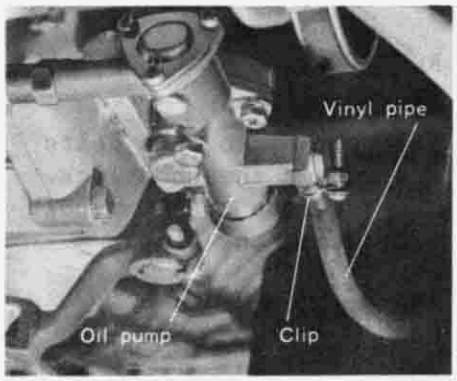
Remove the 10 mm bolt which fixes diagonal member to the cross member; loosen the 10 mm bolt on the other side and shift the position of the diagonal member (toward the inside) so that it will not be in the way when the engine is to be removed.




D. REMOVING THE CLUTCH CABLE

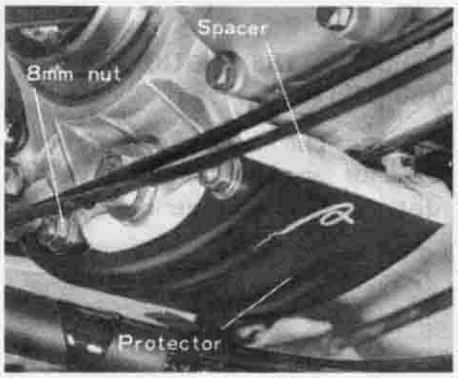
Loosen the 6 mm bolt of the clamp to detach the cable from the bracket and then remove the wing nut.

[NOTE]
When pulling the cable out from the clutch lever the pin (clutch lever) sometimes drops.
Be careful not to lose it.



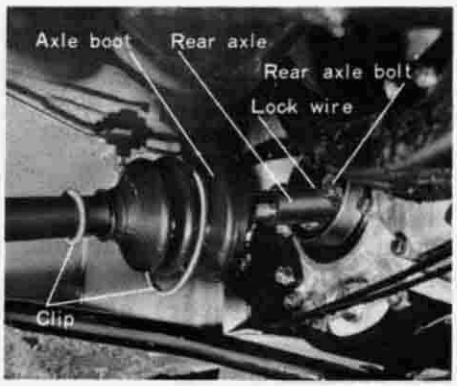

E. REMOVING THE OIL TANK PIPE.

Loosen the screw of the oil pump side clip and pull out the pipe from the oil pump.




F. PROTECTOR (WHEN REMOVING THE CLUTCH HOUSING)

Remove the three 8 mm nuts and detach the protector and spacer.



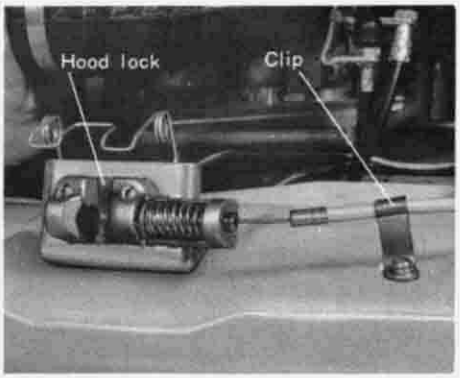

G. REMOVING THE REAR AXLE

| SPECIAL TOOL | 921220000 |
|---|---|

(a) First remove the clip of the axle boot and pull out the boot. Then cut off the lock wire.

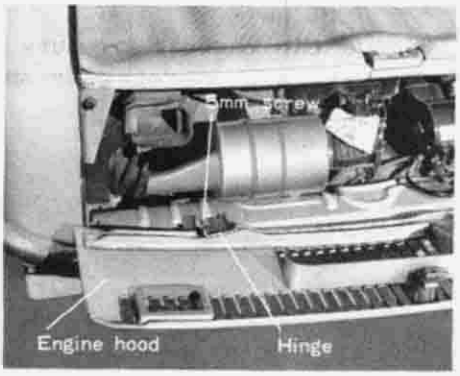
(b) Remove the rear axle bolts using the special tool 921220000.

(c) Pull the wheels outward and disconnect the coupling of the axle.



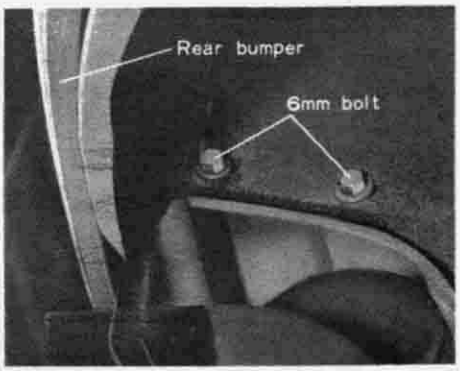

H. REMOVING THE REAR HOOD LOCK (SEDAN only)

Remove the two 5 mm bolts and remove the hood lock. Then, remove the 4 mm bolt and detach the clip.



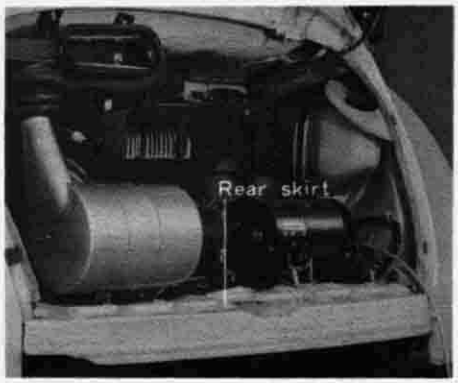

I. REMOVING THE ENGINE HOOD (CUSTOM only)

Remove the four 5 mm screws of the engine hood hinge and detach the engine hood.




J. REMOVING THE REAR BUMPER

Remove the four 6 mm bolts (two on the right and two on the left) and remove the rear bumper from the body.




K. REMOVING THE REAR SKIRT

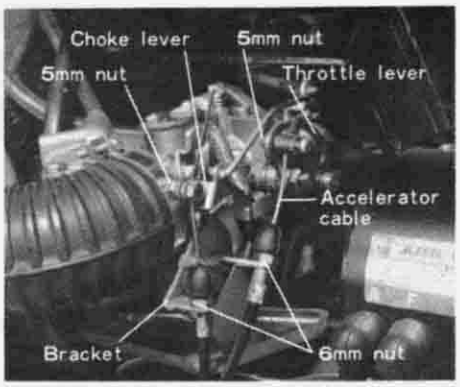
(a) SEDAN

Remove the three 6 mm nuts and the two 6 mm bolts to detach the rear skirt.


(b) CUSTOM

Remove the three 5 mm screws and four 6 mm bolts to remove the rear skirt.

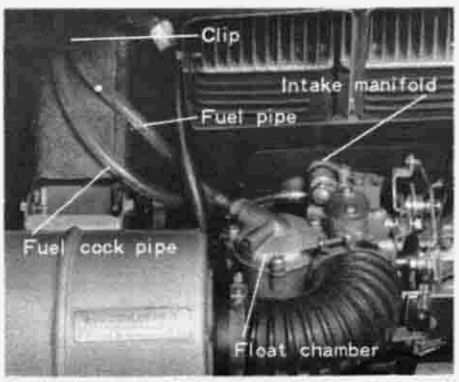
## L. REMOVING THE CHOKE CABLE AND ACCELERATOR CABLE




(a) Remove the 5 mm nut to remove the choke cable from the choke lever.
Loosen the 6 mm nut and detach the cable from the bracket (cable guide).

(b) Remove the 5 mm nut to remove the accelerator cable from the throttle lever.
Loosen the 6 mm nut and detach the cable from the bracket.

## M. REMOVING THE FUEL PIPE AND FUEL COCK PIPE

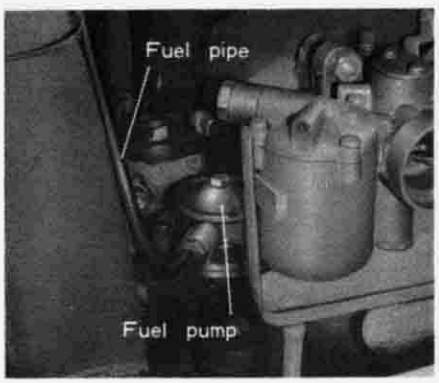



(a) SEDAN

(1) Detach the fuel pipe and fuel cock pipe from the clips.

(2) Remove the fuel pipe from the carburetor float chamber.

(3) Pull out the fuel cock pipe from the intake manifold.

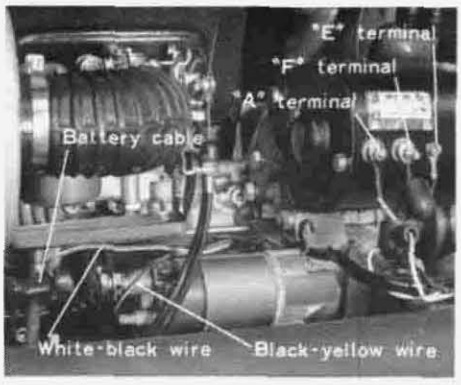



(b) CUSTOM

(1) Detach the fuel pipe from the clip.

(2) Remove the fuel pipe from the fuel pump.

N. REMOVING THE WIRING HARNESS (REAR) AND BATTERY CABLE

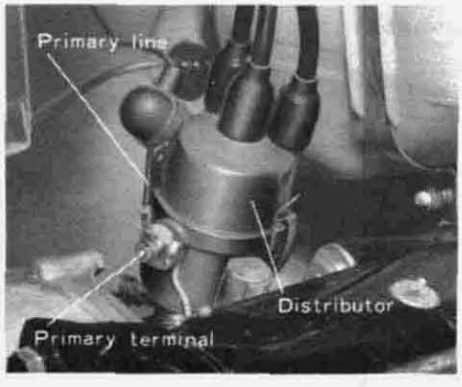



(a) Remove the 5 mm nuts and screw and disconnect the A, F and E wires from the generator.
A terminal : White-red wire
F terminal : White wire
E terminal : Black wire

(b) Remove the 8 mm nut of the starter switch terminal and remove the battery cable (thick black wire) and white-black wire (thin).

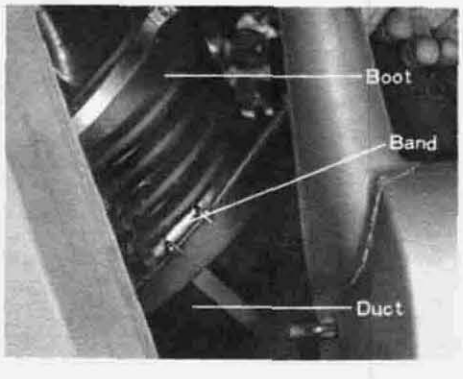
(c) Remove the 6 mm bolt of the clip and detach the battery cable with the clip from the cowl.

(d) Remove the black-yellow wire of the wiring harness from the terminal S of the starter switch.



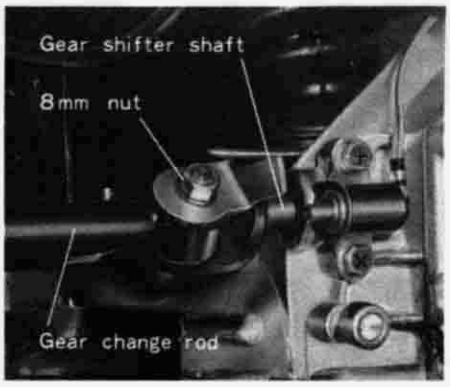

(e) Pull out the high tension cord from the ignition coil and loosen the primary terminal nut of the distributor to remove the primary line.

O. REMOVING THE BOOT (DUCT)



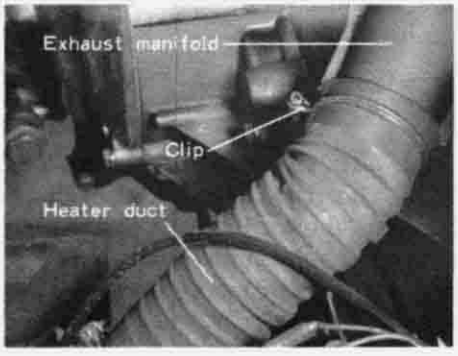

(a) Remove the air intake boot from the air cleaner cover.

(b) Remove the duct side band (boot) and remove the boot from the duct.



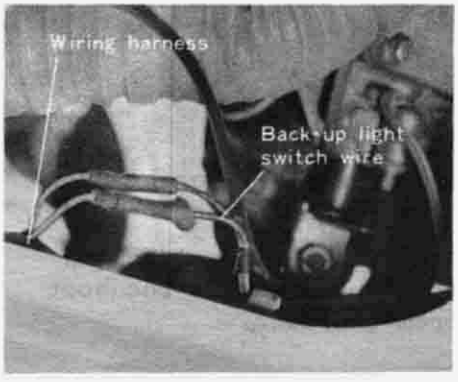

P. REMOVING THE GEAR CHANGE ROD

Remove the 8 mm nut and separate the gear change rod from the gear shifter shaft.




Q. REMOVING THE HEATER DUCT

Loosen the clip (exhaust manifold side) and disconnect the heater duct from the exhaust manifold.

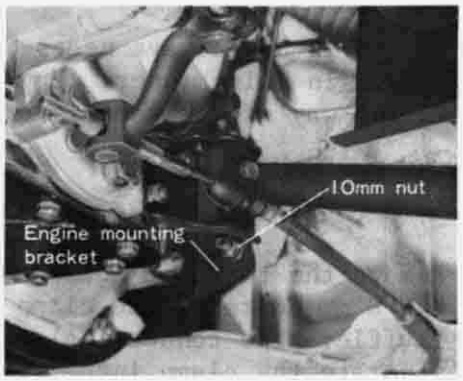



R. DISCONNECTING THE BACK-UP LIGHT SWITCH WIRES

Disconnect the back-up light switch wires from the wiring harness.

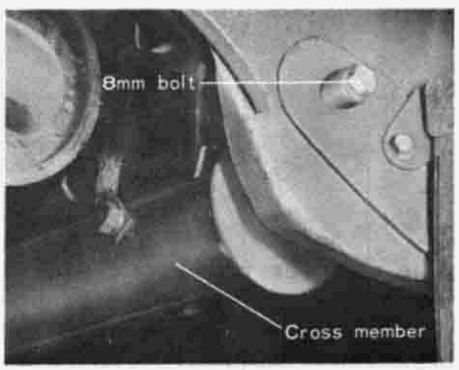
S. SUPPORTING THE ENGINE

Support the lower side of the engine with a stand, box or garage jack.




T. REMOVING THE ENGINE MOUNTING BRACKET (Engine front side)

Remove the two 10 mm nuts of the engine mounting bracket. Leave the bolts in the hole so that they can be pulled out at any time.




U. REMOVING THE CROSS MEMBER (Engine rear support)

(a) Remove the left and right 8 mm bolts of the cross member.

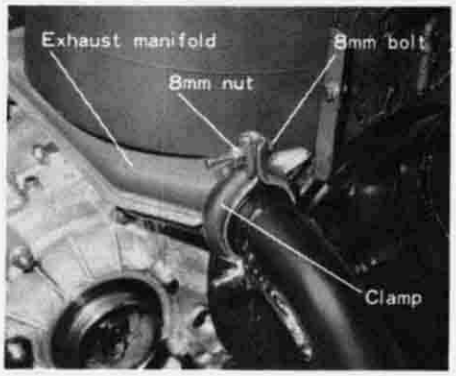
[NOTE]
The bolt is a through bolt from the outside of the car body. In this case, do not pull out the bolt. Leave the bolt in the hole so that it can be pulled out at any time but keep the nut removed. This is safer.

(b) Now cautiously push in two 10 mm bolts of the bracket (engine front); pull out two each left and right 8 mm bolts of the cross member and dismount the engine from the car body.

## 3 : REMOVING ANCILLARY PARTS

In this section, in consideration of those cases in which the engine proper, transmission and differential are disassembled completely, the order and method of removing the ancillary parts are explained.
In the case of partial maintenance, it is not always necessary to remove all the ancillary parts in this manner. Do not remove them unless they are in the way of disassembly or repair work.

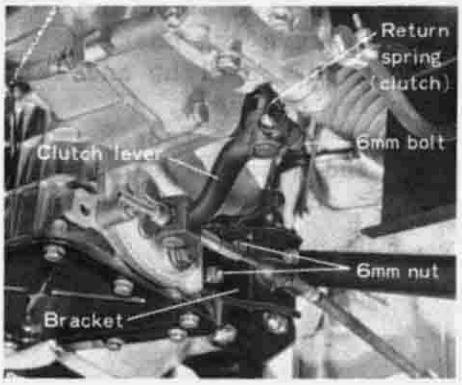
### A. REMOVING THE MUFFLER




(a) Remove the two 8 mm nuts and two 8 mm bolts of the clamp (muffler pipe connecting) and separate the clamp into two pieces.


(b) The muffler will come off when the four 8 mm nuts and four 8 mm bolts.
The ring (muffler pipe connecting) is between the muffler pipe and exhaust manifold.

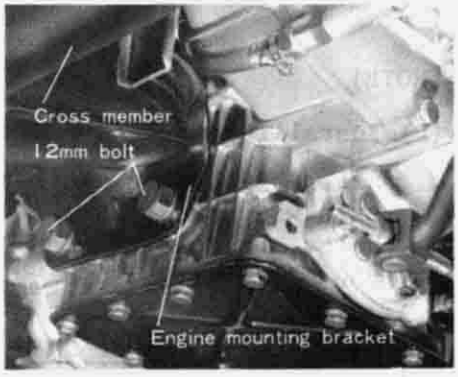
B. REMOVING THE CLUTCH LEVER AND BRACKET (Clutch cable support)




(a) Remove one 6 mm bolt and pull out the lever. Remove one 4 mm woodruff key and then remove the return spring (clutch).

(b) To remove the bracket, remove the two 6 mm nuts. Of these 6 mm nuts one secures the clutch housing with the studs of the engine case.

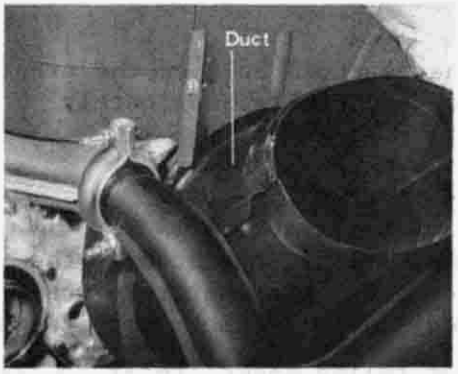
C. REMOVING THE CROSS MEMBER (Engine rear support)




(a) Remove the grouding band (engine) from the cross member.

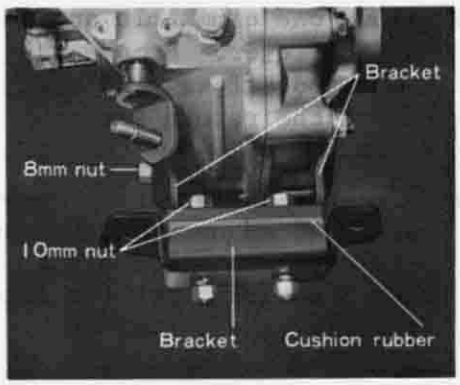
(b) Remove the two 12 mm bolts of the engine mounting bracket. Then, the cross member will be removed together with the bracket and cushion rubber.

D. REMOVING THE LOWER DUCT




Remove the three 6 mm bolts and remove the duct from the fan cover.

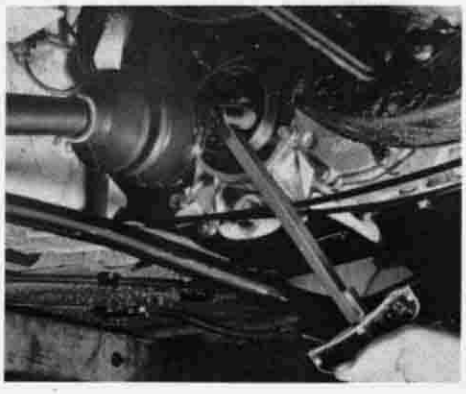
E. REMOVING THE ENGINE MOUNTING BRACKET & CUSHION RUBBER




Loosen the two 10 mm nuts which secure the cushion rubber to the right and left mounting brackets.
Then remove the four 8 mm nuts and detach the cushion rubber and both brackets.

## 4 : MOUNTING THE ENGINE

Mounting the engine is performed by reversing the procedures of the engine dismounting.



[NOTE]

(1) Installing the rear axle

After tightening the rear axle with the rear axle bolts, be sure to lock the bolts with a lock wire.

| TIGHTENING TORQUE |
|---|
| 3.0 - 3.3 kg-m<br>(21.7 - 23.8 lb-ft) |

(2) Supplying gear oil

Remove the 22 mm plug from the gear oil hole on the transmission cover II and fill the case with approximately 1.6 ℓ (3.4 US pt., 2.8 Imp.pt.) of gear oil.

(3) Adjusting idling speed

a. First, make sure that the carburetor choke valve and throttle valve actuate smoothly when operated by the choke lever and accelerator pedal and that they come to the correct fully-opened and fully-closed positions.

b. Regarding the adjustment of idling speed, refer to item H on page 3-99.

(4) Adjusting the clutch cable

Adjust the clutch cable with the wing nut. Refer to item (h) on page 3-21.

(5) Checking the gear shift

Check gear shifting gently at low speed.

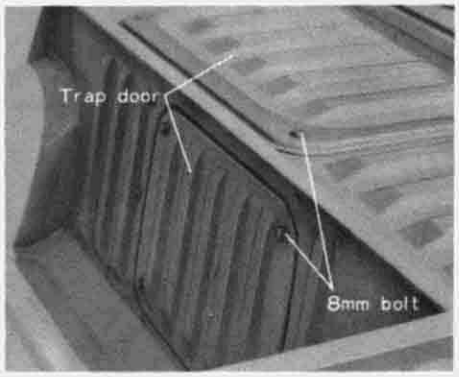
(6) Make sure there is no absormality in any part.

## 2–2 MOUNTING AND DISMOUNTING THE ENGINE FOR THE SUBARU 360 TRUCK & VAN

### 1 : PREPARATION

Support the car body by placing it on a sturdy block and raise the rear wheels off the ground.

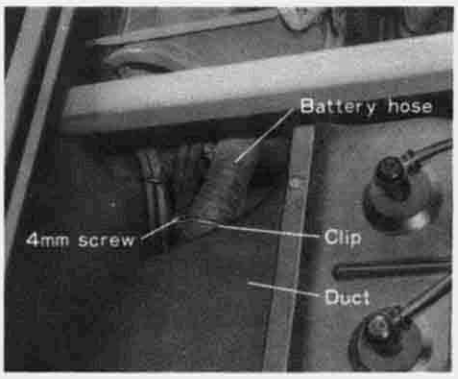
### 2 : DISMOUNTING THE ENGINE




A. REMOVING THE TRAP DOOR AND GROUNDING BAND

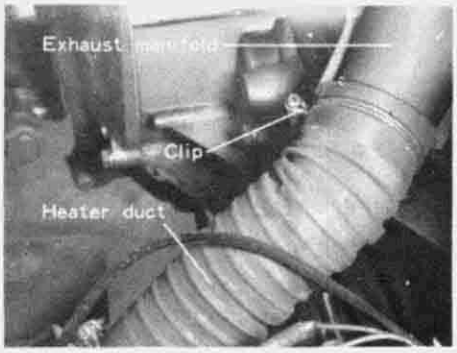
(a) Remove the four each 8 mm bolts to detach the trap doors on the rear shelf and rear bulkhead.

(b) Remove the 6 mm bolt of the battery grounding band. Bend the grounding band so that it does not contact the car body.



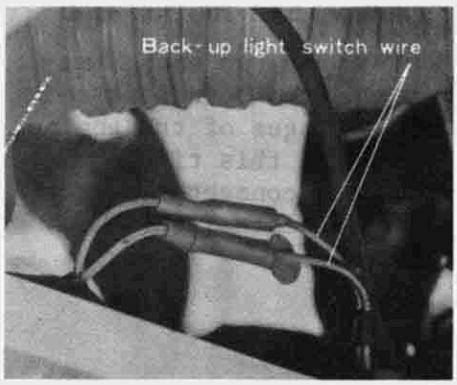

B. REMOVING THE HOSE (BATTERY)

Loosen the 4 mm screw of the duct side clip and remove the hose from the duct.



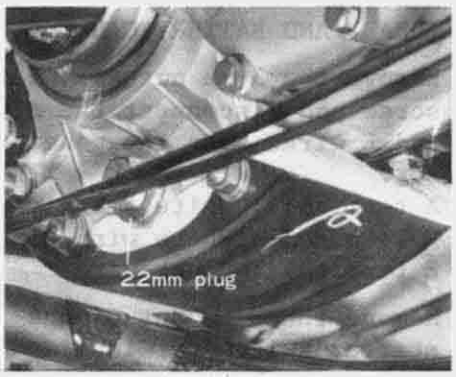

C. REMOVING THE HEATER DUCT

Loosen the clip (exhaust manifold side) and disconnect the heater duct from the exhaust manifold.



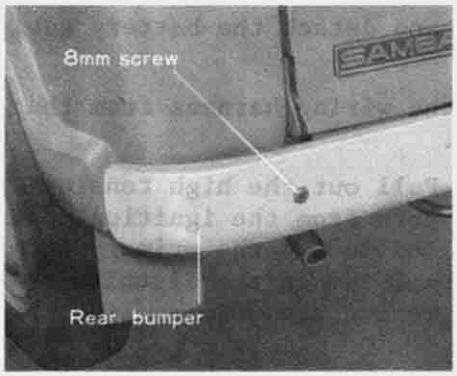

D. DISCONNECTING THE BACK-UP LIGHT SWITCH WIRE

Disconnect the back-up light switch wires from the wiring harness.



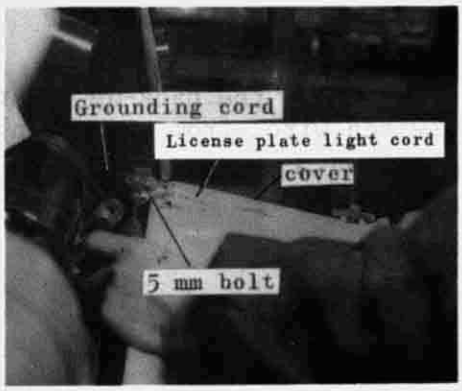

E. DRAINING GEAR OIL

Remove the 14 mm plug (clutch housing) and 22 mm plug (transmission case) and drain the gear oil.



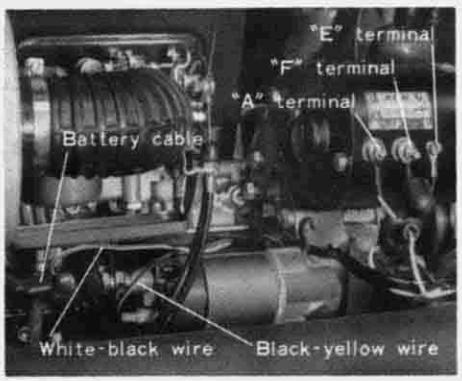

F. REMOVING THE REAR BUMPER

Remove the two 8 mm screws and detach the rear bumper.




G. REMOVING THE ENGINE HOOD

Remove the two each 5 mm screws from both left and right hinges of the engine hood. At this time, remove the cord connector of the license plate light and ground cord.



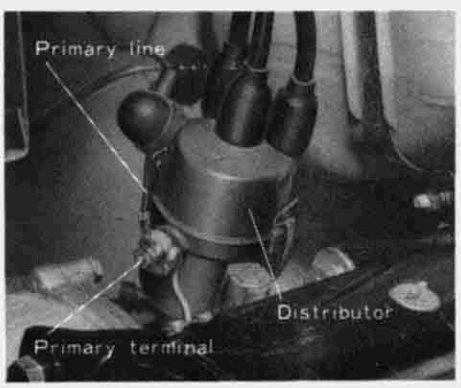

H. REMOVING THE WIRING HARNESS (REAR) AND BATTERY CABLE.

(a) Remove the 5 mm nuts and 5 mm screw and disconnect the A, F and E wires from the generator.
A terminal : White-red wire
F terminal : White wire
E terminal : Black wire

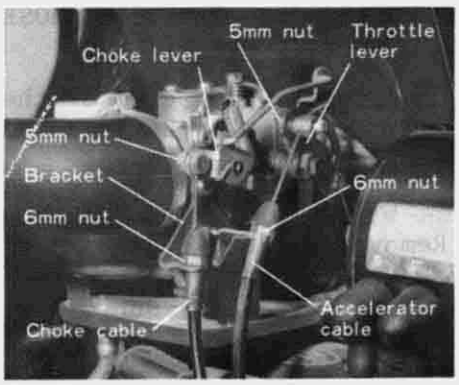
(b) Remove the 8 mm nut of the starter switch terminal and remove the battery cable (thick black wire) and white-black wire (thin).

(c) Remove the 6 mm bolt of the clip and detach the battery cable with the clip from the cowl.

(d) Remove the black-yellow wire of the wiring harness from the terminal S of the starter switch.



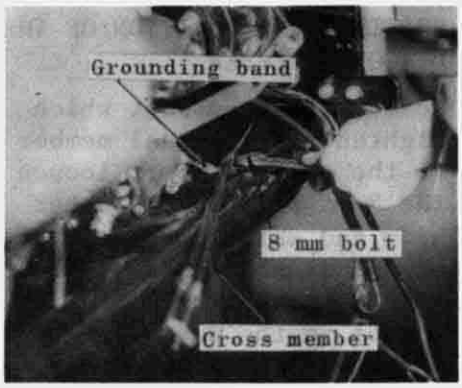

(e) Pull out the high tension cord from the ignition coil and loosen the primary terminal nut of the distributor to remove the primary line.




I. REMOVING THE CHOKE CABLE AND ACCELERATOR CABLE

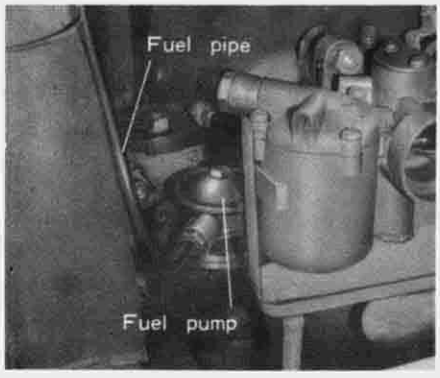
(a) Remove the 5 mm nut to remove the choke cable from the choke lever. Then loosen the 6 mm nut and detach the choke cable from the bracket.

(b) Remove the 5 mm nut to remove the accelerator cable from the throttle lever. Then loosen the 6 mm nut and detach the accelerator cable from the bracket.




J. REMOVING THE ENGINE GROUNDING BAND

Remove the 8 mm bolt and detach the grounding band from the cross member.



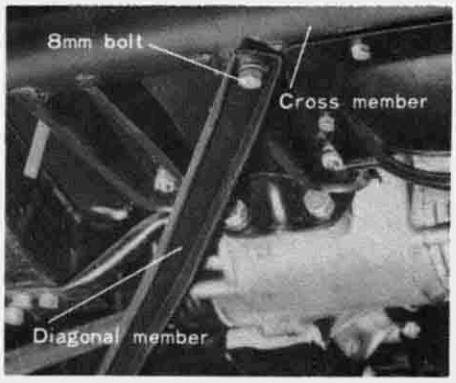

K. REMOVING THE FUEL PIPE

Disconnect the fuel pipe from the fuel pump.


L. REMOVING THE AIR INTAKE HOSE AND BOOT (DUCT)

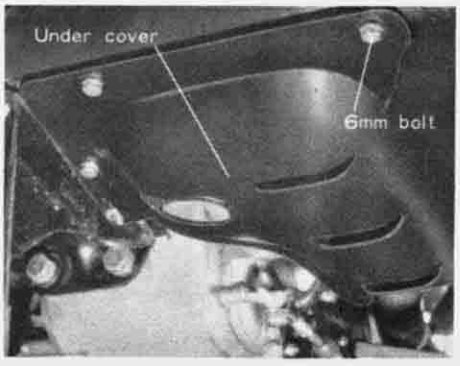
(a) Loosen the 4 mm screw of the clip and remove the air intake hose from the air cleaner cover.

(b) Remove the duct side clip of the boot (duct) and remove the boot from the duct.



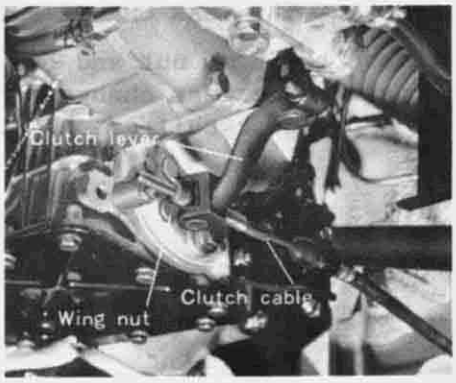

M. SHIFTING THE POSITION OF THE DIAGONAL MEMBER

Remove the 8 mm bolt which tighten the diagonal member to the cross member; loosen the 8 mm bolt on the other side and shift the position of the diagonal member toward the inside so that it will not be in the way when the engine is to be removed.




N. REMOVING THE UNDER COVER

Remove the six 6 mm bolts to detach the under cover.

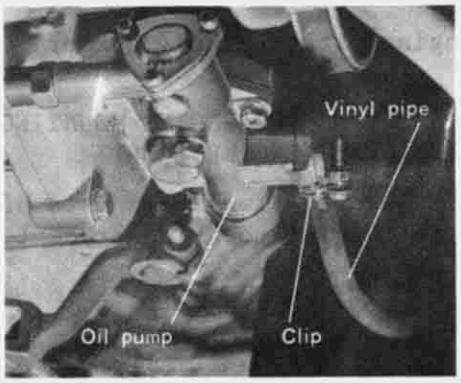



O. REMOVING THE CLUTCH CABLE

Loosen the 6 mm bolt to detach the cable from the bracket and remove the wing nut.

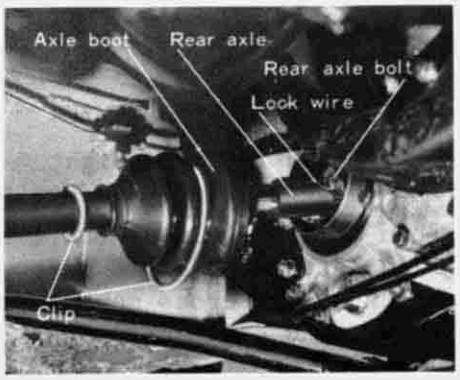
[NOTE]

When pulling the cable out from the clutch lever, the pin sometimes drops. Be careful not to lose it.




P. REMOVING THE OIL TANK PIPE

Loosen the screw of the oil pump side clip and pull out the pipe from the oil pump.



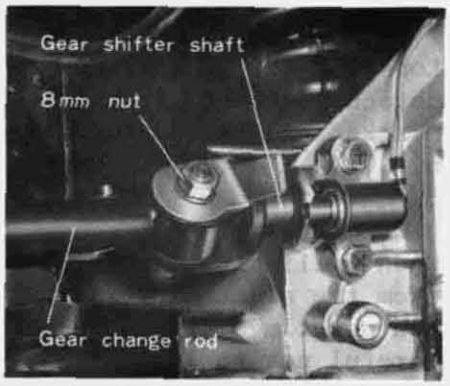

Q. REMOVING THE REAR AXLE

| SPECIAL TOOL | 921220000 |
|---|---|

(a) First, remove the clip of the axle boot and pull out the boot. Then, cut off the lock wire.

(b) Remove the rear axle bolts with the special tool 921220000

(c) Pull the wheels outward and disconnect the coupling of the axle.

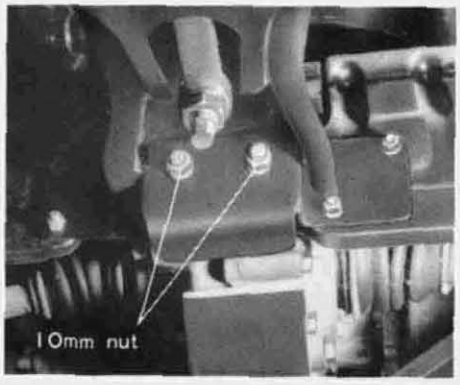



R. REMOVING THE GEAR CHANGE ROD

Remove the 8 mm nut and separate the gear change rod from the gear shifter shaft.

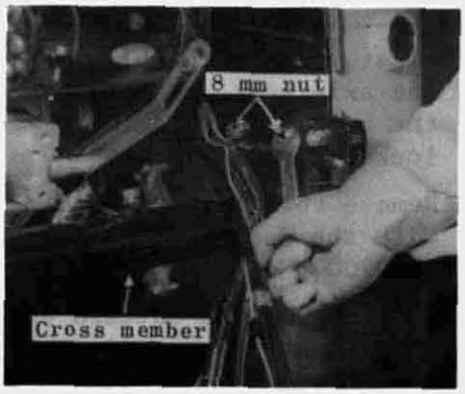
S. SUPPORTING THE ENGINE

Support the lower side of the engine with a stand, box or garage jack.




T. REMOVING THE ENGINE MOUNTING BRACKET (ENGINE FRONT)

Remove the two 10 mm nuts of the engine mounting bracket.




U. REMOVING THE CROSS MEMBER

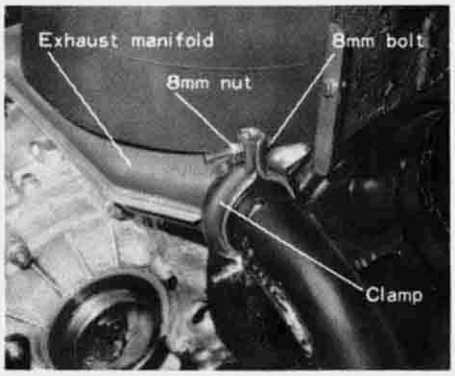
(a) Remove the left and right 8 mm nuts of the cross member.

(b) Then cautiously pull out two each left and right 8 mm bolts of the cross member and remove the engine from the chassis.

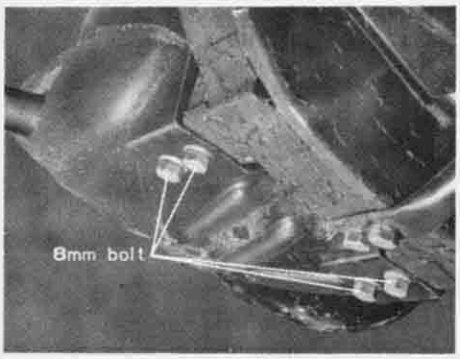
## 3 : REMOVING ANCILLARY PARTS

In the case of partial maintenance, it is not always necessary to remove all the ancillary parts in this manner. Do not remove them unless they are in the way of disassembly or repair work.

A. REMOVING THE MUFFLER

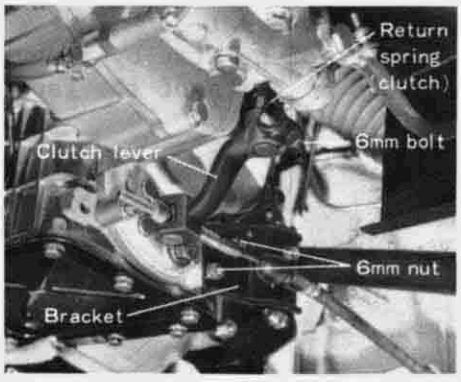



(a) Remove the two 8 mm nuts and two 8 mm bolts of the clamp (muffler pipe connecting) and separate the clamp into two pieces.




(b) Remove the muffler by removing the four 8 mm bolts.
A ring (muffler pipe connecting) is inserted between the muffler pipe and exhaust manifold.

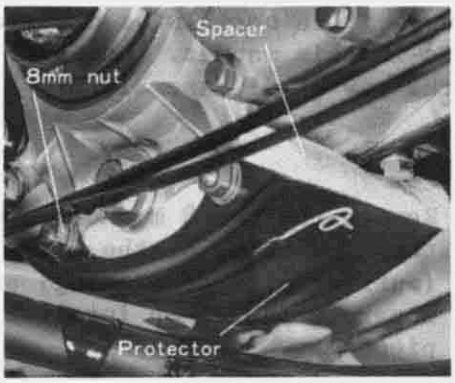
B. REMOVING THE CLUTCH LEVER AND BRACKET (CLUTCH CABLE SUPPORT)




(a) Remove one 6 mm bolt and pull out the lever. Remove one 4 mm woodruff key and then remove the return spring (clutch).

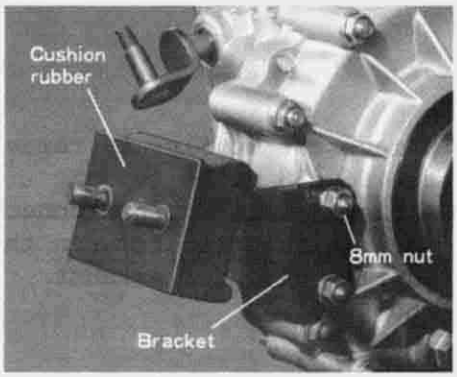
(b) To remove the bracket, remove the two 6 mm nuts. Of these 6 mm nuts one secures the clutch housing with the stud of the engine case.

C. REMOVING THE PROTECTOR (DIFFERENTIAL CASE LOWER SIDE)



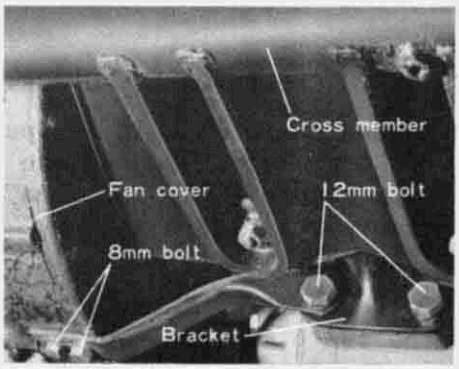

Remove the three 8 mm nuts and remove the protector together with the spacer.

D. REMOVING THE ENGINE MOUNTING BRACKET & CUSHION RUBBER



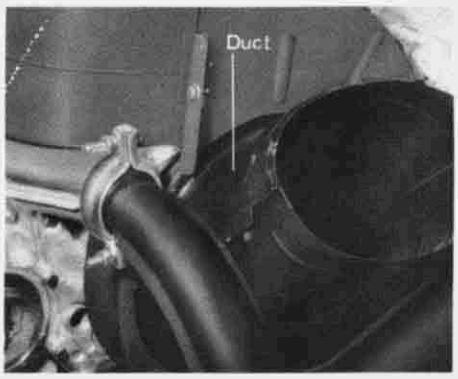

Loosen the two 10mm nuts which secure the cushion rubber to the right and left mounting brackets. Then remove the four 8 mm nuts and detach the cushion rubber and both brackets.

E. REMOVING THE CROSS MEMBER AND BRACKET (ENGINE REAR SUPPORT)




Remove the two 12 mm bolts of the engine mounting bracket. Then, the cross member will be removed together with the cushion rubber and bracket.
Also, detach the stay by removing the two 8 mm bolts of the fan cover side.

F. REMOVING THE LOWER DUCT




Remove the lower duct by removing the three 6 mm bolts.

## 4 : MOUNTING THE ENGINE

Mounting the engine is performed by reversing the procedures of the engine dismounting.

[NOTE]

(1) Installing the rear axle

After tightening the rear axle with the rear axle bolts, be sure to lock the bolts with a lock wire.

| | |
|---|---|
| TIGHTENING TORQUE | 3.0 - 3.3 kg-m (21.7 - 23.8 lb-ft) |

(2) Supplying gear oil

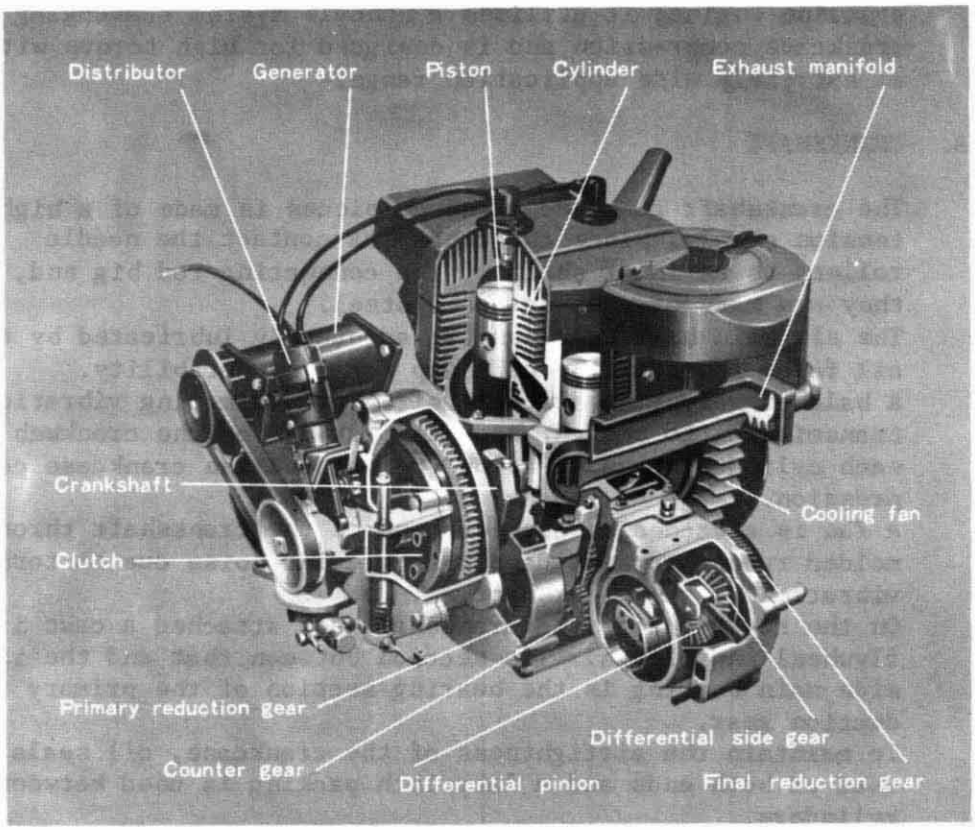
Remove the 22 mm plug from the gear oil hole on the transmission cover II and fill the case with approximately 1.6 ℓ (3.4 US pt., 2.8 Imp.pt.) of gear oil.

# CHAPTER 3 : ENGINE AND TRANSMISSION



3

## 3 - 1 ENGINE POWER UNIT




The engines for the Subaru 360 Sedan, Subaru 360 Custom, Subaru 360 Truck and Subaru 360 Van have most of their constructional parts in common. They have a unique arrangement and construction which aims for compactness, light weight and high efficiency.
The engine, clutch, transmission and differential are arranged into a unified structure with all superfluous parts eliminated to simplify handling and maintenance. At the same time, the number of points where trouble is liable to occur is reduced greatly to raise durability. The above unified structure (including ancillary parts) is called a power unit.

## I : CONSTRUCTION OF ENGINE

The engine is a two-stroke, air-cooled, in-line two-cylinder gasoline engine; it utilizes a Schnule system scavenging using crankcase compression and is designed for high torque with an extremely wide application range.

### A. CRANKSHAFT

The crankshaft composed of seven pieces is made of a high tension steel. Since the crankpins contact the needle rollers as an inner shaft of the connecting rod big end, they are made of case-hardened steel.
The six main ball bearings are adequately lubricated by the oil force fed from the oil pump for long durability.
A balance weight of suitable size for minimizing vibration transmission to the car body is provided on the crankweb for each cylinder; it also helps to increase the crankcase compression.
A fan is attached on the left end of the crankshaft through a molded rubber torsion damper to prevent noise due to torsional vibration of the crankshaft.
On the right end of the crankshaft are attached a cast iron flywheel and clutch. The section between that and the right side main bearing is the bearing section of the primary reduction gear.
To maintain the airtightness of the crankcase, oil seals are used at both ends and a labyrinth packing is used between the cylinders.

### B. CRANKCASE

The aluminum alloy cast crankcase is, for assembly of the crankshaft, split into front and rear sections and is assembled with the twelve 8 mm high tension steel bolts. The joint is made airtight with the use of liquid packing.
The front half forms a unit with the transmission case and differential housing; cooling fins which also act as reinforcing material run in the rear half.
The hole which supports the crankshaft main bearing has a cast sleeve to prevent slip and wear due to slipping of the bearing.

### C. CYLINDER AND CYLINDER HEAD

The cylinder is made of special cast iron of excellent wear-resisting and seize-resisting characteristics; the cooling fins of 7.5 mm (19/64 in) pitch are designed with special emphasis on cooling of the area around the exhaust port. Therefore, lowering of output due to accumulation of carbon inside the port never occurs.

The cylinder head is made of cast aluminum alloy 9 mm (23/64 in) pitch cooling fins stand vertically and are curved along the flow of the cooling air. The combustion chamber is designed for high efficient performance.
With an actual compression ratio of 6.7, it has been verified that no knocking occurs with ordinary fuels.

D. PISTON

The piston is made of low heat expansion, high silicon-aluminum alloy. Its top is ball-shaped and its skirt section forms a special cross section of tapered barrel type. In its ring slots are three rings: top ring-chrome-plated, second ring - taper ring of 1° , third ring - an orthodox ring.
The 18 mm (0.71 in) diameter piston pin is made of case-hardened steel and is a full floating type with both ends held by snap ring retainers. Its surface is super-finished and is selectively coupled to the piston within a range of 0.006 mm (0.0002 in).
When a cylinder has an inner diameter of 61.5 mm (2.42 in) as in the 2-stroke air-cooled engine cooling of the piston presents a difficult problem. However, by selecting the materials and form described above, it was possible to reduce seizing and knocking to a minimum.

E. CONNECTING ROD

The connecting rod is made of case-hardened steel and the big end has been hardened by cementation.
Caged needle rollers are used in the big and small ends for adequate durability.

F. INTAKE AND EXHAUST MANIFOLDS

The intake manifold is made of cast aluminum alloy and is attached to the cylinder through a gasket. Also, an insulating bakelite plate is attached between the manifold and the carburetor.
The exhaust manifold is made of cast iron and is attached to the cylinder through a gasket.
It is connected to the exhaust pipe leading to the muffler with a ring and clamp band.
The exhaust manifold has the fins and forms a kind of heat exchanger as the heat source for the car heater and defroster.

## G. COOLING SYSTEM

The cast aluminum alloy fan attached to the left end of the crankshaft has an outside diameter of 210 mm (8.27 in) and is a sirocco type centrifugal fan which has a rather large air flow in spite of its small size. Also, since parts such as belts are not used, its reliability in cooling is ensured.
The air coming out of the volute chamber of the fan is turned 180° in direction by the air duct, led approximately midway between the two cylinders, passed from the exhaust side to the intake side of the cylinder, and is discharged outside the engine room by an outlet duct.
In the Sambar, an pipe for cooling the battery is provided in one part of the air duct.
The exhaust manifold is located below the air duct and acts as the source of heat for the car heater and defroster. A part of the air coming out of the volute chamber is led from below the manifold to the chamber. The air receives heat from the cooling fins of the manifold while it is passing through the chamber, and as heated air of approximately 50° - 90° (120° - 190°F), it flows out through the heater hose.

## H. CARBURETOR AND INTAKE SYSTEM

The carburetor used is a Hitachi HAB-28 side draft type and its main nozzle is a multi-hole type. Its outstanding feature is that the slow system is on the center line in consideration of fuel flow balance to both cylinder.
In the Subaru 360 Sedan, fuel feeding is of the gravity type; fuel is sent to the float chamber through a strainer. In the Subaru 360 Custom, Truck and Van, however, because of the tank position, a fuel pump is provided. This pump pressure feeds the fuel utilizing the variation of the pressure inside the crankcase which is designed especially for a 2-stroke engine.
The air cleaner is a oil wet filter paper type. Because it has a filtering area proportional to the piston displacement, it exhibits excellent cleaning efficiency.
The air intake for the Subaru 360 Sedan and Subaru 360 Custom is located on the fender of the left rear wheel. For the Sambar, the frame (left) front where there is comparatively less dust is the location of the air intake.
Because of these locations for air intake, Subaru engines, even though they are rear mounting engines, do not experience trouble due to road dust.

## 2 : CLUTCH

The dry single plate type clutch is enclosed in a flywheel which can be split into two sections. Constructionally, since the input and output sides are in the same direction, the output shaft is on the outside of the input shaft and they form a double shaft. Because of this the clutch looks a bit different but functionally it does not differ much from a conventional clutch.
The friction plate use a resin mold material. Its outside and inside diameters are 160 mm (6.30 in) and 110 mm (4.33 in) respectively and it is compressed uniformly by six springs and a pressure plate.
For the release bearing, a thrust ball bearing is used. It has a life of several ten thousand mileage without lubrication. Repair and replacement of the clutch can be performed only by removing the clutch housing cover; this is much simpler than the clutches of ordinary construction which require removal of the transmission case for repair or replacement.

## 3 : TRANSMISSION

The transmission with four-forward and one-reverse speeds uses inertia lock type synchromesh for second, third and fourth (OT) speeds and a selective sliding type for first and reverse speeds. The transmission case, as has been stated before, forms a unit with the crankcase. It is made of cast aluminum alloy.
Each of the primary and final reduction gears is made of case-hardened steel hardened by cementation. Helical gears are used. Other transmission gears are all spur gears and are made of the same material.
The counter shaft is supported at both ends by ball bearings and there is no increase in noise due to wear.
For the fitting of the main drive gear and main shaft, two needle roller bearings are used and there is absolutely no seizing of this part.
Furthermore, both the main drive gear and mainshaft (output side) is supported by ball bearings to the case.
Since the gear shafts are located at right angles to the running direction, a mechanism for changing to ordinary driving operation (horizontal H type) is provided on the transmission cover.

## 4 : DIFFERENTIAL

The differential system consists of two pairs of bevel gears made of case-hardened steel hardened by cementation and one shaft and is located in a compartment surrounded by the final reduction gear and differential case made of pearlite malleable.

The shaft section of the side gear (bevel gear of the driven side) encloses a cross-shaped universal joint. The construction utilizing a thrust block made of an aluminum alloy between the two side gears is unique and not found in any other make. (Utility model)
The universal joint is an enclosed type because when a swing axle type rear axle is utilized, to decrease uneven velocity rotation of the axle as much as possible it is necessary to make the swing angle of the rear axle as small as possible. For this the distance between the left and right universal joints must be made as short as possible. Thus the enclosed type universal joint was adopted.
The reason for insertion of the thrust block, in the case of Subaru, is that a swing axle without an outer tube is used to simplify the construction. Consequently, the axial load from the wheels is applied on the axle. This load is transmitted to the side gears through the universal joints. In a case in which a great force of compression direction is applied by the wheels, the side gears are pushed inward and the backlash between it and the pinion becomes 0, the bearing becomes poor and also there is a danger of damage. To prevent these, the thrust block is inserted between the side gears and by maintaining the gap properly, it is possible to maintain a suitable value of backlash. In this case, force in the axial direction is transmitted from the side gear → thrust block → side gear. Then from the shoulder of the side gear on the opposite side, it passes to the differential case; it then passes to the differential housing through the ball bearing which supports the differential case and further passes to the car body via the engine mounting rubber.
In the case of a force of pull direction, the thrust block is unnecessary.
Sleeves made of malleable steel are connected on the ends of the side gears. Leakage of gear oil is prevented by oil seals and boots.
The gear oil also flows through the transmission case; both the oil hole and drain hole are located on the transmission case.

## 5 : ANCILLARY PARTS

### A. IGNITION SYSTEM

As the ignition system, a battery-coil system utilizing a distributor is used to simplify starting and servicing.
The distributor is provided on the clutch housing cover and is driven by a skew gear assembled on a shaft spline-coupled to the clutch cover.

Bacause the distributor speed is reduced to 1/2 by the above gear, the rotor head has terminals at both ends and is of a special shape to prevent reverse rotation.
Also, a governor advancer is provided (advancing angle :3.5°).

B. STARTER MOTOR

The magnetic-shift type 0.6 KW starter motor is started by the same key switch as the ignition; at a reduction ratio of approximately 1:9, the motor meshes with the ring gear of the flywheel and has an efficiency which starts the engine at a tempreature as low as -20°C (-4°F).

C. GENERATOR

A constant voltage DC 200W dynamo is provided, driven by a pulley attached to one end of the distributor driving shaft at a speed accelerated 1.2 times.
The battery can be maintained in sufficiently charged condition at all times even when various equipments are used.

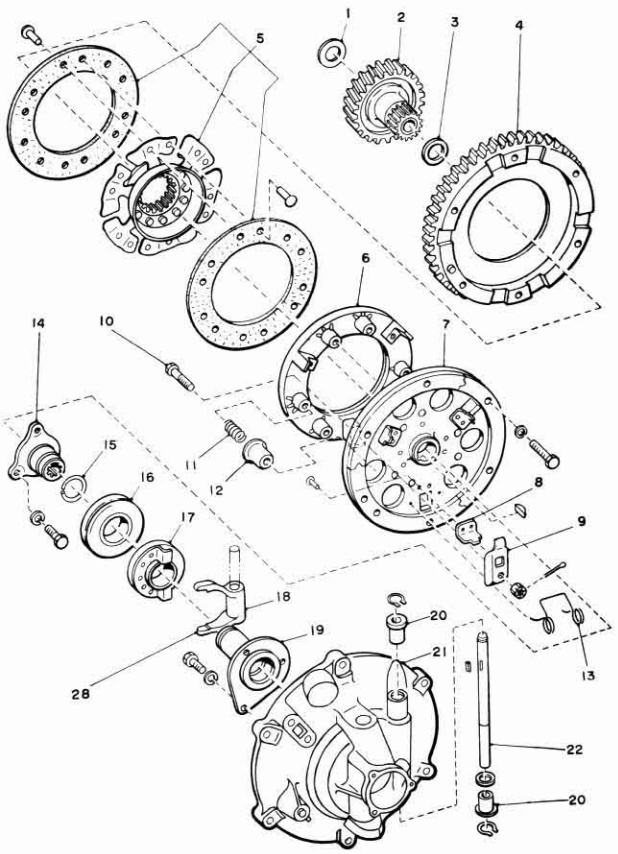
## 3 - 2 ENGINE MAINTENANCE( I )

In this section, maintenance of the engine without dismounting it from the car body is described.

[NOTE]

The maintenance which can be performed without dismounting the engine from the car body is maintenance of the clutch and its related parts and of the cylinder, piston, etc. For correct maintenance of the engine, disassembly and assembly of the parts other than referred to above are not desirable. Since the space around the engine mounted on the car body is very limited, there are many places in which work becomes difficult. Use the correct tools properly and avoid forcing. The engine on the car body is usually dirty. Clean the outside (blow air) thoroughly taking care so that no dust enters the engine interior. Place the car on a stand or in a pit to make maintenance easier.

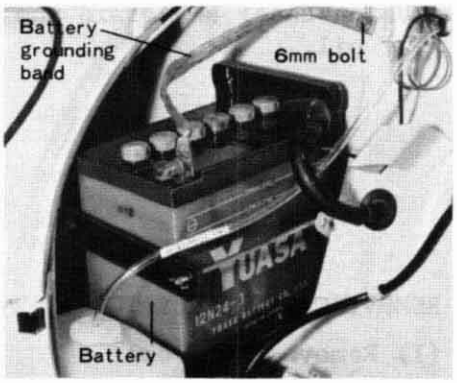
### I : CLUTCH




(1) Spacer
(2) Primary reduction pinion
(3) Washer
(4) Flywheel
(5) Clutch disc
(6) Pressure plate
(7) Clutch cover
(8) Seat (release lever)
(9) Release lever
(10) Release bolt
(11) Clutch spring
(12) Cap (clutch spring)
(13) Return spring
(14) Coupling
(15) Snap ring
(16) Release bearing
(17) Bearing holder
(18) Release fork
(19) Bearing guide
(20) Bushing
(21) Clutch housing cover
(22) Release fork shaft

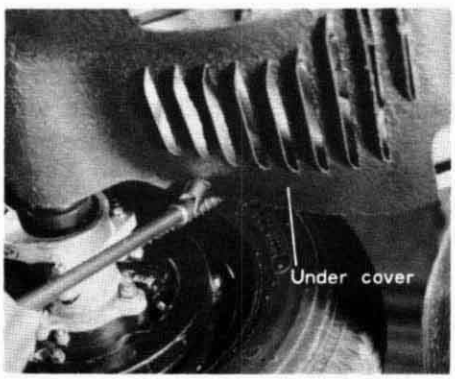
In this section, the procedure for replacing the clutch (the clutch housing must be removed) is described. When performing partial repair, disassembly is unnecessary each time.

A. DISASSEMBLY




(a) REMOVING THE BATTERY GROUNDING BAND

Open the front hood and remove the 6 mm bolt which connects the grounding band to the body. If tools contact the car body when removing the battery cable, shorting will occur and the battery and other parts will be damaged. Be sure to remove the grounding band before removing the battery cable.



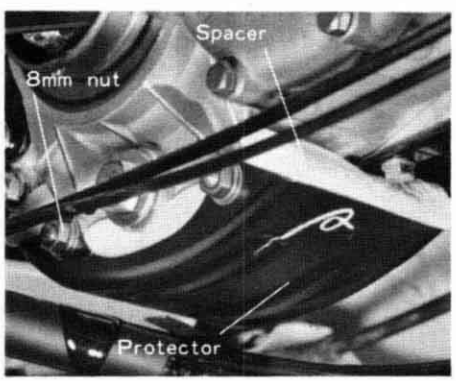

(b) REMOVING THE ENGINE ROOM UNDER COVER

Remove the bolts and detach the under cover.

SEDAN: 6 x 12 mm bolt:4 each
10 x 22 mm bolt:1 each

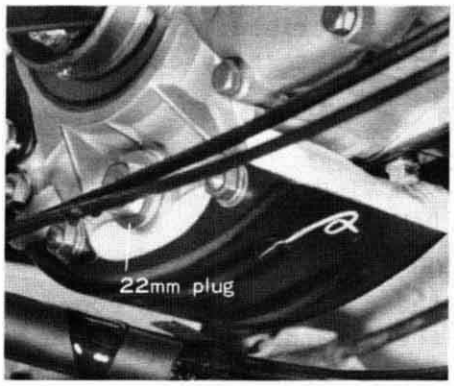
CUSTOM: 6 x 12 mm bolt:4 each
6 x 16 mm bolt:2 each
10 x 22 mm bolt:1 each

SAMBAR: 6 x 14 mm bolt:6 each



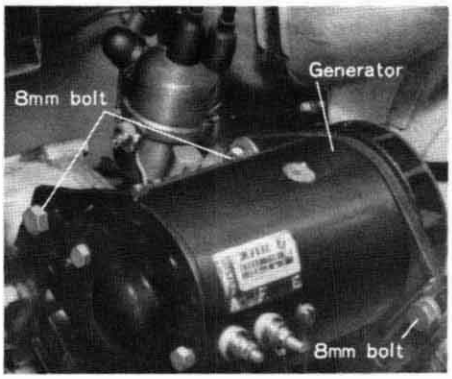

(c) PROTECTOR (When the clutch housing is to be removed)

Remove the three 8 mm nuts and remove the protector and spacer.




(d) DRAINING GEAR OIL (When the clutch housing is to be removed)

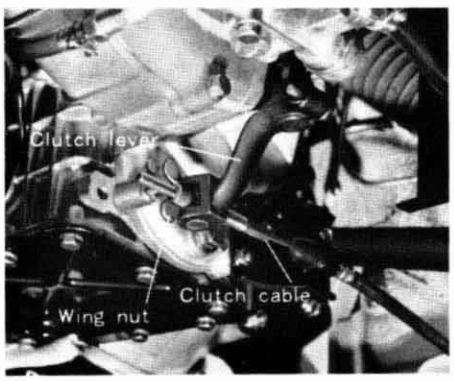
Remove the 14 mm plug (clutch housing) and 22 mm plug(transmission case) and drain the gear oil.




(e) REMOVING THE GENERATOR

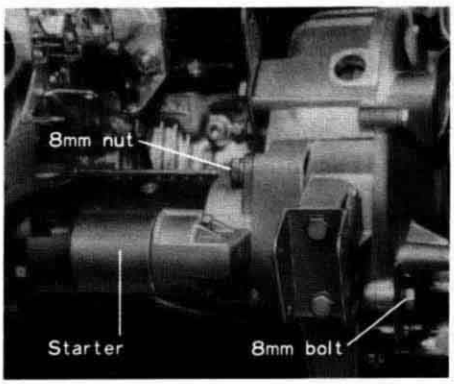
(1) Remove the V-belt.

(2) Remove the three 8 mm bolts of the brackets and then remove the generator. In this case, do not disconnect the connection of each terminal of the wiring harness and generator but place these on the rear skirt as they are.




(f) REMOVING THE CLUTCH CABLE

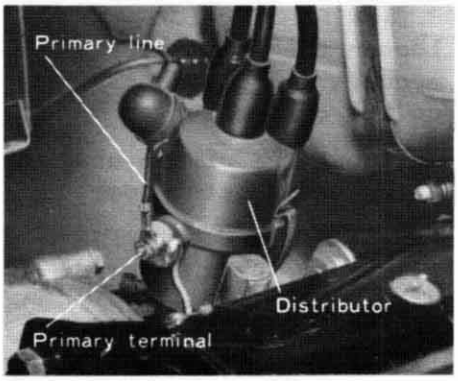
Remove the wing nut and detach the cable from the clutch lever. Record the tightening degree (the number of turns it is tightened) of the wing nut.




(g) REMOVING THE STARTER
(When the clutch housing is to be removed)

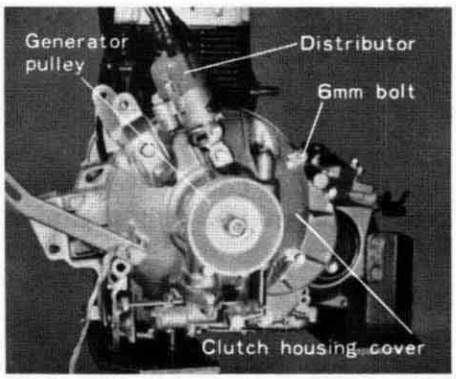
(1) Remove the battery cable and white - black wire from the B terminal and the black-yellow wire from the S terminal.

(2) Remove the 8 mm nut and 8 mm bolt (L=100 mm; it secures the grounding band (engine) and as a through bolt, it secures the starter to the clutch housing) and remove the starter.




(h) REMOVING THE CLUTCH HOUSING COVER

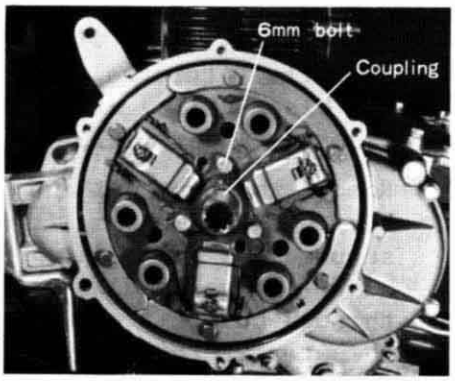
(1) Remove the spark plug caps and pull out the high tension cord from the ignition coil.
Remove the primary line from the distributor primary terminal.



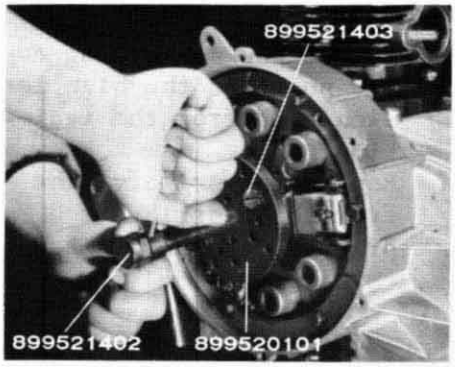

(2) Remove the five 6 mm bolts; then with the distributor and generator pulley attached, remove the clutch housing cover.
If it is difficult to remove, remove while tapping around the fitting section uniformly with a mallet.

(i) REMOVING THE CLUTCH ASSEMBLY

| SPECIAL TOOL | 899520120 (89520101), (899521402), (899521403) |
|---|---|




(1) Remove the three 6 mm bolts and disconnect the coupling.



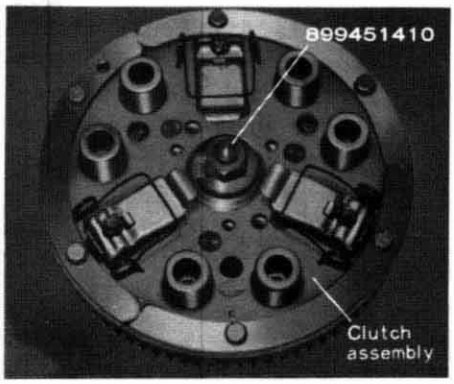

(2) Loosen the 12 mm bolt which secures the clutch assembly to the crankshaft.

(3) Pull out the clutch assembly using the special tool 899520120.

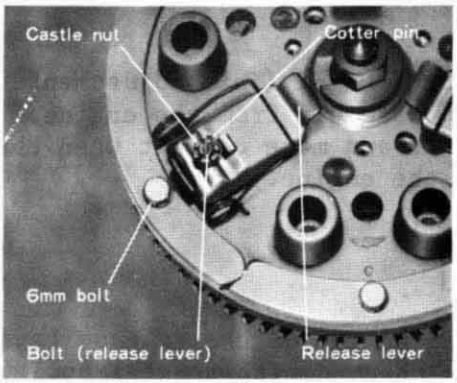
(4) Remove the bolt loosened at (2).

(j) DISASSEMBLY OF CLUTCH ASSEMBLY
(When checking or replacing the clutch disc and springs)

| SPECIAL TOOL | 899481410 |
|---|---|




(1) Place the clutch assembly on the special tool 899451410 and tighten it with the nut.

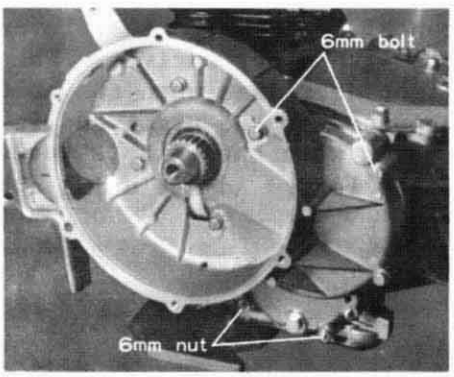



(2) Remove the 1.2 mm cotter pin of the release lever; hold the castle nut with a wrench; turn the bolt (release lever) with a screwdriver and remove the castle nut. Remove six 6 mm bolts from the clutch cover.

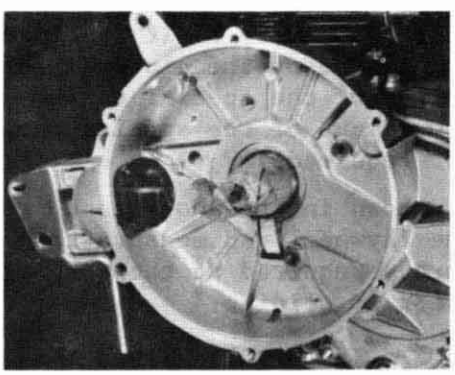
(3) Gradually loosen the 10 mm nut from the clutch assembly separate the flywheel and clutch cover and take out the internal parts of the clutch.

During disassembly, be sure not to smear the clutch facing with oil or grease.

(k) REMOVING THE CLUTCH HOUSING (When replacing the clutch assembly or primary pinion thrust washer).




(1) Remove the two 6 mm bolts, four 6 mm bolts and three 6 mm nuts from the clutch housing. When the 6 mm nuts are removed, the bracket (clutch cable support) will come off. Of these three 6 mm nuts, two secure the clutch housing.

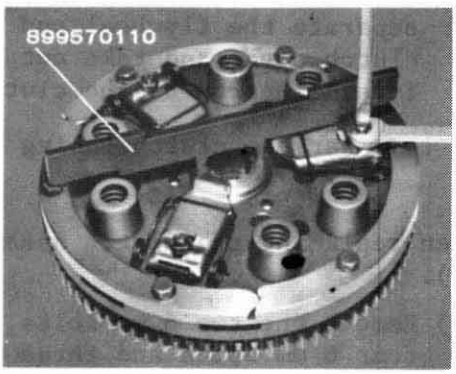


(2) As shown in the photograph, cover the primary reduction pinion spline section with thin paper (such as kraft peper) to protect the oil seal lip from damage.
Remove the clutch housing while uniformly tapping the housing with a mallet.

B. CHECKING AND ADJUSTING PARTS

(a) ADJUSTING THE HEIGHT OF THE RELEASE LEVER (This adjustment is made without removing the clutch assembly from the engine. However, adjustment becomes easier and more correct when the clutch assembly is removed from the engine.)

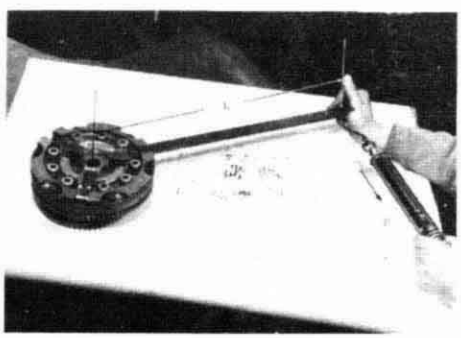
| SPECIAL TOOL | 899570110 |
|---|---|




The height of the release levers is checked with special tool 899570110 gage by checking the heights of the tips of the three levers. The standard height is 13 mm (0.51 in).
When the height of the levers is too high or too low, remove the 1.2 mm cotter pin of the release lever bolt; hold the nut with a wrench; turn the release lever bolt with a screwdriver. The height decreases when the bolt is turned to the right and increases when the bolt is turned to the left. Adjust using a gage.

(b) TRANSMISSION TORQUE OF CLUTCH

| SPECIAL TOOL | 899481410 |
|---|---|



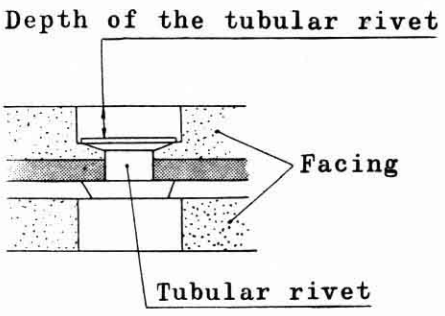
Secure (with a vise, etc.) the special tool 899481410; place the clutch assembly on it and engage the spline of the clutch disc and spline of the special tool. (10 mm nut of the special tool is not required.)

As shown in the photograph, rotate the flywheel and measure the torque required at the time of start of sliding.

When the torque is less than 3.0 kg-m (27.7 lb-ft), disassemble and check the clutch springs, facing of the clutch disc, pressure plate and drive plate. Standard transmission torque is

4 - 5 kg-m (28.9 - 36.1 lb-ft).
The dynamic friction coefficient of the facing is 0.3 - 0.6. With a new facing, the dynamic coefficient is slightly low. Measure after sliding it 20 - 30 times manually.

(c) CHECKING THE CLUTCH DISC




(1) When the depth of the tubular rivet is less than 0.3 mm (0.0118 in), replace the clutch disc with a new one.

(2) When the surface of the facing is smeared with oil or grease, remove the oil with gasoline, clean with a thinner solvant and then dry thoroughly.

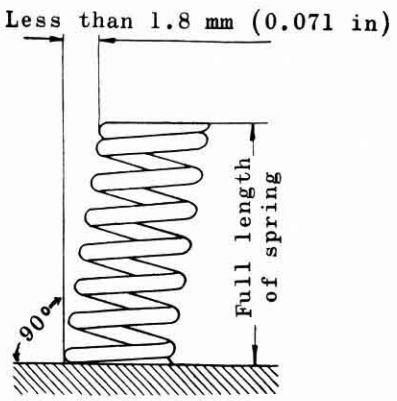
(3) Re-line any damaged facing.

(4) When the deflection of the clutch disc (facing surface) exceeds 1.0 mm (0.0394 in), correct or replace.

| | |
|---|---|
| STANDARD DEFLECTION | Less than 0.7 mm (0.0276 in) |

(d) LOAD OF THE CLUTCH SPRING

| SPRING SPECIFICATIONS | | |
|---|---|---|
| ITEM | STANDARD | LIMIT |
| Free length | 48.6 mm (1.91 in) | 47.6 mm (1.87 in) |
| Mounting length | 30.0 mm (1.18 in) | |
| Load when mounted | One: 22.6-25.0 kg (49.8-55.1 lb)<br>Six: 140 kg (308.7 lb) | 21 kg (46.3 lb) |
| Inclination | Less than 1.8 mm (0.0709 in) at the end of the spring | |




When a spring free length, mounted load, or inclination exceeds the limit, replace it with a new one. Even when the spring is normal, a condition similar to the condition of decreased load sometimes occurs due to worn facing of the clutch disc and pressure plate. In cases like this, insert washers under the springs to bring the load to the correct value.

(e) WEAR OF THE CLUTCH DISC AND SPLINE OF THE PRIMARY REDUCTION PINION

When the play in the rotating direction exceeds 0.5 mm (0.0197 in), correct or replace.

| STANDARD PLAY | 0.01 - 0.05 mm (0.0004 - 0.0020 in) |
|---|---|

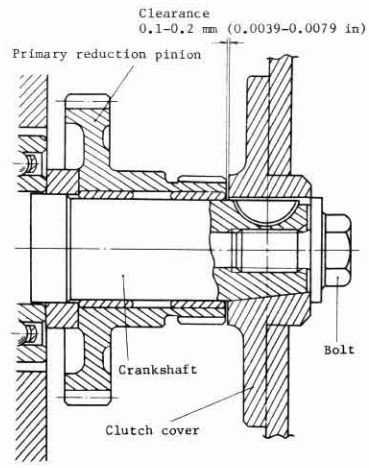
(f) CONTACTING SURFACE OF PRESSURE PLATE

Check the contacting surface with the facing. A pressure plate with wavy wear can be refinished on a lathe or grinder when the wear is slight. When the wear is excessive, replace.

(g) CLUTCH RELEASE BEARING

Turn the bearing by hand; replace any which catches or is noisy. The bearing is grease sealed type; never try to clean them. Limit cleaning to wiping with a dry cloth.

(h) CLEARANCE BETWEEN THE CLUTCH COVER AND PRIMARY REDUCTION PINION




When the clutch cover detached from the clutch assembly is secured to the crankshaft with the bolt, the clearance between the clutch cover and primary reduction pinion should be 0.1 - 0.2 mm (0.0039 - 0.0078 in).

| TIGHTENING TORQUE |
|---|
| 5.7 - 6.2 kg-m<br>(41.2 - 44.8 lb-ft) |

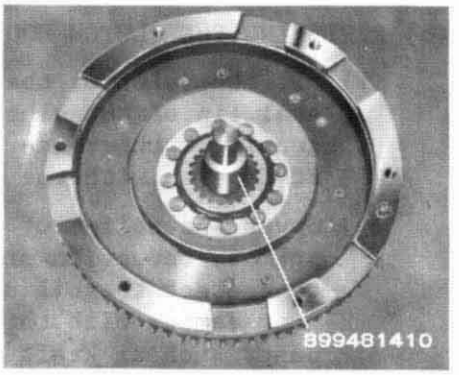
Adjust with seven kinds of washers inserted between the primary

reduction pinion and clutch cover.
When replacing the clutch assembly with a new one, be sure to adjust the clearance between the clutch cover and primary reduction pinion.
When installing the clutch assembly, make sure that it disengages completely.

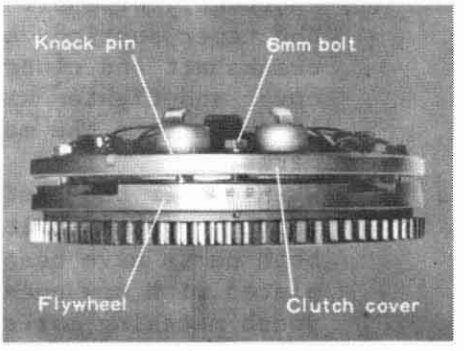
C. ASSEMBLY

(a) ASSEMBLING THE CLUTCH ASSEMBLY

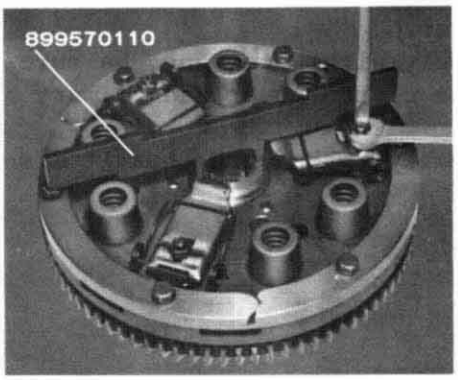
| SPECIAL TOOL | 899481410<br>899570110 |
|---|---|




(1) Place the flywheel and clutch disc on the special tool 899481410. Place the longer side of the bending section of the oil slinger toward the pressure plate side. Thoroughly wipe oil from the facing, flywheel and pressure plate before assembling.
Insert the bolts (release lever) in the pressure plate and place the pressure plate on the clutch disc. Then place the clutch springs and caps (clutch spring) over.



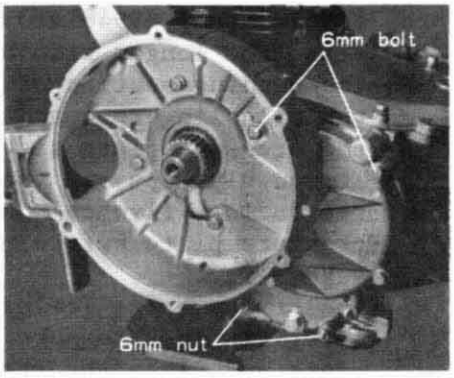

(2) Matching the knock pin of the flywheel and knock pin hole of the clutch cover and secure the flywheel and the clutch cover with the six 6 mm bolts.




(3) Secure the release levers with the nuts (release lever).

(4) With the special tool 899570110,adjust so that the height of the tips of three release levers is of specified value.

(5) Move each lever several times with a hand press and make sure that there is no deviation before attaching the 1.2 mm cotter pin.

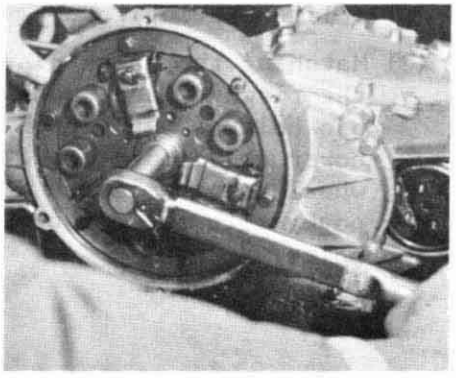



(b) REFITTING THE CLUTCH HOUSING

(1) Fill the slot of the oil seal lip of the clutch housing with grease until it is even with the edge.

(2) Cover the spline of the primary reduction pinion to protect the oil seal from damage with thin paper such as kraft paper.

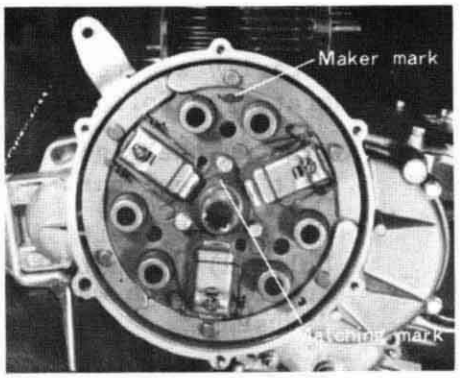
(3) Secure the clutch housing with the six 6 mm bolts and three 6 mm nuts.



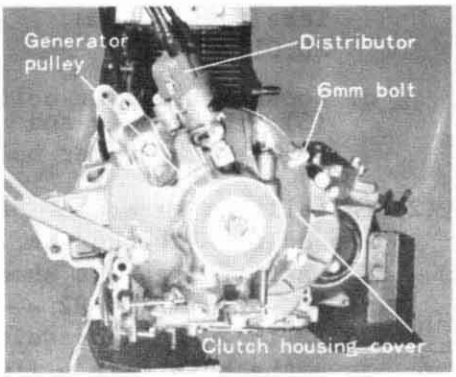
(c) REFITTING THE CLUTCH ASSEMBLY

(1) Thoroughly wipe oil from the taper sections of the crankshaft and clutch cover and tighten with the 12 mm bolt to the maching marks.
When either the clutch assembly or 12 mm bolt or both parts have been replaced with new ones, punch matching marks after tightening torque to facilitate the next disassembly and assembly.

| TIGHTENING TORQUE | 5.7 - 6.2 m-kg (41.2 - 44.8 ft-lb) |
|---|---|

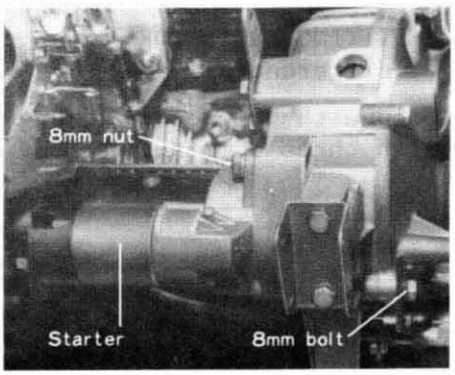



(2) Match the mark of the coupling to the maker mark on the clutch cover and secure with the three 6 mm bolts.
Apply a thin coat of grease on the spline of the coupling.




(d) REFITTING CLUTCH HOUSING COVER

Lightly strike the clutch housing cover in the clutch housing and secure with the five 6 mm bolts.
Next, fix the caps to the spark plugs; insert the high tension cord into the ignition coil and connect the primary wire to the distributor primary terminal with the 4 mm nut.

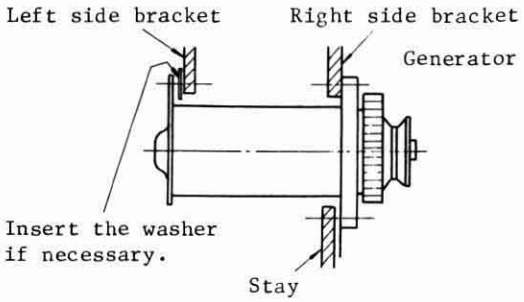



(e) REFITTING STARTER

Secure the starter with the 8 mm nut and bolt. The 8 mm bolt is a through bolt for the clutch housing. At the same time attach the grounding band (engine) to the clutch housing cover with this bolt.

(f) REFITTING GENERATOR

(1) Temporarily secure the generator as follows.

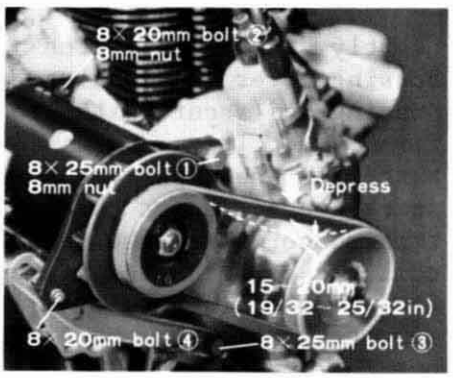



a. Tighten the right side bolt (1) and nut.

b. Tighten the left side bolt (2) and nut after inserting the washer if used.

Make sure that the clearance between the left side bracket and generator flange is less than 0.4 mm (0.0157 in).

c. Loosen the lower bolt (3) of the stay and tighten the upper bolt.

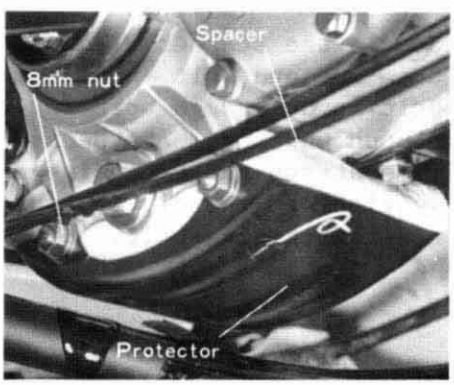


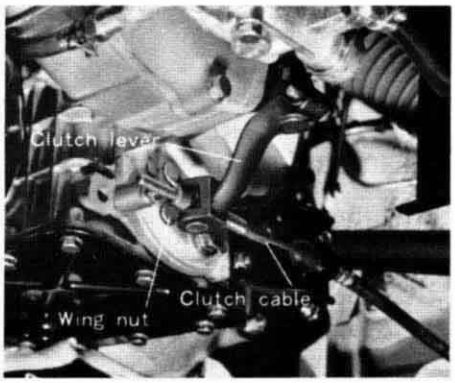

(2) Install the generator belt and adjust its tension. The sag of the belt should be 15 - 20 mm (19/32 - 25/32 in) when depressing down the belt with a finger

(3) Tighten the four 8 mm bolts completely.

(g) REFITTING PROTECTOR (Lower side of differential case)

Secure the protector and spacer with three 8 mm nuts.






(h) REFITTING THE CLUTCL CABLE

Insert the clutch cable into the clutch lever and tighten with the wing nut. In this case, hold the tip of the cable with pliers. The wing nut stops automatically at every half rotation.


(i) ATTACHING THE ENGINE ROOM UNDER COVER

Attach the under cover with the following bolts.

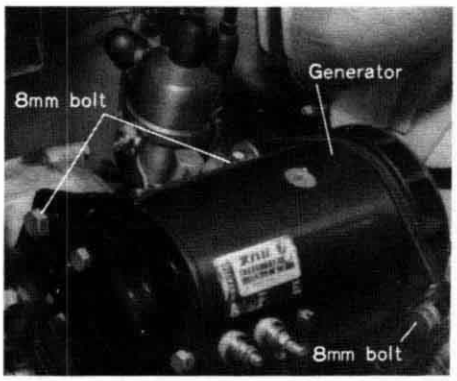
SEDAN: 6 x 12 mm bolt:4 each
10 x 22 mm bolt:1 each

CUSTOM:6 x 12 mm bolt:4 each
6 x 16 mm bolt:2 each
10 x 22 mm bolt:1 each

SAMBAR:6 x 14 mm bolt:6 each

## 2 : CYLINDER HEAD, CYLINDER AND PISTON

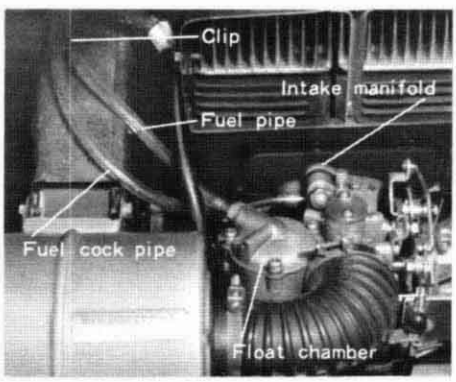
### A. DISASSEMBLY




(a) REMOVING THE GENERATOR

(1) Remove the V-belt.

(2) Remove the three 8 mm bolts of the brackets and then remove the generator.



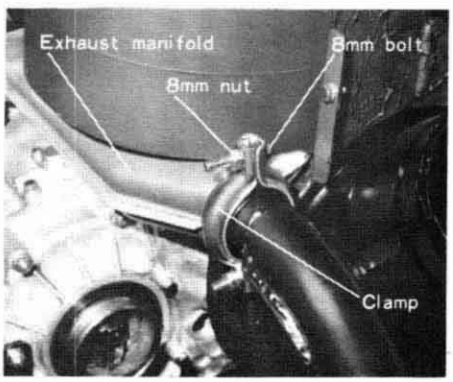

(b) REMOVING THE FUEL PIPE AND FUEL COCK PIPE

(1) SEDAN

Remove the fuel pipe from the carburetor float chamber and the fuel cock pipe from the intake manifold.

(2) CUSTOM, TRUCK & VAN

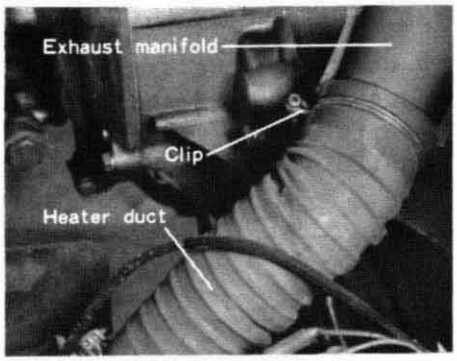
Remove the fuel pipe from the fuel pump.




(c) REMOVING THE CLAMP (Muffler pipe connecting)

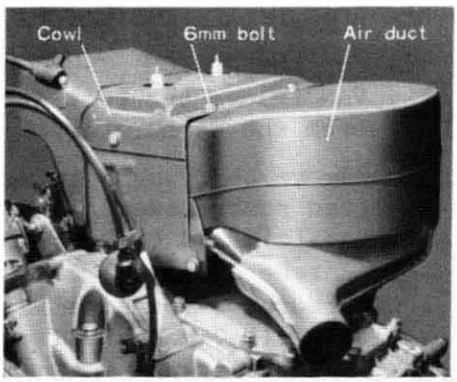
(1) Remove the trap door.
SEDAN: 2, on the rear bulkhead
CUSTOM: 1, on the rear shelf
TRUCK: & VAN 2, on the rear bulkhead and rear shelf

(2) Remove the two each 8 mm nuts and bolts from the disconnect the muffler from the exhaust manifold.



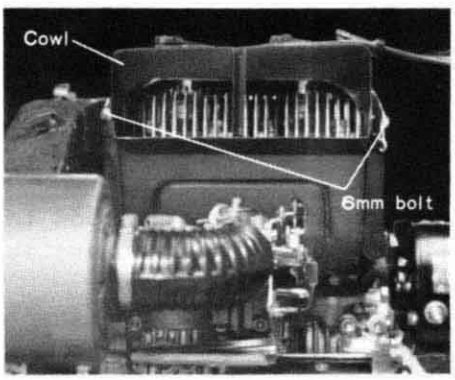

(d) DISCONNECTING THE HEATER DUCT

Loosen the screw of clip and disconnect the heater duct from the exhaust manifold.

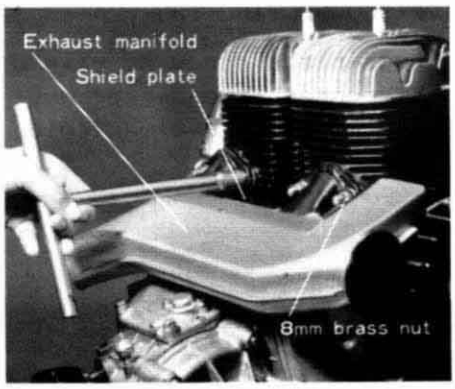



(e) REMOVING THE AIR DUCT AND COWL

(1) Remove the five 6 mm bolts and detach the air duct.

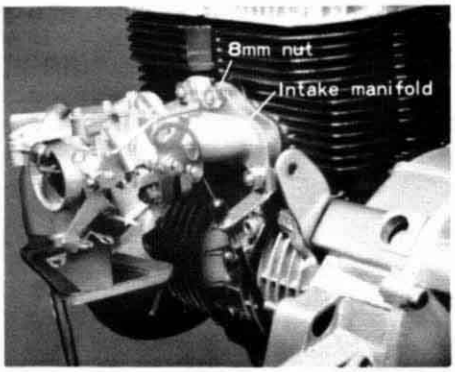



(2) Remove the two 6 mm bolts from the cowl and remove the cowl.




(f) REMOVING THE EXHAUST MANIFOLD

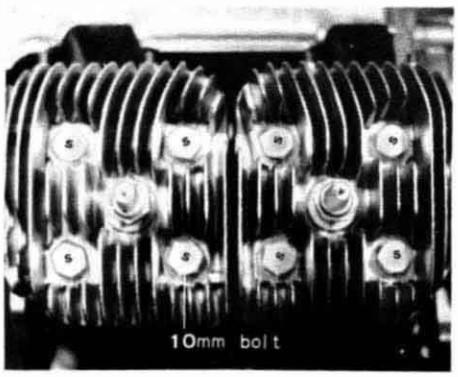
Remove the four 8 mm brass nuts and remove the exhaust manifold, two gaskets (exhaust manifold) and shield plate.




(g) REMOVING THE INTAKE MANIFOLD

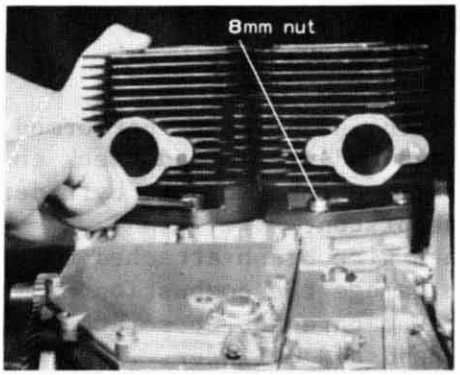
(1) For the CUSTOM, TRUCK and VAN remove the fuel pipe from the carburetor.

(2) Remove the four 8 mm nuts; then remove the intake manifold and two gaskets (intake manifold) with the carburetor connected. At this time, check and see if there is any indication that air and dust have been sucked in.




(h) REMOVING THE CYLINDER HEADS

Remove the 10 mm bolts (letter S is embossed on the hexagonal head of the bolts) and remove the cylinder head together with the gasket (cylinder head).
Check adhering of carbon in the cylinder head combustion chamber.

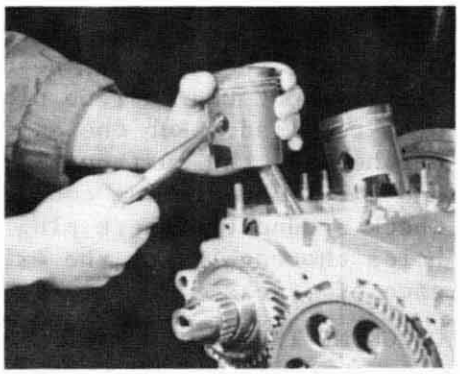



(i) REMOVING THE CYLINDER

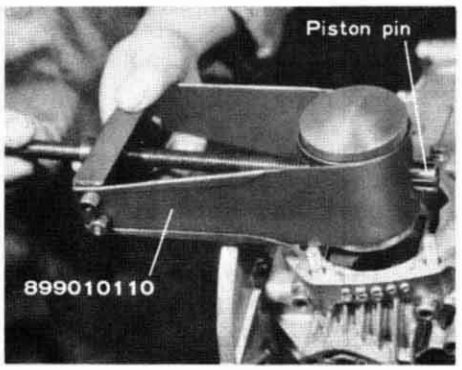
Remove the 8 mm nuts and pull up the cylinder gently. Sometimes some force is required to pull up the cylinder because of sticking the gasket. In case like this, lightly tap the cylinder with a mallet to facilitate their removal. When pulling out the cylinder, be careful not damage the piston rings.

(j) REMOVING THE PISTON

| SPECIAL TOOL | 899010110 |
|---|---|



(1) Remove the circlips from the piston.



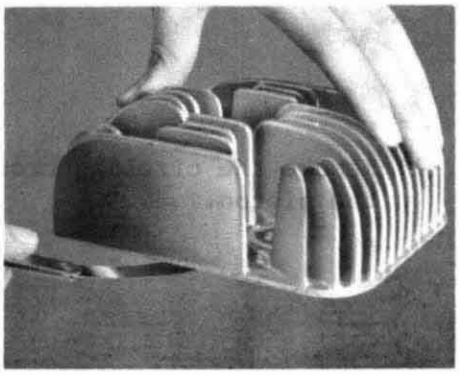

(2) With the special tool 899010110 push out the piston pin. Always use the special tool 899010110 from the input side (clutch side).

To remove the #2 piston only, the fan cover must be removed. But it is easier to remove the #2 piston after removing the #1 cylinder instead of removing the fan cover.

B. CHECKING AND ADJUSTING OF PARTS

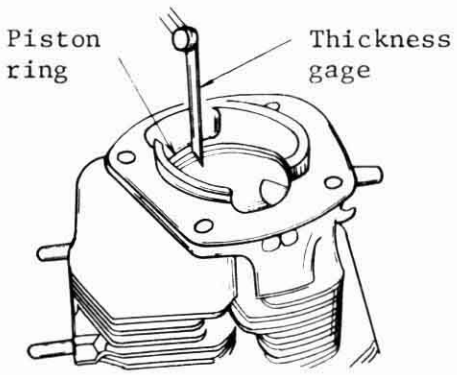
(a) CLEANING CARBON

When knocking is not eliminated by the adjustments performed externally, remove the cylinder head and piston and check the carbon accumulation in the cumbustion chamber of the cylinder head and on the top surface of the piston.
Clean the accumulated carbon with a wire brush attached to an electric drill taking care not to damage the combustion chamber and piston top. Also take sufficient care not to scratch the fitting surfaces of the cylinder head and cylinder.



(b) CHECKING THE CYLINDER HEAD DISTORTION

Place the cylinder head on a surface plate and check by inserting a thickness gage under its circumference.
When a thickness gage of 0.2 mm (0.0079 in) goes in, correct or replace the cylinder head.
Lightly coat the surface plate with red lead. Rub the cylinder head on the surface plate and check the fitting condition
Check around the spark plug holes thoroughly for the existence of cracks.




(c) CHECKING THE PISTON RING

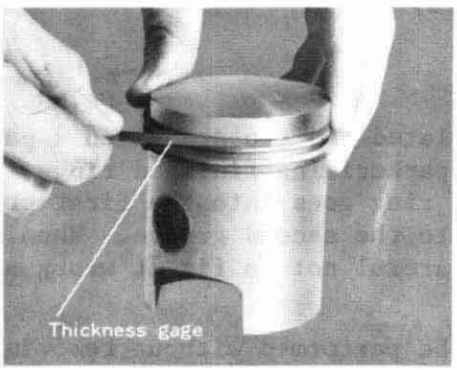
There are three kinds of piston ring and the identification mark is stamped on each ring.

Top ring: 1R
2nd ring: 2R
3rd ring: 3R

(1) Insert the piston ring into the cylinder from its lower part and hold it horizontally within 10 mm (0.3937 in) of the edge. Then, as shown in the picture, measure the gap between the ring ends with a thickness gage.

| PISTON RING END GAP | | |
|---|---|---|
| RING | STANDARD | LIMIT |
| Top | 0.1 - 0.3 mm (0.0039 - 0.0118 in) | 1.5 mm (0.0591 in) |
| 2nd | 0.1 - 0.3 mm (0.0039 - 0.0118 in) | 2.0 mm (0.0787 in) |
| 3rd | 0.1 - 0.3 mm (0.0039 - 0.0118 in) | 2.0 mm (0.0787 in) |

* When the gap of any ring exceeds the correcting limit, replace the ring with a new one.

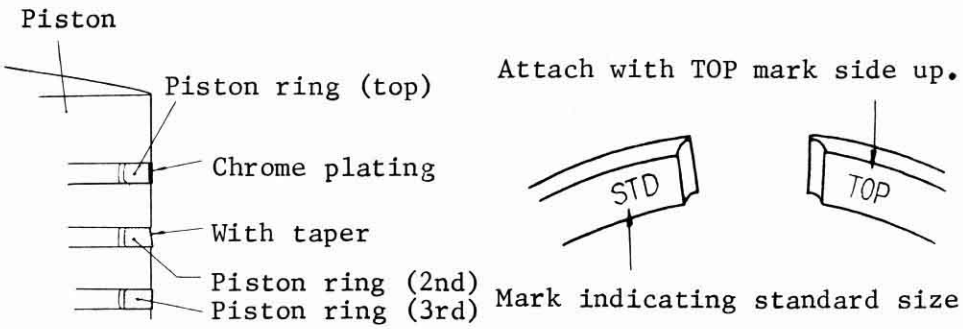



(2) Clearance between the piston ring and piston ring groove.
Thoroughly clean the piston ring groove of the piston and measure the clearance at several places as shown in the photograph.

| CLEARANCE BETWEEN PISTON RING AND PISTON RING GROOVE AND PISTON RING TENSION | | |
|---|---|---|
| RING | CLEARANCE | TENSION |
| Top | 0.080-0.120 mm(0.0032-0.0047 in) | 0.9-1.2 kg(2.0-2.6 lb) |
| 2nd | 0.040-0.069 mm(0.0016-0.0027 in) | 1.0-1.3 kg(2.2-2.8 lb) |
| 3rd | 0.040-0.069 mm(0.0016-0.0027 in) | 1.0-1.3 kg(2.2-2.8 lb) |

Replace any with too large clearance.
Tension is measured with a tensimeter, Measurement is made with the ring compressed so that the gap between its ends are of specified value.

(d) REFITTING THE PISTON RING




One piston ring is chrome-plated and two are given a parkerizing finish. One of the parkerizing finished rings is tapered. The chrome-plated ring goes into the first groove and the tapered one goes into the second groove. When fitting the tapered ring, be careful not to fit it wrong side up.

(e) Boring of the cylinder can be performed without removing the engine from the car body. However, when cylinder boring is necessary, checking of other parts of the engine interior may also be necessary, except in some special cases. For this reason, boring of the cylinder is described in ENGINE MAINTENANCE (II) in which boring is performed with the engine dismounted from the car body.

(f) WEAR OF THE PISTON PIN

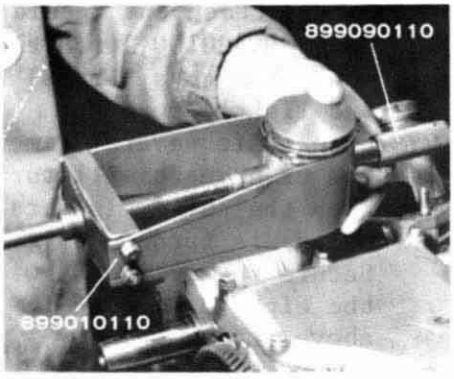
This also is described in ENGINE MAINTENANCE (II).

C. ASSEMBLY

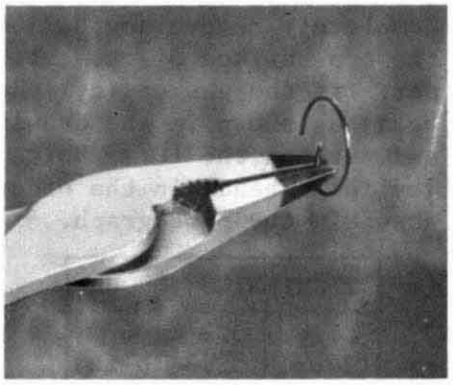
(a) REFITTING THE PISTON

| | |
|---|---|
| SPECIAL TOOL | 899010110<br>899090110 |

(1) Coat the piston pin with engine oil (SAE #30), press it into the small end of the connecting rod and check the play of the piston pin. Be careful not to damage the needle roller the small end of the connecting rod when installing the piston pin.



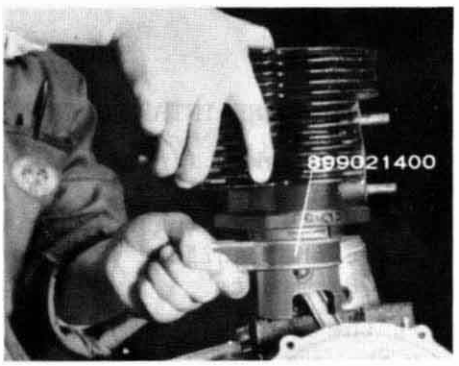

(2) Insert the piston into the small end of the connecting rod and fit the piston pin with the special tools 899010110 and 899090110. The piston should be installed so that the arrow mark comes to the intake manifold side.



(3) Fit the circlips on both sides of the piston pin so that their rising parts face outward.

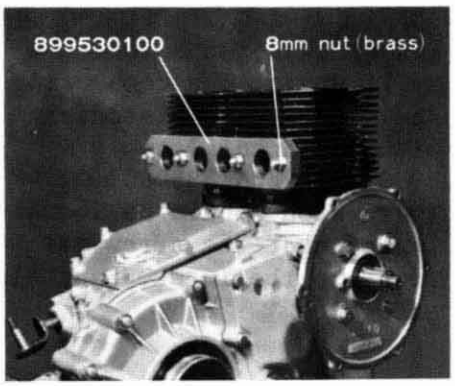
(b) REFITTING CYLINDER

| SPECIAL TOOL | 899021400<br>899530100 |
|---|---|



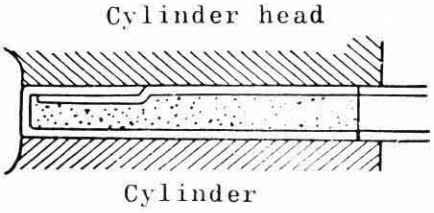

(1) Attach the gasket (cylinder) by matching it to the shape of the seating surface.

(2) While supporting the piston ring with the special tool 899021400, push down the cylinder slowly and insert the piston into the cylinder.



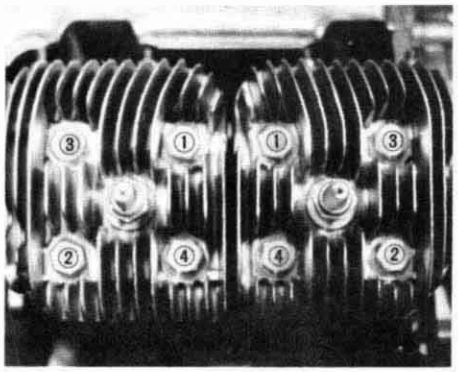

(3) After fitting both cylinders, attach the special tool 899530100, with the four 8 mm nuts (brass) and lightly turn the crankshaft several times. The crankshaft will turn when the pulley (generator drive) is turned.
Secure the cylinders with the eight 8 mm nuts in the above condition.
Remove the special tool 899530100

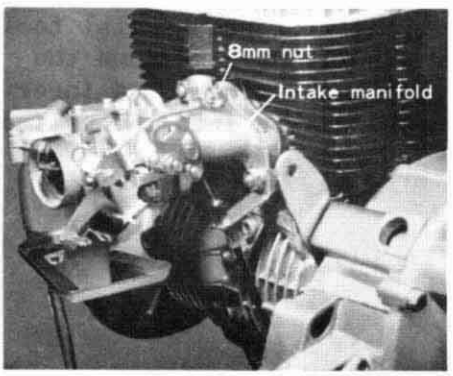
(c) REFITTING THE CYLINDER HEAD




Completely remove any oil on the top surface of the cylinder; fit the gasket (cylinder head) as shown in the drawing and tighten the 10 mm bolts (cylinder head) in the order shown in the photograph.

| TIGHTENING TORQUE |
|---|
| 4.8 - 5.3 kg-m<br>(34.7 - 38.3 lb-ft) |

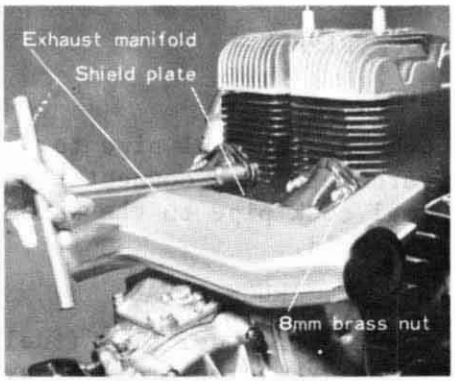



(d) REFITTING THE INTAKE MANIFOLD

Fit the gasket (intake manifold) on the stud bolts of the cylinder attaching surface and secure the manifold with the four 8 mm nuts.

Fit the oil pump cable bracket at the same time.



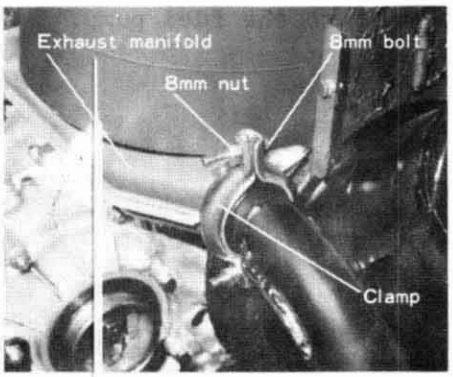

(e) REFITTING THE EXHAUST MANIFOLD

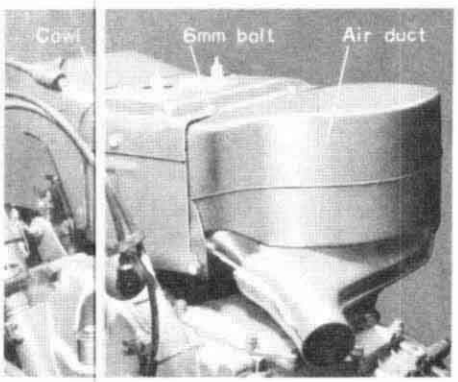
(1) Fit the gasket (exhaust manifold) on the stud bolts of the cylinder. Fitting is the same as that of the gasket for the cylinder head.

(2) Insert the ring (muffler pipe connecting) between the manifold and muffler pipe.

(3) Secure the manifold with the four 8 mm nuts (brass) after fitting the shield plate.

(4) Attach the clamp (muffler pipe connecting) with the two 8 mm bolts and nuts.



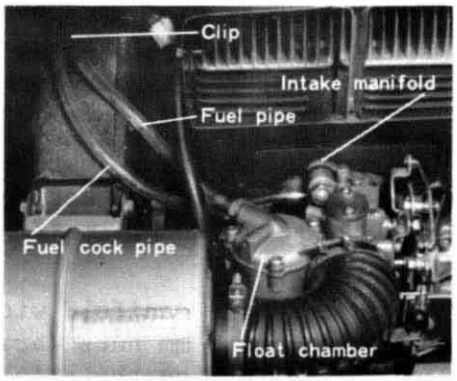




(f) REFITTING THE AIR DUCT AND COWL

Install the air duct and cowl with the seven 6 mm bolts as follows.

two bolts ... air duct to fan cover
one bolt .... air duct and cowl to exhaust manifold.
two bolts ... cowl to cylinder head
two bolts ... cowl to air duct

(g) REFITTING THE FUEL PIPE AND FUEL COCK PIPE




(1) SEDAN

Connect the fuel pipe to the carburetor and connect the fuel cock pipe to the intake manifold.

(2) CUSTOM, TRUCK & VAN

Connect the fuel pipe (fuel pump-carburetor) to the carburetor and then connect the fuel pipe (fuel strainer-fuel pump) to the fuel pump.

(h) REFITTING THE GENERATOR

Refer to item (f) on page 3-20.

## 3 - 3 ENGINE MAINTENANANCE(II)

In this section, the extensive maintenance which is performed with the engine dismounted from the car body is described.

A: VARIOUS PREPARATIONS NECESSARY FOR DISASSEMBLY AND ASSEMBLY (Work table and tools)

(a): WORK TABLE ..... for easy performance of good maintenance work:

(1) A table at which maintenance personnel are able to work standing.

(2) Space sufficient for arranging the parts.

(3) Clean surroundings.

(b): CONTAINERS FOR SMALL PARTS ..... to simplify checking after disassembly and to ensure that all the parts are readily available at assembly time (use tags and envelopes, etc.)

(c): Cleaning pans ..... for cleaning soiled parts, size: about 200 x 200 x 100 mm (8 x 8 x 4 in).

(d): Oil pans ..... to be used when draining gear oil from the transmission and primary case, with a capacity of 2 liters (4 pts).

(e): Tools ..... special tools, tool kit, general tools.

(f): Others

(1) Light oil ..... for cleaning
(2) Sandcloth ..... fine, medium and coarse
(3) Oil stone ..... for correcting
(4) Red lead ..... for checking bearing
(5) Liquid packing ..... for fitting surfaces

PRECAUTIONS IN DISASSEMBLY AND ASSEMBLY

For facilitating disassembly and assembly work and for preventing errors, pay attention to the following points:

(1): Perform cleaning and washing of the engine exterior.

(2): Use correct tools properly.

(3): Without fail, thoroughly clean disassembled parts in cleaning solvent and arrange them neatly.

(4): Pay attention to matching parts. (front and back, left and right, up and down, sequence, matching marks and tightening degree, etc.)
Observance of the disassembled engine is an invaluable reference when trouble occurs in remedying trouble, study and adjusting, etc. Scrutinize all parts carefully and if necessary, take measurements and record all data.

(5): When the disassembled parts are to be left alone for some time, give the parts a rust-proofing treatment (by coating them with oil or grease).

(6): Take the greatest care when assembling parts which have been cleaned, checked, measured and repaired. Coat all moving parts with a proper amount of engine oil (SAE #30) or grease. Even fixed parts which are to be assembled by sliding should be coated with oil. However, do not coat the clutch and its related parts, electrical parts, the carburetor and rubber products with oil or grease.

(7): At assembly time, replace all gaskets with new ones.

(8): Often indentions and burrs occur during disassembly operation. After cleaning, check the parts and when indentions are found, correct them carefully. Indentions on moving parts cause noise and become a source of trouble so care should be exercised.

B: CLEANING

(a): CLEANING METHOD

(1) After disassembling, clean each part carefully with cleaning solvent.

(2) Use light oil as the cleaning solvent.

(3) Clean large parts in a cleaning tank with a brush.

(4) Place small parts in a basket made of fine-mesh screen and clean them by shaking the basket in a clean solvent tank.
Before cleaning parts, check them for adhering metal chips, etc. Any metal piece found can be an important clue to the cause in case trouble occurs.

(5) Dry clean parts with compressed air.

(6) Blow air not only on the cleaned parts but also through oil holes and inside parts, etc.

(7) The cleaning operation is extremely important and should be performed with care.

(8) When cleaned parts are to be left standing, give them a rust-proofing treatment.

(9) Handle the gears and bearings, etc., with special care. Do not rotate the bearings heedlessly.

[NOTE]

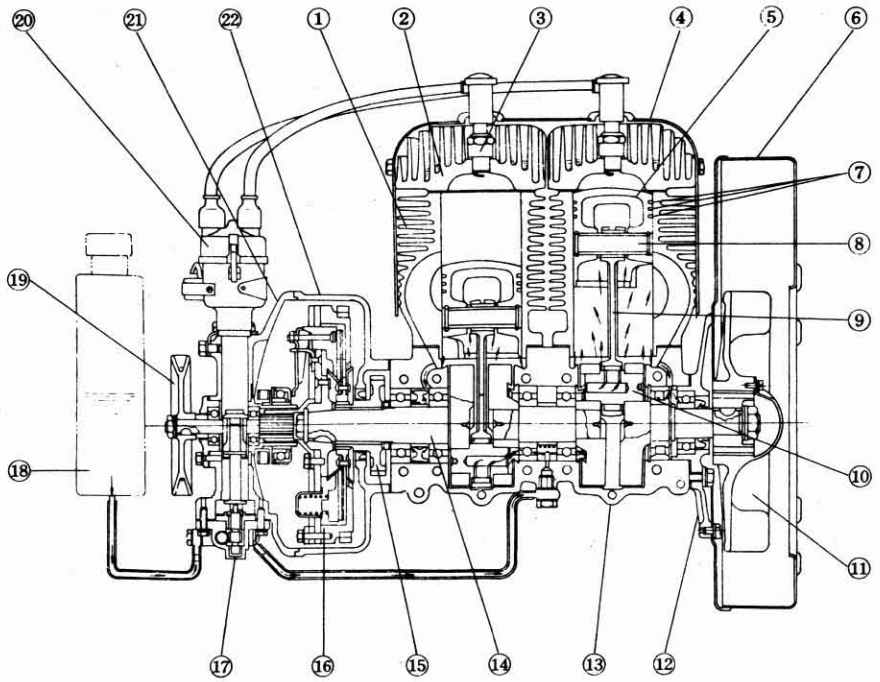
(1) Since the bushing (release fork shaft), bushing (oil pump shaft) and bushing (primary reduction pinion) are made of an oil-containing alloy, do not clean them.

(2) Clean the clutch disc, carburetor, clutch release bearing, electrical equipment, fan cover and V belt (generator) by the following methods:

* Clutch disc ..... Blowing air or dry cloth
* Electrical equipment ..... Blowing air or dry cloth
* Fan cover ..... Blowing air or dry cloth
* V-belt ..... Blowing air or dry cloth
* Carburetor ..... Gasoline
* Clutch release bearing ... Dry cloth

## I : ENGINE PROPER

In this section, the procedure for complete disassembly of the engine proper (including clutch) and distributor driving section is described. For partial repair, complete disassembly such as this is not always necessary.



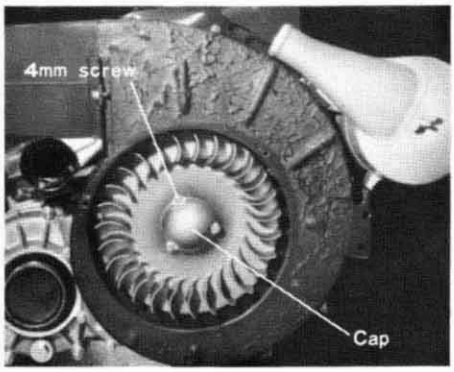

Engine Cross-Section Drawing

1. Cylinder
2. Cylinder head
3. Spark plug
4. Cowl
5. Piston
6. Fan cover
7. Piston ring
8. Piston pin
9. Connecting rod
10. Crankpin
11. Fan
12. Crankcase cover
13. Crankcase
14. Crankshaft
15. Primary reduction pinion
16. Clutch
17. Oil pump
18. Oil tank
19. Pulley
20. Distributor
21. Clutch housing cover
22. Clutch housing

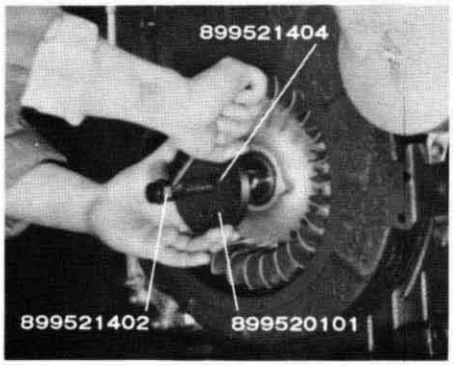
A. DISASSEMBLY

(a) REMOVING THE FAN

| SPECIAL TOOL | 899520120 (899520101, 899521402, 899521404) |
|---|---|

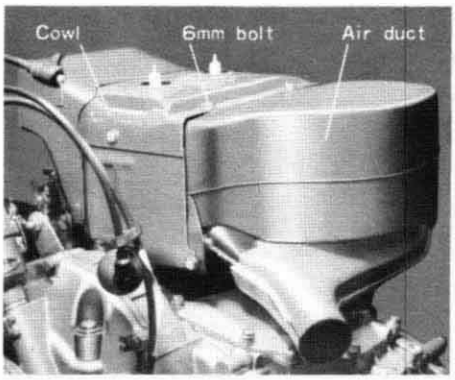



(1) Remove the three 4 mm screws and remove the cap.



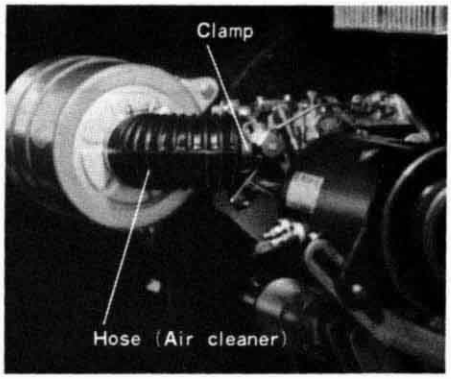

(2) Remove the 14 mm nut securing the fan and pull out the fan by using the special tool 899520120.

(b) REMOVING THE AIR DUCT

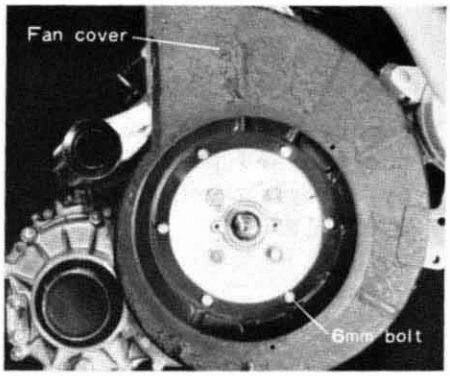



Remove the five 6 mm bolts and detach the air duct.

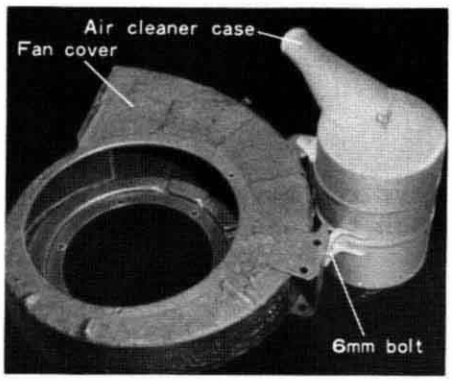
(c) REMOVING THE FAN COVER




(1) Loosen the carburetor side clamp of the air cleaner hose and disconnect the hose.

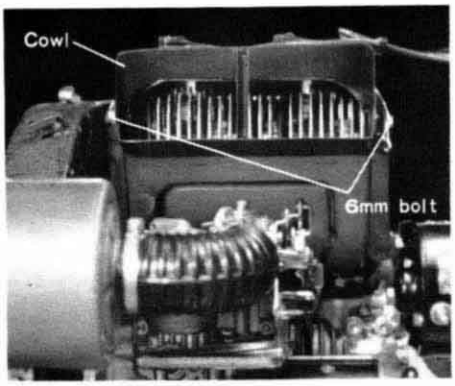



(2) Remove the six 6 mm bolts and remove the fan cover.
The fan cover will come off together with the air cleaner case.




(3) The air cleaner case will detach from the fan cover when the three 6 mm bolts are removed.

(d) REMOVING THE COWL

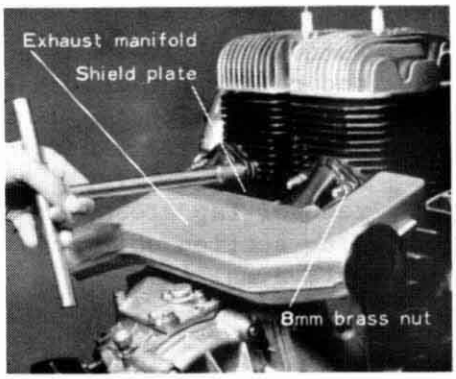



(1) Remove the two 6 mm bolts and detach the cowl.

(2) CUSTOM, TRUCK & VAN

The cowl and outlet duct will separate when the five 6 mm bolts are removed.

(e) REMOVING THE EXHAUST MANIFOLD

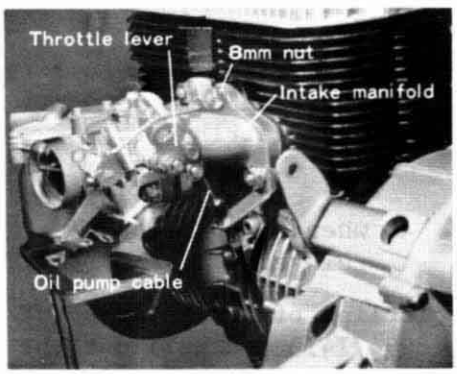



Remove the four 8 mm nuts (brass) and detach the exhaust manifold, shield plate and gaskets.

(f) REMOVING THE GENERATOR

Refer to item (a) on page 3-22.

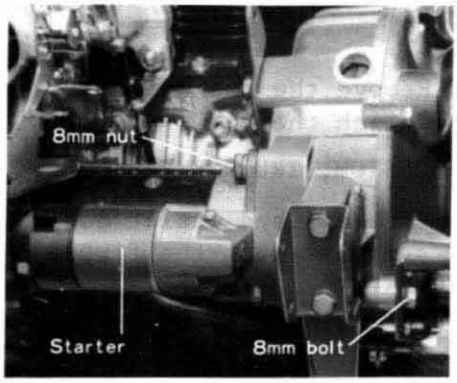
(g) REMOVING THE INTAKE MANIFOLD




(1) Remove the oil pump cable from the throttle lever.

(2) Remove the four 8 mm nuts to detach the intake manifold. Check for signs of suction of air and dust from the fitting surfaces.

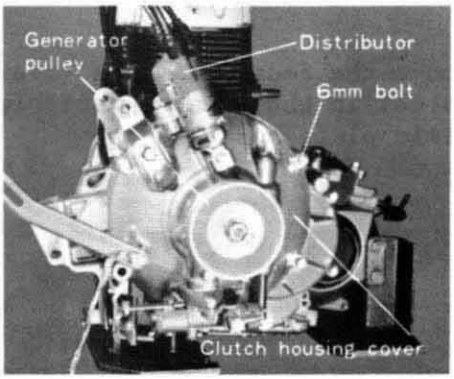
(3) When the two 8 mm nuts are removed, the carburetor will come off the intake manifold.




(h) REMOVING THE STARTER

Remove the 8 mm nut and 8 mm bolt (L=100 mm) and remove the starter.

(i) REMOVING THE CLUTCH HOUSING COVER

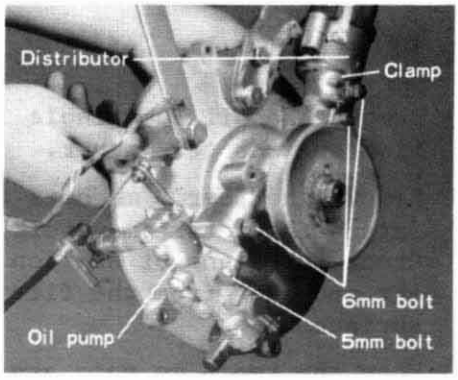



(1) Remove the union bolt and disconnect the oil pump hose from the crankcase.

(2) Remove the five 6 mm bolts and remove the clutch housing cover with the distributor and pulley attached. When it is difficult to remove, tap around the fitting section uniformly with a mallet.

(j) DISASSEMBLY OF THE CLUTCH HOUSING COVER

| SPECIAL TOOL | 899471410 |
|---|---|

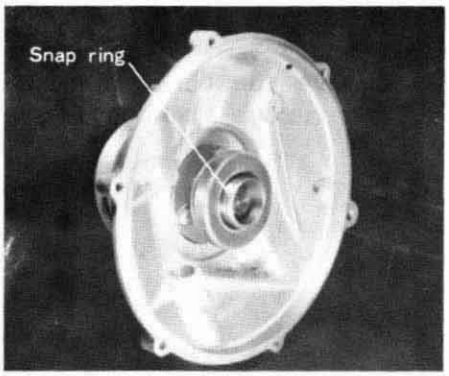


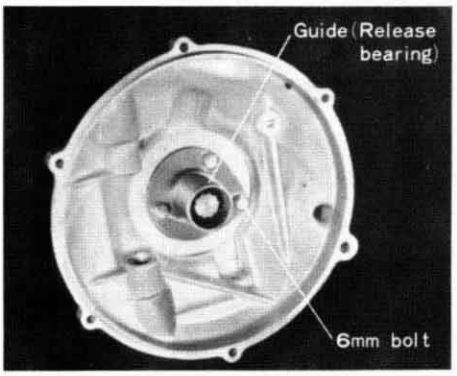

(1) Remove the two 5 mm bolts and detach the oil pump and gasket (oil pump). Next, remove the 6 mm bolt and pull out the oil pump shaft assembly.

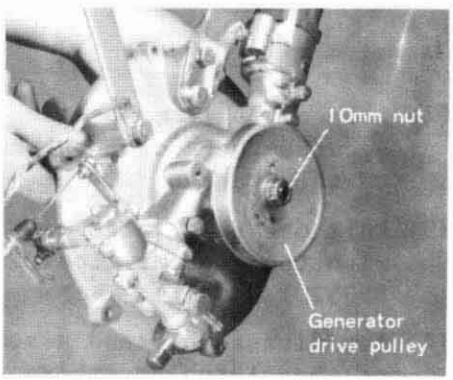
(2) Remove the 6 mm bolt from the clamp and pull out the distributor. The clamp will come off the clutch housing cover when the 6 mm bolt is removed.

(3) Remove the upper and lower circlips of the release fork shaft with the special tool 899471410 and pull out the upper and lower bushings. Next, tap the shaft lightly. Then the shaft and release fork will come off.

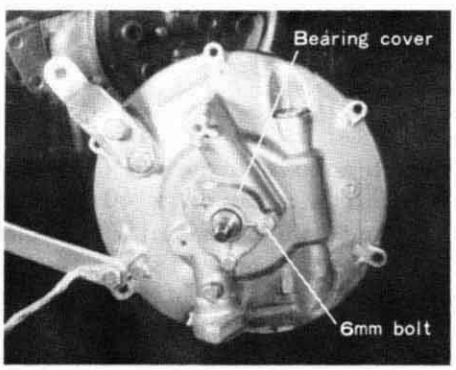
(4) Remove the snap ring of the tip of the guide (release bearing) and pull out the release bearing together with the holder (release bearing). Detach the guide from the clutch housing cover by removing the three 6 mm bolts.



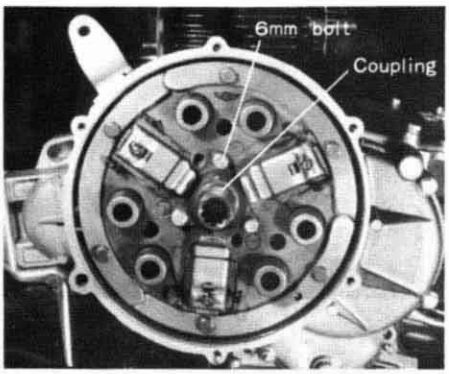

(5) Remove the generator drive pulley from the distributor drive shaft by removing the 10 mm nut.



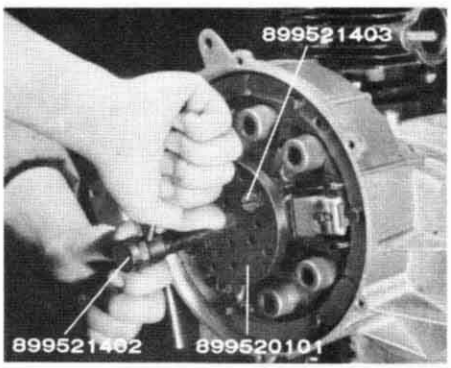

(6) The bearing cover can be detached from the clutch housing cover together with the distributor drive gear and two ball bearings by removing the three 6 mm bolts and by knocking the shaft from the guide side.

(k) REMOVING THE CLUTCH ASSEMBLY

| | |
|---|---|
| SPECIAL TOOL | 899520120<br>(899520101)<br>(899521402)<br>(899521403) |




(1) Remove the three 6 mm bolts and remove the coupling.

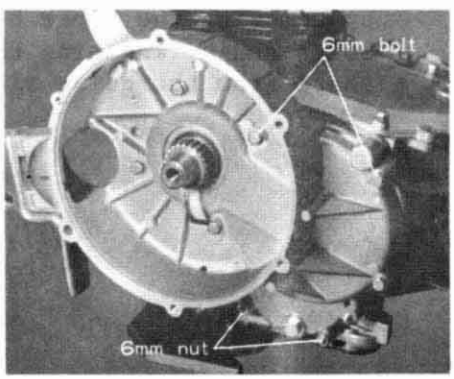



(2) Loosen the 12 mm bolt which secures the clutch assembly to the crankshaft.

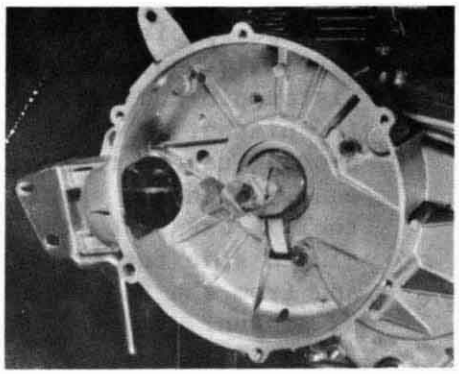
(3) Pull out the clutch assembly with the speciall tool 899520120.

(4) For disassembly and assembly of the clutch assembly, refer to pages 3-12 to 3-18.

(1) REMOVING THE CLUTCH HOUSING




(1) Remove the two 6 x 35 mm bolts, four 6 x 40 mm bolts and two 6 mm nuts but one of the two nuts is removed when the bracket (clutch cable) is removed.



(2) As shown in the photograph, cover the spline of the primary reduction pinion with thin paper (kraft paper) to protect the oil seal lip from damage. Remove the clutch housing while tapping around the housing with a mallet.

(m) REMOVING THE PRIMARY REDUCTION PINION


(1) Remove the 5 mm Woodruff key.

(2) Remove the adjusting washer, pinion and spacer. Be careful not to lose adjusting washer and spacer.

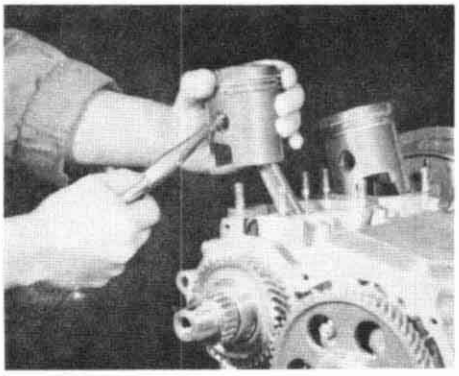
(n) REMOVING THE CYLINDER HEADS

Refer to page 3-24.

(o) REMOVING THE CYLINDERS

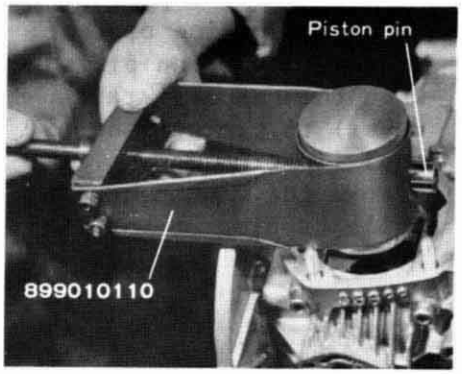
Refer to page 3-24.

(p) REMOVING THE PISTONS



| SPECIAL TOOL | 899010110 |
|---|---|

(1) Remove the four circlips from the both pistons.



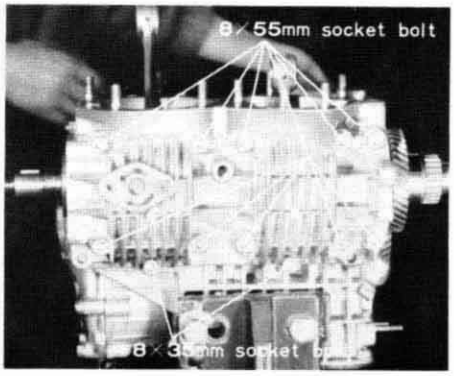

(2) Use the special tool 899010110, pull out the piston pin and remove the piston. The both pistons can be removed easily when the special tool is used from the clutch side for #1 piston and from the fan side for #2 piston.

In this case, be careful not to bend the connecting rod.

(q) REMOVING THE CRANKCASE COVER


| | |
|---|---|
| SPECIAL TOOL | 899520120<br>(899520101)<br>(899521402)<br>(899521404) |

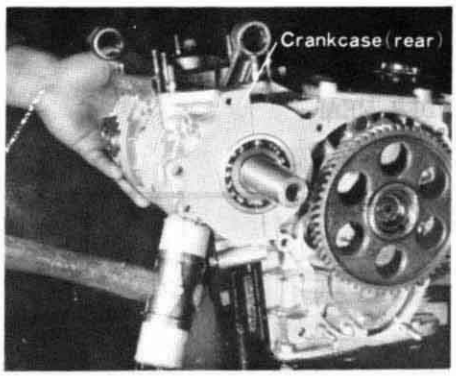
Remove the four 8 mm bolts and pull out the crankcase cover by using the special tool 899520120.



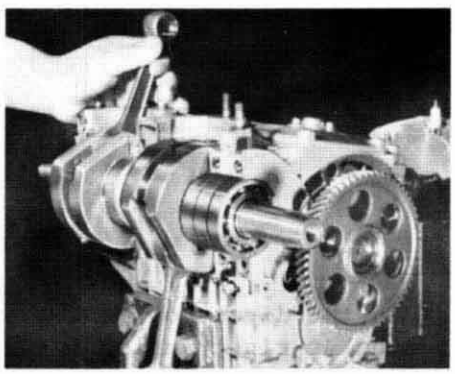

(r) REMOVING THE CRANKCASE (REAR)

| | |
|---|---|
| SPECIAL TOOL | 899431400 |

(1) Remove the ten 8 x 55 mm socket bolts and two 8 x 35 mm socket bolts using the special tool 899431400.

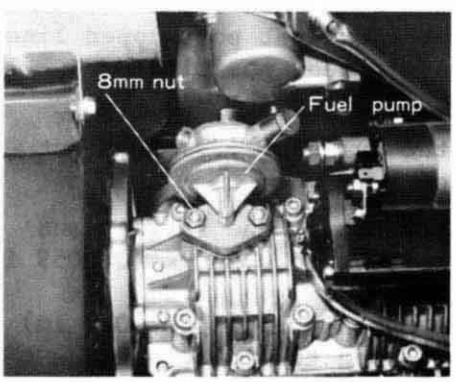



(2) Remove the crankcase (rear). when it is difficult to remove, tap the sides of the case alternately. Then the case will come off easily. Be careful not to hit the stud bolts of the case.



(s) REMOVING THE CRANKSHAFT ASSEMBLY

As shown in the photograph, hold the connecting rod firmly and remove by lightly tapping the crankshaft.

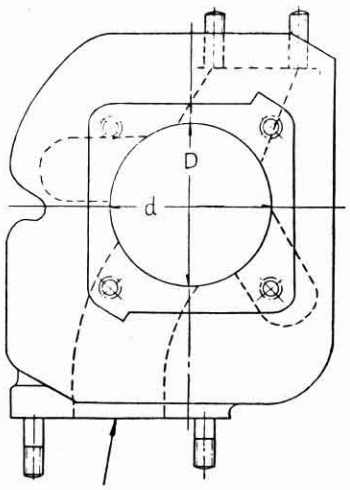


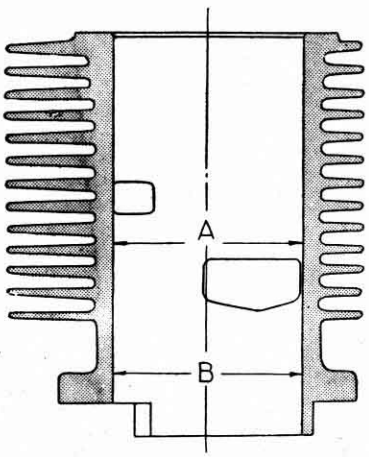

(t) REMOVING THE FUEL PUMP (CUSTOM, TRUCK & VAN)

Remove the two 8 mm nuts of the fuel pump.

B. CHECKING AND ADJUSTING OF PARTS

(a) MEASURING AND CORRECTING CYLINDER WEAR




(1) MEASURING THE CYLINDER DIAMETER

Measure diameters (D and d) in the direction of the piston pin and in the direction at right angles to the piston pin with a cylinder gage or bore micrometer at following positions.

Position A : 40 mm (1.6 in) downward from the upper surface of the cylinder or 5 mm (0.2 in) upward from the exhaust port upper line ... the greatest wear position

Position B : 10 mm (0.4 in) upward from the lower surface of the cylinder ... the least wear position

(2) When the difference in diameters at the largest and least wear position is greater than 0.15 mm (0.0059 in), correct by reboring.
When the difference is less than 0.15 mm (0.0059 in) reboring is unnecessary but when the inner surface of the cylinder ridges, smooth it with a ridge reamer or scraper.

| | |
|---|---|
| STANDARD DIAMETER OF THE CYLINDER | 61.514 - 61.520 mm (2.4218 - 2.4220 in) |

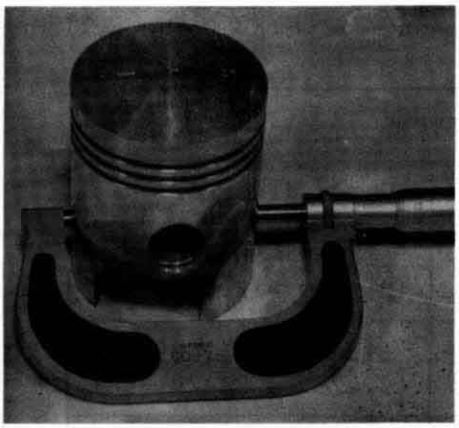
(b) BORING AND HONING OF THE CYLINDER

Bore the cylinder to an oversize nearest to the finish dimension after measuring the amount of wear of the cylinder.

| OVERSIZE PISTONS | |
|---|---|
| Piston size | Outer diameter |
| Standard size | 61.443 - 61.449 mm (2.4190 - 2.4192 in) |
| 0.25 mm (0.01 in) Oversize | 61.693 - 61.699 mm (2.4289 - 2.4291 in) |
| 0.50 mm (0.02 in) Oversize | 61.943 - 61.949 mm (2.4387 - 2.4389 in) |
| 0.75 mm (0.03 in) Oversize | 62.193 - 62.199 mm (2.4485 - 2.4488 in) |
| 1.00 mm (0.04 in) Oversize | 62.443 - 62.449 mm (2.4584 - 2.4586 in) |
| 1.25 mm (0.05 in) Oversize | 62.693 - 62.699 mm (2.4682 - 2.4685 in) |

| CYLINDER | |
|---|---|
| Honing allowance | less than 0.005 mm (0.0002 in) |
| Difference of diameters in each direction | less than 0.005 mm (0.0002 in) |
| Perpendicularity after honing | less than 0.005 mm (0.0002 in) |

(c) MINIMUM CLEARANCE BETWEEN THE CYLINDER AND PISTON



The minimum clearance between the cylinder and piston is the difference between the maximum piston diameter and minimum diameter of the cylinder.
To obtain the maximum diameter of the piston, measure at a position 26 mm (1 in) from the lower end of the piston in a direction at right angles to the piston pin with a micrometer.
When boring a cylinder or when the cylinder and piston are to be replaced, match the clearance to a standard clearance of 0.065 - 0.077 mm (0.0026 - 0.0030 in).

(d) FITTING OF THE PISTON AND PISTON PIN

When the fitting clearance of the piston and piston pin exceeds 0.1 mm (0.0039 in), correct or replace these.

| | |
|---|---|
| STANDARD CLEARANCE | 0.001 - 0.009 mm<br>(0.00004 - 0.00035 in) |

(When this clearance is correct, the piston pin can be pressed easily by thumb into a piston which has been immersed in warm oil for several minutes.) When the fitting is too hard, refinish the piston pin hole with a reamer.

| | |
|---|---|
| STANDARD DIAMETER OF PISTON PIN | 17.977 - 17.988 mm<br>(0.7078 - 0.7082 in) |

(e) CLEARANCE BETWEEN THE NEEDLE BEARING AND PISTON PIN AT CONNECTING ROD SMALL END

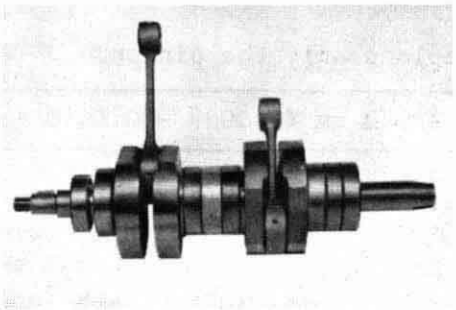
| | |
|---|---|
| STANDARD CLEARANCE | 0.004 - 0.017 mm<br>(0.0002 - 0.0006 in) |

(f) WEIGHT DIFFERENCE BETWEEN THE PISTONS

Select the pistons #1 and #2 so that the weight difference between the two is less than 6 grams (0.2 oz).

(g) CHECKING THE CRANKSHAFT ASSEMBLY

The crankshaft is an assembled unit.
It cannot be disassembled without special tools.



When the following correcting limits are exceeded (except for bending of the crankshaft), the entire assembly must be replaced or disassembled and repaired:

| | |
|---|---|
| Play between the connecting rod big end and crankpin | 0.06 mm (0.0236 in) |
| Play of the connecting rod big end in the axial direction | 1.0 mm (0.0394 in) |
| Play of the ball bearing in the axial direction | 0.3 mm (0.0118 in) |
| Play of the ball bearing in the radial direction | 0.1 mm (0.0039 in) |
| Bending of the crankshaft | Correct to less than 0.045 mm (0.0018 in) |

(h) WEAR OF THE SPLINE OF THE DISTRIBUTOR DRIVE SHAFT AND COUPLING

Replace when the play in the rotating direction exceeds 0.5 mm (0.02 in).

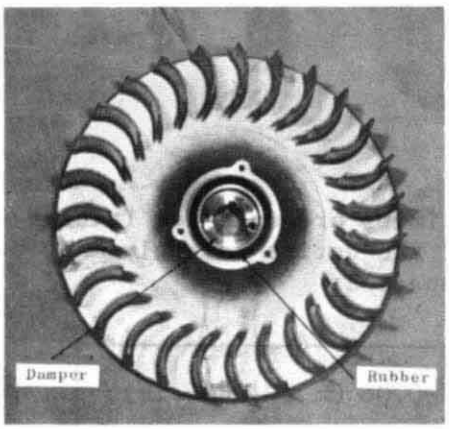
| | |
|---|---|
| STANDARD PLAY | 0.038 - 0.136 mm (0.0015 - 0.0053 in) |

(i) WEAR OF THE DISTRIBUTOR DRIVE GEAR AND DISTRIBUTOR PINION

When chipping, eccentric wear of the teeth tips and wear of the tooth faces of the gear and pinion are large and the backlash exceeds 0.8 mm (0.0315 in), replace whichever is worn more.
When the pinion is worn, replace only the pinion.

| | |
|---|---|
| STANDARD BACKLASH | 0.1 - 0.3 mm (0.0039 - 0.0118 in) |

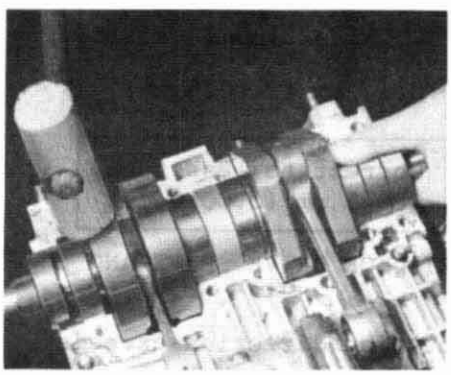
(j) CHECKING THE FAN




Replace any fan with a broken or cracked blade. Check the rubber attached surface of the damper. Replace any damper when the rubber is starting to come off. Press-in tightness of the damper is 0.047 - 0.085 mm (0.0019 - 0.0033 in).

C. ASSEMBLY

(a) REFITTING THE CRANKSHAFT

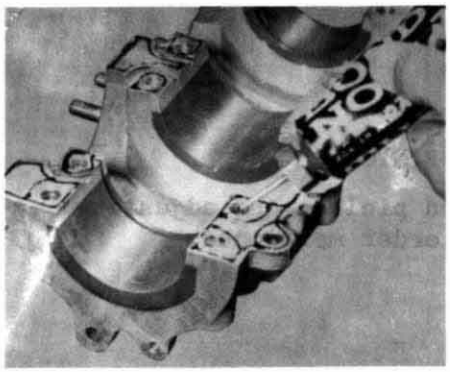


(1) Thoroughly remove oil from the outer races of the crankshaft bearings and oil seal with a dry cloth.

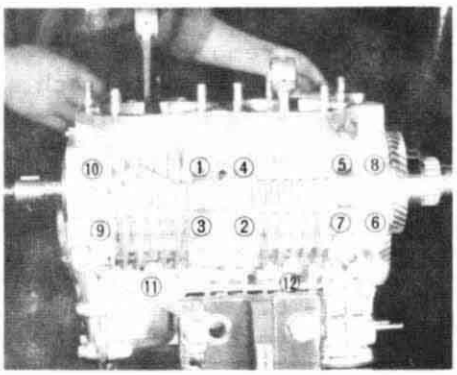
(2) Snugly fit the crankshaft on the crankcase (front) as shown in the photograph by tapping it lightly with a mallet.
Make sure that the crankweb and the crankcase do not interfere with each other.

(b) REFITTING THE CRANKCASE (REAR)

| SPECIAL TOOL | 899431400 |
|---|---|



(1) Thoroughly clean the fitting surface of the crankcase (rear) with trichloroethylene or thinner solvent and coat the surface with liquid packing as shown in the photograph.

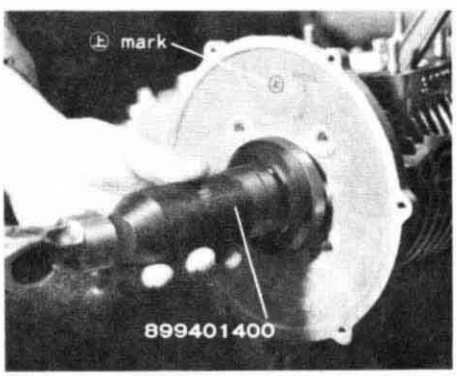



(2) Fit the crankcase (rear) on the crankcase (front) with the ten 8 x 55 mm socket bolts and the two 8 x 35 mm socket bolts by using the special tool 899431400 in the order shown in the photograph.

| TIGHTENING TORQUE |
|---|
| 2.1 - 2.5 kg-m<br>(15.2 - 18.1 lb-ft) |

(c) REFITTING THE CRANKCASE COVER

| SPECIAL TOOL | 899401400 |
|---|---|




(1) Refit the crankcase cover with embossed mark ㊤ up and strike in with the special tool 899401400.

(2) Tighten the four 8 mm bolts.

(d) REFITTING THE PISTON

Refer to item (a) on page 3-28

(e) REFITTING THE CYLINDER

Refer to item (b) on page 3-29

(f) REFITTING THE CYLINDER HEAD

Refer to item (c) on page 3-30

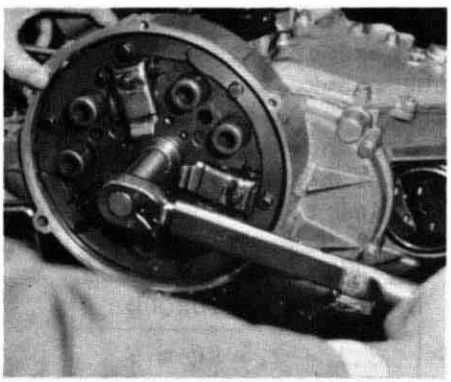
(g) REFITTING THE PRIMARY REDUCTION PINION

Fit the spacer, primary reduction pinion, and adjusting washer on the crankshaft in the order mentioned.

(h) REFITTING THE CLUTCH HOUSING

Refer to item (b) on page 3-18.

(i) REFITTING THE CLUTCH ASSEMBLY



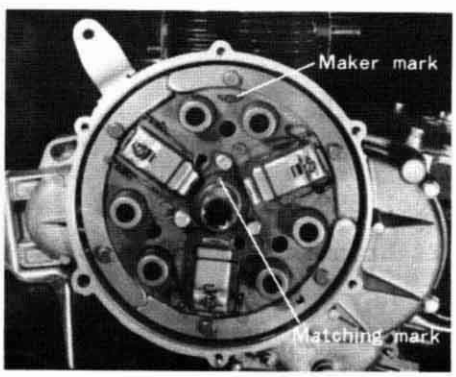
(1) Strike the 5 mm Woodruff key into the crankshaft.

(2) Thoroughly remove the oil from crankshaft and clutch assembly taper section.

(3) Tighten the bolt to the matching mark.

| TIGHTENING TORQUE |
|---|
| 5.7 - 6.2 kg-m<br>(41.2 - 44.8 lb-ft) |

(4) Match the coupling to the manufacturer's mark of the flywheel and secure with the three 6 x 18 mm bolts.



(j) REFITTING THE CLUTCH HOUSING COVER

(1) Fit the ball bearing, 4 mm Woodruff key and distributor drive gear on the distributor drive shaft and fit the shaft into the release bearing guide.
When fitting the ball bearing, fit it so that its dust seal will face the spline side of the distributor drive shaft.

(2) In this condition, secure the release bearing guide on the clutch housing cover with the three 6 x 25 mm bolts.

(3) Press the ball bearing into the bearing cover so that its dust seal faces the pulley side. Secure the bearing cover on the clutch housing cover with the three 6 x 18 mm bolts.

(4) Attach the release bearing to the release bearing guide together with the release bearing holder and fix them with the snap ring.

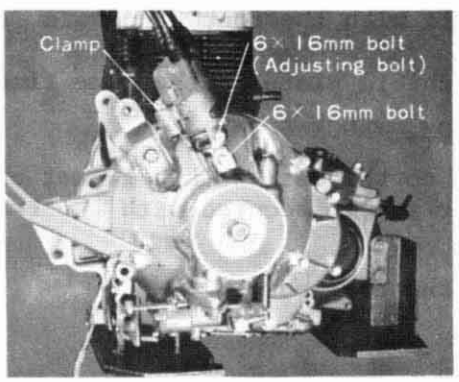
(5) Attach the 4 mm key on the release fork shaft and mate the release fork and the release bearing holder.
Insert the shaft in the clutch housing cover and push it into the clutch release fork.
Insert the bushings (release fork shaft) both up and down and secure with the circlip.

(6) Attach the spacer (generator pulley), 4 mm Woodruff key and pulley to the distributor drive shaft and secure them with the 10 mm nut.

(7) Insert the oil pump shaft assembly with the 6 mm setting screw.
When assembly is completed, check and make sure each moving part moves accurately.

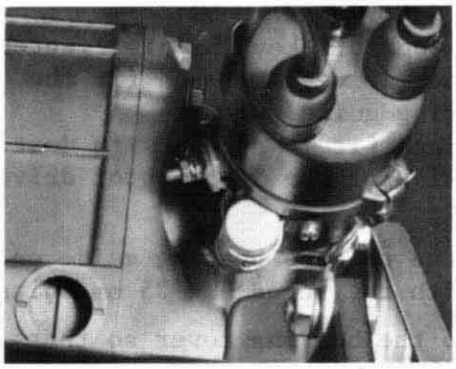
(8) Lightly strike the clutch housing cover into the clutch housing and secure it with the five 6 x 28 mm bolts.

(k) REFITTING THE DISTRIBUTOR




(1) Attach the clamp with the 6 x 16 mm bolt on the distributor so that the distributor can be turned by hand.

(2) Turn the pulley by hand and match the mark of the ignition timing inspection hole located on the clutch housing and 13° of the timing mark on the periphery of the flywheel.

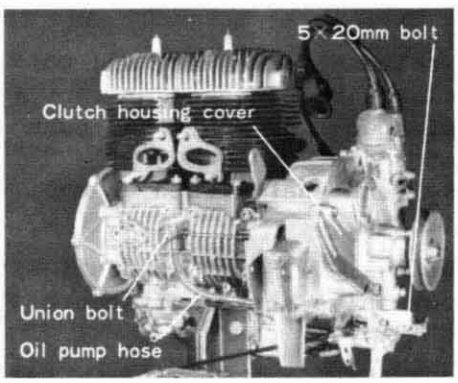


(3) Insert the distributor (with the clamp) so that it will be positioned as shown in the photograph.

(4) Secure the clamp to the clutch housing cover with the 6 x 16 mm bolt.

(5) Adjust the ignition timing.

(l) REFITTING THE OIL PUMP




(1) Secure the gasket and oil pump to the clutch housing cover with the two 5 x 20 mm bolts.

(2) Secure the oil pump hose to the crankcase with the 10 mm union bolt.

(m) REFITTING THE EXHAUST MANIFOLD

(1) Fit the gasket (exhaust manifold) on the stud bolts on the cylinder fitting surface. The direction of the gasket fitting is the same as that for the gasket (cylinder head).

(2) Secure the exhaust manifold with the four 8 mm nuts (brass).
In this case, secure the shield plate at the same time.

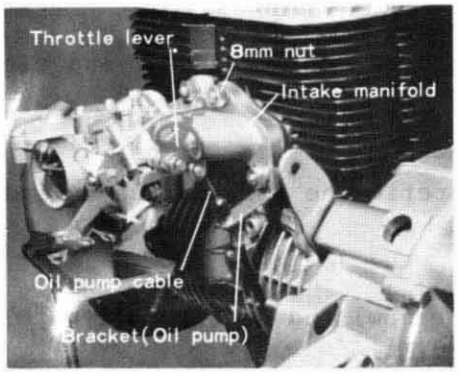
(n) REFITTING THE FUEL PUMP (CUSTOM, TRUCK & VAN)

(1) The fuel pump is attached to the case with a gasket on each side of the insulator and is secured with the two 8 mm nuts.

(2) Connect the fuel pipe to the fuel pump.

(o) REFITTING THE INTAKE MANIFOLD

(1) Attach the carburetor to the intake manifold beforehand to simplify its attaching to the cylinder. Fit on the stud bolts of the intake manifold, gasket (carburetor), heat insulator (carburetor) and gasket (carburetor) in that order and secure the carburetor with the two 8 mm nuts.

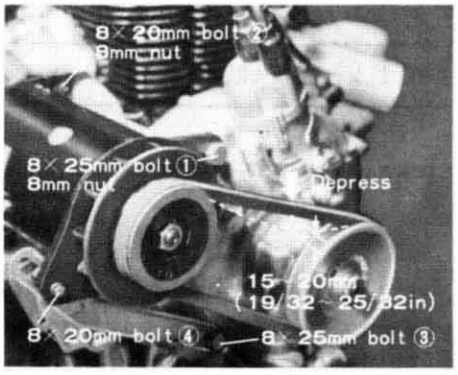



(2) Fit the gasket (intake manifold) on the stud bolts on the cylinder fitting surface and secure the intake manifold with the four 8 mm nuts. Fit the bracket (oil pump cable) at the same time.

(p) REFITTING THE STARTER

Secure the starter with the 8 mm nut and the 8 x 100 mm bolt. The 8 mm bolt is a through bolt and also fix the bracket (oil pump cable).
When the engine is mounted on the car body, connect the grounding band (engine) with this bolt.

(q) REFITTING THE GENERATOR




(1) Temporarily secure the generator with the three 8 mm bolts.
In this case, make sure that the adjusting washer is inserted between the left side bracket and generator if it was used before disassembling and that its clearance is less than 0.4 mm (0.0157 in).

(2) Keep the 8 x 25 mm bolt of the stay loose.

(3) Attach the generator belt and raise the generator with a wooden rod such as the handle of a mallet.
Adjust the tension of the generator belt so that the center of the belt sags 15 - 20 mm(19/32 - 25/32 in) when pressed and tighten the four 8 mm bolts securely.

(r) REFITTING THE FAN COVER

(1) Attach the air cleaner case with the 6 mm bolts to the fan cover beforehand.

| | | |
|---|---|---|
| [SEDAN & CUSTOM] | 6 x 10 mm bolt | : 3 each |
| [SAMBAR] | 6 x 10 mm bolt | : 3 each |
| | 6 x 14 mm bolt | : 1 each |

(2) Refit the fan cover on the crankcase cover with the six 6 x 12 mm bolts.

(3) Connect the air cleaner hose to the carburetor and tighten the clamp (air cleaner hose).

(s) REFITTING THE COWL

With the two 6 x 12 mm bolts, refit the cowl on the cylinder head.

[NOTE]
On Custom & Sambar, connect the cowl and outlet duct with the five 6 x 10 mm bolts beforehand.

(t) REFITTING THE AIR DUCT

With the five 6 x 12 mm bolts, refit the air duct on the cowl, fan cover and exhaust manifold.

| | | |
|---|---|---|
| 2 ea. | : | on the cowl |
| 2 ea. | : | on the fan cover |
| 1 ea. | : | on the cowl and exhaust manifold |

(u) REFITTING THE FAN

(1) Strike the 5 mm Woodruff key into the crankshaft and secure the fan with the 14 mm nut.

| | |
|---|---|
| TIGHTENING TORQUE | 5.8 - 6.1 kg-m (42.0 - 44.1 lb-ft) |

(2) With the three 4 x 8 mm screws, attach the cap to the fan.

D. RUNNING-IN OPERATION

When an engine has been overhauled or when a part or parts of the engine proper has been replaced, be sure to perform a running-in operation for better fitting of the parts.

(a) After the engine has been mounted on the car body, perform running-in operation for 30 minutes at idling speed (700-900 rpm).

(b) Up to about 1000 km (600 miles), handle the car in the same way as a new car.

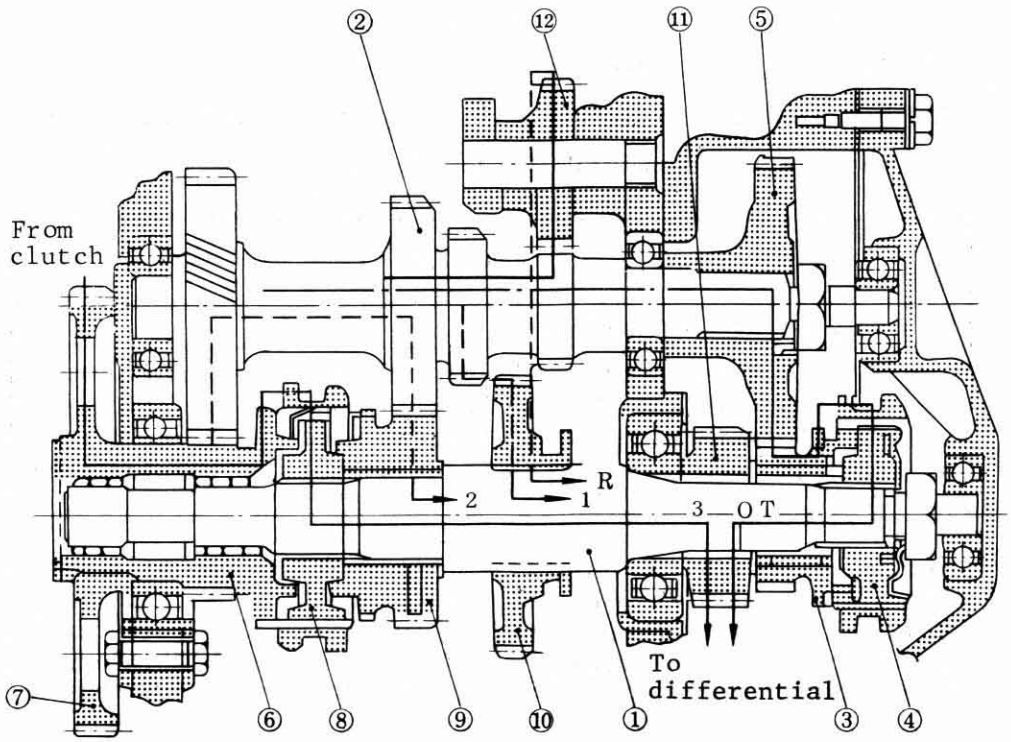
(1) Immediately after starting of the engine, avoid sudden increase of engine revolution.

(2) Avoid climbing steep grades.

(3) Use a mixing ratio of 20:1 for gasoline and engine oil.

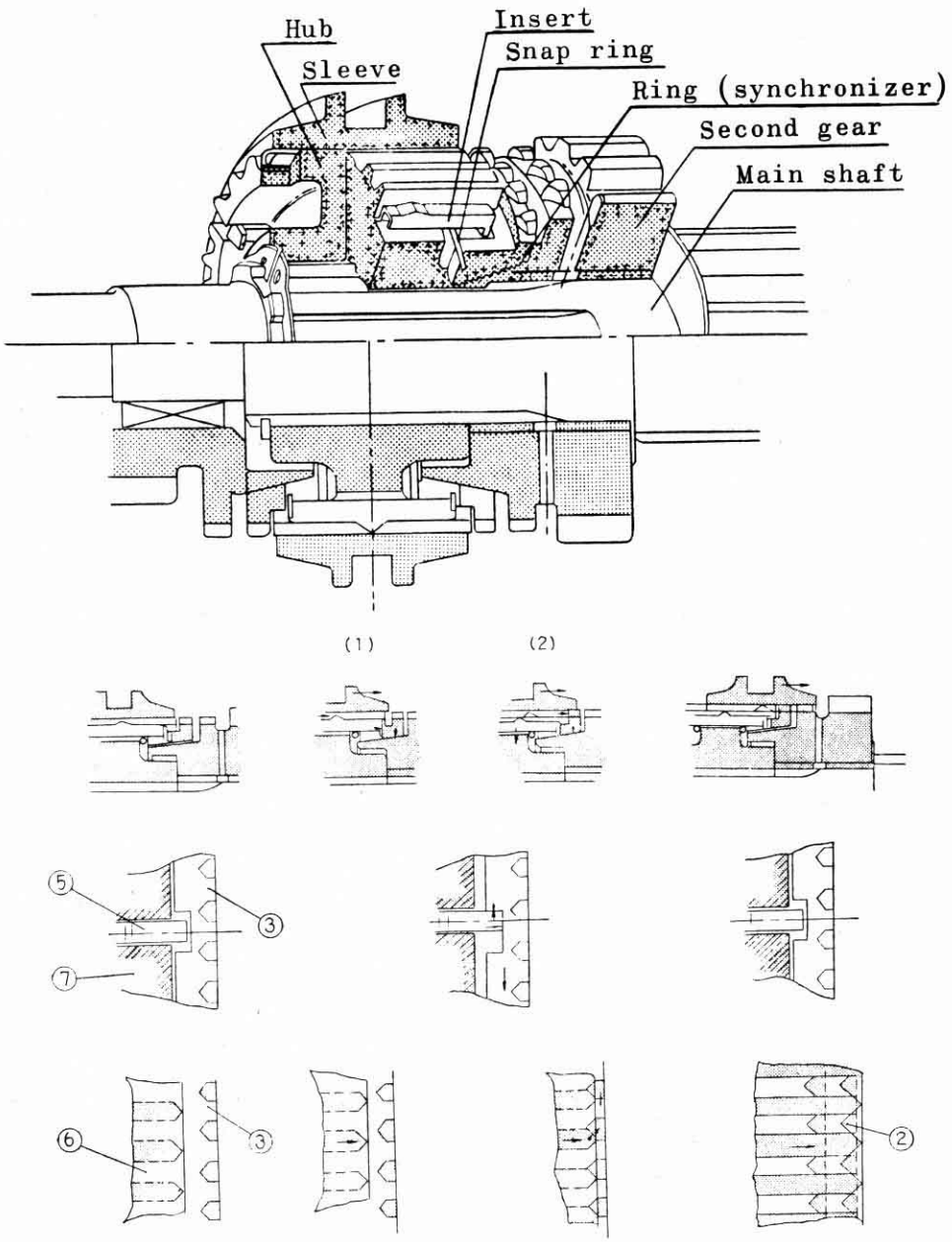
(4) Observe the speed limit faithfully.

| | SEDAN | CUSTOM | SAMBAR |
|---|---|---|---|
| Up to 1,000 km (600 miles) | | | |
| 1st | 15 km/h(10 mph) | 15 km/h(10 mph) | 15 km/h(10 mph) |
| 2nd | 35 km/h(22 mph) | 30 km/h(19 mph) | 25 km/h(16 mph) |
| 3rd | 50 km/h(31 mph) | 50 km/h(31 mph) | 45 km/h(28 mph) |
| 4th (OT) | 55 km/h(34 mph) | 55 km/h(34 mph) | 50 km/h(31 mph) |
| Up to 2,000 km (1,200 miles) | | | |
| 1st | 20 km/h(13 mph) | 20 km/h(13 mph) | 20 km/h(13 mph) |
| 2nd | 40 km/h(25 mph) | 40 km/h(25 mph) | 35 km/h(22 mph) |
| 3rd | 60 km/h(38 mph) | 60 km/h(38 mph) | 55 km/h(34 mph) |
| 4th (OT) | 75 km/h(47 mph) | 75 km/h(47 mph) | 65 km/h(41 mph) |




(1) Main shaft
(2) Counter gear
(3) Driven gear (overdrive)
(4) Synchronizer (overdrive)
(5) Drive gear (overdrive)
(6) Main drive gear
(7) Primary reduction gear
(8) Synchronizer (2nd & 3rd)
(9) 2nd driven gear
(10) 1st and reverse driven gear
(11) Final reduction pinion
(12) Reverse idler gear

A. REGARDING THE SYNCHROMESH GEAR SYSTEM



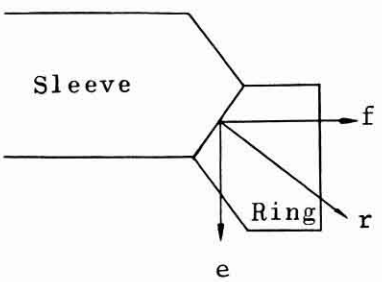

The synchromesh, as its name indicates, is a system in which two meshing devices of different revolutions are meshed after their revolutions have been forced into a single revolution. For instance, when the clutch has been released, the revolution of the main drive gear or the revolution of the second speed gear is not always the same as the revolution of the main shaft and sleeve (synchronizer) driven by the rear wheel. Meshing is performed after matching the revolution of the gear to that of the sleeve.

(a) EXPLANATION ON THE WORKING OF SYNCHROMESH

As an example, a case of meshing in the second speed gear is described below.

(1) As the change lever is pushed slightly in the direction of the second gear, the sleeve slides over the hub and moves toward the second speed gear. At this time, three inserts, the projecting parts of which are pressed in the slot of the sleeve by the snap ring, are also moved; the end faces of the inserts push the bottom of the slot of the synchronizer ring to cause the conical surfaces of the gear and ring to contact.
Because of this, when there is a difference between the revolutions of the gear and ring, the ring is dragged by the gear. The ring turns the distance which is equal to the width of the clearance of the slot width of the ring which is slightly larger than the width of an insert and the tooth line of the sleeve and ring shifts 1/4 pitch.

(2) As the change lever is pushed further, only the sleeve moves still more. The projecting parts of the inserts get out of the slot of the sleeve and at the same time, the addendams of the sleeve and ring contact with their tooth lines off 1/4 pitch as shown in the drawing.
If the sleeve is pushed in with a force "f", the addendum of the sleeve pushes the addendum of the ring. As a result the conical surfaces of the ring and gear are pressed together and a torque "e" is created in the ring. The composite force of "f" and "e" creates the force "r" which is at a right angle to the contacting surface.
This force "r" aids the transmission of torque, improves the contact of the conical surfaces of the ring and gear and makes the revolutions of both the same.



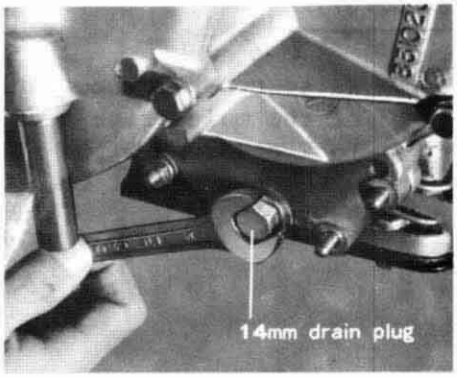

(3) When the revolutions of the ring and gear become equal, the forces "e" and "r" disappear and the sleeve meshes with the gear thrusting away the ring.

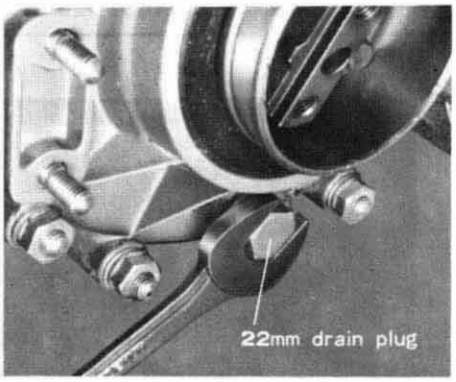
The above is an explanation of the working of the synchromesh. Since the synchronizer requires some time before it completes its working, perform the lever operation slowly. The fine lines cut on the conical surface of the ring are provided to cut oil film on the surface to improve the contact with the conical surface of the gear and at the same time, they function as oil grooves to decrease wear.

B. DISASSEMBLY

(a) DRAINING GEAR OIL

Remove the 14 mm and 22 mm drain plug and drain gear oil.




(b) REMOVING FAN

Refer to item (a) on page 3-37.

(c) REMOVING AIR DUCT

Refer to item (b) on page 3-37.

(d) REMOVING FAN COVER

Refer to item (c) on page 3-38.

(e) REMOVING EXHAUST MANIFOLD

Refer to item (e) on page 3-39.

(f) REMOVING GENERATOR AND STARTER

Refer to item (e) on page 3-10 and item (h) on page 3-40.

(g) REMOVING CLUTCH HOUSING COVER

Refer to item (i) on page 3-40.

(h) REMOVING CLUTCH ASSEMBLY

Refer to item (k) on page 3-42.

(i) REMOVING CLUTCH HOUSING

Refer to item (l) on page 3-42.

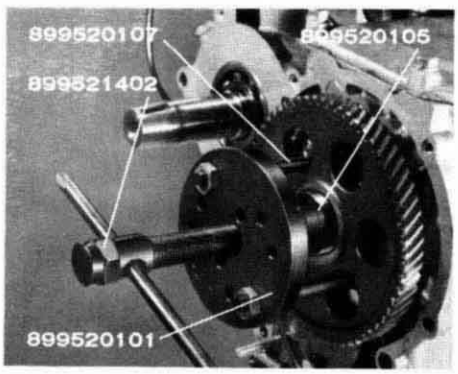
(j) REMOVING PRIMARY REDUCTION PINION

Refer to item (m) on page 3-43.

(k) REMOVING THE PRIMARY REDUCTION GEAR

| | |
|---|---|
| SPECIAL TOOL | 899500100<br>899520120<br>(899520101) (899521402)<br>(899520105) (899520107) |


(1) Raise two bent sections of the main drive gear lock and remove the nut with the special tool 899500100.



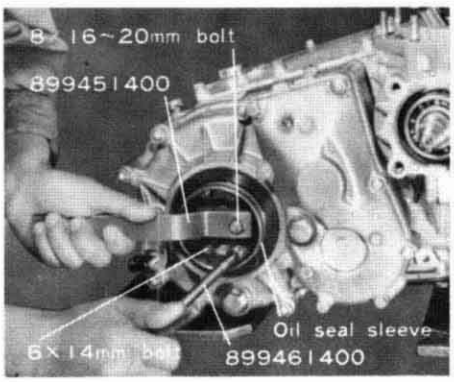

(2) Pull out the gear with the special tool 899520120.

(l) REMOVING THE CRANKCASE COVER

Refer to item (q) on page 3-44.

(m) REMOVING THE OIL SEAL SLEEVE

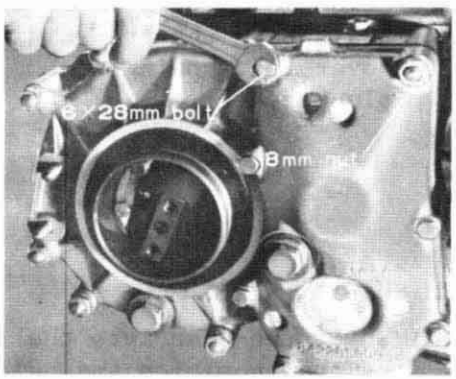
| SPECIAL TOOL | 899451400<br>899461400 |
|---|---|




(1) Raise the bent section of the lock washer.

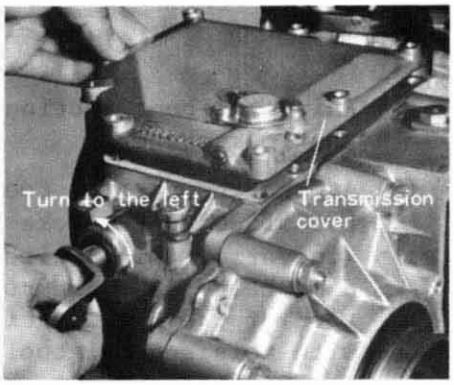
(2) Attach the special tool 899451400 to the yoke (universal joint) with a 8 mm bolt; stop the rotation of the differential with this special tool; remove the four 6 mm bolts of the oil seal sleeve with the special tool 899461400 and remove the oil seal sleeve.

(n) REMOVING THE TRANSMISSION COVER II

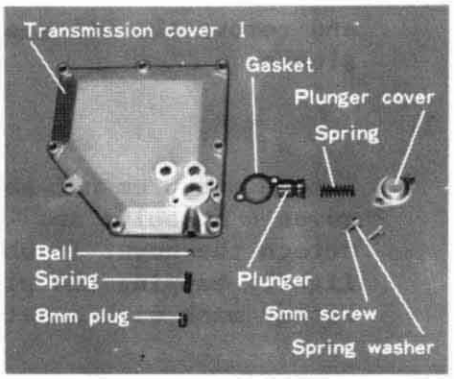



Remove one 8 mm nut and the seven 6 mm bolts and detach the cover II while lightly tapping the places with * mark with a mallet.

(o) REMOVING THE TRANSMISSION COVER I



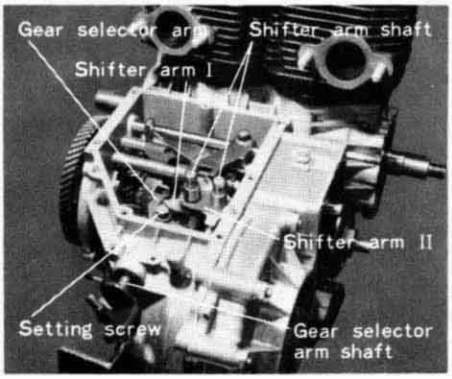

(1) Remove the seven 6 mm bolts and detach the transmission cover I.
In this case, the cover I can be removed easily by turning the gear selector arm shaft to the left.




(2) Disassembly of the transmission cover I is performed as follows.

Remove the 8 mm plug and take out the spring and ball. Remove the two 5 mm screws and detach the transmission cover III, spring and plunger.

(p) REMOVING THE GEAR SELECTOR ARM SHAFT



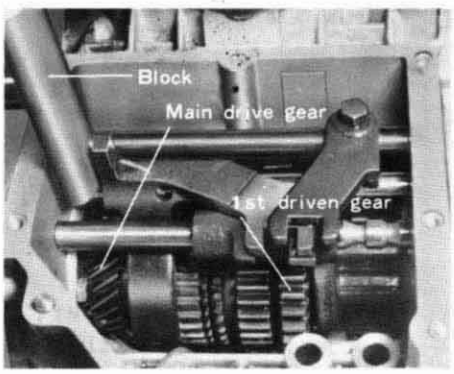

(1) Shift the gear into the neutral position and pull out two shifter arm shafts.

(2) Then remove the shifter arm I, and shifter arm II while turning the gear selector arm shaft counter clockwise.

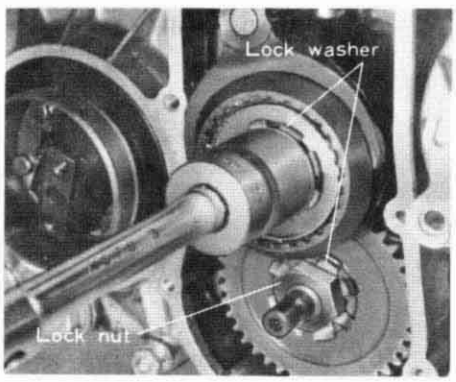
(3) Loosen the setting screw and remove the gear selector arm and shaft.

(q) DISASSEMBLING THE OVER DRIVE MECHANISM

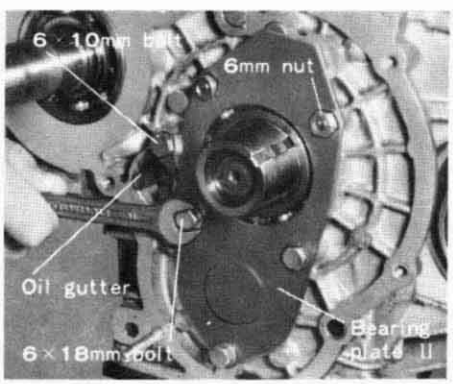
| | |
|---|---|
| SPECIAL TOOL | 899495000<br>899520120<br>(899521402) |



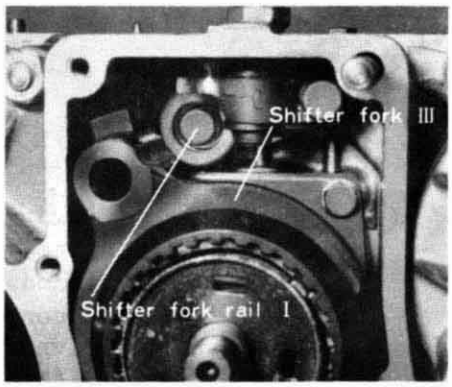

(1) Mesh the 1st driven gear with the counter gear (1st drive gear) and mesh the sleeve (synchronizer) with the main drive gear to lock the main shaft. In this case, place a block (approx. 25 mm or 1 in. in width) between the crankcase and shifter fork to regulate the stroke of the shifter fork.



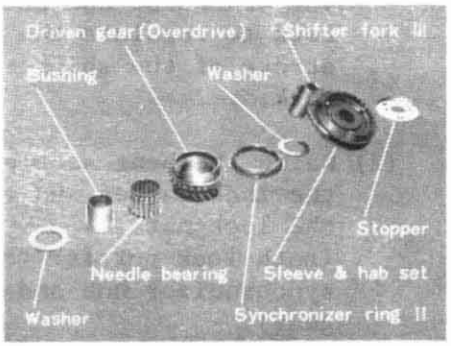

(2) Raise the bent section of the lock washer and remove the lock nut.
(Both lock nut for the synchronizer hub and drive gear).



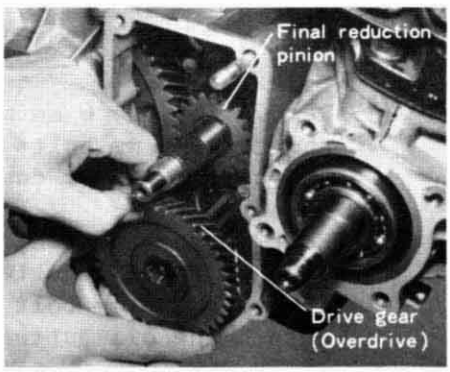

(3) Remove the two 6 mm nuts and three 6 mm bolts. Then the bearing plate can be detached.
Next, raise the bent section of the oil gutter and remove the 6 mm bolt to detach the oil gutter.



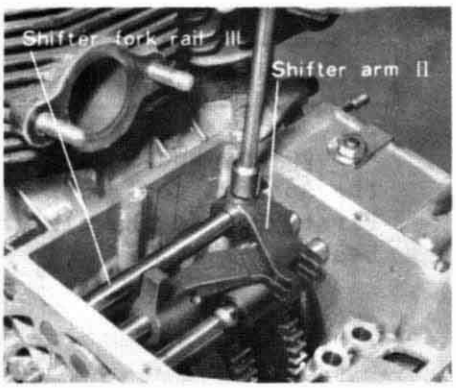

(4) Hold the shifter fork I and detach the shifter fork III by shifting the shifter fork rail as shown in the photograph.



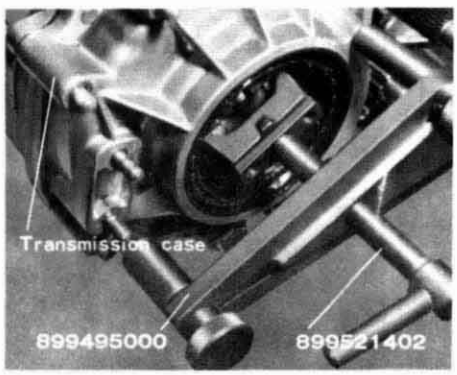

(5) Remove the stopper, sleeve and hub set with shifter fork III, washer, synchronizer ring II, driven gear, needle bearing, bushing and washer.



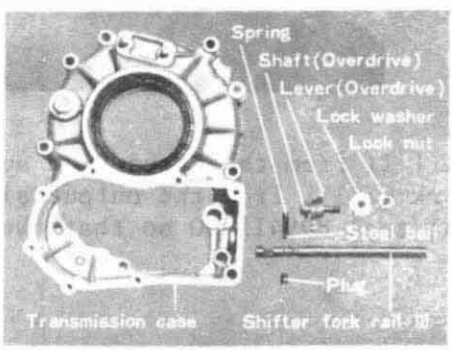

(6) Remove the drive gear and final pinion.




(7) Remove the setting screw which secures the shifter arm II to the shifter fork rail III.




(8) Remove the eight 8 mm nuts and pull out the transmission case by using the special tools 899495000 and 899520120.




(9) Disassemble the transmission case as follows.

Raise the bend section of the lock washer and remove the lock nut.

Pull out the lever and shaft.

Remove the 8 mm plug and pull out the shifter fork rail III.

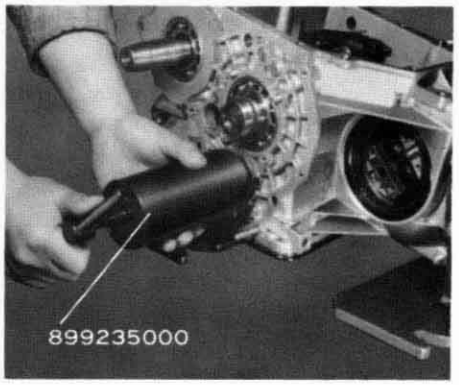
Remove the lock ball and spring.

(r) REMOVING THE DIFFERENTIAL ASSEMBLY

(1) Remove the differential whole evenly tapping the side gear of the differential assembly.

(2) Check the existence and number of the shims between the differential case and ball bearing.

(s) REMOVING THE TRANSMISSION COUNTER GEAR BEARING

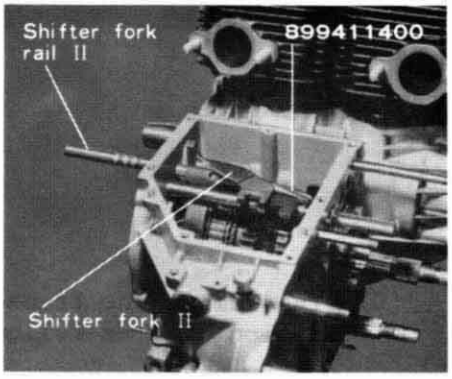


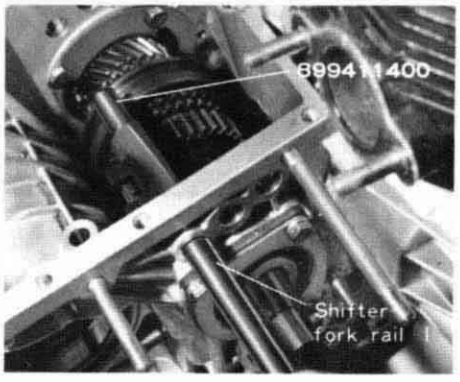

| SPECIAL TOOL | 899235000 |
|---|---|

Remove the bearings by using the special tool 899235000. First, remove the clutch side bearing.

(t) REMOVING THE SHIFTER FORK AND SHIFTER FORK RAIL

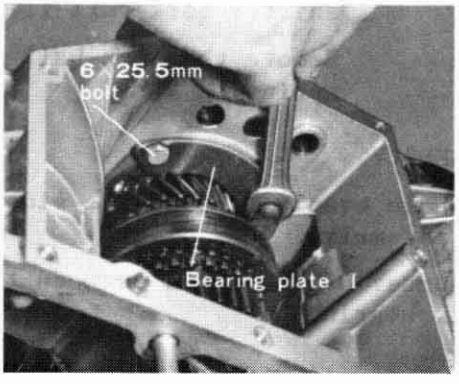
| SPECIAL TOOL | 899411400 |
|---|---|



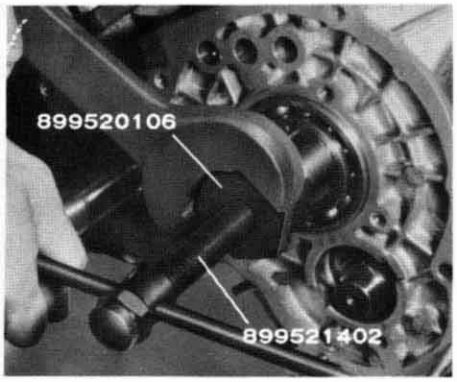

Pull out the shifter fork rail II from the input-side and then pull out the shifter fork rail I from the output side. In this case, use the special tool 899411400 so that the ball and spring do not jump out.

(u) REMOVING THE BEARING PLATE I




Detach the bearing plate I by removing the two 6 mm bolts.

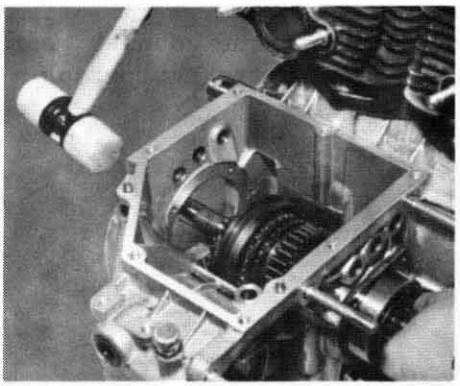
(v) REMOVING THE MAIN DRIVE GEAR




| | |
|---|---|
| SPECIAL TOOL | 899520120<br>(899521402)<br>(899520106)<br>899471410 |

Remove the main drive gear together with the ball bearing by using the special tool 899520120 as shown in the photograph.

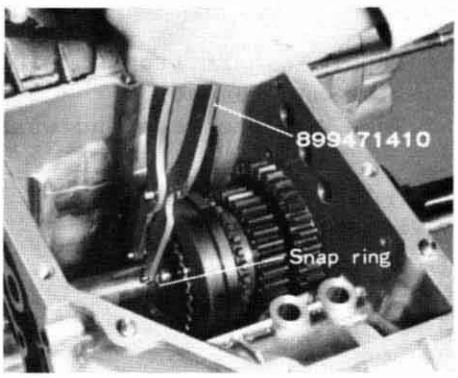
(w) REMOVING THE MAIN SHAFT



(1) Remove the bearing plate III and tap the main shaft with a mallet at the input side. Then, the main shaft and ball bearing will come off from the crankcase.

[NOTE]

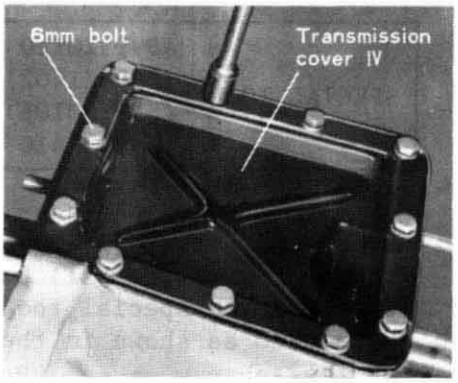
When removing the ball bearing from the main shaft, hold the ball bearing and push down the end of the main shaft with a press.




(2) Remove the snap ring from the main shaft by using the special tool 899471410.

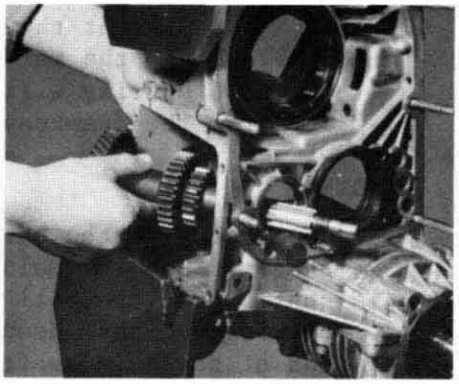
(3) Hold the gears bunched together and take out the main shaft by pulling it out on the output side.

(x) REMOVING THE TRANSMISSION COVER IV



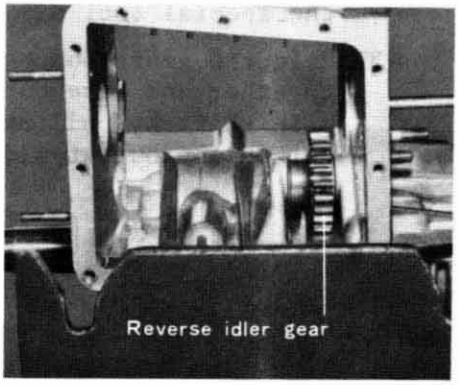

Remove the eleven 6 mm nuts and detach the transmission cover III.

(y) REMOVING THE COUNTER GEAR



Take out the counter gear as shown in the photograph.

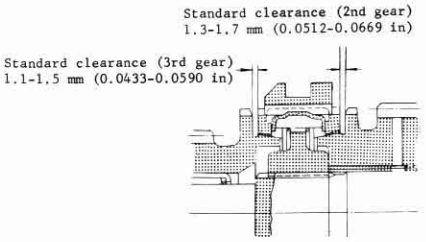
(z) REMOVING THE REVERSE IDLER GEAR




Tap the shaft from the input side and remove.
Take out the gear and washer.

## C. CHECKING AND ADJUSTING OF PARTS

### (a) WEAR OF THE SYNCHRONIZER RING

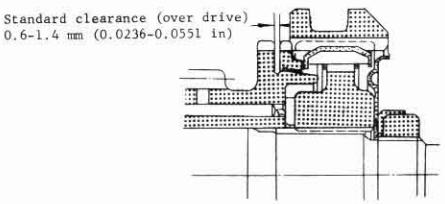



(1) When the clearance between the ring and main drive gear is less than 0.3 mm (0.0118 in), replace the ring.

| | |
|---|---|
| STANDARD CLEARANCE | 0.816-1.182 mm (0.0321-0.0465 in) |

(2) When the clearance between the ring and second gear is less than 0.3 mm (0.0118 in), replace the ring.

| | |
|---|---|
| STANDARD CLEARANCE | 1.316-1.682 mm (0.0518-0.0662 in) |



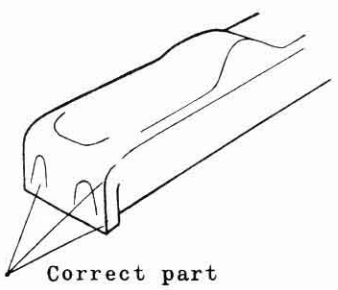

(3) When the clearance between the ring and driven gear (OT) is less than 0.3 mm (0.0118 in), replace the ring.

| | |
|---|---|
| STANDARD CLEARANCE | 0.779-1.165 mm (0.0307-0.0459 in) |

(4) Check and make sure that the ring contacts fully on the conical surface of the mating gear. If the contacting is not sufficient (the gear chatters), grind them together. In this case, use the finest lapping compound.

(5) Correct and smooth down the three slot bottoms of the ring where the inserts (synchronizer hub) enter when these are scratched or marked otherwise.

### (b) WEAR OF THE INSERT (SYNCHRONIZER HUB)




Smoothen those insert with burrs or sharp edges on the end face or corner with an oil stone. Replace any with an abnormal wear.

(c) DEFORMATION AND WEAR OF THE SNAP RING (TRANSMISSION SYNCHRONIZER)

When the end of the snap ring touches the inner wall of the synchronizer hub, bend that part inside or cut.
Replace any snap ring deformed abnormally.

(d) MESHING OF THE SYNCHRONIZER SLEEVE AND SYNCHRONIZER HUB

When the play of the sleeve and hub in the rotating direction exceeds 0.3 mm (0.0118 in) replace the sleeve and hub in assembly.

| | | |
|---|---|---|
| STANDARD PLAY | 3rd-2nd side | 0.05-0.15 mm (0.0020-0.0059 in) |
| | 4th(OT) side | 0.01-0.12 mm (0.0004-0.0047 in) |

When the teeth of the sleeve are chipped badly, replace the sleeve and hub in assembly.

(e) WEAR OF THE MAIN SHAFT SPLINE

When the play of the main shaft spline outside diameter (25 mm or 1 in) (final reduction pinion) in the rotating direction exceeds 0.2 mm (0.0079 in), replace whichever is worn more.

| | |
|---|---|
| STANDARD PLAY | 0.026-0.084 mm (0.0010-0.0033 in) |

When the play of the main shaft spline outside diameter (32 mm or 1.26 in) (reverse and low gear) in the rotating direction exceeds 0.2 mm (0.0079 in), replace whichever is worn more.

| | |
|---|---|
| STANDARD PLAY | 0.05-0.130 mm (0.0020-0.0051 in) |

(f) WEAR OF GEARS

When a gear has chipped or is worn eccentrically or has a badly worn tooth surface and the backlash exceeds 0.3 mm (0.0118 in), replace.

| STANDARD BACKLASH | |
|---|---|
| Reverse & 1st driven gear<br>Reverse idler gear | 0.04 - 0.12 mm<br>(0.0016 - 0.0047 in) |
| Primary reduction gear<br>Primary reduction pinion | 0.04 - 0.08 mm<br>(0.0016 - 0.0032 in) |
| Main drive gear | 0.04 - 0.11 mm<br>(0.0016 - 0.0043 in) |
| Second driven gear | 0.05 - 0.13 mm<br>(0.0020 - 0.0051 in) |
| OT drive gear<br>OT driven gear | 0.04 - 0.11 mm<br>(0.0016 - 0.0043 in) |
| Final reduction gear<br>Final reduction pinion | 0.06 - 0.12 mm<br>(0.0024 - 0.0047 in) |

(g) WEAR OF BUSHING

When the clearance between the bushing and shaft of the primary reduction pinion, 2nd gear and reverse idler gear exceeds 0.12 mm (0.0047 in), replace whichever is worn more.

| STANDARD CLEARANCE | 0.02-0.06 mm (0.0008-0.0024 in) |
|---|---|

(h) WEAR OF THE BALL BEARINGS AND NEEDLE BEARING

(1) Wear of the ball bearings

#6008 for main drive gear
#6004 for counter shaft
#6305 for main shaft

When the play in the axial direction exceeds 0.3 mm (0.0118 in) and play in the radial direction exceeds 0.1 mm (0.0039 in), replace.
Clean the bearings well and replace any bearing which makes a loud noise or catches when rotated by hand.

(2) Wear of the needle bearing of the main drive gear.
Replace when the play in the radial direction exceeds 0.15 mm (0.0059 in)
Replacement of the needle bearing:
Pull out or press in the needle bearing with the special tool 899540100.

(i) GEAR SHIFTING FORCE

Match the teeth lines of the gears for top and low; attach a spring balance to the shaft (gear selector arm) and measure the shifting force of gear change.
When the shifting force is less than 7 kg (15.4 lb) in changing from neutral to top and 4.5 kg (9.9 lb) in changing from neutral to low, replace the spring (transmission).

| | |
|---|---|
| STANDARD SHIFTING FORCE | Neutral to top:12.5 kg (27.5 lb) |
| | Neutral to low: 7.5 kg (16.5 lb) |

| SPECIFICATIONS OF SPRING (TRANSMISSION) | |
|---|---|
| STANDARD FREE LENGTH | 22.5 mm (0.89 in) |
| STANDARD MOUNTING LENGTH | 19.2 mm (0.76 in) |
| STANDARD LOAD AT MOUNTING TIME | 4.8 kg (10.6 lb) |

(j) FITTING OF THE RAILS (GEAR SHIFT)

| | |
|---|---|
| STANDARD CLEARANCE | 0.016-0.052 mm (0.0006-0.0020 in) |

(k) FITTING OF THE SHAFT (GEAR SELECTOR ARM)

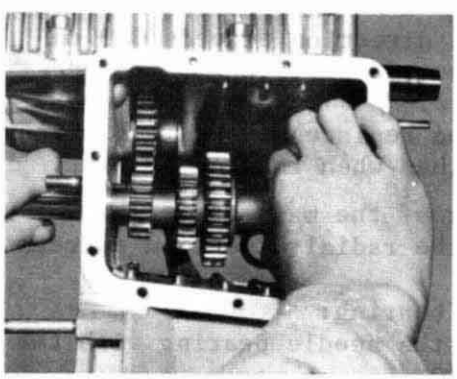
| | |
|---|---|
| STANDARD CLEARANCE | 0.016-0.052 mm (0.0006-0.0020 in) |

D. ASSEMBLY

(a) REFITTING THE GEAR

Fit a washer on each side of the reverse idler gear and strike in the shaft from the output side.

(b) REFITTING THE TRANSMISSION COVER IV



(1) Put the counter gear into the case as shown in the photograph.

(2) Install the transmission cover with the eleven 6 x 16 mm bolts on the case.

| TIGHTENING TORQUE |
|---|
| 0.5 kg-m (3.6 lb-ft) |

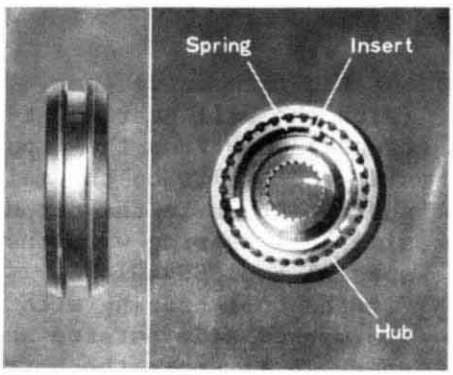
(c) REFITTING THE MAIN SHAFT

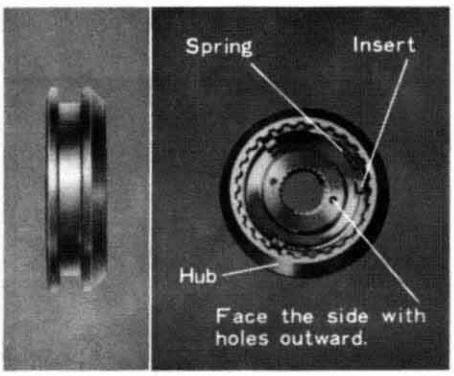
| SPECIAL TOOL | 899471410<br>899401400 |
|---|---|

(1) Fit the synchronizer sleeve and synchronizer hub together and insert three synchronizer hub inserts. Hook the spring (synchronizer hub) on the inserts as shown in the photograph.

[NOTE]

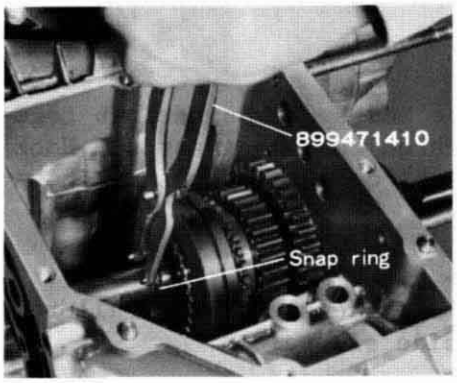
The outer diameter of the OT side sleeve is smaller than that of the lst-2nd side sleeve.



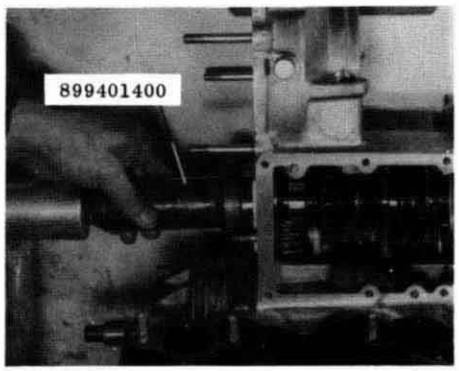




(2) Assemble all parts onto the main shaft and check their fitting condition.

(3) Insert the main shaft from the output side and fit the first driven gear and washer. (The bent section of the washer points to the output side and enters the slot of the spline.)
Hold the second driven gear and synchronizer ring as shown in the photograph and fit on the main shaft.

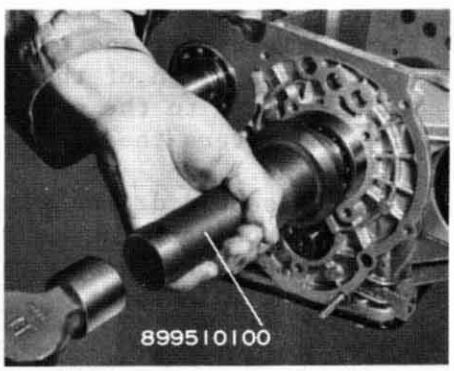



(4) Fit the snap ring on the main shaft with the special tool 899471410.
Move the snap ring to the left and right and make sure that the entire circumference of the snap ring is in the slot.




(5) Let the main drive gear (with the ball bearing attached) show from the input side and fit it on the main shaft. Press in the output side ball bearing with the special tool 899401400.
Fit the ball bearing with its marked side outside and press in it up to the bottom of the retainer sleeve (bearing).

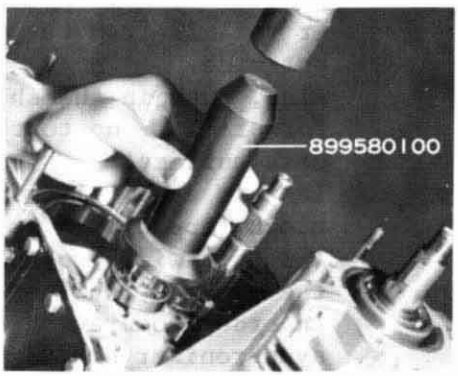
(d) REFITTING THE MAIN DRIVE GEAR




| SPECIAL TOOL | 899510100 |
|---|---|

First press in the ball bearing on the gear and then press in with the special tool 899510100 up to the crankcase surface.

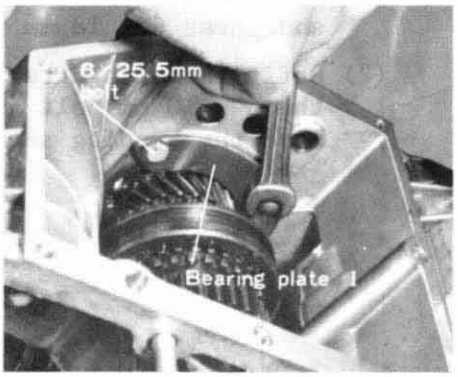
(e) REFITTING THE COUNTER GEAR BEARING

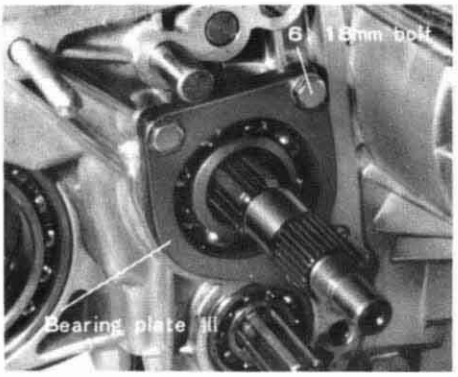



| SPECIAL TOOL | 899550100<br>899580100 |
|---|---|

From the output side, press in the ball bearing with the special tool 899580100 until it is even with the crankcase surface.
Next, press in the input side ball bearing with the special tool 899550100 in the same manner as mentioned above.

(f) REFITTING THE BEARING PLATE I AND BEARING PLATE III



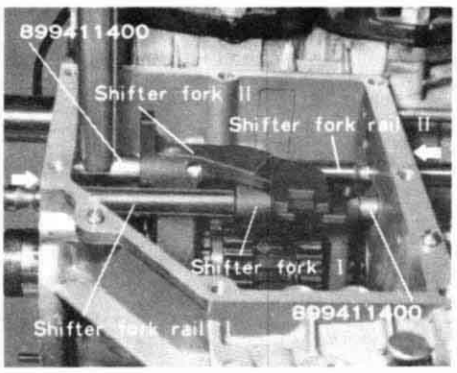




(1) Refit the bearing plate I with the two 6 x 25.5 mm bolts.

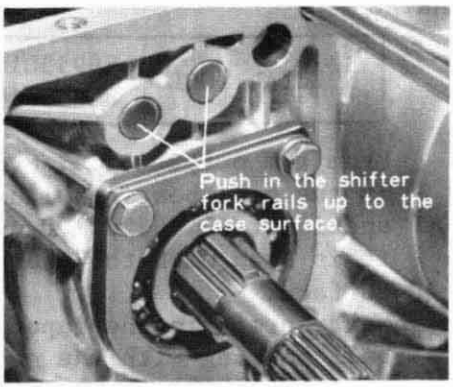
(2) Refit the bearing plate III with the three 6 x 18 mm bolts.

(g) REFITTING THE SHIFTER FORK AND SHIFTER FORK RAIL

| SPECIAL TOOL | 899411400 |
|---|---|

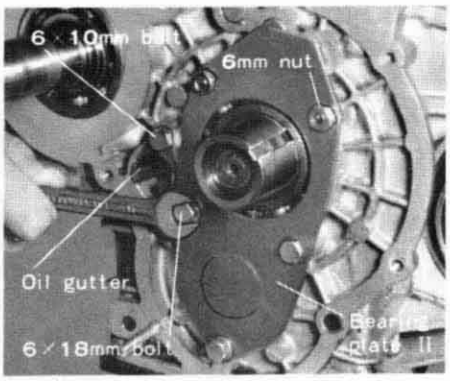



(1) Insert the special tool 899411400 into the shifter fork I to hold the steel ball.
Then, insert the shifter fork rail I into the case from the input side to install the shifter fork I. Push in the shifter fork rail I up to the case surface.




(2) In the same way, fit the shifter fork II and shifter rail II from the output side.
Also, push in the shifter fork rail II up to the case surface.
In this case, place the block (approx. 25 mm or 1 in. in width) between the case and shifter fork in order to prevent the synchronizer sleeve from moving to the 3rd gear side.

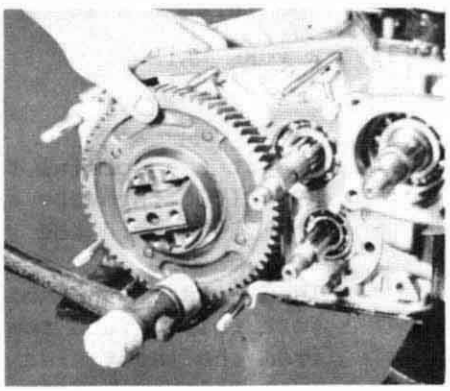
(h) REFITTING THE BEARING PLATE II AND OIL GUTTER




(1) Refit the bearing plate II with the two 6 mm nuts and three 6 x 18 mm bolts.

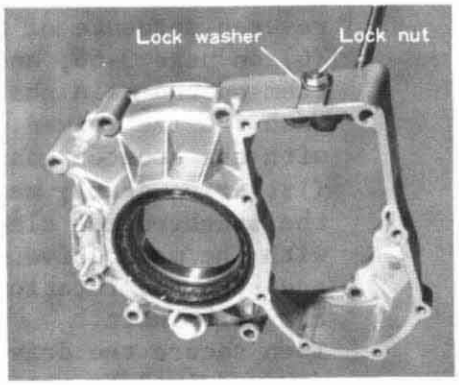
(2) Refit the oil gutter with the 6 x 10 mm bolt and bend the bending section.

(i) REFITTING THE DIFFERENTIAL ASSEMBLY



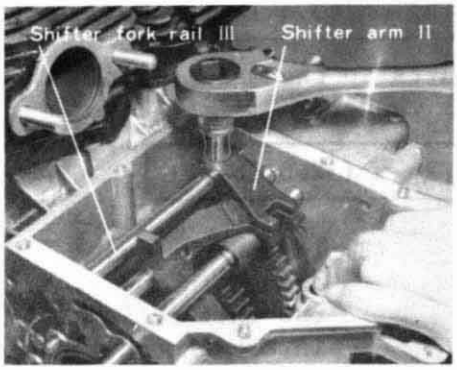
Lightly strike the differential assembly into the crankcase.
In this case, if shims (0.2 mm or 0.0079 in) are required between the differential case and ball bearing, insert them without fail.

(j) REFITTING THE TRANSMISSION CASE




(1) Reassemble the parts on the transmission case in the reverse sequence of the disassembly.
See item (9) on page 3-67.
After tightening the lock nut, bend the lock washer as shown in the picture.

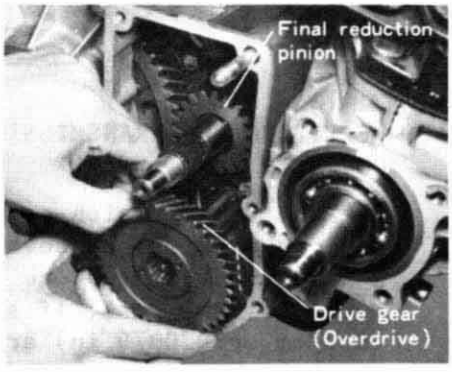
| TIGHTENING TORQUE |
| --- |
| 1.3 kg-m (9.4 lb-ft) |



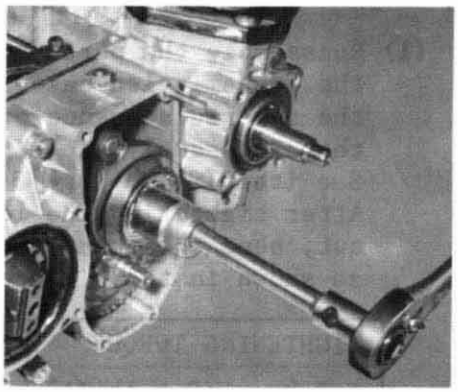

(2) Insert the shifter fork rail III into the crankcase and fit the shifter arm II on the shifter fork rail III as shown in the picture. Fix the transmission case to the crankcase with the eight 8 mm nuts.
Then, secure the shifter arm II with the set screw.

| TIGHTENING TORQUE |
| --- |
| 2.0 kg-m (14.5 lb-ft) |

(k) REFITTING THE OVERDRIVE MECHANISM




(1) Fit the final reduction pinion on the main shaft and the drive gear (overdrive) on the shaft of the counter gear as shown in the picture.

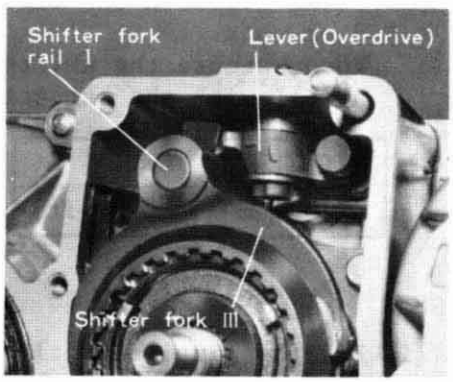


(2) Assemble the synchronizer parts (overdrive) in the reverse sequence of item (6) on page 3-66, and fit them on the main shaft. Mesh the 1st driven gear with the counter gear (1st drive gear); mesh the synchronizer sleeve with the main drive gear and stop the rotation of the main shaft.
Then secure the drive gear (over drive) to the counter shaft with the lock nut and bend the lock washer.

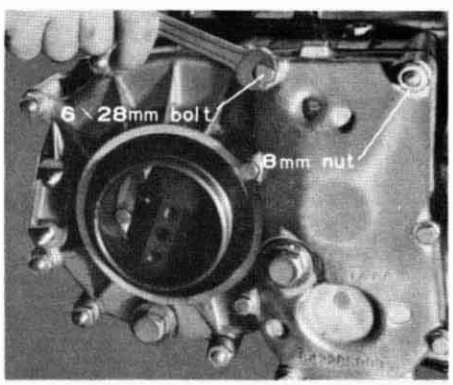
| TIGHTENING TORQUE | 6.0 kg-m (43.4 lb-ft) |
|---|---|

Secure the synchronizer parts to the main shaft with the lock nut and bend the lock washer.

| TIGHTENING TORQUE | 4.5 kg-m (32.6 lb-ft) |
|---|---|




(3) Insert the lever (over drive) in the groove of the shifter fork III and insert the shifter fork rail I into the shifter fork III up to its outer surface.



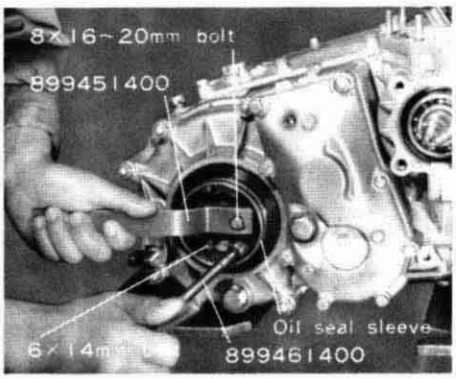

(1) REFITTING THE TRANSMISSION COVER II

Fit the transmission cover II and gasket with the seven 6 x 28 mm bolts and one 6 mm nut. In this case, if shims (0.2 mm or 0.0079 in) are required between the differential case and ball bearing, insert them without fail.

(m) REFITTING THE OIL SEAL SLEEVE

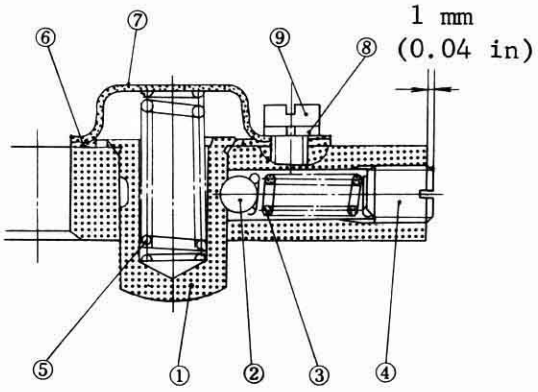
| SPECIAL TOOL | 899451400<br>899461400 |
|---|---|

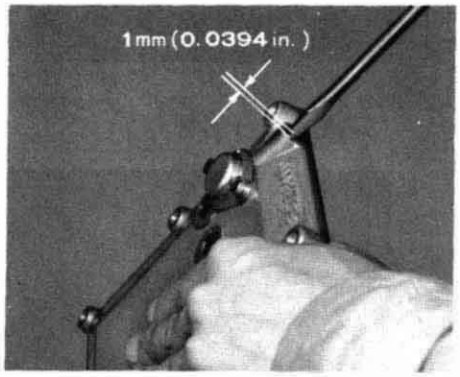
(1) Fill the grooves of the oil seal lips of the crankcase and transmission case with grease.




(2) Attach the special tool 899451400 to the yoke (universal joint) with an 8 x 16-20 mm bolts; with this tool, stop the rotation of the differential and tighten the oil seal sleeve with the eight 6 x 14 mm bolts (four at the crankcase side and four at the transmission case side) and lock washers. Band the lock washers.

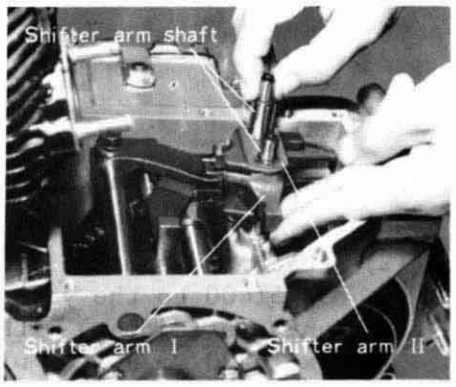
(n) REFITTING THE TRANSMISSION COVER I



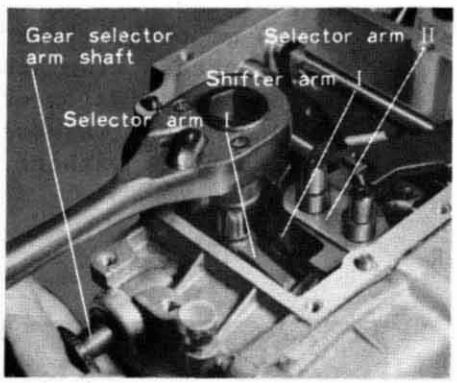




(1) Assemble the following parts in the following order. In this case, coat the liquid packing to the plug and fit the plug to the transmission cover I as shown in the drawing and photograph.

1 Plunger
2 Steel ball
3 Spring
4 Plug
5 Plunger spring
6 Gasket
7 Plunger cover
8 Spring washer
9 5 mm screw

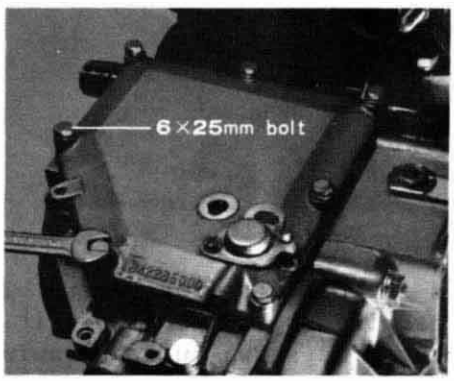



(2) Pair the shifter arm I with the selector arm II and fit them to the case with the two shifter arm shaft as shown in the photograph.



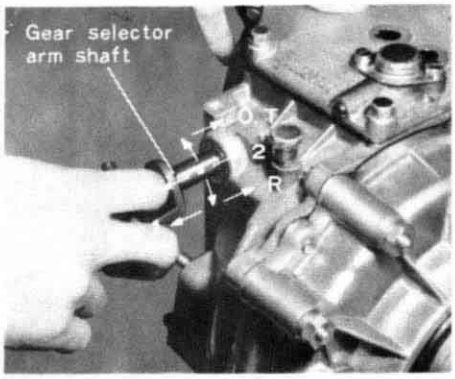

(3) Set the selector arm I in the shifter arm I and selector arm II. Insert the gear selector arm shaft into the selector arm I and tighten it with the set screw.

| TIGHTENING TORQUE |
| --- |
| 2.0 kg-m (14.5 lb-ft) |




(4) Fit the transmission cover I to the crankcase with the seven 6 x 25 mm bolts.

(o) CHECKING THE ACTION OF THE GEARS

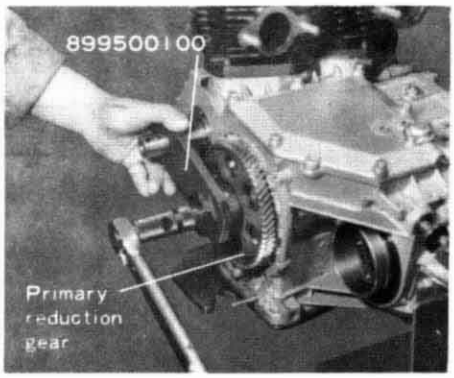



Shift the gear selector arm shaft as shown in the photograph and check the action of the gears.

(p) REFITTING THE CRANKCASE COVER

Refer to item (c) on page 3-51.

(q) REFITTING THE PRIMARY REDUCTION GEAR




| SPECIAL TOOL | 899500100 |
|---|---|

(1) Attach the primary reduction gear to the main drive gear; fit the lock nut and tighten with the special tool 899500100.

| TIGHTENING TORQUE |
|---|
| 5.7 - 6.3 kg-m (41.2 - 45.6 lb-ft) |

(2) Bend the lock washer at two opposing sides.

(r) REFITTING THE PRIMARY REDUCTION PINION

Refer to item (g) on page 3-52.

(s) REFITTING THE CLUTCH HOUSING

Refer to item (b) on page 3-18.

(t) REFITTING THE CLUTCH ASSEMBLY

Refer to item (i) on page 3-52.

(u) REFITTING THE CLUTCH HOUSING COVER

Refer to item (j) on page 3-53.

(v) REFITTING THE EXHAUST MANIFOLD

Refer to item (m) on page 3-54.

(w) REFITTING THE STARTER AND GENERATOR

Refer to items (p) and (q) on page 3-55.

(x) REFITTING THE FAN COVER

Refer to item (r) on page 3-56.

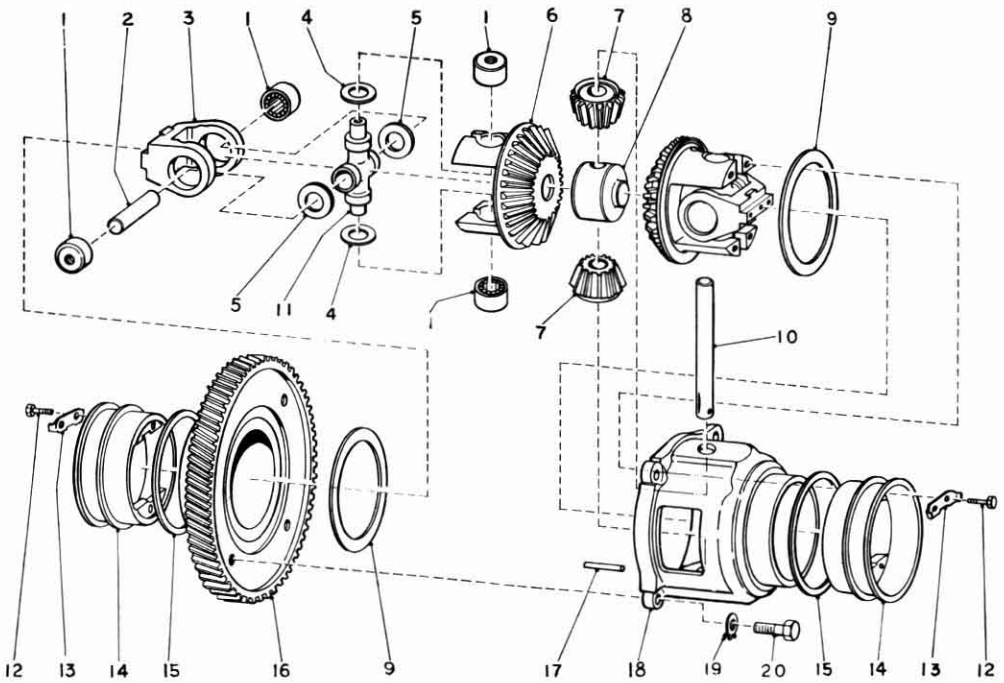
(y) REFITTING THE AIR DUCT

Refer to item (s) on page 3-56.

(z) REFITTING THE FAN

Refer to item (u) on page 3-56.

## 3 : DIFFERENTIAL




1. Needle bearing
2. Universal joint shaft
3. Universal joint yoke
4. Adjusting washer
5. Adjusting washer
6. Side gear
7. Differential pinion
8. Block
9. Thrust washer
10. Pinion shaft
11. Universal joint cross
12. Bolt
13. Lock washer
14. Sleeve
15. Washer
16. Final pinion
17. Straight pin
18. Differential case
19. Lock washer
20. Bolt

A. DISASSEMBLY

(a) DRAINING GEAR OIL

Refer to item (a) on page 3-61.

(b) REMOVING THE FAN

Refer to item (a) on page 3-37.

(c) REMOVING THE AIR DUCT

Refer to item (b) on page 3-37.

(d) REMOVING THE FAN COVER

Refer to item (c) on page 3-38.

(e) REMOVING THE EXHAUST MANIFOLD

Refer to item (e) on page 3-39.

(f) REMOVING THE CRANKCASE COVER

Refer to item (q) on page 3-44.

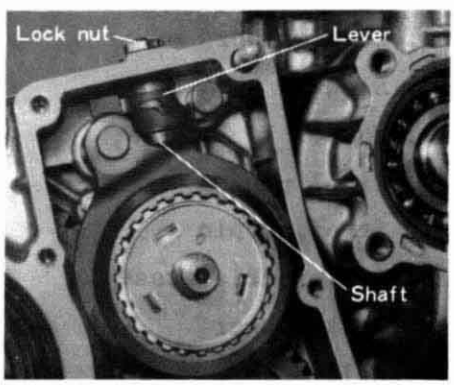
(g) REMOVING THE OIL SEAL SLEEVE

Refer to item (m) on page 3-63.

(h) REMOVING THE TRANSMISSION COVER II

Refer to item (n) on page 3-63.

(i) REMOVING THE OVERDRIVE MECHANISM PARTS AND TRANSMISSION CASE




(1) Raise the bent section of the lock washer and remove the lock nut. Then pull out the lever and shaft.

(2) Remove the synchronizer parts (overdrive), drive gear (overdrive), final reduction pinion, etc.

(Refer to item (2) on page 3-65 and items (4)-(6) on page 3-66.)

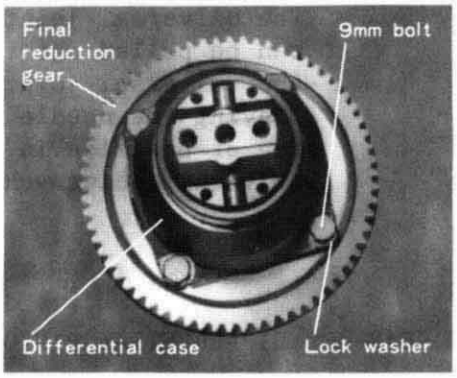
(3) Remove the transmission case.

(Refer to item (8) on page 3-67.)

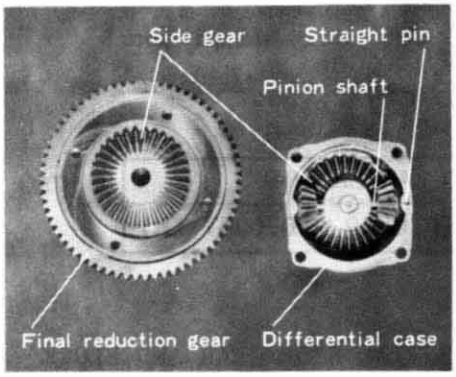
(j) REMOVING THE DIFFERENTIAL ASSEMBLY

Refer to item (r) on page 3-67.

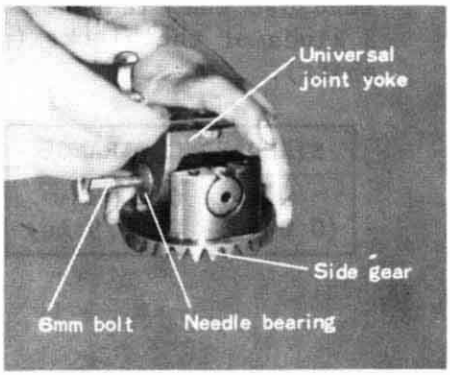
(k) DISASSEMBLY OF THE DIFFERENTIAL ASSEMBLY



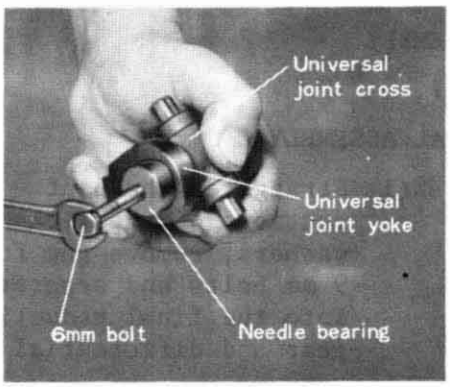

(1) Straighten the bent sections of the lock washers, remove the four 9 mm bolts and separate into the final reduction gear and differential case.




(2) Push out the straight pin and remove the differential pinion shaft. Remove the side gear assembly from the differential case and final reduction gear.




(3) The side gear assembly can be disassembled by removing the needle bearing. As shown in the photograph, screw a 6 mm bolt into the hole of the needle bearing case to remove the needle bearing. When the needle bearing comes out, be careful not to let the needles inside the case scatter. Remove the universal joint cross and universal joint yoke connected together from the side gear.




(4) Pull out the needle bearing from the universal joint yoke. For one side, use a 6 mm bolt as in the case of the side gear.
The universal joint shaft can be pulled out from the universal joint cross leaving the needle bearing of one side in the universal joint yoke.

B. CHECKING AND ADJUSTING OF PARTS

(a) WEAR OF THE DIFFERENTIAL SIDE GEAR AND DIFFERENTIAL PINION

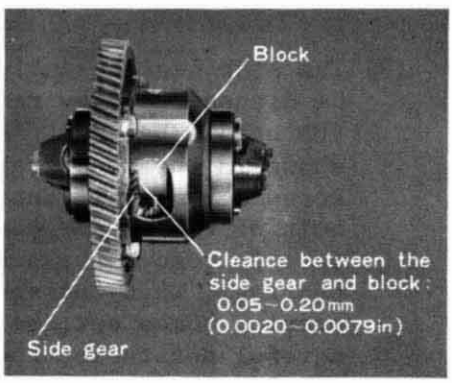
(1) When the gear and pinion have chipped teeth or are worn eccentrically or have worn tooth surfaces and backlash exceeds 0.3 mm (0.0118 in), readjust, correct or replace.

(2) Adjusting the backlash of the gear and pinion

Adjust the backlash with 5 kinds of the side gear thrust washers.

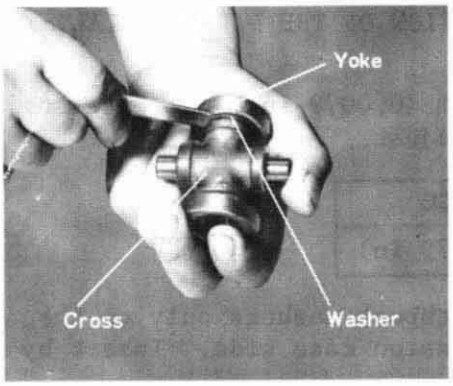
| STANDARD BACKLASH |
|---|
| 0.10 - 0.17 mm (0.0039 - 0.0067 in) |

(b) CLEARANCE BETWEEN THE DIFFERENTIAL SIDE GEAR AND BLOCK




When the axial direction play exceeds 0.2 mm (0.0079 in), readjust the clearance with 3 kinds of the blocks (pinion shaft).

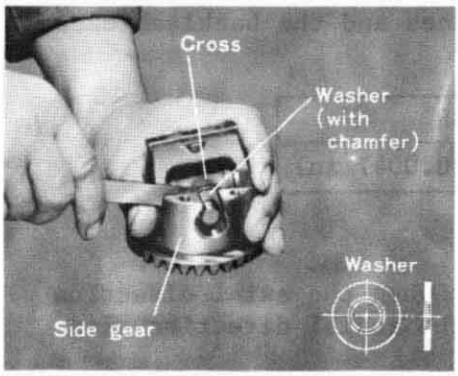
| STANDARD CLEARANCE |
|---|
| 0.05 - 0.20 mm (0.0020 - 0.0079 in) |




(c) CLEARANCE BETWEEN THE UNIVERSAL JOINT CROSS AND UNIVERSAL JOINT YOKE

If the clearance exceeds 0.1 mm (0.0039 in), readjust with 14 kinds of washers

| STANDARD CLEARANCE |
|---|
| 0-0.005 mm (0-0.0002 in) |




(d) CLEARANCE BETWEEN THE UNIVERSAL JOINT CROSS AND SIDE GEAR

If the clearance exceeds 0.1 mm( 0.0039 in), readjust with 14 kinds of washers (This washer is chamfered on inner diameter).

| STANDARD CLEARANCE |
|---|
| 0-0.005 mm (0-0.0002 in) |

(e) WEAR OF THE UNIVERSAL JOINT NEEDLE BEARING

When the radial direction clearance between the universal joint shaft and needle bearing exceeds 0.12 mm (0.0047 in), correct or replace.

CLEARANCE = CASE INSIDE DIA. - [SHAFT DIA.+(2 x NEEDLE DIA.)]

| STANDARD CLEARANCE |
|---|
| 0.01 - 0.03 mm (0.0004 - 0.0012 in) |

(f) CLEARANCE IN THE REAR AXLE DIRECTION OF THE DIFFERENTIAL ASSEMBLY

When the clearance exceeds 0.2 mm (0.0079 in), increase the number of thrust washers and readjust.

| STANDARD CLEARANCE |
|---|
| 0 - 0.2 mm (0 - 0.0079 in) |

Do not insert all the necessary thrust washers only on the crankcase side or on the transmission case side. Insert by dividing them suitably.

(g) WEAR OF THE FINAL REDUCTION GEAR AND PINION

When the gear and pinion have chipped teeth or eccentric wear or great wear on the tooth surfaces and the backlash exceeds 0.3 mm (0.0118 in), replace.

| STANDARD BACKLASH |
|---|
| 0.06 - 0.12 mm (0.0024 - 0.0047 in) |

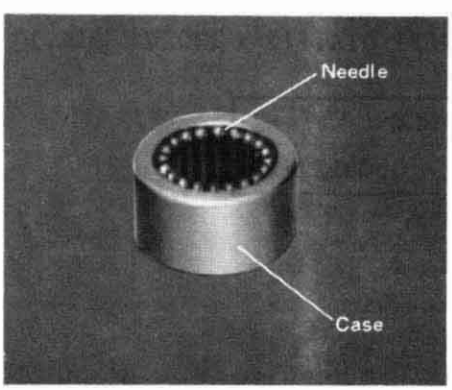
(h) WEAR OF THE BALL BEARING (#6915)

Replace the ball bearing (#6915) when the axial direction play exceeds 0.3 mm (0.0118 in) and the radial direction play exceeds 0.1 mm ( 0.0039 in).

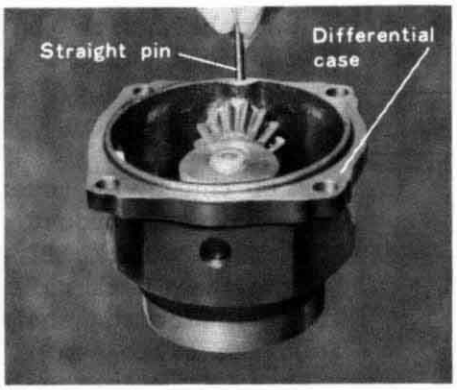
C. ASSEMBLY

(a) ASSEMBLING THE DIFFERENTIAL ASSEMBLY

(1) Fit the washers on both ends of the universal joint cross with holes and insert the universal joint cross between two arms of the universal joint yoke.




Insert the universal joint shaft. Stick 20 needles with grease in the needle case and press in the needle bearing on the universal joint yoke. (Press in the needle bearing so that the its case inner surface and yoke inner surface are the same.)




(2) Attach washers, which are chamfered on inner diameter, on both side of the universal joint cross shaft and insert the universal joint cross between the arms of the side gear.
Stick bearing needles to the case from the outside of the side gear.
Press in the needle bearing on the side gear in the same manner as mentioned above.

(3) On the differential case, refit the side gear assembly, differential pinion and block and insert the pinion shaft so that the holes in the pinion shaft and differential case match properly. Insert the pin into them to lock the pinion shaft.

(4) Fit the side gear assembly on the final reduction gear and then fit this on the differential case (incorporates the side gear).
Tighten then with the four lock washers and four 9 x 21 mm bolts. Bend the lock washers.

| TIGHTENING TORQUE | 4.6 - 5.6 kg-m (33.3-40.5 lb-ft) |
|---|---|

(b) REFITTING THE DIFFERENTIAL ASSEMBLY

Refer to item (i) on page 3-78.

(c) REFITTING THE TRANSMISSION CASE

Fit the transmission case with the eight 8 mm nuts to the crankcase.

(d) REFITTING THE OVERDRIVE MECHANISM

(1) Fit the final reduction pinion and drive gear (overdrive)

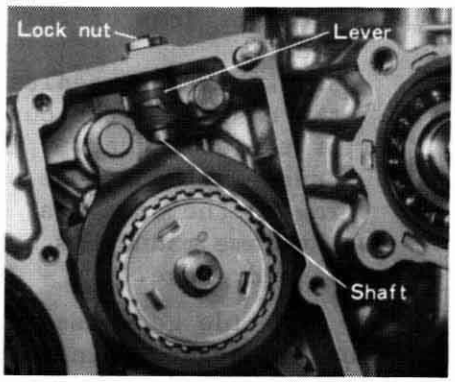
Refer to item (1) on page 3-79.

Then, secure the drive gear (overdrive) with the lock washer and look nut and bend the lock washer.

| TIGHTENING TORQUE | 6.0 kg-m (43.4 lb-ft) |
|---|---|

(2) Fit the synchronizer parts on the mainshaft with the lock washer and lock nut and bend the lock washer.

| TIGHTENING TORQUE | 4.5 kg-m (32.6 lb-ft) |
|---|---|




(3) Insert the lever (overdrive) in the groove of the shifter fork III and the shifter fork rail III. Then, insert the shaft into the lever and tighten it with the lock washer and lock nut. Bend the lock washer.

| TIGHTENING TORQUE |
|---|
| 1.3 kg-m (9.4 lb-ft) |

(e) REFITTING THE TRANSMISSION COVER II

Refer to item (l) on page 3-80

(f) REFITTING THE OIL SEAL SLEEVE

Refer to item (m) on page 3-81

(g) REFITTING THE CRANKCASE COVER

Refer to item (c) on page 3-51

(h) REFITTING THE EXHAUST MANIFOLD

Refer to item (m) on page 3-54

(i) REFITTING THE FAN COVER

Refer to item (r) on page 3-56

(j) REFITTING THE AIR DUCT

Refer to item (s) on page 3-56

(k) REFITTING THE FAN

Refer to item (u) on page 3-56

## 4 : CHECKING AND ADJUSTING ENGINE

In this section, checking and adjusting of the engine with the engine mounted on the car body are explained.

### A. CHECKING COMPRESSION PRESSURE

(a) SPECIFIED STANDARD COMPRESSION PRESSURE

When the engine is turned with fully charged battery at 300 - 500 rpm on a test stand: 9.1 kg/cm$^2$ (129.4 lb/in$^2$)

(b) PROCEDURE FOR MEASURING COMPRESSION PRESSURE

(1) Start the engine and run it for 5 - 10 minutes to warm it up.

(2) Turn off the key switch and remove the spark plugs (#1 and #2).

(3) Maintain the throttle lever of the carburetor and choke lever at the fully open position.

(4) Insert a compression gage in the spark plug hole and press down to prevent air leakage.

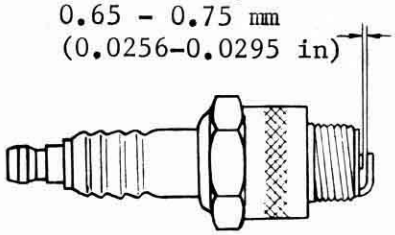
(5) Turn the engine with the starter (for over 300 rpm) and read the maximum indication of the gage.

(6) Perform the same measurement on the other cylinder.
When the compression pressure measurement in the above manner is less than 70 % (6.4 kg/cm$^2$ or 90.6 lb/in$^2$) of the specified pressure, it is necessary to overhaul the engine according to the correcting standards.
When the compression pressure difference between the #1 and #2 cylinder is over 1.1 kg/cm$^2$ (15.6 lb/in$^2$), overhaul the engine in the same way as above.
When the compression pressure of both the #1 and #2 cylinders is uniform, if the condition of the engine is normal, the car can be used without trouble.

### B. CHECKING SPARK PLUGS

(a) Remove the carbon, rust, etc., adhering to the spark plugs with a spark plug cleaner, wire brush or sandpaper and then clean the spark plugs in gasoline.

(b) Bridging between two electrodes of a spark plug is caused by too rich a mixture due to clogging of the element (air cleaner) or sucked-in dust or the wrong king of oil (recommended 2-stroke engine oil is not used). Check, clean or replace the air cleaner or use the 2-stroke oil recommended.




(c) Adjust the gap between the electrodes to 0.65 - 0.75 mm (0.0256 - 0.0295 in). Check this gap with the thickness gage furnished. Adjustment is made by bending or stretching the side electrode.

(d) Replace any spark plug with excessively worn electrodes.

(e) Check the spark generated between the electrodes with a spark plug tester.

(f) Spark plugs with a cracked or chipped insulator will misfire. Replace.

(g) Replace any badly crushed gasket. Be sure to use only one specified gasket.

(h) When fitting a spark plug, be careful not to drop anything into the cylinder. Clean the seat and check the gasket. Turn the spark plug until it can no longer be turned by hand and then firmly tighten it with the furnished plug wrench taking care not to damage the insulator. If a spark plug is inserted crookedly, the threaded section will be damaged.

(i) When replacing spark plugs, use the following brand:

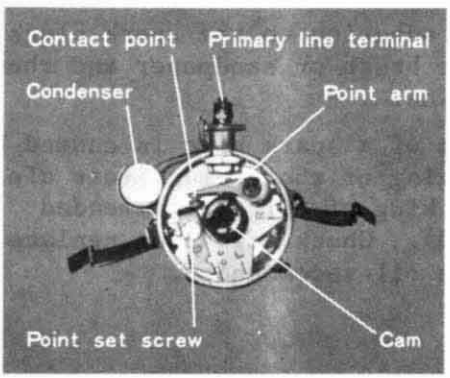
NGK B-7H

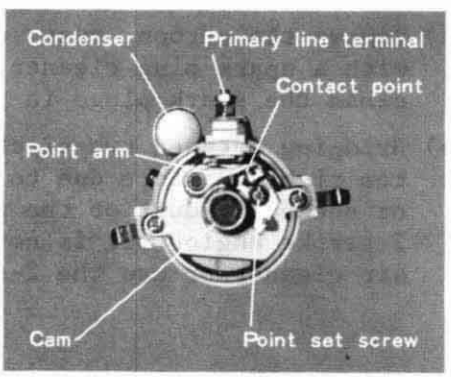
C. ADJUSTING IGNITION TIMING

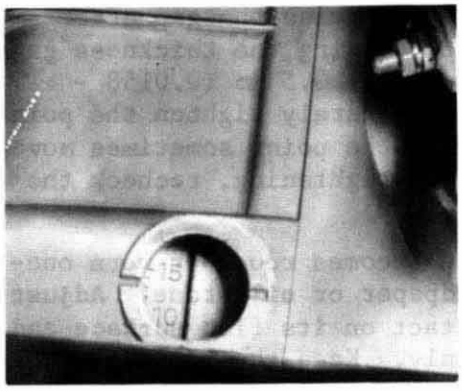
(a) CONFIRMING IGNITION TIMING

(1) Turn off the key switch.

(2) Detach the distributor cap and rotor head.



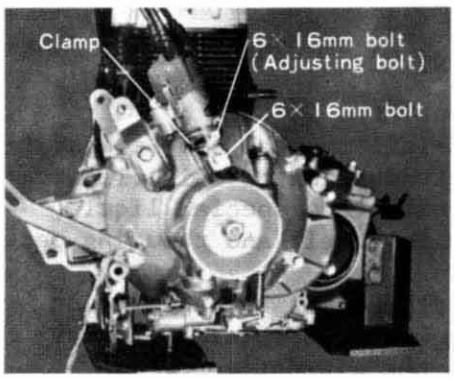


(3) Remove the plug of the timing hole on the clutch housing and slowly rotate the pulley (generator) clockwise by hand. When the matching mark and 13° of the timing marks (the space between 10° and 15° is divided into five equal parts) on the periphery of the flywheel match, if the point just starts to open, the ignition timing is correct.

(4) Method of confirming with a tester: Fasten the (+) line of the tester on the primary terminal of the distributor and ground the (-) line securely on the housing (distributor). When the point opens the pointer starts to return.

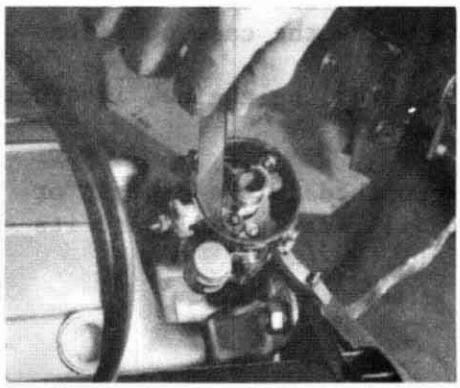
(5) When the ignition timing is not correct, adjust.

(b) ADJUSTING IGNITION TIMING




(1) Loosen the 6 mm bolt from the clamp so that the distributor can be turned by hand.
In this case, do not remove the 6 mm bolt which holds the clamp to the clutch housing cover.

(2) Slowly turn the pulley by hand and locate the position at which the gap of the point becomes maximum.
The gap becomes greatest when the slipper of the breaker arm comes to the top of the cam of the distributor shaft.



(3) The standard gap of the point for both Hitachi and Nippon Denso distributors is 0.4 - 0.5 mm (0.0158 - 0.0197 in). When the gap of the point is not proper, adjust.

(4) Move the point to increase or decrease the gap after loosening the point set screw. Using the thickness gage furnished, adjust the gap to 0.4 - 0.5 mm (0.0158 - 0.0197 in). After adjusting, securely tighten the point set screw. During tightening, the point sometimes moves and the gap is changed. After tightening, recheck the gap with the thickness gage.

(5) Sometimes, the point surface becomes rough or worn one-sided. Polish with #00 sandpaper or oil stone. Adjust so that the point makes contact on its flat surface and does not wear on one side only. Keep the point clean at all times.

(6) Next, match the matcing mark of the timing hole on the clutch housing to the timing mark 13° located on the periphery of the flywheel and move the distributor to adjust the ignition timing so that the point is starting to open. Since this adjustment is for the ignition timing of the #1 cylinder, make sure that there is no mistake from the relative positions of the rotor head and distributor cap.

(7) After tightening the 6 mm bolt of the clamp, check the ignition timing again.

D. REPLACING THE AIR CLEANER ELEMENT

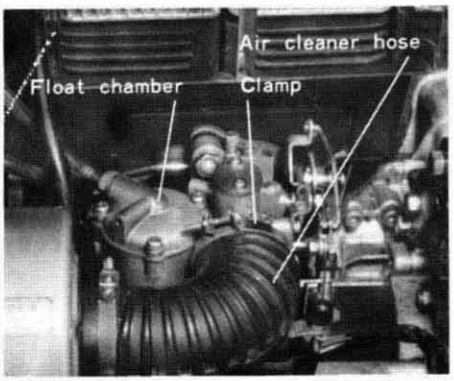
The element is of a oil-wet type.
It is soaked with a special non-inflammable, slow-evaporating and cold-resistant liquid. Dirt adhering to this filter paper forms porous laminations with this special liquid, building up a filteration layer in itself and reducing penetration into the laminations.
If cleaning of this element is attempted, the filtration layer thus formed is lost along with the special liquid. Therefore, do not clean or wash the element.

(a) Replace the element every 30,000 km (18,000 miles)

(b) Clean the interior of the air cleaner case every 1000 km (600 miles) and check the points where the case contacts closely with the element.
Since the element controls the life of the engine, instruct the users not to use imitation parts.

[NOTE]
If the engine is run with holes punched in the element or without the element, the engine will wear rapidly and its life will be shortened greatly.

E. CLEANING THE CARBURETOR (WITHOUT REMOVING)




(a) Loosen the screw of the clamp (air cleaner hose) and remove the air cleaner hose.

(b) Remove the float chamber cover of the carburetor and take out the float. Sometimes dirt accumulates on the bottom of the float chamber. When a great deal of foreign matter is found in the chamber, check the fuel strainer.

(c) When the main jet retainer is removed, the fuel flows out of the float chamber. Clean the chamber letting all foreign matter flow out with the fuel. The jet is assembled in the main jet retainer.

(d) Remove the slow jet.

(e) Remove the air chamber cover and remove the plug (slow air bleed) and plug (main air bleed).

(f) Remove the idle adjust screw.

(g) Clean the carburetor interior passages, jets and plugs, etc. only with compressed air, Never use wire or other cleaning methods. The slow jet becomes clogged even with dust which is difficult to see with the naked eye.

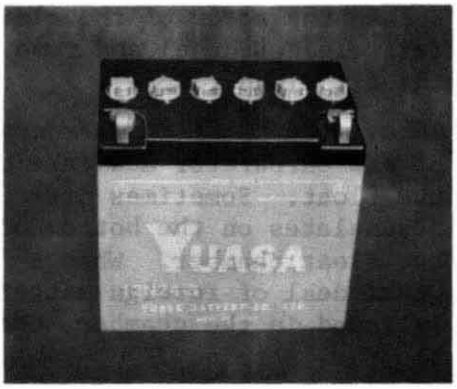
(h) Remove the needle valve assembled in the float chamber cover and clean it with air.

(i) Clean the dirt adhering to the inner wall of the air cleaner hose with gasoline. When a great deal of dirt is found inside the hose, check the air cleaner case and element.

(j) Attach the jets and plugs; insert the float and fit the cover. Be careful not to mistake the attaching positions of the plugs (slow and main air bleeds).

(k) Tighten the hose securely with the clamp.

F. CHECKING THE BATTERY




(a) MEASURING VOLTAGE

Measure the voltage of each cell with an excel tester. If the tester indicates 1.5 V past 5 seconds after connection and if the voltage difference between the cells is less than 0.1 V, the battery is in good condition.

(b) MEASURING SPECIFIC GRAVITY

Measure the specific gravity of the electrolyte with a hydrometer. When the specific gravity is 1.220 - 1.280 at a standard temperature of 20°C (68°F), the electrolyte is normal.

(c) When the level of the electrolyte is below minimum level, replenish with distilled water. In this case, watch the long side of the battery and fill the cells with distilled water up to the maximum level.

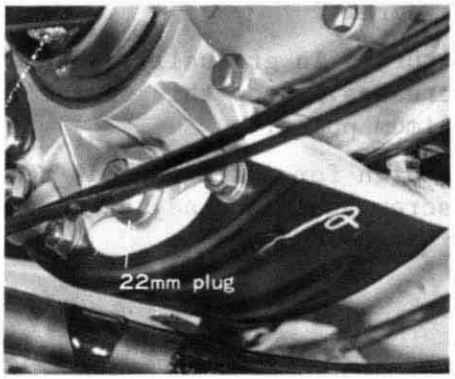
If the level of the electrolyte is higher than maximum level, the solution sometimes will spout out during running of the car.

Replenishing with diluted sulfuric acid in place of distilled water is injurious.

(d) Check the container, filling holes, connecting rods, compound, terminals, etc., for damage and cracks. Clean soiled parts with water to remove sulfuric acid and wipe with a dry cloth. Polish the terminals well and coat them with grease to protect them from rust.

(e) Tighten the battery cable and ground cable securely.

G. CHECKING AND CHANGING GEAR OIL




(a) CHECKING THE GEAR OIL

(1) Remove the 22 mm plug on the transmission cover.

(2) When the oil level is about 25 mm (1 in) below the lower end of the threaded section of the oil hole, replenish up to the lower end of the threaded section. After checking, tighten the plug firmly.

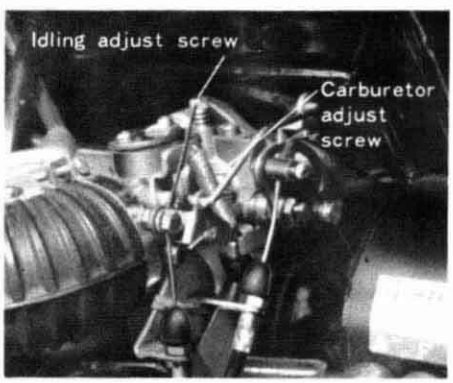
(b) CHANGING THE GEAR OIL

(1) Change the gear oil periodically.

(Refer to the engine lubrication table.)
To drain the gear oil, remove the 14 mm drain plug (clutch housing lower side) and the 22 mm plug (transmission case lower side). Drain the oil in a container and check its color, viscosity and sediments. The total amount of the gear oil is 1.6 ℓ (3.4 US pt, 2.8 Imp. pt).

(2) When replenishing or changing the gear oil, use SAE #90 gear oil in summer and SAE #80 in winter.

H. ADJUSTING ENGINE IDLING SPEED




(a) Adjust the engine idling speed to 700 - 900 rpm.

(b) Start the engine and run for 5 - 10 minutes to warm up.

(c) Turn back the idling adjust screw of the carburetor for about two rotations from a fully closed position; screw in the carburetor adjust screw and start the engine with the throttle valve slightly open.

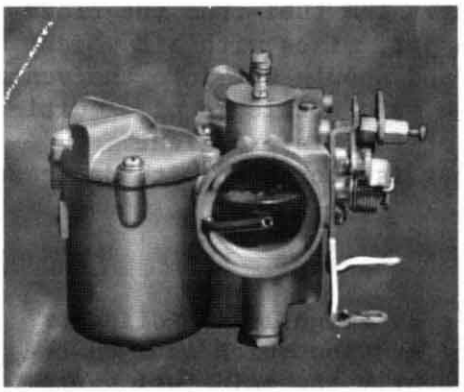
(d) As the carburetor adjust screw is gradually turned back, the revolution decreases and becomes unstable.
Tentatively stop turning back the screw.

(e) Next, the idling adjust screw is turned in gradually, the revolution becomes stable and increases. Stop this operation when the revolution reaches a maximum point.

(f) Since the above revolution is too high for idling speed, again turn back the carburetor adjust screw again and adjust to the specified idling speed.

# CHAPTER 4 : ENGINE ANCILLARY PARTS

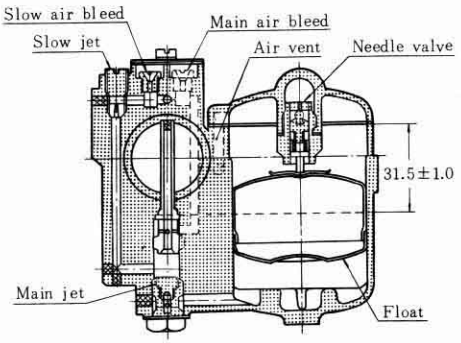
## 4 - 1 CARBURETOR

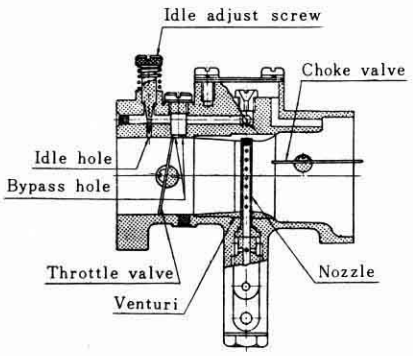


Model HAB28 carburetor is a horizontal butterfly valve type carburetor which utilizes a multi-hole nozzle for improved fuel atomization. All jets are of fixed type and of a construction which permits easy disassembly and assembly.

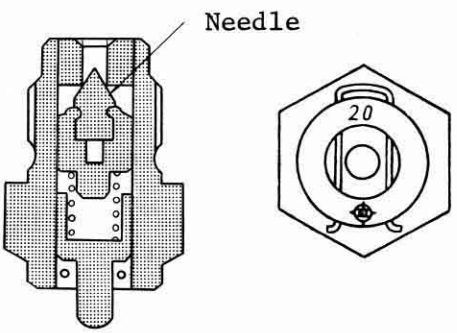
### 1 : CONSTRUCTION AND FUNCTION

This carburetor consists of a float, main fuel, slow speed and starting systems.




### A. FLOAT SYSTEM




Fuel which has been sent from the fuel tank passes through the needle valve and enters the float chamber. The fuel in the float chamber is maintained at a constant level by the action of the float and needle valve.

B. MAIN FUEL SYSTEM

This fuel system functions in normal running other than idling or very low speed running. The fuel from the float chamber, after passing the main jet, mixes with air which enters from the main air bleed and spouts out into the venturi from the main nozzle. Since the main nozzle is of a multi-hole construction, atomization of fuel is excellent. Because of this, the power output is increased with decreased fuel consumption.

C. LOW SPEED SYSTEM

Since the throttle valve opens only slightly in idling or extremely low speed running, the suction which acts on the main nozzle is small and consequently the main fuel system cannot function. In such a case, the low speed system functions. Fuel which has passed through the main jet diverts into the slow jet, mixes with air admitted through the slow air bleed and spouts out of the idle hole. Here, as the throttle valve opens slightly, the fuel also spouts out of a bypass hole which is located near the fully closed position of the throttle valve and thus the changeover to the main fuel system is made easier.

D. STARTING SYSTEM

The starting system is a choke valve type and is used in starting and warming up. For instance, as the choke valve is closed, a large negative pressure is created in its downstream side and fuel is spouted out of the main nozzle.

With a conventional choke valve, when starting the engine with the choke valve fully closed, starting is easy.
However, for a novice the operation of the choke valve and accelerator after starting the car is difficult. If the choke valve is left fully closed, the mixture rapidly become too rich causing engine stalling or oversuction (over choking) of fuel. If the choke valve is opened immediately after starting the engine, the mixture becomes too lean again causing engine stalling. Thus it is necessary to operate several times before the proper result is obtained.
However, with a popet type choke valve for EK32 engine, even if the engine is started with the choke valve fully closed, since a plate valve opens in accordance with the negative pressure inside the intake manifold, the engine keeps on turning without stalling.
The method of starting the engine when the above choke valve is used is as follows (especially in cold weather):

(1) Fully close the choke valve.

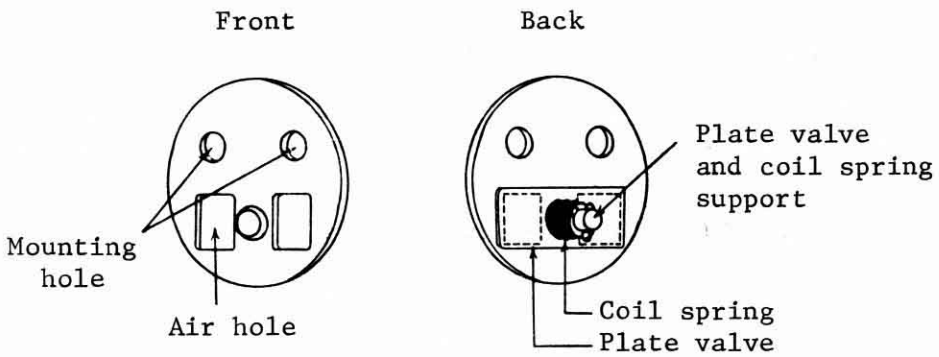
(2) Press down the accelerator pedal for about 1/4 of its stroke.

(3) Start the engine with the starter motor.

(4) At a temperature of -20°C (-4°F) the engine starts in about three seconds. (Turn off the starter switch). Let the engine run for about 30 seconds after starting and open the choke valve slightly when the revolution of the engine stabilizes.

(5) When the engine is sufficiently warm, fully open the choke valve.

POPPET TYPE CHOKE VALVE




The numbers stamped on the jets are the scale numbers of a Hitachi micrometer. As a number gets larger, the hole diameter of the jet becomes larger. Consequently, when the number of the main jet or slow jet becomes larger, the air and fuel mixture becomes richer. Conversely, since the main air and slow air bleeds are the jets through which air passes, when the numbers of these get larger, the mixture becomes leaner and when the numbers of these become smaller, the mixture becomes richer. Now, if the running condition of a car is used as an example, when the load is especially light and when it is necessary to decrease fuel consumption at a slight sacrifice of the power output, the objective will be realized if the car is operated with the main jet (or slow jet) set at a smaller number than the standard setting number. On the other hand, when the car is to be operated with heavier load, sacrificing fuel consumption economy, the main jet can be set for a larger number than the standard.

## 2 : CARBURETOR SETTING

As has been described in the section on construction, the fuel passes through jets such as the main and slow jets.
Thus the fuel consumption and output change with the size of the jets. For this reason, before selecting a jet size conduct a careful test and determine the size which is most suitable for the engine. The selection and combination of jets are called the setting of the carburetor. The carburetor setting is shown below:

| Type | Main jet | Spare main jet | Main air bleed | Spare main air bleed | Slow jet | Slow air bleed | Needle valve diameter |
|---|---|---|---|---|---|---|---|
| Sedan | #112 | #108 | #180 | | #45 | #130 | 2.0 mm |
| Custom | #110 | | #160 | #200 | #45 | #130 | 1.2 mm |
| Truck & Van | #105 | #100 | #140 | | #45 | #130 | 1.2 mm |

## 3 : PRECAUTIONS IN HANDLING

A. USE THE CHOKE VALVE ONLY WHEN STARTING AND WARMING UP

If the choke valve is closed during normal running, output is decreased and fuel consumption increased with no benefit whatsoever.

B. ADJUST THE IDLING SPEED PROPERLY

When this adjustment is not proper, fuel consumption increases and at times hissing occurs.

C. TAKE GOOD CARE OF THE JETS

The jets are the vital parts of a carburetor and are made with meticulous care. When cleaning the jets, clean them in gasoline and blow them with air after they have been cleaned.

D. METHOD OF USING THE SPARE MAIN JET AND SPARE MAIN AIR BLEED

The spare main jet or spare main air bleed are attached on the carburetor.
During summer when the temperature is high (over 25°C or 77°F), the main jet or main air bleed are replaced with the spare main jet or spare main air bleed which are effective in improving acceleration in speed reduction (from third speed to second speed).

When the temperature drops and is below 25°C (77°F) (autumn, winter and spring), again change over to the main jet and main air bleed.
If the car is run with the spare main jet or spare main air bleed in temperatures below 25°C (77°F) a poor running condition such as knocking develops when accelerating the car.

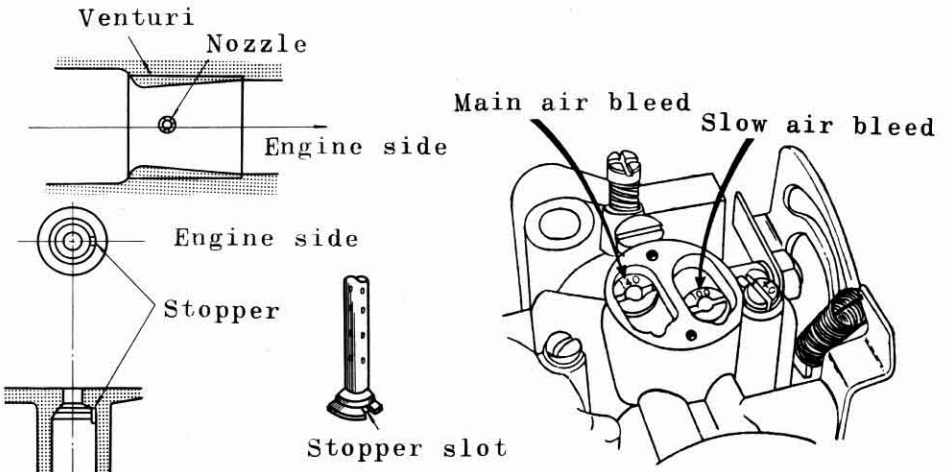
E. PRECAUTIONS IN DISASSEMBLY AND ASSEMBLY

(a) Use only the proper wrenches and screwdrivers, etc. Use of improper tools causes damage and clogging of jets during operation.

(b) Perform disassembly and assembly on a clean work table. Make sure no foreign matter enters the interior of any part.

(c) When assembling the main nozzle, be sure to point the hole in the proper direction as shown in the drawing.

(d) The main and slow air bleed are screwed in as indicated in the drawing. When cleaning or replacing them be sure to replace them in their proper position.



Nozzle seat section

(e) Careless attaching of the throttle valve causes unstable slow speed and malfunction of the accelerator, etc. To attach the throttle valve: insert the throttle valve shaft; place the washer and spring on the throttle lever side and after securing the throttle lever with the nut, attach the throttle valve to the throttle valve shaft with small screws.
Make sure there is no gap around the throttle valve when it is open fully.

(f) After disassembly of the poppet choke valve, if the cotter pin located on the support drops off, the plate valve, etc., gets in the crankcase and causes a severe accident. Be sure to bend the pin.

## 4 : TROUBLES AND REMEDIES

Carburetor troubles which are liable to occur during operation, methods of detecting and their remedies are listed below.
Even if the carburetor is working properly, the engine may malfunction when the engine is worn badly or when some part of the electrical system is out of order. For efficient and smooth running of a car, check not only the carburetor but also all other parts as well.

**Does not start**

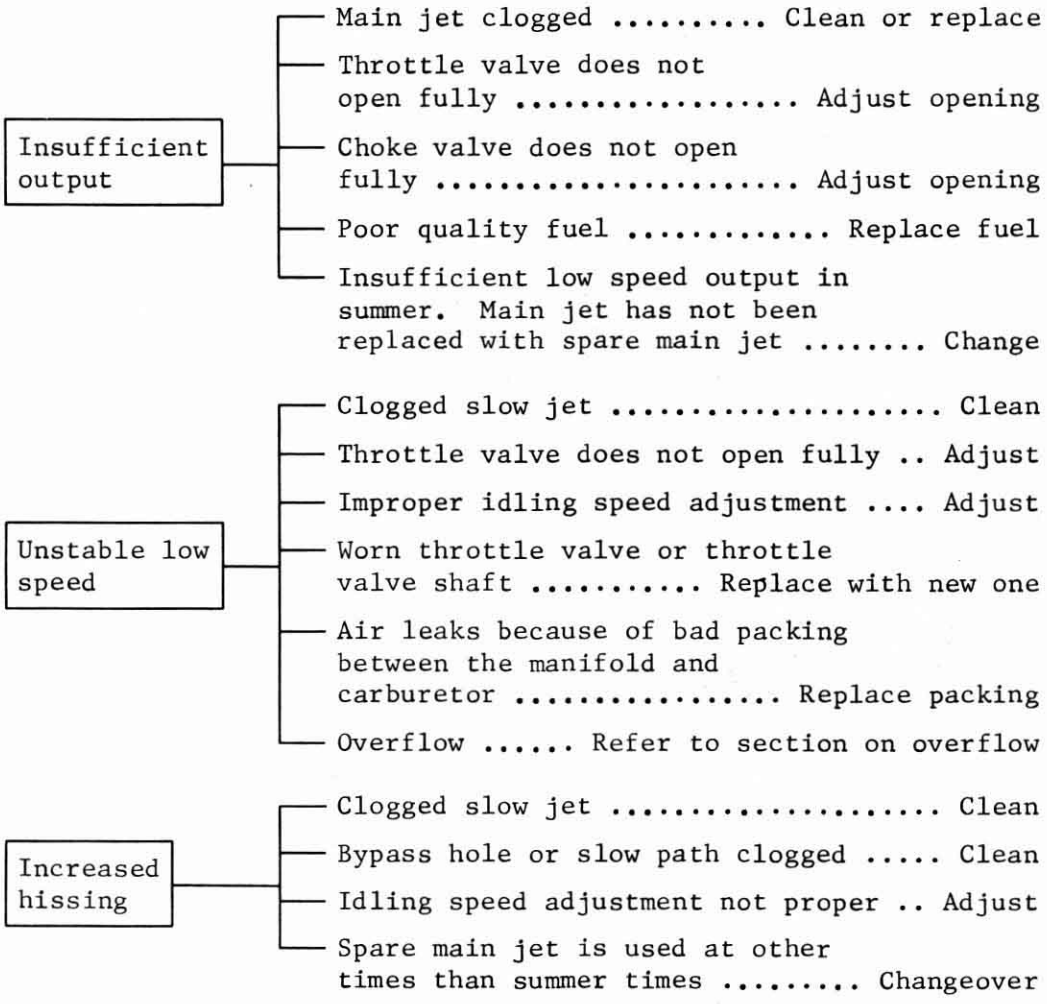
- Poor working of the fuel pump (see section on fuel pump)
- Too much fuel sucked in because of improper use of the choke
- When the choke valve is not used in cold weather.
- When the throttle valve is open too widely. (This is different from too much sucking of fuel)
- Overflowing
- The spring of the poppet type choke valve is weakened or broken ..... Replace

**Overflow**

- Float leakage — Replace with a new one
- Clogged needle valve ..... Clean
- Worn needle valve ... Replace with a new one
- Insufficient tightening of needle valve ..... Tighten

**Too great fuel consumption**

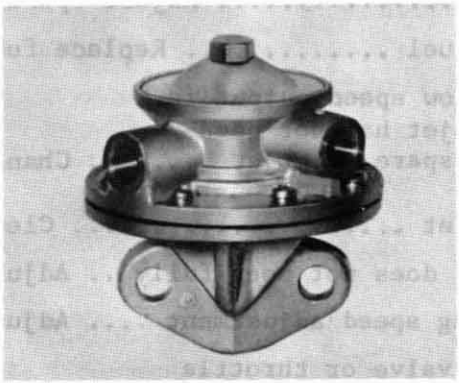
- Choke valve is not open fully ..... Check
- Overflow ... Refer to section on overflow
- Clogged slow air bleed or main air bleed ..... Clean
- Too large main or slow jet .....Replace
- Clogged air inlet ..... Clean
- Air cleaner clogged with dust ..... Clean
- Fuel leakage from bottom tightening sections ..... Tighten
- Fuel leakage from the joints between the fuel tank and carburetor ..... Tighten


Insufficient output
Main jet clogged ..... Clean or replace
Throttle valve does not open fully ..... Adjust opening
Choke valve does not open fully ..... Adjust opening
Poor quality fuel ..... Replace fuel
Insufficient low speed output in summer. Main jet has not been replaced with spare main jet ..... Change
Unstable low speed
Clogged slow jet ..... Clean
Throttle valve does not open fully .. Adjust
Improper idling speed adjustment .... Adjust
Worn throttle valve or throttle valve shaft ..... Replace with new one
Air leaks because of bad packing between the manifold and carburetor ..... Replace packing
Overflow ..... Refer to section on overflow
Increased hissing
Clogged slow jet ..... Clean
Bypass hole or slow path clogged ..... Clean
Idling speed adjustment not proper .. Adjust
Spare main jet is used at other times than summer times ..... Changeover

## 4 - 2 FUEL PUMP

Fuel pumps are mounted on the Subaru 360 Custom, Subaru 360 Truck and Subaru 360 Van.

### 1 : PERFORMANCE AND SPECIFICATIONS



| | |
|---|---|
| Model | CUSTOM:DF-62T-D1<br>SAMBAR:DF-62T-D |
| Delivery pressure | 0.175-0.325 kg/cm$^2$<br>(2.49-4.62 lb/in$^2$)<br>(Flow=0) at 1250rpm |
| Suction pressure | 90 mm Hg or over<br>at 1500 rpm |
| Delivery | 250 cc(8.5 oz)/min<br>or greater at<br>1250 rpm |

### 2 : TEST STANDARD

Delivery pressure (flow = 0) is over 0.15 kg/cm$^2$ (2.13 lb/in$^2$) when rotating the engine with the starter motor and engine revolution is over 450 rpm.

[PRECAUTIONS IN MEASURING DELIVERY PRESSURE]

(1) Attaching the measuring instrument is difficult if the carburetor is not removed. Remove the carburetor together with the intake manifold. Leave the cables attached to the carburetor undetached.

(2) Convenient measuring instrument is a vacuum fuel pump tester.

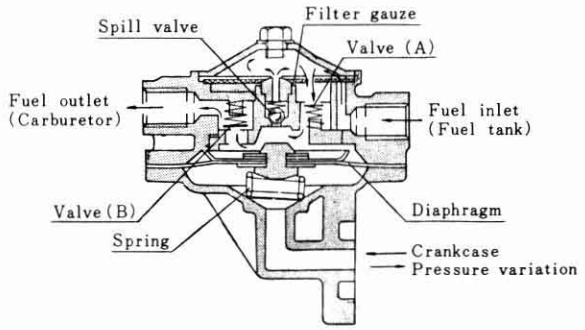
(3) The delivery pressure stabilizes in about 10 seconds.

(4) Before turning the starter, be sure to disconnect the primary terminal cord of the distributor.

(5) Revolution can be measured easily with a Hasler tachometer at the distributor shaft after removing the distributor cap.

(6) When reading the tester, vibrate it slightly. Otherwise the pointer may snag.

## 3 : CONSTRUCTION AND FUNCTION




This pump utilizes the variation of pressure in the crankcase of the engine to actuate a diaphragm for pumping action.
When the pressure of the crankcase becomes negative, the diaphragm is pulled while pressing on a spring and the pump chamber pressure also becomes negative. The fuel is sucked in from the fuel inlet through a filter gauge and valve A shown in the drawing.
Next, as the crankcase pressure becomes positive, the diaphragm is pressed, the fuel in the pump chamber is discharged from valve B and supplied to the carburetor.
Now, if the carburetor does not need fuel and the needle valve is closed, the fuel from the pump chamber does not pass through the valve, returns to the suction side via a spill valve and repeats the above series of actions. The fuel pressure at the time when the spill valve actuates is called the delivery pressure (normal fuel pressure) of the pump and in the case of this pump, this pressure is adjusted to 0.175 - 0.325 $kg/cm^2$ (2.49 - 4.62 $lb/in^2$). When this pressure is higher or lower than the values shown, the efficiency of the carburetor is affected.

## 4 : DISASSEMBLY AND ASSEMBLY

(a) Remove the eight 4 mm screws tightening the upper and lower body. The pump separates into upper and lower sections and the diaphragm and diaphragm spring can be taken out.

(b) Remove the three 4 mm screws of the upper body and take out the parts around the valves. Next, by removing one 5 mm bolt on the top of the pump, the cup (filter), gasket (filter cup) and filter gauge can be taken out and by removing the screw (spill valve), the spill valve and spring can be taken out.

(c) When disassembly is completed, thoroughly clean the above parts in fresh gasoline.

(d) Assemble in the order opposite to that of disassembly.

[NOTE]

(1) As there are many small parts, have containers ready for them before disassembly.

(2) The valves are vital parts of a pump. Handle them with care in order not to damage them in any way.

(3) The spill valve spring is used for regulating the delivery pressure; handle it carefully.

(4) In assembling, tighten every part firmly to prevent leakage.

## 5 : CHECKING AFTER ASSEMBLY

(a) Apply air pressure of about 1 kg/cm$^2$(14.2 lb/in$^2$) to the hole of the flanged surface for mounting the pump and check for air leakage in the water or gasoline.

(b) Stop the delivery outlet with a finger; apply air pressure to the fuel inlet and check for air leakage in gasoline or water.

(c) Place mouth on the fuel inlet and test for leakage by sucking.

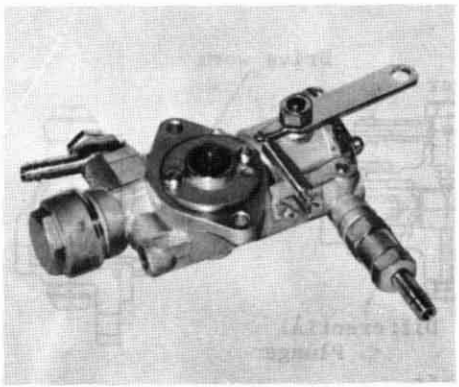
(d) Place mouth on the delivery outlet and test for leakage by blowing.

[PRECAUTIONS IN MOUNTING]

(1) Be sure to place the gaskets on each side of the insulator for the pump mounting flange for complete air tightness.

(2) Exercise the same care for ensuring airtightness when connecting pipes.

## 4 - 3 OIL PUMP



The oil pump is a Mikuni Kogyo Plunger Pump, Model 1P-7D-3A, equipped with a check valve. Its plunger is provided with a screw gear which transmits rotating movement and a cam groove which converts rotating movements into reciprocating movements. A plunger guide is fitted in the cam groove and reciprocating movements are produced by the plunger guide and cam groove when the plunger rotates.

### 1 : PERFORMANCE AND SPECIFICATIONS

| Model | 1P-7D-3A | |
|---|---|---|
| Delivery at 1500 rpm | Lever angle | cc/hr |
| | 0° | 60 ± 6 |
| | 20° | 116.4 ± 9 |
| | 40° | 168 ± 12 |

### 2 : EXPLANATION OF PRINCIPAL FUNCTIONS

The functions of this pump may be classified roughly as follows:

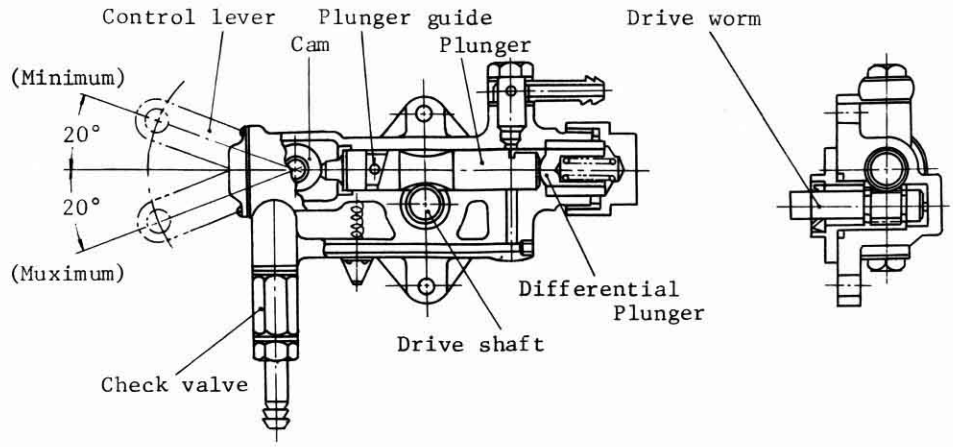
* Pumping action
  The action in which oil is sucked in from its suction inlet and delivered from its delivery outlet.
* Delivery controlling fuction
  The function which controls delivery in accordance with the opening of the carburetor.

These functions are explained below.

A. PUMPING ACTION

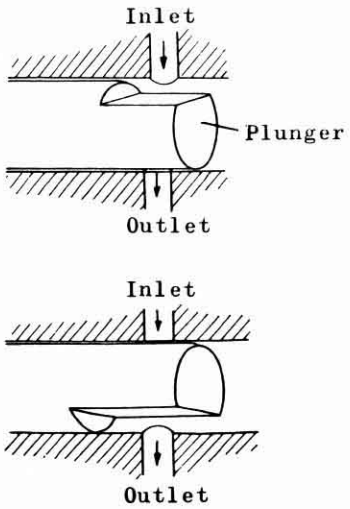
A pump which pumps water from a well does so by the reciprocating movement of a piston and action of two valves. The action of this oil pump is exactly the same as that of a water pump. However, one point which differs from a water pump is that the valves open or close the suction and delivery outlets while maintaining a certain relationship with the reciprocating movements by means of the notch of the plunger.

(a) RECIPROCATING AND ROTATING MOVEMENT OF THE PLUNGER




As can be seen from the cross sectional drawing, the control part of the plunger is made into a gear and this part engages with a worm. The end of this worm shaft is connected in a parallel plane with the rotating shaft of the engine and rotates to impart rotating movement to the plunger.
A slanting surface is provided on the end of the plunger and as this surface contacts the plunger guide which is screwed into the pump body, reciprocating movement is created by the rotating movement of the plunger. The plunger guide and the slanting surface of the plunger are pressed against each other by a spring located on the other end of the plunger.

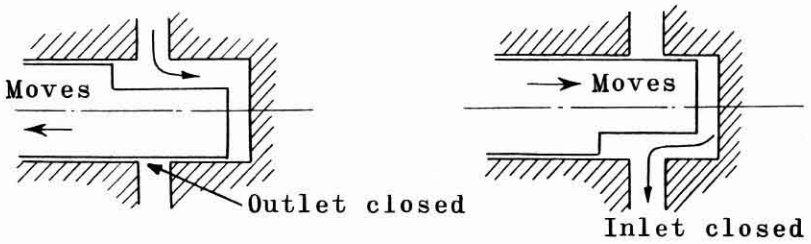
(b) ROTATING MOVEMENT OF THE PLUNGER AND VALVE ACTION




As shown in the drawing, if a notch is provided on the end of the plunger, when this notch faces, for example, the suction inlet, the suction inlet opens and the delivery side closes. When the plunger turns and the notch faces the delivery outlet, the suction inlet closes and the delivery outlet opens.

(c) PUMPING ACTION

When the notch faces the suction inlet and the plunger moves toward the suction side, the oil is sucked into the cylinder from the suction inlet.



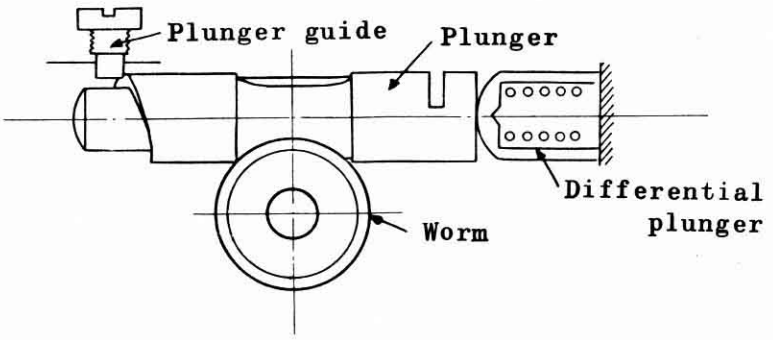

Next, when the notch faces the derivery outlet and the plunger moves toward the delivery side, the oil in the cylinder is pushed out from the delivery outlet.
Pumping action is performed when the opening and closing of the suction inlet and delivery outlet and reciprocating movements are performed continuously.

DUTY OF DIFFERENTIAL PLUNGER

On the end surface of the notched side of the plunger is a small plunger which performs reciprocating movements with the main plunger. This small plunger is called a differential plunger; its outside diameter is slightly smaller than that of the main plunger.

| | |
|---|---|
| Main plunger | 12.500 mm (0.4921 in) |
| Differential plunger | 11.835 mm (0.4659 in) |

Since the pumping capacity due to the reciprocating movements of the main plunger is very large, the differential plunger is made to perform a negative pumping action so that the pump can function as a pump of micro capacity.



For instance, the pumping capacity of one reciprocating movement of the plunger when there is no differential plunger is:

$$\frac{\pi}{4} \times 12.5^2 \times 2.5 = 306.65 \text{ mm}^3/\text{stroke}$$

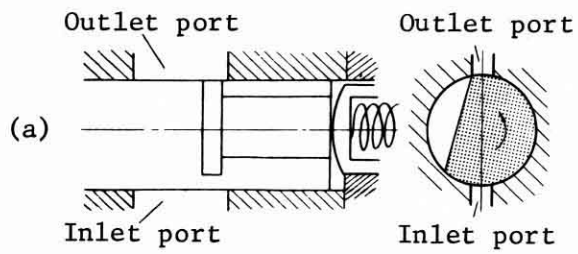
When there is a differential plunger:

$$\frac{\pi}{4} (12.5^2 - 11.835^2) \times 2.5 = 31.75 \text{ mm}^3/\text{stroke}$$

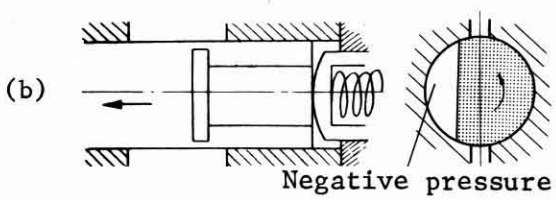
This equals a full admission delivery of 280 cc/hour at a revolution of 2500 rpm and when there is no differential plunger, the delivery reaches an excessive amount of 2710 cc/hour.

The actuating condition of the pump which accompanies the relative position of the plunger notch and suction inlet and delivery outlet is described in detail below.

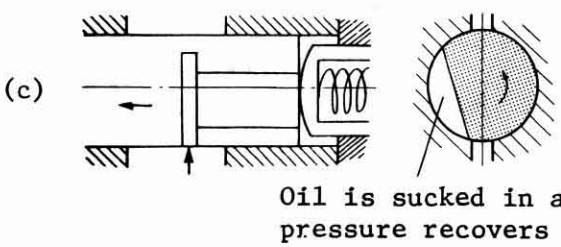
Simultaneously with the end of suction or delivery stroke, the suction inlet or delivery outlet closes; then with the suction inlet or delivery outlet closed, suction or delivery stroke starts and when the stroke progresses slightly, the suction inlet or delivery outlet opens.




Delivery stroke end; suction stroke starts

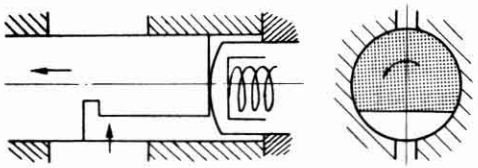



Suction stroke (inlet port closed)



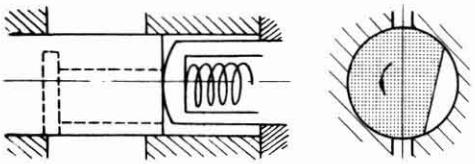

Inlet port opens and suction starts

(d)

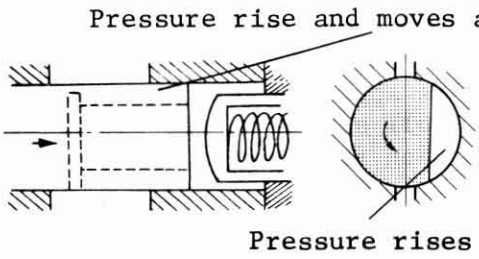


Suction stroke;
sucking-in continues

(e)



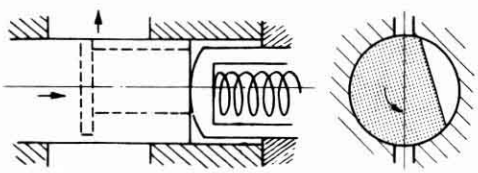
Suction stroke end
(inlet port closed)




(f)

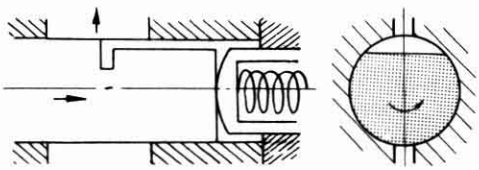
Delivery stroke
(outlet port closed)

(g)



Outlet port opens;
delivery starts

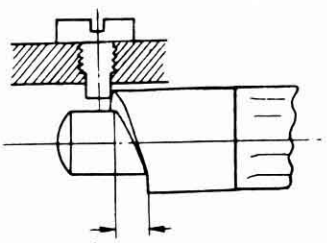
(h)



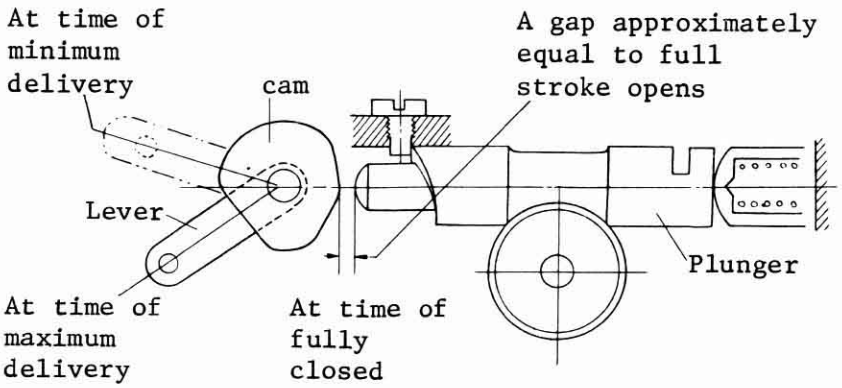
Delivery stroke;
delivery continues

B. DELIVERY CONTROLLING FUNCTION

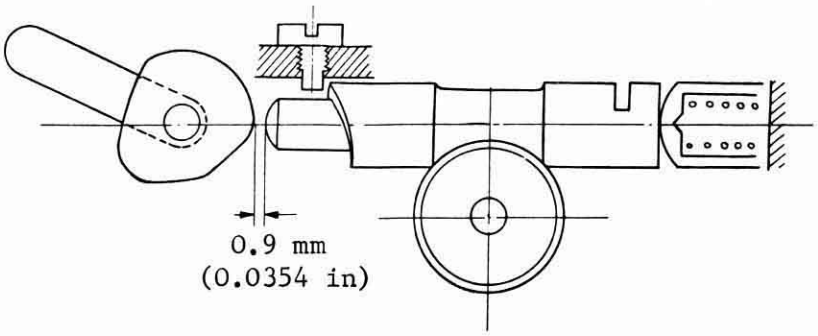
Delivery is controlled by turning a control lever. The mechanism of this control is described below.
Since the suction and delivery of oil by the pump are accomplished by the reciprocating movement of the plunger, the delivery changes according to the moving distance.
The stroke of the slanting surface on the end of the plunger is 2.5 mm (0.9842 in) and delivery at the time when the plunger completes a reciprocating movement over this 2.5 mm (0.9842 in) is termed as full admission delivery.




To obtain a delivery smaller than the full admission delivery, the stroke must be decreased. For this reason, a cam was provided in relationship to the plunger as shown in the drawing. The drawing shows the lever position for full admission delivery.
In the drawing, the plunger is shown at the right end of the stroke and there is a gap which is approximately equal to the full stroke of the plunger between the plunger and cam.

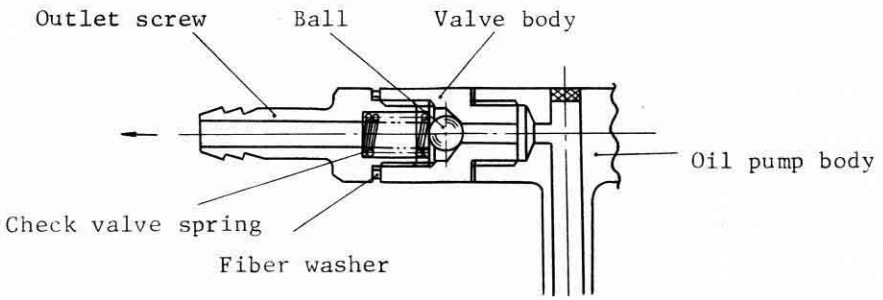



The drawing below shows the lever placed on the position of minimum delivery. Since the gap between the cam and plunger end is approximately 0.9 mm (0.0354 in), even though the slanting surface permits a stroke of 2.5 mm (0.9842 in), the stroke is limited by the cam and no stroke greater than 0.9 mm (0.0354 in) is possible.
For the openings between the maximum and minimum deliveries, the stroke changes accordingly.




C. CHECK VALVE

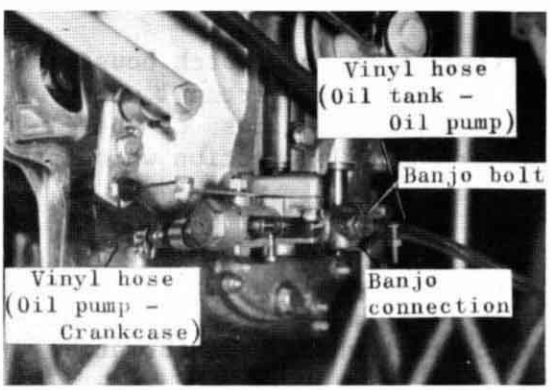
The check valve held in a valve holder is attached to the oil pump body on its delivery side; its construction is shown in the drawing below.
The check valve prevents the leakage of oil into the engine when the engine is not operated for a long time.




## 3 : MAINTENANCE

A. DRAINING AIR FROM OIL PIPES

(a) BETWEEN THE OIL TANK AND OIL PUMP




(1) Fill the oil tank with the specified amount (minimum 1 ℓ - 2.1 US pt.,1.8 Imp. pt.) or more recommended 2-stroke oil.

(2) Loosen the banjo bolt of the oil inlet for the oil pump.

(3) When the oil from the oil tank pushes air out of the vinyl hose and reaches the banjo connection, tighten the banjo bolt.

(b) BETWEEN THE OIL PUMP AND CRANKCASE

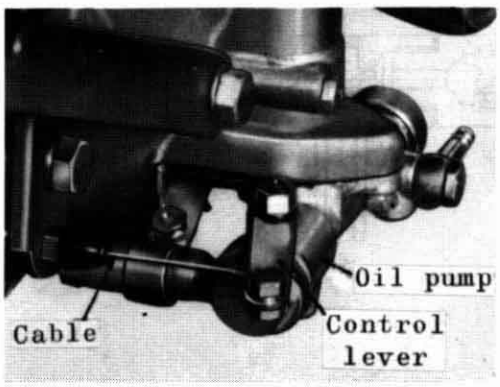
When a great deal of air is in the vinyl hose which connects the oil pump and crankcase, operate the engine at slightly high idling speed using a mixed fuel instead of pure gasoline. In a few minutes, the pipe will be filled with oil.

[PRECAUTION]

When the vinyl hoses of the oil tank - oil pump - crankcase are filled with oil, the engine can be run with pure gasoline without any trouble but until all the air in these pipes is driven out completely, use mixed fuel.

B. ADJUSTING THE OIL PUMP CONTROL CABLE

The oil pump control cable of a new car is adjusted correctly but when the cable gets out of adjustment because of checking, maintenance or other reasons, readjust the cable after checking and making sure that the following parts are attached correctly.




(a) CABLE BRACKET II

This is a bracket secured on the intake manifold.
When this bracket is mounted, the marks are shown on its front. The marks are as follows:

A: Sedan
E: Custom

(b) CABLE BRACKET I

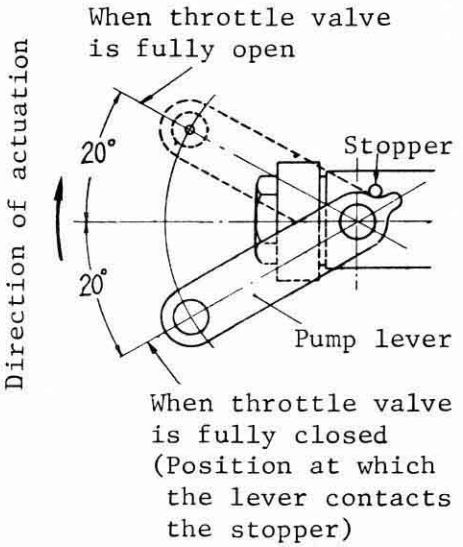
This bracket is attached vertically on the clutch housing cover near the oil pump. This bracket is vertical when mounted correctly; it is mounted along the boss of the clutch housing cover and fits on a key-shaped projection which protrudes from the boss.

(c) OIL PUMP LEVER

This lever is flat and must be horizontal when attached to the pump. Since a deformation of this lever causes the accelerator pedal to be heavy, correct whenever deformation occurs in this lever.


Adjust the control cable so that the center of the bolt is the same as the center of the pump lever.

When no abnormality is found in the checking of (a) - (c) above, adjust the oil pump control cable according to the following procedure:




When the cable has been adjusted correctly, the pump lever, as seen from above, must be at a position 20° to the right of the pump center line with the carburetor throttle lever fully closed (a condition in which the slow adjusting screw is loosened and turned back).
When the throttle lever is fully open, the pump lever must be at a position 20° to the left of the pump center line.
Thus the actuating angle of the pump lever is 20° to the right and 20° to the left of the center line or a total of 40°.

(d) CABLE ADJUSTING PROCEDURE

(1) Turn back the slow adjusting screw until the throttle valve is closed entirely.

(2) Fully loosen the adjusting nuts which secures the outer cable on the bracket II fixed on the intake manifold.

(3) Remove the cotter pin and nut to disconnect the inner cable from the pump lever.

(4) Move the pump lever to the right as seen from above and push it until it contacts the stopper. At this time, a slight resistance is sometimes felt in the lever. This is caused by the contact between the pump cam and plunger and disappears when the pump is operating. Even in a case like this, push the lever until it contacts the stopper.

(5) Adjust the outer cable so that the center of the bolt on the inner cable end matches the center of the pump lever hole. In case the bolt center does not match the hole center, move the outer cable up or down at the bracket II.

(6) Maintain the condition of (5) above; then tighten the adjusting nuts of the bracket II taking care so that the outer cable does not twist.

(7) Secure the inner cable on the pump lever with the nuts and apply the cotter pin.

(8) When the above adjustments are completed, slightly move the carburetor throttle lever. If the pump lever does not move even when the bolt on the end of the inner cable moves,the adjustment is imperfect. Adjust the outer cable so that the pump lever moves when the throttle lever is moved even slightly and furthermore, adjust so that the pump lever also returns until it contacts the stopper when the throttle lever is returned to its original position.

(9) Under the above condition, move the carburetor throttle lever from a fully closed position to a fully opened position (actuating angle 80°) and check whether the pump lever moves from the position where it contacts the stopper (20° to the right of the pump center line as seen from above) to a position 20° to the left of the pump center line.

(10) When the adjustments of (1) - (9) above are completed, tighten the carburetor slow adjusting screw and adjust so that the engine idles at proper idling speed. (At idling, the pump lever should be at a position slightly to the left from the position where it had contacted the stopper.)

C. CHECKING AND CORRECTING THE OIL PUMP

This oil pump wears very little and has excellent durability and a minimum of trouble but in the following instances, check and correct the pump and its related parts:

(a) WHEN THE LOWER SECTION OF THE ENGINE IS GIVEN AN IMPACT DURING RUNNING OF THE CAR:

When an impact is given to the pump or its related parts, perform the following checking:

(1) Check the pump for cracks and other damage.

(2) Check the clutch housing cover (pump mounting section, drive shaft, etc.) for cracks and other damages.

(3) Check the cable and brackets for damage, deformation and for their action.
When an abnormality is found, it is repaired depending on the nature of abnormality but when the oil pump is damaged, replace the pump assembly. Also, thoroughly check the inner cable; do not leave even a slight bend.
Be sure to correct and make it straight especially between the end of the outer cable and pump lever.

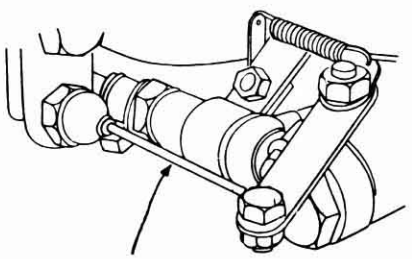
(4) Check the plunger guide for damage.

(b) WHEN OIL CONSUMPTION IS EITHER TOO HIGH OR TOO LOW

Since oil consumption, like fuel consumption, is affected by the running condition it cannot be determined generally. When the car is running on a level road at a speed of 30 - 60 km/h (19-38 mph), the average oil consumption is approximately 1 ℓ /600 - 800 km (1 US pt/180 - 240 miles, 1 Imp. pt/210 - 280 miles). However, even on a good level road, when it is necessary to run the car in low or second gear often and when it is necessary to make many stops, the oil consumption may increase to 1 ℓ /400 km (1 US pt/120 miles, 1 Imp. pt/140 miles). When a car is climbing a very long grade or is making a continuous run at high speed, the oil consumption may often increase to 1 ℓ /300 - 400 km (1 US pt/90 - 120 miles, 1 Imp. pt/110 - 140 miles).
When the oil consumption exceeds 1 ℓ /350 km (1 US pt/100 miles, 1 Imp. pt/120 miles) or when it is below 1 ℓ /1000 km (1 US pt/300 miles, 1 Imp. pt/360 miles) when the car is making a general run on a good level road at a speed of 30 - 60 km/h (19 - 38 mph), it can be considered that there is an abnormality. Check according to the following procedure:

(1) Checking and correcting the pump control cable and brackets

All oil pumps are subjected to a delivery efficiency test and there is no possibility of deviation in the adjustment of the pumps or of sudden change of their delivery efficiency. For this reason, when oil consumption is considered to be abnormal, first check the operating system (cable, etc.) for bend, deformation or looseness, etc.
With a new car, there is practically no deformation of the brackets or pump lever but the inner cable between the pump lever and bracket I on the clutch housing cover may be bent during an oil change operation by moving of the lever.



This cable must be straight at all times. Also, when the engine is idling, the pump lever must be in contacting position with the stopper.

Check this section with special care and straighten when any bent section is found.
Also, even when the cable is straight, it is not sufficient unless the pump lever is at a closed position or at a position where it almost contacts the stopper pin when the engine is idling.
When correcting the cable, brackets, etc. refer to section (B) on pages 4-18 to 4-20.
After correcting the abnormalities of the cables and their related parts, run the car for some time and check to see if the oil consumption is normal.
When it is considered that oil consumption is not normal, whether the methods of measuring and calculating oil consumption are proper or not and whether the adjustment of the above cables and their related parts is correct or not must be determined first. It can be considered that practically all the complaints on abnormal oil consumption are included in the above.

(2) Inspecting the oil pump delivery efficiency.

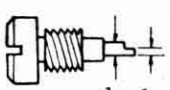
When oil consumption is still abnormal after the above corrections, check the delivery efficiency of the pump. (Refer to section 4.)

(c) WHEN THE ACCELERATOR PEDAL BECOMES SUDDENLY LIGHT OR HEAVY

When the accelerator pedal becomes light suddenly, check the cable for breakage and separated soldered parts; conversely, when the pedal becomes heavy, the inner cable (made of standard fine wires) may be frayed and is interfering with the outer cable or foreign matter is lodged in the operating system such as the cable and lever, etc. Check.

(d) CHECKING OF THE OIL PUMP AT 50,000 KM (30,000 MILES)

The oil pump has a durability of over 150,000 km (90,000 miles). However, the plunger guide wears a bit more rapidly than other parts and wears approximately 0.02 - 0.03 mm/10,000 km (0.0008 - 0.0012 in/6,000 miles).
When the plunger guide wear exceeds 0.15 mm (0.0059 in), replace as this wear causes the pump delivery efficiency to drop below its permissible value.




Wear = $d_1 - d_2$

The wear is expressed by the difference between the diameter of the part not worn and the diameter of the worn part. When the mileage on the speedometer shows 50,000 km (30,000 miles), check the oil pump according to the following procedure:

(1) Remove the oil pump from the engine

In this case, if several cubic centimeters of oil flow out of the pump mounting section, it indicates that the oil seal of the pump driving worm shaft is damaged and oil is leaking.
Replace the oil seal.
When the above oil leakage exists, it can be considered that oil is also leaking inside the clutch housing.
Remove the clutch housing cover, check the leakage and take proper steps to stop leakage.

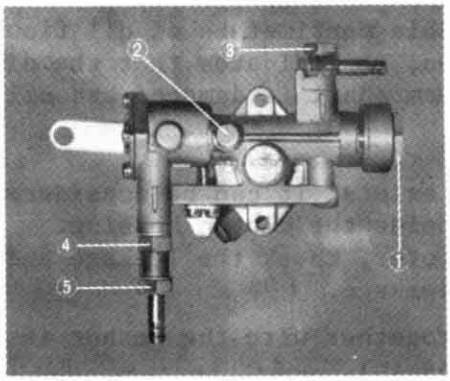
(2) Replace the plunger guide together with the washer if the wear exceeds 0.15 mm (0.0059 in).

| | |
|---|---|
| TIGHTENING TORQUE | 0.4 - 0.5 kg-m(2.9 - 3.6 lb-ft) |

(3) Disassembly and maintenance of the pump

Disassemble the pump which has been dismounted and perform the following maintenance:

* When oil residue is adhering to the inlet and delivery outlet and notched part of the main plunger, clean.
* Disassemble the check valve and clean the spring and oil path, etc. to remove oil residue, etc.
* Replace the oil seal when the oil leakage refered to the item (1) exists. In this case, thoroughly clean the oil around the oil seal periphery (pressure-fitting section) and the hole into which the oil seal is fitted.
  Then press in the oil seal.
  (If oil is used in pressing in an oil seal, the oil seal slips out at times)
* When assembling, replace all the packings of the oil inlet and outlet with new packings.
* Fill 50 - 60 % of the cam chamber with heat-resistant grease.
* Use the following tightening torque in tightening of each part.




| TIGHTENING TORQUE | |
|---|---|
| Banjo bolt on crankcase | 1.35-1.65 kg-m( 9.8-11.9 lb-ft) |
| Differential cylinder cap(1) | 1.5 -2.5 kg-m(10.9-18.1 lb-ft) |
| Plunger guide (2) | 0.4 -0.5 kg-m( 2.9- 3.6 lb-ft) |
| Banjo bolt of inlet (3) | 1.1 -1.8 kg-m( 8.0-13.0 lb-ft) |
| Check valve body (4) | 1.1 -1.8 kg-m( 8.0-13.0 lb-ft) |
| Valve outlet screw (5) | 1.1 -1.8 kg-m( 8.0-13.0 lb-ft) |

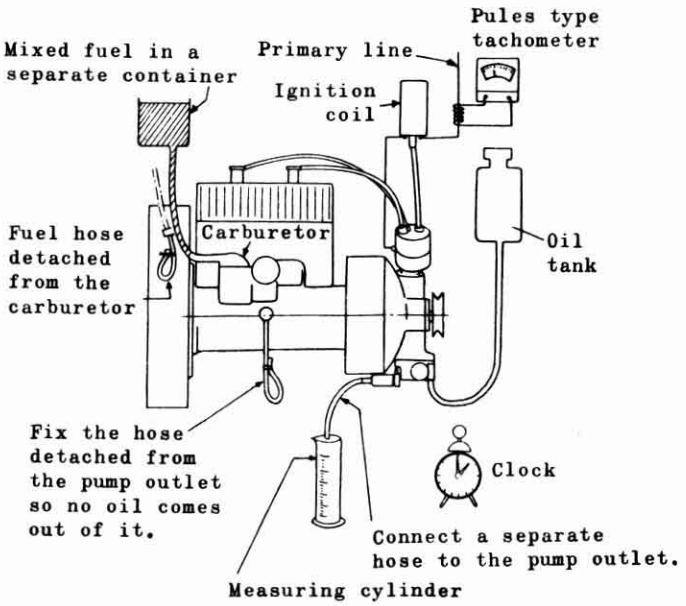
(4) Replacing the oil pump

At the 50,000 km checking when it is necessary to correct or replace the plunger guide, worm shaft oil seal and banjo packings and delivery efficiency is not normal, replace the oil pump assembly.

## 4 : MEASURING METHOD OF THE OIL PUMP DELIVERY EFFICIENCY

For accurate testing, the oil pump tester (999990000) should be used. However, when high accuracy is not required, the test can be made with the oil pump mounted on the engine.

A. MEASURING METHOD WITHOUT OIL PUMP TESTER




(a) EQUIPMENT

(1) Engine tachometer

There are pulse type (electric) and clock type. The pulse type is easier to handle.

(2) Measuring cylinder

Capacity : 100 - 200 cc
One scale : 1 cc or less

(3) Clock

A clock which indicates seconds. A stopwatch is better.

(4) Mixed fuel

Place the mixed fuel in a separate container and supply the mixed fuel from this container to eliminate the necessity of mixing oil with the gasoline in the car tank.

(b) TESTING METHOD

(1) Remove the under cover.

(2) Disconnect the oil pump cable from the pump lever.

(3) Remove the vinyl hose from the oil outlet of the oil pump check valve and attach another vinyl hose to the oil outlet. (Tie the vinyl hose detached from the oil outlet with twine or wire so that the oil insides does not flow out. This is to facilitate restoring of the pump to its formar state)

(4) Disconnect the vinyl hose that runs from the fuel strainer to the carburetor at the float chamber.
Attach another hose and couple the other end of the hose to the separate container for mixed fuel. The above completes the preparation for testing. Any method of supplying the mixed fuel can be used but be sure to use a mixed fuel of 20:1 to 25:1 mixing ratio.

(5) Start the engine; screw in the slow adjusting screw (the screw which controls the throttle valve opening) and adjust so that the engine will maintain a constant revolution at about 3000 rpm.

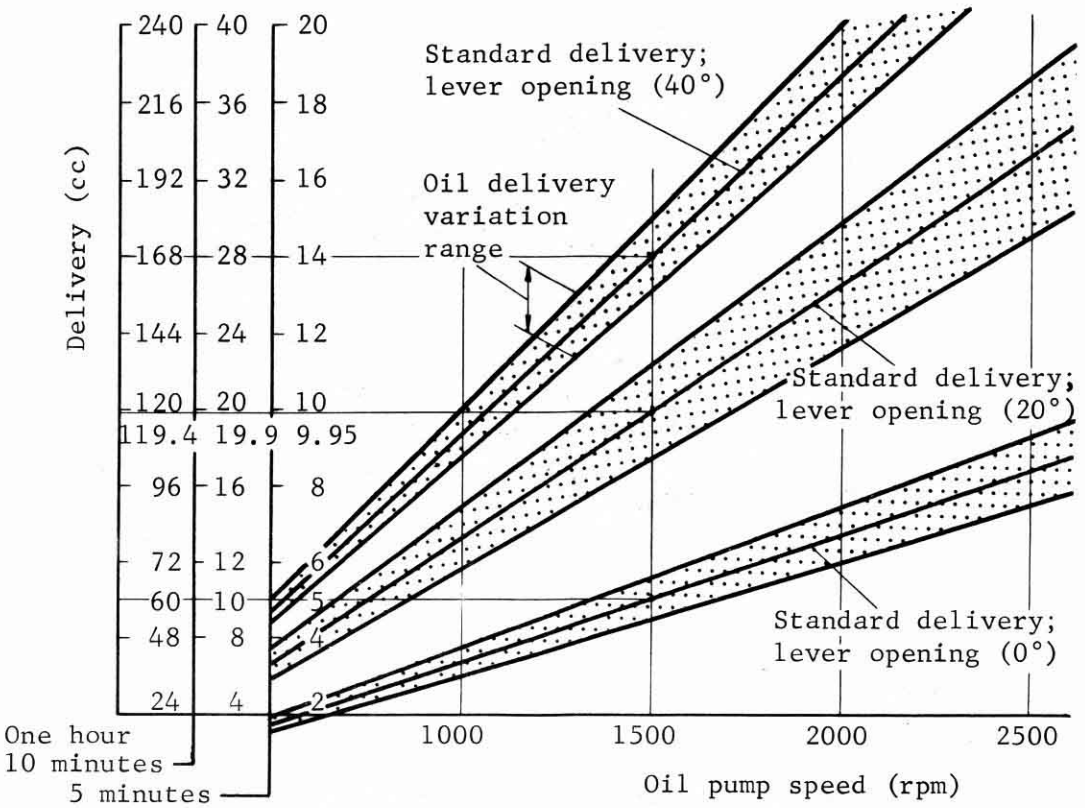
(6) Insert the end of the vinyl hose of the oil pump outlet (check valve) in the measuring cylinder and at the same time, read the time. (Start the stopwatch when one is used.) Or the vinyl hose can be placed in the measuring cylinder from the start to let the oil flow and time measuring can be started when the oil reaches a certain level. (This is an easier method.)

(7) Maintain the above condition for a definite time (the longer the time, the greater the accuracy) and measure the oil delivery for that duration of time.

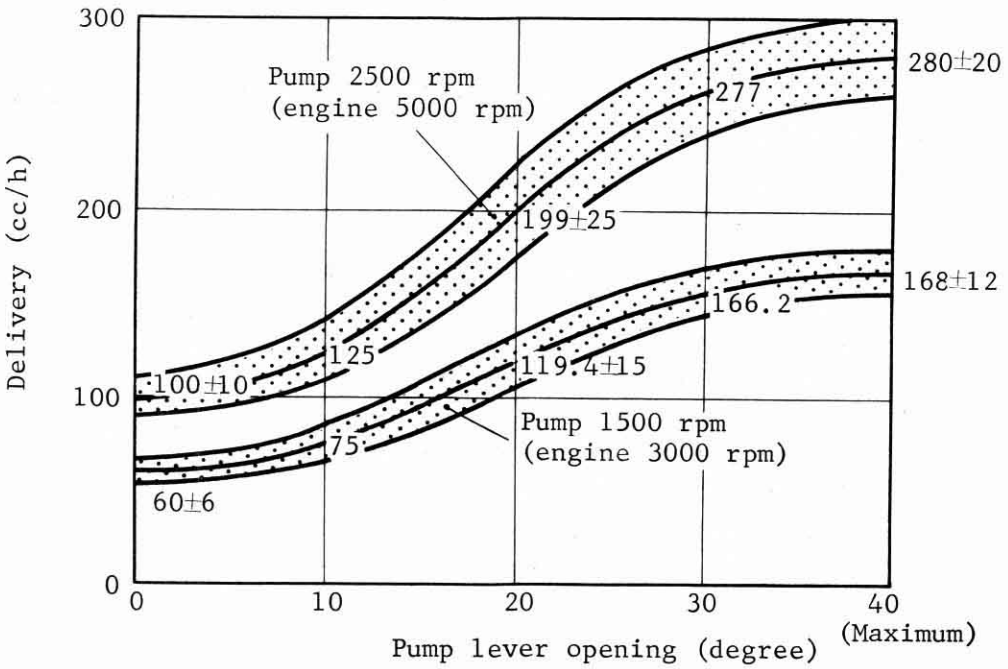
(8) For better results, the delivery should be measured at the pump lever positions (opening) of fully closed (0°), half open (20°) and fully open (40°) but the accuracy of measurement is more accurate for the larger delivery (larger opening angle). Set the lever openings accurately using a protractor.

(9) Plot the measurement result (delivery cc/hr) and measuring conditions (engine speed and pump lever opening) to make a graph and check to see if the measured values are within tolerance.
Since this test is performed with the engine unloaded, its accuracy is not very high because of unstable engine revolution and errors in measurement. A result with an accuracy of 15 % can be obtained by making time for the measuring cylinder and measuring process more accurate but the most important thing is to maintain the engine revolution constant.

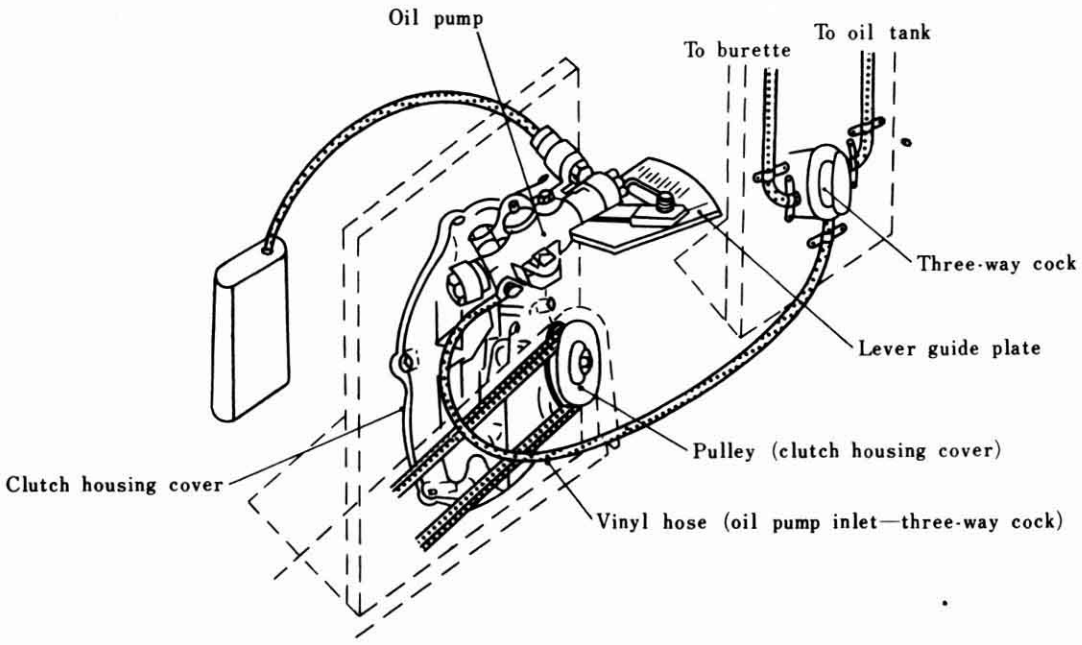
OIL PUMP DELIVERY EFFICIENCY TEST GRAPH




OIL PUMP DELIVERY EFFICIENCY GRAPH



B. MEASURING METHOD BY OIL PUMP TESTER




(a) EQUIPMENT

(1) Oil pump tester

The oil pump tester number : 999990000

(2) Tachometer

The clock type is convenient.

(3) Clock

A clock which indicates seconds. A stopwatch is better.

(b) TESTING METHOD

(1) Fit the oil pump on the clutch housing cover of the oil pump tester.

(2) Set the oil pump lever to the 0° position.

(3) Connect the vinyl hose of the three-way cock to the oil pump inlet. Attach another vinyl hose to the oil pump outlet and put the end of it in a container.

(4) Turn the three-way cock knob to open the passages to the oil tank and oil pump and rotate the motor to confirm that the oil flows from the oil pump outlet.

(5) Next, turn the three-way cock knob to open the passages to the burette and oil pump.

(6) Start to read the time (start the stopwatch when one is used) when the oil in the burette reaches a certain level and measure the time for a definite delivery from the oil pump outlet.

(7) Also, measure when the oil pump lever is in the 20° and 40° positions.

(8) The test result should be satisfied the following value.

Condition:-

1. Oil used : Recommended 2-stroke oil
2. Oil temperature : 15 - 30° (59 - 86°F)
3. Outlet side : Open to atomesphere

| Pump lever opening angle | Delivery to be measured (minimum) | Time measured | Delivery per hour |
|---|---|---|---|
| 0° | 2 cc | 120 ± 13 sec. | 60.0 ± 6 cc/hr |
| 20° | 2 cc | 61 ± 8 sec. | 119.4 ± 15 cc/hr |
| 40° | 4 cc | 86 ± 6 sec. | 168.0 ± 12 cc/hr |

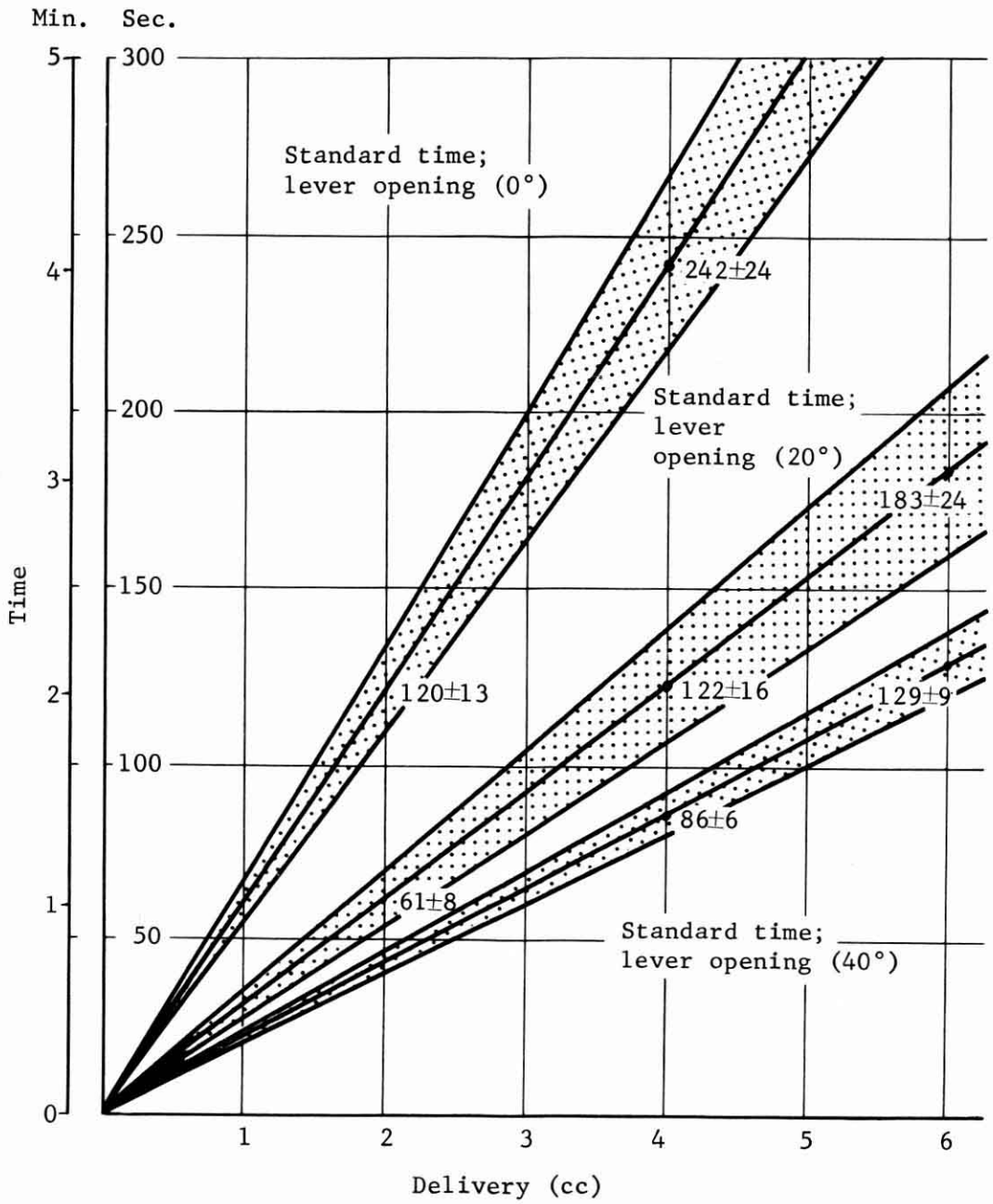
[NOTE]

Before measurement, check the oil pump tester as follows.

(1) When rotating the motor, the pulley speed (clutch housing cover side) should be 3000 rpm.

(2) Check the vinyl pipe connecting parts for oil leakage.

(3) The lever guide plate should be adjusted so that the closed position of the oil pump lever matches with the scale of 0° surely.


Min.
Sec.
5
4
3
2
1
0
300
250
200
150
100
50
Time
Standard time;
lever opening (0°)
242±24
Standard time;
lever
opening (20°)
183±24
120±13
122±16
129±9
86±6
61±8
Standard time;
lever opening (40°)
1
2
3
4
5
6
Delivery (cc)

# CHAPTER 5 : ELECTRICAL EQUIPMENT

## 5 - 1 SPECIFICATIONS

| | | |
|---|---|---|
| Starter motor ..... | Type S108-17 | (Hitachi) |
| Generator ..... | Type 27000-116-0 | (Nippon Denso) |
| Regulator ..... | Type 26000-125-0 | (Nippon Denso) |
| Distributor ..... Sedan and Custom | Type 29100-135-0 | (Nippon Denso) |
| Truck and Van | Type D203 | (Hitachi) |
| Ignition coil ..... | 51504-1100 | (Hitachi) |
| Spark plug ..... | NGK-B7H | |
| Battery ..... | 12N24-3 | |

Battery voltage/capacity (20 hour rate) ..... 12V/26AH

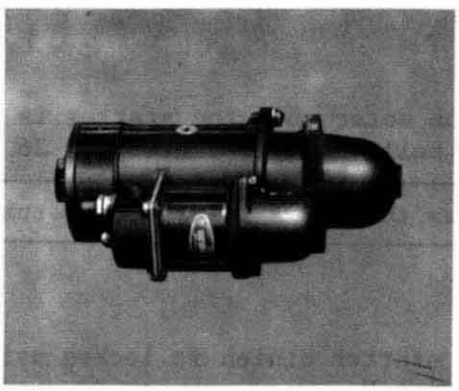
" charging current ..... 3A

" specific gravity fully charged (20°C) .. 1.280

" grounding terminal ..... Minus

" electrolyte ..... 1.5 ℓ

## 5 - 2 STARTER MOTOR



## A. PERFORMANCE AND SPECIFICATIONS

| | |
|---|---|
| Part number | 829910141 |
| Model | S108-17 |
| Rating | 12 V, 0.6 KW |
| Pole number and type | 4P, DC, series-wound |
| Pinion | M2.5, 9 teeth |
| Rotating direction | Counterclockwise as seen from pinion side |
| Brush length | 14 mm |
| Brush sping load | 750 g |
| Commutator outside diameter | 28 mm |
| Yoke outside diameter/ total length | 68/208.5 mm |
| Weight | 3.5 kg |
| Applicable battery | 26 A.H |

## B. TEST STANDARD

### (a) NO-LOAD CHARACTERISTICS

Current and revolution of the motor when the starter is turned with no-load using a fully charged battery of 26 A.H

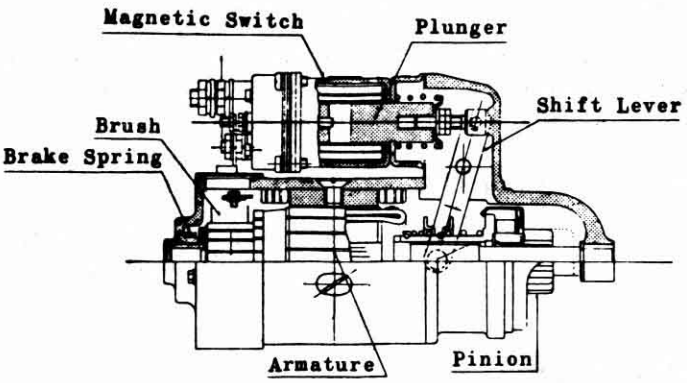
| | |
|---|---|
| With current of less than 40 A | Over 10,000 rpm |

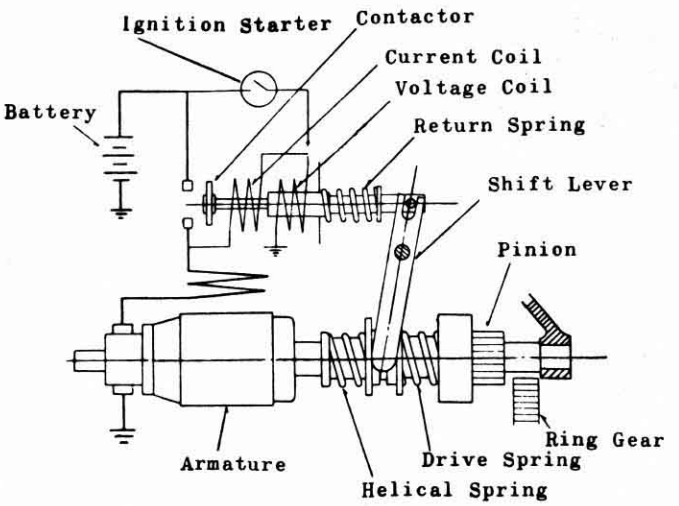
### (b) LOCK TROQUE CHARACTERISTICS

Current and torque when the starter pinion is locked using a fully charged battery of 26 A.H

| | |
|---|---|
| With current of less than 240A | Over 0.4 m-kg |

C: CONSTRUCTION AND FUNCTION




(a) THE STARTER CONSISTS OF THE FOLLOWING PRINCIPAL PARTS:

(1) A device which creates a magnetic field (pole core and field coil)

(2) Rotating part (armature)

(3) A part (yoke) which supports the pole core and which forms the path of magnetic lines (magnetic circuit).

(4) A device (commutator and brushes) which causes current always to flow in the same direction when the armature coil is in a certain position.

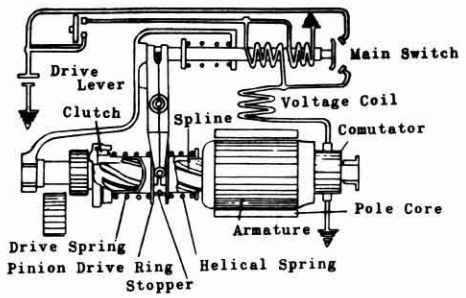
(5) A power transmission and protection device (over-running clutch) which transmits the rotation of the starter to the engine but which does not transmit the rotation of the engine to the starter.

(6) A protection device (magnetic switch) which performs starting and stopping, determines the stop position of the shift lever and protects the switch.

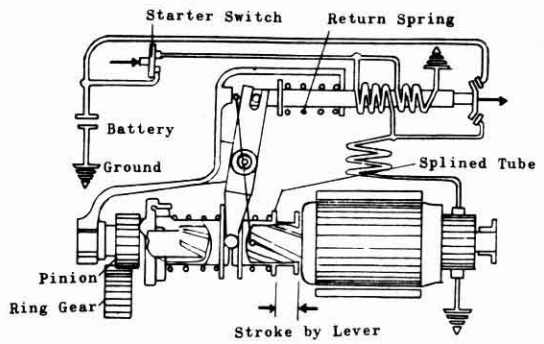
(7) A device (brake) which suppresses an abnormally high speed rotation at no-load and simplifies restarting after the switch has been cut off.

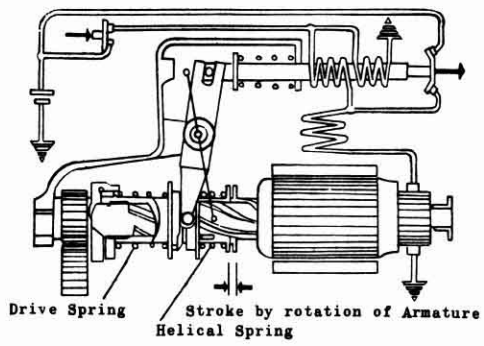
(b) FUNCTION OF THE STARTER

(1) The drawing shows a stationary starter.

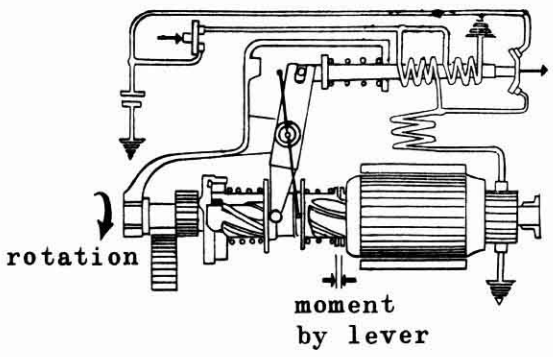



(2) The drawing shows a case in which the pinion and ring gear are ready to engage.
When the second step of the ignition-starter switch (shortened to switch in this section) is turned on, the current coil (pull-in coil) of the magnetic switch actuates to move the drive lever; the pinion will engage even before the main switch closes.
As the main switch closes, the main current flows and since a large torque is created, the clutch is pushed further forward by the threaded spline and reaches the position shown in the drawing.






(3) In the drawing, the drive spring is not compressed at all, but moving slightly back and forth. Only the helical spring is compressed slightly. Also, as the current coil of the magnetic switch is shorted by the main switch, no current flows in the coil.



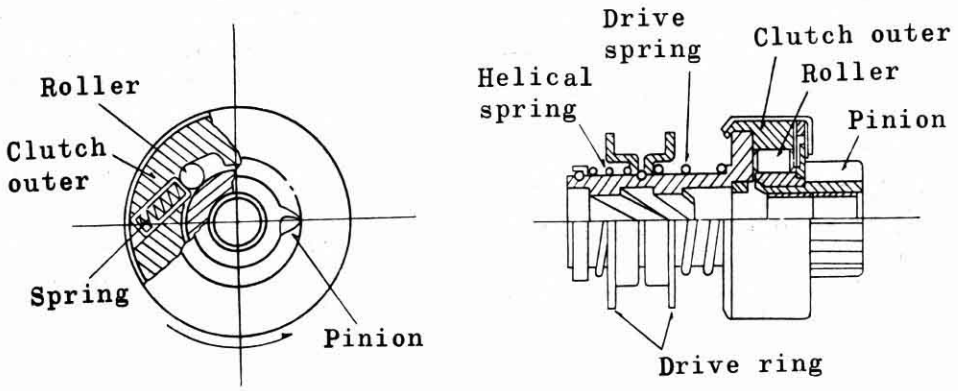

(4) The drawing shows a case in which the pinion has hit the ring gear and the drive ring is in a fully compressed state. Under this condition, the main switch closes and as the armature shaft rotates powerfully, the contact between the pinion and ring gear becomes increasingly closer and their engaging becomes extremely easy.

After starting, when the switch is turned off, a current flows from the current coil to the voltage coil via the main switch.

In this case, because the directions of the force of the two coils oppose each other, there is no attracting force and the main switch is turned off by the return spring.

When the main switch is turned off and torque disappears, the starter motor stops quickly with the action of the brake.

D. FUNCTION AND CONSTRUCTION OF THE STARTER PARTS




(a) OVER-RUNNING CLUTCH

The over-running clutch is a device which transmits the power of the starter to the engine in starting and which protects the starter by not transmitting the rotation of the engine once the engine starts.

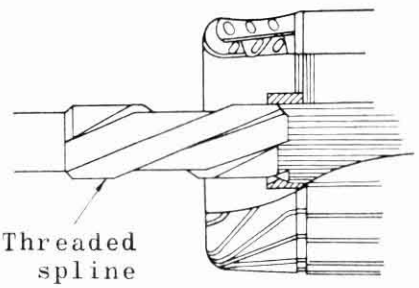
This clutch may be divided roughly into an outer section and pinion gear section. On the armature shaft, splines are cut in the rotating direction and on the inside of the spline tube of the outer section, grooves are cut also. As these engage with each other, the outer section slides in an axial direction over the shaft but in respect to the rotating direction, it is the same as if it was fixed. Consequently, if it is assumed that the pinion section is secured entirely on the outer section, it will be rotated by the engine at an extremely high speed after completion of starting causing damage to the armature. For this reason, the clutch is constructed so that, after starting of the engine, only the pinion rotates without load with no relation whatsoever to the armature shaft. For instance, when the outer section turns together with the shaft in the direction indicated by the arrow in the drawing.

If the resistance of the engine is on the pinion, the roller naturally is pressed in the narrowest gap and functions as a kind of key. The pinion then rotates with the outer section or the starter shaft. When the engine starts and the rotating speed of the pinion becomes faster than that of the outer section, the roller is sent in the widest part of the gap. Play is created for the roller and the armature is not affected by the engine. Also, since the pinion rotates by following the ring gear, when the magnetic force applied to the shift lever is removed, the pinion is detached very easily from the ring gear by the return spring.

(b) MAGNETIC SWITCH

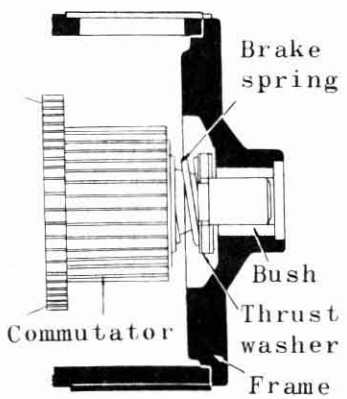
When the switch is turned on, the current is grounded through the holding coil (shunt coil), at the same time, a current flows in the pull-in coil (series coil) and is grounded through the starter. Because of these currents, the plunger (a lever which pushes out the over-running clutch is coupled) is attracted, pushing out a contactor. This contactor shorts the battery terminal (B) and starter terminal (M.30) and at this stage, a large current flows directly in the starter for the first time from the battery and the starter generates a powerful torque.
The reason for using a magnetic switch in this manner is to prevent wasteful voltage in the long wire from the starter to the starter switch and to protect the switch.

(c) THREADED SPLINE




Unlike a straight spline, the threaded spline, when the pinion engages with the ring gear even slightly, is pushed out by the rotation of the armature and engages completely with the ring gear.
Even when the teeth of both hit against each other, the pinion is pushed hard by armature rotation and since the contact pressure of the teeth of both does not depend, as in the case of a conventional type, only on the drive spring, the drive spring can be a spring with less strength. For instance, since the attracting power of the magnetic switch can be less, the magnetic switch itself can be made very small.

(d) ARMATURE BRAKE




A brake spring and thrust washer are assembled in between the rear of the armature commutator and commutator end frame and braking is done utilizing the friction of these.
As the high speed rotation is suppressed by this brake during no-load operation, malfunction is practically eliminated and as the armature stops within a short time after turning off of the switch, quick re-starting is possible.
The tention of the brake spring is such that it does not affect the torque at the time of an on-load operation.

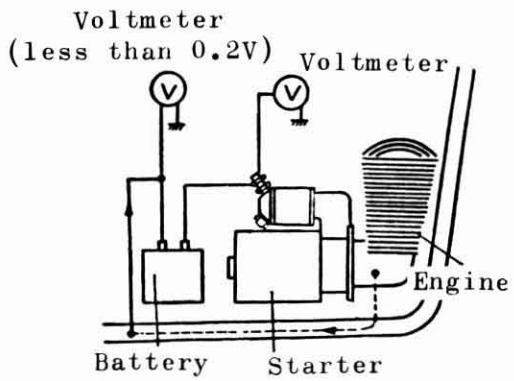
E. LUBRICATING PROCEDURE

After disassembly, clean and lubricate each part according to to the following procedure:

| Lubricating point | Lubricant used |
|---|---|
| Bush on the ends of the armature shaft | 2-3 drops of turbine oil |
| Pinion bush | |
| Entire armature shaft (thin coat) | Grease |
| Clutch pinion and return spring | |
| Clutch drive ring (coat a little thicker) | |
| Thrust washers on the front and rear ends of armature shaft | Grease |
| Each part of drive lever (coat a little thicker) drive lever pin, fitting sections, magnetic switch, etc. | Grease |

F. TROUBLES AND REPAIRS

The starter is used to turn the engine at a speed of 200 - 300 revolutions per minute. If an engine cannot be started at the above revolutions, the cause may not be the efficiency of the starter, but in the ignition system or the fuel system.




In case starting is impossible because of low revolution, first check the voltage between terminal B and the engine or the chassis. At starting (w/load), unless a voltage greater than 8 V exists between the above points, the power source side is out of order. In this case, the starter malfunctions; the voltage applied to the ignition becomes insufficient and starting becomes impossible. When these occur, it is necessary to check the battery capacity and wiring, etc. As the causes for these failures, insufficient electrolyte, poor battery terminal connection, especially a poor ground connection to the car body, and poor installing can be pointed out. Sometimes, poor grounding of the engine cross member

causes the same trouble.
A general outline of these troubles can be made known by checking the voltage between the battery ground terminal and the car body. This voltage must be less than 0.2 V. After fully checking the above points, if the cause for failure is still unknown, then remove the starter and test it according to the previously described testing procedure.

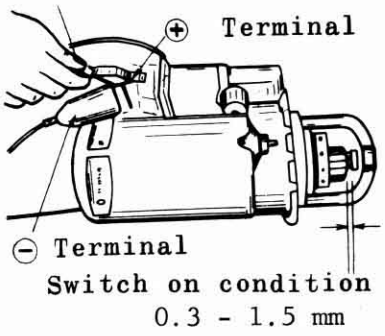
(a) MECHANICAL FAILURES

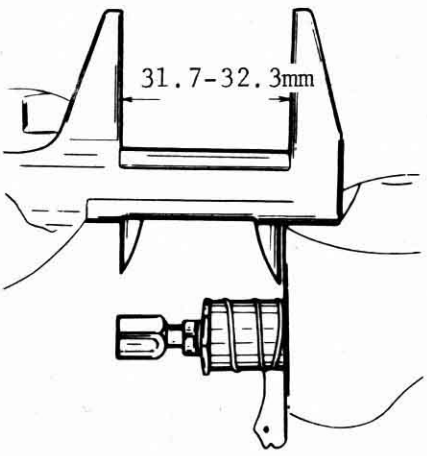
(1) Worn bearing bush

To make the starter more compact, the gap between the armature and pole core is made narrow. Consequently, when the bush is worn and the shaft becomes loose, the armature contacts the pole core and generates abnormal noise. In such a case, the worn bush must be replaced. At disassembly time, measure the clearance between the shaft and bush and if the clearance exceeds 0.2 mm (0.0079 in), replace the bush.

(2) Poor engaging between the pinion and gear

When the starter pinion does not engage properly, adjust the moving position of the pinion.
In this case, apply the power source between terminals S.50 and M of the left upper Figure on page 5-10 (do not ground the starter in this case; this is to prevent the starter from rotating); actuate the magnetic switch and move the clutch forward. Perform this action as quickly as possible. At this time, adjust so that the clearance between the pinion and stop collar is 0.3 - 1.5 mm (0.012 - 0.059 in). Adjust this clearance with the stud bolt of the magnetic switch. First, loosen the nut; adjust the fork type joint so that its length is 31.7 - 32.3 mm (1.25 - 1.27 in). Turn it counterclockwise to lengthen and clockwise to shorten. Take measurement with the spring in fully compressed state.
When the starter has been disassembled, it is always necessary to adjust the stud bolt. After adjusting, fully tighten the stud bolt lock nut and coat it with lacquer or adhesive to prevent the nut from rotating.



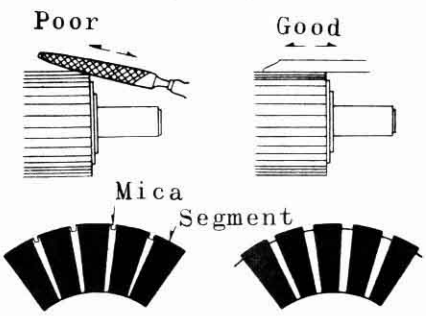

(b) ELECTRICAL FAILURES

(1) Brush

For passing of large current, brushes made of special metallic carbon are used for the starter. When any brush wears to 1/3 of its original size, replace. (If brushes made of too hard material are used, the commutator will wear instead of the brushes. Also, brushes with large carbon content have large contact resistance, do not pass large currents and cause insufficient power output. For these reasons, use genuine Subaru carbon brushes when replacing). Replace corroded or elongated brush springs.
To check the insulation of the brush holders, check for continuity between ⊕ brush and ground with an ordinary tester. If there is no continuity, the insulation is normal.

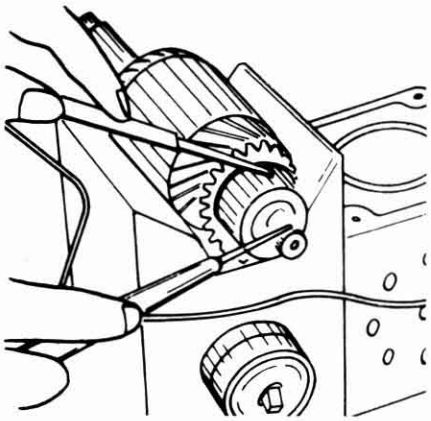
(2) Armature

When the commutator surface is damaged, polish with No. 00 sandpaper; if oil is found on the surface, remove it with gasoline.

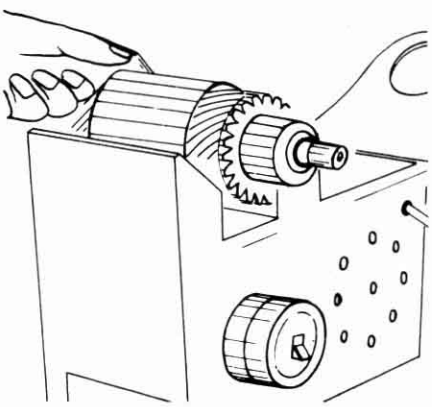



If the commutator surface is badly damaged and the surface which the brush contacts is worn deep, smooth by cutting the surface on a lathe. In this case, if the insulation mica between the segments protrudes above the commutator, the contact between the brush and commutator surface becomes poor and the commutator surface will soon be damaged by

burning. During use, the segments wear faster than the mica causing a condition of too high mica.
The mica should be about 0.5 - 0.8 mm (0.02 - 0.03 in) below the segments. All segments must be cut evenly as shown in the picture.

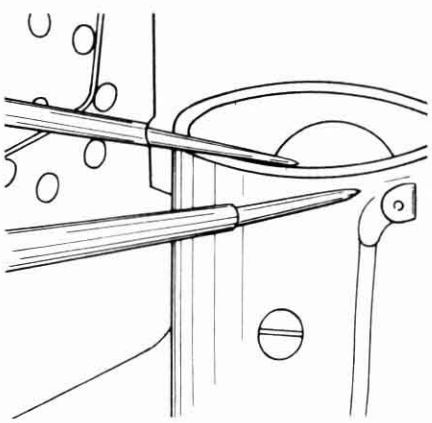


Test the insulation between the shaft and commutator with a continuity tester as shown in the picture.



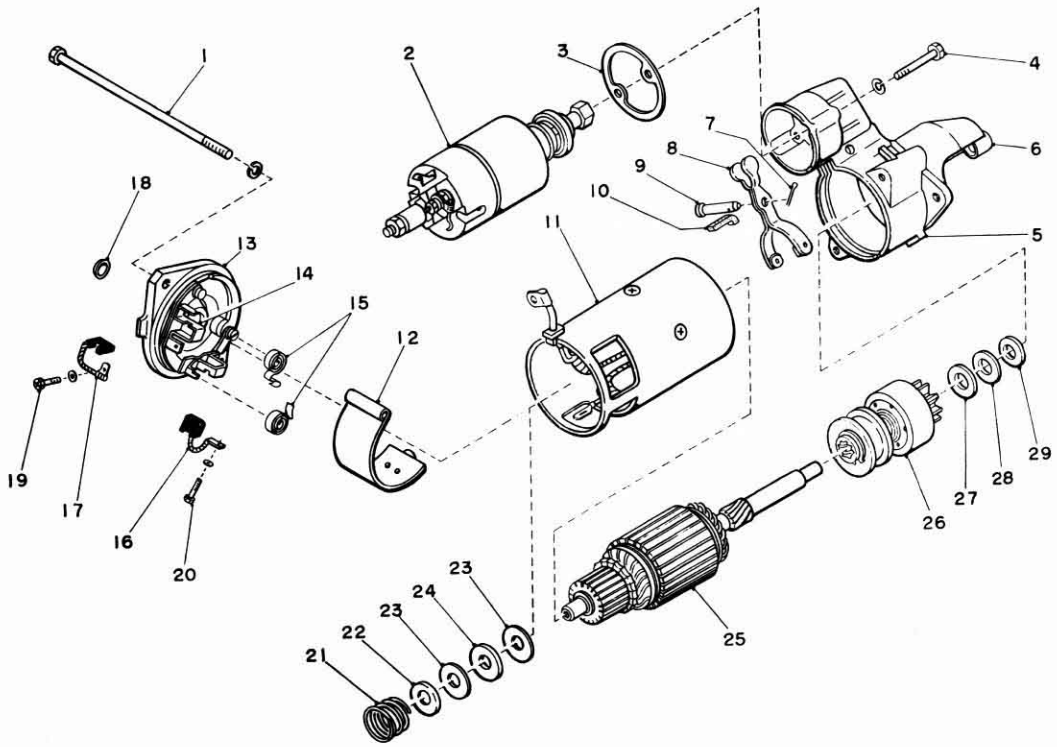
Next, as shown in the picture, place the armature core on a growler tester; contact the core surface with a piece of iron.
If the iron piece vibrates with a buzzing noise and is attracted, the armature core has shorted layers.
For example, there is short between windings. Repair or replace.

(3) Field coil



The field coil is wound on four poles. Since the field coil for the starter uses very thick wire, it does not break. Check and make sure that connections and leads do not ground to the yoke.
To test the field coil, disconnect the brush connection and apply test prods of a continuity tester between one end of the coil and the yoke.
The meter pointer should not deflect.

## G. DISASSEMBLY AND ASSEMBLY ORDERS




1. Bolt
2. Starter Switch
3. Gasket (Housing)
4. Bolt
5. Housing (Starter Pinion)
6. Bushing (Armature Shaft)
7. Cotter Pin
8. Lever (Starter Pinion)
9. Pin (Lever)
10. Sealing (Housing)
11. Frame (Starter Field)
12. Band (Starter Field Frame)
13. Holder
14. Bushing (Armature Shaft)
15. Spring (Brush)
16. Brush I
17. Brush II
18. Plug (Holder)
19. Screw
20. Screw
21. Spring (Armature Brake)
22. Washer
23. Washer
24. Plate
25. Armature
26. Starter Pinion
27. Washer
28. Washer
29. Washer

(a) DISASSEMBLY

(1) First, remove the lead wire tightening nuts and two setting bolts (4) of the magnetic switch and then remove the magnetic switch.

(2) Next, remove the cover band (12) ; pull up the brush and remove two through bolts (1) with a plus screwdriver. Insert the tip of a screw-driver or similar tool between the yoke and drive lever housing and tap the screwdriver lightly with a hammer. The commutator end frame and the yoke can be disassembled as a unit.
Remove the drive lever set pin by straightening the cotter pin.

[NOTE]

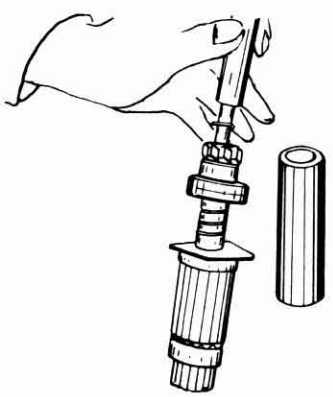
Be sure to remember the attaching position of the brake spring and washer.

(3) Removing the over-running clutch; pull out the armature (25) from the starter pinion housing (5) as much as possible. Then while tilting the top of the starter pinion lever (8) with the fingers, take out the starter pinion (26) complete from the drive ring of the clutch toward one side of the armature.

(4) While holding the starter pinion lever (8) with the fingers, apply force on the armature as if it was being pulled; then both drive levers will detach from the drive ring of the clutch.

(5) If a force is applied on the starter pinion lever to make it parallel with the armature, the lever fits in the slot of the housing and becomes parallel to the armature.

(6) Taking care not to lose the adjust washer, (27) (28) (29) pull out the armature. It will come out easily.



(7) To remove the starter pinion complete (26) from the armature shaft, the caulking of the stop collar on the end of the clutch must be removed. To removing the caulking, use a pipe-shaped tool such as shown in the picture.

(8) Fit the pipe-shaped tool on the top of the clutch stop collar, tap it with a hammer 2 - 3 times. Caulking is removed and a snap ring is exposed.

(9) Use of a special tool is very convenient to remove the snap ring but, a screwdriver can be used to remove it. Place a screwdriver near the cut of the snap ring and remove the ring taking care not to damage the armature shaft.

(10) At assembly time, replace the clutch stop collar and snap ring with new ones.

(b) REFITTING

Refitting order is the reverse of disassembly.

(1) Fit the center plate on the armature shaft and then fit the starter pinion complete (26). (Coat the armature shaft, starter pinion, return spring and drive ring with grease).

(2) Fit a new stop collar on the armature shaft; lock it with a new snap ring and tighten the stop collar at four points. Check and make sure that the starter pinion complete does not come off.

(3) Fit a thrust washer (adjust washer) on the tip of the armature shaft; coat every part of the lever (8) with grease and refit the lever to the housing (5) together with the armature. At this time, coat the housing bush with turbine oil.

(4) Insert the yoke matching it to the housing knock pins; refit the brake spring and washer on the commutator side of the armature shaft correctly; coat the commutator frame bush with turbine oil; fit it on matching to the knock pins of the yoke and secure it to the housing with two through bolts. In this case, if the brake spring and washer have been fitted incorrectly the commutator end frame will not fit on the nock pins of the yoke.

(5) Before installing the magnetic switch, check the length of the stud bolt. Hook the fork type joint on the lever end inside the housing; after making sure it is hooked on firmly, pass the drive lever set pin through the housing; lock it with a cotter pin and then tighten the flange of the magnetic switch. Also, check and make sure that the drive lever pin is fully fitted in the drive ring of the starter pinion complete.

(6) Attach the brush; secure the connecting lead which comes out of the yoke to the terminal M of the magnetic switch. After checking and making sure that the ⊕ brush lead is not near the commutator end frame and yoke and there is no danger of grounding, attach the cover band.

(7) After refitting, check and see if the armature can be turned lightly by hand. If it does not turn lightly, change the number of thrust washers for the armature shaft.

(8) Checking after refitting

Checking the pinion forward moving position ..... Refer to (a) on page 5-9
No-load test ..... Refer to (H) on page 5-15

H. TESTING

(a) NO-LOAD TEST

The starter test is performed with and without load. However, as rather complete facilities are required for a test under load, normally a no-load test is utilized to determine whether a starter is good or not. For instance, the voltage, current and revolution are checked. If a starter turns smoothly at a high speed when used with a good battery (fully charged battery), it is considered to be good.

(b) TESTING THE ACTION OF A MAGNETIC SWITCH

To eliminate fluttering, etc. due to poor actuation when the voltage is low, perform the following tests:

(1) Attraction test with the pull-in coil

When a voltage of 12 V is applied between the terminals M.30 and S.50 if the magnetic switch attracts strongly, the pull-in coil is normal.

(2) Attraction maintaining test with the holding coil

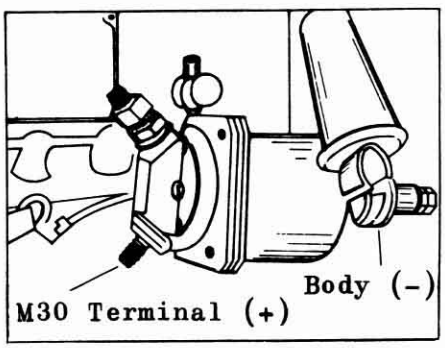
Ground the terminal M.30 and the magnet proper; apply a voltage of 8 V to the terminal S.50. If the magnetic switch attracts strongly and if this attraction is maintained even when the grounding of the terminal M.30 is removed, the holding coil is normal. In the above, if the attraction is released, there is a danger of fluttering during operation.

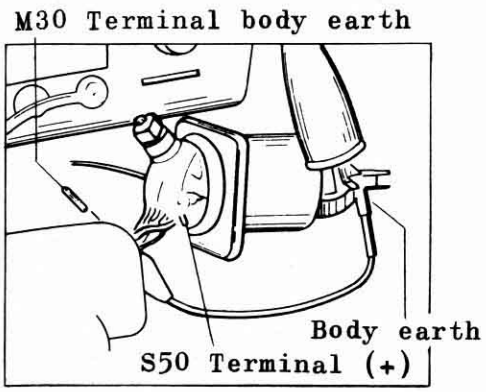
(3) Return test

When a voltage of 12 V is applied between the terminal M.30 and ground, no attraction should occur. If an attraction occurs in this case, the clutch does not return even when the switch is turned off after the engine starts; the starter is turned by the engine causing severe trouble.

(4) Measuring actuation voltage

The switch is normal if it works when a voltage of 8 V is applied to the magnetic switch coil.




Replace any magnetic switch which does not pass the tests under (b) above.

I. PRECAUTIONS IN HANDLING

Since the starter is the device which converts the electric power of the battery into mechanical power for turning the engine, the starter output is insufficient when the battery power is insufficient. Thus the power source section including the wiring and the starter have an inseparable relationship.

(a) At installing time, if the starter does not achieve close fitting because of insufficient tightening, the contacting of the pinion gear and ring gear becomes poor. This sometimes causes damage to the pinion and housing and at times, even the rotation of the starter itself becomes impossible.

(b) Since large currents (100-200 A) flow in the starter, fully tighten the terminals of the battery cables and grounding band, etc., when connecting the starter. Replace any cable when even a part of its core wire is broken. When connecting the battery terminals, be sure to polish them thoroughly before connection as they form complete insulation when they are corroded even if they may be completely tight mechanically.

(c) If the engine does not start easily even when it is turning at proper revolution after the switch has been turned on, check the ignition and fuel systems, etc., and remove the cause of difficult starting.

(d) Even in a difficult starting, never turn the starter longer than 30 seconds. As a starter of a very short time rating, long use of the starter causes the solder of the armature to melt and splash and burning of the coil or lead wires.
Furthermore, the current of the battery is expended rapidly and the starter rotation decreases more and more. When starting is difficult, turn the starter for 10 seconds and stop for 10 seconds (wait till the starter stops). Repeat the above procedure.

(e) When the starter races because the pinion and the ring gear of the flywheel do not engage correctly, the tips of the ring gear wear rapidly.

(f) After the engine starts, turn off the switch as soon as possible. An over-running clutch is provided to prevent turning of the starter by the engine after the engine has been started but after starting, since the starter is in noload condition, sometimes the armature shaft jumps out because of a large centrifugal force due to high speed rotation or the pinion and shaft seizure. While the switch is in, the pinion and gear are in a state of engagement. This point is different from a Bendix type starter and should be noted.
In case trouble such as this occurs, the cause is a poor contact of the ignition starter switch or magnetic switch. Unless the defective switch is replaced, the same trouble will occur repeatedly.

(g) If the engine is started with the firing position advanced too much, the engine will rotate in reverse giving a great impact to the starter pinion and causing chipping of the pinion teeth or damaging of the housing.

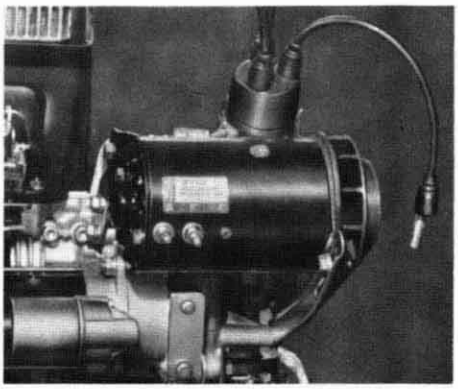
(h) Be careful not turned on the starter switch while the engine is running. If the starter switch is turned on, the pinion gear hits the rotating ring gear, and serious accidents such as a broken pinion gear, bent shaft and cracked housing, etc. will occur.

(i) If the starter pinion only makes a slight noise and does not engage with the ring gear even when the switch is turned on and the starter does not turn, the resistance of the switch circuit is too large.
For the switch circuit, wires with larger gage than others are used; be sure to make the contact of each terminal perfect.

Reference

If the voltage applied to terminal S of the starter drops below 5 V immediately after turned on the switch, a poor attraction of the magnetic switch occurs as has been described above.

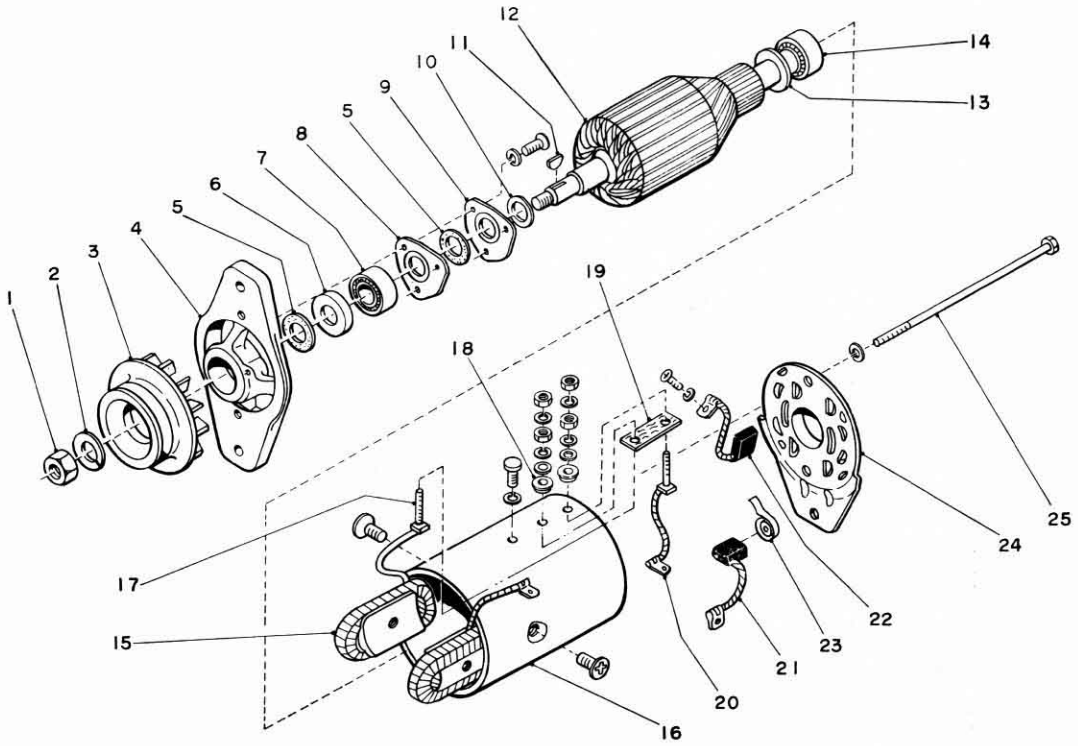
## 5 - 3 GENERATOR(DC)



A. PERFORMANCE AND SPECIFICATIONS

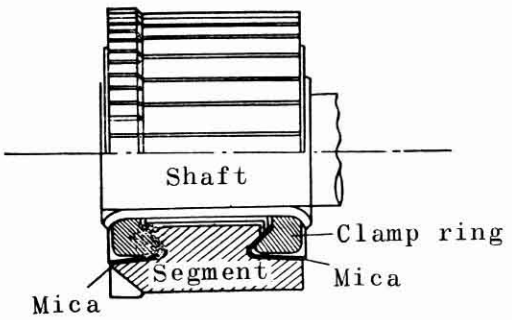
| | |
|---|---|
| Part number | 829900102 |
| Model | 27000-116-0 |
| Rating | 12 V, 200 W |
| Pole number and type | 2 P, shunt wound |
| Rotating direction | Clockwise as seen from pulley side |
| Adjuster type and type number | Regulator (Bosch type) 26000-125-0 |
| Cut-in | Less than 1250 rpm |
| Yoke outside diameter/ total length | 100 mm/200 mm |
| Weight | 5.8 kg |
| Commutator outside diameter | 37 mm |
| Brush length | 24 mm |
| Brush spring load | 900 gr. |
| Motoring | 5 - 8 A |

B. CONSTRUCTION OF GENERATOR




1. Nut
2. Spring Washer
3. Pulley (Generator)
4. Front Cover (Generator)
5. Oil Felt (Generator Bearing)
6. Cover I (Oil Felt)
7. Ball Bearing
8. Plate (Generator Bearing)
9. Cover II (Oil Felt)
10. Spacer (Armature)
11. Key
12. Armature Complete
13. Spacer (Generator Bearing)
14. Ball Bearing
15. Field Coil Complete
16. York (Generator)
17. Bolt (Terminal)
18. Insulator (Terminal)
19. Plate (Terminal)
20. A Terminal (Generator)
21. Brush I (Commutator)
22. Brush II (Commutator)
23. Spring (Commutator Brush)
24. Rear Cover (Generator)
25. Bolt (6 x 14.6 x 7)

When a generator is to generate power and to be used for car, the following parts are necessary:




(a) For creating a magnetic field,

POLE CORE

FIELD COIL

(b) For smooth operation and inducing current,

PULLEY OR GEARS

ARMATURE CORE

ARMATURE COIL

ARMATURE SHAFT

BEARINGS

(c) For converting AC to DC for external use,

COMMUTATOR

BRUSH

(d) For supporting the field coil and forming a magnetic circuit,

YOKE

(e) For controlling output,

THIRD BRUSH

REGULATOR

(f) For automatic closing or opening of battery circuit,

CUT-OUT RELAY

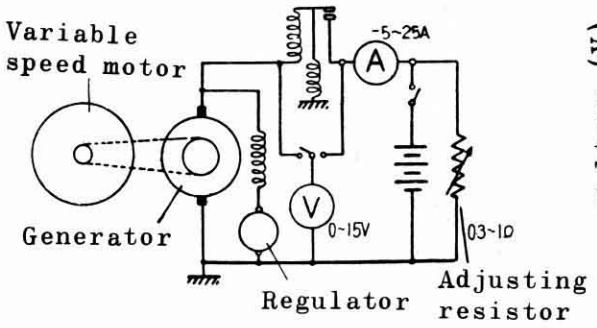
To prevent heating, the armature is made by laminating thin insulated iron plates; slits are cut on its circumference and insulated armature coils are inserted in the slits. For winding the armature coil, there are lap and wave winding methods. The commutator is made of wedge-shaped hard copper pieces which are fully insulated with thin mica and are assembled into a cylindrical form. Carbon brushes are used to improve rectifying efficiency and to prevent burning due to sparking.

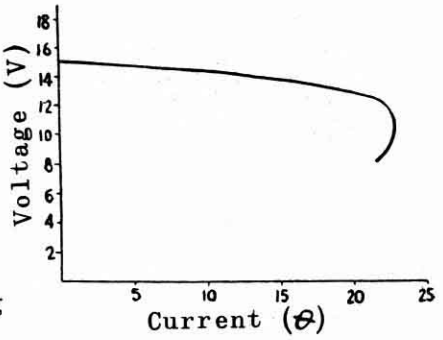
C. TESTING THE GENERATOR

The specifications of a generator differ according to its type and testing of a generator must be performed according to its specifications.

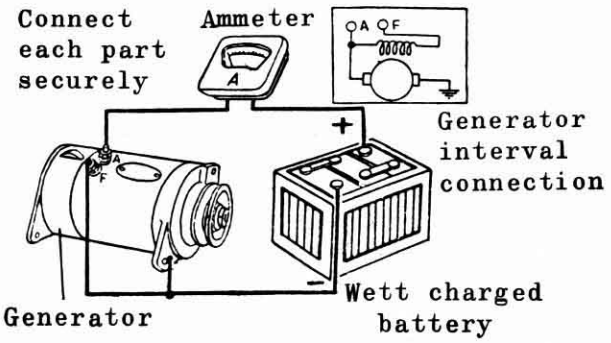
(a) OUTPUT TEST

To test a completed generator, it can be driven by a motor and the voltage and current generated at each revolution can be measured. However, an item which must be taken into consideration in this case is that the output current of a generator changes greatly according to its terminal voltage and that measurement must be made at a designated voltage (a designated regulator connected with the generator).




(b) MOTORING TEST

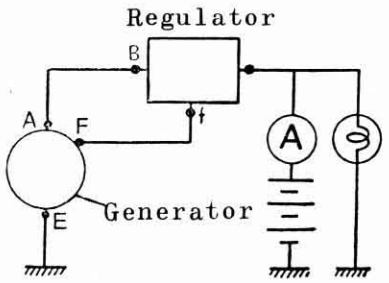



This is a simple testing method in which the generator is rotated like a motor with a battery as the power source and the efficiency of the generator is judged from its current and revolution. In this test, all the connections must be made perfectly to decrease contact resistance and a fully charged battery must be used. The generator must rotate smoothly and generator can be considered normal if the current at A is within the range shown in the table of efficiency specifications. In performing a motoring test, pay attention to the connection of terminals. (Refer to the picture).

D. TROUBLE AND REPAIR

(a) DETECTING FAULTS

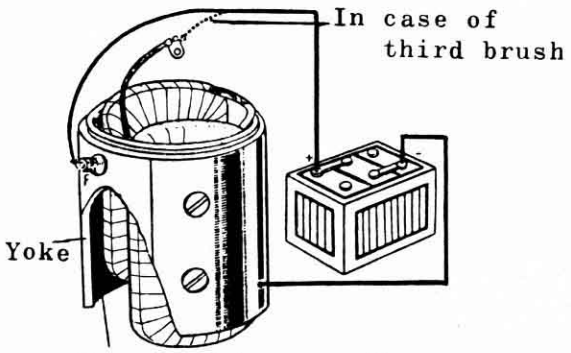
As has been described before, accurate detection of trouble in charging is rather difficult. Usually, insufficient charging is detected quickly as in this case, the running of the car is hindered. However, in the case of excess charging, the fault is not detected often until the battery or lamps become inoperative. At times, a normal condition is erroneously diagnosed as an abnormal condition due mainly to the difference in charge of the third brush and regulator types.




When it has been established clearly that the fault is in the charging system, determine whether the fault is in the generator, regulator, circuit or the battery. In the case of insufficient charging, if the system charges efficiently when points E and F (field terminals) are connected directly, then the adjustment of the regulator is incorrect or the wiring (E-f) is faulty. If the system does not charge even when E and F are connected, the generator does not generate or the wiring of A-B is at fault. Excess charging is cuased by incorrect adjustment of the regulator or a defective battery.

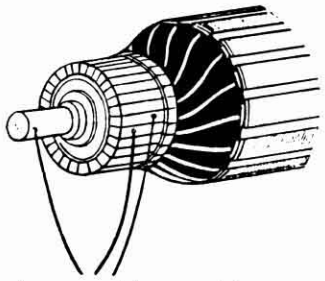
(b) CAUSE AND REMEDY FOR POOR GENERATION

Among component parts, those which cause trouble are the field coil, armature coil, bearings, commutator and brush.



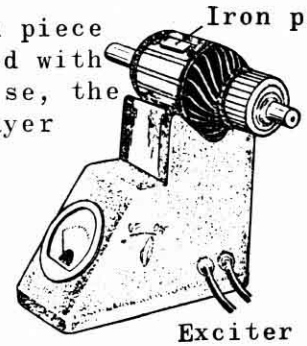

(1) FIELD COIL

Broken connection and grounding are the main troubles. Broken connection in the coil occurs in the grounding section or in the connection with the brush or in the connection with terminal F. Grounding of the coil occurs at the contacting surface with the pole core when the insulation is broken by the vibration of the coil. This can be corrected by improving the insulation and by retightening the pole core.



Between these there must not be continuity

If the iron piece is attracted with buzzing noise, the coil has layer shorting



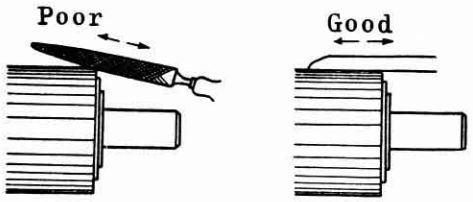

(2) Armature coil

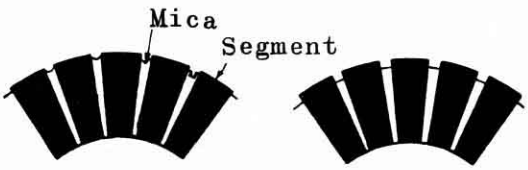
The chief troubles are layer-shorting, broken connection and grounding. When layer short or grounding occurs in the armature core, the armature must be replaced or rewound.

(3) Bearing

When the clearance between the shaft and bearing exceeds 0.1 mm (0.0039 in) because of a worn bearing, the bearing must be replaced. Unless this is doen, the armature and pole core contact each other causing a serious accident. Apply the grease for the ball bearing.

(4) Commutator

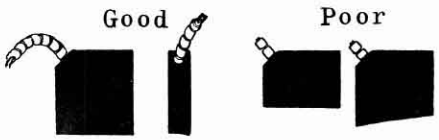



Commutator troubles are caused by burning, soiling or wear due to sparking or poor contact or shorting between the segments due to scattering of solder. These are caused mostly by an excessive output of the generator.
Polish the burned part with fine sandpaper and clean the soiled part with gasoline When wear is excessive, the commutator is cut on a lathe but as commutator efficiency drops when the commutator surface is cut to depth greater than 3 mm (0.118 in) from its original dimension. (Refer to Table for Trouble and Repair.) Cut the insulating mica between the commutator segments down to a depth of 0.5 - 0.8 mm (0.02 - 0.03 in) from the surface of the commutator.

(5) Brush wear

Grounding and poor holding of the brush holder are the main troubles.
When the brush wear over 1/3 from its original dimension, commutator efficiency drops (sparking becomes excessive). In a case like this, replace the brush. A softer brush wears comparatively fast but for the protection of the commutator, rather soft brushes and used. (See Table for Trouble and Repair). Check the ⊕ side brush holder to make sure it is not grounding by performing a continuity test.




The brush should be held securely in the holder without any rattling and should slide smoothly. Poor holding of the brush causes imperfect contact between the brush and commutator decreasing the commutator efficiency. Whether the contact is good or not also depends on the tension of the spring.
When commutator sparking is excessive, replace the spring to see if the sparking decreases. When the above is completed, perform output and motoring tests before installing the generator on the car.

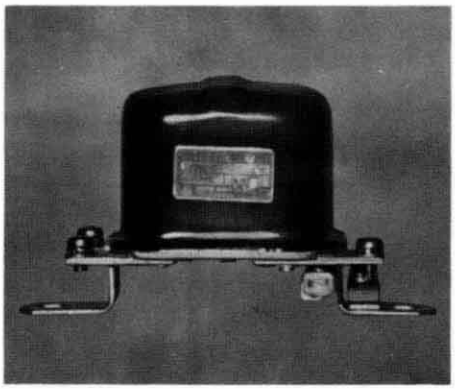
Table for Trouble and Repair

| Trouble | Trouble point | Remedy | Precautionary item |
|---|---|---|---|
| 1 When the battery goes dead | A Defective generator | Since poor generation is due to poor brush contact, burned commutator, poor insulation of terminal section, broken connection or grounding of the field coil, grounding of the armature coil, etc., check these and repair the defective part. | Short terminals E and F. If strong spark generates when terminal A is grounded lightly, the generator is normal. (Charge pilot does not go out) |
| | B Defective wiring | Check the wiring cord for its size, tightening of terminals and grounding of the cord because of broken insulation and repair when a defect is found. | It is wrong to think that too small a charging current is caused by regulator trouble. The causes for this are many and often are difficult to detect. |
| | C Poor installing | When installing of the generator is poor, the generator is not grounded perfectly causing poor power generation. Remove the paint and oil from the installing surface and tighten firmly. | |
| | D Defective battery | Unsuitable electrolyte, defective plate, broken pole, poor wiring and insufficient tightening, etc., are the causes. Check and repair. | |
| | E Burned points | File with a fine file. | |

| Trouble | Trouble point | Remedy | Precautionary item |
|---|---|---|---|
| | F Incorrect adjusting value | Readjust the voltage regulator | Refer to the section on adjusting the voltage regulator. |
| 2 When large charging current persists to flow and does not decrease (battery electrolyte decreases rapidly or its temperature rises) | H Defective generator | Wiring of A and F terminals is shorting in the yoke interior or exterior of the dynamo | If the current drops to zero when terminal F is removed, the trouble is not in the generator. |
| | I Incorrect adjusting value | Readjust the voltage regulator. | When the adjustment of the regulator is incorrect, a specified current flows continuously. |
| | J Defective battery | Trouble is due to excessively diluted electrolyte or shorted pole plates. Repair | When the charging current does not decrease for a long time it is often due to a defect in the battery. |
| 3 Charge pilot light sometimes flashes unstably. | K Poor adjusting | Adjust the cut-out relay. | |
| | M Defective wiring | When a defect such as insufficient tightening of the terminal or poor installing exists in the circuit, the current through these points flows intermittently because of vibration of the car in running and indication deflects abnormally. | |

For generator repairs, utilize Subaru dealers.

## 5 - 4 REGULATOR



A. PERFORMANCE AND SPECIFICATIONS

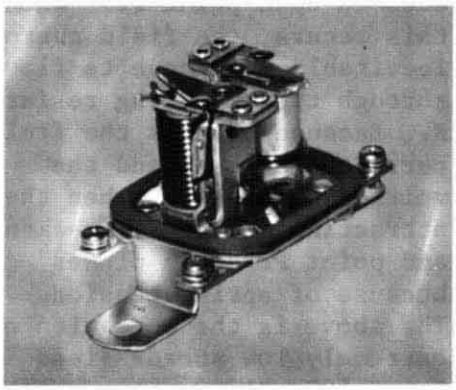
| | |
|---|---|
| Part Number | 829890512 |
| Model | 26000-125-0 |
| Regulator type | Bosch |
| No-load voltage/ generator revolution | 15.0 - 16.0/2000 - 4000 rpm |
| Cut-in voltage/ generator/revolution | Less than 12.5 - 13.5V/1250 rpm |

B. SPECIAL PRECAUTIONARY ITEMS

A voltage regulator performs its function only when it it used together with a generator. However, for greater efficiency, a generator and regulator of different capacities or those made by different manufacturers should not be used. Use only the generator and regulator of matching capacities manufactured by a single manufacturer.
Also, when an abnormal charging condition of the battery occurs, do not conclude immediately that the generator or regulator is defective. Check the battery wiring and connections, etc., for abnormality.
When no abnormality is found in these, measure the no-load voltage of the generator and if the voltage is of specified value, then the generator and regulator can be considered to be normal.
(No-load voltage is measured by measuring the voltage between terminal A of the regulator and ground while rotating the generator at a specified rotation after removing the regulator terminal.)

When the no-load voltage is not of specified voltage, the regulator is adjusted. However, as disassembly or adjustment of the regulator by inexperienced personal may make the condition still worse, ask someone experienced to adjust the regulator or have it adjusted or repaired at a service station. Under normal conditions, a regulator can be used without adjustment for a mileage of 50,000 - 60,000 km (30,000 - 37,000 miles).

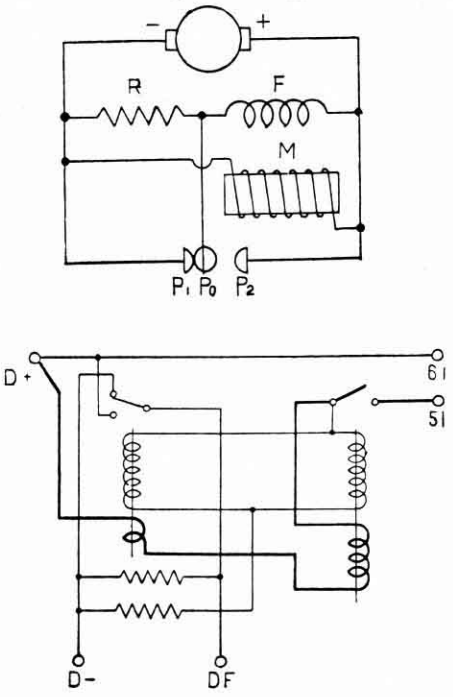
C. CONSTRUCTION



This regulator is called a Bosch type and has many excellent features. The greatest feature of a Bosch type regulator is that it is provided with two sets of contacts for high and low speeds. At low speeds, an adjusting resistor is inserted or shorted to adjust and at high speeds, the field is shorted to prevent voltage rise. To lessen the sparking of the points, very small values are used for the adjusting resistors. Because of this, the contacts are not damaged and for shorting of the field, the voltage can be adjusted for unlimited revolution.

D. WORKING PRINCIPLE

Principle Diagram



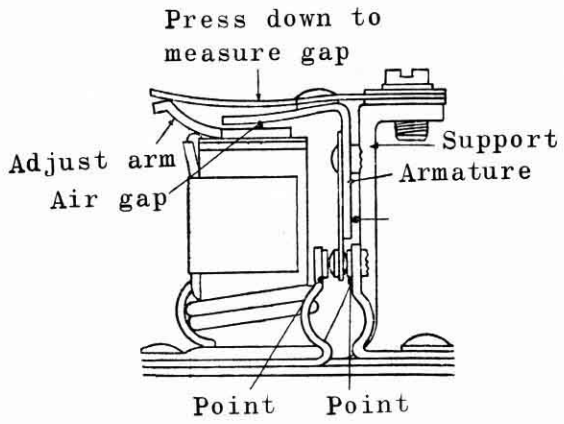

The working principle is explained according to the drawing. The current from the generator flows through the field F and point Pl. As the dynamo revolution rises and the voltage reaches a specified value, the attracting force of the magnet (voltage coil) M acts to open point Pl. When this occurs, the field current inevitably will have to flow through the adjusting resistor R. Because of this the field current decreases and the voltage decreases. Then the attracting force of M weakens and point Pl again closes because of spring tension. The above is the actuation at extremely low speeds (less than 1500 - 1700 rpm). When the generator revolution rises above the values referred to above, because the resistor value is small (decreases the sparking of the points), the voltage rises even when point Pl opens and the field current too increases. Thus when the voltage rises, the attracting force of M becomes very strong and closes point P2. As this happens, the field is shorted completely and the generated voltage drops rapidly. In this manner, the voltage is maintained practically constant regardless of the revolution of the generator.

E. ADJUSTING THE REGULATOR

Proper adjustment of a regulator means adjusting for smooth actuation of the voltage regulator of for smooth vibration of the contact. Since matching of voltage or current to a specified value can be done with the tension of the spring, it is not difficult.

With a Bosch type regulator, almost all adjustments can be made by cleaning the points and by fine adjustment of the spring. However, additional operations such as loosening the screws of the armature and bending of the point holders should never be attempted. This is a very important point to remember. For instance, uneven point vibration and excessive sparking can often be corrected completely by simple cleaning of the point.

Next, when the armature point has been removed becuase of a severe trouble, the following preadjustment and electrical adjustment must be performed again.




(a) PREADJUSTMENTS

Preadjustments mean the adjustment of various gaps and adjustment of contact pressures. The key point of adjustment is in these preadjustments. When the preadjustments are done accurately, the values of electrical adjustments can be obtained easily. Of course it is impossible to obtain the electrical adjustment values with the preadjustments only and there are some adjustments which must be performed again when performing electrical adjustments. Except when the armature has been replaced or when the armature has been moved by loosening screws, do not perform preadjustments.

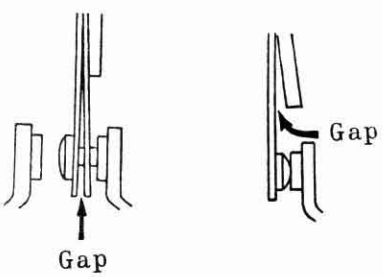
[VOLTAGE REGULATOR]

(1) Angle gap at operation ..... Drawing A 0.2 - 0.4 mm (0.008 - 0.016 in)

Operation is the time when the armature is held downward. In this case the high speed point is in the way and is turned outward for the time being. Moreover, this air gap must be maintained.

(2) Air gap at time of standstill .. Drawing B 0.8 - 1.3 mm (0.032 - 0.051 in)

Adjust in its natural state (at standstill with the low speed point).




(3) Point gap at standstill
0.2 - 0.4 mm (0.008 - 0.016 in)
.. Drawing C

Adjust the gap between the armature point and high speed point with the high speed point holder. Check and make sure that the armature spring works (the spring bends) when the armature is held downward.

[CUT-OUT RELAY]

(1) Angle gap at actuation time ..... Drawing A 0.2 - 0.4 mm (0.008 - 0.016 in)

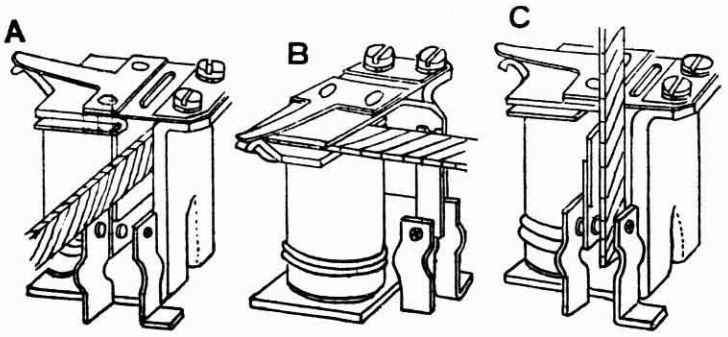
The condition of adjustment is the same at that for the voltage regulator.

(2) Air gap at standstill ..... Drawing B 0.8 - 1.3 mm (0.032 - 0.051 in)

Adjust with the armature stopper.

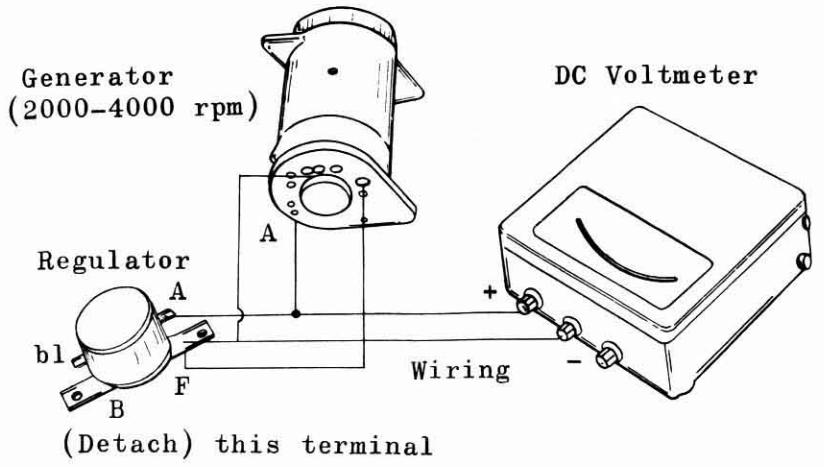
(3) Point gap at standstill ..... Drawing C 0.4 - 1.2 mm (0.016 - 0.047 in)

The point gap is adjusted with the stationary point. After adjusting, check to see if the spring is working.



(b) ELECTRICAL ADJUSTMENTS

When the preadjustments are completed, proceed with electrical adjustments.
Since the phenomenon of hysteresis occurs in adjusting, be sure to lower the generator revolution to the minimum first and take a reading at the rising of revolution every time adjustment or checking is made. Also, do not touch the support unless it is absolutely necessary. Adjust mainly with the adjusting arm.




Adjust according to the following procedure:

[VOLTAGE REGULATOR]

(1) Adjusting no-load voltage 15.0 - 16.0 V

Disconnect terminal 51 of the regulator. Adjust the voltage of D ⊕ terminal at 2,000 rpm and 4,000 rpm of the regulator under no-load condition.

(2) Voltage with load Over 13.5 V

Adjust the voltage of D = terminal at 2,500 rpm of the regulator when a load of 11 A is connected.

(3) Lastly, check the contact pressure

Contact pressure Over 180 g (6.35 oz)
Drawing D (next drawing)

[CUT-OUT RELAY]

(1) Cut-in voltage 12.5 - 13.5 V

Gradually raise the revolution of the dynamo and adjust the voltage of cut-in time.

(2) Reverse current 1 - 8 A

Check the reverse current by connecting a battery which is almost fully charged.

(3) Spring pressure

Over 120 gr (4.25 oz) ..... Drawing E

(c) REMEDIES FOR ABNORMALITIES

When the voltage rises abnormally with uneven or high speed armature vibration, take the following steps:

(1) Voltage varies greatly because of uneven armature vibration

First, thoroughly clean the point surface with a chamois or paper. This is very important as in a Bosch type regulator the above trouble is often corrected completely by simple cleaning of the points. The points can be polished as they are made of silver or turngsten but after polishing, they must be cleaned in trichloroethylene (obtainable at drag stores) to remove sandpaper abrasives, oil, etc. Next, make the point gap small. Then make the armature gap slightly larger. The limits of this decrease or increase of the gaps should be within the specified range.

(2) Voltage rise too high at high speed rotation

* Clean the points and decrease the armature gap slightly.

* Increase the point gap slightly.

(3) Voltage drops too low at high speed rotation

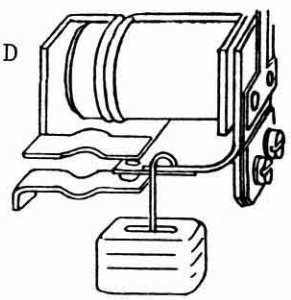
* Increase the armature gap slightly.

* Decrease the point gap slightly.

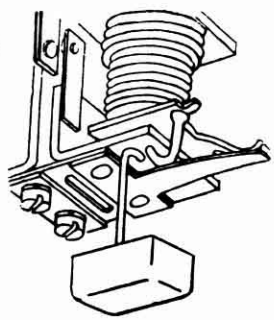
(4) Cut-out relay actuates.

* Slightly decrease the point gap.

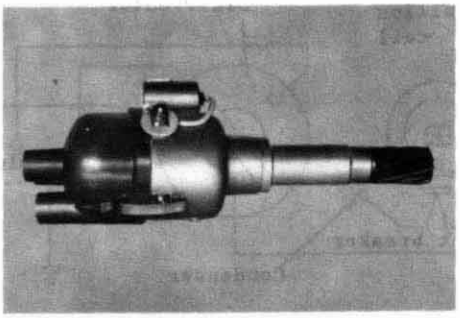
D



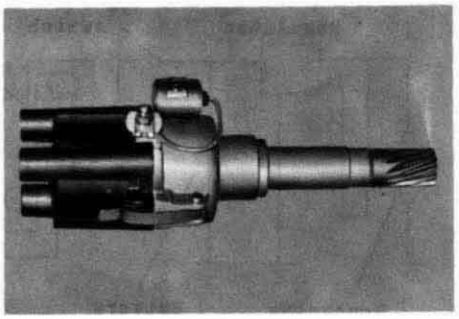
E



## 5 - 5 DISTRIBUTOR



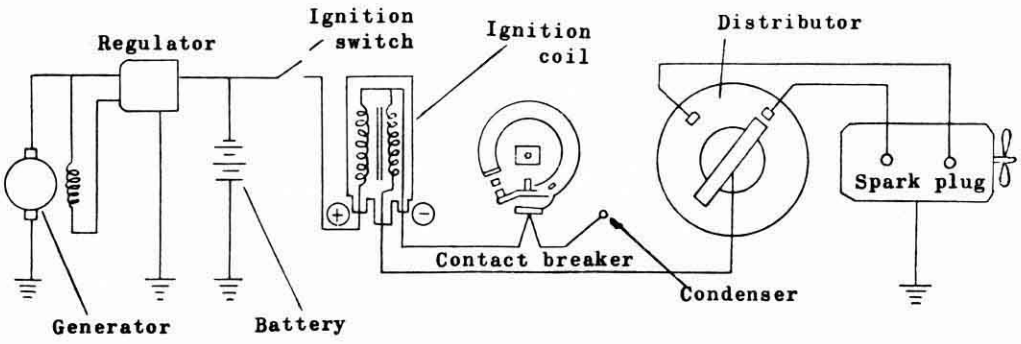
Nippon Denso Distributor
Model 29100-136-0



Hitachi Distributor
Model D203-31

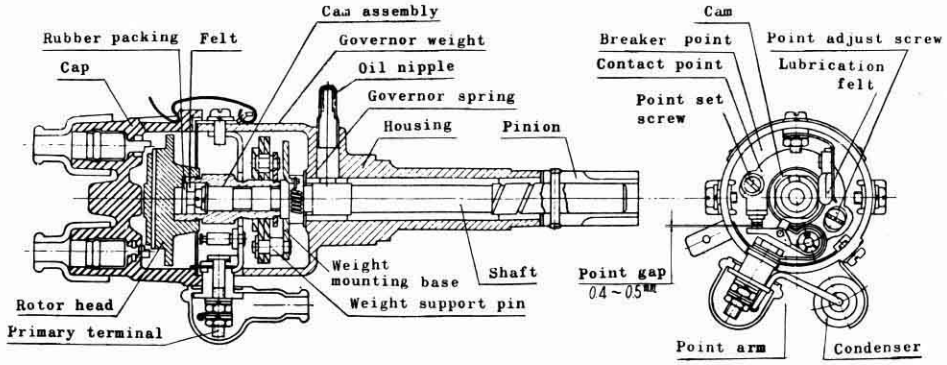
A. PERFORMANCE AND SPECIFICATIONS

| | | Hitachi distributor | | Nippon Denso distributor | |
|---|---|---|---|---|---|
| Model | | D203-31 | | 29100-136-0 | |
| Rotating direction | | Clockwise as seen from rotor side | | | |
| Firing interval | | 90° ± 1° | | 90° ± 1.5° | |
| Point gap | | 0.45 - 0.55 mm (0.018 - 0.022 in) | | 0.4 - 0.5 mm (0.016 - 0.020 in) | |
| Point pressure | | 500 - 650 gr | | 440 g ± 15 % | |
| Closing angle | | 48 - 53° (at 0.5) | | 47° (at 0.45) | |
| Condenser capacity | | 0.22μF ± 10 % | | 0.25μF ± 10 % | |
| Ignition timing | | 13° before top dead center | | | |
| | | Distributor | | Crankshaft | |
| | | Advance angle | Speed | Advance angle | Speed |
| Advance angle Characteristics | start | 0° | 1000 rpm | 0° | 2000 rpm |
| | end | 3.5° | 2000 rpm | 7° | 4000 rpm |



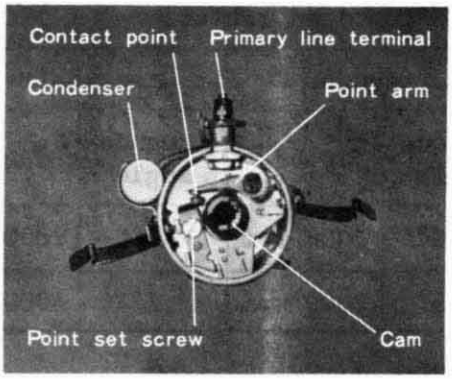

B. CONSTRUCTION

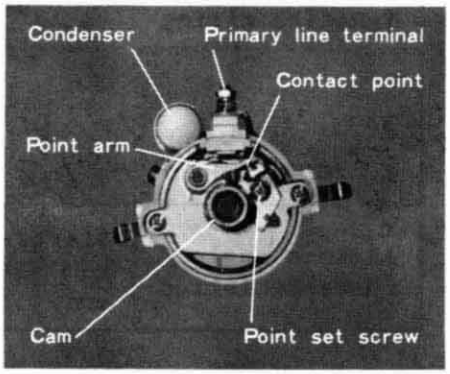
The distributor is used as an electrical circuit of the ignition system shown in the preceding drawing; functionally, it consists of a contact breaker section, distributor section and governor advancer section. Its construction is shown in the figure.




Distributor section

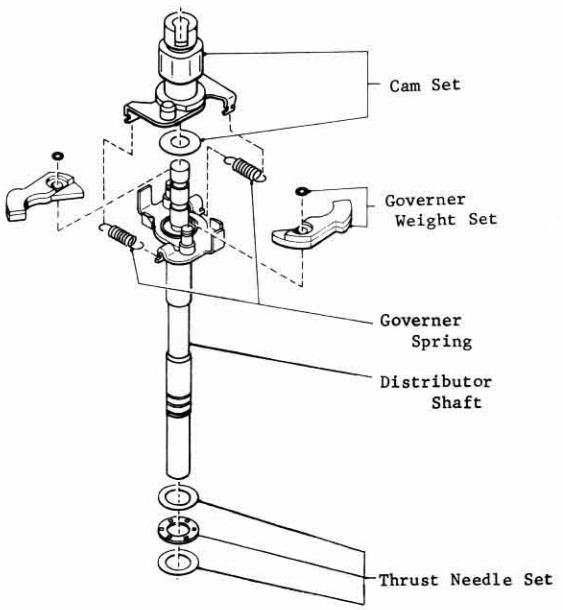
Breaker section



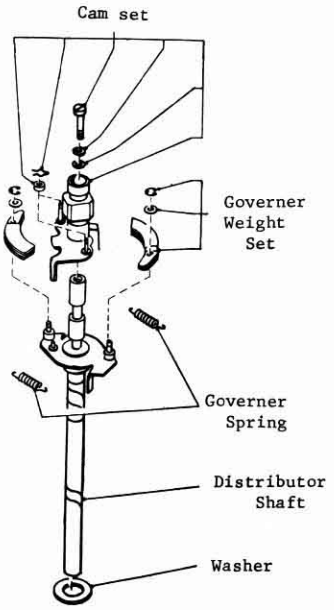



C. REVERSE ROTATION PREVENTION

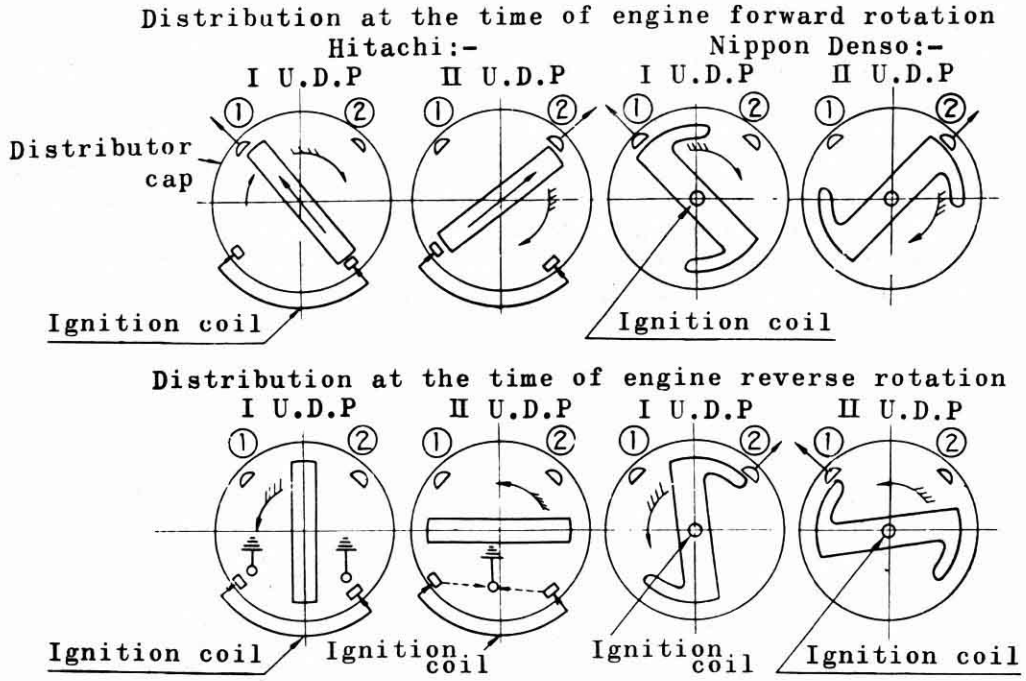
With a crankcase compression, piston valve type 2-cycle engine, it can be rotated in either forward or reverse direction by the determination of its firing time and the engine rotation direction at the time of starting. For a 2-cycle engine for a car, since reverse rotation is very dangerous, the distributor is provided with a reverse rotation prevention device.
The reverse rotation prevention device is in the distributor cap (Hitachi) and rotor head (Nippon Denso).




Nippon Denso




Hitachi




In each case, the electric power is not distributed to the cylinder; the high voltage current coming from the ignition coil is grounded to the nearest metal part.

In each case, the electric power is distributed to the cylinder which is at non-compression stroke.

D. PRECAUTION IN HANDLING

(a) SET THE TIMING ACCURATELY

Initial incorrect setting of timing is out of the problem. Timing differs with the type of engine but it must be set correctly for the designated position for each kind of engine.

(b) ALWAYS KEEP THE POINTS CLEAN

Because the point interrupts the primary current, soiling of its contact surface must be avoided. If the soiled point surface is left uncleaned, the flow of the primary current becomes difficult causing the engine to misfire. Polish the soiled point surface with #00 sandpaper and replace when the point is roughened excessively.

(c) ADJUST THE POINT GAP ACCURATELY

Check the contact point gap periodically and adjust to the specified value of 0.4 - 0.5 mm. When the gap is narrower or wider than the specified value, the firing time goes out of order and causes the engine to malfunction. (Since a wider gap causes less trouble than too narrow a gap, adjust is as wide as possible. (It can be adjusted to a maximum value of 0.5 mm)).

(d) Proper tension for the spring of the point arm for the Hitachi distributor is 500 - 650 gr and that for the Nippon Denso distributor is 370 - 500 gr. If this is adjusted to tightly, the point gap changes easily because of the wear of the contact arm heel and cam. On the other hand, if the tension is too weak, the point arm jumps at high speed and causes the engine to misfire. If checking finds the spring defective, replace with a new one.

(e) CHECKING THE CONDENSER

If the engine still misses or the point wears rapidly after cleaning or replacing the point, check the condenser. Often the terminals are not tightened sufficiently or the insulation resistance decreases because of accumulated dust on the terminal section. When a condenser has low capacity, replace it with a new condenser and clean when the condenser is soiled.

(f) CHECKING THE CAP ROTOR HEAD

When dust adheres between the plugs of the cap and between the distributor piece and cam (ground) and absorbs moisture, discharging occurs in the interior and the engine misses.
Once a discharge occurs inside, the cap rotor head cannot be used again. Keep it clean at all times. When the interior is damaged by burning, replace. Also, as the cap rotor head is made of a high quality molded insulating material and is easily breakable, handle it with utmost care.

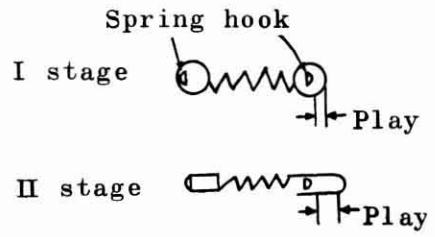
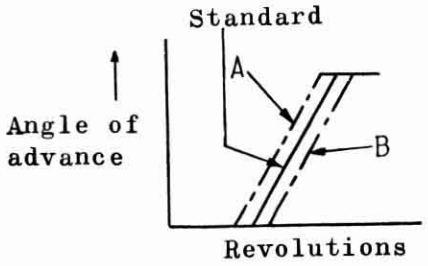
(g) PRECAUTIONS IN HANDLING THE GOVERNOR ADVANCER

The centrifugal angle advancing characteristic differs with each type. When new, each governor advancer holds its own characteristic but after long use, looseness develops in each rotating part and the characteristics of the governor advancer change. When looseness in the governor advancer has been judged as the cause of engine malfunction, remove the distributor from the engine, test it with a distributor tester and check its characteristics.
If the characteristics are found to be normal, the cause may have been a poor installing of the distributor or defect in other parts. In this case, do not disassemble the distributor.

When the characteristics are not normal, remove only the contact breaker; check the governor advancer without removing and take appropriate steps after observing the points listed on the next table.
Also, when the governor advancer section has been disassembled, recheck and make sure of the angle advancing characteristic.
In case a distributor tester is not available, the governor advancer can be disassembled and maintenanced according to the procedure for treating the defective advancer referred to above to obtain characteristics similar to standard characteristics. This does not hinder the use of the car but recheck and confirm the angle advancing characteristic at the first available chance.

* Trouble and remedy for the governor advancer

| Defective part | Remedy |
|---|---|
| Cam assembly | When looseness of the roller is excessive in a Hitachi governor advancer cam assembly, replace it. Also, if the roller is rusty, clean it and make it turn freely or replace.<br>If the pin of a Nippon Denso governor advancer is worn badly and has a step, replace the cam assembly. |
| Governor weight | When the hole and sliding surface are worn as shown by the dotted lines and are so badly worn that the wear can be seen with the naked eye, replace with a new one.<br>When vertical sliding of the weight is too great, adjust with sliding washers. |
| Shaft assembly | When the weight support shaft is worn the caulked part between the base plate and shaft is loose, replace with a new one. |

| Defective part | Remedy |
|---|---|
| Governor spring<br>  | Play in the spring of the second stage is permissible but when there is play in the spring of the first stage, it is caused by the wear of other parts. Observe carefully and then take necessary measures. Never bend the spring hook heedlessly. |
| Angle of advance<br>  | When the above disassembly and repair, normally the result of inspection with a distributor tester, does not coincide with the standard characteristic as shown by A and B in the drawing: When the difference is not too extreme, the governor advancer can be used without trouble. When the difference is great, have a qualified mechanic repair it. |

(h) PRECAUTIONS IN LUBRICATION

It is necessary to lubricate once each month but too much lubrication causes electrical troubles. Use caution on this point. For example, to prevent the wear of the heel, it is necessary to apply a thin coat of oil (or grease) to the cam but if too much oil is applied, it is splashed because of centrifugal force and adheres to the point. When this happens, the point will wear rapidly.

(i) OTHER PRECAUTIONS

(1) It is absolutely necessary to make the connections of the high tension cord and low tension circuits securely. When the plug-in connection of the high tension cord is not perfect, it becomes difficult for the high tension current to flow through causing burning of the plug-in hole interior and rotor head, cap, etc.

(2) When disassembling for cleaning, disassemble and assemble correctly according to a set order. Lubricate the rotating and sliding sections with engine or dynamo oil and when replacing parts, be sure to use genuine parts only.

E. TROUBLE AND REMEDY

(a) THE ENGINE DOES NOT START

When the fuel system of the engine is normal, check the ignition system. To judge the condition of the system, remove the high tension cord from a spark plug, attach it to a separate spark plug, turn the engine with the starter to check the sparking condition. Then determine the measure to be taken.

| Spark | Location of trouble | Cause | Treatment |
|---|---|---|---|
| No spark at all | Distributor | Poor insulation of condenser | Replace |
| | | Disconnected low voltage side lead | Repair |
| | | Poor insulation of rotor head | Replace |
| | | No contact breaking of point | Correct |
| | Ignition coil | Disconnected or shorted coil | Replace |
| Weak or irregular spark | Distributor | Too large point gap | Correct |
| | | Oil on point | Clean |
| | | Point burned excessively | Replace |
| | Ignition coil | Layer short | Replace |
| Weak spark | Spark plug | Too large electrode gap | Correct or replace |
| | | Soiled with carbon | Clean or replace |
| | | Broken insulator | Replace |
| | | Deteriorated spark plug | Replace |

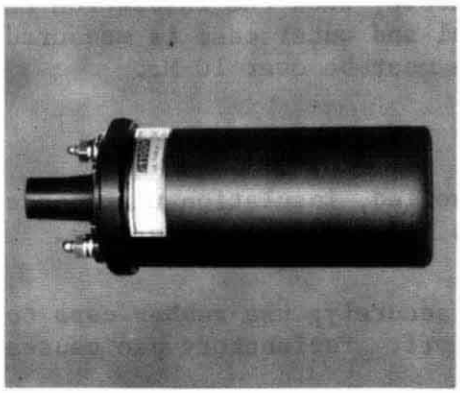
(b) THE ENGINE TURNS BUT THE RUNNING CONDITION IS NOT GOOD

As there are many causes for this it is difficult to determine the basic cause. If the ignition system only is considered, pay attention to the following points:

| Condition | Location of trouble | Cause | Treatment |
|---|---|---|---|
| Engine misfires constantly | Distributor | Soiled point | Correct, clean |
| | | Improper point gap | " |
| | | Surface leakage of gap rotor head | Clean or replace |
| | | Poor insulation of condenser | Replace |
| | | Poor insulation of condenser lead | Correct |
| | | Sluggish action of contact arm | Lubricate the shaft slightly |
| | | Fatigues spring of contact arm | Correct or replace |
| | | Loose distributor | " |
| | Ignition coil | Layer short or inferior part is used | Replace |
| | High tension cord | Deteriorated insulation and leakage | Replace |
| | Spark plug | Soiled | Clean or replace |
| | | Leakage at upper insulator | Clean |

| Condition | Location of trouble | Cause | Treatment |
|---|---|---|---|
| Engine knocks constantly | Distributor | Timing is incorrect and is leading | Correct mounting |
| | | Detached or broken governor spring | Correct or replace |
| | | Worn pin or hole of governor section | Replace |
| | Spark plug | Easily burned type | Replace with specified type |
| Insufficient engine output | Distributor | Timing is incorrect and is lagging | Correct installing |
| | | Sluggish governor movement | Correct |
| | | Soiled point | " |
| | | Too narrow point gap | " |
| | Spark plug | Soiled | Clean |

## 5 - 6 IGNITION COIL



A. CONSTRUCTION

| | |
|---|---|
| Part number | 829880111 |
| Model | 51504-1100 |
| Primary voltage | 12 V |

The ignition coil generates the high voltage necessary to let an electrical spark jump across the gap between the electrode of the spark plug. The high tension generating section is sealed in a case and has an iron core at its center. On this are wound two kinds of coils. The inside coil which is the secondary coil has approximately 20,000 turns of fine wire and the primary coil which is one the outside has several hundred turns of larger wire.
To withstand high voltage, the coils are given an insulating treatment, are enclosed in a case and are held by the bottom insulator and a cap on the top. The case interior is filled with compound.

B. PERFORMANCE

(a) THE IGNITION COIL IS MANUFACTURED ACCORDING TO THE FOLLOWING SPECIFICATIONS:

The secondary voltage, after being held in an atmosphere of 80°C for over 60 minutes and when combined with a distributor, must cause a spark of over 6 mm (0.236 in) across a three-electrode needle gap at a terminal voltage of 12 V and revolution of 2,000 rpm.

(b) INSULATION RESISTANCE

Under the same condition as above, when the insulation resistance between the coil terminal and outer case is measured with a 500 V megger the resistance must be over 10 MΩ.

C. HANDLING

(a) When the distributor cap is soiled, insulation resistance decreases; high voltage leaks and the engine misfires. Always keep the cap clean.

(b) Insert the high tension cord securely; use rubber caps to prevent the cord from coming off. Perfunctory use causes trouble.

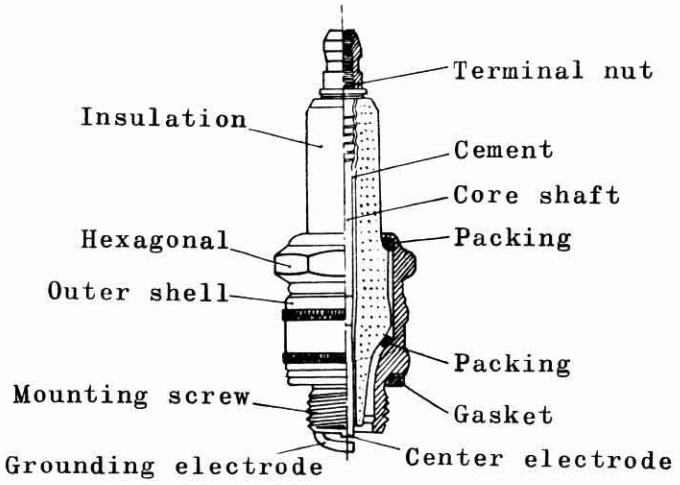
(c) When the engine is stopped, be sure to turn off the key switch. If current is left flowing in the primary circuit of the coil, not only is the life of the coil shortened but also the battery discharges rapidly and in some extreme cases, its continued use becomes impossible.

(d) When the ignition coil is defective and only weak spark is given off or no spark is generated at all, replace the coil as a defective ignition coil cannot be repaired.

## 5 - 7 SPARK PLUG

A. DESIGNATED SPARK PLUG

Since the spark plug is an important part and affects engine performance greatly, not only should the designated spark plugs be used but also they should be handled and maintenanced with greatest care.




Model

NGK B-7H

(Nippon Tokushu Togyo)

B. PRECAUTIONS IN HANDLING

(a) The standard spark gap is 0.7 mm (approx. 0.028 in). When installing, be sure to check. As the electrodes of a spark plug wear with use, correct the gap when it is approximately 1.0 mm (0.039 in).

(b) In the case of a 2-cycle engine, more combustion residue deposits on the spark plug than in the case of a 4-cycle engine. Clean it periodically.

(c) Be sure to use the spark plug gasket. Replace any burned gasket.

(d) When attaching a spark plug, clean the insulator and spark plug installing seat. Turn the gasket by hand until it is tight; then with correct spark plug wrench, tighten the spark plug firmly taking care not to damage the insulator.

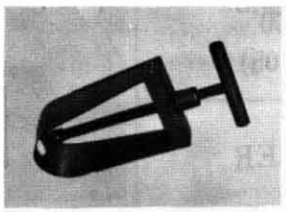
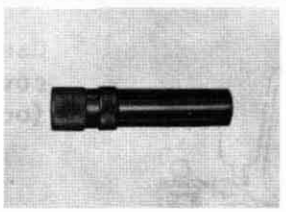
# CHAPTER 6: TIGHTENING TORQUE

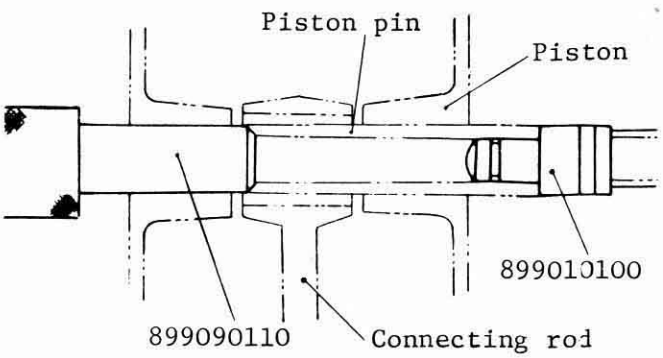
6

| PART NO. | NOMENCLATURE | TIGHTENING TORQUE | | TIGHTENING POSITION |
|---|---|---|---|---|
| | | kg-m | lb-ft | |
| 800105050 | 5mm bolt | 0.25-0.30 | 1.8- 2.2 | Oil pump |
| 800106110 | 6mm bolt | 0.4 -0.7 | 2.9- 5.1 | Distributor |
| 800112050 | 12mm bolt | 5.7 -6.2 | 41.2-44.8 | Clutch |
| 800209010 | 9mm bolt | 4.6 -5.6 | 33.3-40.5 | Differential case |
| 800210010 | 10mm bolt | 4.8 -5.3 | 34.7-38.3 | Cylinder head |
| 800308010 | 8mm socket bolt | 2.1 -2.5 | 15.2-18.1 | Crankcase |
| 800308020 | 8mm socket bolt | 2.1 -2.5 | 15.2-18.1 | Crankcase |
| 802016010 | Lock nut (16mm) | 5.3 -6.7 | 38.3-48.5 | Drive gear (Over drive) |
| | | 4.2 -4.8 | 30.4-34.7 | Synchronizer hub (Over drive) |
| 802034010 | Nut (34mm) | 5.7 -6.3 | 41.2-45.6 | Primary reduction gear |
| 820541800 | Spark plug | 2.8 -3.4 | 20.3-24.6 | |
| 824561110 | Banjo bolt | 1.35-1.65 | 9.8-11.9 | Oil pump hose (Crankcase side) |
| 842094100 | Set screw | 1.85-2.15 | 13.4-15.5 | Selector arm, Shifter arm |
| 893361103 | Plunger guide | 0.4 -0.5 | 2.9- 3.6 | Oil pump |
| 893391113 | Banjo bolt | 1.1 -1.8 | 8.0-13.0 | Oil pump inlet |
| 016306161 | 6mm bolt | 0.35-0.65 | 2.5- 4.7 | Transmission cover IV |
| 016306221 | 6mm bolt | 0.8 -1.2 | 5.8- 8.7 | Clutch cover |
| 022808000 | 8mm nut | 2.5 -2.8 | 18.1-20.3 | Cylinder |
| | | 1.2 -1.4 | 8.7-10.1 | Lever shaft (Over drive) |
| 022814000 | 14mm nut | 5.8 -6.1 | 42.0-44.1 | Fan |

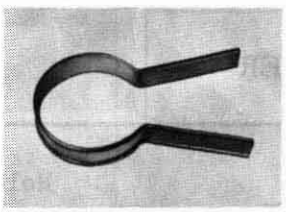
# CHAPTER 7: SPECIAL TOOL

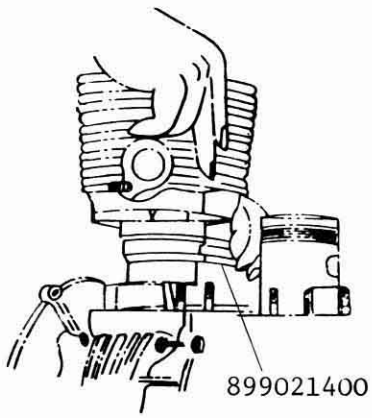
7

| | | | |
|---|---|---|---|
| 1 | 899010110<br>(EK32Y-131)<br>HAND PRESS |  | To attach or remove the piston pin. |
| | 899090110<br>(EK32Y-109)<br>GUIDE |  | |

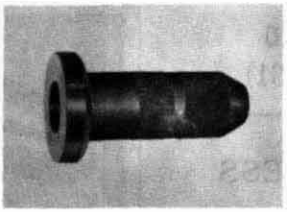


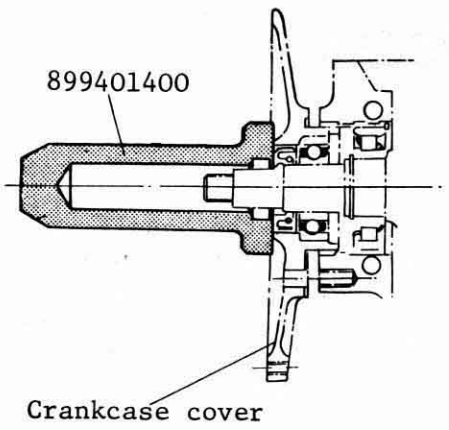

Turn the handle to attach or remove the piston pin. When attaching the piston pin, use the GUIDE 899090110.

| | | | |
|---|---|---|---|
| 2 | 899021400<br>(EK31Y-108)<br>RING BAND |  | To hold the piston ring. |

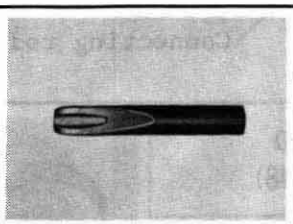


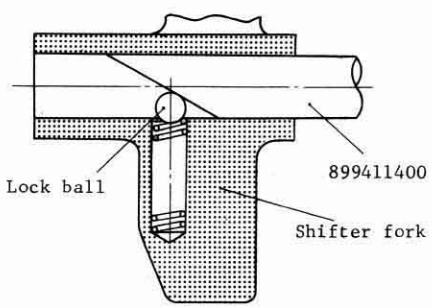

At insertion of the cylinder, this tool holds the piston rings to make insertion easy.

| | | | |
|---|---|---|---|
| 3 | 899401400<br>(EK31Y-105)<br>INSTALLER |  | Pressing-in of the crankcase cover and main shaft bearing. |

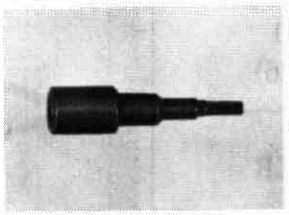


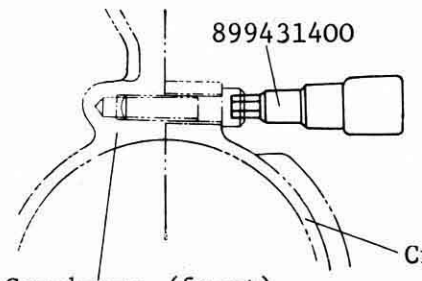

Use when pressing the crankcase cover and the main shaft bearing (output side) in the case.

| | | | |
|---|---|---|---|
| 4 | 899411400<br>(EK31Y-111)<br>INSTALLER |  | To hold the shifter fork rail lock ball |

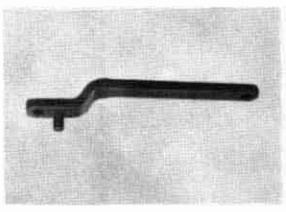
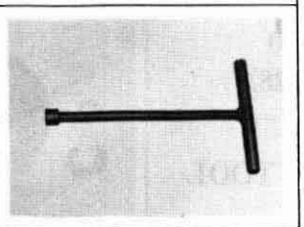


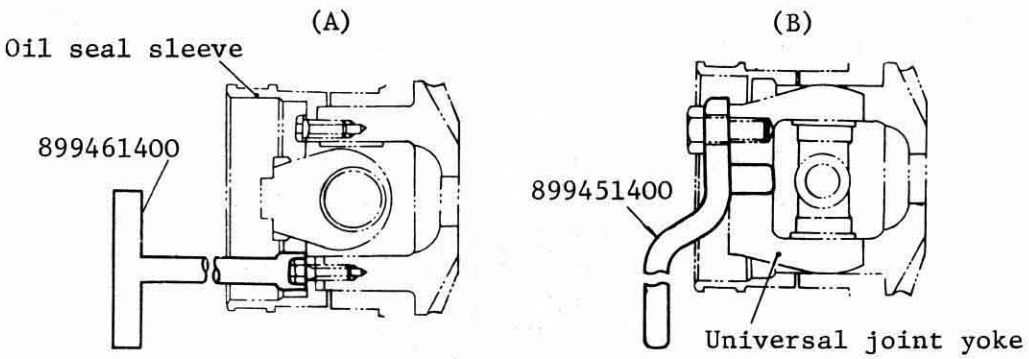

Hold the lock ball and make it a guide for the shifter fork rail.

| | | | |
|---|---|---|---|
| 5 | 899431400<br>(EK31Y-117)<br>KEY WRENCH |  | To tighten or remove the crankcase socket bolts. |

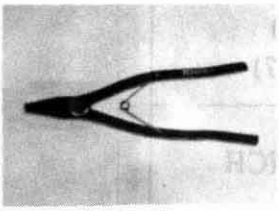


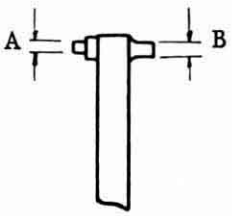

When fitting the front and rear crankcases, tighten the socket bolts using this tool with tightening torque of 2.4 - 2.7 kg-m (17 - 20 lb-ft).

| | | | |
|---|---|---|---|
| 6 | 899451400<br>(EK32Y-122)<br>LEVER |  | To attach or remove the oil seal sleeve. |
| | 899461400<br>(EK32Y-136)<br>T-HANDLE WRENCH |  | |



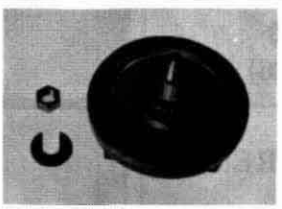

Secure the universal joint yoke with the LEVER as (B) in the drawing. The oil seal sleeve can be removed or installed easily with the T-HANDLE WRENCH.

| | | | |
|---|---|---|---|
| 7 | 899471410<br>(EK31Y-126)<br>EXPANDER |  | To attach or remove the snap ring. |

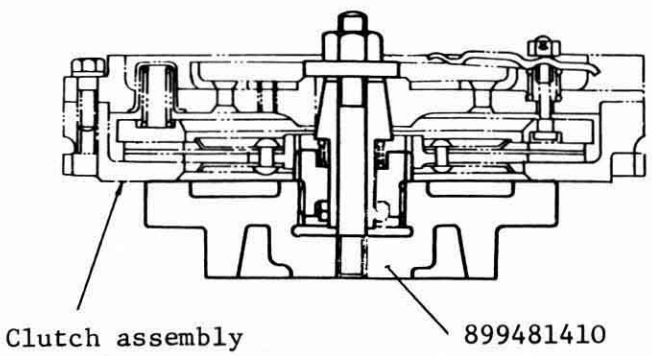


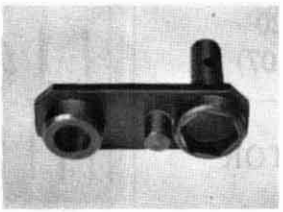

A side (1.5 mm dia.):-
snap ring of the clutch release yoke shaft.

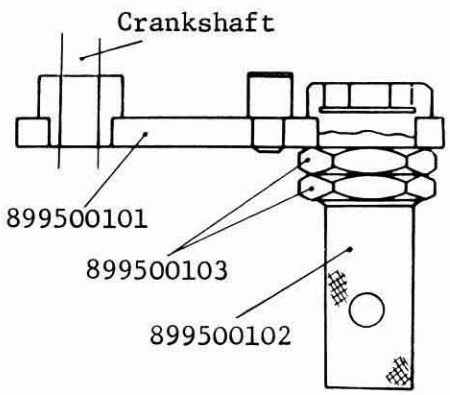
B side (2 mm dia.):-
snap ring of the main shaft.

| | | | |
|---|---|---|---|
| 8 | 899481410<br>(EK31Y-128)<br>ASSEMBLY TOOL |  | To assemble or disassemble the clutch. |

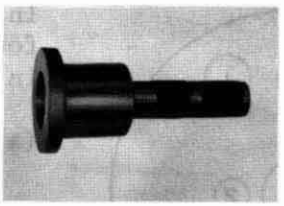
As shown in the drawing, if the clutch parts are fitted in order on the ASSEMBLY TOOL, they can be assembled correctly.

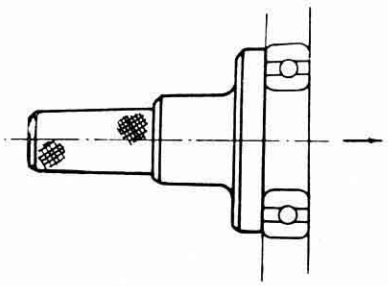


| | | | |
|---|---|---|---|
| 9 | 899500100<br>(EK32Y-102)<br>SOCKET WRENCH |  | To tighten or remove the primary gear lock nut. |

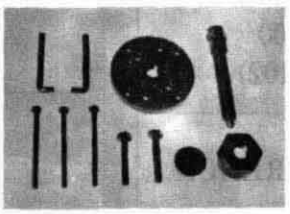



Fit the crankshaft in the hole of the SOCKET and insert the pin of the SOCKET into the hole of the primary gear.
Turn 899500102 to tighten or remove the lock nut.
When tightening the lock nut, tightening torque is 5.7 - 6.2 kg-m (41 - 45 lb-ft).

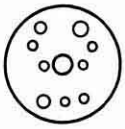
| | | | |
|---|---|---|---|
| 10 | 899510100<br>(EK32Y-104)<br>INSTALLER |  | Pressing-in of the main shaft bearing. |



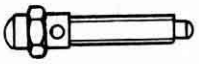
Tap lightly on the end to press in the main shaft bearing (input side) to the same plane as the crankcase surface.

| 11 | 899520120<br>(EK32Y-107)<br><br>EXTRACTOR |  | To pull out the clutch, primary reduction gear, main drive gear, fan and crankcase cover. |
|---|---|---|---|

COMPONENT PARTS

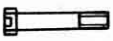


899520101



899521402

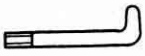
899521403



899521404

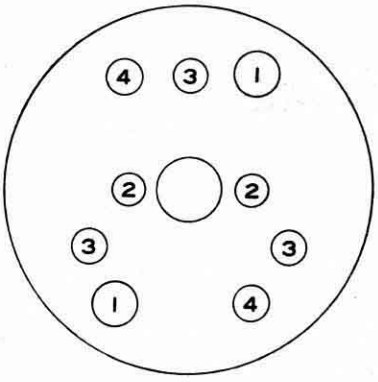
899520105

8995220106



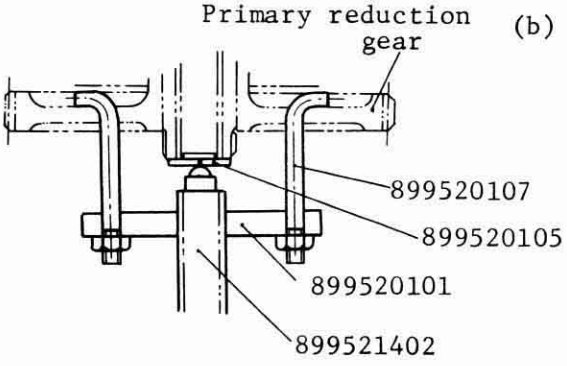
899520107

A. Pulling out the clutch, primary reduction gear, fan and crankcase cover.




Insert the bolts into the holes for removing each part and screw in the bolt 899521402 to remove.

(a) Pull out the clutch assembly with two 8 mm bolts (899521403) by using the holes (1).



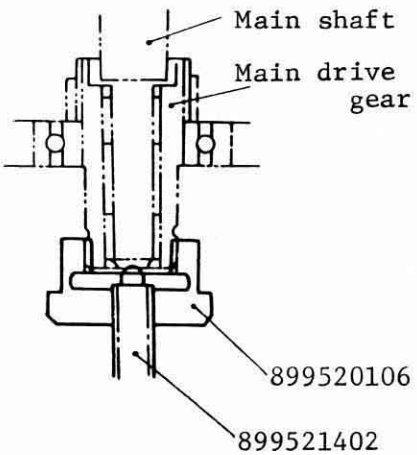

(b) Pull out the primary reduction gear with two 8 mm bolts (899520107) and one plate (899520105) by using the holes (1).

(c) Pull out the fan with two 6 mm bolts (899521404) by using the holes (2).

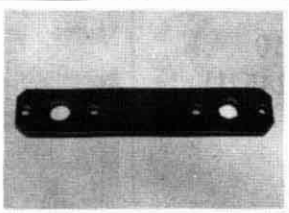
(d) Pull out the crankshaft fan side bearing with three 6 mm bolts (899521404) by using the holes((3). See item 16 on page 7-9.

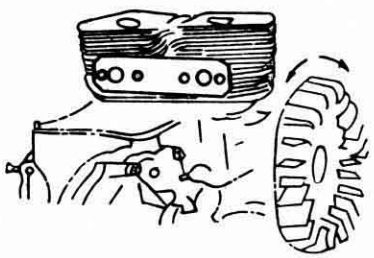
(e) Pull out the crankcase cover with two 6 mm bolts (899521404) by using the holes (4).

B. Pulling out the main drive gear.

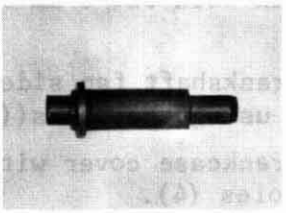


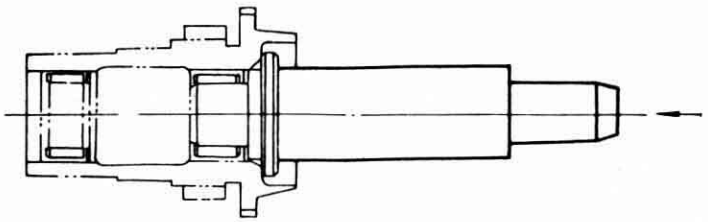

Attach the nut 899520106 to the main drive gear and screw in the bolt 899521402 to remove.

| | | | |
|---|---|---|---|
| 12 | 899530100 (EK32Y-119) ALIGNER |  | To fit the cylinder |

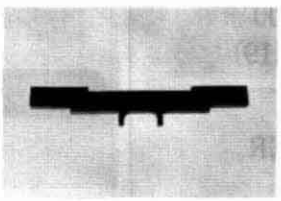


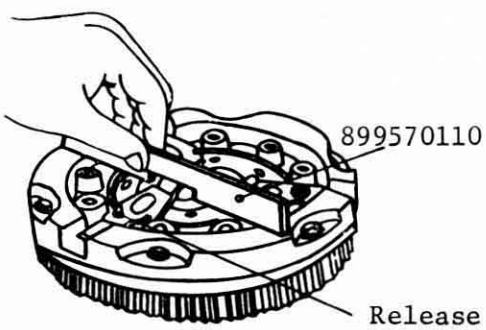
After inserting both cylinders, attach the aligner on the exhaust side with four 8 mm nuts; turn the crankshaft clockwise and counterclockwise 2-3 times and then tighten the cylinders.

| | | | |
|---|---|---|---|
| 13 | 899540100<br>(EK32Y-133)<br>REPLACING TOOL |  | Tc attach or remove the needle bearing |

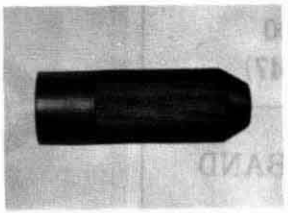


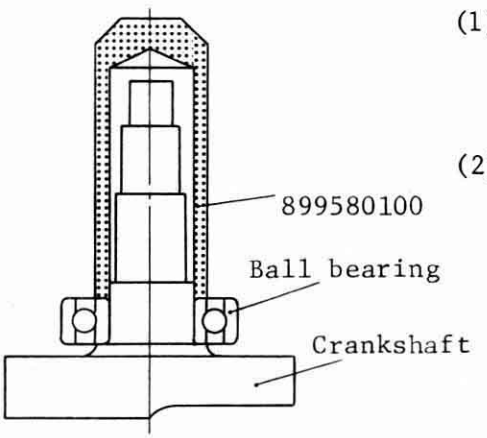
When pressing in the needle bearing on the main drive gear, use the flanged side as shown in the drawing.
Use the opposite side to remove the needle bearing.

| | | | |
|---|---|---|---|
| 14 | 899570110<br>(EK32Y-145/1)<br>GAGE |  | To adjust height of the clutch release lever |



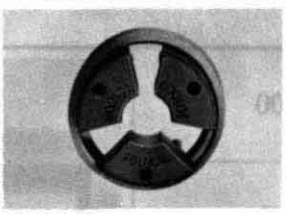

This is used to adjust the height of the clutch release lever.
The adjusted height is 4.5 mm (0.1772 in) above the outer surface of the flywheel. When the height adjustment is off, readjust with the release bolt.

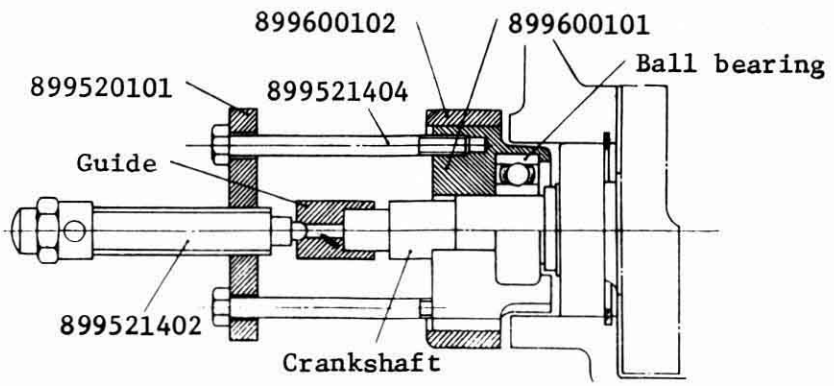
| | | | |
|---|---|---|---|
| 15 | 899580100<br>(EK32Y-140)<br>INSTALLER |  | To press in the crankshaft ball bearing and the counter shaft ball bearing (output side) |



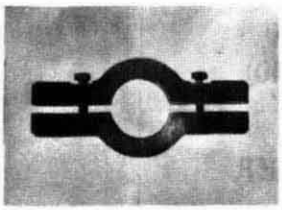

(1) Press the fan side and clutch side ball bearings in slowly by using a press.
(Do not tap them with a hammer).

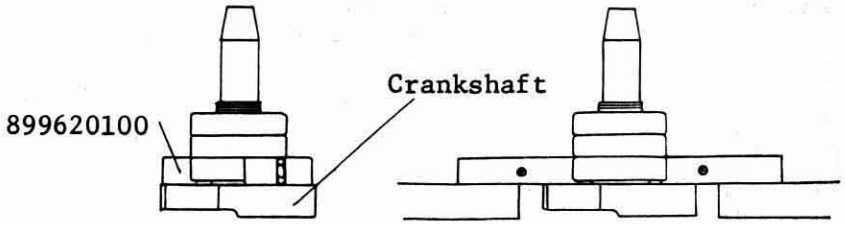
(2) Fit the counter shaft ball bearing (output side) with 899580100 until it is flush with the transmission case.

| | | | |
|---|---|---|---|
| 16 | 899600100<br>PULLER |  | To pull out the crankshaft fan side ball bearing |

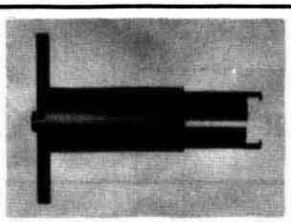


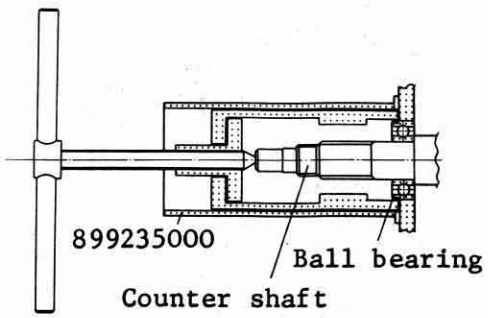

Hook 899600101 separated into three pieces to the ball bearing and fit 899600102 on 899600101.
Then, attach 899520101, 899521402 and 899521404 (three); place a guide on the end of the crankshaft and screw in 899521402 to pull out the ball bearing. (Refer to item (d) on page 7-7.)

| | | | |
|---|---|---|---|
| 17 | 899620100<br>(EK32Y-147)<br>BEARING BAND |  | To remove the crankshaft clutch side ball bearing |

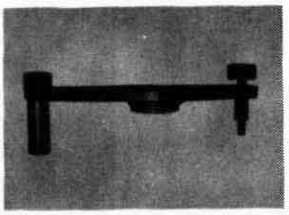


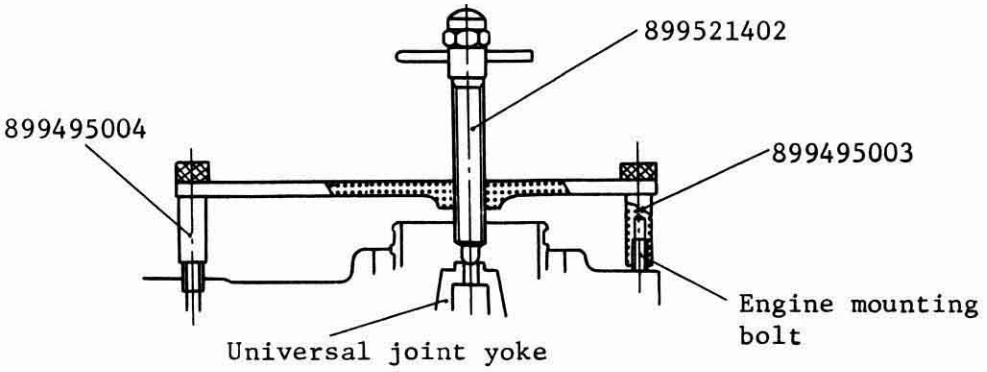

Attach 899620100 as shown in the drawing; place a protector on the end of the crankshaft and push the crankshaft with a press. The two ball bearing, oil seal and spacer II will be removed.

| | | | |
|---|---|---|---|
| 18 | 899235000<br>PULLER |  | To remove the counter shaft ball bearing |

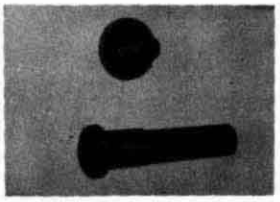


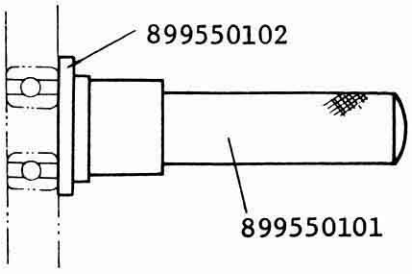

Hook 899235001 to the groove of the ball bearing; fit 899235002 on it and screw in 899235003 to pull out the ball bearing.

| | | | |
|---|---|---|---|
| 19 | 899495000<br>EXTRACTOR |  | To remove the transmission case |




The transmission case can be pulled off by fitting 899495003 on the engine mounting bolt and screwing 899495004 into the hole for pulling out and by screwing 899521402 after contacting it to the universal joint yoke.

| | | | |
|---|---|---|---|
| 20 | 899550100<br>(EK32Y-135)<br>INSTALLER |  | To press in the counter shaft bearing (input side) |




Press in the counter shaft bearing (input side) with 899550101 and 899550102 combined until it is flush with the crankcase.

# SUPPLEMENT



S

# SEPARATE LUBRICATION SYSTEM (SUBARUMATIC)

## A. GENERAL

In the past, practically all 2-stroke engines for automobiles used a mixed fuel of gasoline and oil. Recently, however, to eliminate the inconvenience of using mixed fuel and to compensate the disadvantages inherent in 2-stroke engine, new methods in which gasoline and lubricating oil are supplied to the engine from two separate tanks are being adopted.
However, these methods are not very much different from a conventional fuel system; for example, in these methods, either gasoline and lubricating oil are mixed in the carburetor or the lubricating oil is spouted inside the suction tube and then the oil is sent inside the engine with the suction gas.
The separate lubrication in the SUBARU (SUBARUMATIC) is completely different in essential respects from the methods described above. The use of separate tanks for gasoline and lubricating oil is the same as in the cases of the above methods. In the Subarumatic method, however, the oil is sent directly to the crankshaft bearings by an oil pump for an adequate and positive simultaneous lubrication of the bearings, crankpins, big and small ends of the connecting rods, pistons and cylinders with fresh oil not diluted by gasoline.

Because of the above, the Subarumatic methods has the following advantages:

(a) The trouble of using mixed fuel is eliminated, making the fuel supply simple.

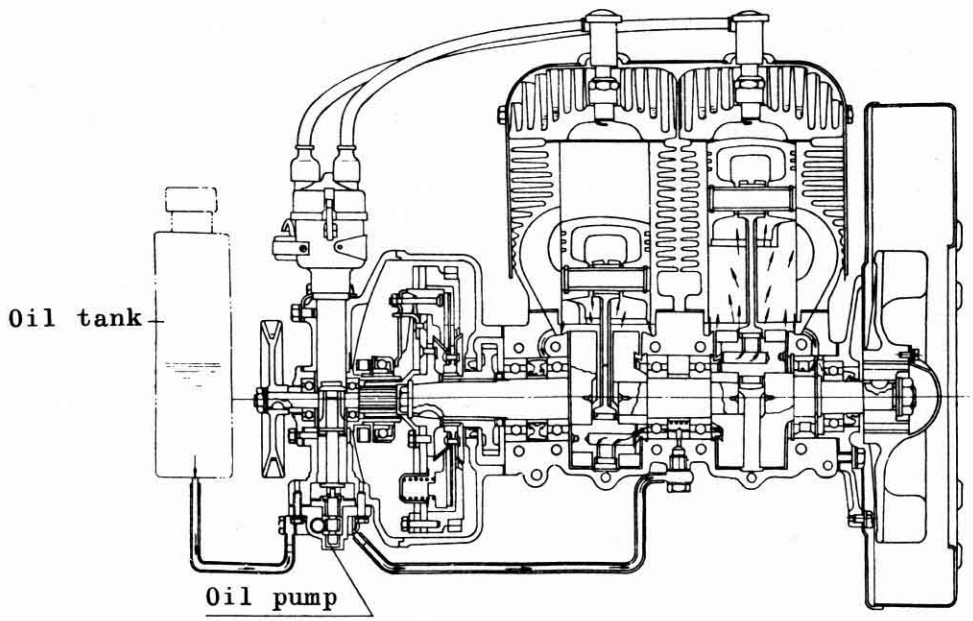
(b) Because fresh oil of high lubricability, undiluted by gasoline, is always supplied to the principal parts of the engine, the life of the engine is prolonged and it exhibits high durability and efficiency in continuous high-speed running.

(c) Exhaust smoke which is regarded as a disadvantage of the 2-stroke engine is decreased; the amount of carbon that adheres to the combustion chambers of the cylinder heads, exhaust ports, piston heads, spark plugs, exhaust manifold and muffler, etc., is kept down to a minimum, practically eliminating the troubles due to accumulation of carbon on these parts and the necessity of maintenance.

(d) Since the proper amount of oil is always supplied to the engine according to the engine speed and load variation, there is no wasteful consumption of oil and fuel cost is much less than in the case of mixed fuel.

(e) Unlike a 4-stroke engine, there is no necessity of changing oil, thus simplifying the lubricant control.

B. OUTLINE OF SUBARUMATIC LUBRICATION SYSTEM




Engine cross sectional drawing

An outline of the separate lubrication method (Subarumatic) is described below.
First, gasoline is supplied from the tank which was used for mixed fuel. Oil is supplied from a tank provided in the engine room. The oil tank is attached to the engine room right side fender apron with brackets and supporters. It is made of white translucent polyethylene; its capacity is 2.5 $\ell$ (2.6 U.S. qt, 2.2 Imp. qt).
The oil pump is Mikuni Kogyo's Model 1P-7D-3A, is mounted below the clutch housing cover and is driven by the same method as the distributor. Oil pump pressure-feeds oil from the oil tank into the central part of the engine crankcase through a check valve. Here, the oil diverts; some lubricates the bearing of the central part of the crankshaft; some oil

splashed by an oil slinger collects in the oil groove provided on the crank web and flows into the crankpin sections. This oil also lubricates the connecting rod big end and bearing; then it is splashed by the revolution of the engine and lubricates the connecting rod small end, bearing, cylinder, piston, etc.

A part of the splashed oil and the oil which drips down from the lower side of the cylinder collects in an oil collecting groove provided on the crankcase below the cylinder, flows into the crankcase and lubricates the bearings on both ends of the crankshaft.

The above is an outline of the path of the lubricating oil. (See the cross sectional drawing). Also, the oil supply is controlled by both the engine revolution and load. The oil pump is a plunger type which performs reciprocating movements while rotating and since it is driven by gears, its actuation is proportional to the revolution of the engine.

On the other hand, the reciprocating movement is a variable stroke type and regulates the stroke of the carburetor throttle valve movement through a cable.

Consequently, the amount of oil increases when either the engine revolution or the opening of the carburetor throttle valve increases.

Also, to facilitate oil supply, a float and an electric transmitter which interlocks with the float are provided in the oil tank; when the oil in the tank drops to 0.8 ℓ (1.7 U.S. pt, 1.4 Imp. pt), the oil warning lamp of the combination meter in the driver's compartment starts to flash. When the oil is reduced to 0.5 ℓ (1.0 US pt, 0.9 Imp. pt), the oil warning lamp lights continuously to indicate the need for replenishing oil.

## C. SPECIAL CHARACTERISTICS OF SUBARUMATIC TWO-STROKE ENGINE

When the running condition of a four-stroke engine is poor, combustion will be incomplete, even if gasoline which is easy to burn and has a low combustion point is used. Carbon and other deposits will form on the cylinder and piston heads. This situation is even more serious in the case of the two-stroke engine. Oil and gasoline enter the combustion chamber together and must be burned. Even if the gasoline is burned completely, complete burning of the oil is very difficult. If the oil should not be burned completely and not be expelled completely from the exhaust, carbon and other deposits will form rapidly, impairing the function and performance of the engine and causing clogging of the exhaust pipe. Four-stroke engine oil is completely unsuitable for use in the two-stroke engine with SUBARUMATIC lubrication system.

(CAUTION): Do not use detergent oil.
If this type of oil should be used, the following troubles will result:

* The necessary amount of oil may not enter or too much may enter, the engine may overheat or fail to start.
* In cold weather, oil cannot circulate due to the decrease in fluidity.
* The spark plug will be fouled and starting of the engine will be impaired.
* Carbon will accumulate rapidly inside the muffler, cylinder head and piston head; the engine performance will be greatly impaired.

D. SUBARUMATIC OIL

Through rigorous tests and experiments by our company staff, the designated oil has been proven to be most suitable for SUBARU 360 Series vehicles and possess the following features.

* PROPER VISCOSITY (7.5-9.5 C. St. at 210°F)
  Flow is hindered when it is too heavy and the lubrication effect is reduced when it is too light.
* HIGH INDEX OF VISCOSITY: Over 90 (Equivalent to SAE#20)
  If the index of viscosity is too low, it thickness in the winter and softens during the summer, thus causing excessive variations in lubrication effectiveness dependent on climate.
* LOW FLUIDITY POINT: under -22.5°C (-8.5°F)
  If the fluidity point is high, it will thicken faster in colder climate and hinder the flow.
* LESS CARBON DEPOSITS on spark plugs and inside the cylinders.

E. SOME OF MANUFACTURE'S RECOMMENDED OIL ARE:

| | |
|---|---|
| Standard Oil Co. | R.P.M. |
| ESSO | 2-Stroke Engine Oil |
| Caltex | 2-Stroke Engine Oil |
| Valvolin Oil Ref. Co. | Valve mix. |
| Mobil Oil Co. | Mobil mix. |

(NOTE)

(1) Regarding above mentioned 2-stroke oil viscosity, if the temperature in your country is always hotter than 10°C (50°F), SAE#30 grade of above mentioned brands must be used instead of SAE#20 or 20W.

If the temperature is below -20°C (-4°F), dilute the SAE#30 grade of above mentioned oil with 10-15% regular gasoline or kerosene.

(2) Do not mix different brands of oil. Each type of two-stroke engine oil has its particular characteristics created by elaborate mixing of different additives. Since additives in some oil types may create bad effects when mixed with another type oil, mixing several types of engine oils should be strictly avoided.
Always use one type of oil; never mix the oils or change the type. When changing the type of oil, be sure that the oil tank is completely drained. In this case oil remaining in the vinyl pipe can be left as is.