SERVICE MANUAL

SERIES 7000
COMPACT TRACTOR
Model Number
7360SS

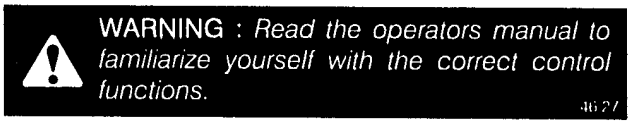
CUB CADET • P.O. BOX 368023 • CLEVELAND, OHIO 44136-9723

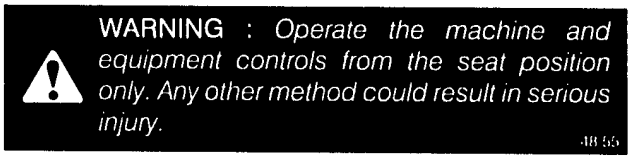
INDEX

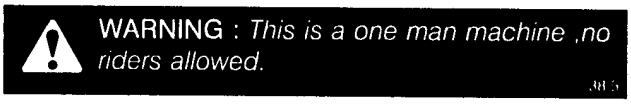
I. GENERAL

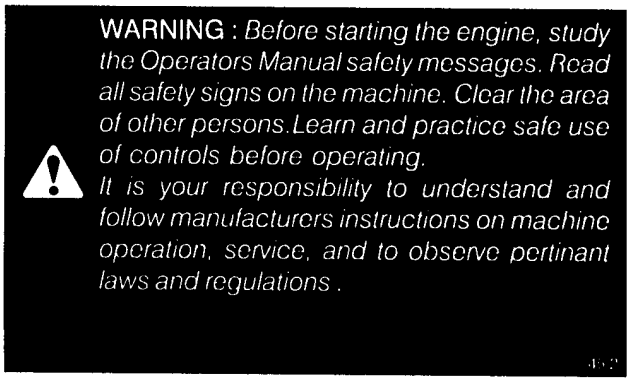
1. SAFETY

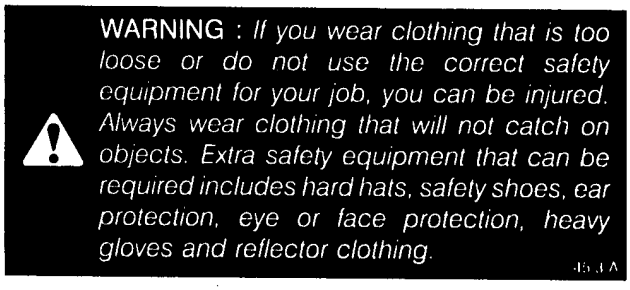
To prevent injury always follow the Warning, Caution and Danger notes in this section and throughout the manual.



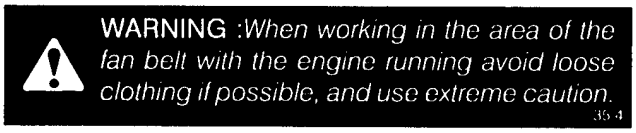


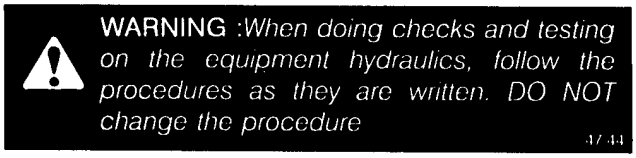


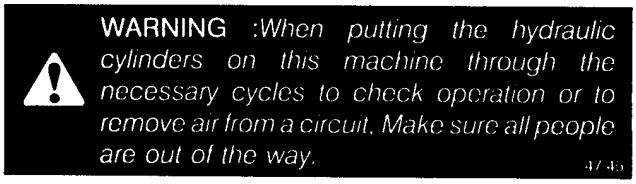




NOTE: *Operator's and Service Manuals may be obtained from your dealer.*







WARNING: *Always use heat protective gloves when handling heated parts.*

47 41A

CAUTION : *Lower all attachments to the ground or use stands to safely support the attachments before you do any maintenance or service.*

49 11

CAUTION : *Pin sized and smaller streams of hydraulic oil under pressure can penetrate the skin and result in serious infection. If hydraulic oil under pressure does penetate the skin, seek medical treatment immediately. Maintain all hoses and tubes in good condition. Make sure all connections are tight. Make a replacement of any tube or hose that is damaged or thought to be damaged. DO NOT use your hand to check for leaks, use a piece of cardboard or wood.*

40 6 A

CAUTION : *When removing hardened pins such as a pivot pin. or a hardened shaft, use a soft head (brass or bronze) hammer or use a driver made from brass or bronze and use a steel hammer.*

46 17

CAUTION : *When using a hammer to remove and install pivot pins or seperate parts using compressed air or using a grinder, wear eye protection that completely encloses the eyes (approved goggles or other approved eye protection).*

46 13

CAUTION : *Use suitable floor (service) jacks or chain hoists to raise wheels off the floor. Always block machine in place with suitable safety stands.*

40 7 A

CAUTION : *When servicing or repairing the machine. Keep the shop floor and operator's compartment and steps free of oil, water, grease, tools etc. Use an oil absorbing material and or shop cloths as required. Use safe practices at all times.*

40 8

CAUTION : *Some components of this machine are very heavy. Use suitable lifting equipment or additional help as instructed in this Service Manual.*

40 10

DANGER : *Engine exhaust fumes can cause death. If it is necessary to start the engine in a closed place, remove the exhaust fumes from the area with an exhaust tube extension. Open the doors and get outside air into the area.*

48 56

DANGER : *When the battery electrolyte is frozen, the battery can explode if (1), you try to charge the battery or (2) , you try to jump start and run the engine. To prevent battery electrolyte from freezing, try to keep the battery at full charge. If you do not follow these instructions you or others in the area can be injured.*

48 35

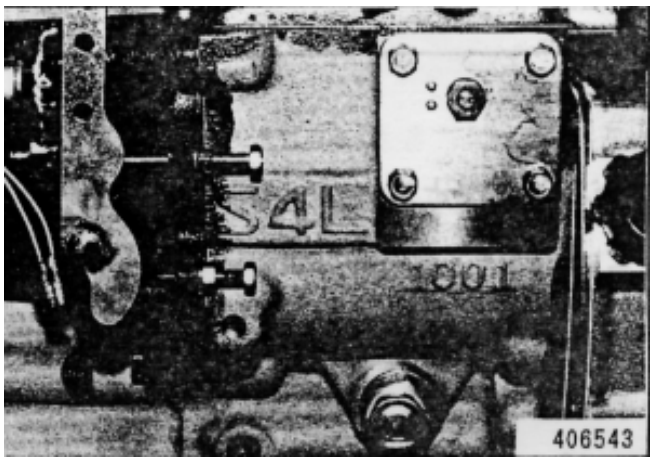
DANGER : *Batteries contain acid and explosive gas. Explosions can result from sparks, flames or wrong cable connections. To connect the jumper cables correctly to the battery of this machine refer to the Operators Manual. Failure to follow these instructions can cause serious injury or death.*

2. LOCATION OF ENGINE MODEL, ENGINE SERIAL NO. AND TRACTOR SERIAL NO. IDENTIFICATIONS

(1) ENGINE MODEL

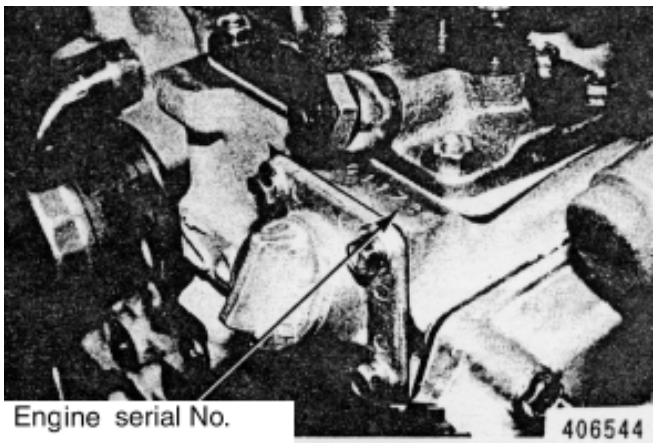
Engine model is relieved on right side of cylinder block . Enter this model and engine serial number

(See next paragraph) for ordering parts.



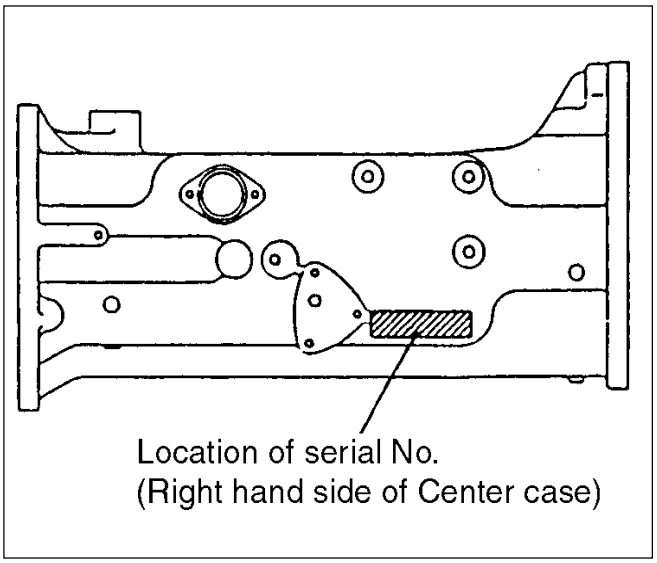
(2) ENGINE SERIAL NO.

Engine serial No. is punched on right side of engine block by the injection pump.



(3) TRACTOR SERIAL NO.

Tractor Serial No. is punched on right side of transmission center case.



3. SPECIFICATION AND DATA

Capacities

Engine oil capacity with filter change	4.5 liters	4.8 QTS

NOTE : Oil filter capacity is 0.5 liters (0.13 US Galls)

Cooling capacity	7.1 liters	7.9 QTS
Transmission & Hydraulic oil	43 liters	45.9 QTS
MFD Axle	6.5 liters	6.9 QTS
Fuel Tank	35 liters	9.2 Gallons

NOTE : Use the capacities listed above only as a guide. Always use the dipstick or level plug to make sure the units are filled to the correct level.

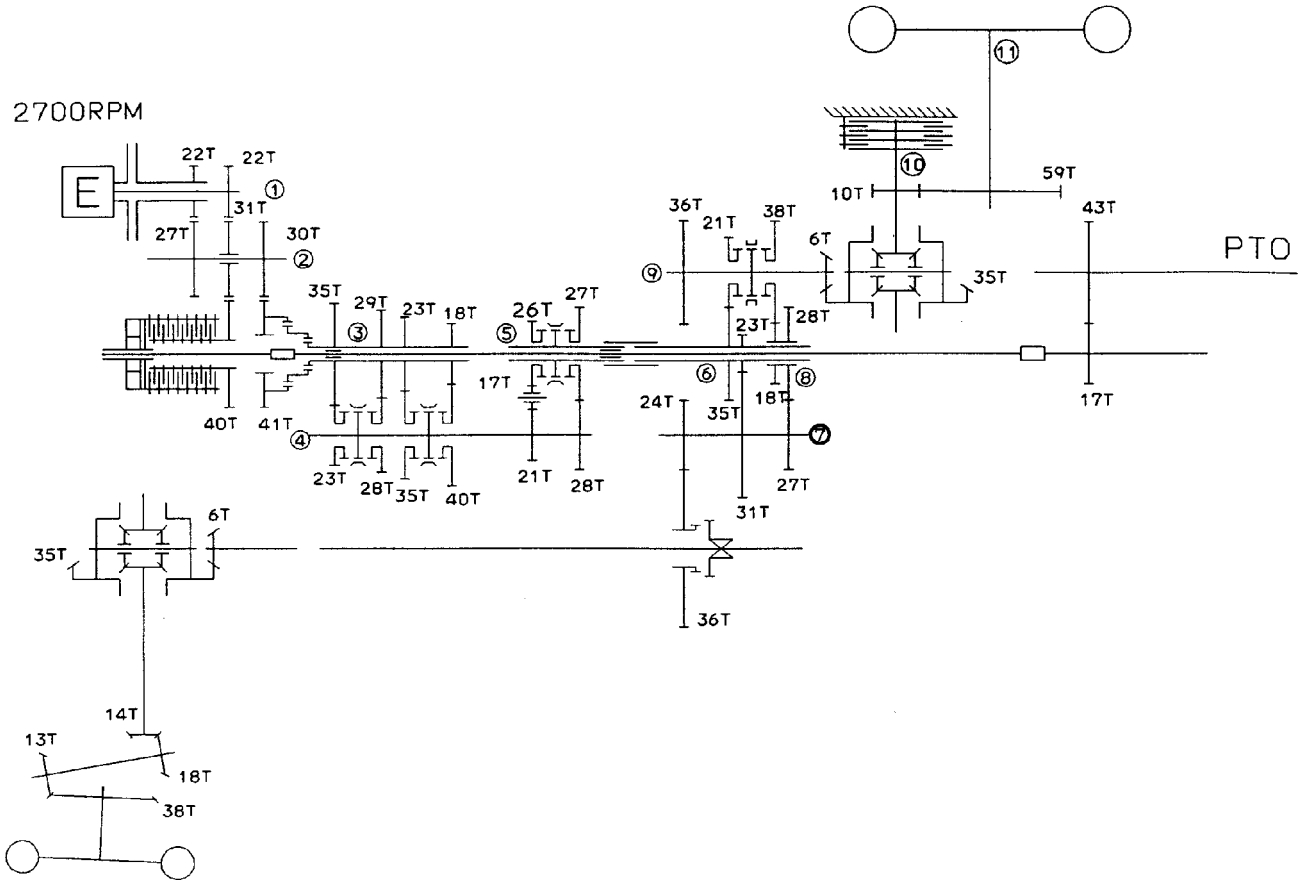
Fuel Specifications

A.P.I Gravity (Min)	34	
Flash Point (Min)	60°C	140°F
Cloud Point (Wax Appearance Point) (Max)	21°C	5.8°F
Pour Point (Max)	26°C	14.8°F
Distillation Temperature, 90% Point	282 to 338flC	539 to 640flF
	Viscosity at 38flC	
Centistokes	2.0 to 4.3	
Saybolt second Universal	32 to 40	
Cetane Number (Min)	43 (45 to 55 for winter or high altitude)	
Water and Sediment by Volume (Max)	0.05 of 1 %	
Sulfer, by weight (Max)	0.50 of 1 %	
Copper Strip Corrosion (Max)	No. 2	
Ash, by weight (Max)	0.01 of 1 %	
Fuel Filter Cup Service Interval	Every 10 Hours	
Fuel Filter Element Change	Replace yearly or as needed	

Fuel injectors

Valve Leakage Rate ——— No Leakage Permissible, Slight Moistening of the Nozzle Tips is allowed

4. POWER TRANSMISSION DIAGRAM



5. TIGHTENING TORQUES

STANDARD BOLT TORQUES

Bolt Grade (Indicated on Bolt Head)				
Bolt Size	4T	6T	7T	8T
5mm	1.5 to 2 lb ft (2 to 3 Nm)	3 to 4 lb ft (4 to 5 Nm)	4 to 4.5 lb ft (5 to 6 Nm)	4.5 to 5 lb ft (6 to 7 Nm)
6mm	4 to 5 lb ft (5 to 7 Nm)	6to 7.5 lbft (8 to10 Nm)	7.5 to 9 lb ft (10 to 12 Nm)	9 to 10.5 lb ft (12 to 14 Nm)
8 mm	9 to 12.5 lb ft (12 to 17 Nm)	15 to 18.5 lb ft (20 to 25 Nm)	18.5 to 21.5 lb ft (25 to 29 Nm)	21.5 to 25 lb ft (29 to 34 Nm)
10 mm	15 to 21.5 lb ft (20 to 29 Nm)	29 to 36 lb ft (39 to 49 Nm)	36 to 43.5 lb ft (49 to 59 Nm)	43.5 to 50 lb ft (59 to 69 Nm)
12 mm	32.5 to 40 lb ft (44 to 54 Nm)	50 to 58 lb ft (69 to 78 Nm)	61 to 68.5 lb ft (83 to 93 Nm)	69 to 79 lb ft (93 to 107 Nm)
14 mm	47 to 58 lb ft (64 to 78 Nm)	72.5 to 87 lb ft (98 to 118 Nm)	87 to 97.5 lb ft (118 to 132 Nm)	97.5 to 108.5 lb ft (132 to 147 Nm)
16 mm	65 to 80 lb ft (88 to 108 Nm)	94 to 108.5 lb ft (127 to 147 Nm)	112 to 127 lb f (152to 172 Nm)	130 to 144.5 lb ft (176 to 196 Nm)
18 mm	87 to 101 lb ft (118 to 137 Nm)	123 to 136.5 lb ft (167 to 185 Nm)	152 to 173.5 lb ft (206 to 235 Nm)	181 to 203 lb ft (245 to 275 Nm)
20 mm	108.5 to 123 lb ft (147 to 167 Nm)	144.5 to 159.5 lb ft (196 to 216 Nm)	173.5 to 203 lb ft (235 to 275 Nm)	231 to 260.5 lb ft (314 to 353 Nm)

STANDARD TORQUE DATA FOR REPLACEMENT NUTS AND BOLTS

Torque Specifications +/- 10%		
SIZE	GRADE 8.8	GRADE 10.9
5 mm	4 lb ft (5.5 Nm)	5.5 lb ft (7.5 Nm)
6mm	7 lb ft (9Nm)	9 lb ft (12.5 Nm)
8 mm	17 lb ft (22.5 Nm)	23 lb ft (31.5 Nm)
10 mm	32.5 lb ft (44 Nm)	46 lb ft (62 Nm)
12 mm	57 lb ft (77.5 Nm)	81 lb ft (110 Nm)
14 mm	88.5 lb ft1 (20 Nm)	125.5 lb ft (170 Nm)
16 mm	140 lb ft (190 Nm)	196 lb ft (265 Nm)
18 mm	192 lb ft (260 Nm)	269.5 lb ft (365 Nm)

6. PRECAUTIONS FOR DISASSEMBLY

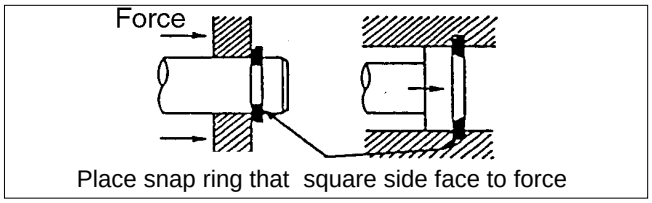
Place the tractor on level and hard ground, put the range shift lever in the L position, apply the park brakes and stop the engine. Put blocks in front of and behind the front wheels.

1. Disassembly

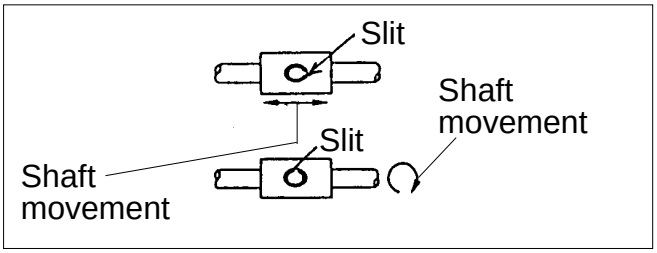
1) Always use tools that are in good condition and be sure you understand how to use them before performing any job.
   Use a work bench , if necessary. Also use bins to keep removed parts in order of removal.
2) When disassemble the electrical parts, place the stater key on OFF position and disconnect the negative side of battery cable. In case of removing the battery, disconnect the negative cable first and disconnect positive cable.
3) Parts must be restored to their respective components from which they were removed at disassembly. This means that all parts must be set aside separately in groups, each marked for its component, so that the same combination or set can be reproduced at assembly.
4) Carefully handle the hydraulic parts during disassembly not to contaminate with dust, metal chips etc.
5) For disassembling the electrical parts, remove the negative battery cable first.
6) Pay attention to mark on assemblies, components and parts for their positions or directions. Put on marks, if necessary, to aid assembly.
7) Carefully check each part or component for any sign of faulty condition during removal or cleaning. The part will tell you how it acted or what was abnormal about it more accurately during removal or cleaning.
8) When lifting or carrying a part too heavy or too awkward for one person to handle, get another person's help and, if necessary, use a jack or a hoist.

2. Assembly

1) Wash all parts, except for oil seals, O-rings, rubber sheets, etc., with cleaning solvent and dry them with pressure air.
2) Clean up the parts before checking the installation parts.
3) Use genuine parts for replacement to keep machine performance and safety.
4) Replace the packing and O-ring for reassembling. Apply grease to O-ring and oil seal for their installation.
5) Use Three bond 1208D as liquid packing.
   - Remove the old packing completely before applying the new packing. Apply new packing with 1 to 2 mm thickness without gap.
   - Assemble the parts within 10 minutes after applying the liquid packing. Pour the oil etc. after 30 minutes of assembling with liquid packing.
6) Install the snap ring as shown below.



7) Install the spring pin that its slit faces to direction of force as shown below..



8) Replace the cotter pin for the reassembling and bend it.
9) Tighten the bolts and nuts etc. to obtain the specified tightening torque by torque wrench.
10) For the battery installation, connect the positive cable first and then connect the negative cable.

7. GENERAL INFORMATION

CLEANING

Clean all metal parts except bearings, in mineral spirits or by steam cleaning. Do not use caustic soda for steam cleaning. After cleaning, dry and put oil on all parts. Clean oil passages with compressed air. Clean bearings in kerosene, dry the bearings completely and put oil on the bearings.

INSPECTION

Check all parts when the parts are disassembled. Replace all parts that have wear or damage. Small scoring or grooves can be removed with a hone or crocus cloth. Complete visual inspection for indications of wear, pitting and the replacement of parts necessary, will prevent early failures.

BEARINGS

Check bearings for easy action. If bearings have a loose fit or rough action, replace the bearings. Wash bearings with a good solvent or kerosene and permit to air dry. DO NOT DRY BEARINGS WITH COMPRESSED AIR.

NEEDLE BEARINGS

Before you press needle bearings in a bore, always remove any metal protrusions in the bore or edge of the bore. Before you press bearings into position, put petroleum jelly on the inside and outside diameter of the bearings.

GEARS

Check all gears for wear and damage. Replace gears that have wear or damage.

OIL SEALS, O-RINGS AND GASKETS

Always install new oil seals, o-rings and gaskets. Put petroleum jelly on seals and o-rings.

SHAFTS

Check all shafts that have wear or damage. Check the bearing and oil seal surfaces of the shafts for damage.

SERVICE PARTS

Always install genuine Mitsubishi service parts. When ordering, refer to the Parts Catalog for the correct part number of the genuine replacement items. Failures due to the use of other than genuine Mitsubishi replacement parts are not covered by warranty.

LUBRICATION

Only use the oils and lubricants specified in the Operator's and Service Manuals. Failures due to the use of non-specified oils and lubricants are not covered by warranty.

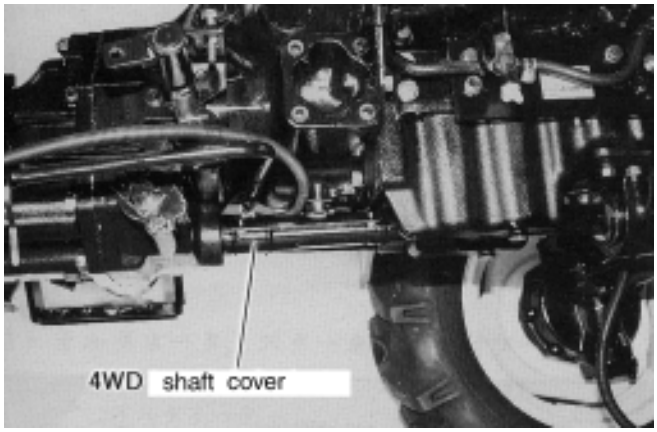
II. ASSY REMOVAL AND REINSTALLATION

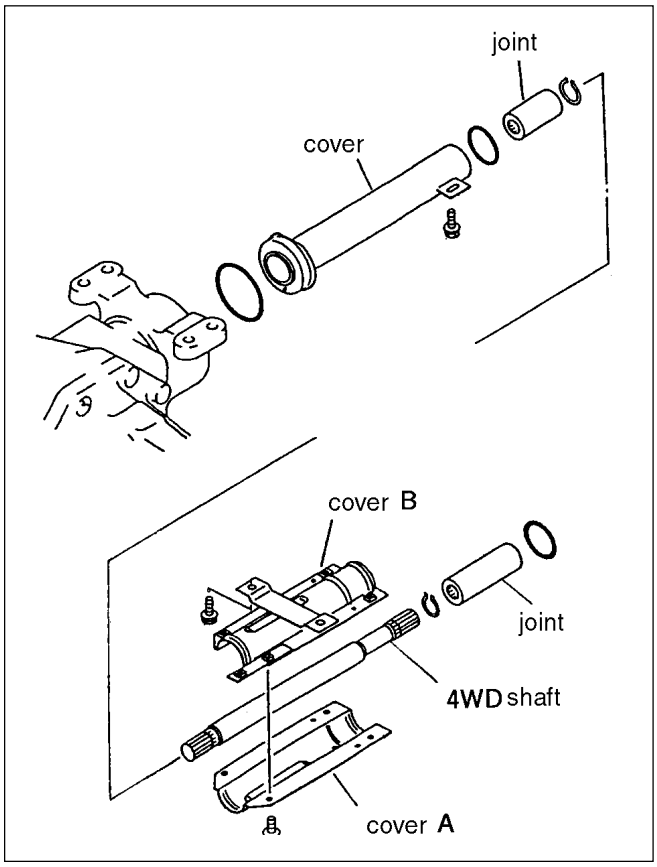
1. FRONT AXLE ASSY REMOVAL AND REINSTALLATION

1-1 FRONT AXLE ASSY REMOVAL

(1) 4WD SHAFT REMOVAL

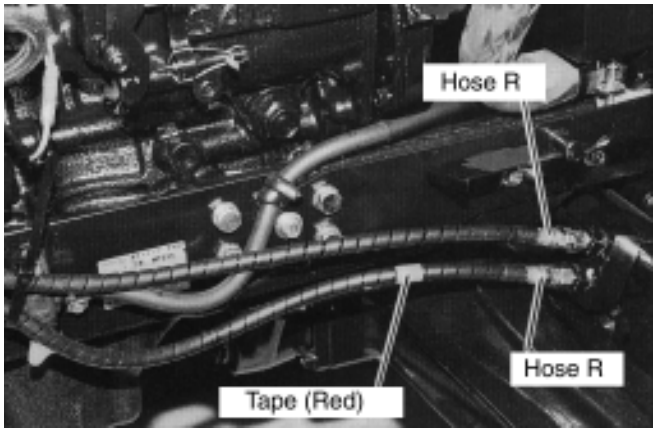
1. Remove cover A
2. Remove the snap ring at joint (rear side) from the shaft groove.
3. Move the joint to front side and remove the 4WD shaft.





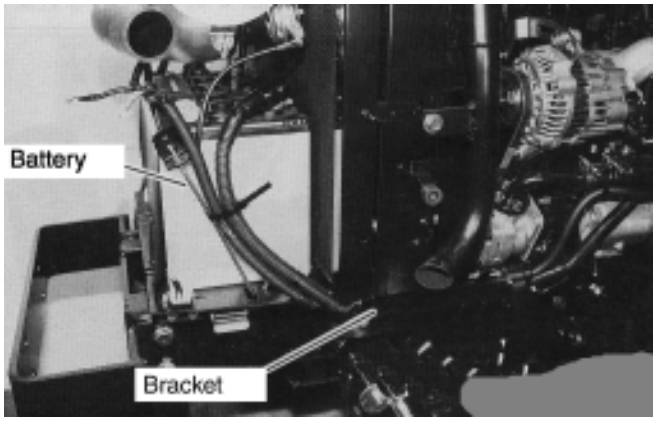
(2)STEERING HOSE REMOVAL

1.Remove the two hoses from steering cylinder



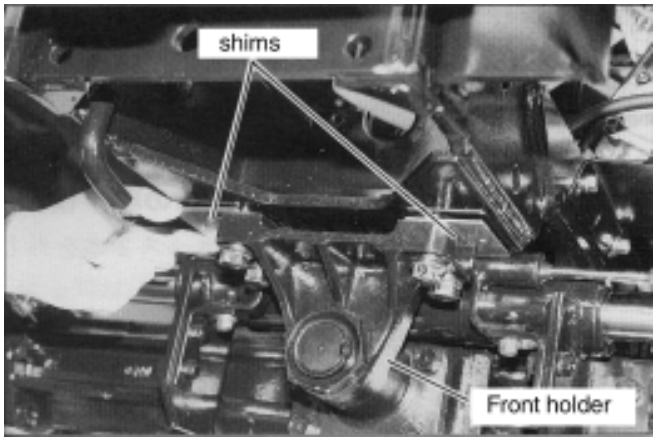
(3) BATTERY CODE DISCONNECTION

1. Disconnect Battery Code (Negative) and loosen fixing bolts of bracket.

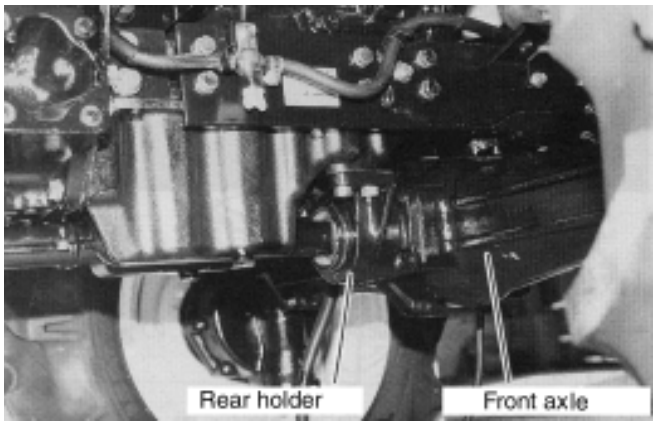


(4) FRONT & REAR HOLDER REMOVAL

1. Remove mounting bolts of front holder.

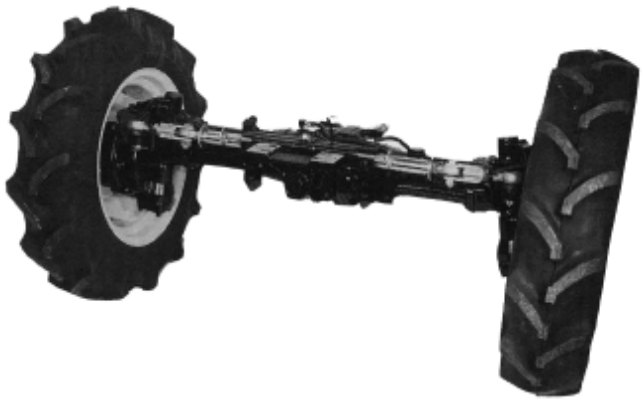


2. Remove mounting bolts of rear holder.



(5) FRONT AXLE ASSY REMOVAL

1. Lift up the chassis by jack and remove the front axle assy from chassis.



1-2 FRONT AXLE ASSY REINSTALLATION

*Install the front axle assy with reversed procedure of removal.
Use following adjustment and service standards for the reinstallation.

1. When reinstall the front axle assy to chassis, tighten the mounting bolts of the rear holder first.
   Tightening Torque : 86.8~97.6lbf.ft
   (12 ~13.5 kgf-m)

2. Measure the clearance between front holder and chassis. Put the shims of which thickness is half of the measured clearance.
   Tighten the mounting bolts of Front Holder.
   Tightening Torque : 61.5~68.7lbf.ft
   (8.5~9.5 kgf-m)

3. When reinstall the hoses to the cylinder, install the hose with red tape to lower side of the port.

4. After install the hoses, turn the steering wheel to left and make sure the front axle is steered to left.

5. When reinstall the 4WD shaft, apply the grease to the spline.

6. Make sure the snap ring is in the groove.

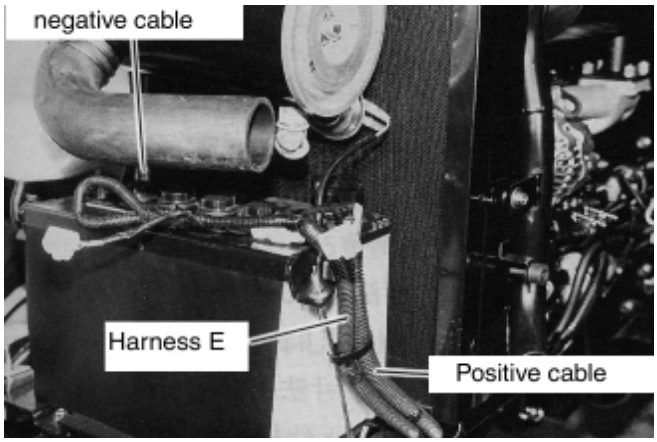
7. After reinstall the front axle assy, check the toe-in and readjust it if necessary.

2. ENGINE ASSY REMOVAL AND REINSTALLATION

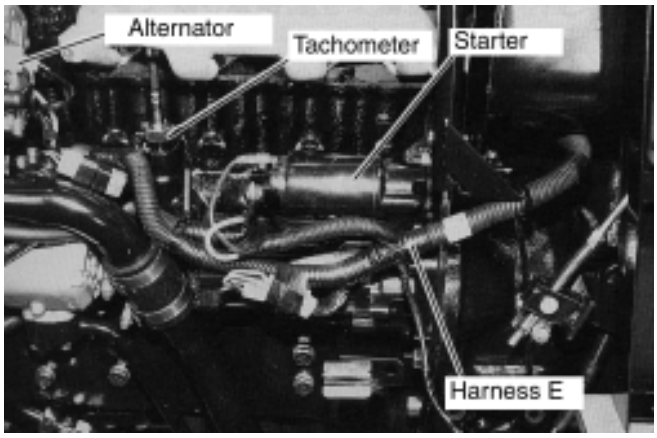
2-1 ENGINE ASSY REMOVAL

(1) HARNESSES REMOVAL

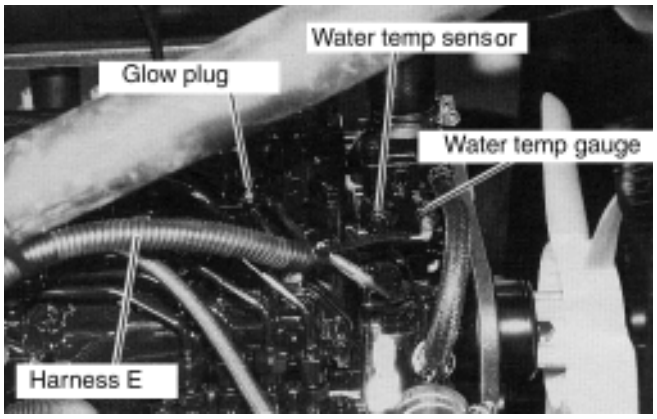
1. Remove front grille, bonnet, side covers and panel cover.
2. Disconnect battery cable (Disconnect negative cable first and then disconnect positive cable.)



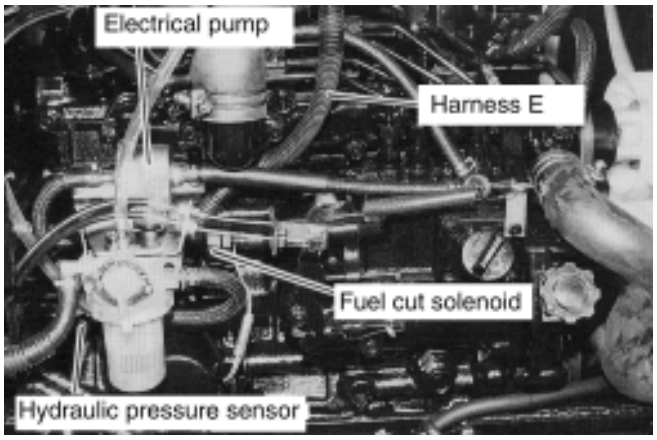
3. Disconnect the harnesses at alternator and starter motor. Disconnect the tachometer cable.



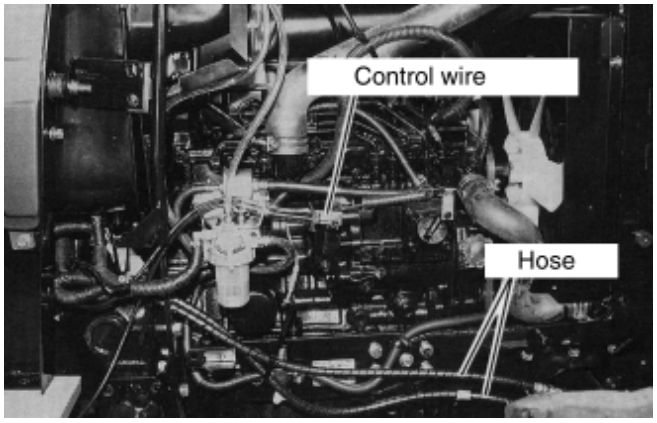
4. Disconnect the harnesses at water temperature gauge, water temperature sensor and glow plug.



5. Disconnect the harnesses at oil pressure sensor, fuel cut solenoid, electric fuel feed pump and fuel gauge.

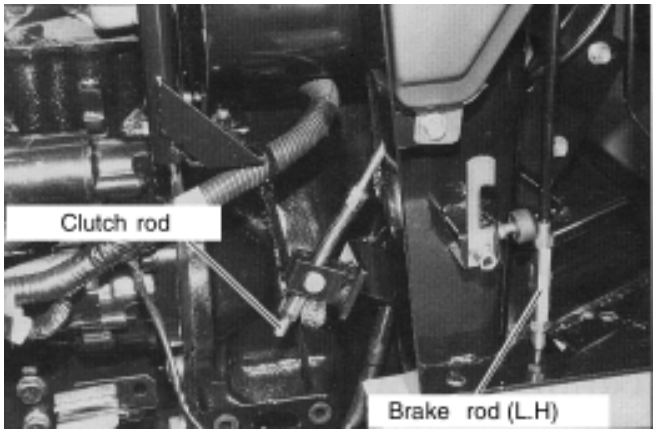


6. Disconnect the engine control wires (2 wires) at governor side. Disconnect the engine control wire for foot accel pedal from step. Remove the power steering hoses (2 hoses) from steering cylinder.

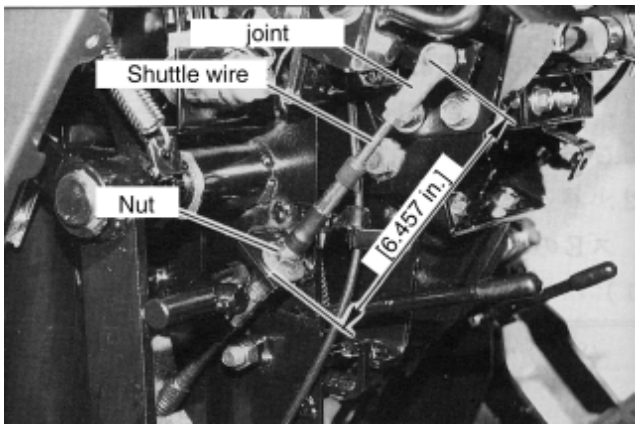


(2) PANEL REMOVAL

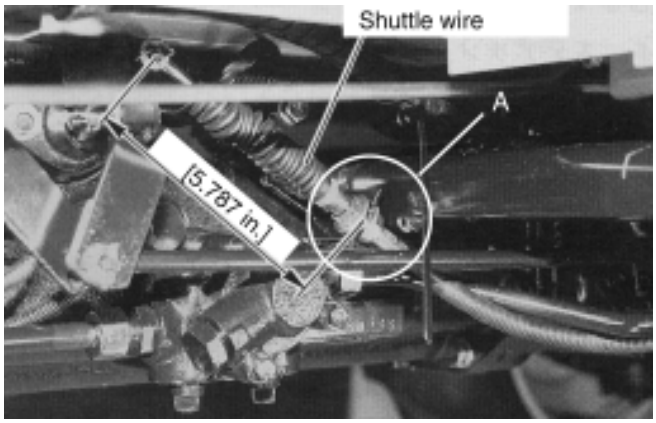
1. Disconnect the clutch rod and brake rods (Left and right brake rods).



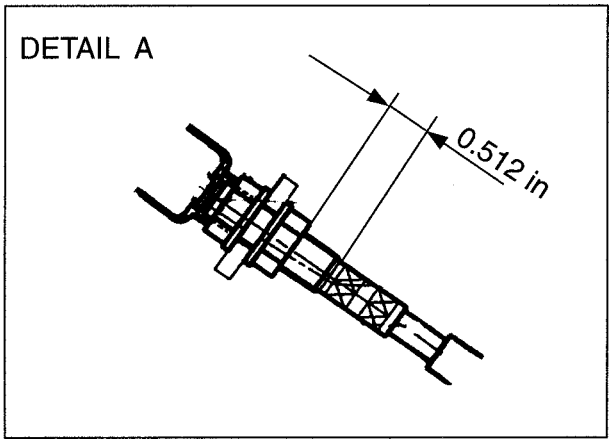
(Lever side)



2. Disconnect the shuttle wire. (Transmission side)



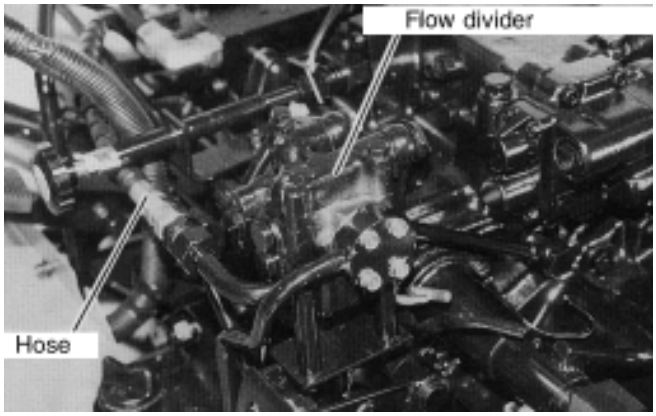
3. Disassemble the operator seat area.



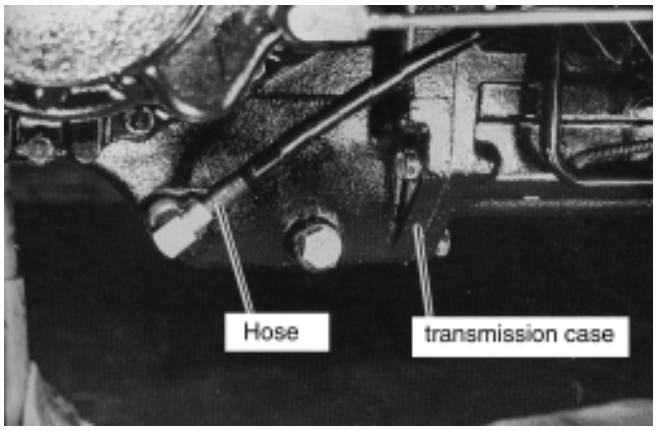
4. Disconnect the connectors of harness B.

5. Remove the steering hoses from the flow divider and transmission case.

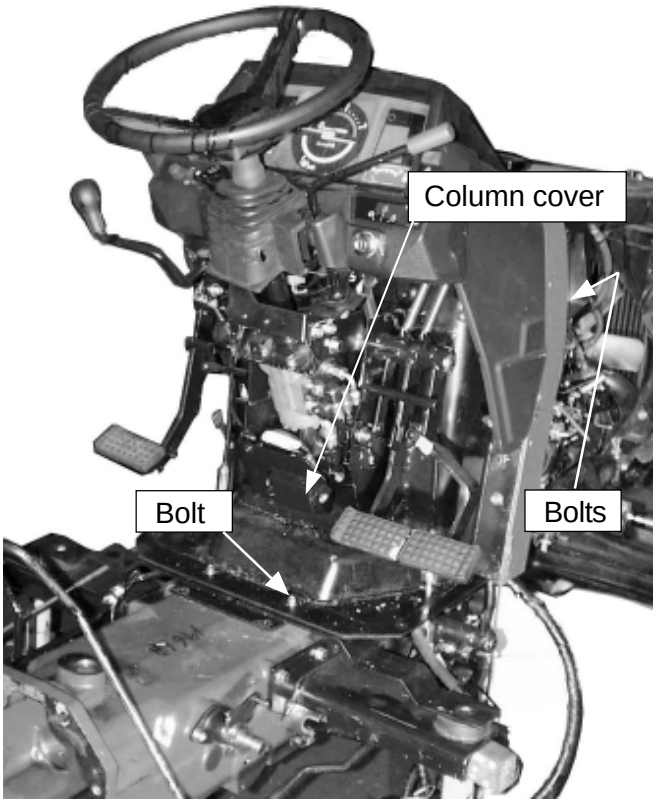
(Flow divider)

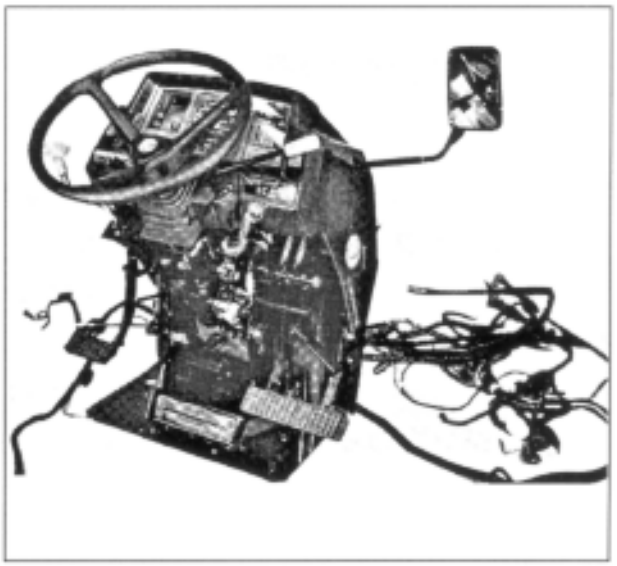


(Transmission case)



6. Remove the fixing bolts at column cover . Lift up the panel assy .





(3) ENGINE REMOVAL

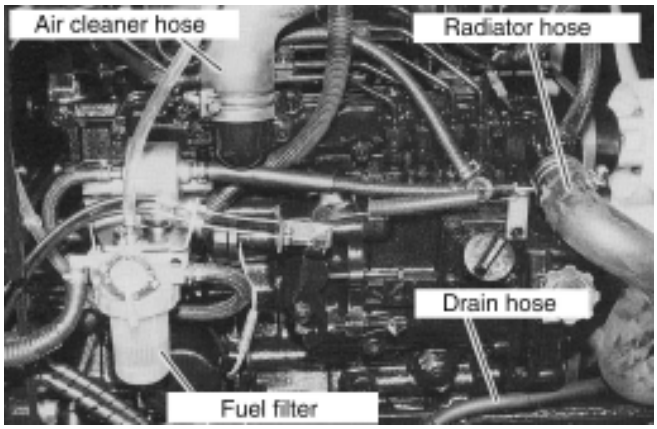
1. Drain the coolant from radiator and drain the transmission oil.

2. Remove the 4WD Shaft. (See Page 13)

3. Remove the panel Assy. (See Page 17)

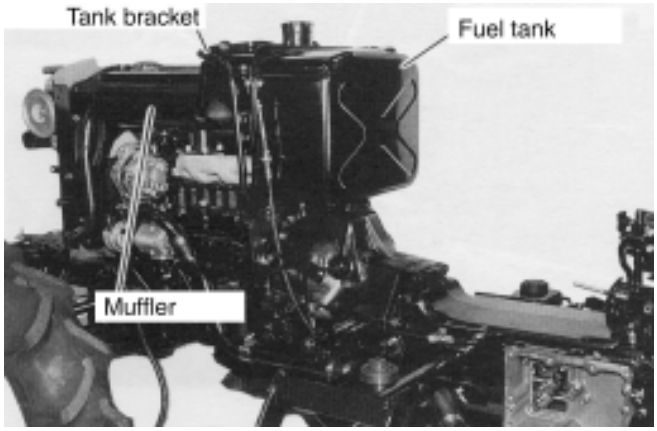
4. Remove the fuel hose at fuel filter and drain the fuel.

5. Remove the air cleaner hose, radiator hoses (2 hoses) and coolant drain hose from engine.

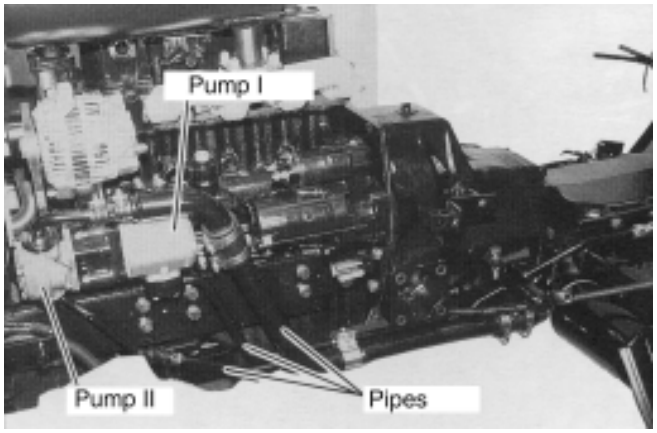


6. Remove the fuel tank bracket and fuel tank.

7. Remove the muffler from engine

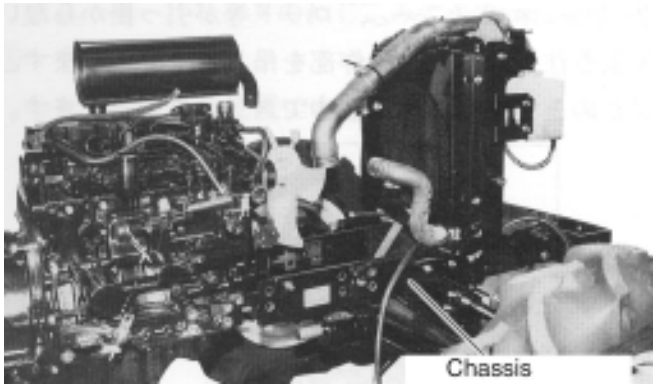


8. Remove the suction and pressure pipe from pump I and II.



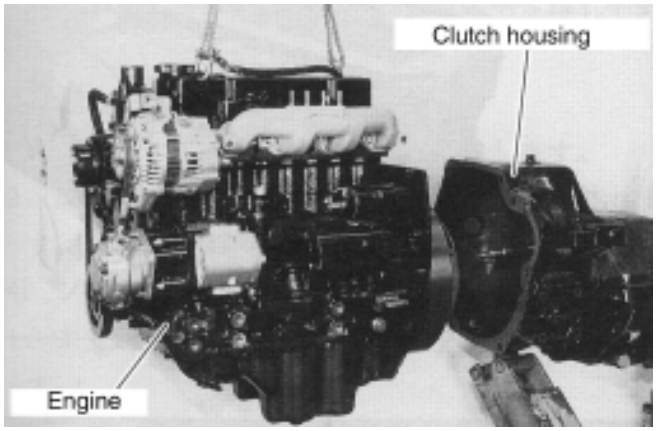
9. Put the jack under the transmission case to support and remove the chassis mounting bolts.

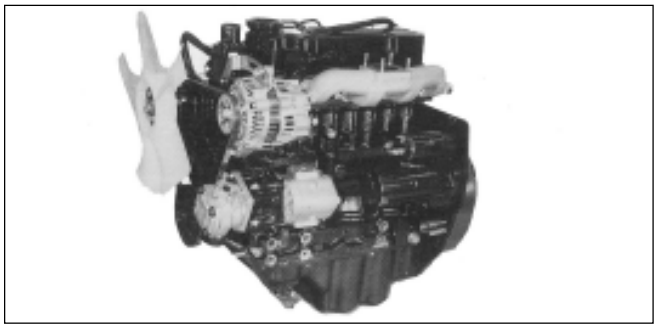
10. Pull the chassis together with front axle assy to front and remove it from engine.



11. Lift the engine by hoist and remove the engine mounting bolts between engine rear plate and clutch housing.

12. Remove the engine from clutch housing.





2-2 ENGINE REINSTALLATION

*Install the engine with reversed procedure of removal
Use following adjustment and service standards for the reinstallation.

1. When reinstall the engine to clutch housing, apply the liquid packing (Threebond #1208D) to the mating surface of engine rear plate and clutch housing.

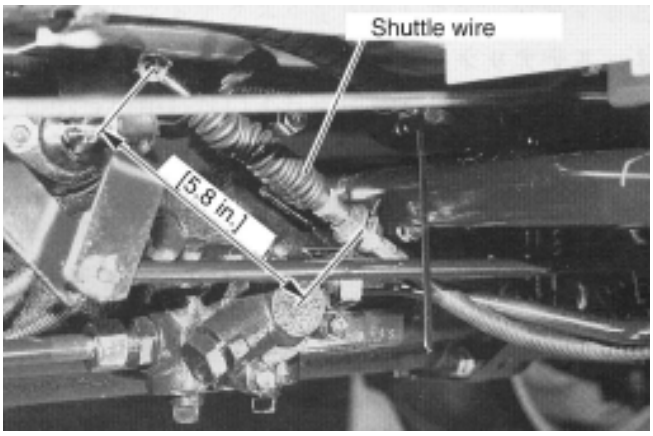
2. When installing the engine, make sure that main shaft and clutch center is aligned

3. Tightening torque of engine mounting bolts
   61.5~68.7 lbf.ft (8.5~9.5 kgf-m)

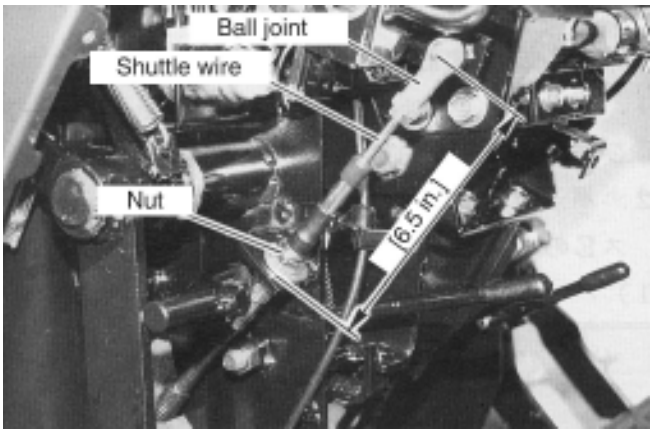
4. Tightening torque of chassis mounting bolts
   68.7~83.2 lbf.ft (9.5~11.5 kgf-m)

5. Tightening torque of power steering hose at transmission side.
   36.2~43.4 lbf.ft (5~6 kgf-m)

6. Shuttle wire installation.
 1) Set the length of wire at transmission side to 5.8 in (147 mm).



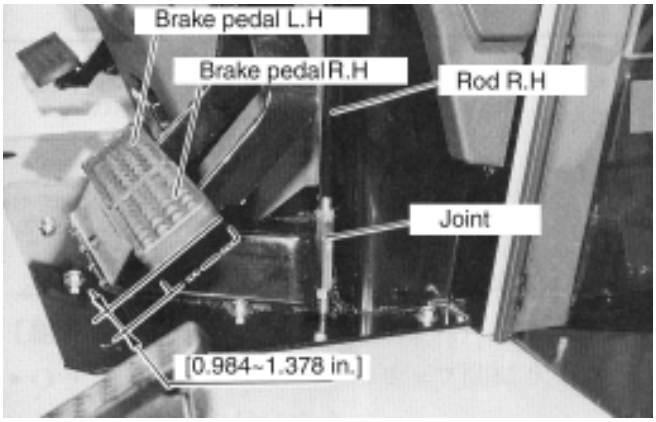
 2) Set the length of wire at shuttle lever side to 6.5in (164 mm).
 *Amount of screw into the ball joint must be 0.32 in (8 mm)

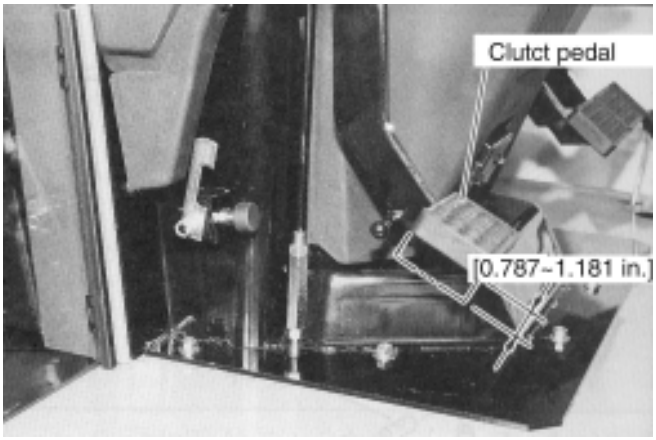


 3) After set of the wire lengths, adjust the wire length by nut to obtain the shuttle shift lever neutral position at lever guide. In the neutral position, shuttle shift lever can be move side to side.

7. Brake pedal adjustment (See page 127)
 Free play : 0.99~1.39in (25 ~35 mm)
 Adjust the left and right brake pedal height difference to be less than 0.12in (3 mm).

8. Clutch pedal free play
 [0.787~1.181 in.]
9. After reinstall the harnesses and tachometer cable, clamp them not to touch the muffler, manifold and fan belt.





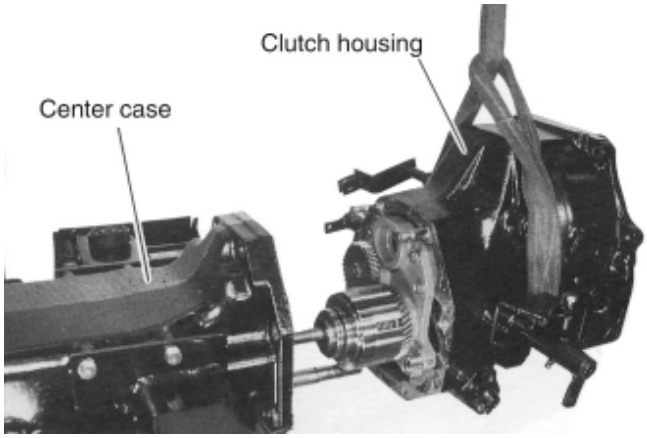
3. CLUTCH HOUSING, TRANSMISSION CASE, REAR AXLE CASE AND HYDRAULIC LIFT CASE REMOVAL AND REINSTALLATION

3-1. HOUSINGS REMOVAL

(1) CLUTCH HOUSING REMOVAL

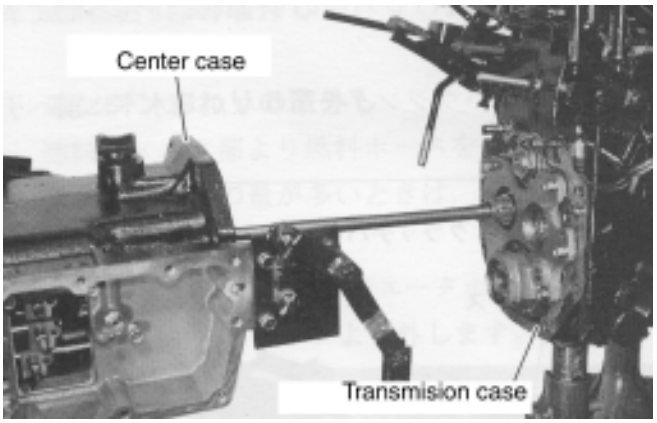
1. Remove the fixing bolts between clutch housing and center case.

2. Lift the clutch housing and remove it from center case.



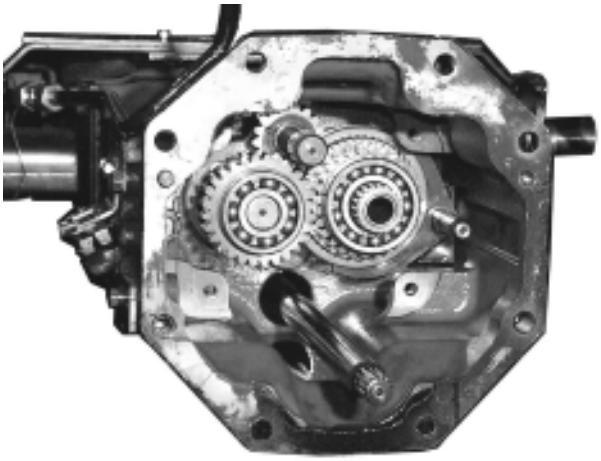
2. Remove the main shift lever linkages.

3. Lift the center case and remove it from transmission case.



(2) CENTER CASE REMOVAL

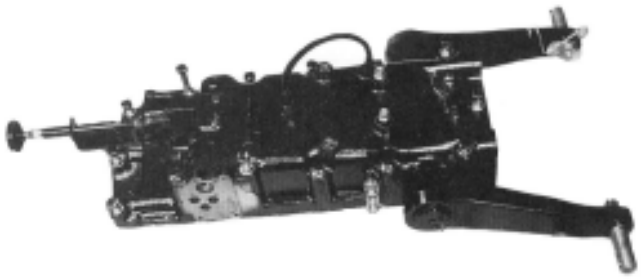
1. Remove the fixing bolts between center case and transmission case.



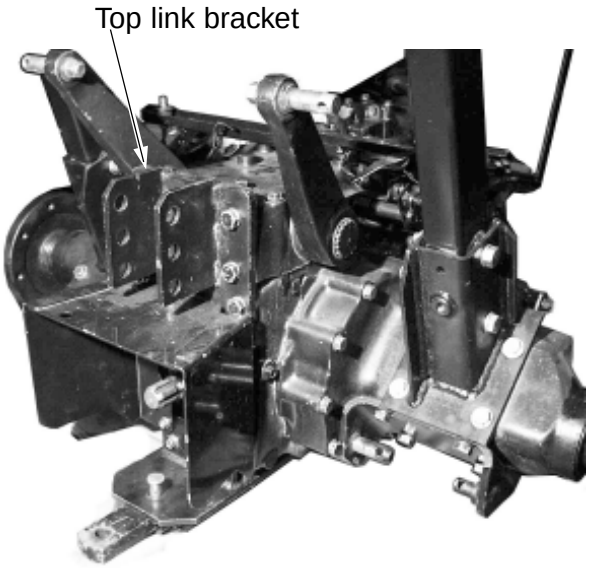
(3) HYDRAULIC LIFT CASE REMOVAL

1. Remove the seat and seat bracket.

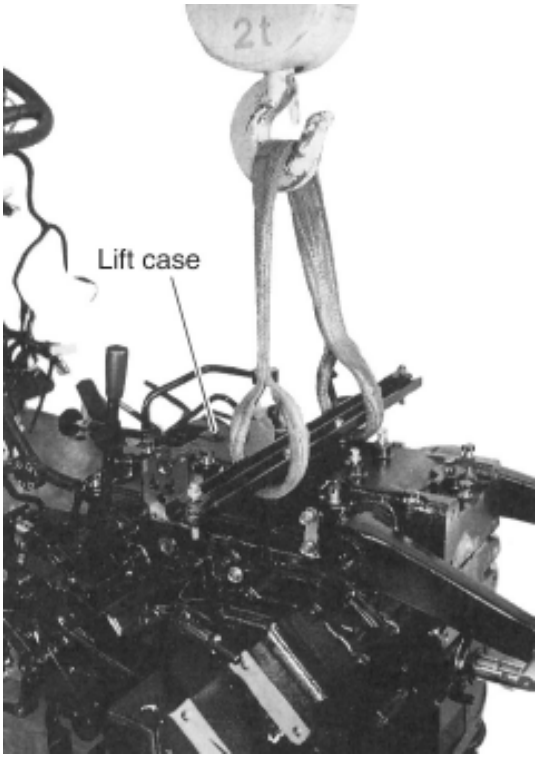
2. Remove the lever grip from position control lever and remove the lever guide by removing the fixing bolts.



3. Remove the top link bracket .



4. Remove the fixing bolts of hydraulic lift case and lift up the hydraulic lift case to remove.

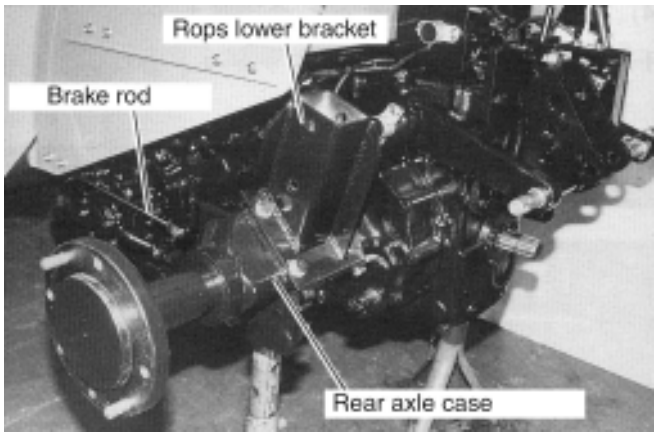


(8) REAR AXLE CASE REMOVAL

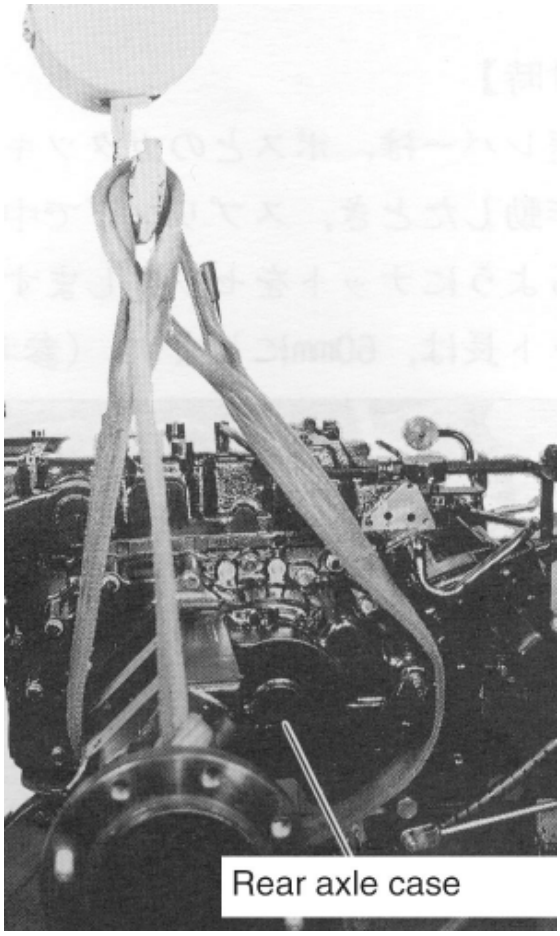
1. Remove the ROPS.
   1) Remove hinge pin and position pin. Remove ROPS upper flame.
   2) Remove fixing bolts of ROPS lower flame and remove ROPS lower flame.

3) Remove mounting bolts of ROPS lower bracket and remove the bracket.

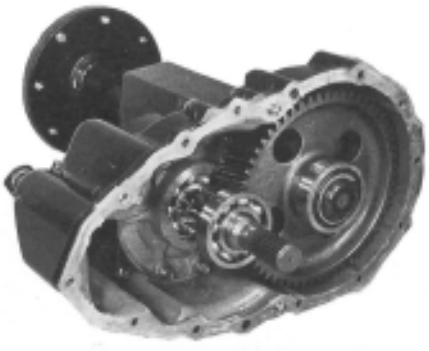
2. Disconnect the brake rod at brake lever on the rear axle case.



3. Lift the rear axle case and remove the mounting bolts.



4. Remove the rear axle assy.



3-2. HOUSING REINSTALLATION

*Reinstall the housings with reverse procedure of the removal. Use following values as adjustment and service standard for the installation.

(1) Rear axle case reinstallation

1. Apply the liquid packing (Threebond #1280D) to the mating surface of the rear axle case and transmission case.

2. Tightening torque of rear axle case mounting bolts.
   61.5~68.7lbf.ft (8.5 ~ 9.5 kgf-m)

(2) Hydraulic lift case reinstallation

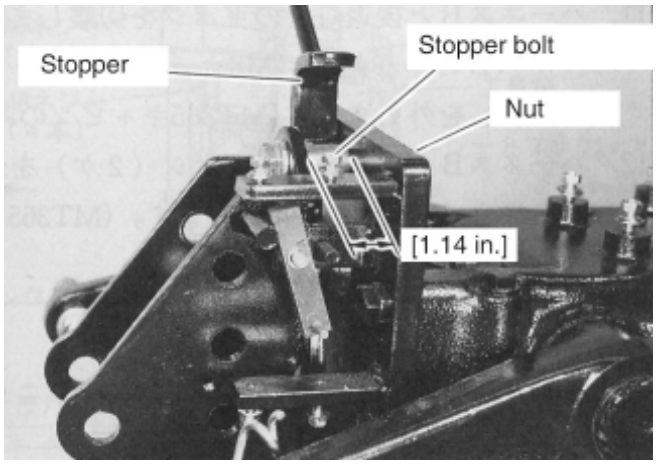
1. Apply the liquid packing (Threebond #1280D) to the mating surface of the hydraulic lift case and transmission case.

2. Tighten the top link bracket mounting bolts before tightening the hydraulic lift case fixing bolts.

3. Tightening torque of hydraulic case fixing bolts.
   61.5~68.7 lbf.ft (8.5 ~ 9.5 kgf-m)

4. Tightening torque of the top link bracket mounting bolts.
   86.8~97.6 lbf.ft (12 ~ 13.5 kgf-m)

5. In case of equipping the draft control and disassembling the top link bracket, adjust the dimension of stopper bolt to 29 mm(1.14in) and lock it by jam nut.



(3) Center case reinstallation

1. Apply the liquid packing (Threebond #1208D) to the mating surface of the center case and transmission case.

2. Tightening torque of center case fixing bolts.
   86.8~97.6 lbf.ft (12 ~13.5 kgf-m)

(4) Clutch housing reinstallation

1. Apply the liquid packing (Threebond #1208D) to the mating surface of the clutch housing and center case.

2. Tightening torque of the clutch housing fixing bolts.
   86.8~97.6 lbf.ft (12 ~13.5 kgf-m)

4. ENGINE

4-1. DETERMINING WHEN TO OVERHAUL THE ENGINE

(1)DETERMINING WHEN TO OVERHAUL THE ENGINE

Generally, when to overhaul the engine is to be determined by taking into account a drop in compression pressure as well as an increase in lube oil consumption and excessive blowby gases. Lower power or loss of power, an increase in fuel consumption, a drop in lube oil pressure, hard starting and excessive abnormal noise are also troubles. These troubles,however,are not always the result of low compression pressure and give no valid reason for overhauling the engine.
the engine develops troubles of widely different varieties when the compression pressure drops in it. Following are the typical troubles caused by the compression pressure failure:

(1)Low power or loss of power
(2)Increase in fuel consumption
(3)Increase in lube oil consumption
(4)Excessive blowby through breather due to worn cylinders, pistons, etc.
(5)Excessive blowby due to poor seating of worn inlet and exhaust valves
(6)Hard starting or failure to start
(7)Excessive engine noise

In most cases, these troubles occur concurrently. Some of them are directly caused by low compression pressure, but others are not. Among the troubles listed above, (2)and(6) are caused by a fuel injection pump improperly adjusted with respect to injection quantity or injection timing, worn injection pump plungers, faulty injection nozzles, or poor care of the battery, starter and alternator.

The trouble to be taken into account as the most valid reason for overhauling the engine is(4): in actually determining when to overhaul the engine, it is reasonable to take this trouble into account in conjunction with the other ones

(2) COMPRESSION PRESSURE MEASUREMENT

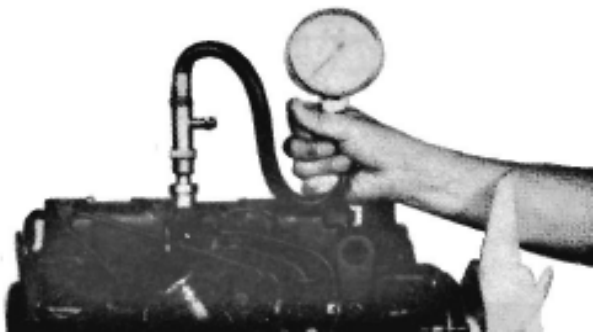
1. Inspection

-Check to make sure-

(1)The crankcase oil level is correct, and the air cleaner, starter and battery are all in normal condition.
(2)The engine is at the normal operating temperature.

2. Measurement

(1)Move the control lever to a position for shutting off fuel supply.
(2)Remove all glow plugs from the engine. Install the compression gauge and adaptor (ST332270)combination to a cylinder on which the compression pressure is to be measured.
(3)Turn the engine with the starter and read the gauge pressure at the instant the gauge pointer comes to stop.
(4)If the gauge reading is below the limit, overhaul the engine.



NOTE

1. Be sure to measure the compression pressure on all cylinder.
2. The compression pressure varies with change of engine r.p.m.. This makes it necessary to check engine r.p.m.. at the time of measuring the compression pressure.
3. It is important to measure the compression pressure at regular intervals to obtain the data on the gradual change of the compression pressure.
4. The compression pressure would be slightly higher than the standard in a new or overhauled engine owing to breaking-in of the piston rings, valve seats, etc. It drops as the engine components wear down.

(3) BASIC PRECAUTION FOR DISASSEMBLY AND ASSEMBLY

This section outlines basic precautions recommended by Mitsubishi that should always be observed.

1. Disassembly

(1)Always use tools that are in good condition and be sure you understand how to use them before performing any job.

(2)Use an overhaul stand or a work bench, if necessary. Also, use bins to keep engine parts in order of removal.

(3)Parts must be restored to their respective components from which they were removed at disassembly. This means that all parts must be set aside separately in groups,each marked for its component, so that the same combination or set can be reproduced at assembly.

(4)Pay attention to marks on assemblies, components and parts for their positions or directions. Put on marks, if necessary,

(5)Carefully check each part or component for any sign of faulty condition during removal or cleaning. The part will tell you how it acted or what was abnormal about it more accurately during removal or cleaning.

(6)When lifting or carrying a part too heavy or too awkward for one parson to handle, get another person's help and, if necessary, use a jack or a hoist.

2. Assembly

(1)Wash all parts, except for oil seals, O-rings, rubber sheets, etc., with cleaning solvent and dry them with pressure air.

(2)Always use tools that are in good condition and be sure you understand how to use them before performing any job.

(3)Use only good-quality lubricants. Be sure to apply a coat of oil, grease or sealant to parts as specified.

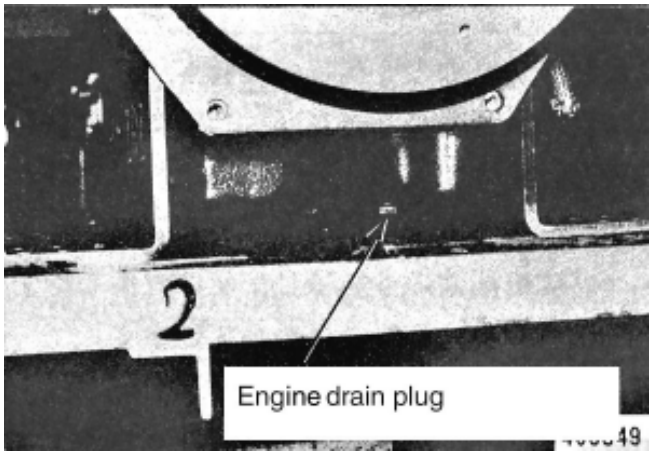
(4)Be sure to use a torque wrench to tighten parts for which torques are specified.

(5)Any time the engine is assembled, new gaskets and O-rings must be installed.

(6)PREPARATION FOR DISASSEMBLY

1. Engine oil draining
   Remove the drain plug from the bottom of the oil pan and allow the oil to drain.

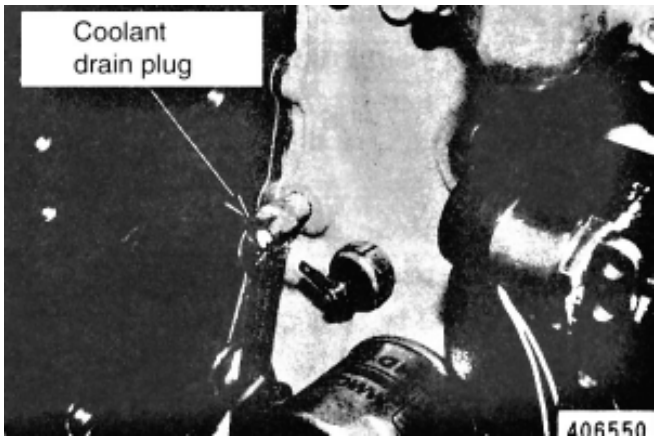
   Refil capacity ——— 1.19 gal (4.5 L)



⚠WARNING

Hot oil and components can cause personal injury. Do not allow hot oil or components to contact skin.

2. Coolant draining
   Loosen the drain plug on the right side of the cylinder block and allow the coolant to drain.
   Refill capacitiy ——— 6.6 gal (2.5 L)



4-2. TROUBLE SHOOTING

Problem 1 : Fuel knock

More or less knock occurs in diesel engines. This may be caused either by an excessively large delay period or by a too fast rate of fuel injection.

(1)Items to be checked for ahead

- Clogged air cleaner
- Poor quality fuel

(2)Inspection procedure

Is injection timing correct (not too advanced)? → No ⇨ Make adjustment to the timing.

⇩ Yes

Is solenoid switch normal? → No ⇨ Check the switch.

⇩ Yes

Is injection pressure (injection nozzle valve opening pressure) correct (not too low)? → No ⇨ Make adjustment to the pressure.

⇩ Yes

Is compression pressure correct? → No ⇨ Check valves, piston rings, and cylinder head gasket.

⇩ Yes

Fuel injection pump is faulty.

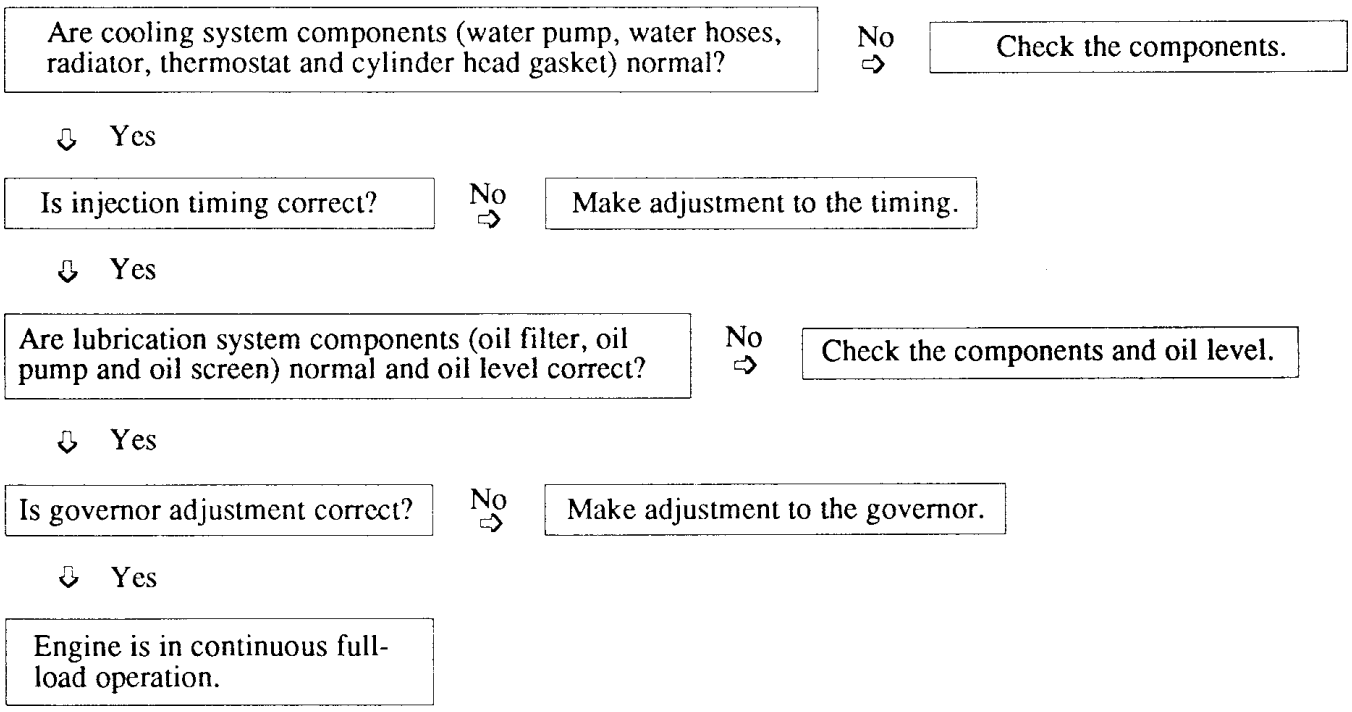
Problem 2 : Overheating

(1) Items to be checked for ahead

Overheating might also be caused by abnormal operating conditions. If the engine is overheating but its cooling system is not contributing to this trouble, it is necessary to check the difference between the ambient temperature when the engine is in normal operation (with the thermostat fully open). If the ambient temperature is higher than the normal coolant temperature by more than 140°F(108°C), investigate other items than those related to the engine cooling system.

- Insufficient coolant and exterior coolant leaks
- Loose fan belt
- Radiator core openings plugged with dirt

(2)Inspection procedure



Problem 3 : Black exhaust smoke

(1)Items to be checked for ahead

- Clogged air cleaner
- Poor quality fuel

(2)Inspection procedure

Are valve clearance and injection timing correct? → No ⇨ Make adjustment to the clearance and timing.

⇩ Yes

Is injection nozzle discharge pattern normal? Is injection pressure correct (not too high)? → No ⇨ Make adjustment to the nozzles.

⇩ Yes

Is compression pressure correct? → No ⇨ Check valves, piston rings and cylinder head gasket.

⇩ Yes

Fuel injection pump is faulty.

Problem 4 : Erratic idle speeds

(1)Items to be checked for ahead

- Maladjusted engine control
- Wrong oil grade for weather conditions
- Poor quality fuel

(2)Inspection procedure

Are valve clearance and injection timing correct? → No ⇨ Make adjustment to the clearance and timing.

⇩ Yes

Is injection nozzle discharge pattern normal? Is injection pressure constant? → No ⇨ Make adjustment to the nozzles.

⇩ Yes

Is compression pressure correct (no difference in compression pressure between cylinders)? → No ⇨ Check valves, piston rings and cylinder head gasket.

⇩ Yes

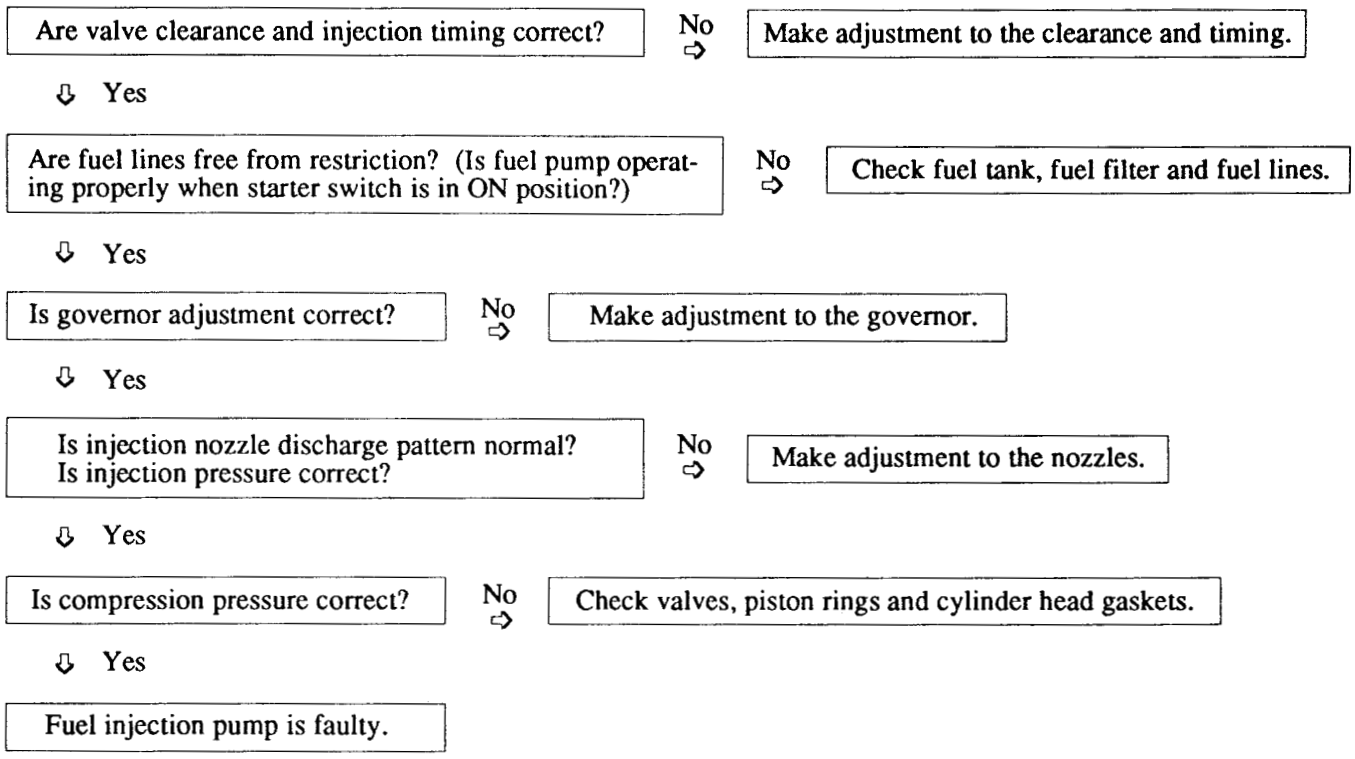
Fuel injection pump is faulty.

Problem 5 : Low power or loss of power

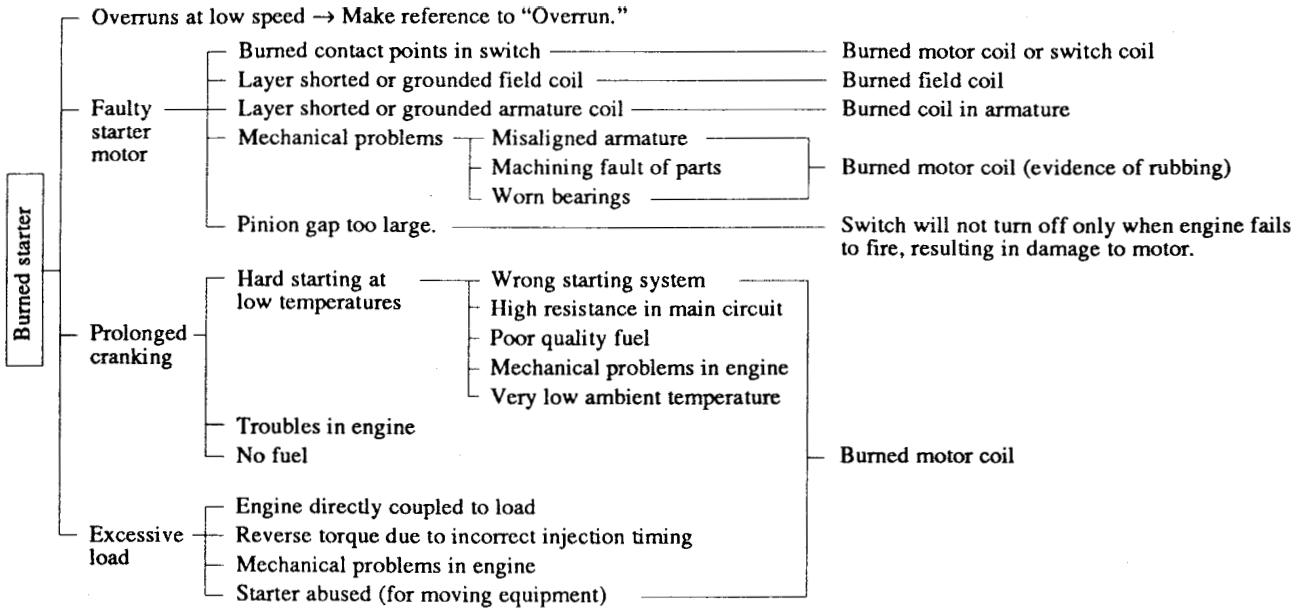
(1)Items to be checked for ahead

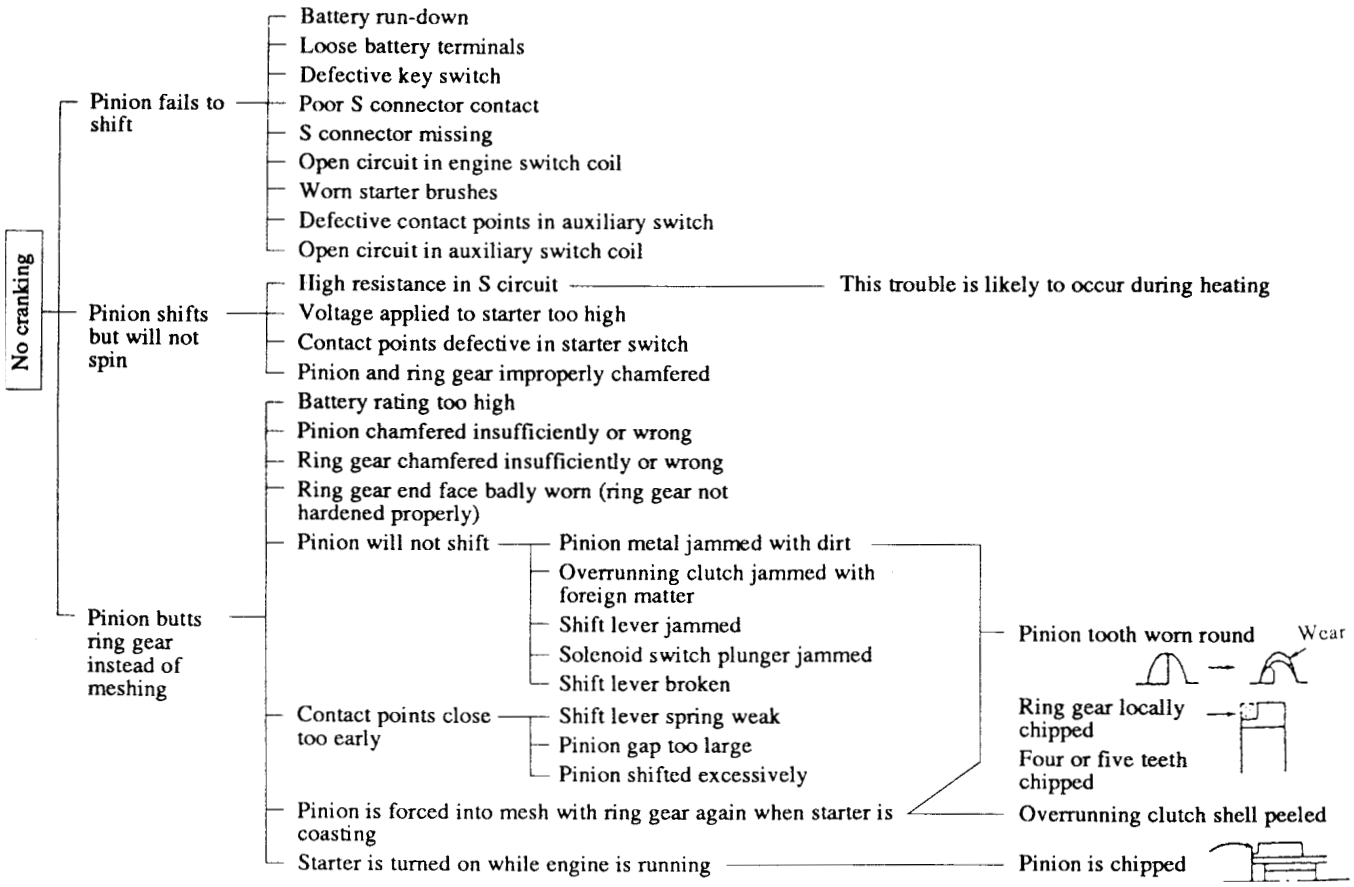
- Stuck running parts
- Wrong oil grade for weather conditions
- Poor quality fuel
- Clogged air cleaner
- Restricted exhaust line
- Faulty power take-off

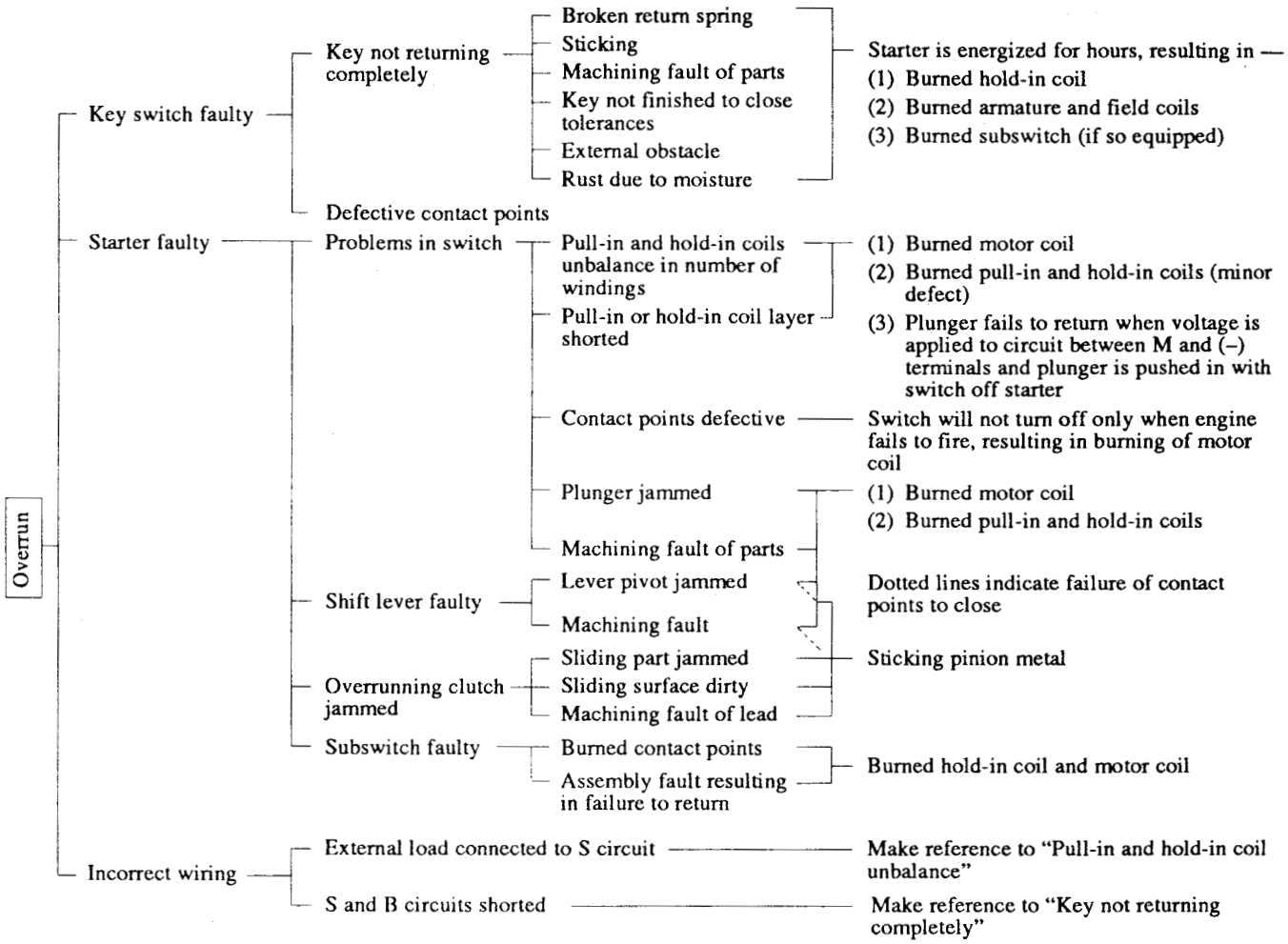
(2)Inspection procedure



Problem 6 : Starting system troubleshooting



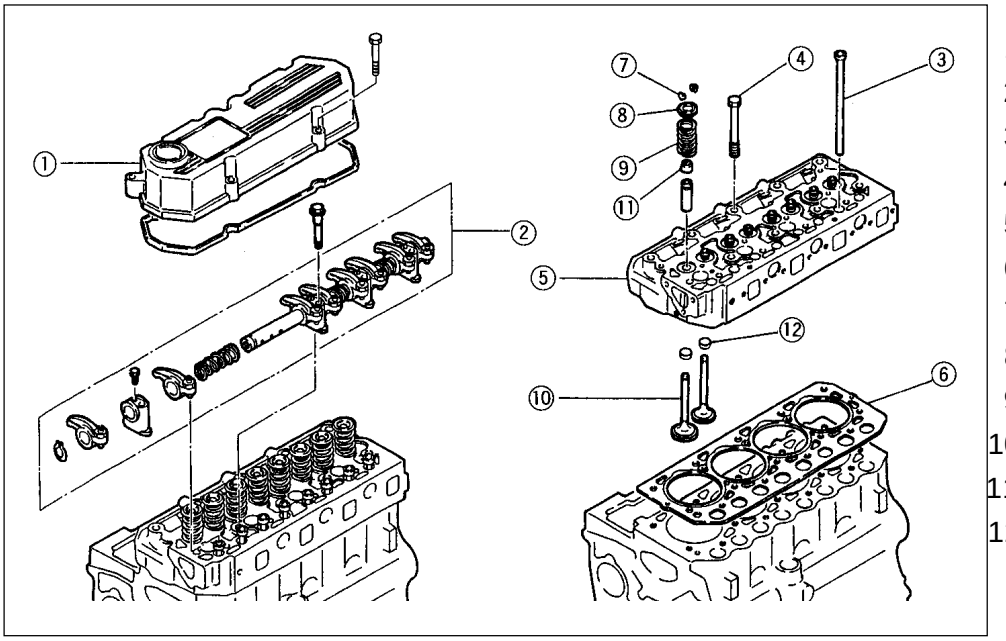




[Other possibility is sticking pinion metal in case of overrun trouble.]

4-3. DISASSEMBLING

(1)CYLINDER HEAD DISASSEMBLY



1.Rocker cover
2.Rocker shaft assembly
3.Push rod
4.Cylinder head bolt
5.Cylinder head
6.Cylinder head gasket
7.Valve lock
8.Valve retainer
9.Valve spring
10.Valve
11.Stem seal
12.Valve cap

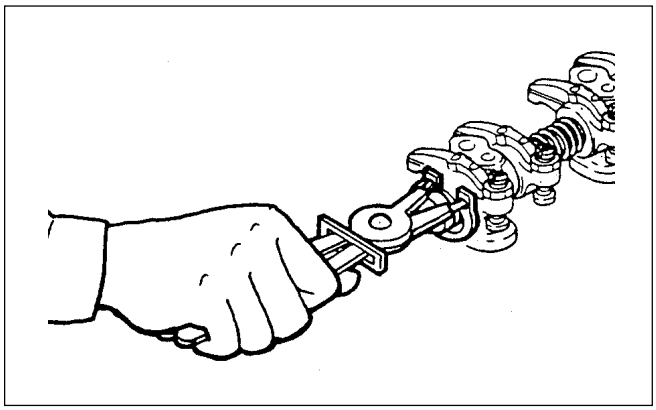
1.Rocker shaft assembly removal

(1)Remove the bolts that hold the rocker stays in position and remove the rocker shaft assembly.

(2)Remove the valve caps.

2.Rocker shaft disassembly

Put identification on each rocker arm as to its location on the rocker shaft.

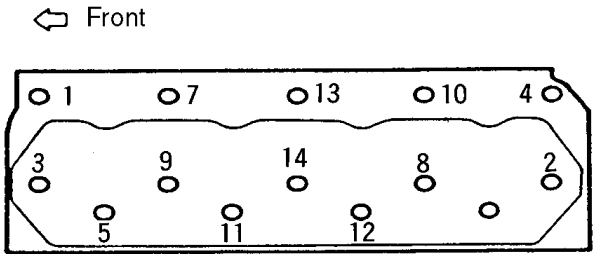


3.Cylinder head bolt removal

Loosen the cylinder head bolts in two or three steps in the sequence shown.

NOTE

If any parts on the cylinder head are faulty, check the cylinder head bolts for tightness with a torque wrench before loosening them.



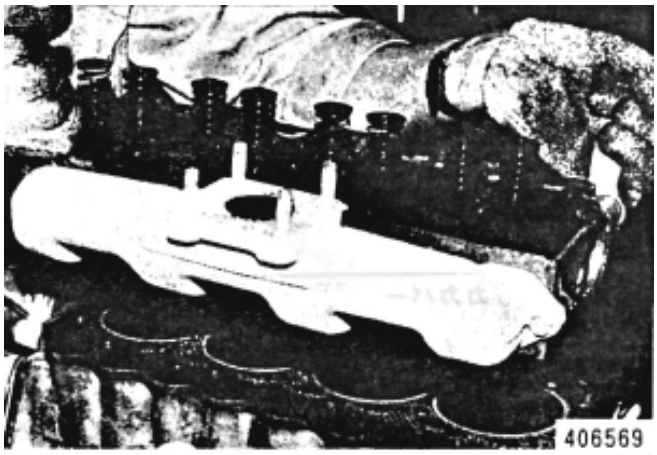
Cylinder head bolt loosening sequence.

4.Cylinder head assembly removal

Lift the cylinder head straight up with a hoist.

NOTE

If the gasket is seized and the cylinder head cannot be separated from the cylinder block, tap around the thick side portion of the cylinder head with a plastic hammer.



5.Valve and valve spring removal

(1)Compress the valve spring with a valve lifter and remove the valve lock.

(2)Remove the retainer, spring and valve.

NOTE

The valves, retainers, springs and valve locks must be set aside separately in groups, each tagged for cylinder number, for correct installation.

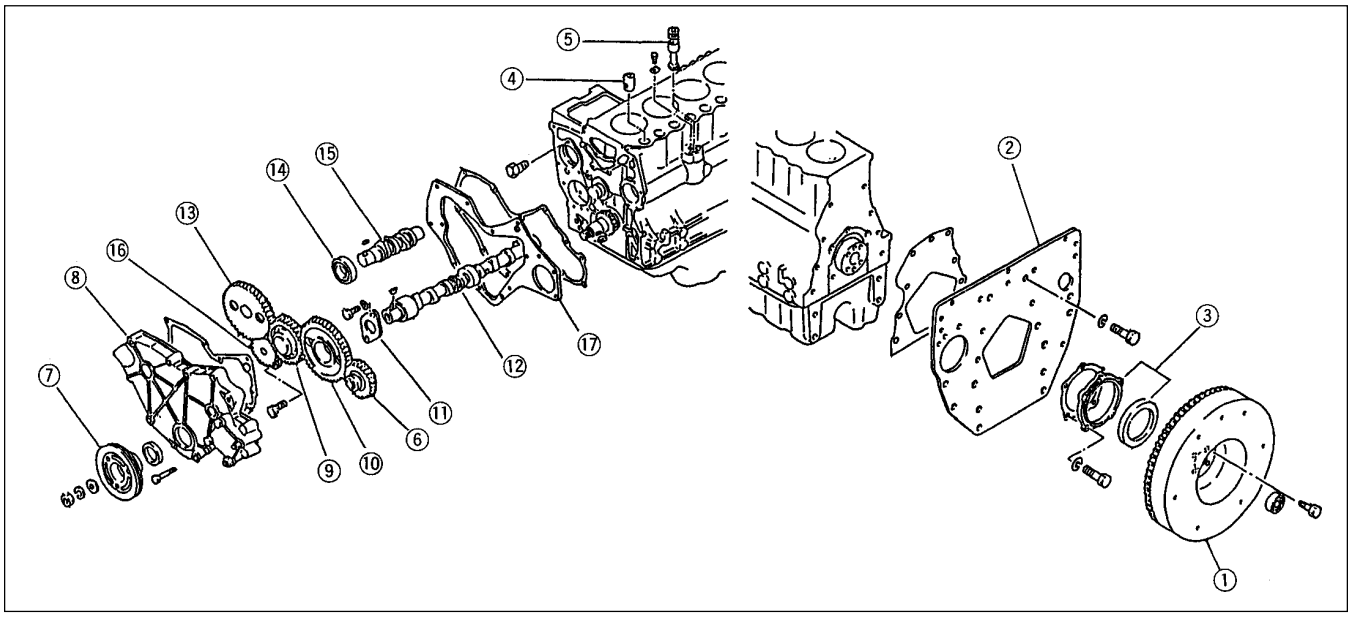
6.Valve stem seal removal

Remove the valve stem seals with pliers.

NOTE

Do not reuse the valve stem seals.

(2) TIMING GEAR•FLYWHEEL

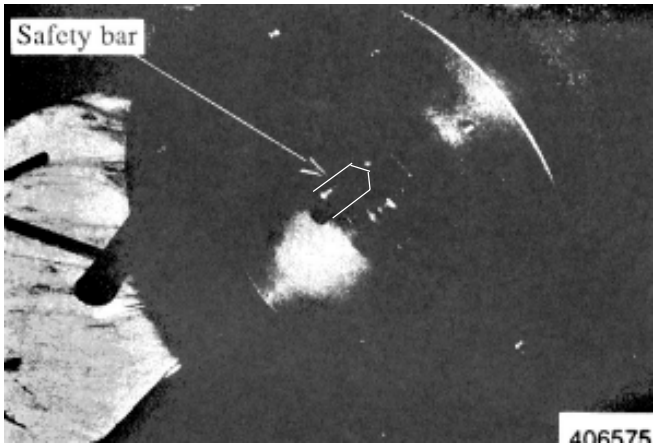


(1) Flywheel
(2) Rear plate
(3) Oil seal case
(4) Tappet
(5) Speedometer driven gear
(6) PTO gear
(7) Crankshaft pulley
(8) Timing gear case
(9) Idler gear
(10) Valve camshaft gear
(11) Thrust plate
(12) Valve camshaft
(13) Pump camshaft gear
(14) Bearing
(15) Pump camshaft
(16) Oil pump
(17) Front plate

1.Flywheel removal

(1)Have someone hold the crankshaft pulley with a wrench to prevent the flywheel from rotating.

(2)Remove one of the bolts that hold the flywheel in position.



(3)Install a safety bar(M12x1.25)into the threaded hole in the flywheel from which the bolt was removed in Step(2). Remove the remaining bolts.

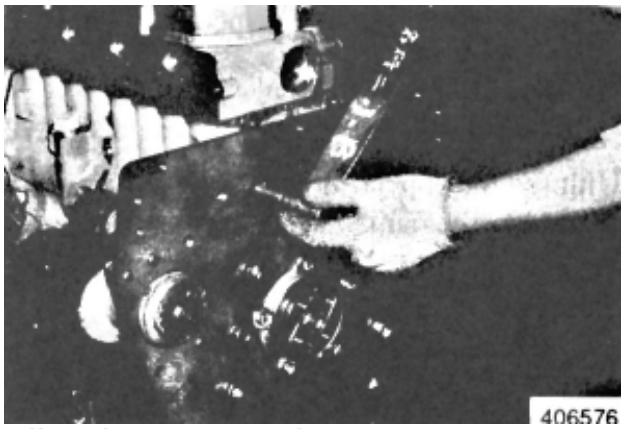
(4)Hold the flywheel by hands and withdraw it from the crankshaft. Joggling the flywheel back and forth will facilitate removal.

⚠WARNING

When removing the flywheel, wear heavy gloves to avoid hand injury.

2.Rear plate removal

The rear plate is doweled in position. Pull the plate as straight as possible when removing it.

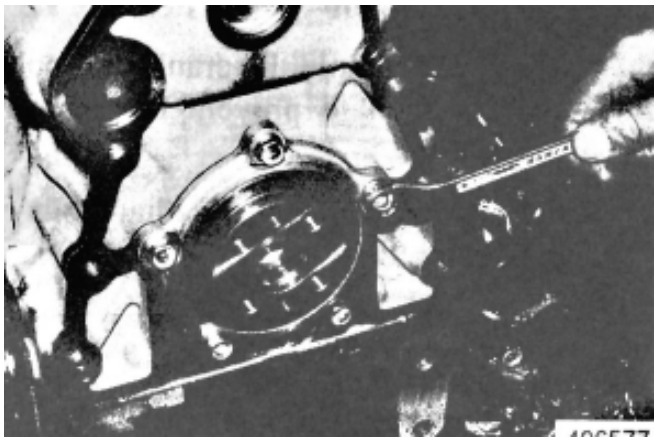


3.Oil seal case removal

Remove the bolts that hold the oil seal case in position. Remove the case from the cylinder block with a screwdriver or the like.

⚠CAUTION

Do not cause damage to the oil seal.

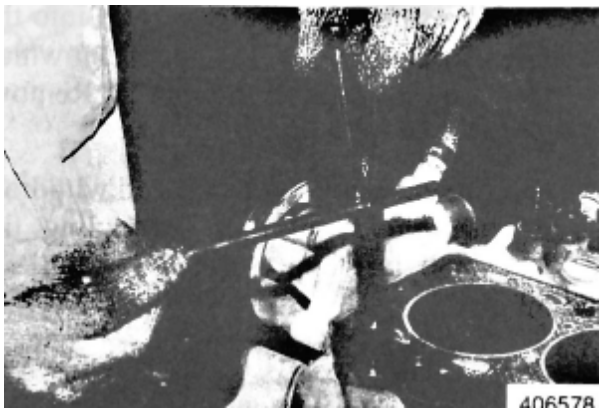


4.Tappet removal

Remove the tappets from the cylinder block with a valve push rod.

NOTE

The tappets will fall into the oil pan if the camshaft is removed before the tappets are removed.

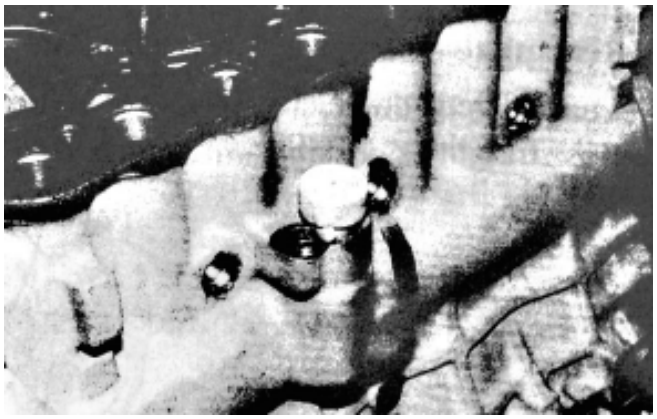


5.Speedometer driven gear removal

Remove the lock plate and speedometer driven gear in that order.

NOTE

Unless the speedometer driven gear is removed, the camshaft cannot be removed.



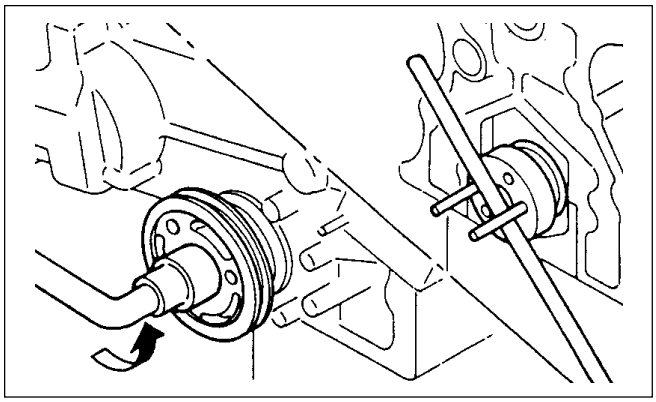
6.Crankshaft pulley removal

(1)Install two safety bars(M12x1.25)into the threaded holes in the rear end of the crankshaft. Put a bar between the safety bars to hold the crankshaft to prevent it from rotating.

(2)Remove the crankshaft pulley.

⚠WARNING

When removing the crankshaft pulley, be prepared to stop the job in case the bar slips off the crankshaft to prevent injury.

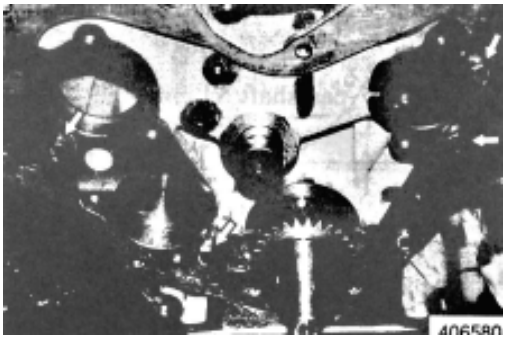


7.Timing gear case removal

Remove the bolts that hold the timing gear case in position and remove the case.

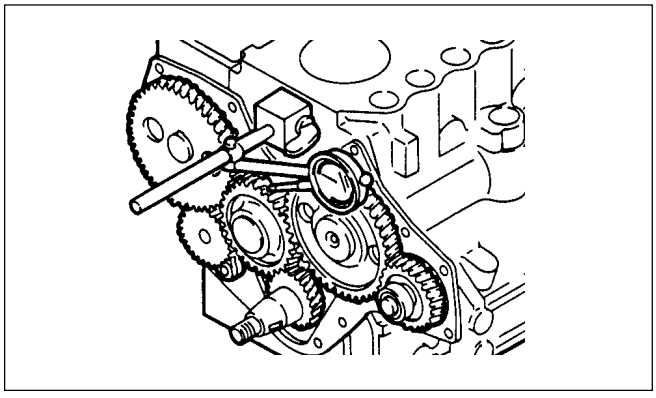
CAUTION

The front plate is bolted inside the timing gear case. Do not attempt to remove this plate along with the timing gear case by tapping.



8.Timing gear backlash measurement

Measure the backlash of each gear and keep a record of it for correct installation. Replace the gears if the backlash exceeds the limit.



	Item	Standard	Limit
Timing gear backlash	Crankshaft gear and idler gear Idler gear and camshaft gear Idler gear and fuel injection pump camshaft gear	0.04 to 0.12 (0.0016 to 0.0047)	0.30 (0.0118)
	Camshaft gear and P.T.O. gear	0.08 to 0.19 (0.003 to 0.0075)	
	Fuel injection pump camshaft gear and oil pump gear	0.007 to 0.20 (0.0028 to 0.0079)	

9.Idler gear removal

To remove the idler gear, rotate the gear in a direction of the helix of the teeth to pull it out of mesh.

10.Camshaft removal

(1)Remove the bolts that hold the thrust plate.

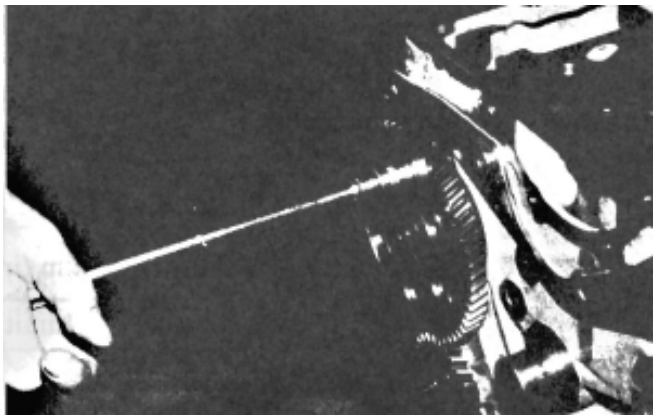
(2)Pull the camshaft out of the cylinder block.

CAUTION

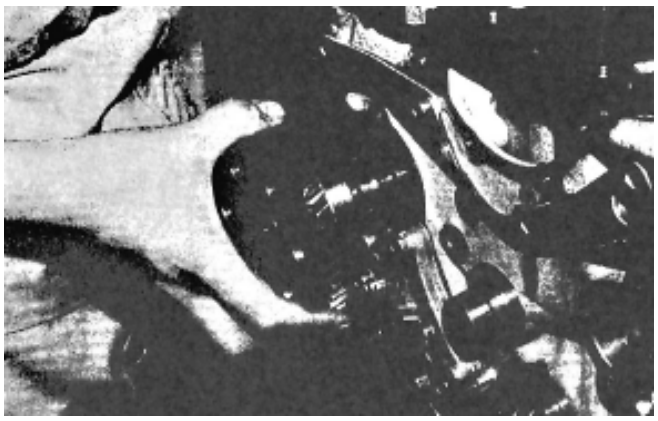
Do not cause the damage to the lobes or bearing journals when removing the camshaft.

11.Fuel injection pump camshaft removal

(1)Remove the stopper bolt.



(2)Tap the rear end of the camshaft with a copper bar to push it out of the front side of the cylinder block.



12.Gear removal(when required)

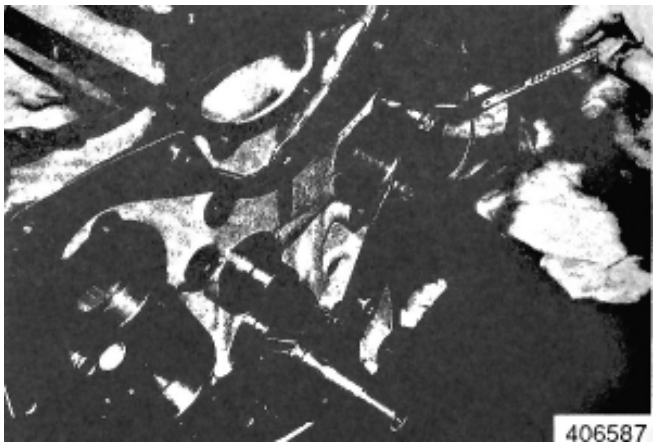
To remove the gears from the camshaft and fuel injection pump camshaft, use an arbor press.

13.Oil pump removal

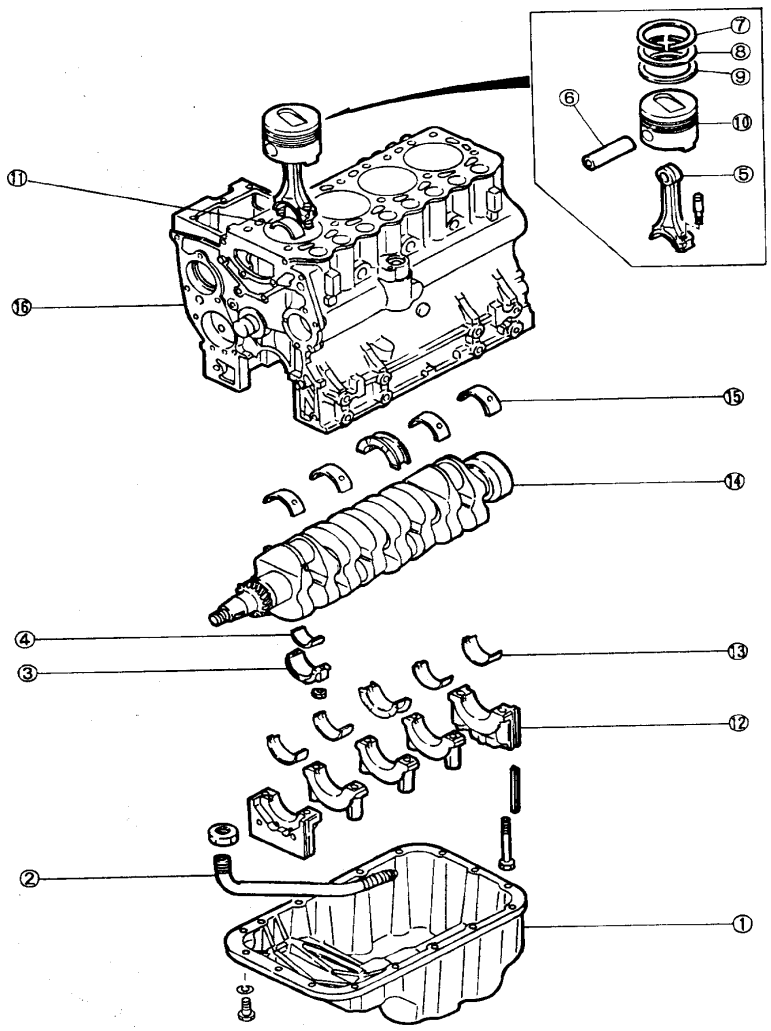
Remove the bolts that hold the oil pump to the cylinder block and remove the pump.

14.Front plate removal

Remove four bolts that hold the front plate in position. Tap the plate lightly with a plastic hammer to separate the gasket.



(3) CYLINDER BLOCK, CRANKSHAFT,PISTONS AND OIL PAN DISASSEMBLY



(1)Oil pan
(2)Oil screen
(3)Connecting rod cap
(4)Connecting rod bearing (lower)
Remove 5 thru 10 as an assembly
(5)Connecting rod
(6)Piston pin
(7)No.1 ring
(8)No.2 ring
(9)Oil ring
(10)Piston

(11)Connecting rod bearing (upper)
(12)Main bearing cap
(13)Main bearing(lower)
(14)Crankshaft
(15)Main bearing(upper)
(16)Cylinder block

1.Oil pan removal

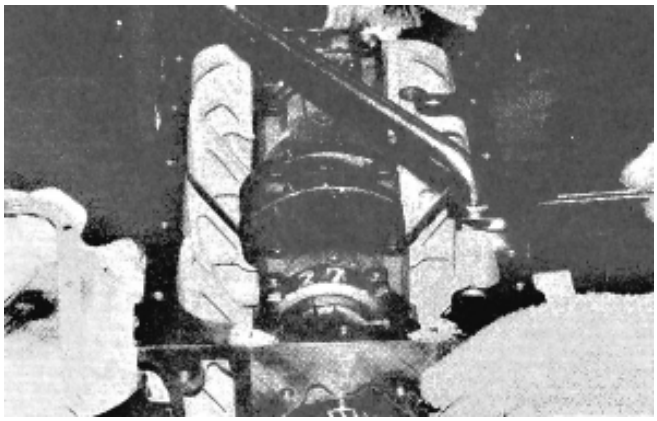
(1)Turn the engine upside down.
(2)Tap the bottom corners of the oil pan with a plastic hammer to remove the oil pan.

⚠CAUTION

Do not attempt to pry off the oil pan by inserting a screwdriver or a chisel between the oil pan and cylinder block. Damage to the oil pan can be the result.

2.Oil screen removal

Loosen the nut that holds the screen in position and remove the screen.

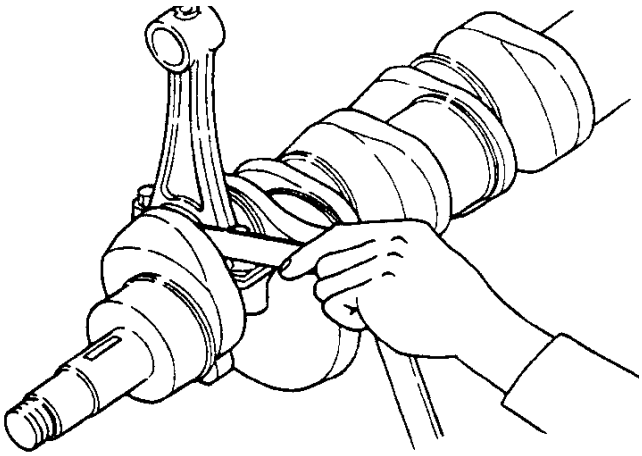


3.Thrust clearance measurement for connecting rod big end.

Install the connecting rod to its crankpin and tighten the cap nuts to the specified torque. Measure the thrust clearance with a feeler gauge. If the clearance exceeds the limit, replace the connecting rod.

Unit:mm(in.)

Item	Standard	Limit
thrust clearance for connecting rod big end	0.10 to o.35 (0.0039 to 0.0138)	0.50 (0.0197)



4.Connecting rod cap removal

(1)Lay the cylinder block on its side.

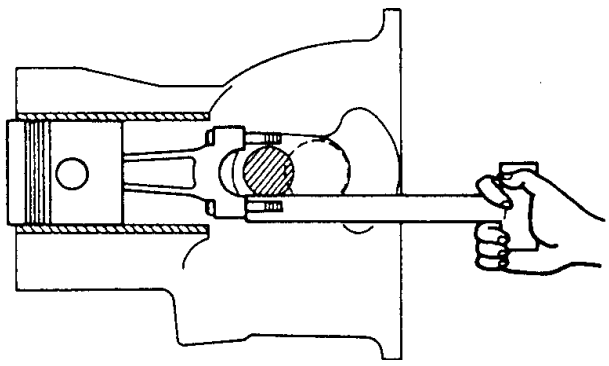
(2)Put identification on each connecting rod and cap combination as to its location in the engine.

(3)Remove the caps.

5.Piston removal

(1)Turn the crankshaft until the piston is at top center.

(2)Push the piston and connecting rod away from the crankshaft with the handle of a hammer or the like until the piston rings are above the cylinder. Remove the piston and connecting rod. Do Steps (1)and(2) for the removal of the other pistons.

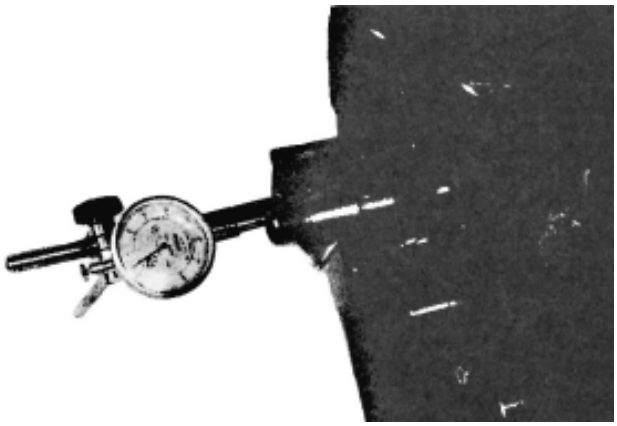


6.End play measurement for crankshaft

Set a dial indicator so that it will touch the end of the crankshaft and measure the end play. If the end play exceeds the limit, replace the flanged bearing in No.3 journal.

Unit:mm(in.)

Item	Standard	Limit
End play for crankshaft end play	0.050 to 0.175 (0.00197 to 0.00689)	0.500 (0.01969)



7.Main bearing cap removal

(1)Lay the cylinder block with its bottom(oil pan)side up.

(2)Remove the bolts that hold the main bearing caps in position. Remove the caps.

(3)Remove the front and rear bearing caps with a sliding hammer

8.Crankshaft removal

Remove the crankshaft.

⚠CAUTION

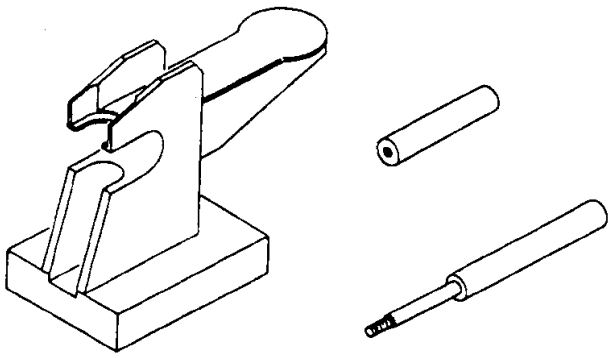
Do not cause damage to the bearings.

N O T E

Put identification on each main bearing as to its location in the engine.

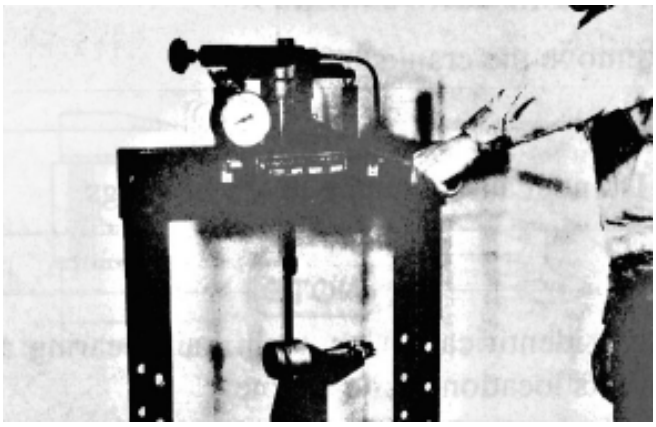
9.Piston separation from connecting rod

(1)Use Piston Pin Setting Tool (31A9100100) (special tool)to separate the piston from the connecting rod.



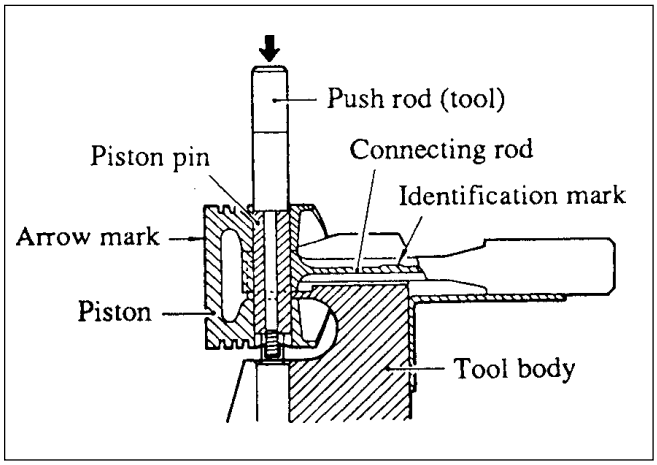
⚠CAUTION

Do not attempt to remove the piston pin by tapping. Replace a piston pin which needs a greater force for removal.



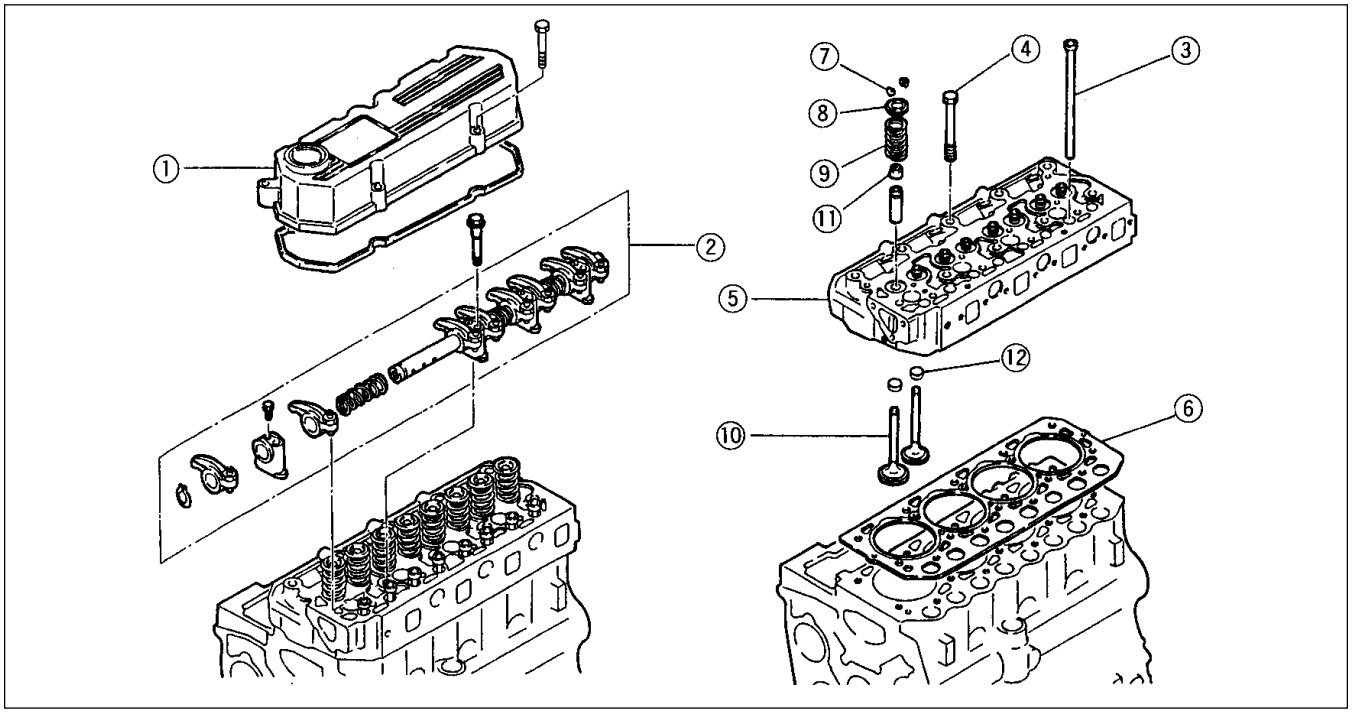
(2)Insert the push rod of the tool into the bore in the piston for the piston pin and, using an arbor press, remove the piston pin.

(3)Use this Piston Pin Setting Tool to install the connecting rod to the piston.



4-4. REASSEMBLING

(1) CYLINDER HEAD REASSEMBLING



* Reassemble the cylinder head with reverse procedure of disassembling. Use the following values as adjustment and service standard.

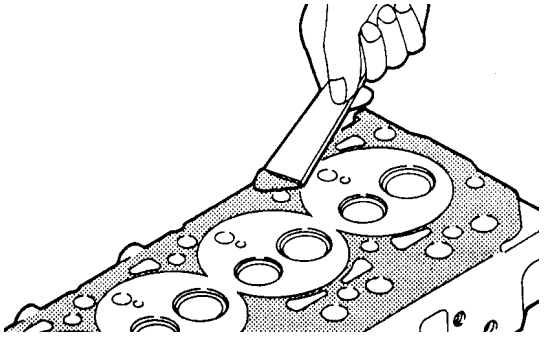
(1) Rocker cover
(2) Rocker shaft assembly
(3) Valve push rod
(4) Cylinder head bolt
(5) Cylinder head
(6) Cylinder head gasket
(7) Valve Lock
(8) Valve retainer
(9) Valve spring
(10) Valve
(11) Valve stem seal
(12) Valve cap

1.Cylinder head bottom face cleaning

Scrape the gasket from the bottom face of the cylinder head.

NOTE

After scraping the gasket, rub off gasket remnants from the face with an oilstone smeared with engine oil and thoroughly clean the face.

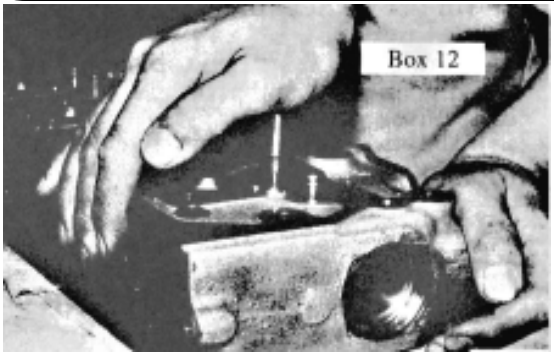


2.Valve stem seal installation

Using Box 12, install the valve stem seal in position in the valve guide. After installation, make sure the seal is in its correct position.

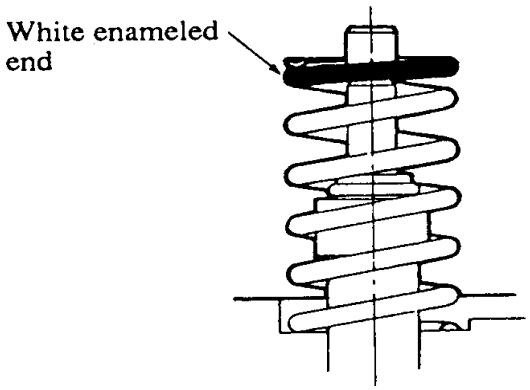
NOTE

Improper stem seal installation can cause a failure to seal against downward flow of oil along the stem.



3.Valve spring installation

Install the valve spring with the white enameled end up.

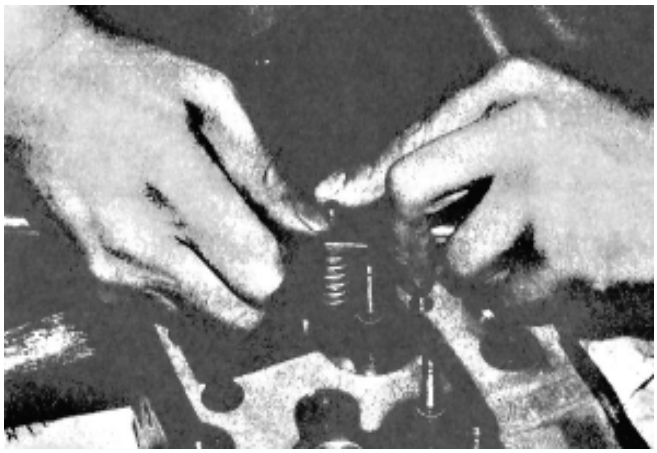


4.Valve block installation

Put compression on the valve spring with a valve lifter and install the block in position on the valve top.

⚠CAUTION

Do not put excessive compression on the valve spring. This can cause the retainer to hit and damage the stem seal.



5.Cylinder head gasket installation

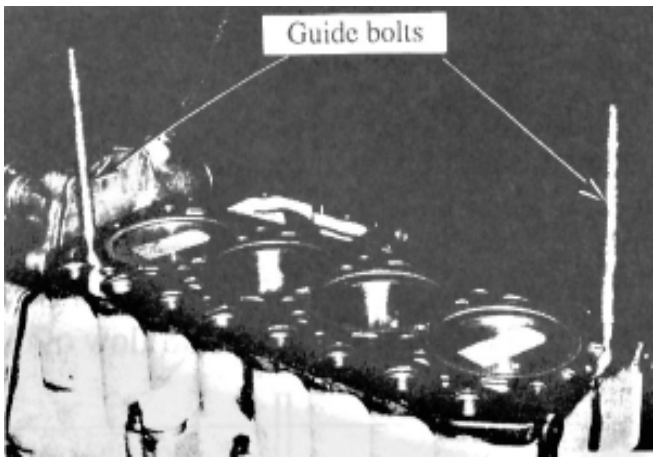
(1)Thoroughly clean the top faces of the cylinder block and pistons.

(2)Install two guide bolts (M10x1.25)in the bolt holes in the cylinder block.

(3)Put new cylinder head gasket in position on the cylinder block, making sure the guide bolts are all in alignment with their respective holes in the gasket.

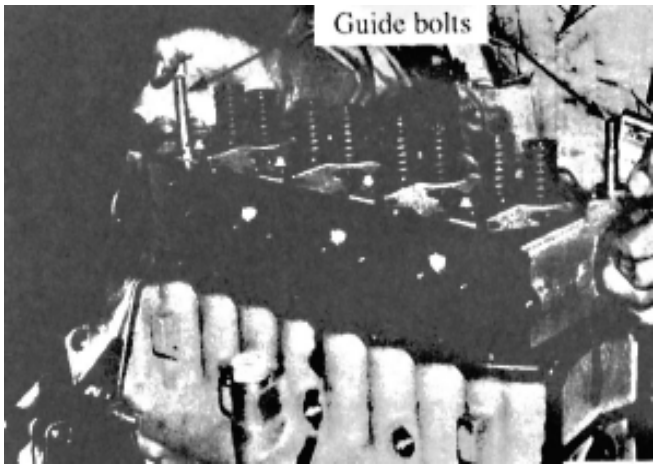
⚠CAUTION

Do not use any gasket adhesive or other substances on the top face of the cylinder block.



6.Cylinder head installation

Put the cylinder head in position on the cylinder block, making sure the guide bolts are all in alignment with their respective bolt holes in the head.

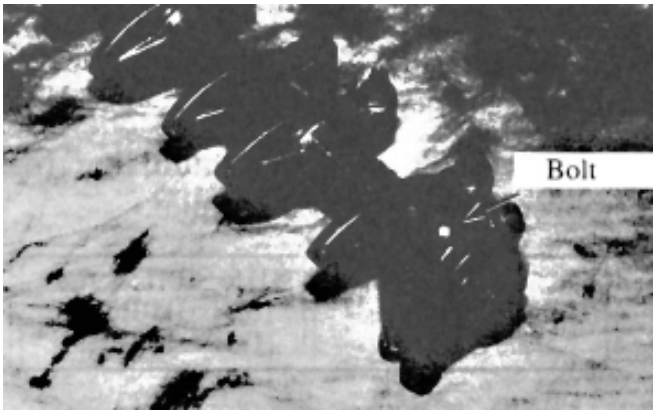


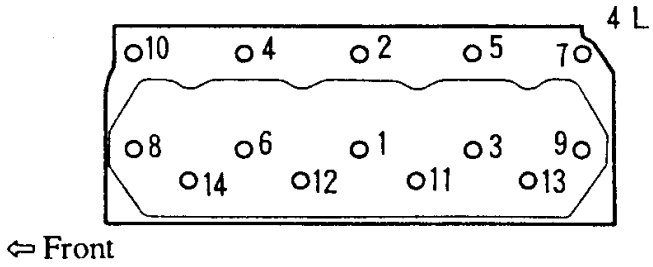
7.Cylinder head bolt tightening

(1)Remove the guide bolts and install the bolts that hold the cylinder head to the cylinder block.

(2)Tighten the bolts in number sequence in two or three steps to the specified torque.

Tightening torque	9 ± 0.5 kgf•m (65 ± 4 lbf•ft) [88 ± 5 N•m]

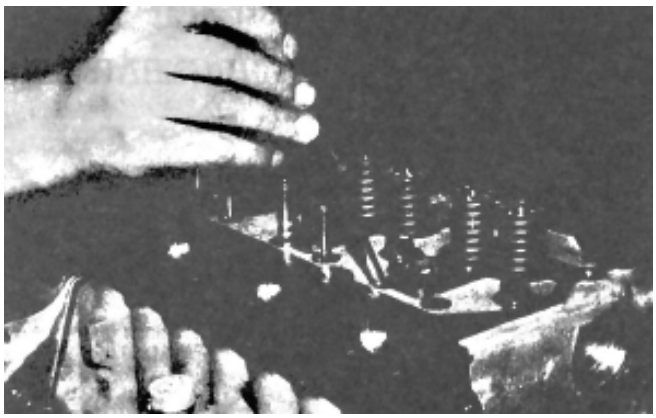




8.Valve push rod installation

(1)Put the valve push rod into position through the bore in the cylinder head.

(2)Make sure the ball end of the push rod has been put into position over the top of the tappet.

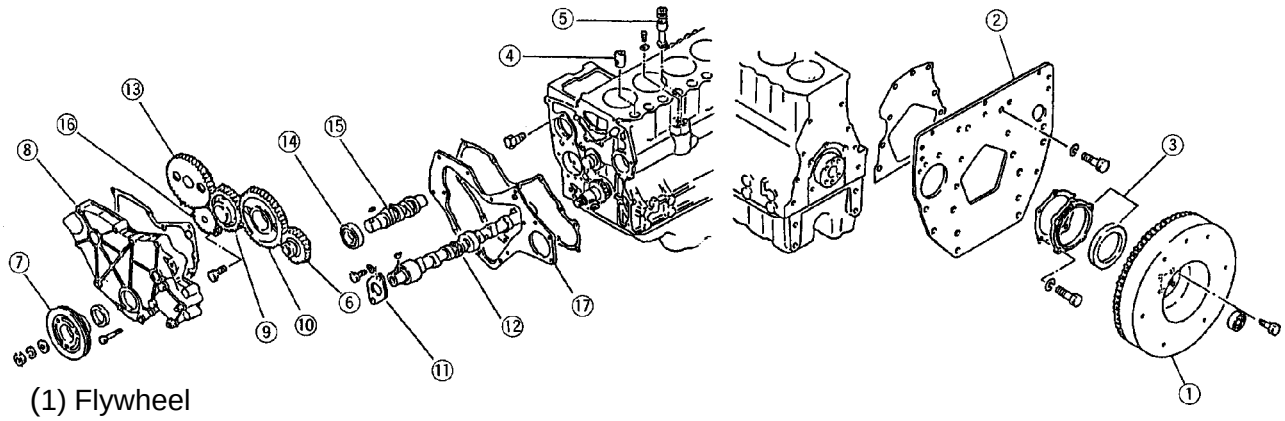


9.Rocker shaft assembling

(1)Install the rocker arms, brackets and springs on the rocker shaft. Secure the brackets to the shaft by tightening the bolts.

(2)Make sure the rocker arms move freely.

(2) TIMING GEAR•FLYWHEEL REASSEMBLING



(1) Flywheel
(2) Rear plate
(3) Oil seal case
(4) Tappet
(5) Speedometer driven gear
(6) PTO gear
(7) Crankshaft pulley
(8) Timing gear case
(9) Idler gear
(10) Valve camshaft gear
(11) Thrust plate
(12) Valve camshaft
(13) Pump camshaft gear
(14) Bearing
(15) Pump camshaft
(16) Oil pump
(17) Front plate

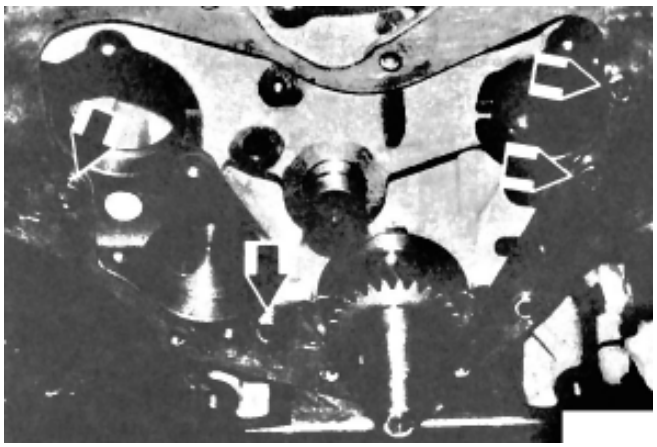
* Reassemble the timing gears and flywheel with reverse procedure of disassembling. Use following values for reassembling as adjustment and service standard.

1.Front plate installation

(1)Scrape the gasket from the cylinder block and front plate.
(2)Coat the gasket contact surface of cylinder block with adhesive and put a new gasket in position, making sure the holes in the gasket are all in alignment with the holes in the cylinder block.
(3)Put the front plate in position. Install four bolts and tighten them.

2.Oil pump installation

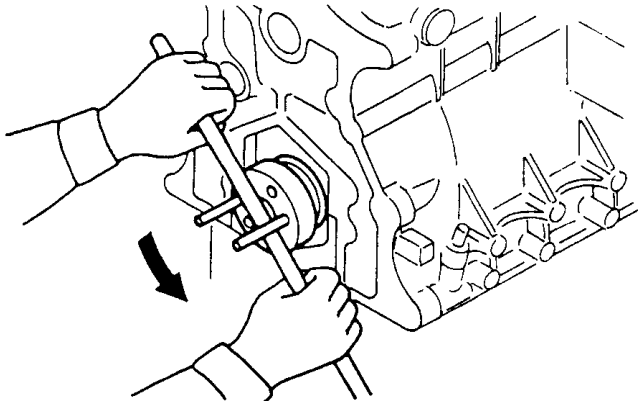
(1)Make sure the packing has been put in position on the oil pump.
(2)Put the oil pump in position on the cylinder block. Install three bolts and tighten them evenly.
(3)Make sure the oil pump gear rotates freely.



3.Engine turning

(1)Install two bolts (M12x1.25)in the flywheel bolt holes in the crankshaft.

(2)Put a bar between the bolts and turn the crankshaft to bring No.1 piston to the top center as shown in the illustration.



4.Fuel injection pump camshaft installation

(1)Put the camshaft(with bearing and gear) in position in the cylinder block.

(2)Hit the gear with a plastic hammer to fit the bearing in position.

(3)Make sure the camshaft rotates freely.

(4)Tighten the stopper bolt.

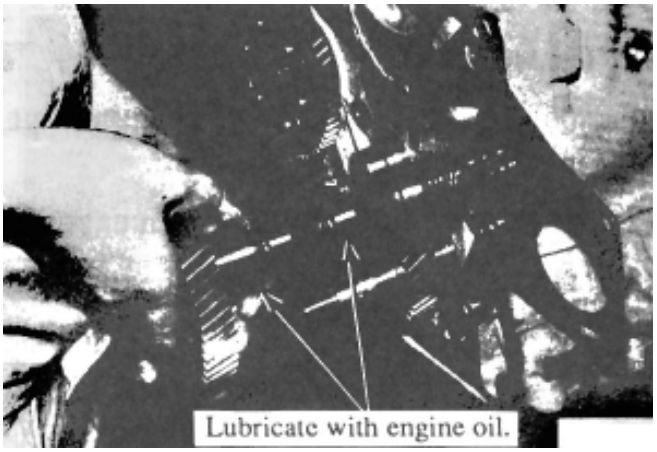
5.Camshaft installation

(1)Lubricate the lobes and journals with engine oil.

(2)Put the camshaft(with gear)in position in the cylinder block.

⚠CAUTION

Do not cause damage to the lobes and journals when the camshaft is installed.



(3)Tighten the bolts that hold the thrust plate to the specified torque.

Tightening torque	1.1 ± 0.1 kgf•m (8 ± 0.7 lbf•ft) [10.8 ± 1 N•m]

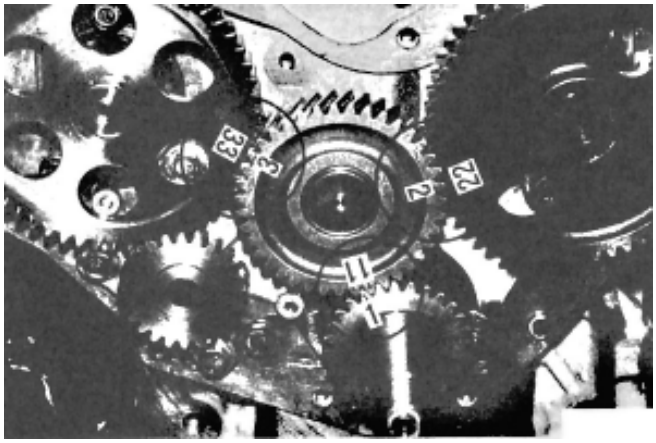
(4)Make sure the camshaft rotates freely. Check the end play for the camshaft.

6.Idler gear installation

(1)Lubricate the idler gear with engine oil.

(2)Install the idler gear in position with its "3","2"and "11"marks in alignment with the "33"mark on the fuel injection pump camshaft gear, the "22"mark on the camshaft gear and the "1"mark on the crankshaft gear respectively.

(3)Check the backlash of the gears. Make reference to "Timing gear backlash measurement"(page 38).



7.Timing gear case installation

(1)Coat the gasket with adhesive and put it in position the front plate.

(2)Lubricate the oil seal lip with engine oil.

(3)tighten the bolts that hold the timing gear case.

8.Crankshaft pulley nut tightening

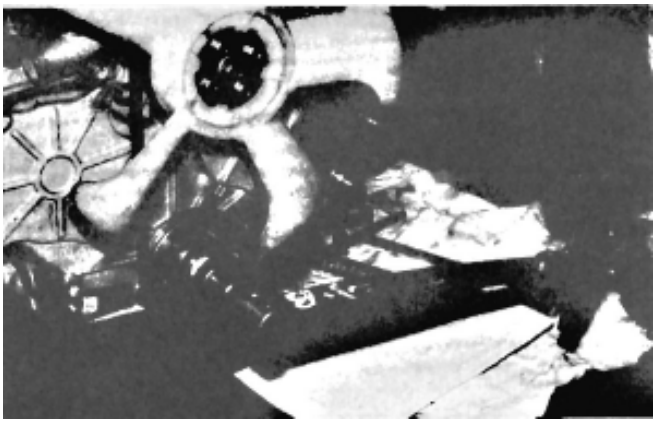
(1)Install two bolts(M12x1.25)in the flywheel bolt holes in the crankshaft and hold the crankshaft.

(2)Tighten the crankshaft pulley nut to the specified torque.

Tightening torque	17.5 ± 2.5 kgf•m (127 ± 18 lbf•ft) [172 ± 25N•m]

⚠WARNING

Check the strength of the bolts and bar used for holding the crankshaft.



9.P.T.O. gear installation

Install the P.T.O. gear in position in the timing gear case with the side that has no oil hole toward the rear of the engine.

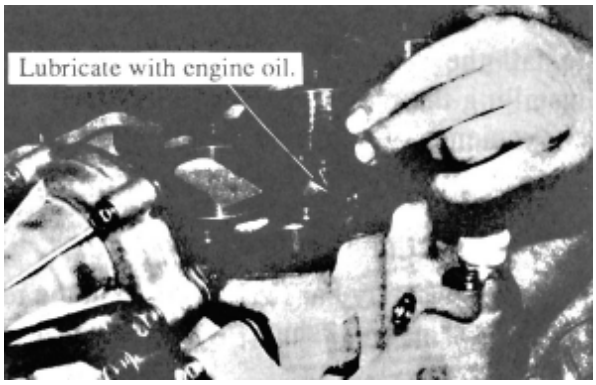
10.Speedometer driven gear installation

(1)Install the O-ring in the groove in the driven gear sleeve.

(2)Install the speedometer driven gear in position in the cylinder block while rotating it or the camshaft.

11.Tappet installation

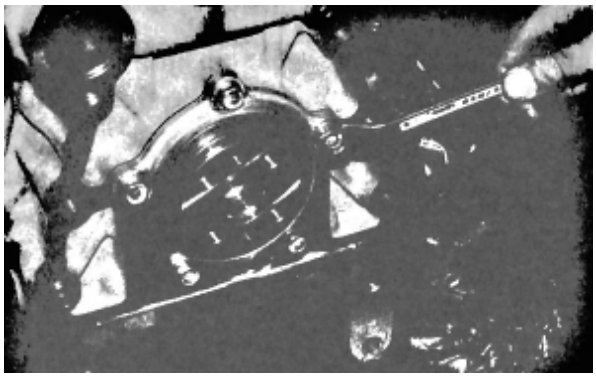
Lubricate the tappets with engine oil and put them in position in the cylinder block.



12.Oil seal case installation

(1)Put new gasket in position on the oil seal case.

(2)Lubricate the oil seal lip with engine oil and install the oil seal in position in the cylinder block.



13.Rear plate installation

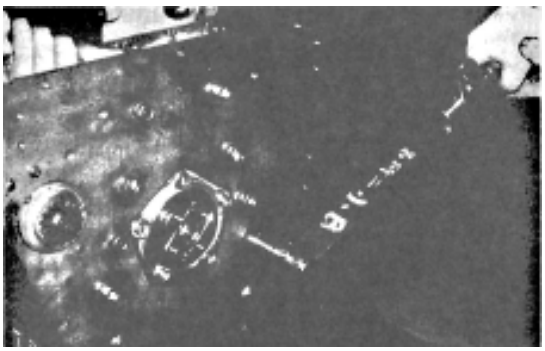
(1)Put a new gasket in position on the rear plate.

(2)Put the rear plate in position on the cylinder block with its dowel holes in alignment with the dowels. Tighten the bolts that hold the rear plate to the specified torque.

Tightening torque	6.5 ±1 kgf•m (47 ±7 lbf•ft) [64 ±10 N•m]

NOTE

Install the starter to the rear plate before installing the plate to the cylinder block for convenience of rear plate installation.



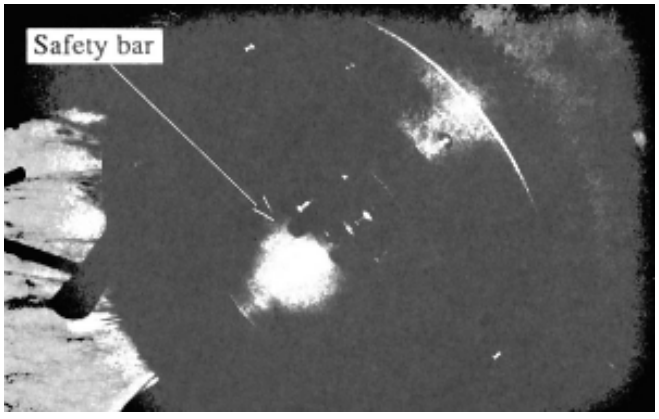
14.Flywheel installation

(1)Install a safety bar(M12x1.25)in the rear end of the crankshaft.

(2)Put the flywheel in position in alignment with the safety bar.

(3)Install three of four bolts in the flywheel and tighten them finger tight only.

(4)Remove the safety bar. Install the last bolt in the flywheel and tighten it finger tight only.

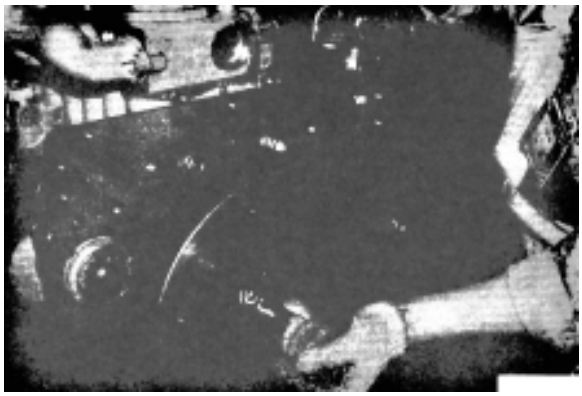


(5)Have someone hold the crankshaft pulley with a wrench to prevent the flywheel from rotating.
(6)Tighten the four bolts that hold the flywheel to the specified torque.

Tightening torque	13.5 ± 0.5 kgf•m (98 ± 4 lbf•ft) [132 ± 5 N•m]

⚠WARNING

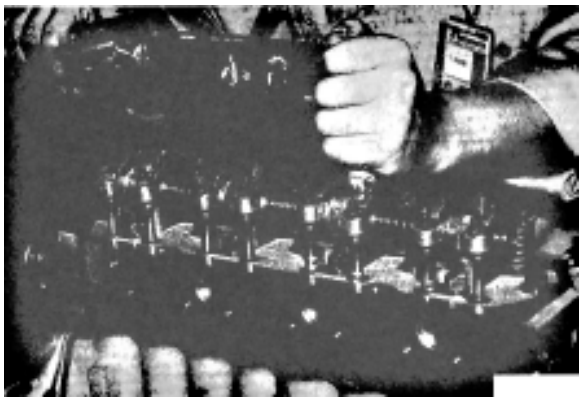
Always signal each other to prevent possible personal injury.



10.Rocker shaft assembly installation

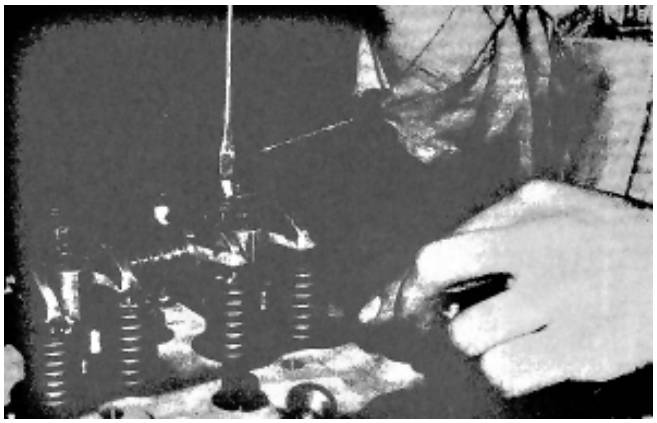
(1)Install the valve caps in position on the top of the valves.
(2)Put the rocker shaft assembly in position on the cylinder head. Tighten the bolts that hold the rocker shaft assembly to the specified torque

Tightening torque	1.5 ± 0.5 kgf•m (11± 4 lbf•ft) [14.7± 5 N•m]



11.Valve clearance adjustment

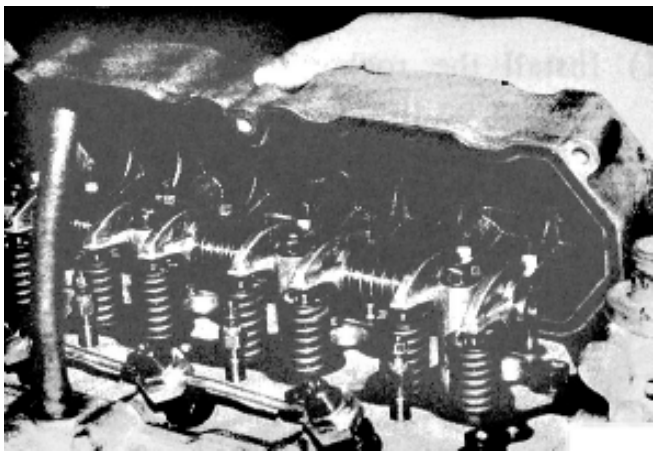
Make reference to“VALVE CLEARANCE” (page 100)



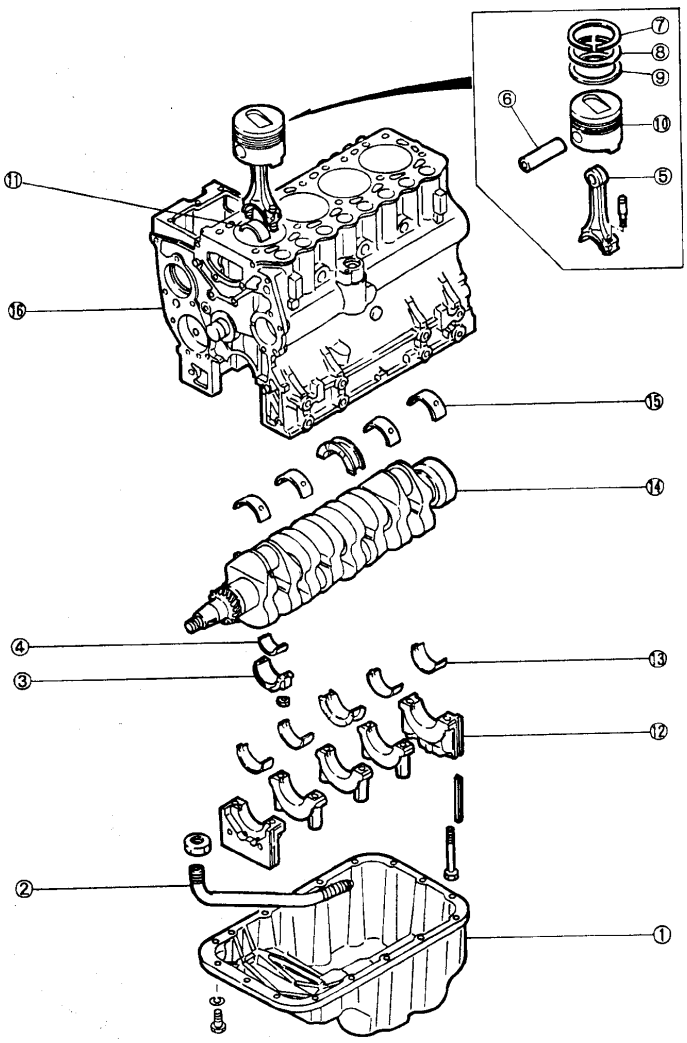
12.Rocker cover installation

(1)Make sure the gasket is put on the rocker cover.
(2)Tighten the bolts that hold the rocker cover to the specified torque.

Tightening torque	1.15 ± 0.15 kgf•m (8.3 ± 1.1 lbf•ft) [11.3 ±1.5 N•m]



(3) CYLINDER BLOCK, CRANKSHAFT,PISTONS AND OIL PAN REASSEMBLING



(1)Oil pan
(2)Oil screen
(3)Connecting rod cap
(4)Connecting rod bearing (lower)
Reassemble 5 thru 10
(5)Connecting rod
(6)Piston pin
(7)No.1 ring
(8)No.2 ring
(9)Oil ring
(10)Piston

(11)Connecting rod bearing (upper)
(12)Main bearing cap
(13)Main bearing(lower)
(14)Crankshaft
(15)Main bearing(upper)
(16)Cylinder block

*Reassemble the cylinder block, crankshaft, pistons and oil pan with reverse procedure of disassemble. Use following values for reassembling as adjustment and service standard.

1.Main bearing installation

(1)Install the upper halves of the main bearings in the cylinder block and the lower halves in the main bearing caps so their tabs fit into the notches in the cylinder block and the main bearing caps.

(2)Install the flanged bearing in the No.3 journal.

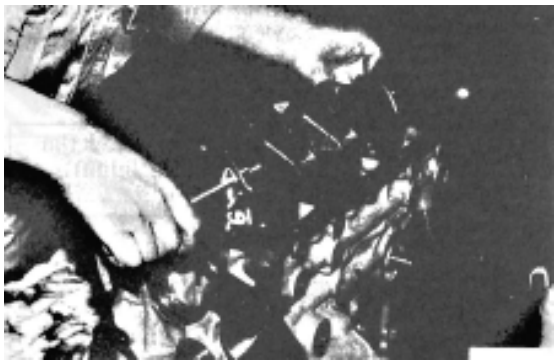
(3)Lightly lubricate the inside surfaces of the bearings with engine oil.

2.Crankshaft installation

(1)Clean the crankshaft with cleaning solvent and blow dry with compressed air.

(2)Fasten a hoist to the crankshaft and hold it in horizontal position. Carefully put the crankshaft in position in the cylinder block.

(3)Lightly lubricate the crankshaft journals with engine oil.

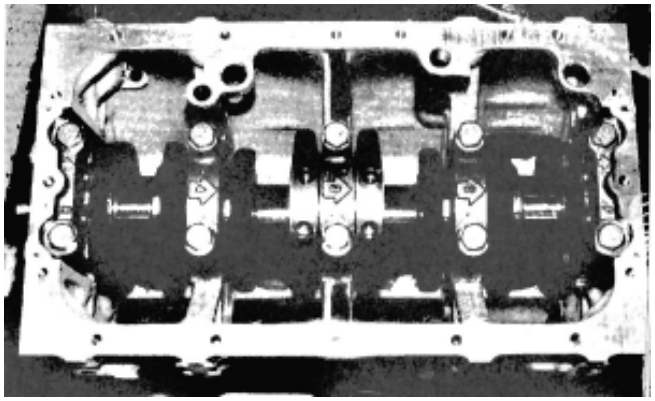


3.Main bearing cap installation

(1)Coat the mating surfaces of the rear bearing cap and cylinder block with Three Bond 1212.

(2)Install the main bearing caps in position. Make sure the number(arrow head)on the main bearing cap is toward the front of the engine.

(3)Tighten the main bearing cap bolts finger tight only.



⚠CAUTION

Install the front and bearing caps in position so their end faces are even with the end faces of the cylinder block.

(4)Tighten the bolts holding the main bearing caps in steps to the specified torque.

Tightening torque	5.25 ± 0.25 kgf•m (38 ± 2 lbf•ft) [51.5 ± 2.5 N•m]

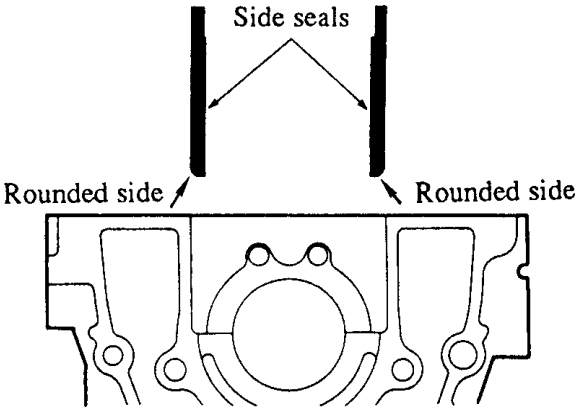
(5)Make sure the crankshaft rotates freely without binding or catching.

(6)Measure the end play for the crankshaft. Make reference to“End play measurement for crankshaft”(page 42). If the end play is incorrect, loosen the bolts holding the main bearing caps once and tighten them again.

4.Side seal installation

(1)Coat the side seals with Three Bond 1212.

(2)Insert the side seals between the cylinder block and the front and rear caps and push in them by hand as far as possible, with their rounded side toward the outside of the cylinder block.

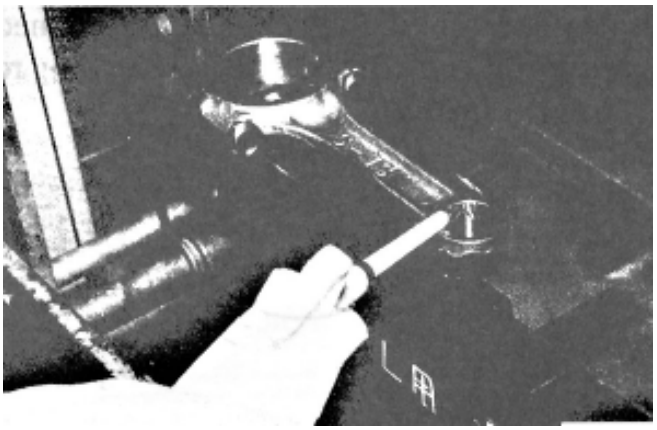


(3)Using a flat plate, push the seals into position, taking care not to bend them.

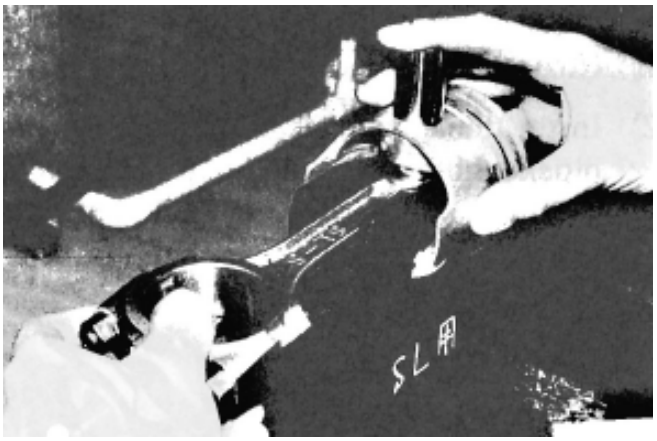
5.Piston assembling to connecting rod

(1)Set Piston Setting Tool(31A91-00100) (special tool)in a hydraulic press.

(2)Put the connecting rod on the tool and lubricate the bore in the rod for the piston pin with engine oil.



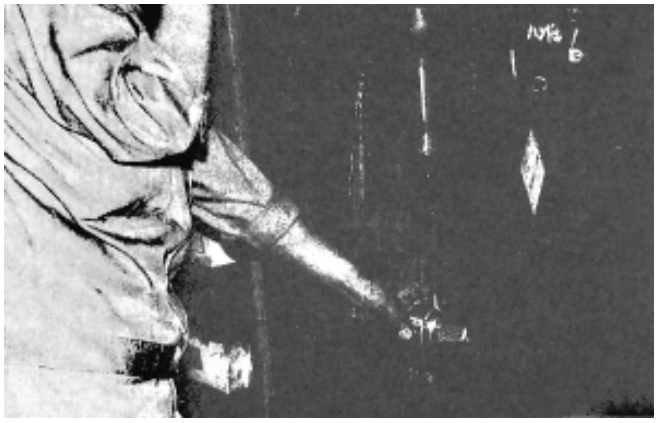
(3)Put the piston in position on the connecting rod, making sure the model identification on the rod is on the same side as the arrow head on the top of the piston.



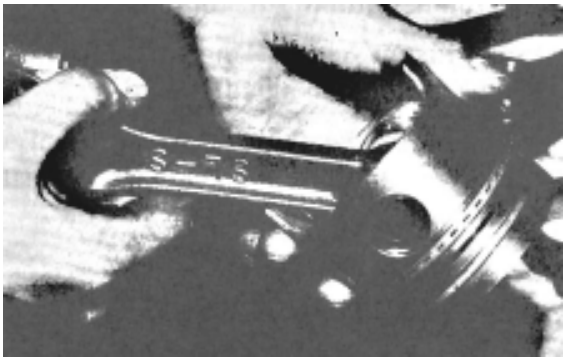
(4)Insert the push rod of the Tool into the bore in the piston for the piston pin and press the pin with the press.

⚠CAUTION

Observe the indicator of the press when pressing the piston pin. If the force of the press is ready to exceed 110 lbf (50 kgf) [490 N], stop pressing the pin and check the bores in the piston and connecting rod for alignment.



(5)After assembling the piston and connecting rod, make sure the connecting rod moves freely.



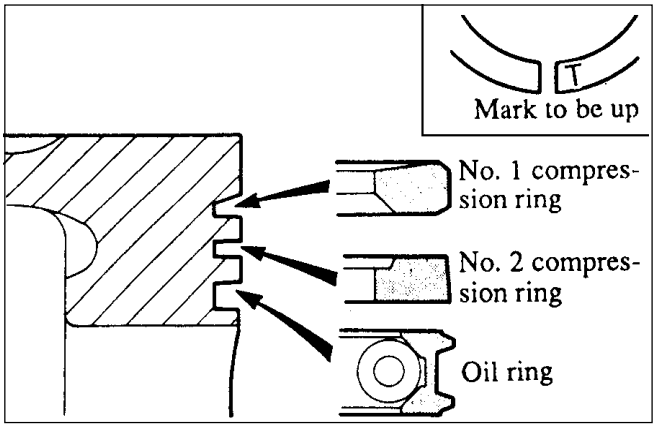
6.Piston ring installation

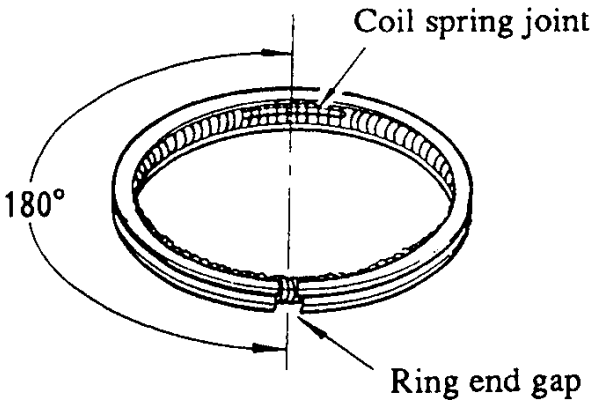
Using a piston ring pliers, install the piston rings on the piston.

NOTE

a)The piston rings must be installed with the side that has the mark “T” toward the top of the piston.

b)The oil ring must be installed with the ring end gap 180°apart from the coil spring joint.





7.Piston and connecting rod installation

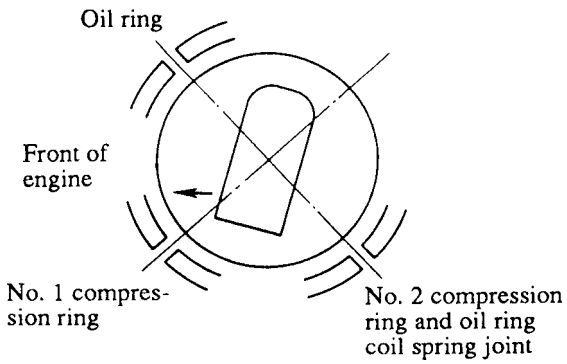
(1)Lubricate the piston and piston rings with engine oil.

(2)Move the piston rings on the piston so that the end gaps are apart from a direction parallel to, or transverse to, the piston pin.

(3)Install the connecting rod bearing(upper half) to the rod, making sure the tab in the back of the bearing is in the notch of the connecting rod.

(4)Turn the crankshaft until the crankpin for the piston and connecting rod to be installed is at the top center.

(5)Hold the piston and connecting rod with “FRONT”mark(arrow head) on the top of the piston toward the front(timing gear case side) of the engine.



(6)Using a piston guide (commercially available), put the piston and connecting rod into the cylinder from the top of the cylinder block.

⚠CAUTION

Do not hit the piston with a hammer to install the piston and connecting rod. This will put force on the piston and connecting rod and cause damage to the piston rings and crankpin.

8.Connecting rod cap installation

(1)Push the piston into position until the big end of the connecting rod is put into position over the crankpin. Then turn the crankshaft 180° while pushing on the top of the piston.

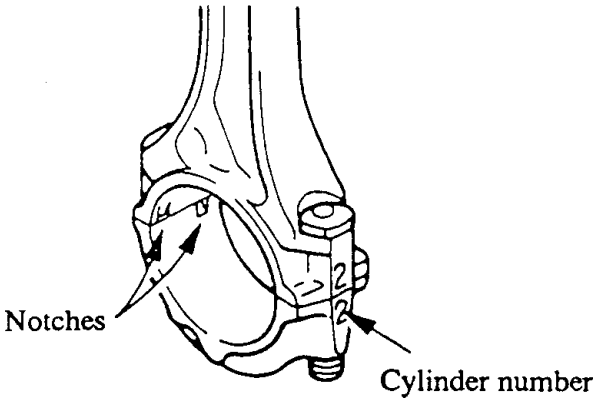
(2)Install the lower halt of the connecting rod bearing in the connecting rod cap, making sure the tab in the back of the bearing is in the notch of the cap.

(3)Install the bearing cap to the connecting rod.

NOTE

a)Make sure the number on the cap is the same as the number on the connecting rod.

b)In case of a new connecting rod having no cylinder number, install the cap to the rod with the notches on the same side.



(4)Tighten the connecting rod cap nuts in steps to the specified torque.

Tightening torque	3.55 ± 0.25 kgf•m (25.7 ± 2 lbf•ft) [34.8 ± 2.5 N•m]

(5)Check the thrust clearance for the connecting rod big end.

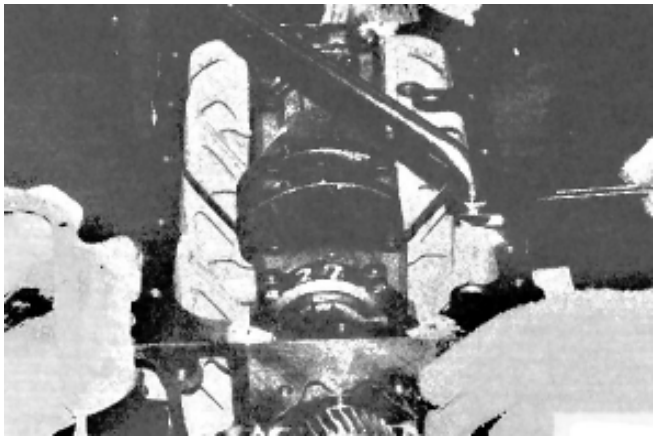
9.Oil screen installation

(1)Lay the cylinder block with the bottom (oil pan side) up.

(2)Install the oil screen in position.

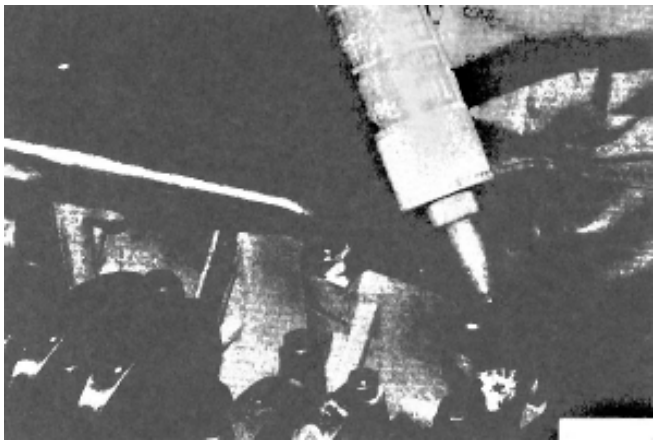
NOTE

The oil screen must be installed in position so that it is below the oil level line and away from the oil pan.



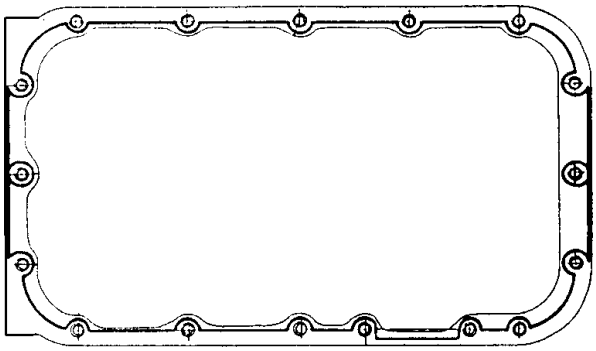
10.Oil pan installation

(1)Clean the mating surfaces of the oil pan and cylinder block and coat them with Three Bond 1207C.



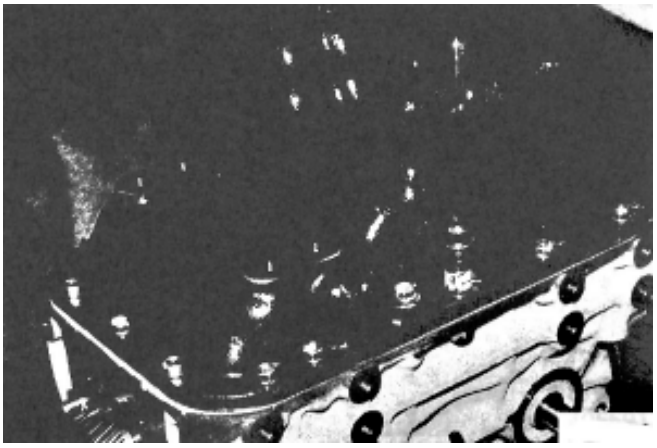
NOTE

Squeeze out a 4mm(0.2 in.) thick bar of sealing compound(three Bond) from the tube and put it on the flange of the oil pan as shown.



(2)Tighten the bolts that hold the oil pan to the cylinder block in a crisscross pattern to the specified torque.

Tightening torque	Cast oil pan: 2.8 ± 0.3 kgf•m (20.3 ± 2.2 lbf•ft) [27.5 ± 3 N•m] Plate oil pan: 1.15 ± 0.15 kgf•m (8.3 ± 1.1 lbf•ft) [11.3 ± 1.5 N•m]



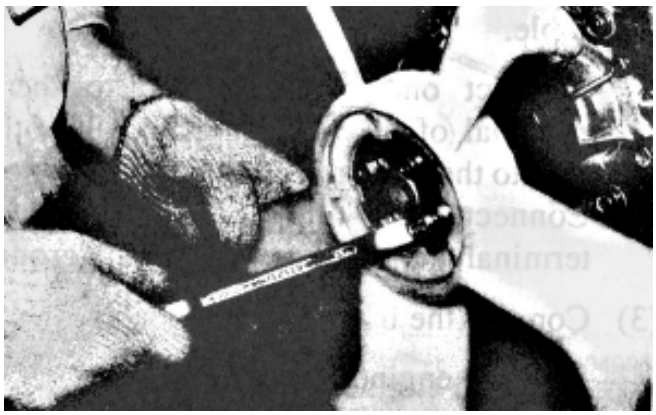
(4)COOLING SYSTEM
DISASSEMBLY REMOVAL

1.Cooling fan removal

Hold the fan by one hand remove the four bolts that hold the fan in position. Remove the fan and spacers.

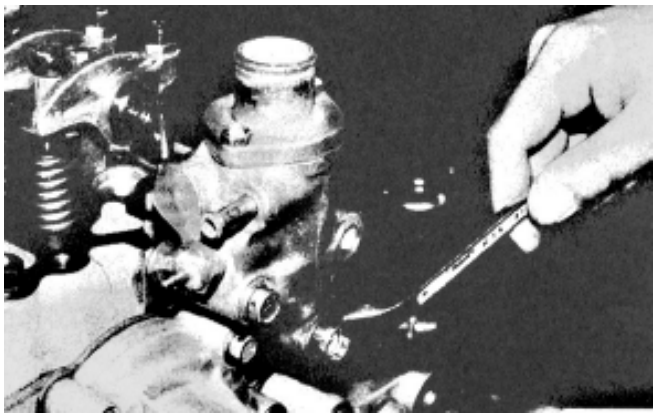
NOTE

Keep the spacers with the for installation.



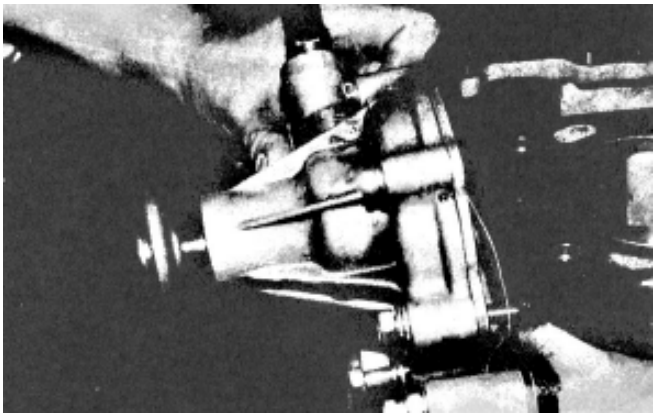
2.Thermostat case removal

Remove the thermostat case assembly containing thermostat.



3.Water pump assembly removal

Remove the water pump assembly.



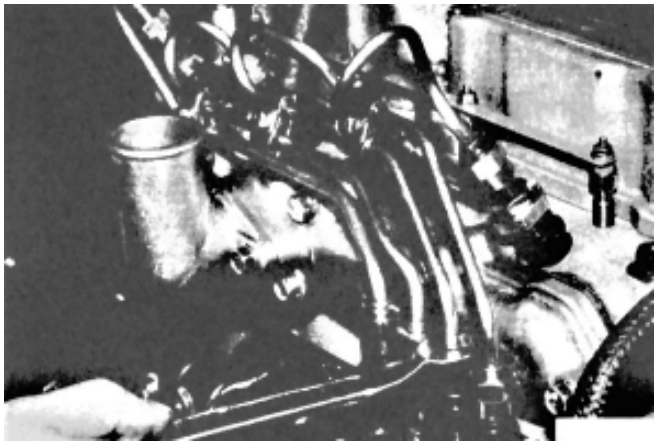
(5)FUEL SYSTEM DISASSEMBLY REMOVAL

1.Fuel injection pipe removal

Disconnect the fuel injection pipes and fuel leak-off pipe from the fuel injection pump and nozzles.

NOTE

Put plugs or caps on the openings of the injection pump and nozzle connectors.



2.Fuel injection nozzle removal

Loosen the fuel injection nozzles with a wrench. Remove the nozzles and gaskets from the cylinder head.

NOTE

Remove the gaskets from the cylinder head with a screwdriver or the like. Discard defective gaskets.

3.Governor assembly removal

(1)Remove the tie rod cover.

(2)Remove the spring from the tie rod with a pliers to disconnect the tie rod from the fuel injection pump.

(3)Remove the governor assembly.

4.Governor weight removal

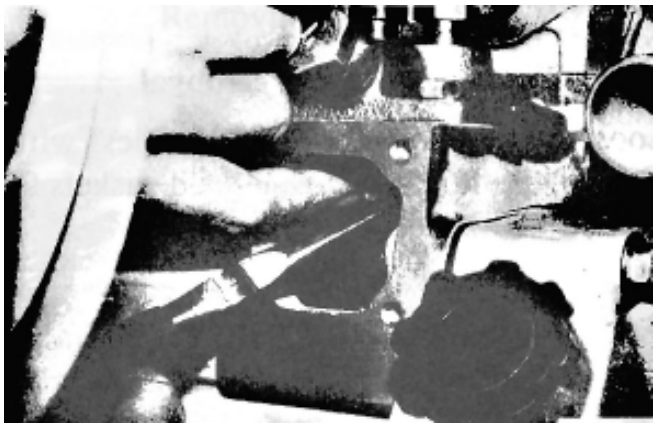
(1)Remove the sliding sleeve.

(2)Remove the sliding sleeve shaft and governor weights.

5.Fuel injection pump removal

(1)Remove the tie rod cover.

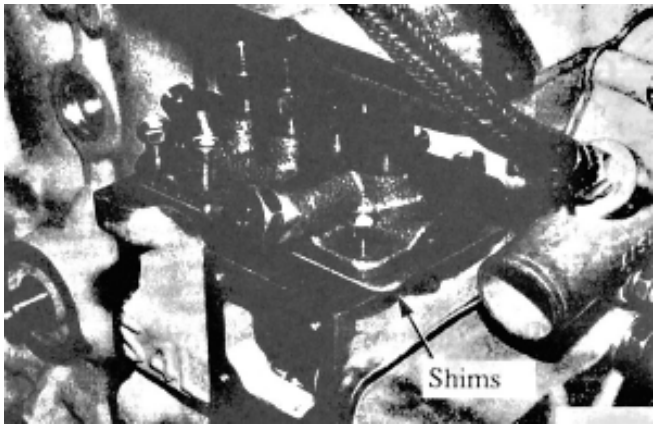
(2)Remove the spring from the tie rod with a pliers to disconnect the tie rod from the fuel injection pump.



(3)Remove the fuel injection pump.

NOTE

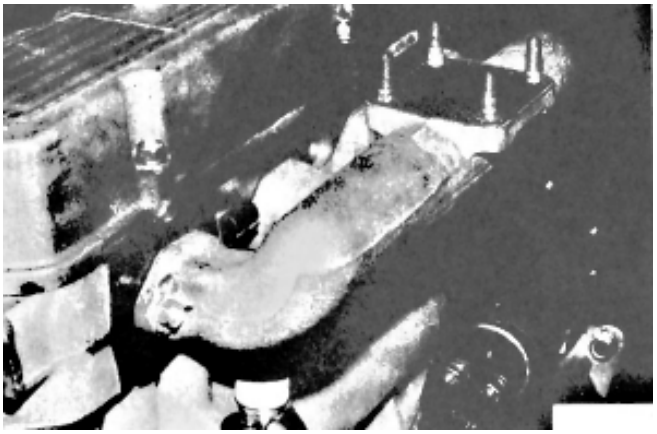
Keep a record of the thickness of shims for installation.



(6)AIR INLET AND EXHAUST SYSTEM DISASSEMBLY REMOVAL

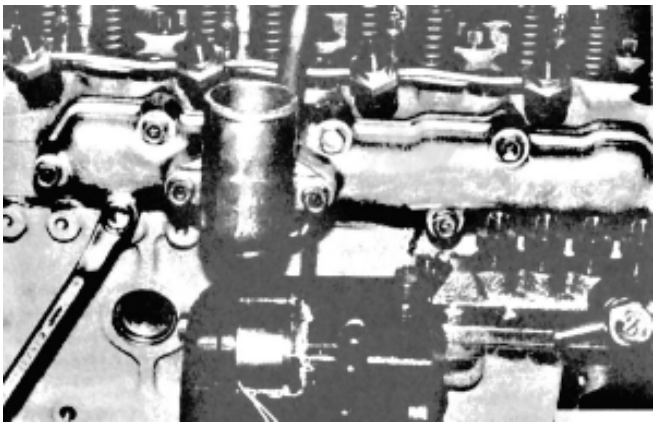
1.Exhaust manifold removal

Remove the exhaust manifold from the cylinder head.



2.Air inlet cover removal

Remove the air inlet cover from the cylinder head.



(7)LUBLICATION SYSTEM REMOVAL

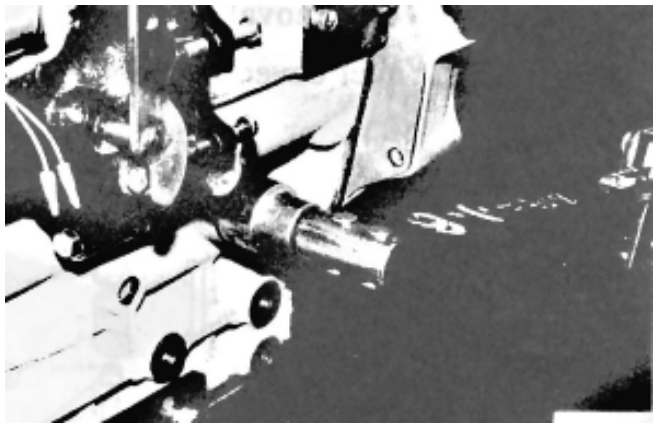
1.Oil filter removal

(1)Put a container under the oil filter to catch the oil.

(2)Remove the oil filter from the cylinder block with a filter wrench.

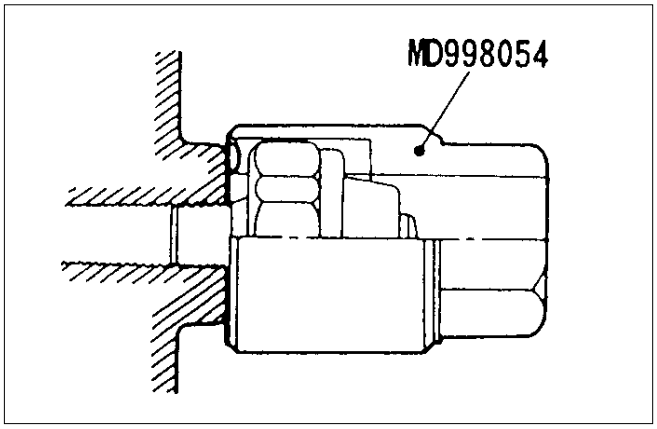
2.pressure relief valve removal

Remove the pressure relief valve from the cylinder block.



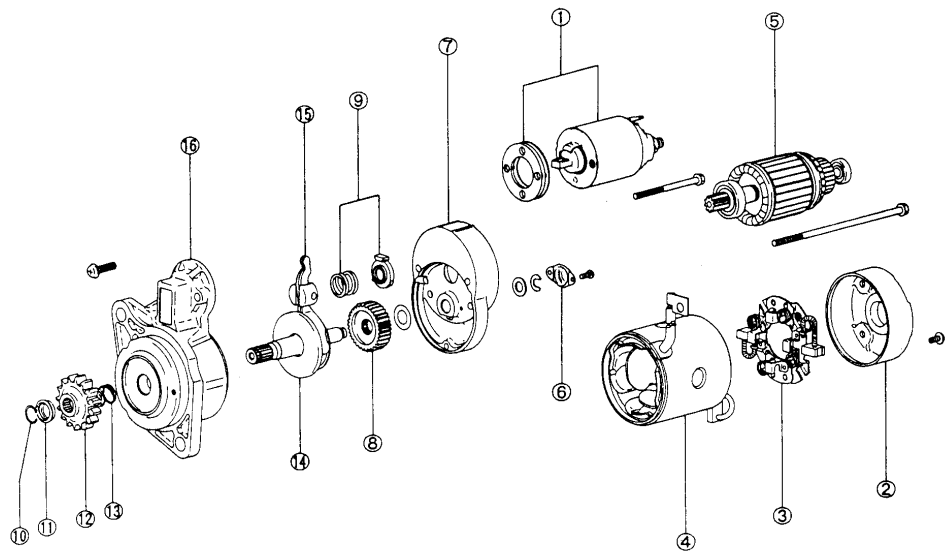
3.Oil pressure switch removal

Remove the oil pressure switch with Oil Pressure Switch Socket Wrench(MD998054) (special tool).



(8)ELECTRICAL SYSTEM DISASSEMBLY

1. Starter disassembly

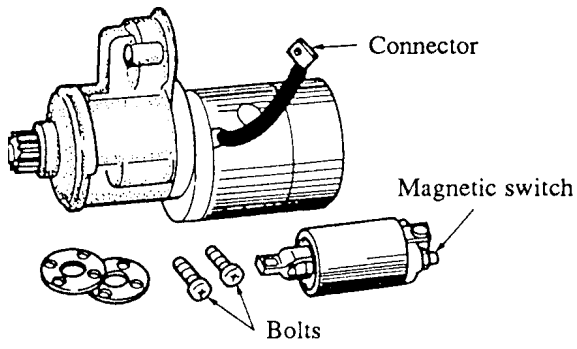


(1)magnetic switch
(2)rear bracket
(3)brush holder assembly
(4)yoke
(5)armature
(6)cover
(7)center bracket
(8)gear
(9)spring set
(10)stopper ring
(11)stopper
(12)pinion
(13)spring
(14)pinion shaft
(15)lever
(16)front bracket

(1)Magnetic switch

(a)Loosen the nut that holds the connector to the M terminal of the magnetic switch and disconnect the connector from the magnetic switch.

(b)Remove the bolts(two) that hold the magnetic switch in position and remove the magnetic switch.

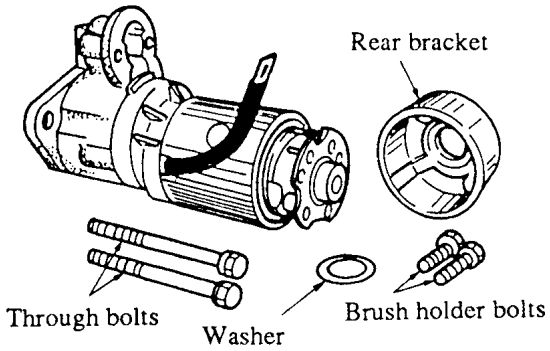


(2)Rear bracket removal

Remove the through bolts(two) and the bolts (two) that hold the brush holder in position. Remove the rear bracket.

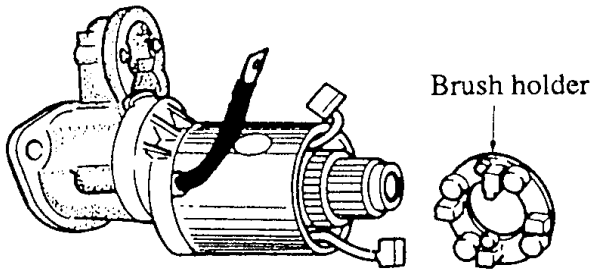
NOTE

Keep the rear bracket with washer for installation.



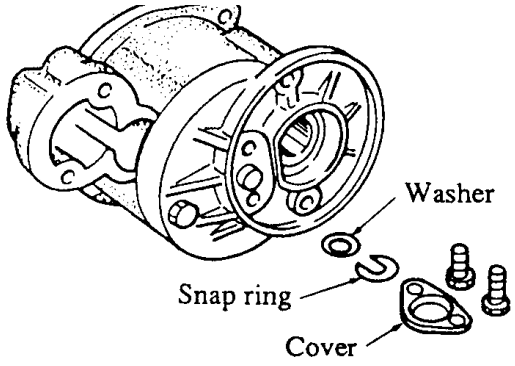
(3)Brush holder removal

With the brushes (two) kept apart from the commutator, remove the yoke and brush holder assembly. Remove the armature.



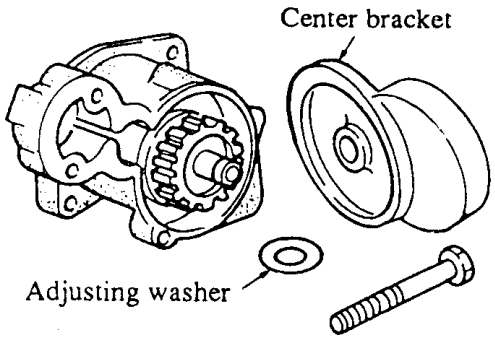
(4)Cover removal

Remove the cover and remove the snap ring and washer.



(5)Center bracket removal

Remove the bolt and remove the center bracket. Remove the washer for adjusting the end play for the pinion shaft.



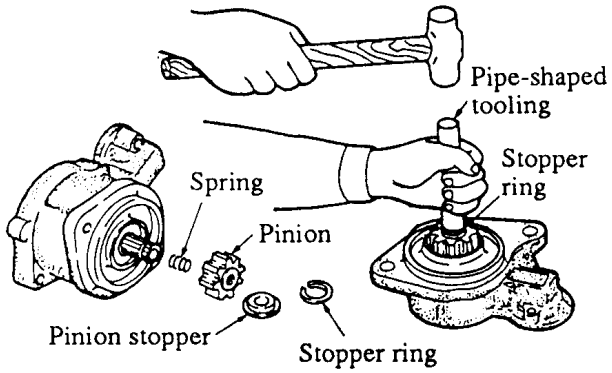
(6)Pinion removal

(a)Put a pipe-shaped tooling on the pinion stopper and hit the stopper with a hammer to expose the stopper ring.

(b)Remove the stopper ring with a pliers and remove the pinion.

NOTE

Any time the pinion is removed, a new stopper ring must be installed.



(7)Pinion shaft removal

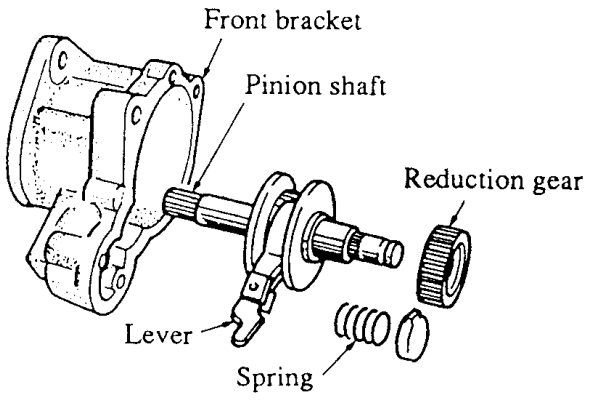
Remove the spring, lever, reduction gear and pinion shaft from the front bracket.

NOTE

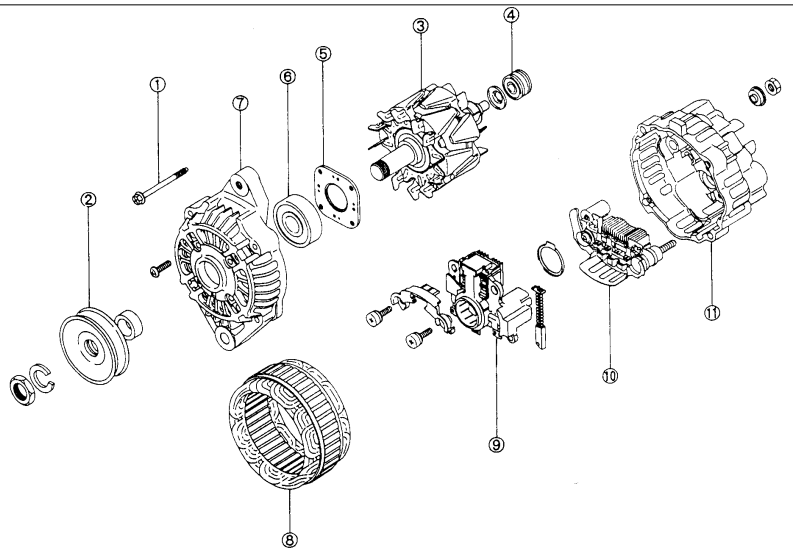
Do not mix the sequence of spring, lever and reduction gear when the pinion shaft is removed.

(8)Bearing removal

To remove the ball bearings from the ends of the armature, use a bearing puller. The bearing fitted in the front bracket is not replaceable. Replace the front bracket assembly if this bearing is defective.



2. Alternator



(1)through bolts
(2)pulley
(3)rotor
(4)rear bearing
(5)bearing retainer
(6)front bearing
(7)front bracket
(8)stator core
(9)brush holder
(10)rectifier
(11)rear bracket

Disassembly procedure

(1)Stator core separation from front bracket

(a)Pry the stator core off the front bracket with a screwdriver as shown in the illustration.

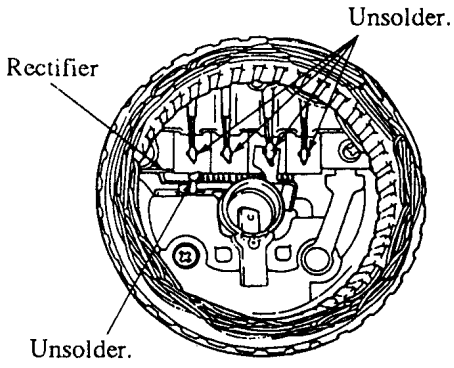
⚠CAUTION

Be careful not to insert the screwdriver too deep. Damage to the stator core can be the result.

(2)Pulley removal

(a)Hold the rotor assembly in a vise by using thick cloth as shown in the illustration. Remove the nut that holds the pulley in position, and remove the pulley and spacer.

(b)Remove the rotor assembly from the front bracket.



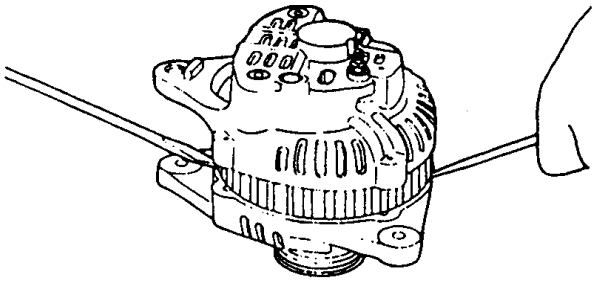
(3)Stator core and rectifier removal

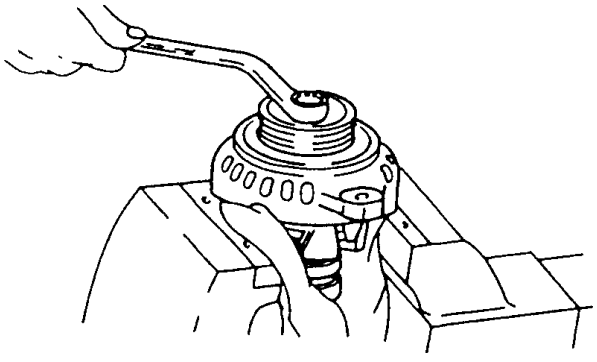
(a)Unsolder the leads from the rectifier and remove the stator core from the rectifier.

⚠CAUTION

Unsolder the leads as quickly as possible to prevent damage to the diodes in the rectifier.

(b)Remove the screws that hold the rectifier in position and remove the rectifier.

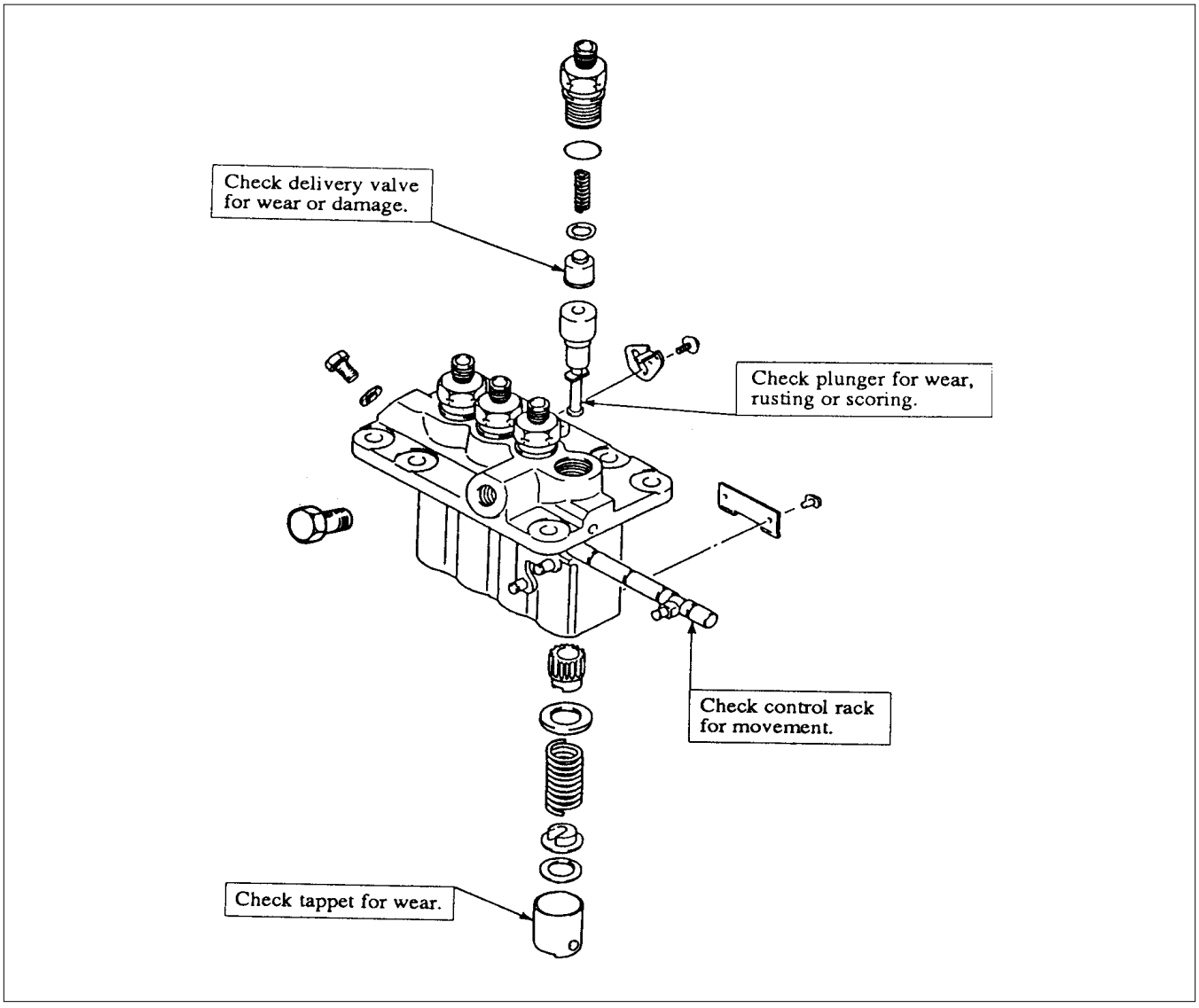




3.Injection pump

Check the injection pump for items listed in the chart below and replace it if defective. Do not attempt to make repairs by disassembling.

Test item	Test method	Criteria
Low idle speed	Use a tachometer.	Standard farm engine: 980 $^{+30}_{0}$ rpm
Exhaust smoke	1)Check by quickly increasing engine speed under no-load condition. 2)Check by staring load.	Not too much black or gray smoke
Orifice discharge pattern	Remove injection nozzle and reinstall it with orifice toward outside of engine. Look at discharge pattern by cranking the engine with starter.	Good discharge pattern



(9)ELECTRICAL SYSTEM REASSEMBLING

1.starter

Follow the reverse of disassembly and use the procedure that follows.

(1)Lubrication

Lubrication the following starter components with grease after the starter has been assembled:

(a)Armature shaft gear and reduction gear

(b)Bearing

(c)Washer and stopper ring of pinion shaft

(d)Pinion

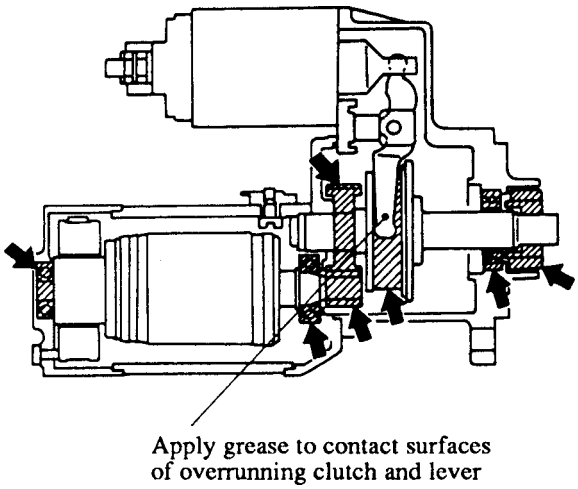
(e)Sliding surfaces of lever

⚠CAUTION

Do not put grease on the starter mounting face,brushes, commutator and other electrical parts.

(2)Stopper ring installation

Put the stopper ring on the pinion shaft. Using a puller, pull the pinion stopper to fit the ring in the groove.

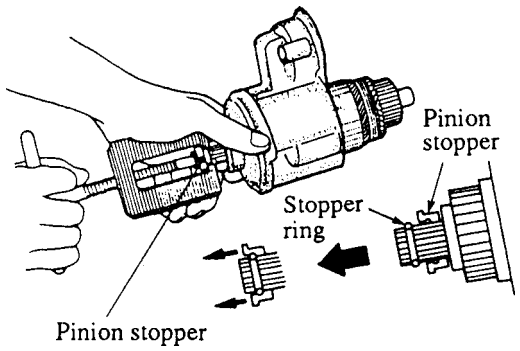


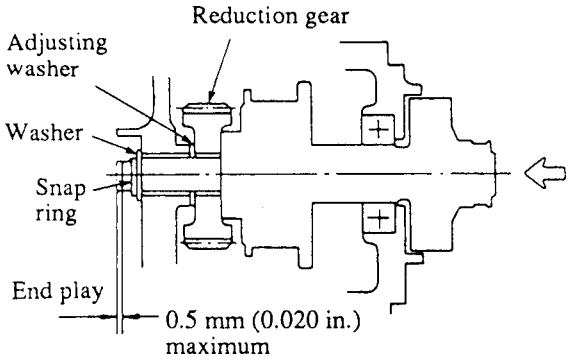
(3)Pinion shaft end play adjustment

The maximum permissible limit of the end play(thrust gap) for the pinion shaft is 0.5mm (0.020 in)

(a)Put the pinion shaft, reduction gear washer and snap ring in position in the center bracket.

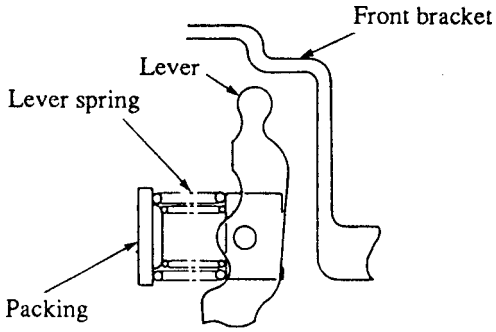
(b)Move the pinion shaft in the axial direction to measure the end play. If the end play exceeds 0.5mm(0.020 in.), make adjustment to it by adding adjusting washer.





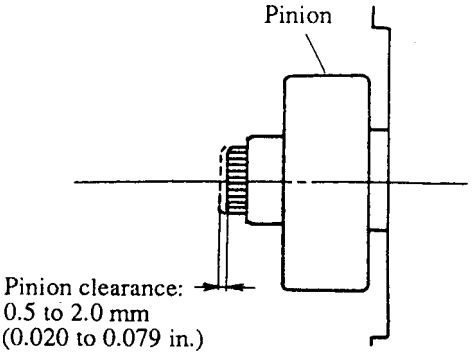
(4)Lever installation

Install the lever in correct position.



(5)Pinion clearance adjustment

The pinion clearance must be 0.020 to 0.079 in. (0.5 to 2.0mm). With the pinion held in cranking position, lightly push it toward commutator end to measure free movement (clearance). If the clearance is not correct, make adjustment to it. Increase the amount of packings if the clearance is too large; decrease it if the clearance is too small.



2.Alternator

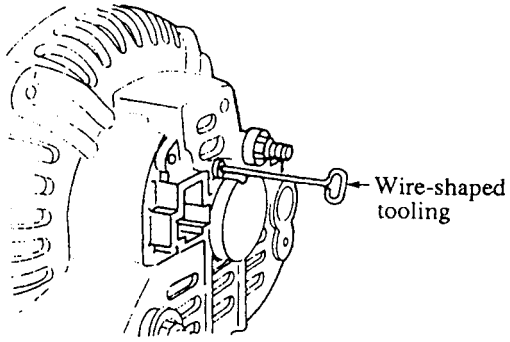
Follow the reverse of disassembly and use the procedure that follows.

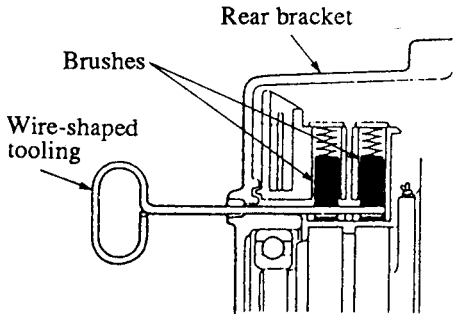
(a)The rear bearing has a groove for the snap ring. Install the snap ring in this groove, making sure its tab is in the deep portion of the groove.

(b)When installing the new rear bearing, put it in position with the side that has a groove toward the slip rings of the rotor.

(c)To install the rear bearing in the rear bracket, heat the rear bracket.

(d)Before installing the rotor in the rear bracket, insert a wire-shaped tooling into the hole in the rear bracket to lift the brushes off the slip rings. Remove the tooling after the rotor has been installed in position.





3. Shutoff solenoid installation

(a)Remove the tie rod cover.

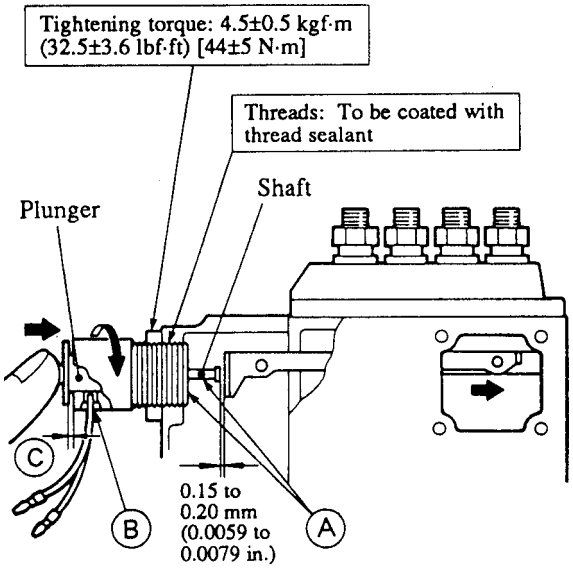
(b)Coat the threads of the stop solenoid with thread sealant(three Bond 1212).

NOTE

Coat the length of the threads to be turned in the governor case.

(c)Temporarily install the shutoff solenoid and nut in the governor case.

(d)Move the injection pump control rack all the way to the non-injection(shutoff) position.



NOTE: Do not allow thread sealant to contact (A).
Do not allow cleaning solvent to enter the solenoid through (B).

(e)Turn the shutoff solenoid in the governor case while pushing the plunger toward the control rack until the shaft is in touch with the tie rod. At this time, clearance C must be 0 mm. (Under this condition, the plunger will be rotated by the shutoff solenoid being turned in.)

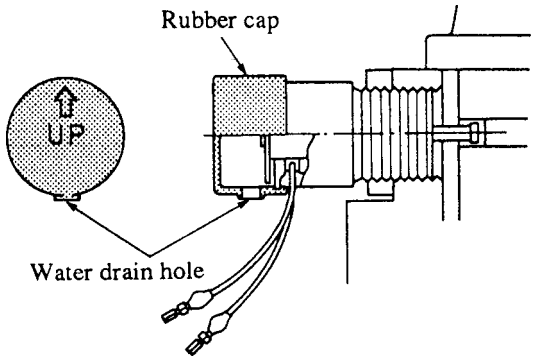
(f)Back off the shutoff solenoid 30•to 45• turn(the clearance between the control rack and plunger will be 0.0059 to 0.0070ı in. (0.15 to 0.20 mm) and tighten the nut to the specified torque.

(g)Start the engine and make sure the engine stops when the plunger is pushed all the way.

(h)Install the rubber cap in position with the arrow head toward up(with the side that has a water drain hole down)as shown in the illustration.

⚠CAUTION

Do not allow cleaning solvent to contact any solenoid parts.



Inspection after assembly

(a)For the schematic of the key shutoff system, see page 168.

(b)Start the engine and make sure the engine stops when the starter switch key is turned to OFF position.

(c)Start the engine and make sure the engine stops when the oil pressure switch terminal is shorted to the switch body.

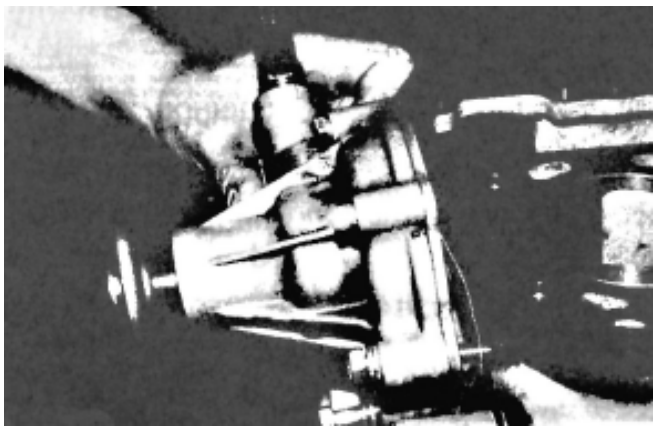
NOTE

It will take about 5 minutes to restart an engine which was shut down by the key shutoff device.

(10)COOLING SYSTEM REINSTALLATION

1.Water pump installation

Put a new gasket in position on the water pump flange. Install the water pump in position on the cylinder block.



2.Thermostat installation

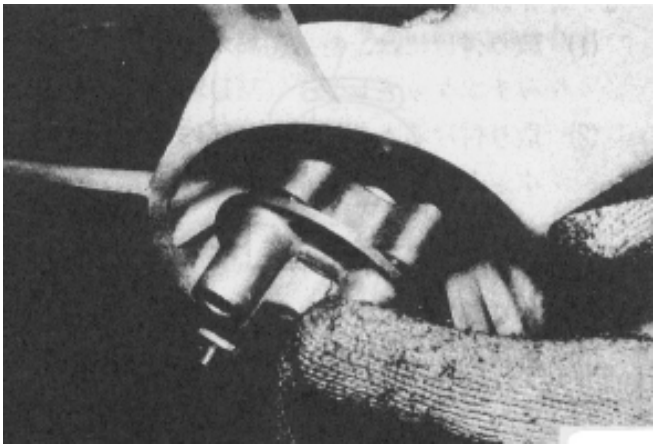
(1)Put the thermostat in the thermostat case.

(2)Put a new gasket in position on the thermostat case. Install the thermostat assembly in position on the cylinder head.

3.Cooling fan installation

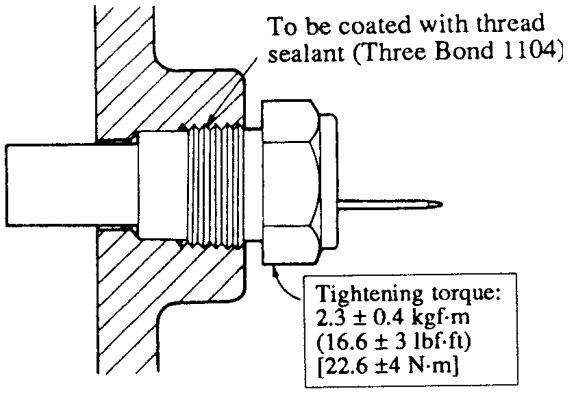
(1)Install the spacers in position in the fan as shown.

(2)Install the pulley in position on the water pump. Install the fan and spacer combination in position on the pulley.



4.Thermoswitch and thermounit combination installation

Coat the threads of the combination with Three Bond 1104. Put the combination in position and tighten it to the specified torque.



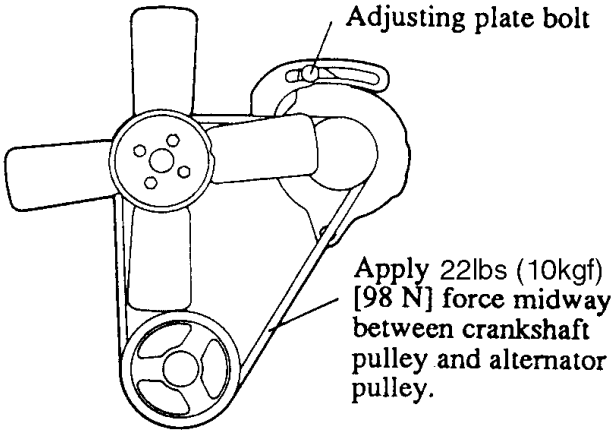
(11)ELECTRICAL SYSTEM

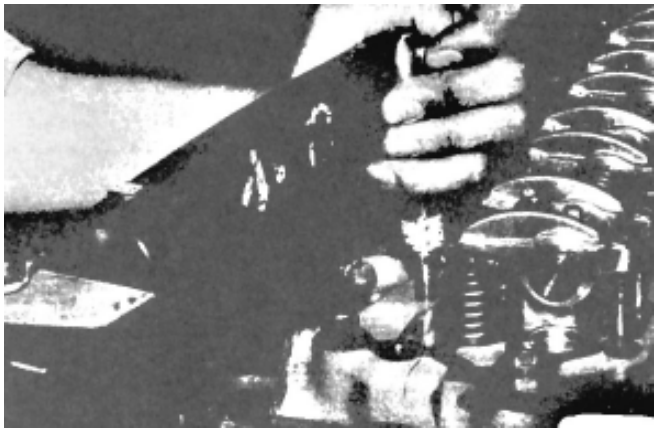
REINSTALLATION

1.Glow plug installation

Install the glow plug in position in the precombustion chamber and tighten in to the specified torque.

Tightening torque	1.75 ± 0.25 kgf•m (12.7 ± 1.8 lbf•ft) [17.2 ± 2.5 N•m]





2.Alternator installation

(1)Put the alternator in position. Install the adjusting plate bolt in position to hold the alternator in position.

(2)Put the belt in position on the pulley. Move the alternator away from the engine to make an adjustment to the belt.

(3)Tighten the bolts.

(4)Make sure the deflection(tension)of the belt is correct.

Unit:in.(mm)

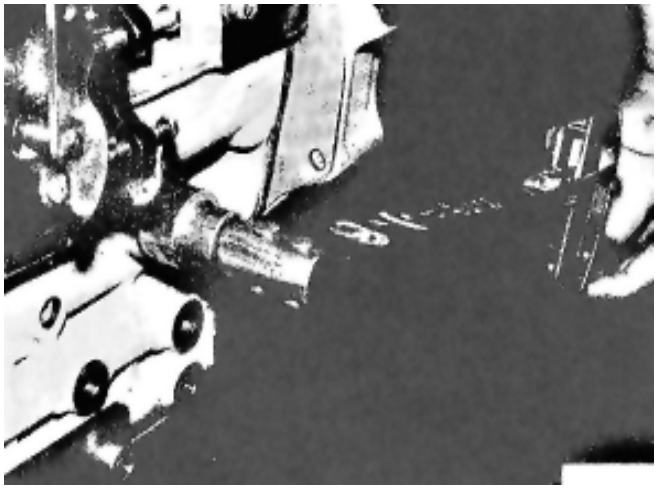
Deflection under 22 lbs (10 kgf)[98 N] force	0.4 to 0.5 (10 to 12)

(12)LUBLICATION SYSTEM REINSTALLATION

1.Pressure relief valve installation

Put the relief valve in position on the cylinder block and tighten in to the specified torque.

Tightening torque	5 ±0.5 kgf•m (36 ± 4 lbf•ft) [49 ± 5 N•m]



2.Oil filter installation

(1)Lightly lubricate the gasket with engine oil.

(2)Install the new filter element by hand.

When the gasket contacts the base, tighten one turn more.

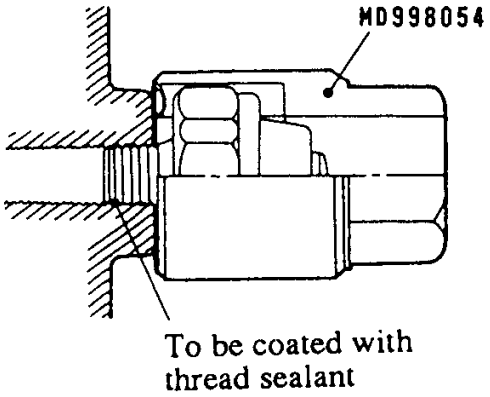
3.Oil pressure switch installation

Coat the threads of the switch with thread sealant (Three Bond 1102). Use Oil Pressure Switch Socket Wrench(MD998054)(special tool) to install the oil pressure switch.

⚠CAUTION

a)Put the sealant on the threads only.

b)Do not over-tighten the oil pressure switch when it is installed.



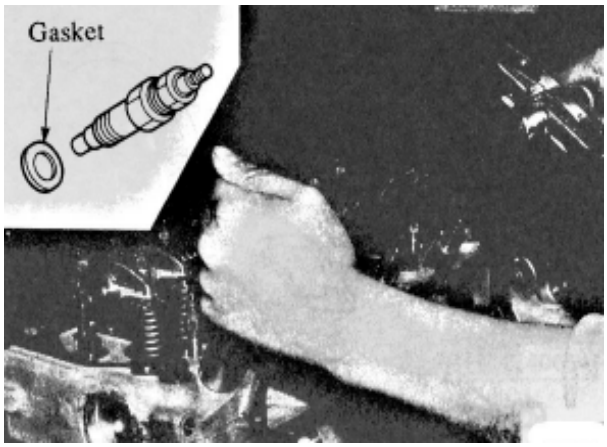
(13)FUEL SYSTEM REINSTALLATION

1.fuel injection nozzle installation

(1)Put the gasket on the nozzle.

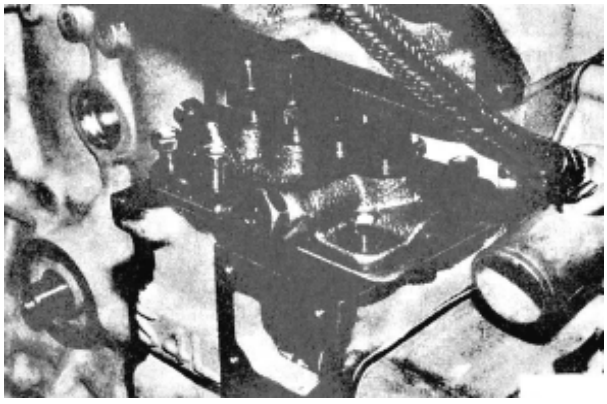
(2)Put the nozzle assembly in position in the cylinder head and tighten it to the specified torque.

Tightening torque	5.5 ± 0.5 kgf•m (40 ± 4 lbf•ft) [54 ± 5 N•m]



2.Fuel injection pump installation

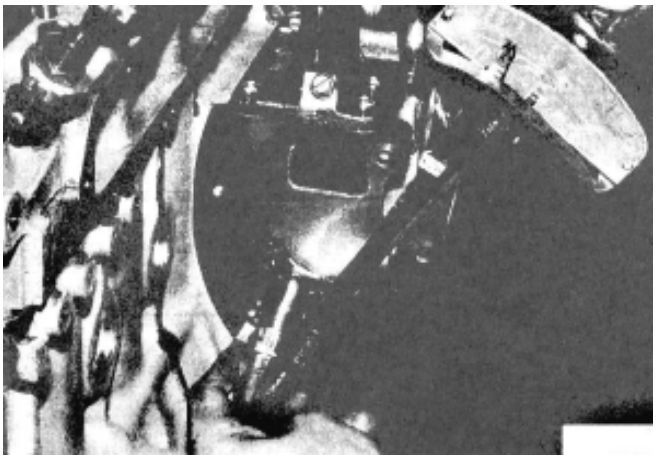
Put the pump in position on the cylinder block and tighten the bolts that hold the pump to the specified torque.



3.Flyweight assembly installation

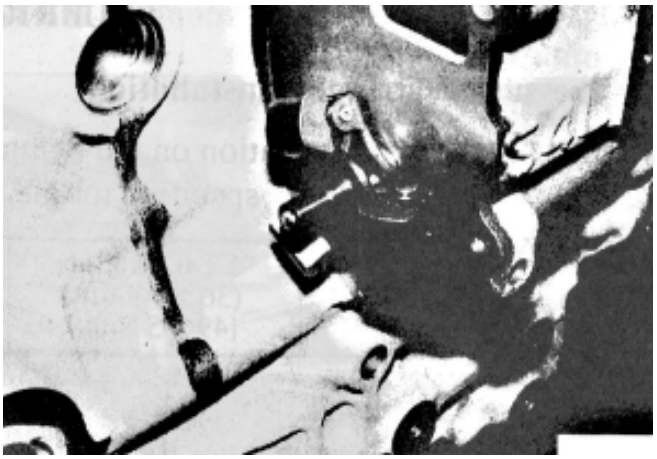
Put the flyweight assembly in position on the rear end of the fuel injection pump camshaft and tighten the sliding sleeve shaft to the specified torque.

Tightening torque	5.5 ± 0.5 kgf•m (40 ± 4 lbf•ft) [54 ± 5 N•m]



4.Sliding sleeve installation

Install the sliding sleeve on the sliding sleeve shaft and make sure the sleeve moves freely.

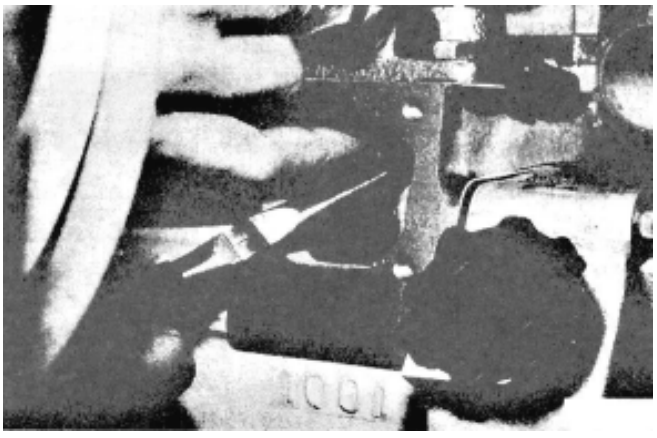


5.Governor assembly installation

(1)Install the governor assembly in position while putting the tie rod and spring into position in the injection pump.

(2)Install the tie rod to the pin of the control rack and secure it with the tie rod spring.

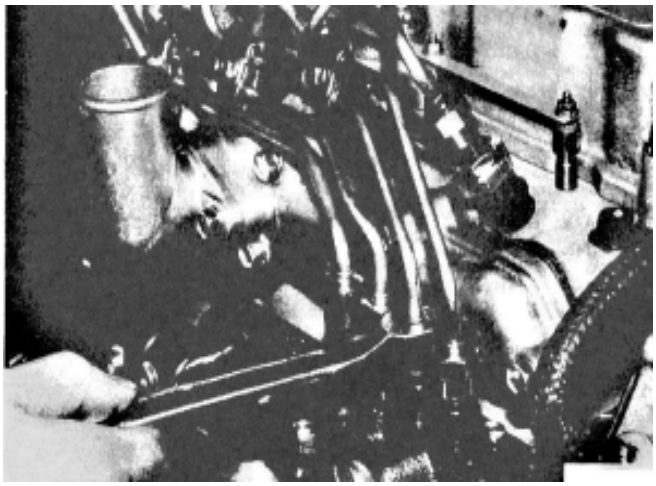
(3)Install the tie rod cover in position.



6.Fuel injection line installation

(1)Put the fuel leak-off line in position and connect it to the fuel injection nozzles.

(2)Put the fuel injection lines in position and connect them to the fuel injection pump. Install the clamps



(13)ELECTRICAL SYSTEM
DISASSEMBLY REMOVAL

1.Starter

1.1Testing before disassembly removal

(1)Clearance between pinion and housing (pinion clearance)

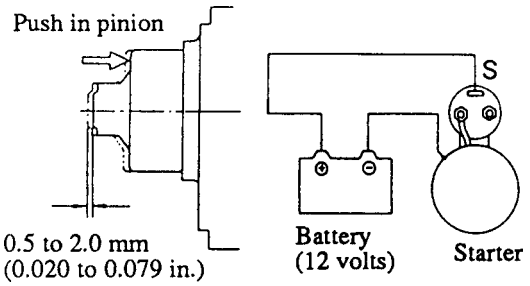
(a)Connect the starter to a 12 volt battery as shown in the illustration to cause the pinion to shift into cranking position and remain there.

⚠CAUTION

Due to the amount of current being passed through the solenoid series winding, this test must be made within 10 seconds.

(b)Push the pinion toward the commutator end by hand to measure its free movement (pinion clearance).

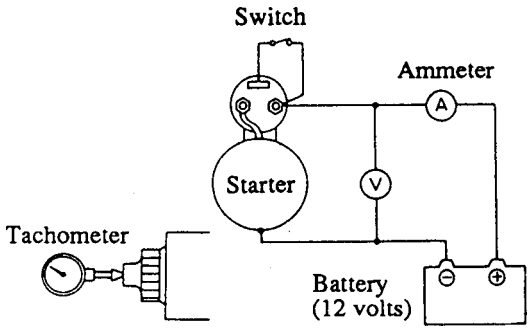
(c)The pinion clearance must be 0.020 to 0.079 in. (0.5 to 2.0mm). If the clearance is out of this range, make an adjustment to it by adding or removing the packings on the magnetic switch. Adding the packings will decrease the clearance.



(2)No-load characteristics

(a)Connect the starter to a 12 volt battery with an ammeter capable of indicating several hundred amperes as shown in the illustration.

(b)Close the switch to make sure the pinion shifts into cranking position properly and the starter runs at speeds higher than is specified. If the current draw and / or operating speed is out of the standard, disassemble the starter for inspection and repairs.



⚠CAUTION

a)The size of wires used for this test must be as large as possible. Tighten the terminals securely.

b)This starter has a reduction gear. Do not confuse gear noise with some abnormal noise else.

c)When measuring the starter speed at the end of the pinion, be ready for accidental shifting of the pinion.

Item		Standard	
Model		M2T5622	M2T50381
Nominal output, V-kW		12-2.0	12-1.6
No-load characteristics	Terminal voltage, V	11	11.5
	Current draw, A	130, maximum	100, maximum
	Speed, rpm	3850,minimum	3000, minimum

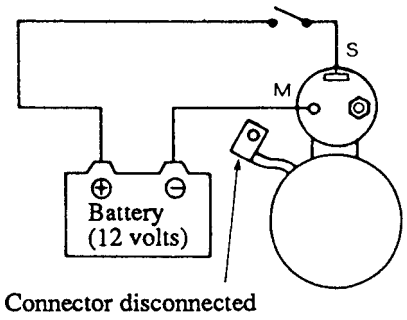
(3)Magnetic switch

(a)disconnect the connector from the M terminal of the magnetic switch.

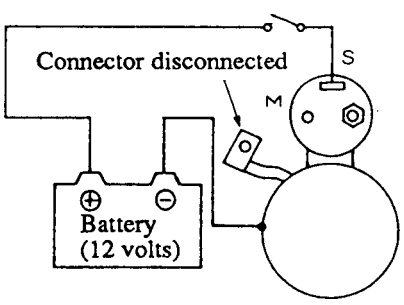
(b)Connect the magnetic switch to a 12 volt battery with a switch as shown in the illustration to test the pull-in coil. Close the switch to see if the pinion shifts. If the piston fails to shift, the magnetic switch is faulty.

⚠CAUTION

Due to the amount of current being passed through the solenoid series winding, this test must be made within 10 seconds.



(c)Connect the magnetic switch to a 12 volt battery with a switch as shown in the illustration to test the hold-in coil. Close the switch and pull the pinion away from the commutator end by hand. Release the pinion to see if it remains there. If the pinion returns, the magnetic switch is faulty.



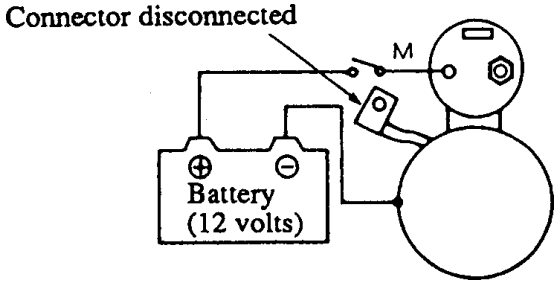
⚠CAUTION

Due to the amount of current being passed through the solenoid series winding, this test must be made within 10 seconds.

(d)Connect the magnetic switch to a 12 volt battery with a switch as shown in the illustration to make a pinion return test. Close the switch and pull the pinion away from the commutator end by hand. Release the pinion to see if it returns immediately when released. If the pinion fails to so return, the magnetic switch is faulty.

⚠CAUTION

Due to the amount of current being passed through the solenoid series winding, this test must be made within 10 seconds.

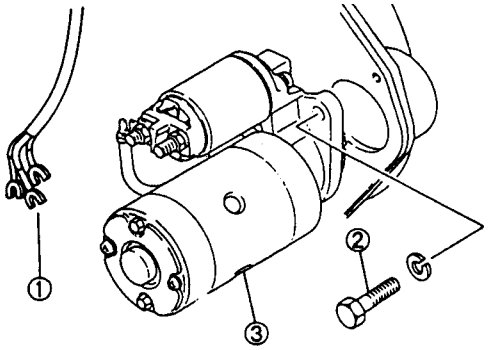


1.2.Removal

(1)Disconnect the battery wires. Disconnect the negative (-) wire first.

(2)Disconnect wire (1) from the starter.

(3)Loosen bolts (2)(two) holding starter(3) in position and remove the starter.

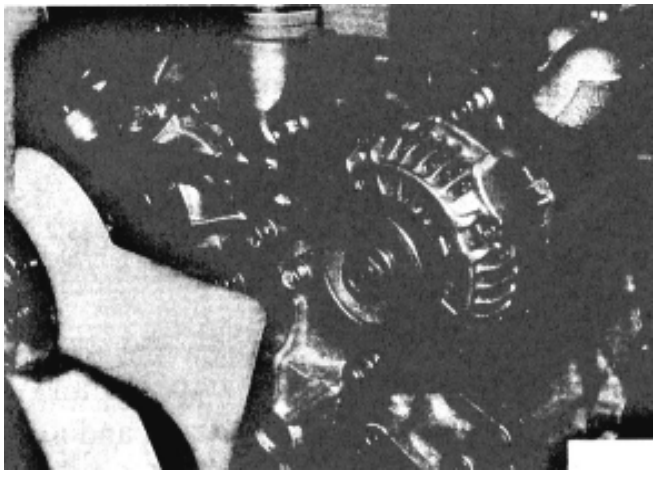


2.Alternator

2.1.Inspection before removal

The correct diagnosis of the charging system requires a careful inspection with the alternator on the engine to determine whether or not it is necessary to remove the alternator from the engine for further inspection. The following chart, in which two troubles are listed with four possible causes of each, will help locate the cause of the trouble:

Alternator charge too high	Voltage regulator setting too high
	Ground return circuit defective
	Wiring incorrect
	Series resistor or winding open-circuited
Alternator gives no charge	Alternator drive belt loose
	Voltage regulator setting too low
	Alternator output low
	Brushes worn



2.2.Precautions for removal

Following is a list of basic precautions that should always be observed for removal:

(1)When installing the battery, care must be used to make sure the negative (-) terminal is grounded.

(2)Do not use a megger (an instrument for high resistance of electrical materials).

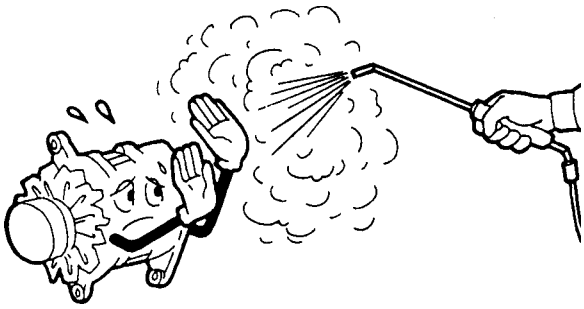
(3)Disconnect the battery cables before charging the battery.

(4)Do not attempt to disconnect the lead from the B terminal of the alternator when the engine is running.

(5)Battery voltage is being applied to the B terminal of the alternator. Do not ground it.

(6)Do not short or ground the terminal of the alternator with a built-in IC regulator.

(7)Do not blow a spray from the steam cleaner nozzle at the alternator.



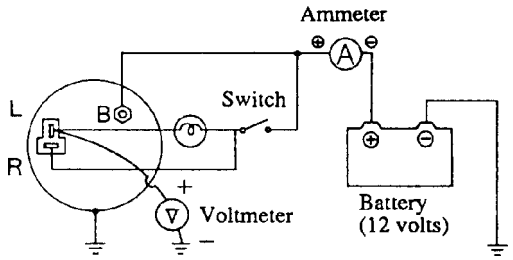
2.3.Testing voltage setting

(1)Connect the alternator to a 12 volt battery with an ammeter, a voltmeter and a switch as shown in the illustration.

(2)The voltmeter reading must be zero(0) when the starter switch is in OFF position. It must be lower than the battery voltage when the switch is in ON position(the engine will not start).

(3)With one ammeter lead short-circuited, start the engine.

(4)Read the voltmeter when the ammeter reading is below five amperes and the engine is running at 1800 rpm and also at 2500 rpm with all electrical loads turned off. The voltage setting varies with alternator temperature. Generally, the higher the alternator temperature, the lower the voltage setting.



Connections for testing voltage setting

Item	Standard
Voltage setting [at 20°C (68°F)]	14.7 ±0.3V

2.4.Testing output characteristics

(1)Disconnect the battery ground(negative) cable

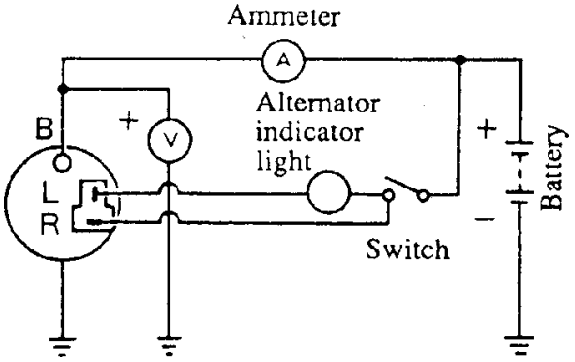
(2)Connect one ammeter lead to the B terminal of the alternator and the other lead to the positive terminal of the battery. Connect one voltmeter lead to the B terminal and the other lead to the ground.

(3)Connect the battery ground cable.

(4)Start the engine.

(5)Turn on all electrical loads.

(6)Increase the engine speed. Measure the maximum output current at the specified alternator speed when the voltmeter reading is 13.5 volts.



-

Item	Model	Standard	
		Terminal voltage / currents	Speed
Output characteristics (at normal temperature)	A7T02071	13.5 V / 33 A	2500 rpm, maximum
		13.5 V / 47 A	5000 rpm, maximum

2.5.Removal

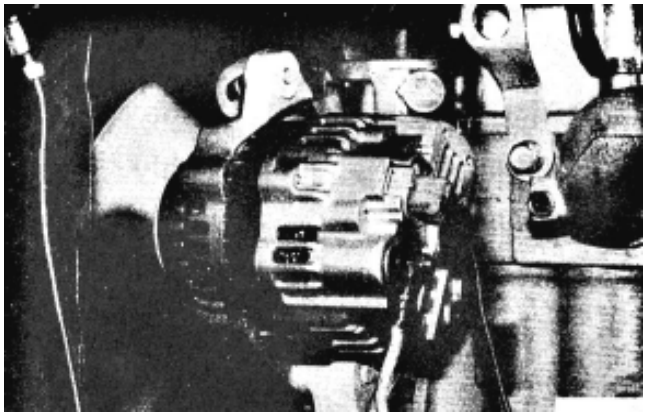
(1)Disconnect the battery cables.

(2)Disconnect the lead from the B terminal of the alternator.

(3)Disconnect the connector from the alternator.

(4)Loosen the brace and support bolts. Move the alternator toward the engine and remove the drive belt.

(5)Remove the alternator.



4-5. INSPECTION

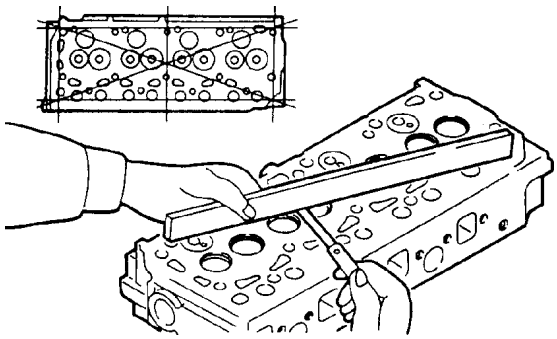
(1) CYLINDER HEAD AND VALVE MECHANISM

1.cylinder head

Using a heavy accurate straight edge and a feeler gauge, check the bottom face for warpage in three positions lengthwise, two crosswise and two widthwise as shown in the illustration. If warpage exceeds the limit, reface the bottom face with a surface grinder.

Unit:mm(in.)

Item	Standard	Limit
Warpage of cylinder head bottom face	0.05(0.0020) maximum	0.10 (0.0039)

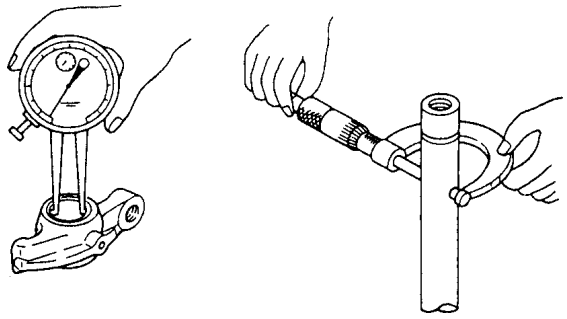


2.Rocker arms and rocker shaft

Measure the bore in the rocker arm for the rocker shaft and the diameter of the rocker shaft to find the clearance between the arm and shaft. If the clearance has reached the limit, replace the rocker arm. If it exceeds the limit, replace both arm and shaft.

Unit:mm(in.)

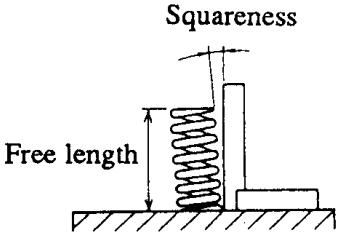
Item	Nominal size	Standard	Limit
Bore in rocker arm for shaft	0.744 (18.9)	0.74449 to 0.74527 (18.910 to 18.930)	
Diameter of shaft for arm	0.744 (18.9)	0.74331 to 0.74401 (18.880 to 18.898)	
Clearance between rocker arm and shaft		0.00047 to 0.00197 (0.012 to 0.050)	0.00787 (0.200)

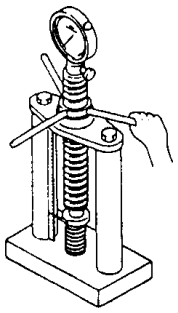


3.Valve springs

Check the squareness and free length. If the squareness and /or free length exceeds the limit, replace the spring.

Item		Standard	Limit
Free length		47(1.85)	46(1.81)
Squareness		1.5° maximum	
Test force,kgf(lbf)[N]	Length under test force: 39.1(1.54)	13.9 0.7 (30.6 1.5) [136 7]	-15%
	Length under test force: 30.5(1.20)	29 2 (64 4.4) [284 20]	



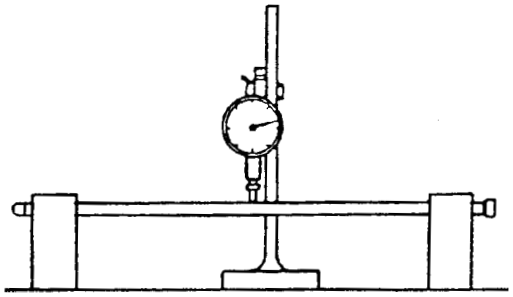


4.Valve push rods

Using V-blocks and a dial indicator, check for bend. If the bend exceeds the limit, replace the push rod.

Unit:mm(in.)

Item	Limit
Bend(dial indicator reading) of valve push rod	0.3(0.012) maximum



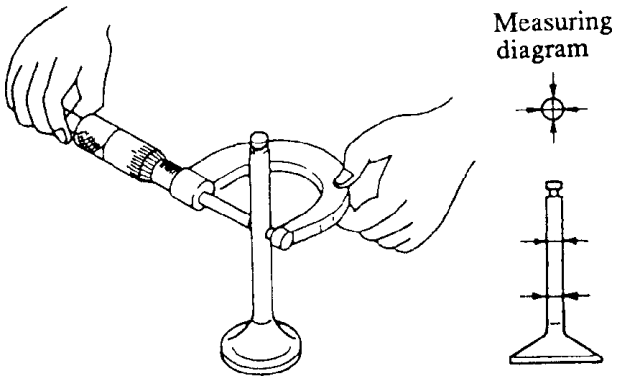
5.Valves, valve guides and valve seats

(1)Diameter of valve stem

Measure the diameter of the valve stem as shown in the illustration. If the stem is worn beyond the limit, or if it is abnormally worn, replace the valve.

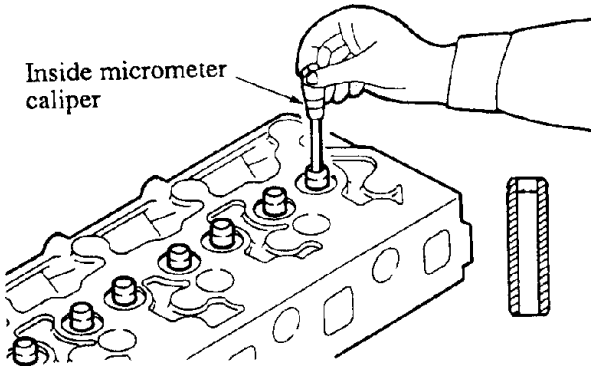
Unit:mm(in.)

Item		Nominal size	Standard	Limit
Diameter of valve stem	Inlet valve	6.6 (0.260)	6.565to 6.580 (0.25846to 0.25905)	6.500 (0.25591)
	Exhaust valve	6.6 (0.260)	6.530to 6.550 (0.25709to 0.25787	



(2)Clearance between valve stem and valve guide.

The valve guide wears more rapidly at its both ends than at any other parts. Measure the bore in the guide for the stem at its ends with an inside micrometer caliper to find the clearance between the stem and guide. If the clearance exceeds the limit, replace the guide or valve whichever is badly worn.



Unit:mm(in.)

Item		Nominal size	Standard	Limit
Clearance between valve stem and valve guide	Inlet valve	———	0.02 to 0.05 (0.008to 0.0020)	0.10 (0.0039)
	Exhaust valve	———	0.05to 0.085 (0.0020to 0.00335)	0.15 (0.0059)
Height to top of valve guide		10(0.39)	9.5to10.5 (0.374to 0.413)	

NOTE

Before measuring the valve guides, clear the guides of lacquer and carbon.

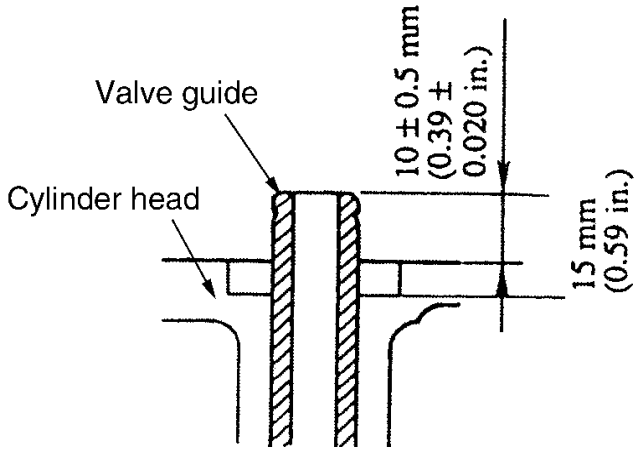
(3)Valve guide replacement

(a)Remove the guide from the cylinder head by pushing it with a tool and an arbor press from the bottom side of the head.

(b)Install a new guide into the cylinder head by pushing it with an arbor press from the upper side of the head until the specified height to the top of the guide is obtained.

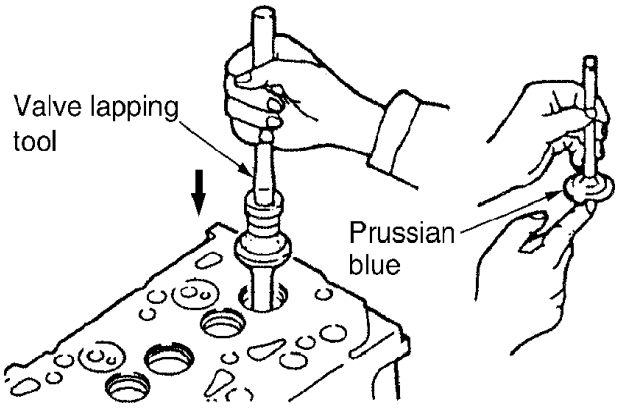
(c)Insert a new valve into the guide and make sure the valve slides in the guide freely.

(d)After the valve guide has been replaced, check the valve contact with its seat.

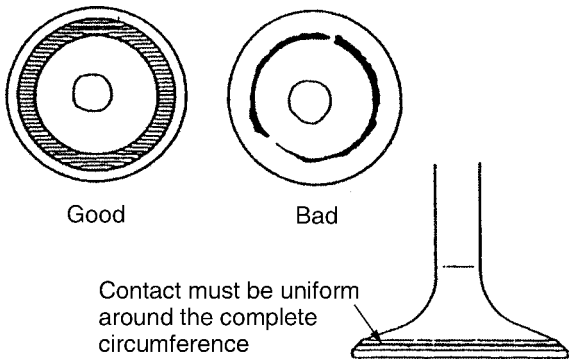


(4)Valves

(a)Put a small amount of Prussian blue or read lead on the valve face. Hold the valve with a valve lapping tool(commercially available)and press it against the seat to check its contact.



(b)The width of contact must be uniform all the way around both seat and valve. If the contact is bad, reface the valve and seat.



(c)If the valve margin(valve lip thickness) exceeds the limit, replace the valve.

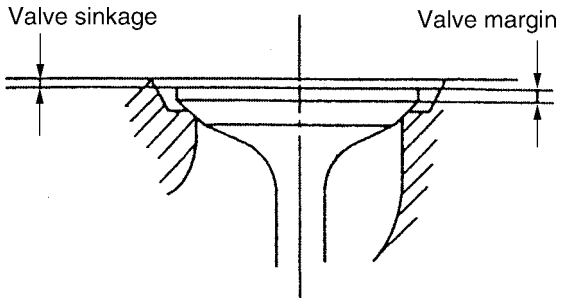
Unit:mm(in.)

Item	Standard	Limit
Valve margin (lip thickness)	1.0(0.039)	0.5(0.020)

(d)If the valve sinkage(the dimension from the top of a closed valve to the face of cylinder head)exceeds the limit, recondition the valve seat or replace the cylinder head assembly.

Unit:mm(in.)

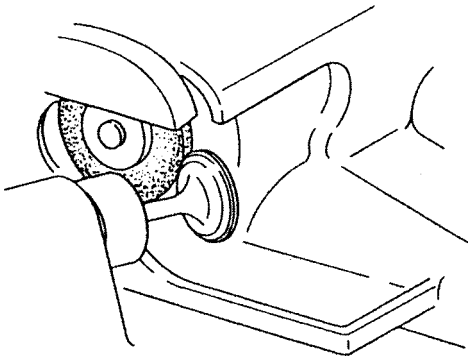
Item	Standard	Limit
Valve sinkage (dimension from top of closed valve to face of head)	0.05 ±0.25 (0.020 ±0.0098)	1.5 (0.059)



(5)Valve refacing

(a)Set the valve refacer at an angle of 45 ° and grind the valve.

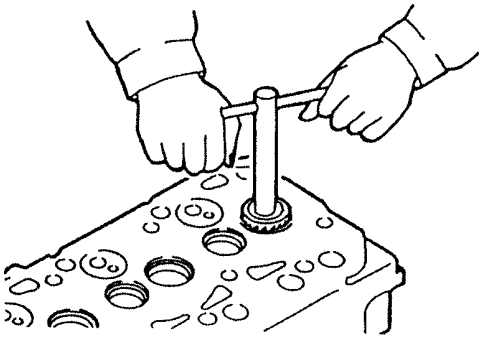
(b)The valve margin must be not less than the limit. If the margin seems to be less than the limit when the valve is refaced, replace the valve.



(6)Valve seat refacing

(a)Before refacing the valve seat, check the clearance between the valve and guide, and replace the guide if necessary.

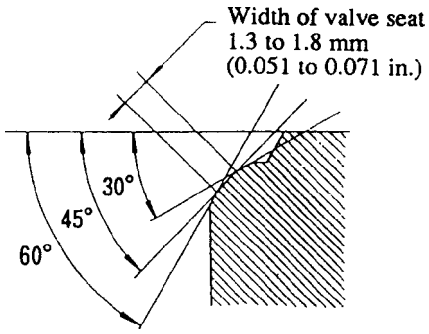
(b)Cut the valve seat with a valve seat cutter(commercially available), or grind it with a valve seat grinder, and finish the width of valve seat and the angle of seat face to the correct values.



Unit:mm(in.)

Item	Standard	Limit
Angle of seat face	45	
Width of valve seat	1.3 to 1.8 (0.051 to 0.071)	2.5 (0.098)

(c)After refacing the valve seat, put lapping compound on the valve face and lap the valve in the valve seat.



(7)Valve lapping

Be sure to lap the valves in the seas after refacing or replacing the valves or valve seats.

(a)Put a small amount of lapping compound on the valve face.

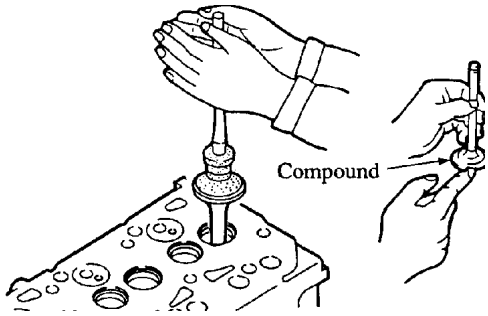
NOTE

a)Do not put lapping compound on the valve stem.

b)Use a lapping compound of 120 to 150 mesh for initial lapping and a compound of finer than 200 mesh for finish lapping.

c)Mixing the compound with a small amount of engine oil will help put the compound on the valve face uniformly.

(b)Using a lapping tool, hold the valve against the seat and rotate it only a part of a turn, then raise the valve off its seal, rotating it to a new position. Press the valve against the seal for another part of a turn. Repeat this operation until the compound wears and loses its cutting property.



(c)Wash the valve and valve seat with dry cleaning solvent.

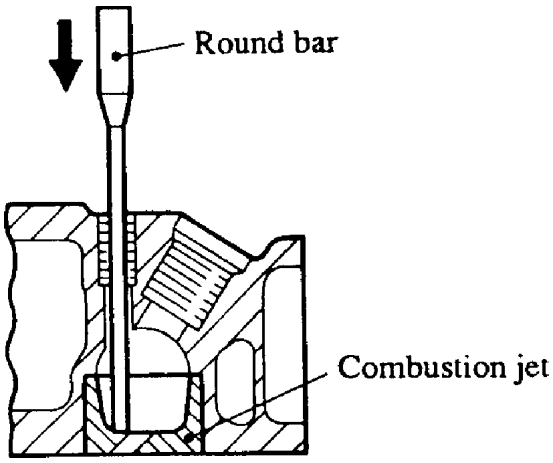
(d)Apply engine oil to the valve and lap it in the seat.

(e)Check the valve face for contact.

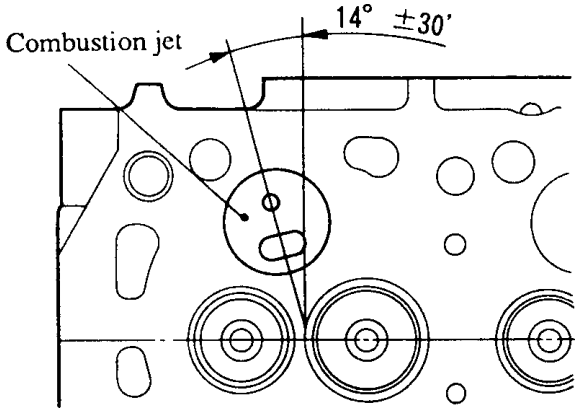
6.Combustion jet replacement

Replace the combustion jets only when they are cracked or defective.

(1)To remove the jet, insert a 6mm(0.24in.) diameter round bar through the bore in the cylinder head for the glow plug and tap around the jet.



(2)To install a new jet, put the jet in position in the head with its tangential orifice in alignment with the center of the main chamber and tap it with a plastic hammer.



(2)TIMING GEARS AND FLYWHEEL

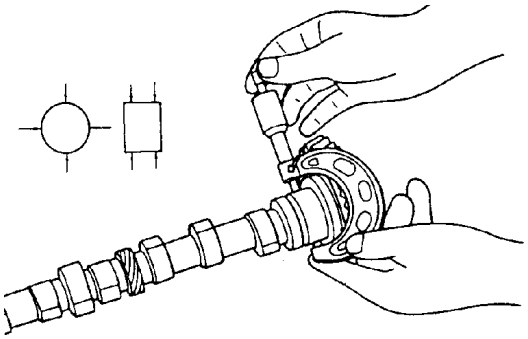
1.Camshaft

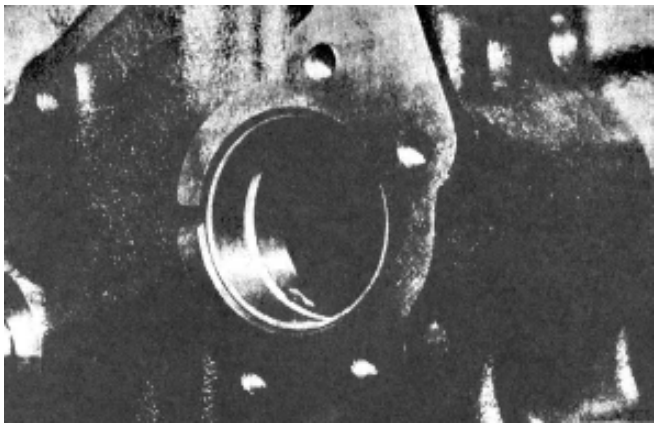
(1)Clearance between journal and bushing

Measure the diameter of the journal and the bore in the bushing for the shaft to find the clearance as shown in the illustration. If the clearance exceeds the limit, replace the bushing.

Unit:mm(in.)

Item	Standard
Clearance between camshaft journal and bushing	0.15(0.0059)



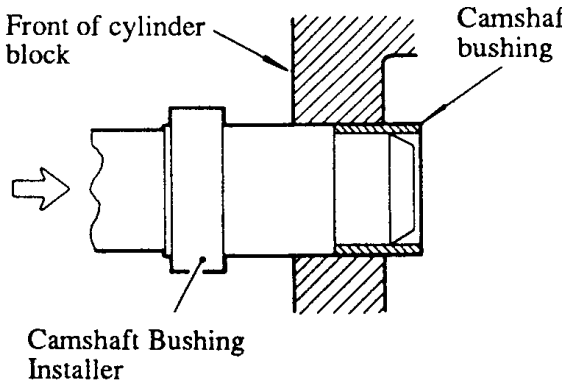


(2)Bushing replacement

Use Camshaft Bushing Installer(ST332340) (special tool) for camshaft bushing replacement.

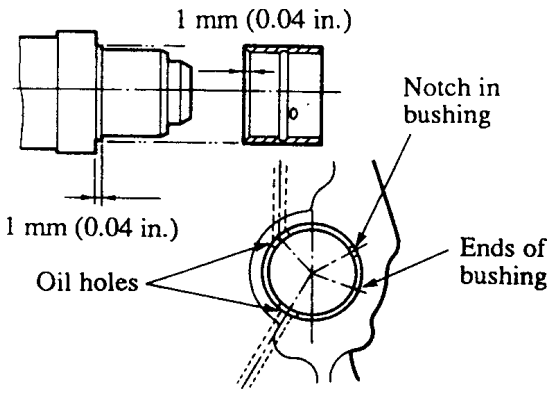
(a)Removal

Remove the oil pan. Using a “remover” end of the Installer, push out the bushing into the cylinder block. Crush and take out the bushing from the block.



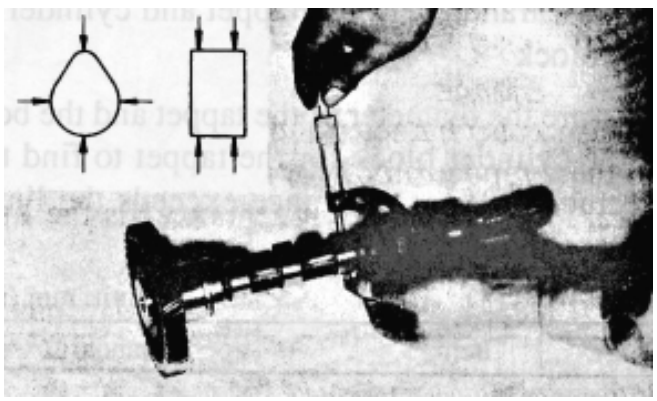
(b)Installation

Install a new bushing in position with its oil holes in alignment with those of the oil gallery.



(3)Lobe lift

Measure the lobe height and base circle as shown in the illustration. Subtract the base circle from the lobe height to find the lobe life. If the lobe lift exceeds the limit, replace the camshaft.



Unit:mm(in.)

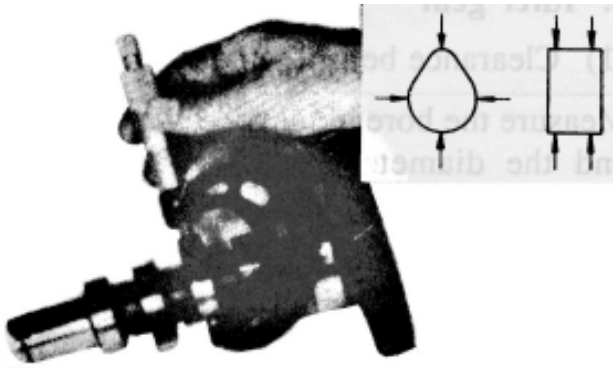
Item	Standard	Limit
Lobe height of camshaft	35.72 (1.4063)	34.72 (1.3669)

2.Fuel injection pump camshaft

Measure the lobe height and base circle as shown in the illustration. Subtract the base circle from the height to find the lobe life. If the lobe lift exceeds the limit, replace the camshaft.

Unit:mm(in.)

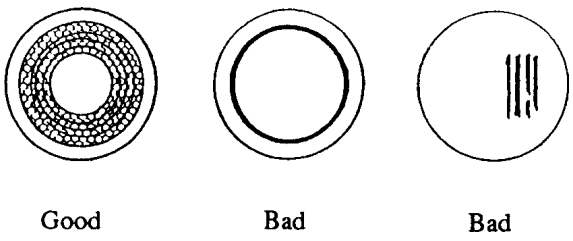
Item	Standard	Limit
Lobe height of fuel injection pump camshaft.	44(1.73)	43(1.69)



3.Tappets

(1)Cam contact face

Check the cam contact face of each tappet for abnormal wear. Replace the tappet if the face is defective.

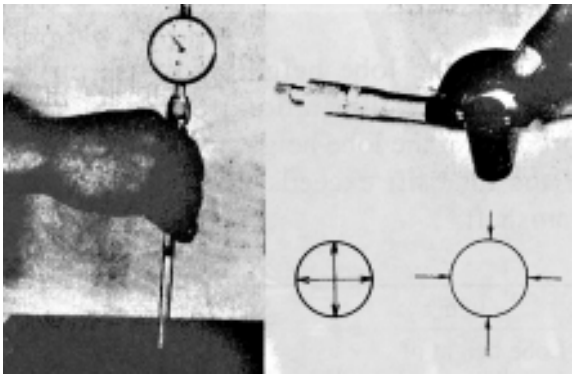


(2)Clearance between tappet and cylinder block

Measure the diameter of the tappet and the bore in the cylinder block for the tappet to find the clearance. If the clearance exceeds the limit, replace the tappet.

Unit:mm(in.)

Item	Standard
Clearance between tappet and cylinder block	0.15(0.0059)



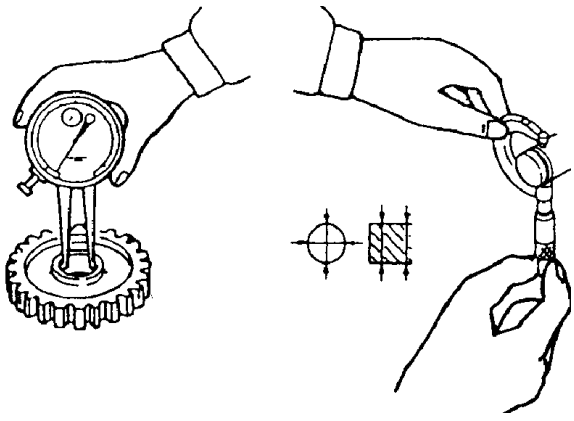
4.Idler gear

(1)Clearance between idler gear and shaft

measure the bore in the idler gear for the shaft and the diameter of the shaft to find the clearance. If the clearance exceeds the limit, replace the gear or shaft whichever is badly worn.

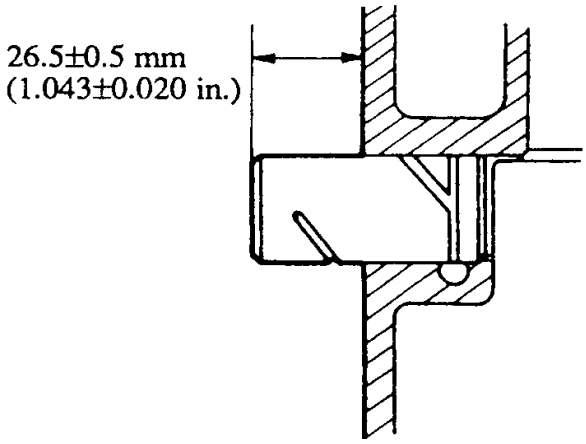
Unit:mm(in.)

Item	Standard	Limit
Clearance between idler gear and shaft	0.03 to 0.0 (0.0012 to 0.0028)	0.20 (0.0079)



(2)Idler shaft replacement

Install a new idler shaft to the cylinder block so that its dimension from the face of the block is 26.5 ±0.5 mm(1.043 ±0.020 in.).



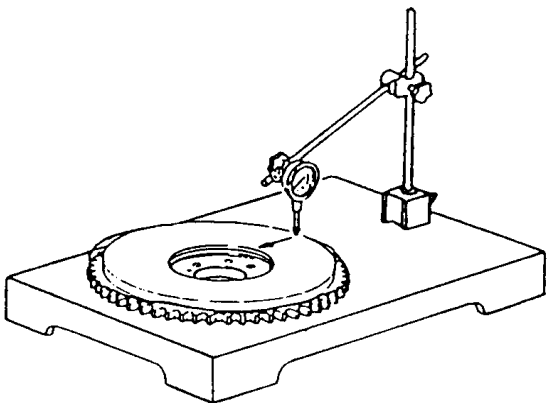
5.Flywheel and ring gear

(1)Flatness(difference between lower and higher measurements)of flywheel

Put the flywheel on the surface plate. Set a dial indicator at one side of the friction(clutch contact) face and move it over to the opposite side of the face as shown in the illustration to find the flatness. If the flatness exceeds the limit, grind the face.

Unit:mm(in.)

Item	Standard	Limit
Flatness of flywheel	0.15(0.0059) maximum	0.50 (0.0197)



(2)Ring gear replacement

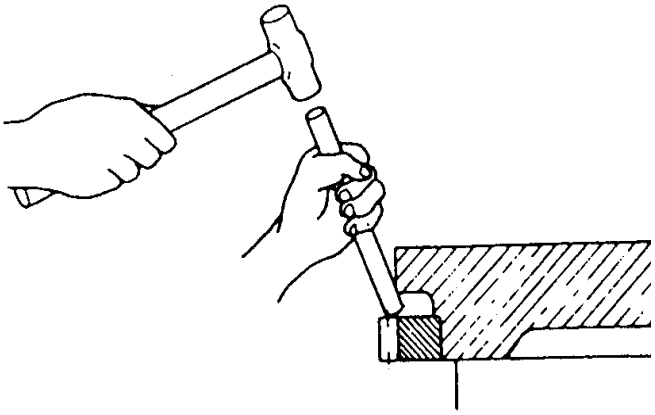
Check the ring gear and replace it if its teeth are abnormally worn or chipped.

(a)Removal

Heat the ring gear evenly with an acetylene torch. Tap the ring gear all the way around with a bar and a hammer as shown in the illustration to remove it from the flywheel.

(b)Installation

Heat a new ring gear up to a temperature of 150°C(302°F) with a piston heater and install it to the flywheel with its unchamfered side foremost.



(3)CYLINDER BLOCK, CRANKSHAFT, PISTONS AND OIL PAN

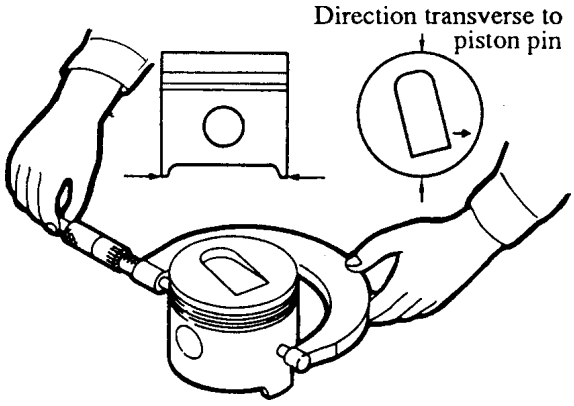
1.Pistons, Piston Rings and Piston Pins

(1)Diameter of piston

Measure the diameter of the piston at its skirt in a direction transverse to the piston pin with a micrometer as shown in the illustration. If the diameter exceeds the limit, replace the piston. Select a new piston so that the difference between average weight of all pistons in one engine does not exceed the standard.

Unit:mm(in.)

Item	Nominal size	Standard	Limit
Diameter of piston	Standard 78.00 (3.0709)	77.93 to 77.95 (3.0681 to 3.0689)	77.80 (3.0630)
	0.25 (0.0098) oversize 78.25 (3.0807)	78.18to 78.20 (3.0779to 3.0787)	78.05 (3.0728)
	0.50 (0.0197) oversize 78.50 (3.0905)	78.43to 78.45 (3.0878to	78.30 (3.0827)
Maximum permissible difference between average weight of all pistons in one engine, g(oz)		5(0.18)	——



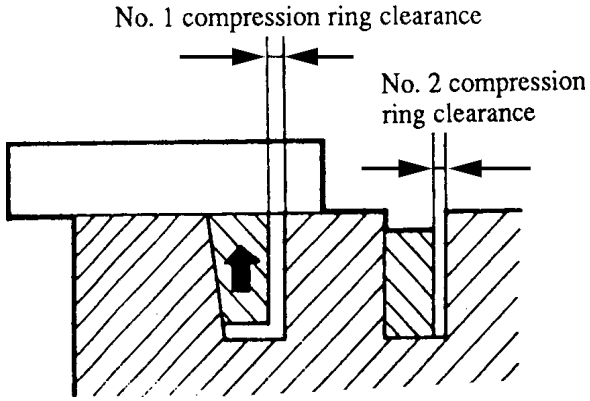
(2)Clearance between piston ring and groove

(a)Measure the clearance between the groove and piston with a straight edge and a feeler gauge as shown in the illustration. If the clearance exceeds the limit, replace the ring.

Unit:mm(in.)

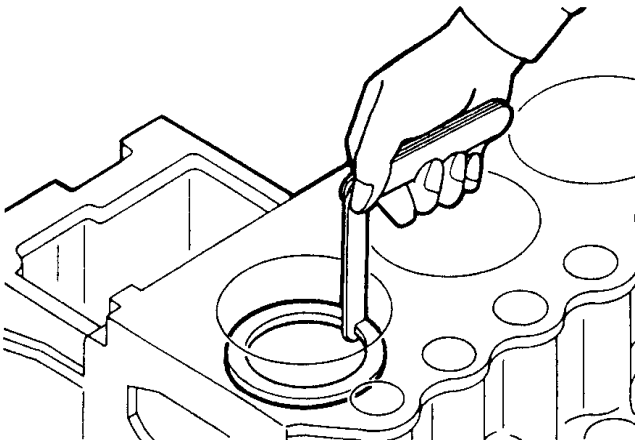
Item	Standard	Limit
No.1 compression ring	0.06 to 0.10 (0.0024 to 0.0039)	0.30(0.0118)
No.2 compression ring	0.05 to 0.09 (0.0020 to 0.0035)	0.20(0.0079)
Oil ring	0.03 to 0.07 (0.0012 to 0.0028)	0.20(0.0079)

(b)If the clearance still exceeds the limit after new piston rings have been installed, replace the piston.



(3)Clearance between ends of piston ring

Put the piston ring in a gauge or in the bore in a new cylinder block and measure the clearance between the ends of the ring with a feeler gauge as shown in the illustration. If the clearance exceeds the limit, replace all the rings.



Inside diameter of gauge
Standard: $78^{+0.03}_{0}$ mm(3.07 $^{+0.0012}_{0}$ in.)
0.25 mm(0.0098 in.)oversize:
$78.25^{+0.03}_{0}$mm(3.08 $^{+0.0012}_{0}$in.)
0.50 mm(0.0197 in.)oversize:
$78.50^{+0.03}_{0}$mm(3.09 $^{+0.0012}_{0}$in.)

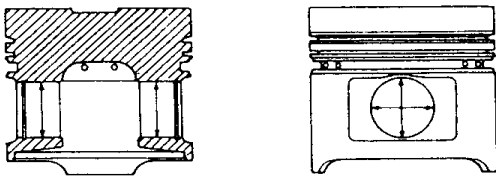
NOTE

Put the piston ring in the gauge or cylinder squarely with piston.

Unit:mm(in.)

Item		Standard	Limit
Clearance between ends of piston ring	No.1 compression ring	0.15 to 0.30 (0.0059 to 0.0118)	
	No.2 compression ring	0.15 to 0.35 (0.0059 to 0.0138)	1.50 (0.0591)
	Oil ring	0.20 to 0.40 (0.0079 to 0.0157)	

(4)Clearance between piston pin and piston
Measure the diameter of the piston pin and the bore in the piston for the pin as shown in the illustration to find the clearance. If the clearance exceeds the limit, replace the piston or pin whichever is badly worn.



Unit:mm(in.)

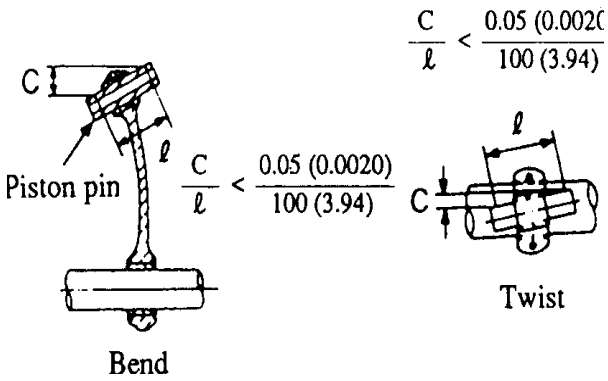
Item	Nominal size	Standard	Limit
Diameter of piston pin	23 (0.91)	22.994 to 23.000 (0.90527 to 0.90551)	
Clearance between piston pin and piston		0.0006to 0.018 (0.00024to 0.00071)	0.050 (0.00197)

2.Connecting rods
Check the connecting rod for bend or twist as follows:
(a)Measure"C"and"L"If"C"exceeds0.05 mm (0.0020 in.)per 100 mm(3.94in.)of"L"straighten the connecting rodwith a press.

Unit:mm(in.)

Item	Standard	Limit
Bend or twist of connecting rod	0.05 / 100(0.0020 / 3.94)maximum	0.15 / 100 (0.0059 / 3.94)

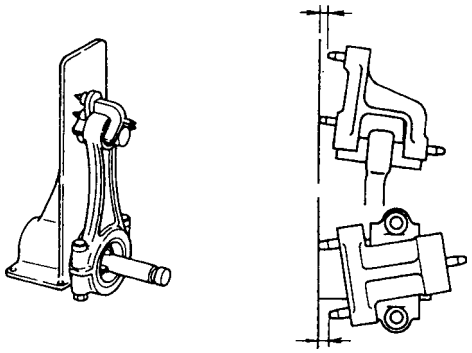
Unit: mm (in.)



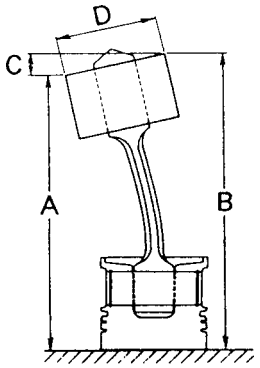
(b)Generally, a connecting rod aligner is used to check the connecting rod for bend or twist.

NOTE

To check the rod for bend, install the cap to the connecting rod and tighten the cap nuts to the specified torque.



(c)To check the connecting rod fitted to the piston for bend, put the connecting rod and piston on the surface plate as shown in the illustration, insert a round bar having a diameter equal to that of the crankpin into the bore in the big end of the rod and measure"A"and"B"with a dial indicator. Subtract"A"from"B" to find the bend("C").

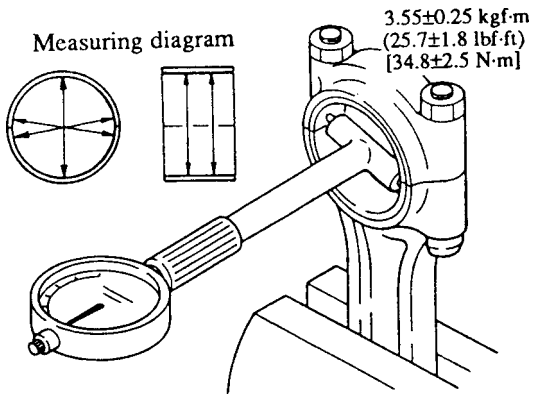


3.Crankshaft

(1)Clearance between crankpin and connecting rod bearing

(a)Install the bearing(upper and lower halves)and cap to the big end of the connecting rod and tighten the cap nuts to the specified torque. Measure the bore in the bearing for crankpin as shown in the illustration.

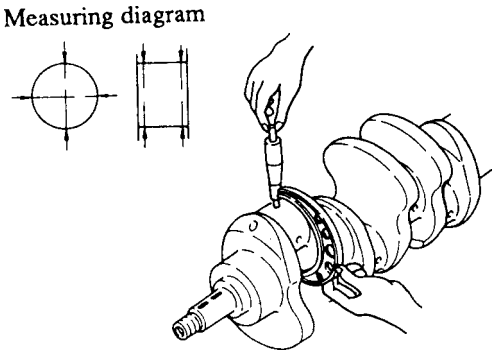
Tightening torque	3.55 ± 0.5 kgf•m (25.7 ± 1.8 lbf•ft) [34.8 ± 2.5 N•m]



(b)Measure the diameter of the crankpin as shown in the illustration to find the clearance between the crankpin and connecting rod bearing.

Unit:mm(in.)

Item	Nominal size	Standard	Limit
Diameter of crankpin (standard)	48 (1.89)	47.950to 47965 (1.88779to 1.88838	———
Clearance between crankpin and connecting rod bearing	———	0.025to 0.072 (0.00098to 0.00283	0.150 (0.00591)



(c)If the clearance exceeds the limit, install a new bearing and check the clearance again.

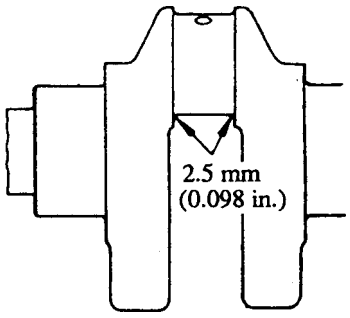
(d)If the clearance still exceeds the limit, grind the crankpin to 0.25 mm(0.098 in.), 0.50 mm(0.0197 in.)or 0.75 mm (0.0295 in.)undersize and use undersize connecting rod bearing.

Crankpin undersizes Unit:mm(in.)

Item	Undersize	Finish
Crankpin	0.25 (0.0098)	$47.75^{-0.035}_{-0.050}$ $(1.8799^{-0.00138}_{-0.00197})$
	0.50 (0.0197)	$47.50^{-0.035}_{-0.050}$ $(1.8701^{-0.00138}_{-0.00197})$
	0.75 (0.0295)	$47.25^{-0.035}_{-0.050}$ $(1.8602^{-0.00138}_{-0.00197})$

CAUTION

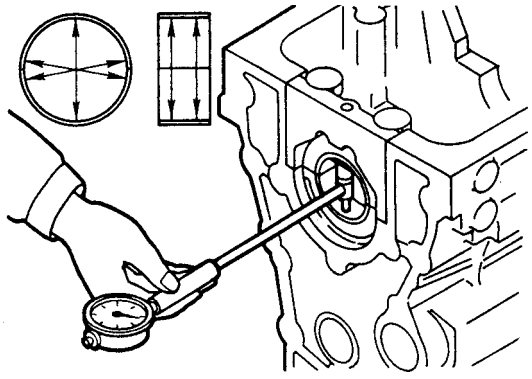
a)Grind all the crankpins of one crankshaft to the same undersize.
b)Finish the crankpin fillets to a radius of 2.5 mm(0.098 in.).



(2)Clearance between journal and main bearing

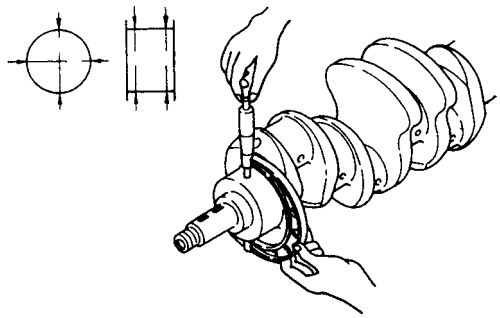
(a)Install the main bearing(upper and lower halves)and cap to the cylinder block and tighten the cap bolts to the specified torque. Measure the bore in the bearing for the journal as shown in the illustration.

Tightening torque	5.25 ± 0.25 kgf•m (38 ± 1.8 lbf•ft) [51.5 ± 2.5 N•m]



(b)Measure the diameter of the journal as shown in the illustration to find the clearance between the journal and main bearing.

Measuring diagram



Unit:mm(in.)

Item	Nominal size	Standard	Limit
Diameter of journal (standard)	52 (2.05)	51.985to 52.000 (2.04665to 2.04724	
clearance between journal and main bearing		0.030 to 0.077 (0.00118to 0.00303	0.100 (0.00394)

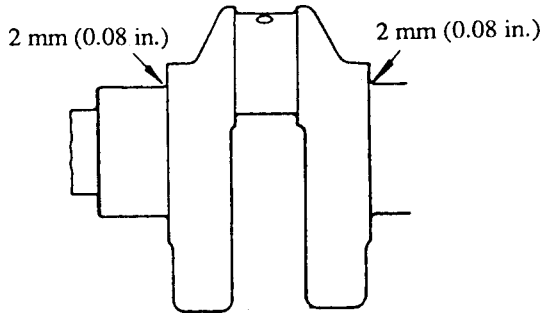
(c)If the clearance exceeds the limit, install a new bearing and check the clearance again.
(d)If the clearance still exceeds the limit,grind the journal to 0.25 mm(0.0098in.), 0.50 mm(0.0197 in.)or 0.75 mm(0.0295 in.) undersize and use undersizemain bearing.

Journal undersize Unit:mm(in.)

Item	Undersize	Finish
Journal	0.25	$51.75\ ^{0}_{-0.015}$
	(0.0098)	$2.0374\ ^{0}_{-0.00059}$
	0.50	$51.50\ ^{0}_{-0.015}$
	(0.0197)	$2.0276\ ^{0}_{-0.00059}$
	0.75	$51.25\ ^{0}_{-0.015}$
	(0.0295)	$2.0177\ ^{0}_{-0.00059}$

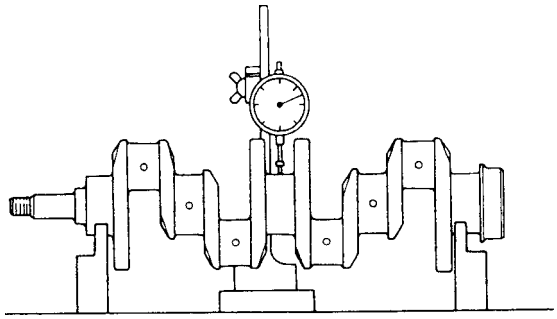
CAUTION

a)Grind all the journals of one crankshaft to the same undersize.
b)Finish the journal fillets to a radius of 2 mm(0.08 in.).



(3)Runout

Support the crankshaft on its front and rear journals in V-blocks or in a lathe and check runout at the center journal with a dial indicator as shown in the illustration. Depending on the amount of runout, repair the crankshaft by grinding or by straightening with a press. If runout exceeds the limit, replace the crank shaft.



Unit:mm(in.)

Item	Standard	Limit
Crankshaft runout	0.025(0.00098)	0.05(0.0020)

(4)Crankshaft gear removal

Use a gear puller to remove the gear from the crankshaft.

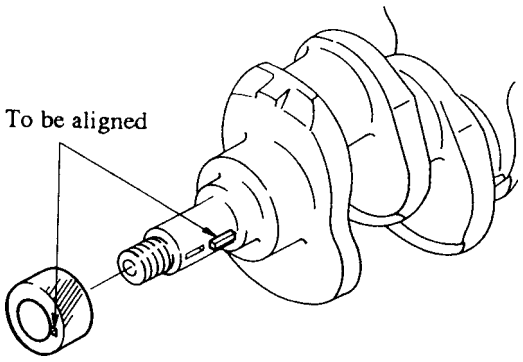
NOTE

Do not remove the gear unless the gear or crankshaft is defective.

(5)Crankshaft gear installation

(a)Install the key in position on the crankshaft.

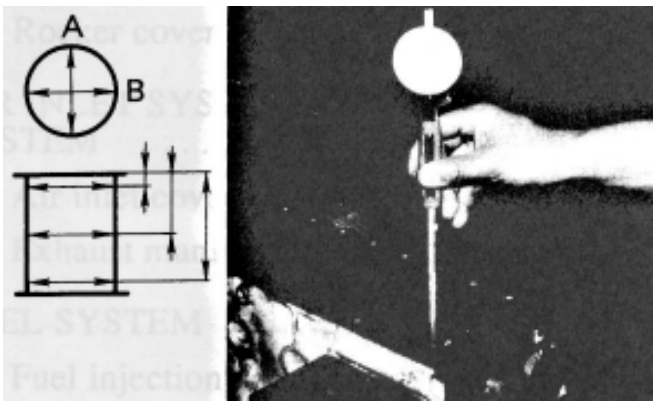
(b)Install the gear in position with its keyway in alignment with the key as shown in the illustration.



4.Cylinder block

(1)Bore

Measure the bore at the top, middle and bottom points on axes A and B with a cylinder bore gauge as shown in the illustration. If any one of the cylinders exceeds the limit, hone out all the bores for oversize pistons.



Unit:mm(in.)

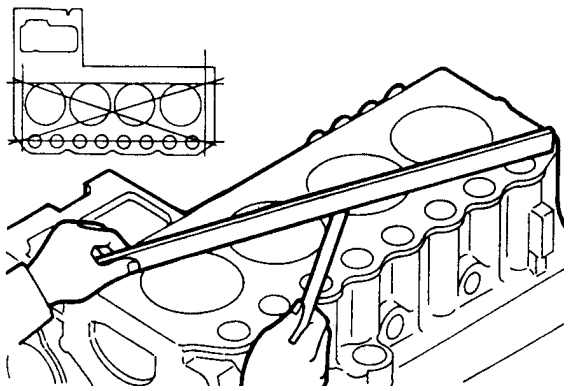
Piston and piston ring		Bore	
Size	Size code	Standard	Limit
Standard	STD	78 $^{+0.03}_{0}$ (3.07 $^{+0.0012}_{0}$)	Standard +0.2 (+0.08)
0.25(0.0098) oversize	25	78.25 $^{+0.03}_{0}$ (3.0807 $^{+0.0012}_{0}$)	
0.50(0.0197) oversize	50	78.50 $^{+0.03}_{0}$ (3.0905 $^{+0.0012}_{0}$)	
Taper and out-of-round		0.01(0.0004) maximum	

(2)Warpage of top face

Using a heavy accurate straight edge and a feeler gauge, check the top face for warpage in two positions lengthwise, two crosswise and two widthwise as shown in the illustration. If warpage exceeds the limit, reface the top face with a surface grinder.

⚠CAUTION

The maximum permissible amount of stock to be removed from the cylinder head and block by grinding is 0.2 mm(0.008 in.)intotal.



Checking cylinder block top face for warpage

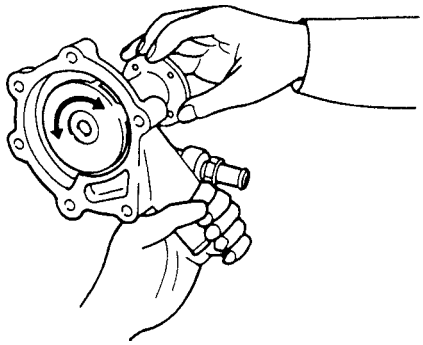
Unit:mm(in.)

Item	Standard	Limit
Warpage of cylinder block top face	0.05(0.0020) maximum	0.10 (0.0039)

(4)COOLING SYSTEM

1.Water pump

Check the impeller and shaft for rotation. If they do not rotate freely or have noise, replace the water pump assembly.



2.Thermostat(standard)

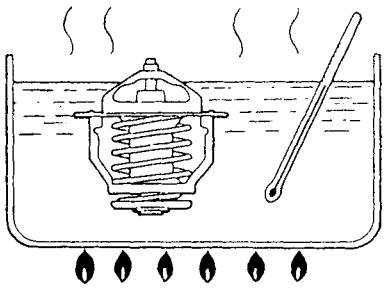
Hang the thermostat in the pan of water as shown in the illustration. The thermostat must be below the surface of the water and its must be away from the sides of the pan. Heat the water uniformly in the pan and measure a temperature at which the valve starts opening and a temperature at which the valve lift (distance)is 8 mm (0.3 in.). Replace the thermostat if defective.

Temperature at which valve starts opening	85 ±1.5°C (180 ±2.7°F)
Temperature at which valve lift is 8 mm(0.3 in.)	95°C (203° F)

⚠WARNING

Water in the pan is hot. Any contact can cause severe burns.

Stir up the water to keep the temperature uniform.



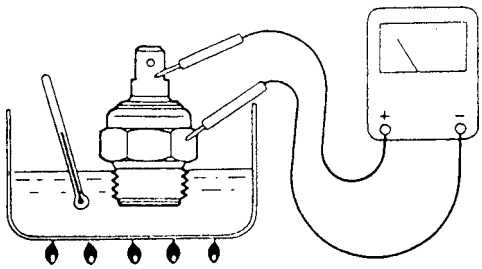
3.Thermoswitch(standard)

Hang the thermoswitch in the pan of oil with its temperature sensing end below the surface of oil and measure the resistance while heating the oil as shown in the illustration. If the resistance is incorrect, replace the thermoswitch.

Resistance at 120 C (248° F)	30m Ω
Temperature at which switch is turned ON	111 ±3.5°C (232 ±6.3° F)

⚠WARNING

Oil in the pan is hot. Any contact can cause severe burns.



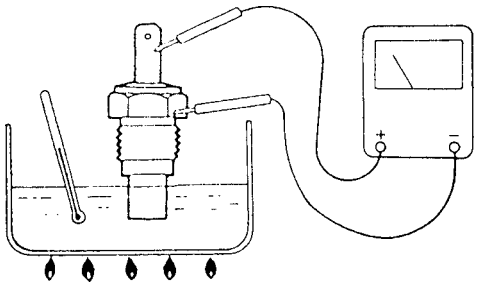
4.Thermounit(standard)

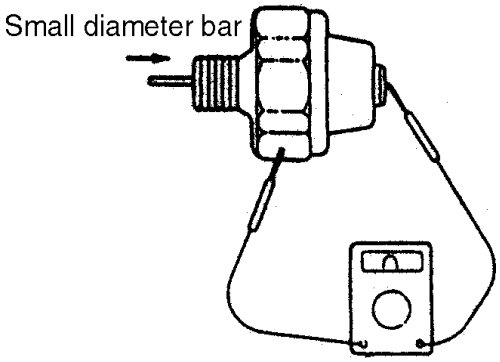
Hang the thermounit in the pan of antifreeze with its temperature sensing end below the surface of antifreeze and measure the resistance while heating the antifreeze as shown in the illustration. If the resistance is incorrect, replace the thermounit.

Standard	50°C(122°F):80 ±10 Ω 80°C(176°F):29.5 ±2.5 Ω 120°C(248°F):10 ±0.3 Ω

⚠WARNING

Antifreeze in the pan is hot. Any contact can cause severe burns.





(5)LUBRICATION SYSTEM

1.Oil pump

Visually check the pump for rough rotation or other defects. Replace the pump assembly if defective.

2.Oil pressure switch

(1)Test for continuity between the terminal and body with an ohmmeter as shown in the illustration. No continuity is the cause for replacing theswitch.

(2)Insert a small diameter bar into the oil hole in the switch and lightly push it in to test for no continuity as shown in the illustration. Any continuity is the cause for replacing the switch.

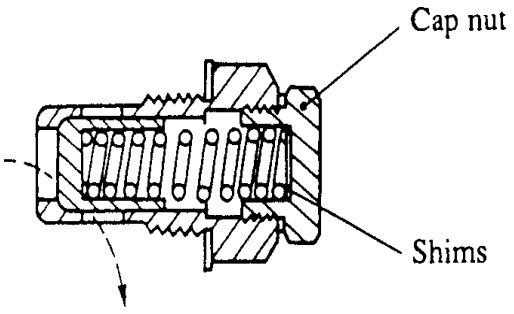
(3)Apply a pressure air of 0.5kgf/cm^2(7psi) (49kpa)to the switch through the oil hole to test for no continuity.
Any continuity is the cause for replacing the switch. Also, check for air leaks.
Any air leak is an indication of a ruptured diaphragm. In such a case, replace the switch.

3.Pressure relief valve

(1)Check the valve seat for contact.
Check the spring for damage.

(2)Measure the oil pressure at which the relief valve opens (the oil pressure with the engine running at the rated rpm).
If the pressure is not correct, remove the cap nut increase or decrease the amount of shims. The engine oil pressure tap is located on the right side of the engine.

Relief valve opening pressure	3.5 ± 0.5kgf/cm^2 (50 ± 7psi) [343 ± 49kPa]



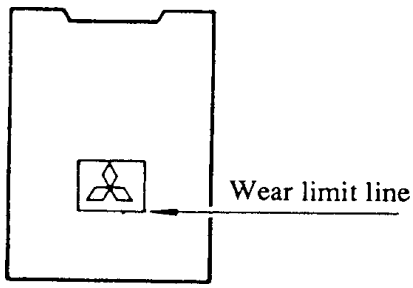
(6)ELECTRICAL SYSTEM

1.Starter

(1)Brushes

(a)Wear

Replace the brushes if they are worn down to the wear limit line which is the bottom of the border for Mitsubishi mark. Replace the brush holder assembly if the brushes are worn beyond the wear limit line.

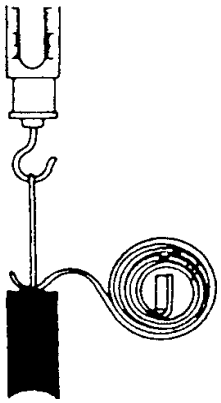


(b)Brush spring tension

Test the spring tension using a new brush as shown in the illustration. Read the load when the spring just moves off the brush. If the tension is below the limit, replace the spring.

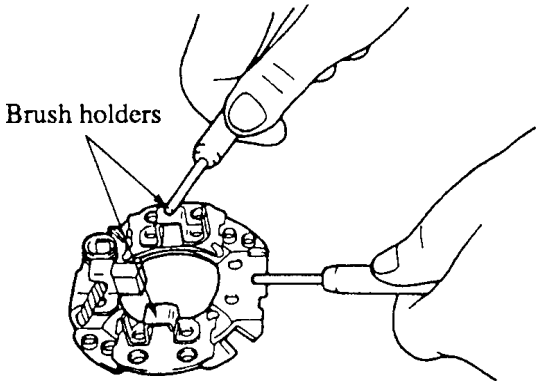
Unit:kgf(lbf)[N]

Item	Standard	Limit
Brush spring tension	3.0(6.6)[29.4]	1.8(4.0)[17.7]



(c)Brush holders

Test for no continuity between the positive brush holder and brush holder base as shown in the illustration. If there is any continuity between them, replace the brush holder. Also, check the brush holder for loose staking.



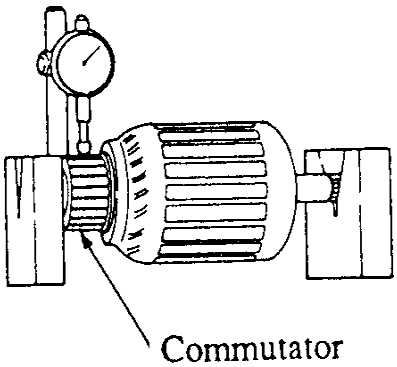
(2) Armature

(a)Commutator runout

Support the armature in V-blocks and measure the commutator runout with a dial indicator. If runout exceeds the limit, turn the commutator in a lathe. The cut should be made within the limit of the commutator diameter.

Unit: mm (in.)

Item	Standard	Limit
Runout of commutator	0.03 (0.0012)	0.10 (0.0039)



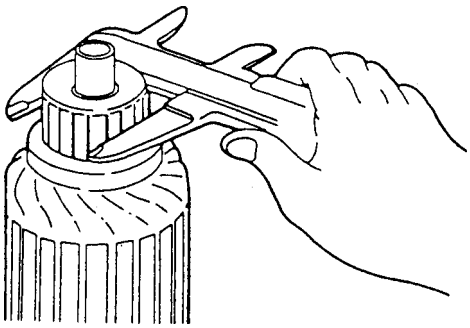
(b)Diameter of commutator

Measure the diameter of commutator.

If it exceeds the limit, replace the armature.

Unit: mm (in.)

Item	Standard	Limit
Diameter of commutator	32(1.26)	31(1.22)

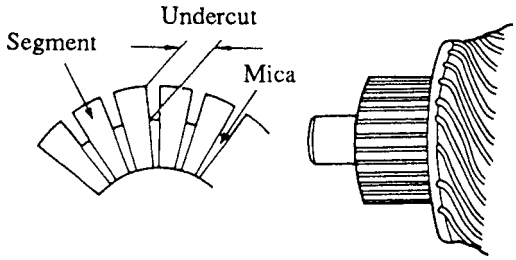


(c)Mica undercut

Measure the undercut of mica insulation between the adjacent segments. If undercut exceeds the limit, recondition the mica, or replace the armature.

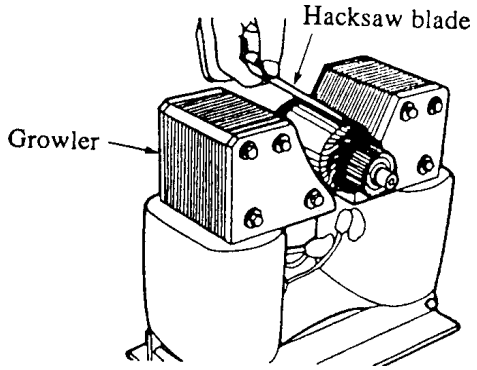
Unit: mm (in.)

Item	Standard	Limit
Undercut of mica	0.5 (0.020)	0.2 (0.008)



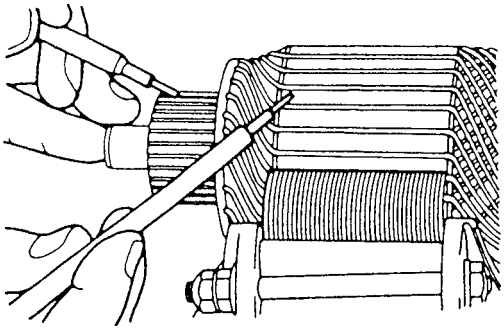
(d)Testing for short circuit

Place the armature on growler and slowly rotate it with a hacksaw blade held above the armature core. The hacksaw blade vibrates against the core when it is above a slot containing a shorted winding. A shorted armature should be replaced.



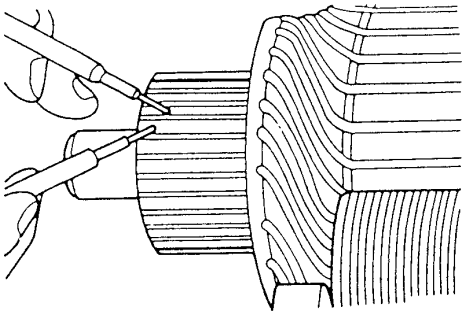
(e)Testing for grounded circuit

Test the armature for grounded circuit as shown in the illustration. If there is any continuity between commutator segment and coil, the armature is grounded and should be replaced.



(f)Testing for open circuit

Test the armature for open circuit as shown in the illustration. If there no continuity between the segments, the armature is open circuited and should be replace.



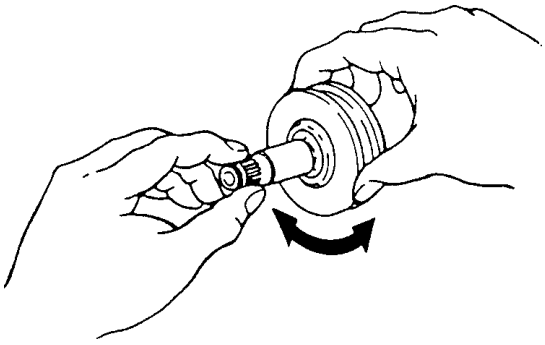
(3)Field coils

Replace the yoke assembly if -

(a)There is any continuity between the brush and yoke.

(b)There is no continuity between the brushes.

(c)The pole piece or coil is loosen.



(4)Bearings

Replace the bearings if they are noisy or fail to run freely.

(5)Overrunning clutch

Replace the overrunning clutch assembly if -

(a)The pinion is not locked when spun freely when spun in the reverse direction (clockwise).

(b)The pinion is worn or chipped

⚠CAUTION

Do not wash the overrunning clutch with cleaning solvent.

(6)Front bracket

Replace the front bracket assembly if the ball bearing is noisy or fails or rotate freely.

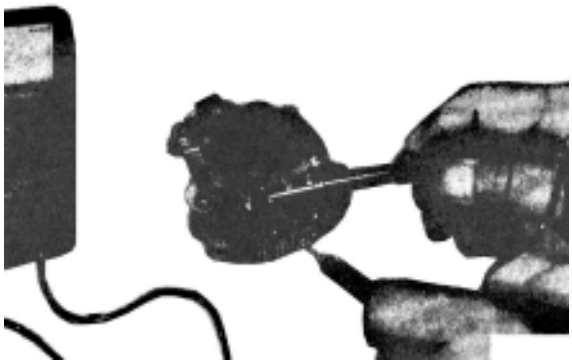
(7)Reduction gears

Replace the reduction gears if they are worn or damaged.

2.Alternator

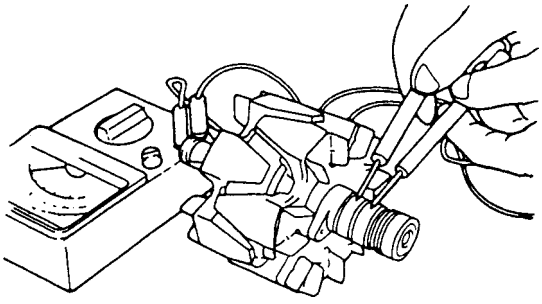
(1)Diodes

(a)Test the resistance between the diode and heat sink. First touch the positive (+) prod of an ohmmeter to the diode, then the negative (-) prod. If the resistance is infinite in both cases, the diode is open. If it is nearly zero in both cases, the diode is shorted. Do the same step for the remainder of the diodes. If any diode is open or shorted, replace the rectifier.

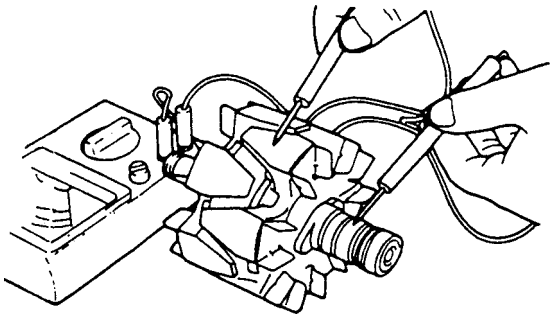


(2)Field coil

(a)Test for continuity between the slip rings as shown in the illustration. No continuity shows there is an open circuit in the field coil. Replace the field coil.

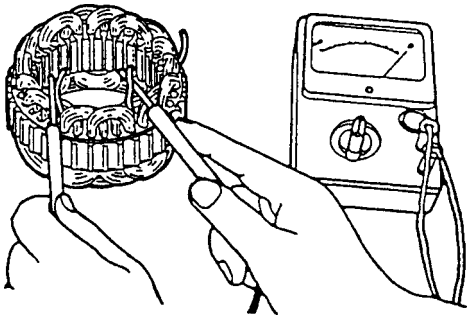


(b)Test for continuity between the slip ring and shaft(or core)as shown in the illustration. Any continuity shows there is a grounded circuit in the field coil. Replace the field coil.

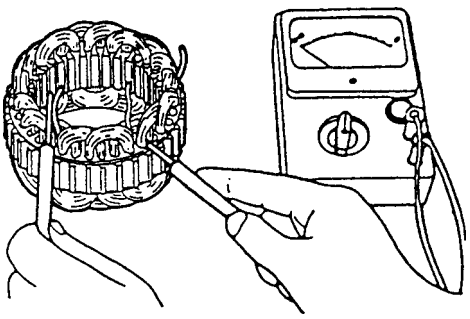


(3)Stator core

(a)Test for continuity between the leads as shown in the illustration. No continuity shows there is an open circuit in the stator core. Replace the stator core.

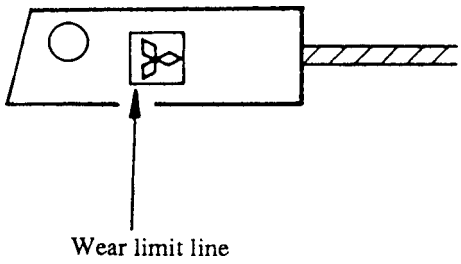


(b)Test for no continuity between each lead and stator core as shown in the illustration. Any continuity shows there is a grounded circuit in the stator core. Replace the stator core.

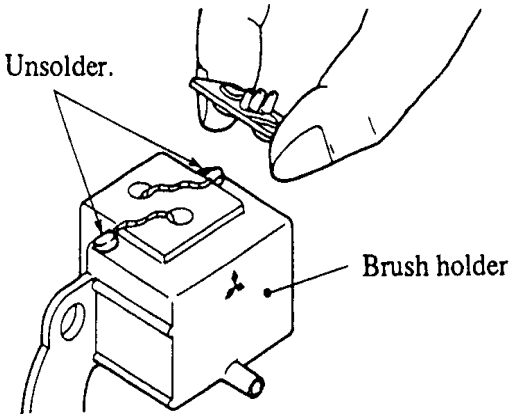


(4)Brushes

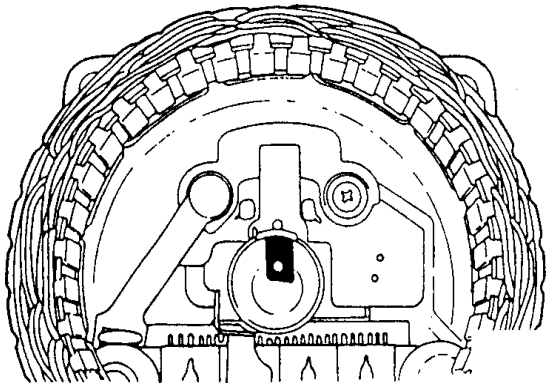
(a)Make replacement of brushes that have been worn down to,or beyond, the wear limit line.



(b)To remove the brushes from the brush holder for replacement, unsolder the leads from the brushes. This will permit removal of the brushes and springs.



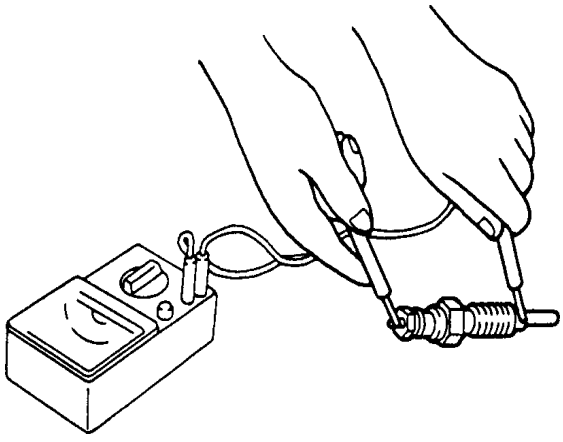
(c)To install the new brushes, put them in position in the brush holder and solder the leads to the brushes.



3.Glow plug

Test for continuity between the terminal and body as shown in the illustration.

Item	Standard
Resistance	0.55 Ω



4-6 ADJUSTMENT

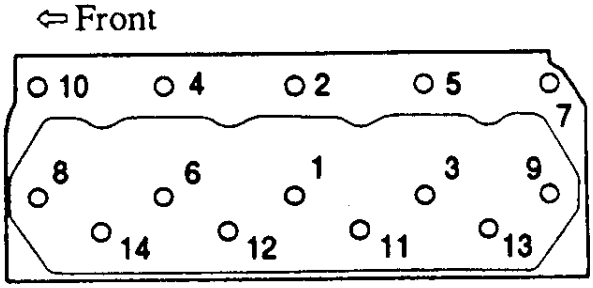
(1)VALVE CLEARANCE

NOTE

Make an adjustment to the valve clearance when the engine is cold.

(1)Slightly loosen the cylinder head bolts and retighten them to the specified torque in number sequence.

Tightening torque	9 ± 0.5 kgf•m (65 ± 4 lbf•ft) [88 ± 5 N•m]



(2)Find top dead center compression for No.1 piston by using the procedure that follows:

(a)Turn the crankshaft until TDC mark on the crankshaft pulley is aligned with the mark on the timing gear case.

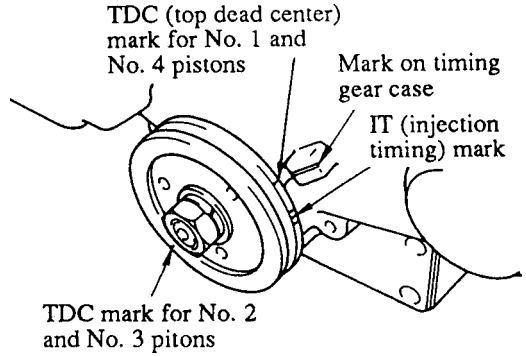
(b)With No. 1 piston at top dead center on the compression stroke, the rocker arms will not be moved when the crankshaft is turned approximately 20° in both directions.

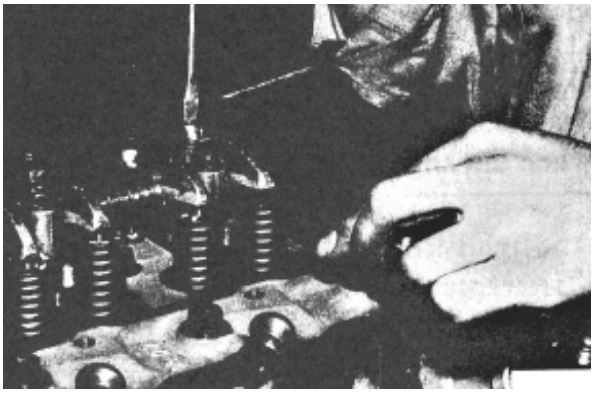
(c)If the rocker move, No. 1 piston is at top dead center on the intake or exhaust stroke. In such a case, turn the crankshaft 360° in the direction of engine rotation again. No. 1 piston is now at top dead center on the compression stroke.

(3)Loosen the lock nut for the adjusting screw. With a feeler gauge inserted between the rocker arm and valve cap, adjust the valve clearance by turning the adjusting screw.

Unit: mm(in.)

Item	Standard
Valve clearance (both inlet and exhaust valves)	0.25(0.0098)





(4)Hold the adjusting screw and tighten the lock nut.

(5)After the valve clearance on the valves for No 1 cylinder has been adjusted, turn the crankshaft 180° in the direction of engine rotation and adjust the valve clearance on the valves for the remainder of the cylinders in firing order (injection sequence)

Firing order (injection sequence)	Crankshaft rotation angle
S4L 1-3-4-2	180°

⚠CAUTION

After the valve clearance on the valves for all cylinders has been adjusted, turn the crankshaft two or three times and make sure the valve clearance is correct.

(2)FUEL INJECTION TIMING

1.Preparation

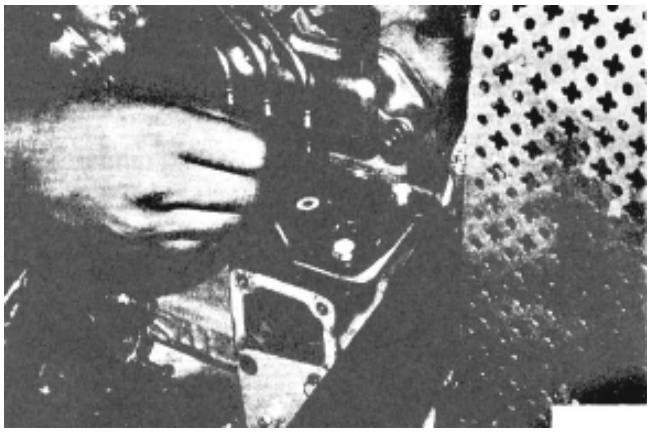
(1)Close the fuel filter valve.

(2)Disconnect the No. 1 fuel injection pipe from the cylinder head and injection pump.

(3)Remove No. 1 delivery valve holder from the injection pump. Remove the delivery valve and spring from the holder. Restore the delivery valve holder only to the injection pump.

(4)Connect the fuel injection pipe to the injection pump.

(5)Hold the speed control lever in the low speed position.



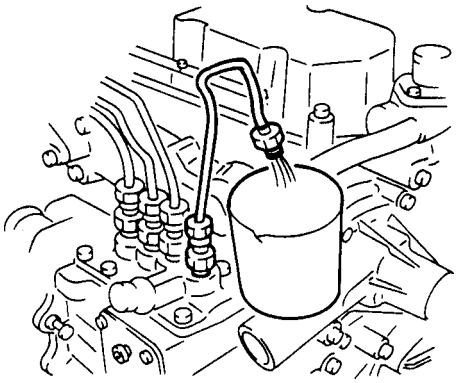
2.Inspection

2.2Fuel flow method

(1)Open the fuel filter. Turn the starter switch key to ON position.

NOTE

Fuel will come from the injection pipe with high pressure when the starter switch key is turned to ON position if the engine is equipped with an electric fuel pump. Direct fuel flow into the container.



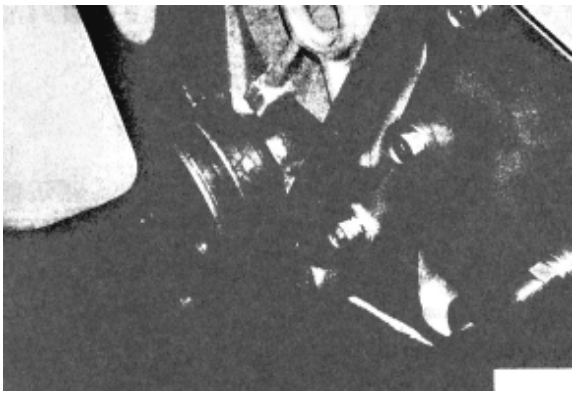
(2)Slowly turn the crankshaft clockwise, looking at the free end of the injection pipe. The instant fuel stops coming out is the fuel injection timing.

NOTE

Turn the crankshaft in reverse direction just a little and do Step (2) again to verify the injection timing.

(3)The fuel injection timing is correct if IT mark on the crankshaft pulley is aligned with the mark on the timing gear case when fuel stops from the injection pipe.

Fuel injection timing (BTDC)	17° (standard)



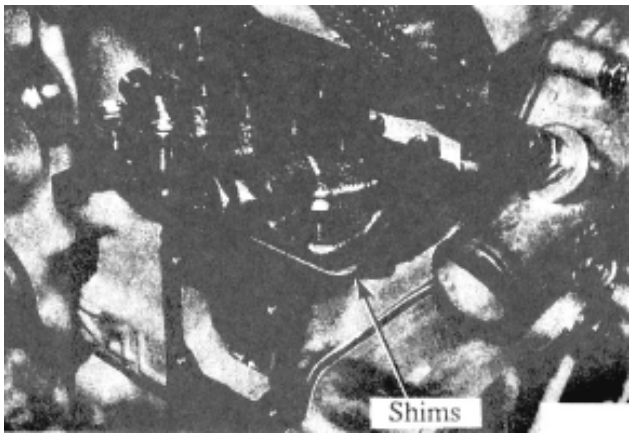
3.Adjustment

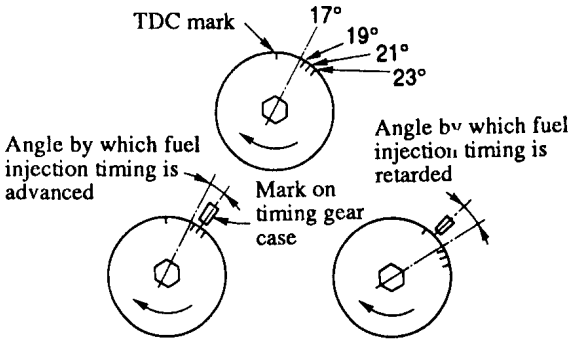
(1)If the fuel injection timing is incorrect, change the thickness of shims under the fuel injection pump. An increase or decrease of the shims by 0.1 mm(0.004 in.)will vary the timing by 1°.

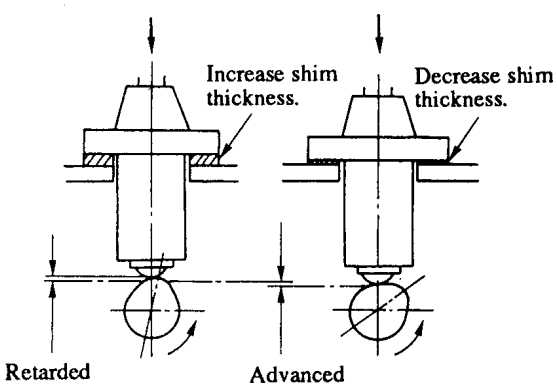
(2)Increase the thickness of the shims to retard the timing or decrease it to advance the timing.

Adjustment range	Standard 1.5°

Four kinds of shims are available in thicknesses 0.2 mm(0.0079 in.), 0.3 mm (0.0118 in.), 0.4 mm(0.0157 in.) and 0.8 mm(0.0315 in.). These shims have no identification; measure the thickness of each shim with calipers before using it.







⚠CAUTION

Apply sealant to both faces of each shim to prevent oil leaks.

(3)After the timing has been adjusted, make sure it is correct.

(4)Close the fuel filter valve and restore the delivery valve and injection pipe to the original state.

4.Installation

(1)Put the gasket on the injection nozzle.

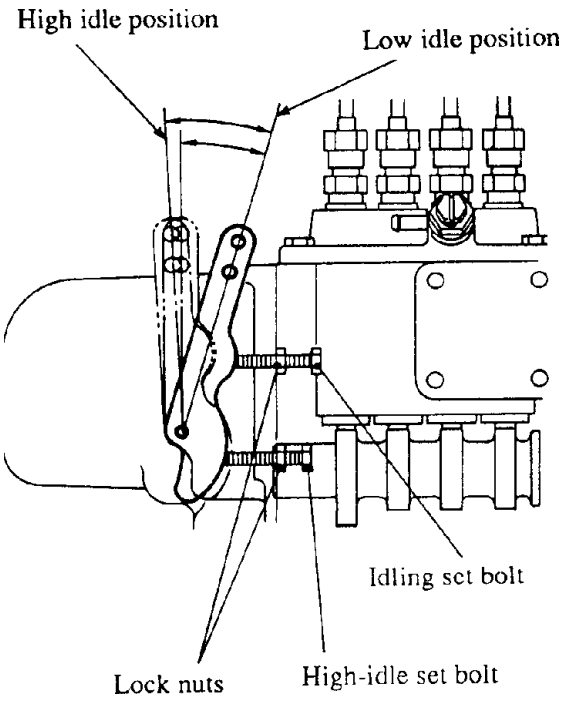
(2)Put the nozzle in position in the cylinder head and tighten it the specified torque.

Tightening torque	9 ± 0.5 kgf•m (65 ± 4 lbf•ft) [88 ± 5 N•m]

(3)IDLER R.P.M SETTING

NOTE

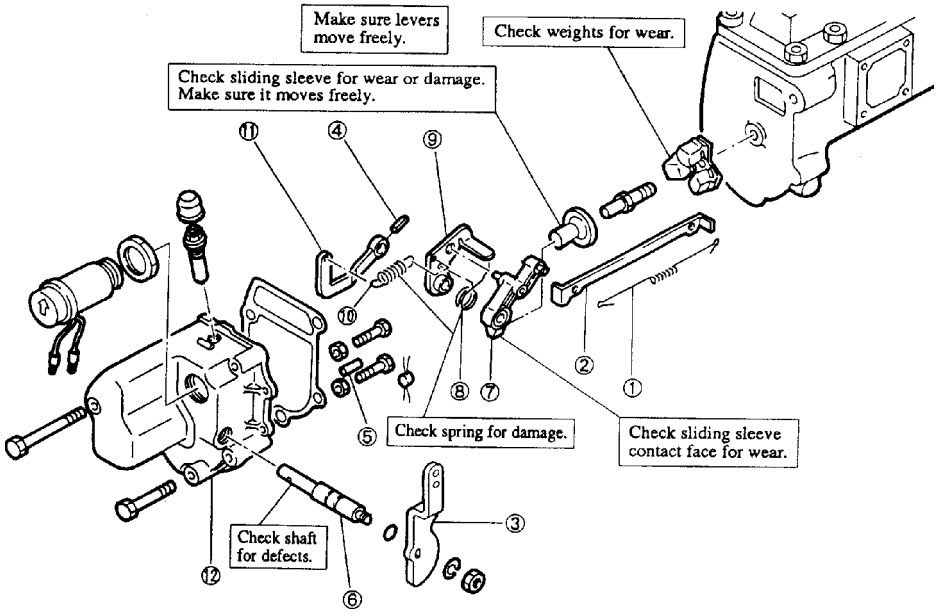
Make sure that the valve clearance and injection timing are correct and that the fuel injection nozzles have no defect.



(1)Start and run the engine at low idle until the coolant temperature above 60°C (140°F).

(2)To set the low idle rpm, loosen the lock nut for the idling set bolt and turn the set bolt to make the engine run at the specified rpm. Tighten the lock nut.

(3)To set the high idle rpm, loosen lock nut for the high-idle set bolt and turn the set bolt to make the engine run at the specified rpm. Tighten the lock nut.



Disassembly sequence and inspection points

(1)Tie rod spring
(2)Tie rod
(3)Speed control lever
(4)Spring pin
(5)Grooved pin
(6)Governor shaft
(Remove (7) thru (11) as an assembly.)
(7) Governor lever
(8) Start spring
(9) Tension lever
(10) Governor spring
(11) Governor spring lever
(12) Governor case

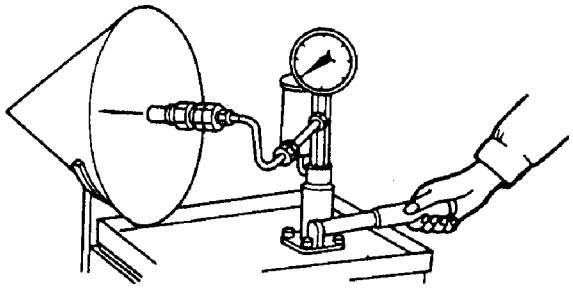
(4)INJECTION NOZZLE

1.Inspection

(1)Injection Pressure (valve opening pressure) test

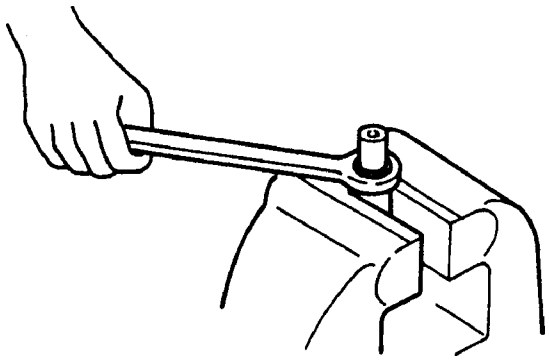
(a)Install the injection nozzle on the tester. Slowly operate the tester handle to bleed (remove) air from the tester.

(b)Operate the tester handle at a speed of one stroke per second to make a slow increase in pressure until the valve in the injection nozzle starts to open. Read the maximum gauge pressure at the instant fluid flows from the tip.



(c)If the injection pressure is incorrect, disassemble the nozzle and change the thickness of the washer.

Injection pressure (valve opening pressure) Standard	140 $^{+5}_{0}$ kgf/cm^2 (1991 $^{+71}_{0}$ psi) [13729 $^{+490}_{0}$kPa]



NOTE

An increase or decrease of washer thickness by 0.1 mm (0.004 in.) will vary injection pressure by 10 kgf/cm^2 (142 psi)[981kPa].
10 kinds of washer are available in thicknesses from 1.25 mm(0.0493 in.) to 1.70 mm(0.0669 in.) in increments of 0.05 mm (0.0020 in.).

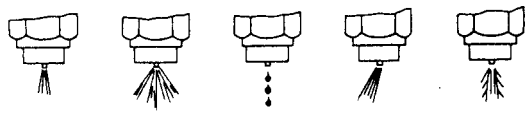
⚠WARNING

When the injection nozzles are tested. be sure to wear eye protection. Fuel comes from the orifices in the nozzle tip with high pressure. The fuel can pierce(go through)the skin and cause serious injury to the operator. Keep the tip of the nozzle pointed away from the operator and into the fuel collector.

(2)Orifice restriction test

(a)Look at the orifice discharge pattern (shape of discharge)when fluid begins to flow through the injection nozzle. The discharge must be straight. Any change is an indication of a bad nozzle.

(b)Operate the tester handle at a speed of one stroke per second to make sure the discharge is straight.

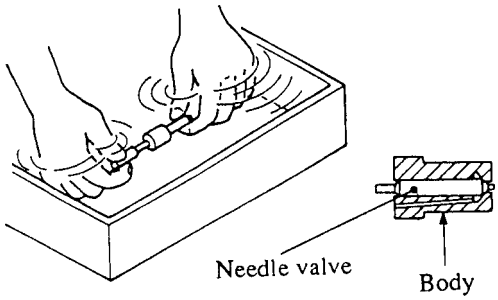


Good nozzle (Use again.)

Discharge pattern for orifice with a restriction (Recondition or replace.)

(3)Nozzle tip washing and replacement

(a)Loosen the retaining nut and remove the tip from the injection nozzle. Wash the needle valve and body in clean diesel fuel. After washing, put the needle valve in the body in clean diesel fuel.



CAUTION

Do not hit the tip when removing it from the injection nozzle.

NOTE

Keep the needle valves with their respective bodies

(b)After cleaning the tip, install it in the nozzle and tighten the retaining nut to the specified torque.

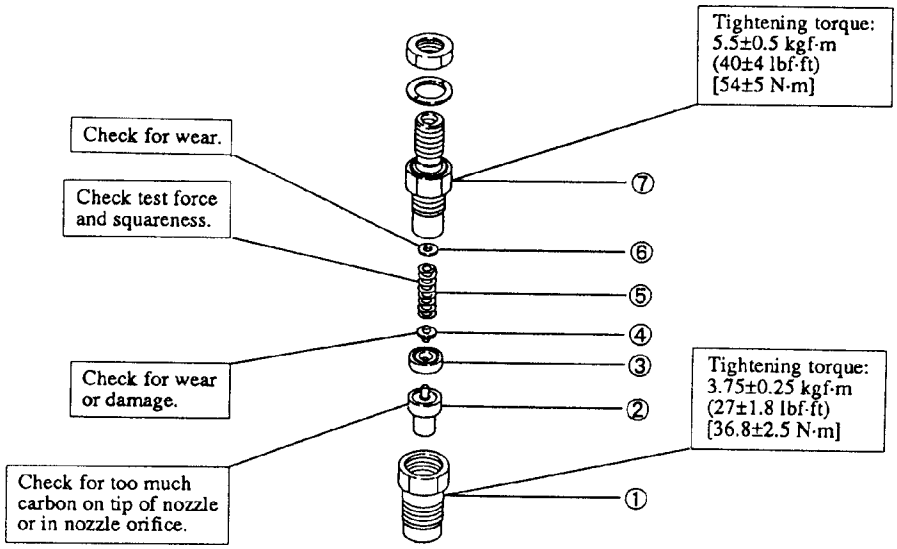
Tightening torque	9 ± 0.5 kgf•m (65 ± 4 lbf•ft) [88 ± 5 N•m]

(c)If the injection nozzle is still bad after the tip has been washed, replace the tip.

NOTE

a)Do not touch the sliding surface of the needle valve.

b)When installing the new nozzle tip, remove synthetic resin film from the tip and slide the needle valve in the body in clean diesel fuel to wash off inhibitor completely.



Disassembly sequence and inspection points

(1) Retaining nut
(2) Nozzle tip assembly
(3) Piece
(4) Pin
(5) Spring
(6) Washer
(7) Body

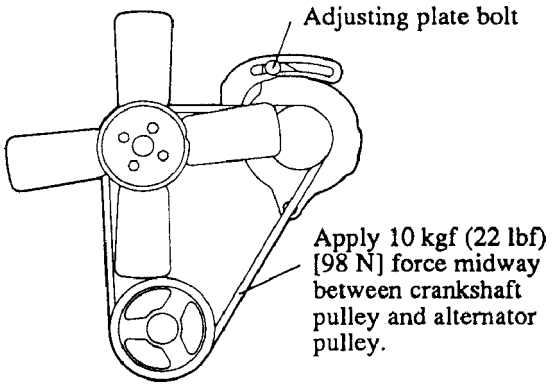
(5)FAN BELT

(1)Measure the deflection of the belt. Apply 10 kgf (22 lbf)[98 N] force midway between the alternator pulley and the crankshaft pulley.

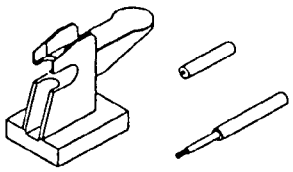
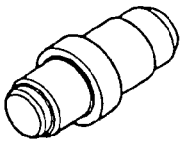
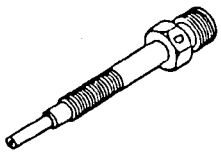
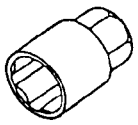
(2)Adjust the belt if the deflection is not correct. Loosen the adjusting bolt and move the alternator to obtain the required belt deflection.

Unit: mm(in.)

Item	Standard
Deflection	10 to 12 (0.4 to 0.5)



4-7.SPECIAL TOOLS

Tool No.	Tool Name	Style	Usage
31A91-00100	Piston Pin Setting Tool	 406808	Piston pin removal and installation
ST332340	Camshaft Bushing Installer	 404704	Camshaft front bushing removal and installation
ST332270	Compression Gauge Adaptor	 404931	Compression pressure measurement
MD998054	Oil Pressure Switch Socket Wrench (26)	 404840	Oil pressure switch removal and installation

NOTE

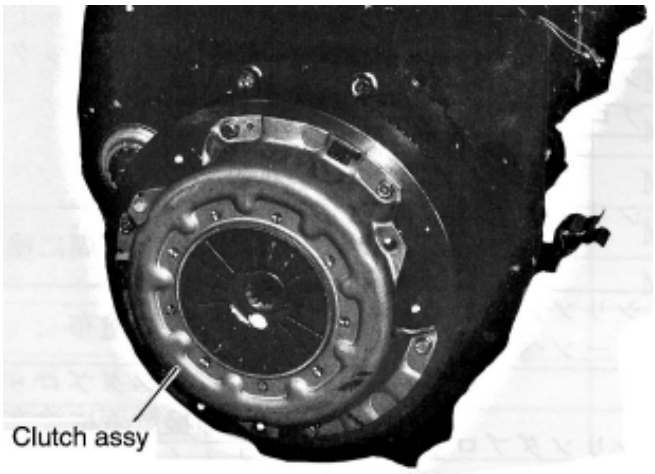
In addition these special tools. commercially available tools such as bearing puller , valve seat cutting tool , valve guide installing tool , valve spring compressing tool , oil filter wrench , etc . are necessary.

5. CLUTCH

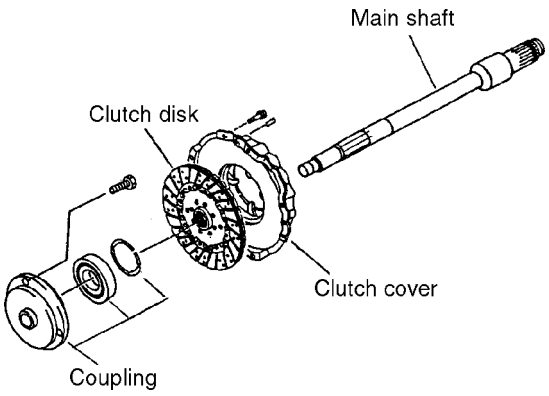
5-1 DISASSEMBLING

(1) DISASSEMBLING CLUTCH ASSY

1. Remove the fixing bolts of clutch cover and remove the clutch assy from engine flywheel.
   *When loosen the fixing bolts, loosen them diagonally .

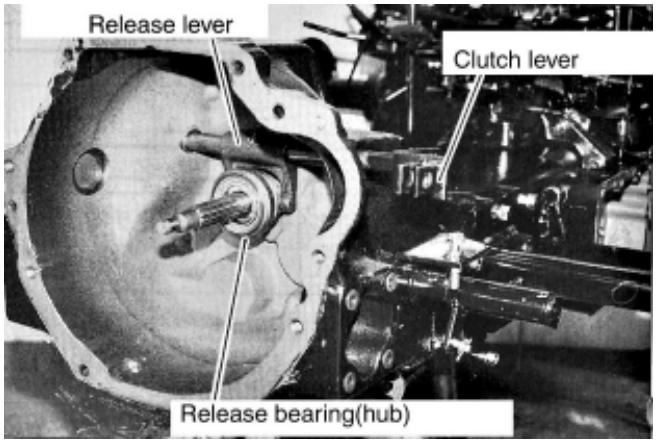


2. Take out cover assy and disk assy.

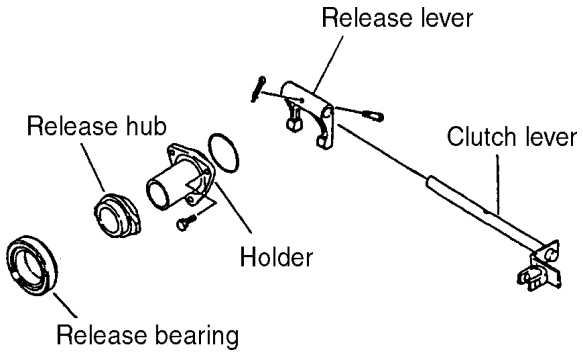


(2) DISASSEMBLING CLUTCH LEVER

1. Remove the release hub with release bearing by moving the clutch lever.



2. Remove cotter pin, clevis pin and release lever.
3. Pull out the clutch lever with removing the release lever.



5-2. REASSEMBLING

(1) REASSEMBLING CLUTCH LEVER

1. Reassemble the clutch lever, release lever, release hub with reverse procedure of disassembling. Use the following values as adjustment and service standard for the installation.
   *For the installation of release bearing, depress the inner hub.

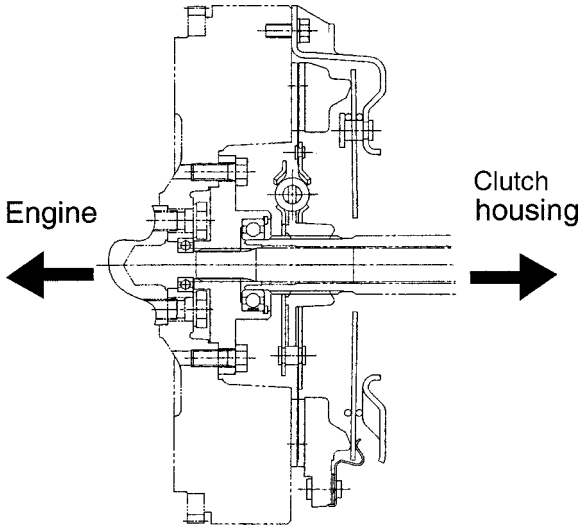
2. Make sure the direction of release lever and release hub for the reassembling.

3. Apply the lithium grease inside of release hub before assembling.

(2) REASSEMBLING CLUTCH ASSY

1. Reassemble the clutch assy with reverse procedure of disassembling. Use following values as adjustment and service standard for the assembling.

2. Set the clutch disk surface which spline boss sticking out longer face to clutch housing



3. Apply the lithium grease to the spline of clutch disk.

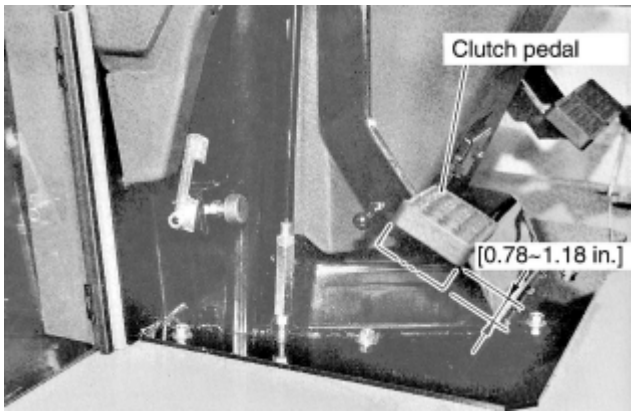
4. Before installing the clutch assy to engine, clean flywheel end. Aline the center of clutch disk ID and flywheel bearing ID.

5. Tightening torque of clutch assy fixing bolts. [18~21.7 lbf•ft]

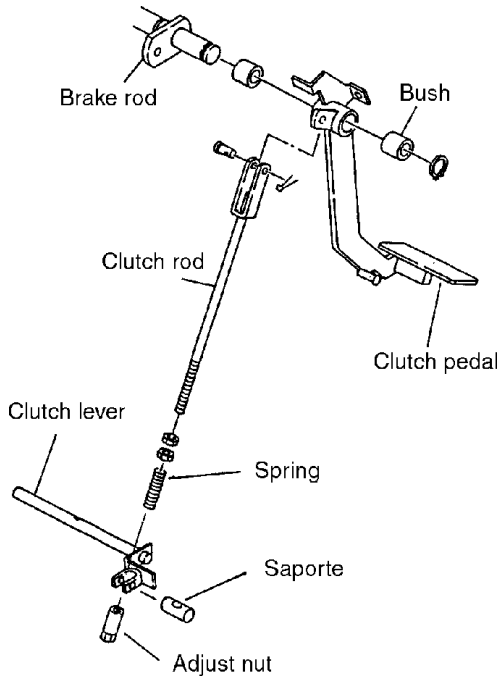
5-3 ADJUSTMENT

(1) CLUTCH PEDAL ADJUSTMENT

1. Depress the clutch pedal by hand and measure the amount of pedal free play at pedal.
   Pedal free play : [0.79~1.18in.]



2. In case that the free play is out of standard value, adjust the rod length by turning the adjust nut.

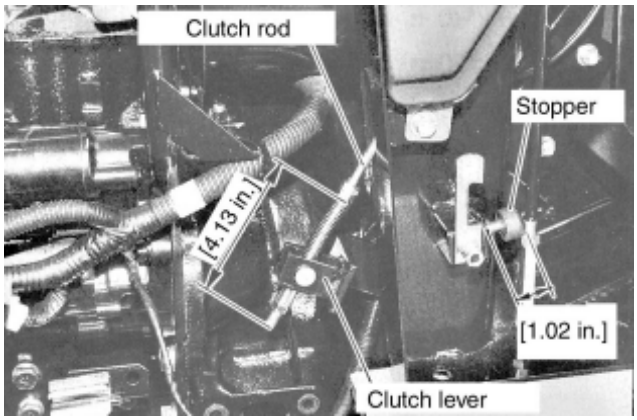


*Apply the grease at pivot point of the pedal.

(2) STOPPER ADJUSTMENT

1. Adjust the stopper length and lock the stopper by lock nut.
   Stopper length : [0.79in.]

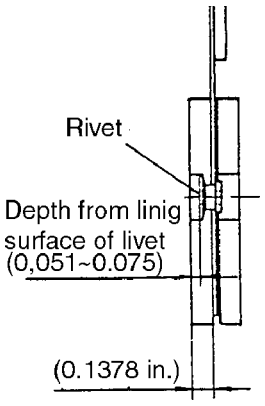
2. Depress the clutch pedal to the stopper and make sure the clutch is disengaged



5-4 CHECK AND MAINTENANCE

(1) CLUTCH DISK

1. Measure the depth from clutch lining surface to rivet.



2. In case that the measurement is out of the following limit, replace the clutch disk assy.

Item	Standard value	Service limit
Depth to rivet	0.05 ~0.075 in.	0.012in.

3. In case that the oil is stick to the lining, lining is carbonized or damaged, replace the clutch disk and check the cause.

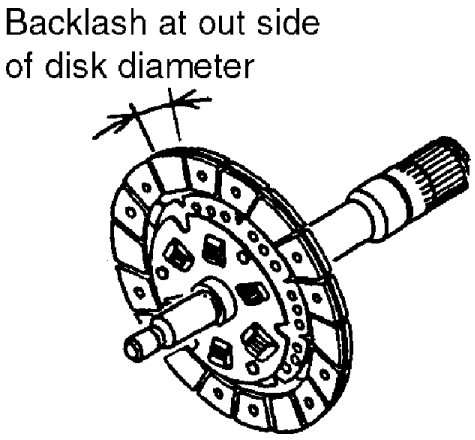
(2) CLUTCH DISK BOSS AND MAIN SHAFT

1. Install the clutch disk to main shaft.

2. Check the backlash at circumference of clutch disk.

3. In case that the backlash exceed from the following value, replace the clutch disk.

Item	Standard value	Service limit
Backlash at out side of disk diameter	0.016~0.039in.	0.787in.

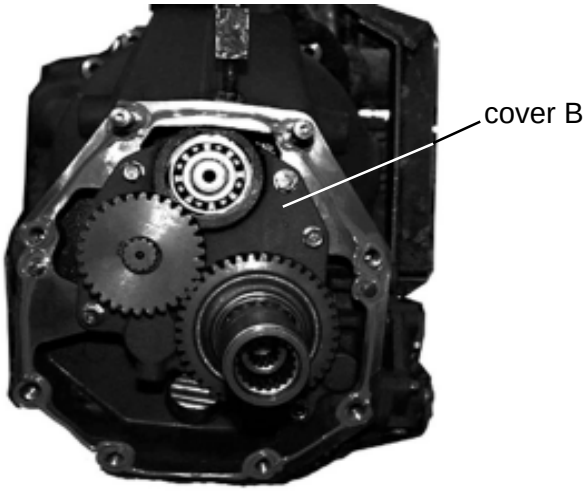


6. TRANSMISSION

6-1. CLUTCH HOUSING DISASSEMBLING

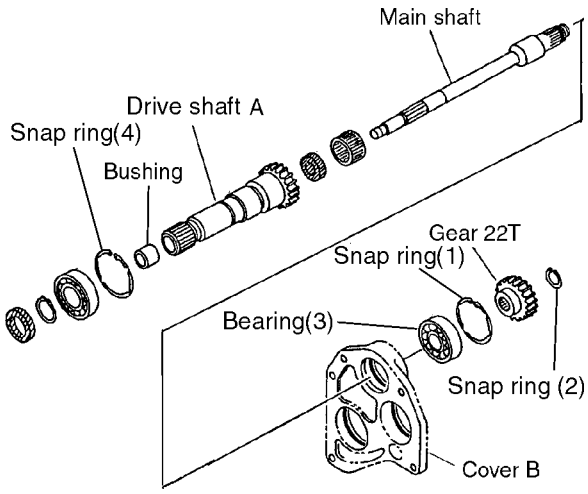
(1) COVER B SUB ASSY REMOVAL

1. Remove the fixing bolt of cover B and remove cover B sub assy.



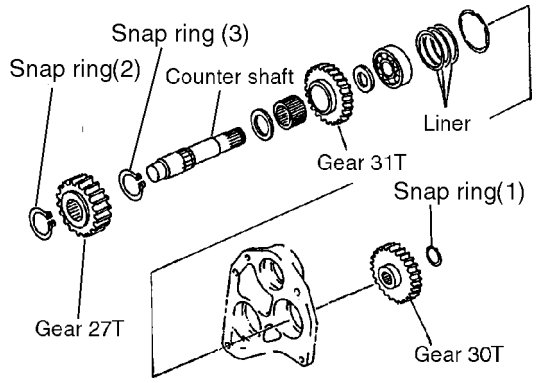
(2) COVER B SUB ASSY DISASSEMBLING

1. Disassemble main shaft
   1) Remove snap ring (1)and remove main shaft from cover B.

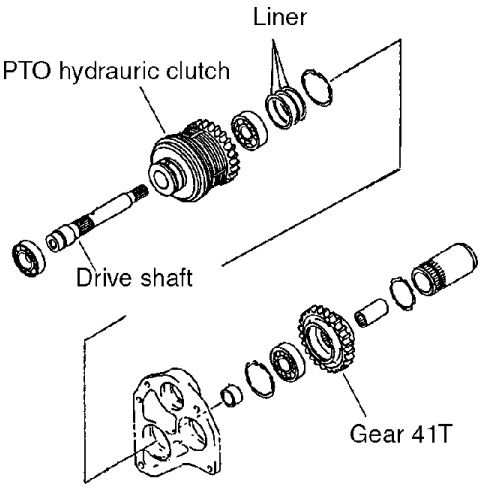


   2) Remove snap ring(2) from main shaft and remove gear 22T and bearing(3).
   3) Remove snap ring(4) and remove drive shaft A.

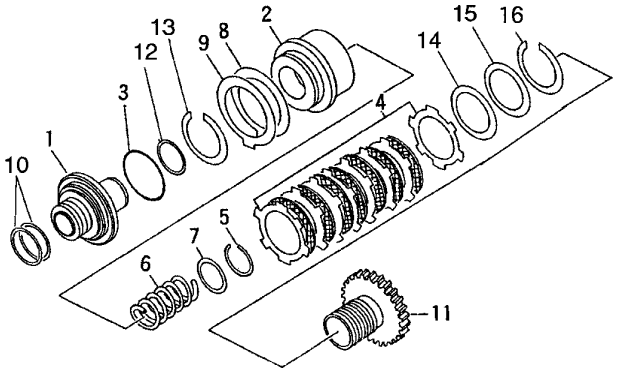
2. Disassemble counter shaft
   1) Remove snap ring(1) and remove gear 30T from counter shaft.
   2) Remove counter shaft from cover A.
   3) Remove gear 31T with needle bearing and washers.
   4) Remove snap ring (2),(3) and remove gear 27T from counter shaft.



3. Remove drive shaft.

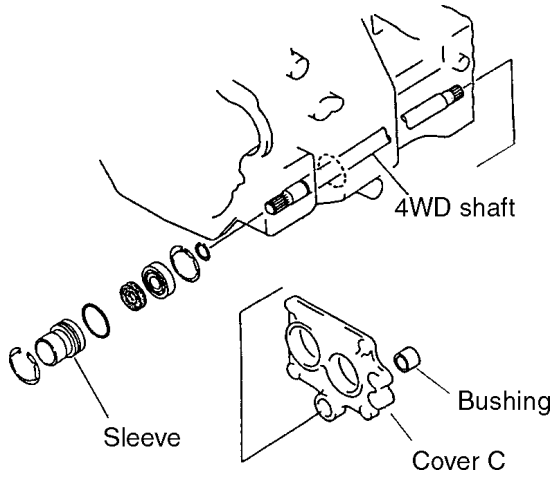


4. Disassemble PTO hydraulic clutch assy.



(1) Case
(2) Piston
(3) Seal ring
(4) Disk assy
(5) Ring set
(6) Spring
(7) Washer
(8) Return plate
(9) Brake disk
(10) Seal ring set
(11) Gear set 40T
(12) Seal ring
(13) Ring
(14) Back plate
(15) Belleville spring
(16) Ring

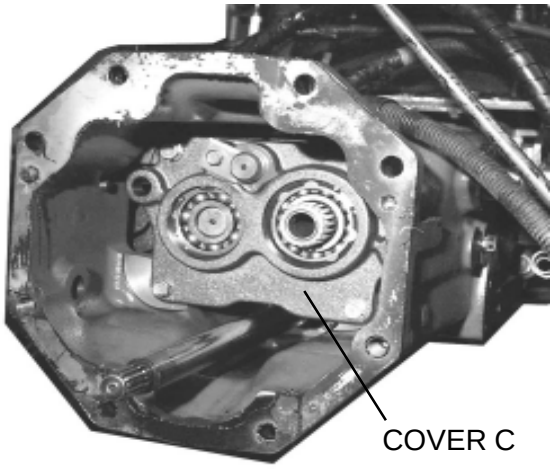
(3) 4WD SHAFT DISASSEMBLING.



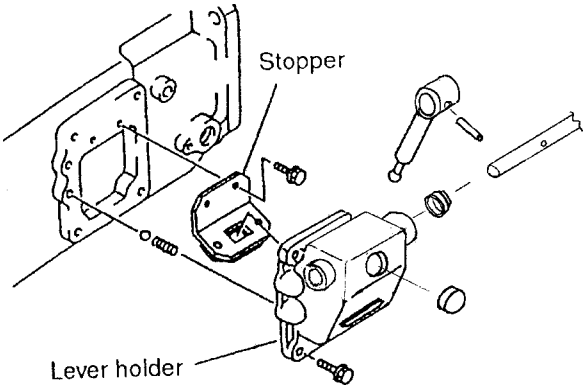
6-2 CENTER CASE DISASSEMBLING

(1) COVER C SUB ASSY REMOVAL

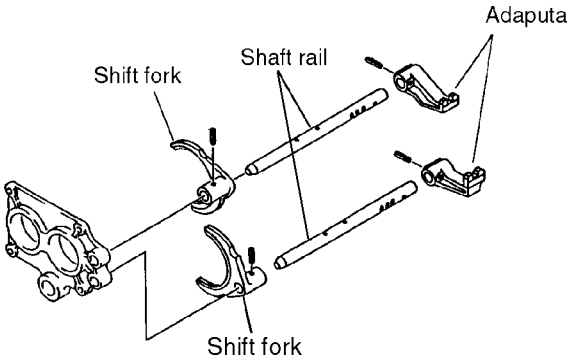
1. Remove the fixing bolts of main shift lever holder and remove the holder.



2. Remove stopper,detent ball and spring.

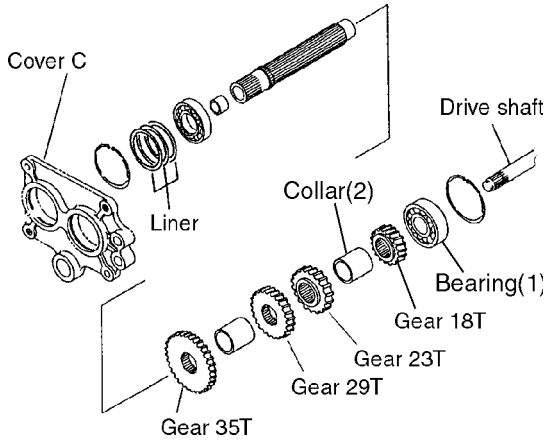


3. Remove fixing bolts of cover C and remove cover C assy.

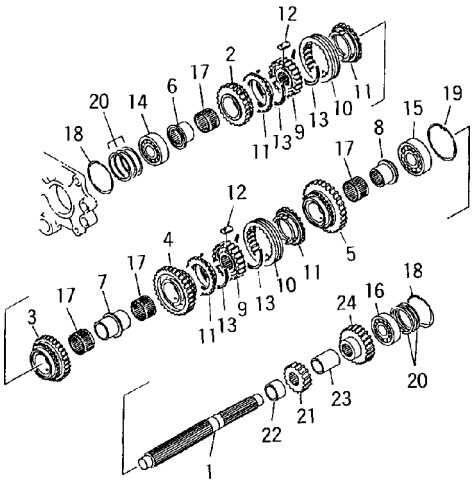


(2) COVER C SUB ASSY DISASSEMBLING

1. Disassemble drive shaft
   1) Remove drive shaft and remove pipe shaft.
   2) Remove bearing(1), gear 18T, collar(2),gear 23T, gear 29T , collar and gear 35T.



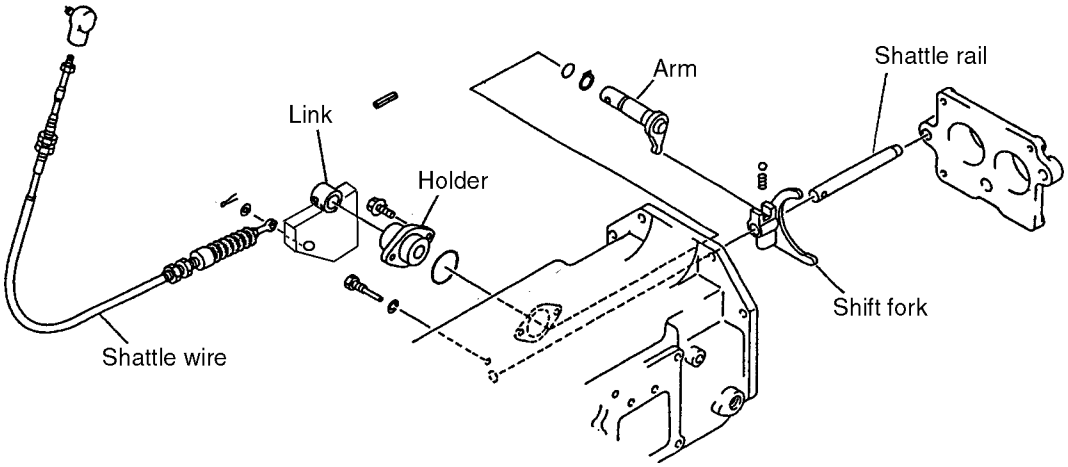
2. Disassemble select shaft.
   1) Remove select shaft with gears.
   2) Remove bearing14 and remove synchronize gears and hubs.
   3) Remove bearing 16 and remove gear 24, collar 23, gear 21 and collar 22.



(1) Select shaft
(2) Gear 23T
(3) Gear 26T
(4) Gear 35T
(5) Gear 40T
(6) Retainer A
(7) Retainer B
(8) Retainer A
(9) Hub
(10) Sleeve
(11) Ring
(12) Piece
(13) Spring
(14) Ball bearing
(15) Ball bearing
(16) Ball bearing
(17) Needle bearing
(18) Snap ring
(19) Snap ring
(20) Liner
(21) Gear 21T
(22) Spacer
(23) Spacer
(24) Gear 28T

(3) DISASSEMBLE SHUTTLE SHIFT CONTROL

1. Disconnect shuttle shift wire from link.
2. Remove link from arm and remove holder.
3. Remove stopper bolt.

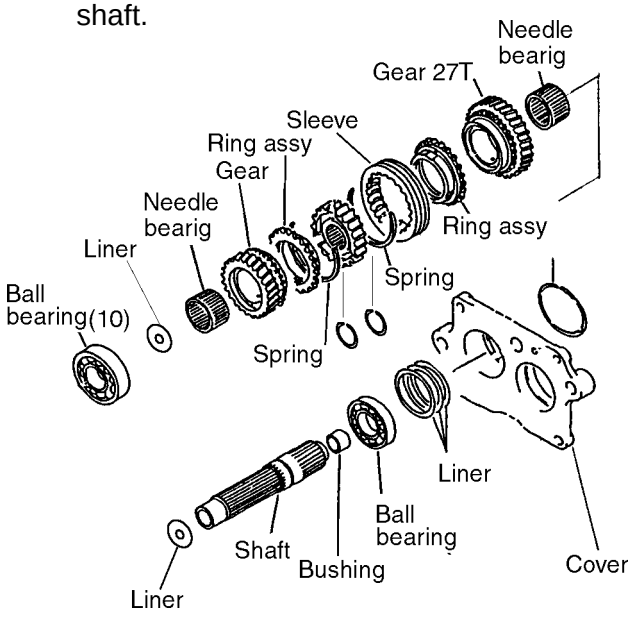


(4) COVER D REMOVAL

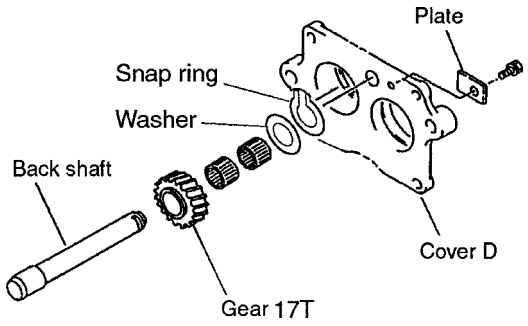
Remove fixing bolts of cover and remove cover from center case

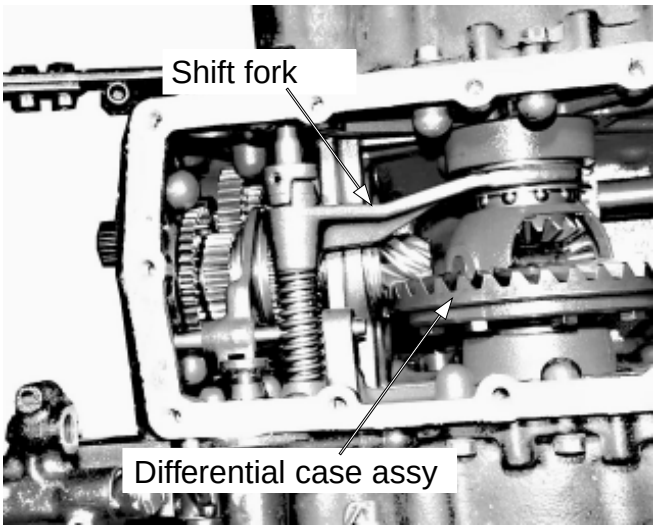
(5) COVER D SUB ASSY DISASSEMBLING

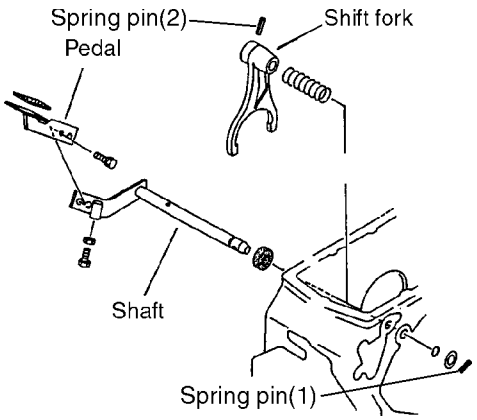
1. Disassemble drive shaft.
   1) Remove drive shaft with bearing and synchronized gears.
   2) Remove bearing(10) and remove synchronize gears and hubs from drive shaft.



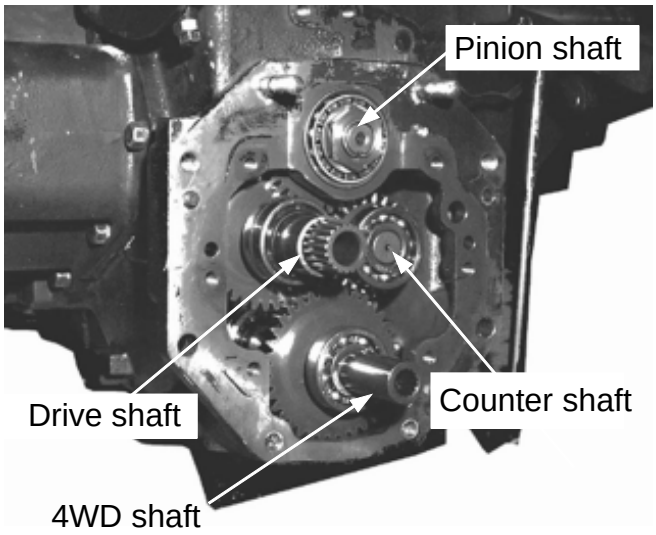
2. Disassemble reverse shaft
   1) Remove plate and remove reverse shaft from cover D.
   2) Remove snap ring , washer, gear 17T, and needle bearings from reverse shaft.







6-3 TRANSMISSION CASE DISASSEMBLY

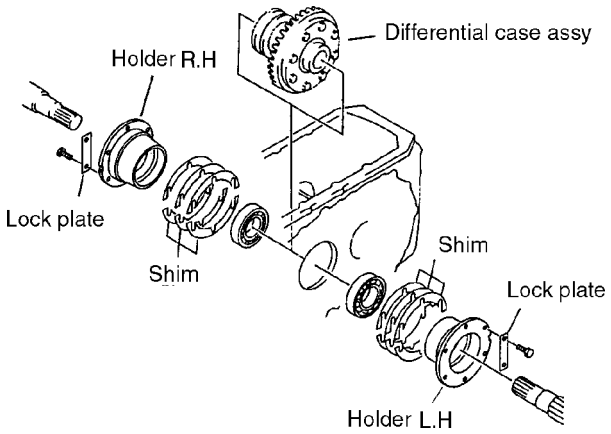


(1) REAR DIFFERENTIAL CASE REMOVAL

1. Remove differential lock pedal fixing bolt and remove the pedal.

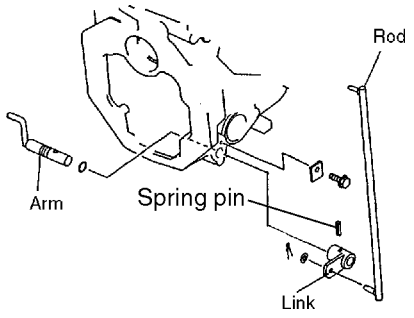
2. Remove spring pin (1), washer and spring pin (2).
3. Pull out the shaft and remove shift fork, cum and spring at shaft.

3. Remove fixing bolts of holder L.H. and R.H. and lock plates. Remove holder L.H. , R.H. and differential case assy.

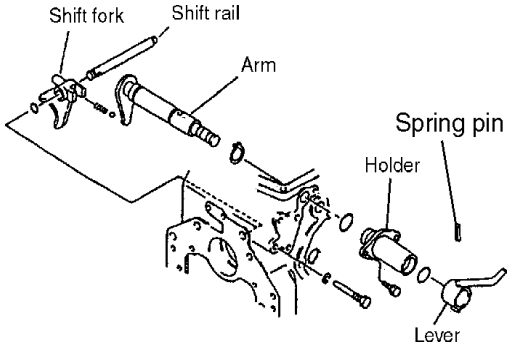


(2) COVER E SUB ASSY REMOVAL

1. Remove 4WD rod and remove fixing bolt of plate.
2. Remove spring pin at link, and remove link and arm.
3. Remove fixing bolts of cover E and remove cover E assy from transmission case.

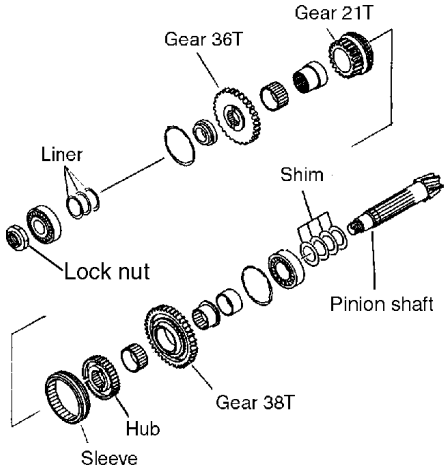


4.Remove spring pin at lever and remove holder and arm.

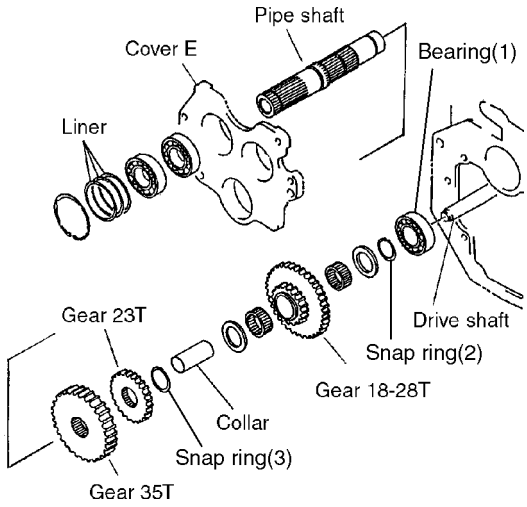


(3) COVER E SUB ASSY DISASSEMBLING

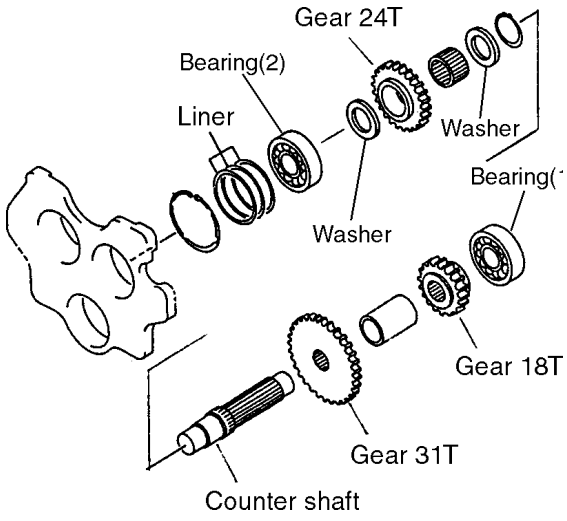
1. Disassemble pinion shaft..
   1) Remove lock nut from pinion gear and remove pinion shaft.



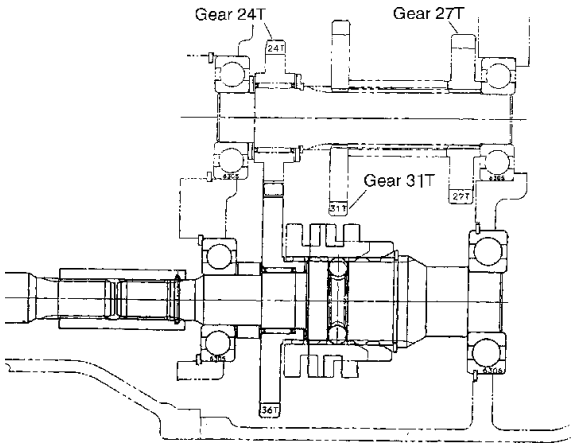
2. Disassemble drive shaft.
   1) Move snap ring(3) and remove gear 23T and 35T from pipe shaft..
   2) Remove bearing(1), snap ring(2) from pipe shaft and remove washers, gear 18-28T and needle bearing.



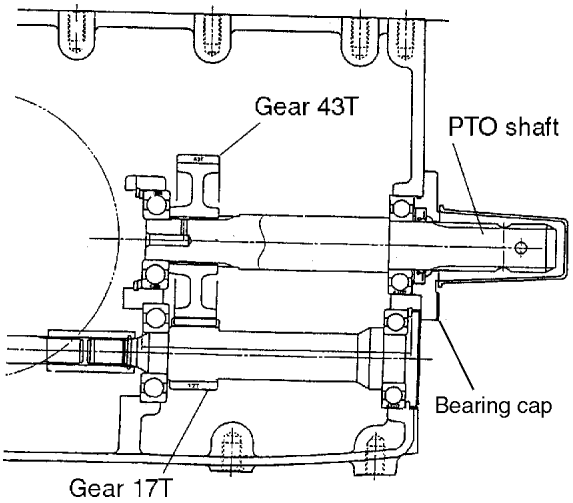
3. Disassemble counter shaft
   1) Remove bearing (1) and remove gear 18T, collar and gear 31T from counter shaft.
   2) Remove bearing (2) and remove washers, gear 24T and needle bearing.



4. 4WD shaft disassembling.
   1) Remove 4WD shaft and gear



5. PTO shaft removal
   1) Remove fixing bolts of bearing cap and remove bearing cap from transmission case.
   2) Remove PTO shaft and gears.



6-4 CLUTCH HOUSING REASSEMBLING

*Assemble the clutch housing with reverse procedure of disassembling.

(1) COVER B REINSTALLATION

Reinstall the cover B with reverse procedure of removal.

Use following adjustment and service standards for the reassembling.

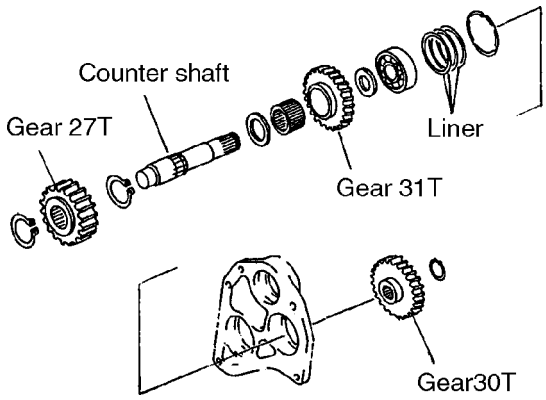
(2) COVER B REASSEMBLING

*Reassemble the cover B with reverse procedure of disassembling.

Use following adjustment and service standards for the reassembling.

1. Counter shaft end play adjustment

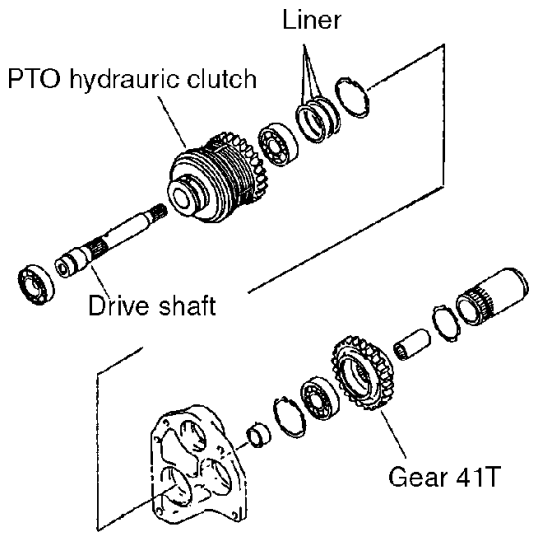
Adjust the end play at counter shaft to [0.002in.~0.008in.] by liner.



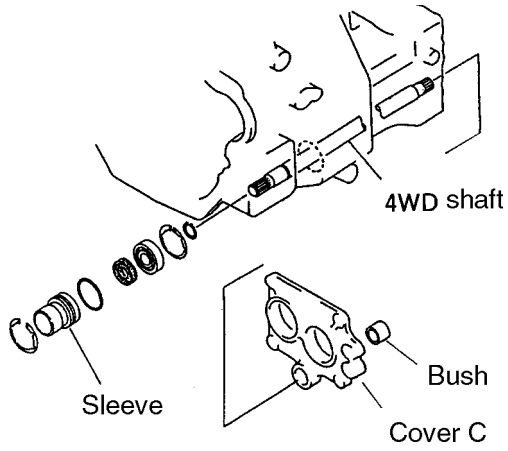
2. Drive shaft end play adjustment

Adjust the end play at drive shaft to [0.002in.~0.008in.] by liner.

3. PTO hydraulic clutch reassembling
   For the installation of return plate, face the stamping surface (round edge side)of the plate to brake disk.



(3) 4WD SHAFT REASSEMBLING
*Reassemble 4WD shaft with reverse procedure of disassembling.



6-5. CENTER CASE REASSEMBLING

*Reassemble the center case with reverse procedure of removal.

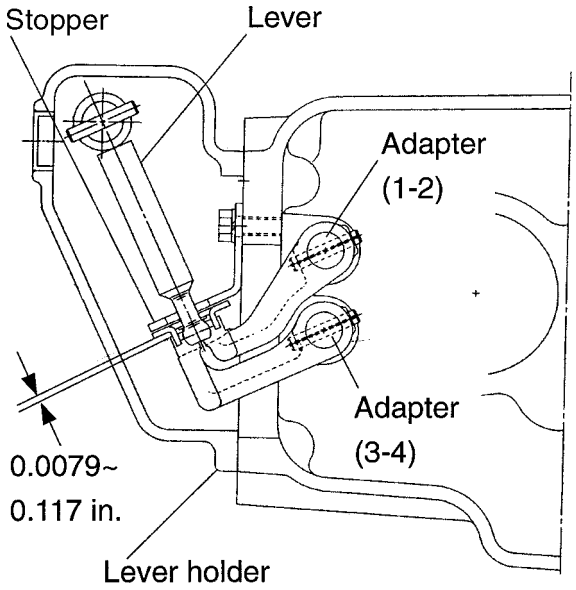
(1) COVER C SUB ASSY REINSTALLATION

*Reinstall the cover C sub assy with reverse procedure of removal.
Use following values as adjustment and service standard for reassembling.

1. Apply liquid packing (three bond #1208D) at the mating surface of center case and lever holder.

2. Tightening torque of fixing bolts of lever holder. [28.93~32.55lbf•ft]

3. Install the stopper to set [0.079~0.118in.] clearance between stopper and adaptor and make sure the lever could be move smoothly in the guide.

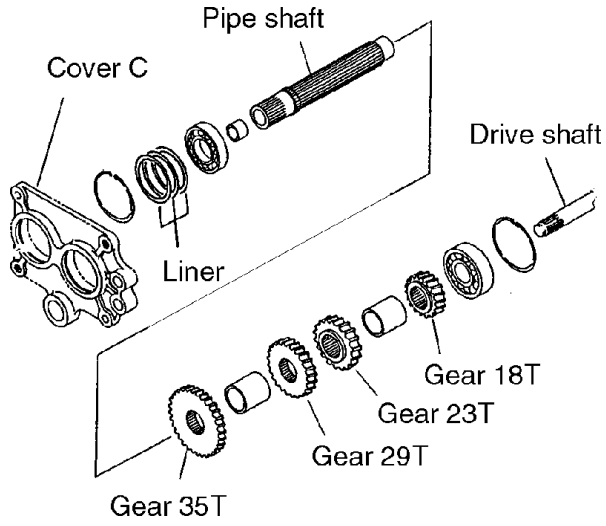


(2) COVER C REASSEMBLING

*Reassemble the cover C with reverse procedure of disassembling. Use following values as adjustment and service standard for reassembling.

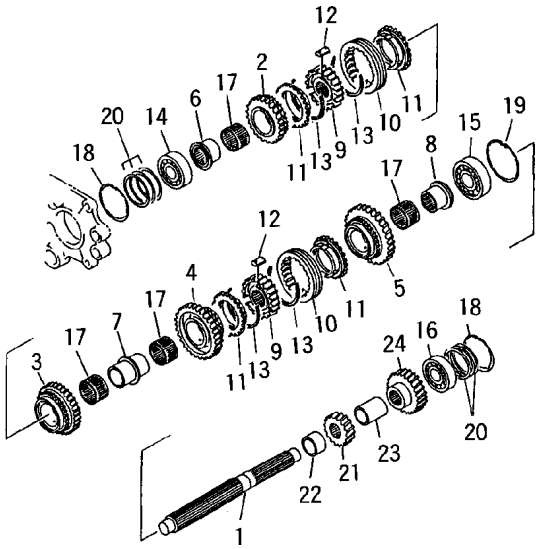
1. Drive Shaft

1) Adjust the end play at drive shaft to [0.002~0.079in.] by liner.

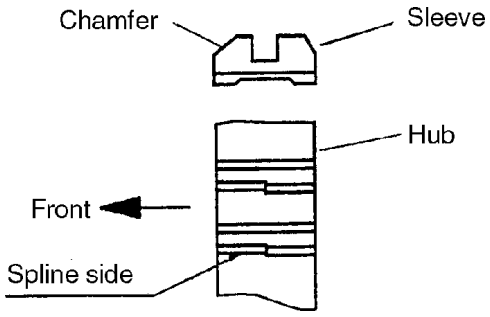


2. Select Shaft

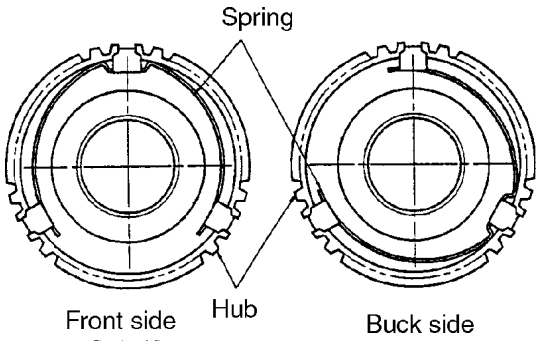
1) Adjust the end play at select shaft to [0.002~0.079in.] by liner.



2) Install the sleeve to hub that the bigger chamfer side of sleeve face to spline step side of hub.



3) Install the spring with shifting the setting position of spring between both sides of hub.



(3) COVER D REINSTALLATION

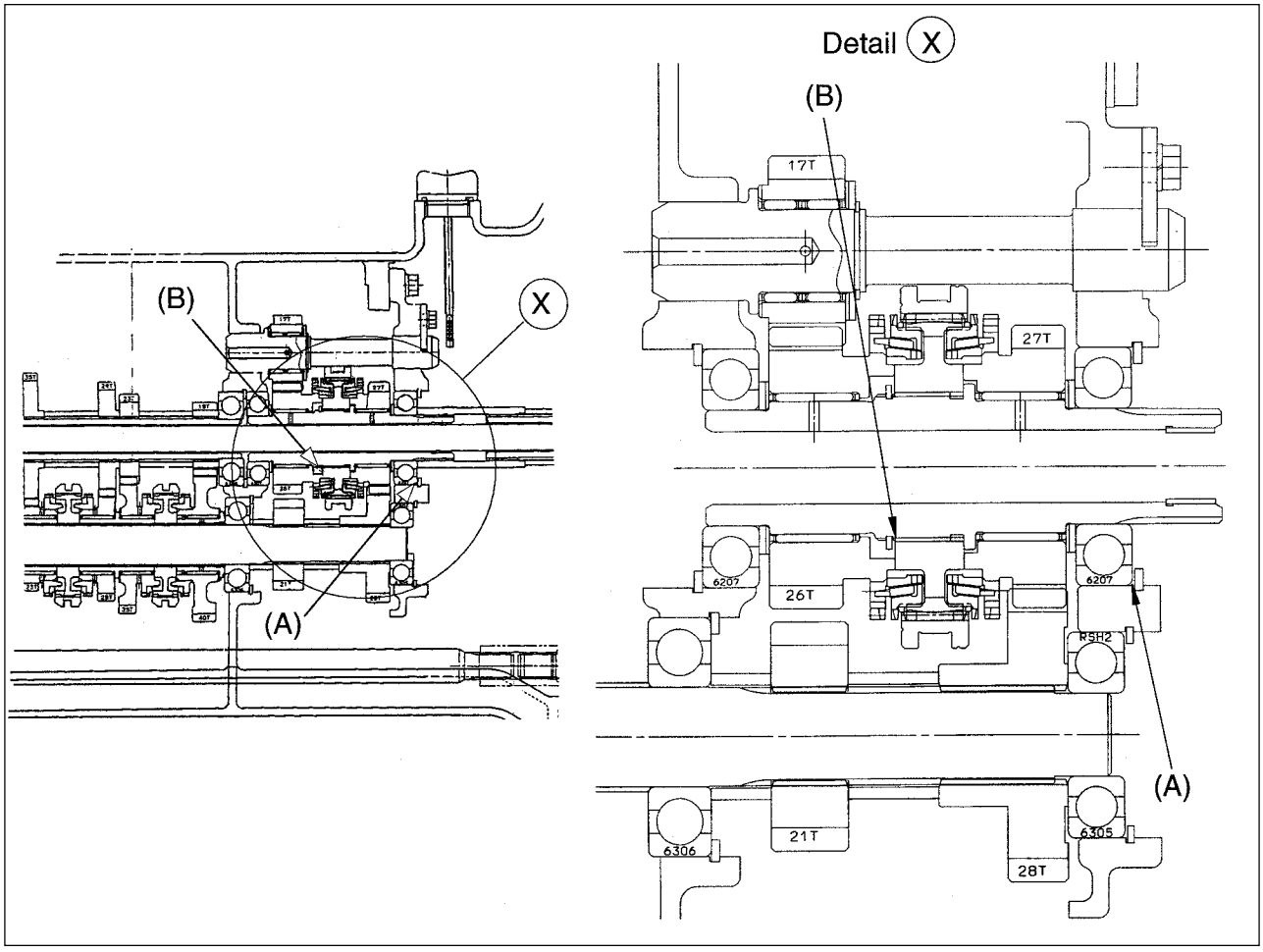
*Reinstall the cover D sub assy with reverse procedure of removal.
Use following values as adjustment and service standard for reassembling.

1. Shuttle Shaft
   1) Adjust the endplay at (A) and (B) to [0.002~0.079in.] by shim.

2. Shuttle linkage.
   Adjust the wire length. (See page 16)

(4) COVER D SUB ASSY REASSEMBLING

*Reassemble the cover D sub assy with reverse procedure of dis assembling.



6-6 TRANSMISSION CASE REASSEMBLING

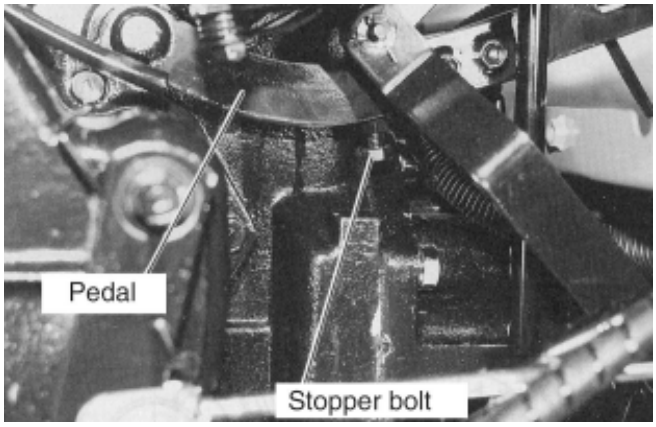
*Reassemble the transmission case with reverse procedure of disassembling.

(1) REAR DIFFERENTIAL CASE REASSEMBLING

*Reassemble the rear differential case with reverse procedure of disassembling. Use following values as adjustment and service standard for reassembling.

1. Differential lock pedal

Adjust the stopper bolt that the clearance between differential case and hub comes to [0.039~0.059in.] when pedal is fully depressed.



2. Holders

1) Adjust the backlash at ring gear and pinion gear to [0.004~0.012] by adjusting shim thickness at left holder.

2) Adjust the clearance between side of differential case assy and transmission case to [0~0.004in.] by adjusting shim thickness at right holder.

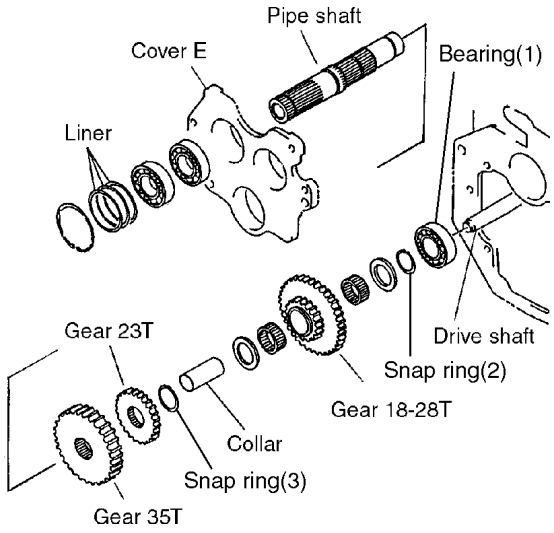
3) Lock the fixing bolts of holders by lock plate.

(2) COVER E SUB ASSY REASSEMBLING

*Reassemble the rear differential case with reverse procedure of disassembling. Use following values as adjustment and service standard for reassembling.

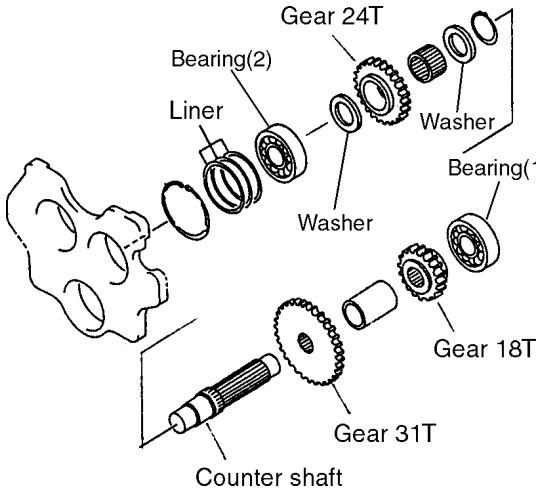
1. Drive shaft

Adjust the end play at drive shaft to be [0.002~0.0079in.] by liner.

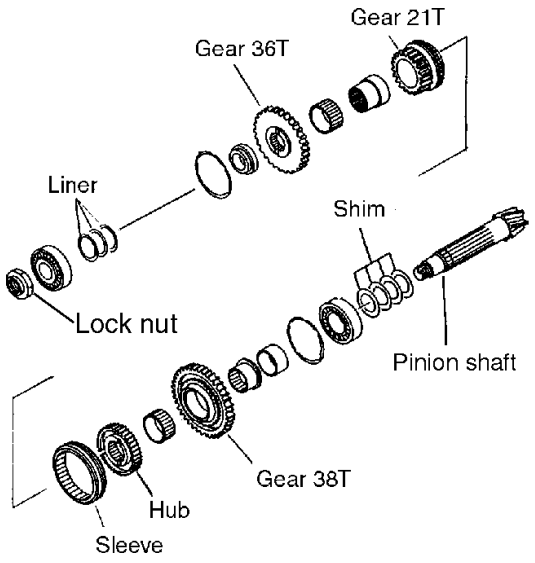


2. Counter shaft

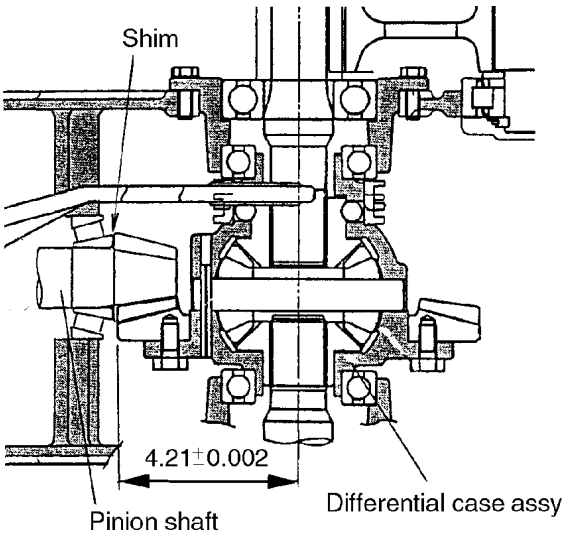
Adjust the end play at counter shaft to [0.002~0.0079in.] by liner.



3. Pinion Shaft



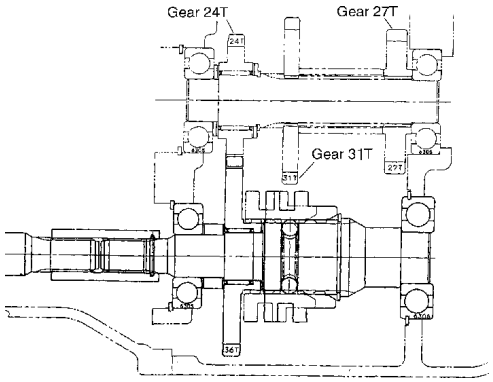
1) Adjust the distance between center of differential case and rear end of pinion gear teeth to [4.21 ± 0.002in.] by shim. (At least one [0.031in.] thickness of shim is installed at factory.) -1961 9010 000-Special Tool parts No.



2) Adjust end play at pinion shaft to [0.002~0.079 in.] by liner.

3) Adjust the pre-load at pinion shaft to [0.72~0.94 lbf•ft]by tightening the nut and calk the nut.

4. 4WD Shaft

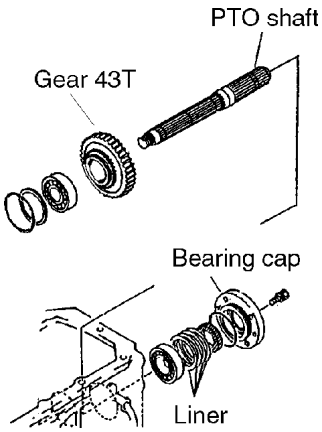


(3) PTO SHAFT REINSTALLATION

*Reinstall the PTO shaft with reverse procedure of removal. Use following values as adjustment and service standard for reinstallation.

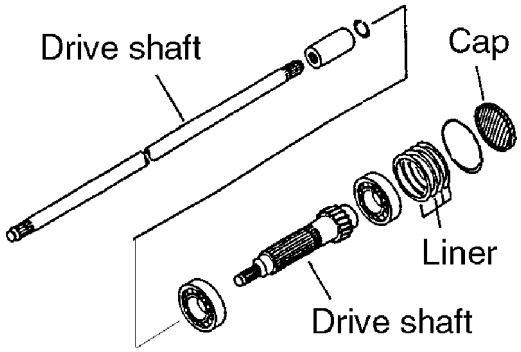
1. PTO Shaft

1) Adjust the end play at PTO shaft to [0.002~0.079 in.] by liner.



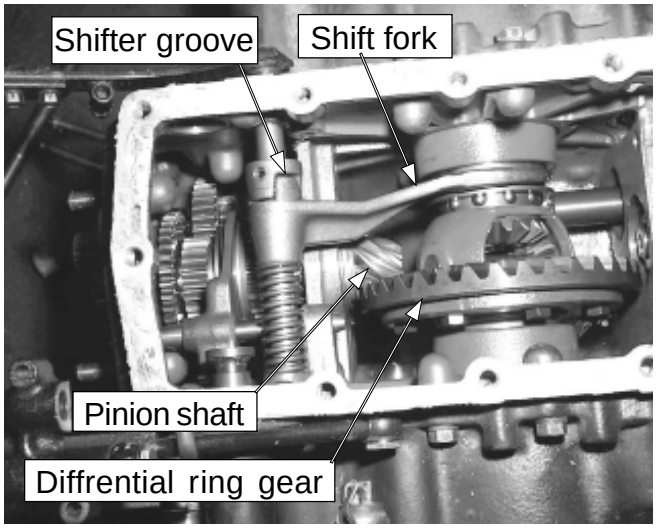
2. PTO Drive Shaft

Adjust the end play at PTO drive shaft to [0.002~0.079 in.] by liner.

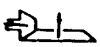


6-6 CHECK AND MAINTENANCE

(1) DIFFERENTIAL GEAR AND PINION SHAFT



1. Checking the gear contact pattern
   1) Clean the contact area of gear thoroughly and coat with Prussian blue or red lead.
   2) Rotate ring gear more than 2/3 turn to check the gear contact pattern. If contact pattern is abnormal, adjust the pinion shaft setting by shim with following the chart below.

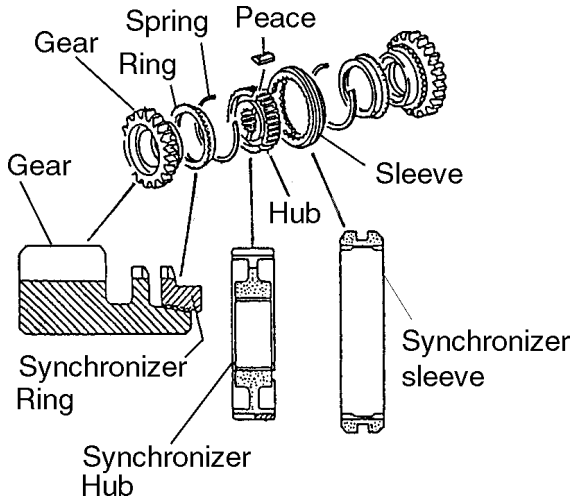
	Gear contact	Counter measure and adjustment.
Normal	 Contact is seen at about 80% of entire tooth area from tooth end, and the contact is uniform.	
Abnormal	 Contact is seen only at tooth crest.	 Bring pinion shaft closer. Adjust back-lash by moving ring gear away.
	 Contact seen only at tooth root	 Move pinion shaft away. Adjust backlash by bringing ring gear closer.
	 Contact seen only at outer end.	 Bring ring gear closer. Adjust back-lash by moving pinion shaft away
	 Contact seen only at inner end.	 Move ring gear away. Adjust backlash by bringing pinion shaft closer.

Checking the tooth contact pattern.

2. Check the backlash of differential ring gears.
   Backlash ;
   Standard value : [0.004~0.008 in.]
   Service limit : [0.012 in.]
   Replace the gear if backlash is out of service limit.

3. Check the clearance between shift fork and shifter.
   Clearance ;
   Standard value : [0.008~0.023 in.]
   Service limit : [0.039 in.]
   Replace the fork or shifter if the clearance is out of service limit.

4. Check the synchromesh gear
   1) Check the abrasion or flaw at mating surface of synchronizer ring, hub and sleeve.
   2) Check the decay of spring and abrasion of piece.

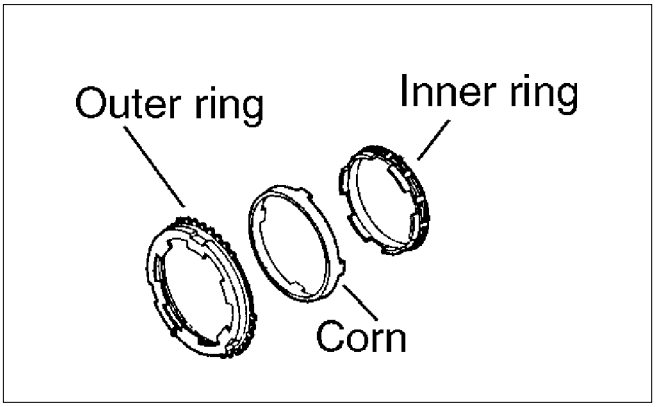


5. Check of Double cone Synchromesh

1) outer synchronizer ring ,inner synchronizer ring ,synchronizer corn

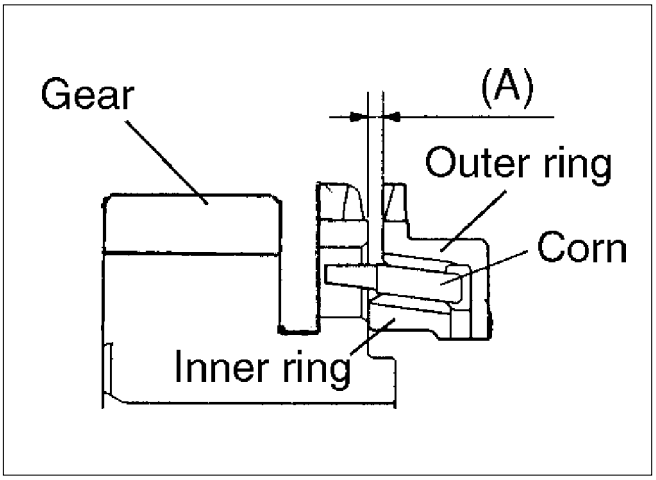
(a) Make sure there is no damage and scratch on the tooth surface of gear and cone surface.

(b) Assemble the outer ring ,innner ring and corn to the gear.
Measure the clearance “A”.
In case that clearance is out of limit, replace them.
limit : [0.197 in.]



NOTE

Replace outer ring ,inner ring and corn by set.



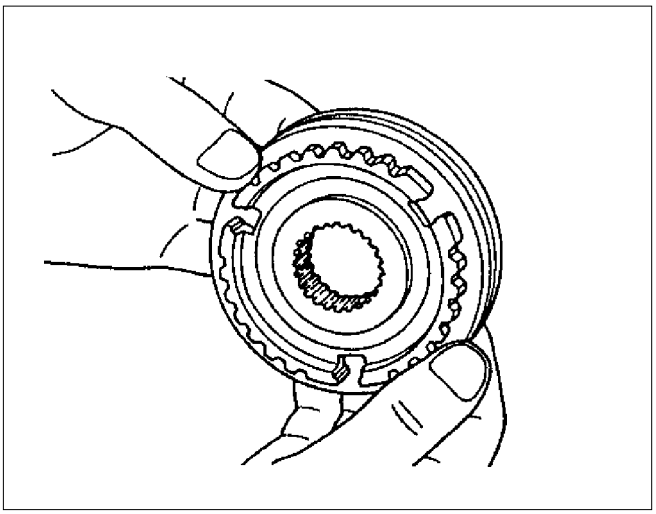
2) Synchronizer sleeve ,Hub

(a) Make sure synchronizer sleeve and hab can be slided smoothly.

(b) Make sure there is no damages on both end of sleeve.

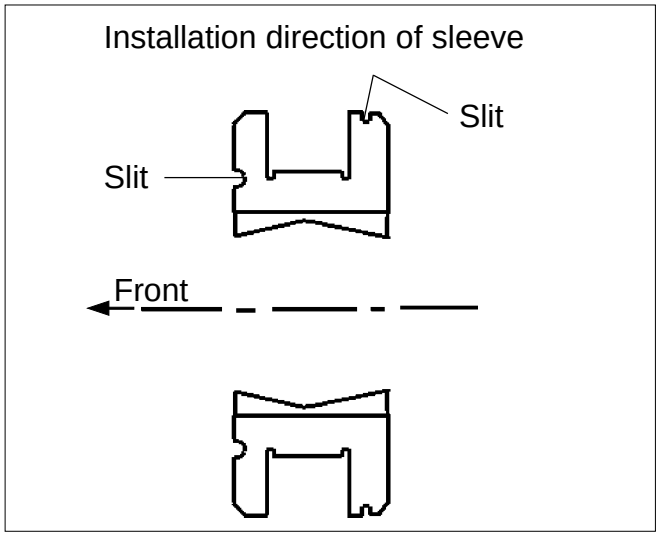
NOTE

Replace the synchronizer sleeve and hab by set.



3) Synchronizer spring

(a) Make sure there is no deformation or breakage.



6. Checking the hydraulic clutch

1) Clutch disk

Measure the clutch disk thickness and check the wear of disk. In case of the depth of groove of disk is out of service limit, replace the disk.

Depth of groove ;

Standard value : [0.0028~0.0079 in.]

Service limit : [0.0012 in.]

2) Steel plate

Check the flatness of steel plate . In case that the flatness of steel plate is out of service limit, replace the steel plate.

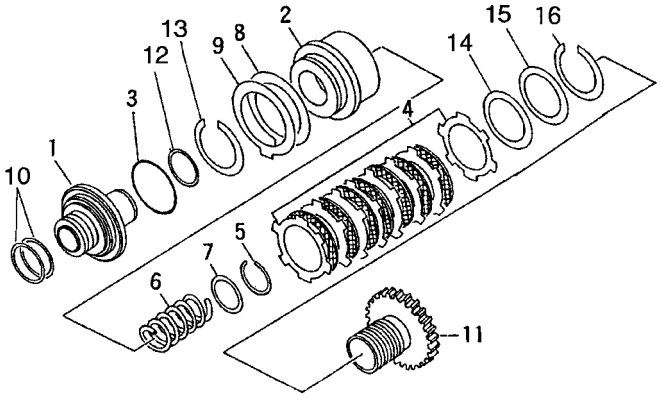
Flatness ;

Standard value : Less than [0.0059 in.]

Service limit : [0.0118 in.]

3) Piston and Seal ring

Check the wear of piston and seal ring.



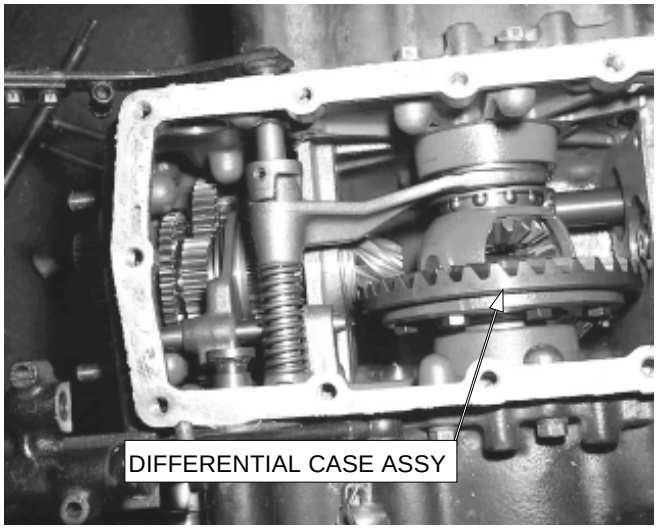
(1) Case
(2) Piston
(3) Seal ring
(4) Disk assy
(5) Ring set
(6) Spring
(7) Washer
(8) Return plate
(9) Brake disk
(10) Seal ring set
(11) Gear set 40T
(12) Seal ring
(13) Ring
(14) Back plate
(15) Belleville spring
(16) Ring

7. REAR AXLE

7-1. DIFFERENTIAL CASE ASSY DISASSEMBLING

(1) DIFFERENTIAL CASE ASSY REMOVAL

(See page 21.)



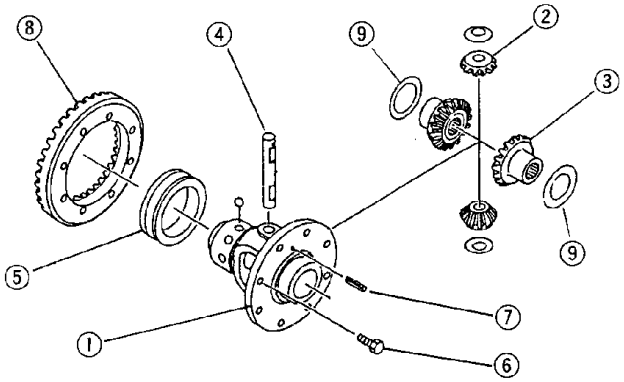
(2) DIFFERENTIAL ASSY DISASSEMBLING

1. Remove the differential lock hub (5) and steel balls.

2. Remove the fixing bolts (6) of ring gear and remove ring gear (8) from differential case.

3. Remove the spring pin (7) and remove the shaft.

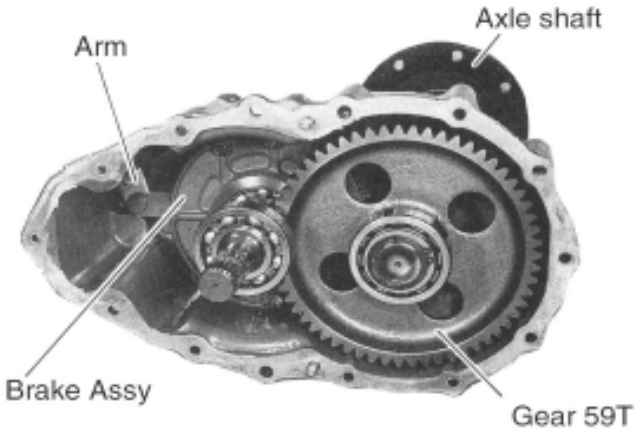
4. Remove diff. side pinion gears, diff. side gears and liners.



7-2. REAR AXLE DISASSEMBLING

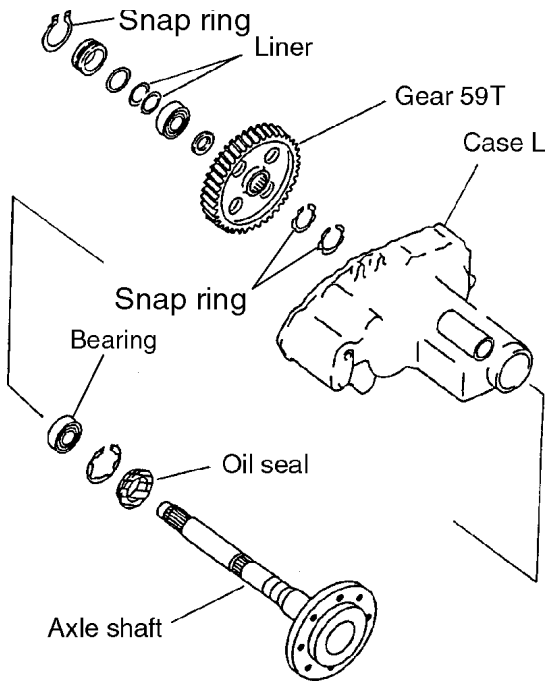
(1) REAR AXLE ASSY REMOVAL

(See page 23.)



(2) REAR AXLE ASSY DISASSEMBLING

1. Remove snap ring and remove liner, bearing and gear 59T from axle shaft. Remove snap ring, bearing and axle shaft from rear axle housing.

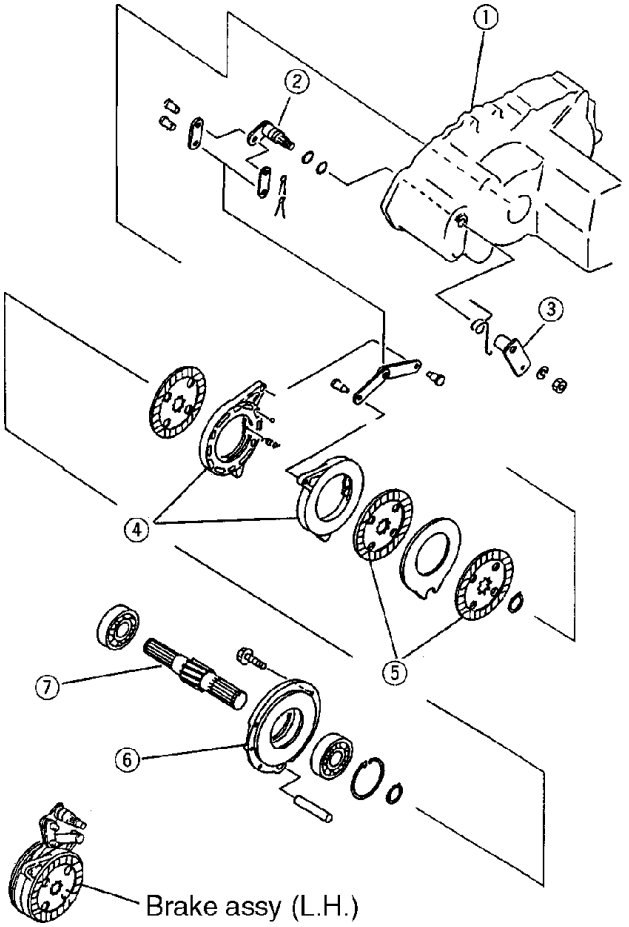


(3) BRAKE ASSY REMOVAL

1. Remove fixing bolts of holder (6).

2. Remove arm (3).

3. Remove brake Assy (4-5).



(1)CASE L.H.
(2)LEVER
(3)ARM
(4)COM PLATE
(5)BRAKE DISK
(6)HOLDER
(7)SHAFT

7-3. BRAKE CONTROL DISASSEMBLING

(1) BRAKE (LH) DISASSEMBLING

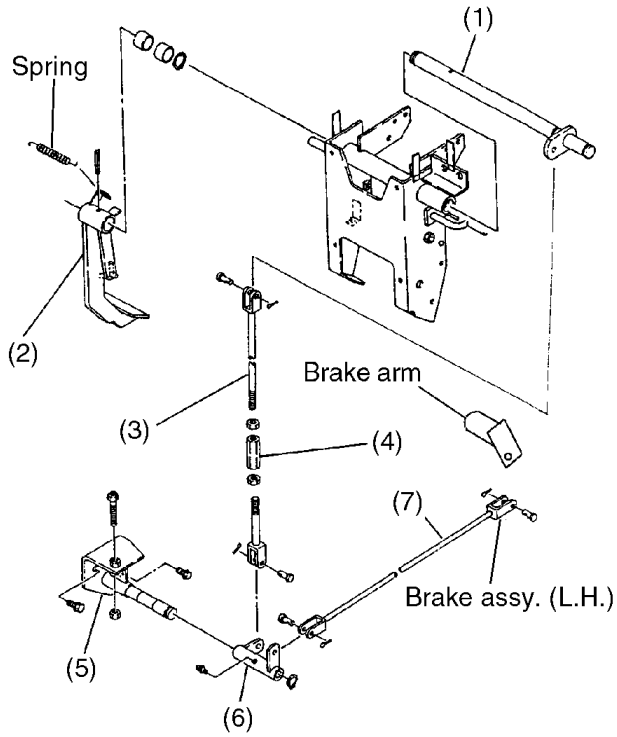
1. Disconnect the rod (7) between brake link L.H. (6) and L.H. brake arm.

2. Remove the return spring from brake pedal L.H. (2) and R.H.. Remove joint (4) to disconnect the brake rod from brake pedal L.H. (2) and brake link L.H. (6), brake pedal R.H. and brake link R.H.

3. Remove the spring pin and remove the brake pedal L.H. (2), R.H. and brake shaft (1) from bracket.

4. Remove snap ring from link shaft (5).

5. Remove fixing bolts of link shaft and remove link shaft (5).



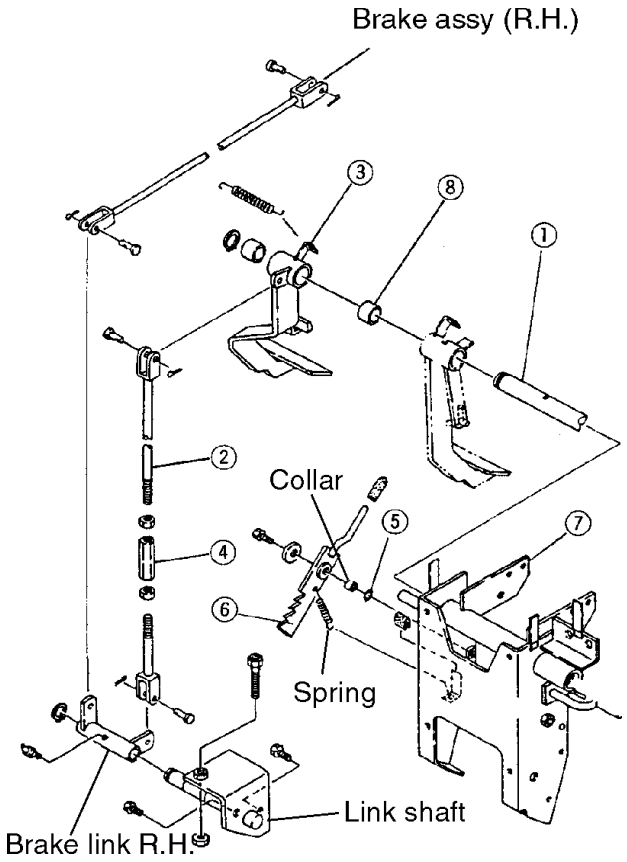
(1)BRAKE SHAFT
(2)ROD
(3)BRAKE PEDAL R.H.
(4)JOINT
(5)LINK SHAFT
(6)BRAKE LINK L.H.
(7)ROD

6. Disconnect the brake rod between brake link R.H. and R.H. brake lever.

7. Remove snap ring and remove brake link R.H. from link shaft.

8. Remove fixing bolts of link shaft and remove link shaft.

9. Remove fixing bolt of parking brake lever (6) and remove parking brake, collar and spring from bracket.



(1)BRAKE SHAFT
(2)ROD
(3)BRAKE PEDAL R.H.
(4)JOINT
(5)LINER
(6)PARKING BRAKE LEVER
(7)BRACKET
(8)BUSHING

7-4. DIFFERENTIAL CASE ASSY REASSEMBLING

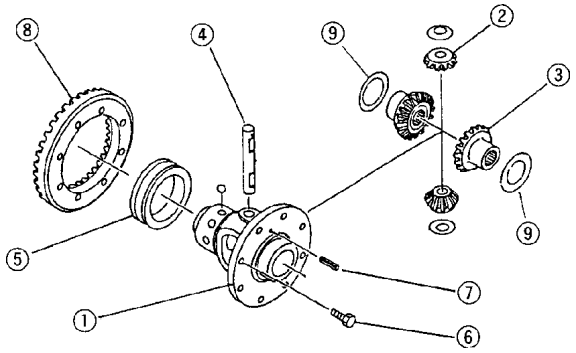
*Reassemble the differential case assy with reverse procedure of disassembling.

(1) DIFFERENTIAL CASE ASSY REASSEMBLING

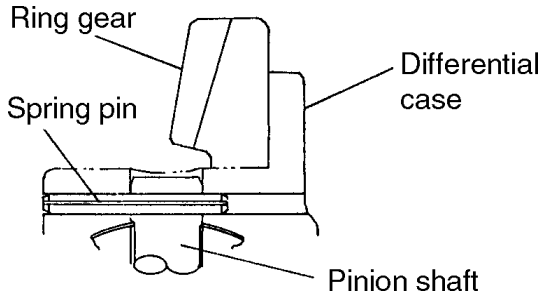
*Reassemble the differential case assy with reverse procedure of disassembling.
Use following values for reassembling of differential case assy as adjustment and service standard.

1. Adjust the backlash between diff. pinion gear and diff. side gear to [0.004~0.012 in.] by adjusting liner (9)

2. Apply bond (threebond #137) to the fixing bolts of ring gear.
Tightening torque of ring gear fixing bolts;
[30.38~36.17lbf•ft]



3. Install the spring pin in the manner that the direction of slit comes as shown below.

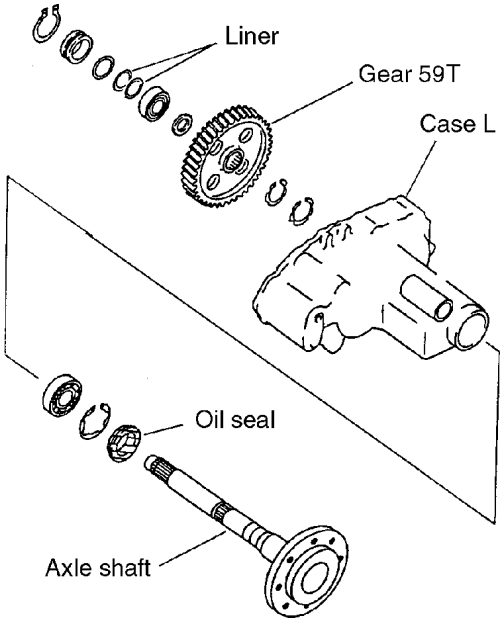


7-5. REAR AXLE REASSEMBLING

* Reassemble the rear axle with reverse procedure of disassembling.

(1) REAR AXLE REASSEMBLING

*Reassemble the rear axle with reverse procedure of disassembling. Use following values for rear axle reassembling as adjustment and service standard.



1. Apply lithium grease at lip of oil seal and install axle shaft carefully not to damage lip.

2. Make sure snap ring is completely installed in the groove.

3. Adjust the end play of axle shaft to [0.002~0.008 in.] by liner.

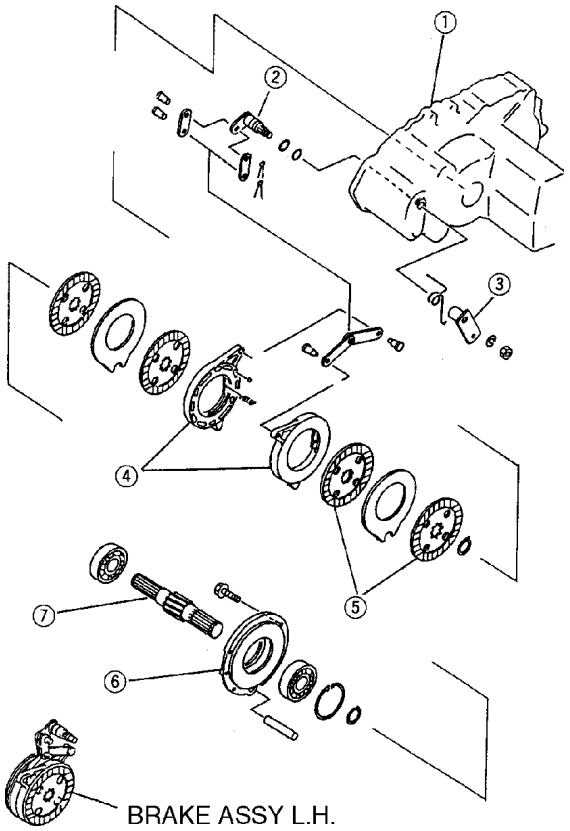
(2) BRAKE ASSY REASSEMBLING

* Reassemble the brake assy with reverse procedure of disassembling. Use following values for rear axle reassembling as adjustment and service standard.

1. Make sure that the snap ring is completely installed in the groove.

2. Pull the brake lever (3) for making sure that the brake is functioning properly.

3. Aline the hole of the two brake disks on each side when assembled. (For lubrication purpose)

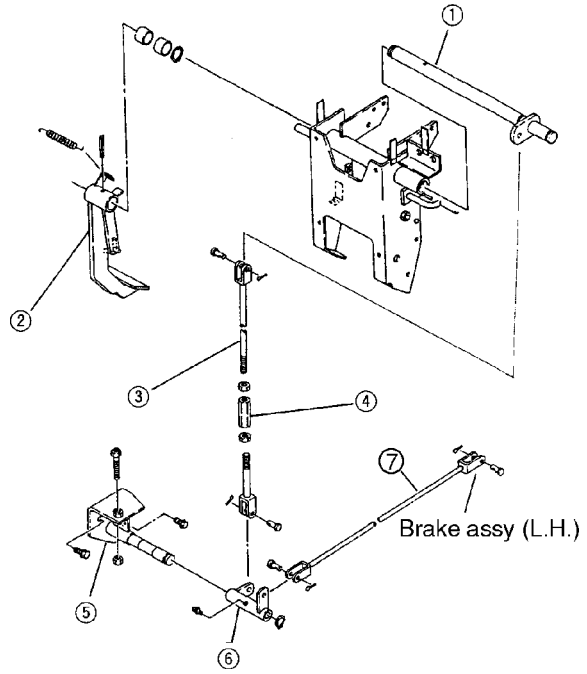


7-6. BRAKE CONTROL REASSEMBLING

*Reassemble the brake control with reverse procedure of disassembling.

(1) BRAKE L.H. REASSEMBLING

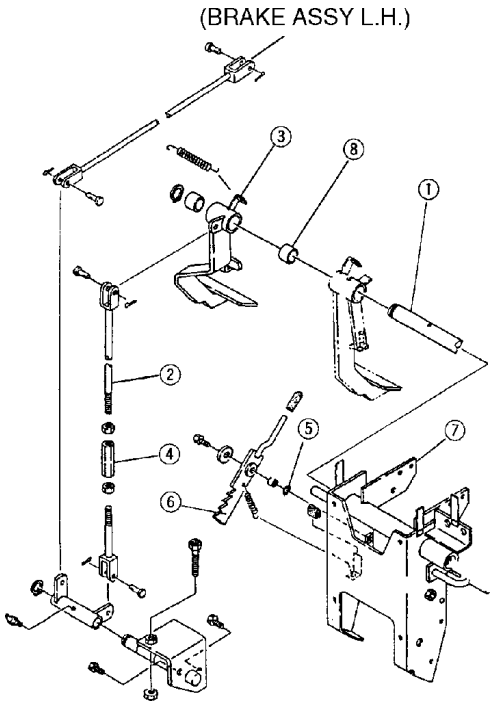
*Reassemble the brake L.H. with reverse procedure of disassembling. Use following values for rear axle reassembling as adjustment and service standard.



1. After installation of the grease nipple, fill up the chassis grease.

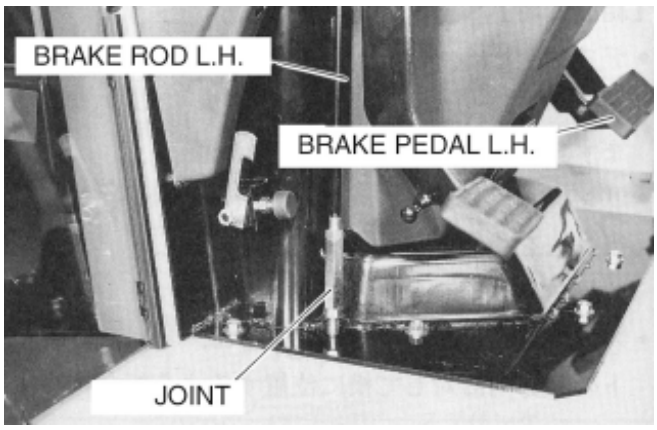
(2) BRAKE R.H. REASSEMBLING

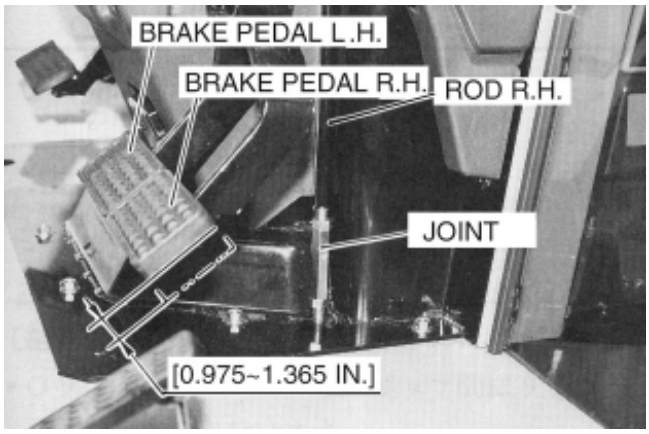
*Reassemble the brake R.H. with reverse procedure of disassembling. Use following values for rear axle reassembling as adjustment and service standard.



1. Adjust the free play of brake pedal L.H. and R.H. by joint(4). Difference of pedal height between brake pedal L.H. and R.H. must be adjusted less than [0.118 in.]

2. Adjust the clearance between bracket (7) and parking brake lever (6) to be less than [0.197 in.] by liner.





7-7. CHECK AND MAINTENANCE

(1) BACKLASH

1. Check the backlash at differential case assy] and side clearance. In case that the values are out of the following standard, adjust them.

Item	Standard (in.)
Backlash at differential case assy	0.004~0.015
Side clearance at differential case assy	0~0.004
Backlash between diff. ring gear and pinion shaft	0.004~0.012

2. Check the backlash between diff. shaft and final gear 59T. In case that the backlash is out of following standard, replace them.

Item	Standard (in.)	Service limit(in.)
Backlash between final gear and diff.shaft	0.004~0.012	0.02

(2) BRAKE DISK

1. Check the worn out of brake disks. In case that the measurement value is out of standard, replace the disks.

Item	Standard (in.)	Service limit (in.)
Thickness of brake disk	0.134	0.126

(3) BRAKE PEDAL

1. Check the clearance between inner diameter of bushing on brake pedal R.H. and outer diameter of brake shaft. In case that the clearance is out of service limit, replace the bushing.

Item	Standard(in.)	Service limit(in.)
Clearance between inner diameter of bushing and outer diameter of shaft	0.0016~ 0.0047	0.197

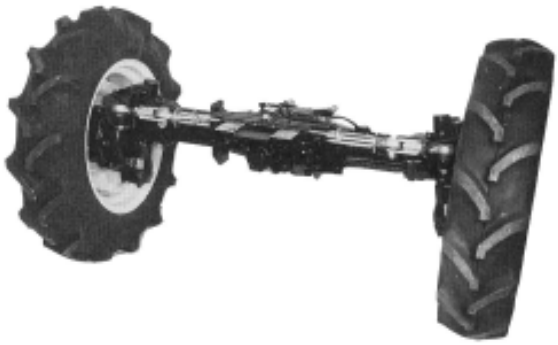
8. FRONT AXLE

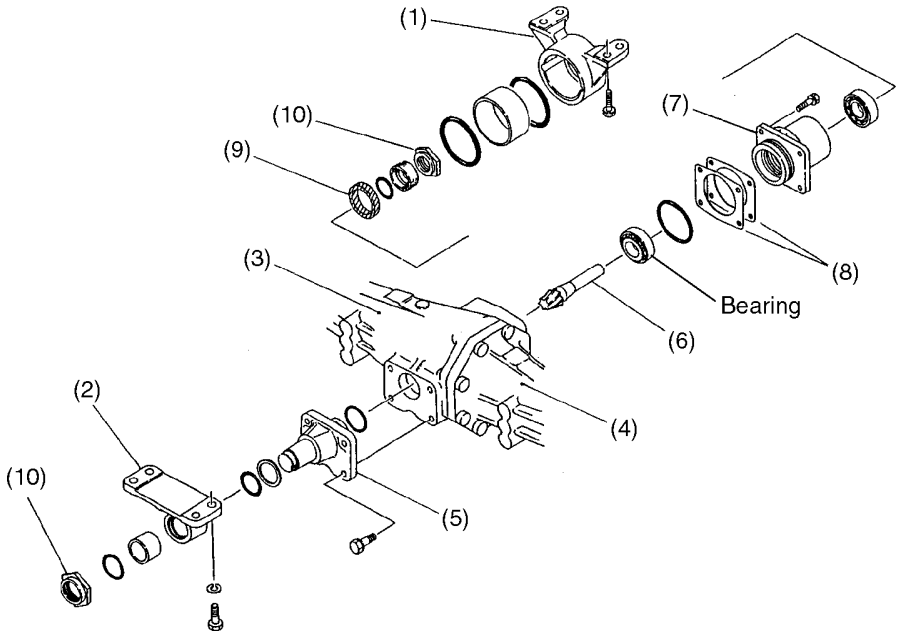
8-1. FRONT AXLE REMOVAL

(1) FRONT AXLE REMOVAL

See page 13.

(2) HOLDER ASSY DISASSEMBLING





(1)REAR BRACKET
(2)FRONT BRACKET
(3)CENTER CASE R.H.
(4)CENTER CASE L.H.
(5)HOLDER
(6)PINION SHAFT
(7)BEARING CASE
(8)SHIM
(9)OIL SEAL
(10)NUT

1. Remove rear bracket (1) from front axle assy.

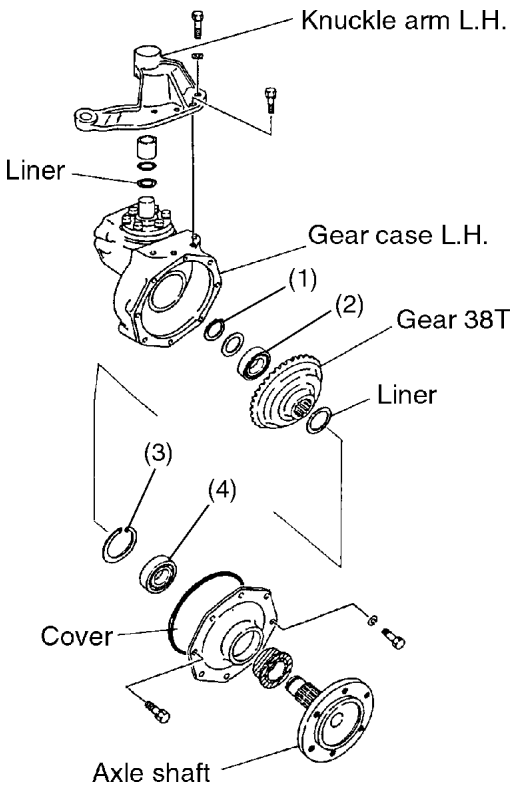
2. Remove fixing bolts of bearing case (7) and remove bearing case from front axle assy.

3. Remove nut (10) and remove pinion shaft(6), bearing, oil seal (9) , collar and shims (8) from bearing case (7).

4. Remove nut (10) and remove front bracket (2).

5. Remove fixing bolts of holder (5) and remove holder(5).

(3) KNUCKLE ARM, FINAL CASE DISASSEMBLING

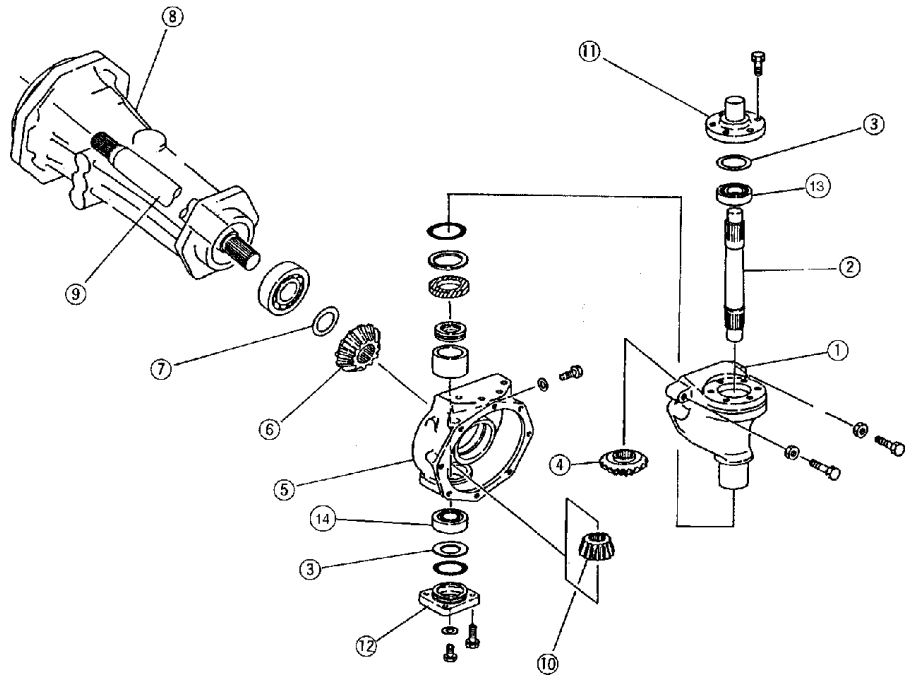


1. Remove fixing bolts of knuckle arm and remove knuckle arm from gear case.

2. Remove fixing bolts of cover and remove cover from gear case.
3. Remove snap ring (1) and remove bearing (2), gear 38T, liner and axle shaft from cover.

4. Remove snap ring (3) and bearing (4) from cover.

(4) KING PIN CASE DISASSEMBLING



(1)KING PIN CASE
(2)KING PIN SHAFT
(3)LINER
(4)GEAR 18T
(5)GEAR CASE L.H.
(6)GEAR 14T
(7)LINER
(8)CENTER CASE L.H.
(9)DIFFERENTIAL SHAFT
(10)GEAR 13T
(11)ARM HOLDER
(12)COVER
(13)BEARING
(14)BEARING

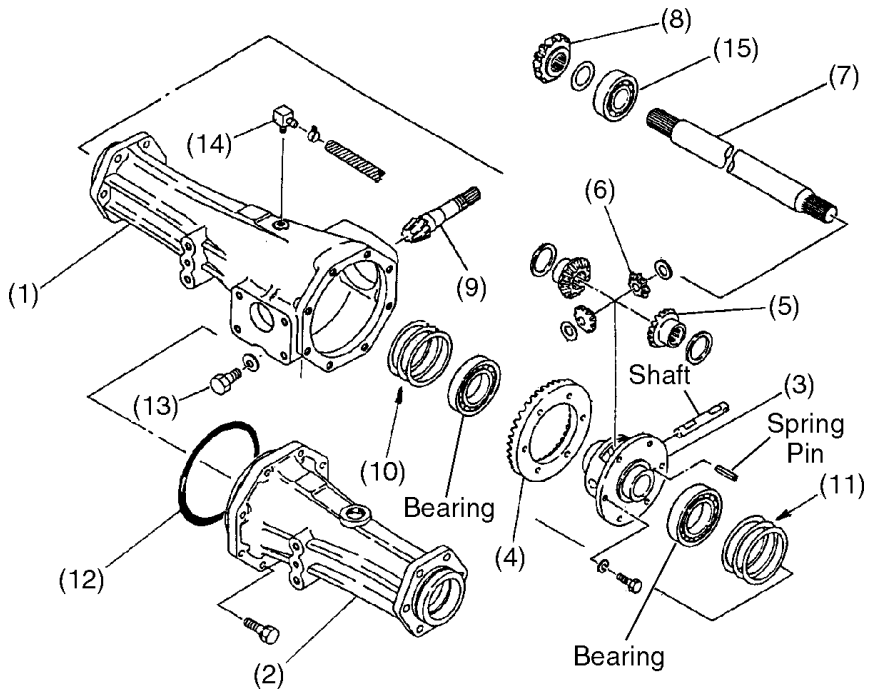
1. Remove fixing bolts of king pin case assy and remove king pin case assy .

2. Remove fixing bolts of arm holder (11) and remove arm holder (11) from king pin case (1).

3. Remove fixing bolts of cover (12) and remove cover (12) from king pin case (1).

4. Remove king pin shaft (2), liners (3), bearings (13),(14),gear 18T and gear 13T from king pin case (1).

(3) CENTER CASE, DIFF. CASE DISASSEMBLING



(1)CENTER CASE R.H.
(2)CENTER CASE L.H.
(3)DIFFERENTIAL CASE
(4)RING GEAR
(5)SIDE GEAR
(6)PINION
(7)DIFFERENTIAL SHAFT
(8)GEAR 14T
(9)PINION SHAFT
(10)LINER
(11)LINER
(12)O-RING
(13)DRAIN PLUG
(14)JOINT
(15)BEARING DIFFERENTIAL CASE

1. Remove gear 14T (8) , bearing (15) and diff. shaft (7).

2. Remove fixing bolts of center case L.H. (2) and R.H. (1) and divide center case L.H. and R.H..

3. Remove diff. case assy from center case R.H. (1).

4. Disassemble diff. case assy.
   1) Remove bearings from diff. case.
   2) Remove fixing bolts of ring gear (4) and remove ring gear from diff. case (3).
   3) Remove spring pin and remove shaft, pinions (6), side gears (5) and liners from diff. case.

8-2. FRONT AXLE REASSEMBLING

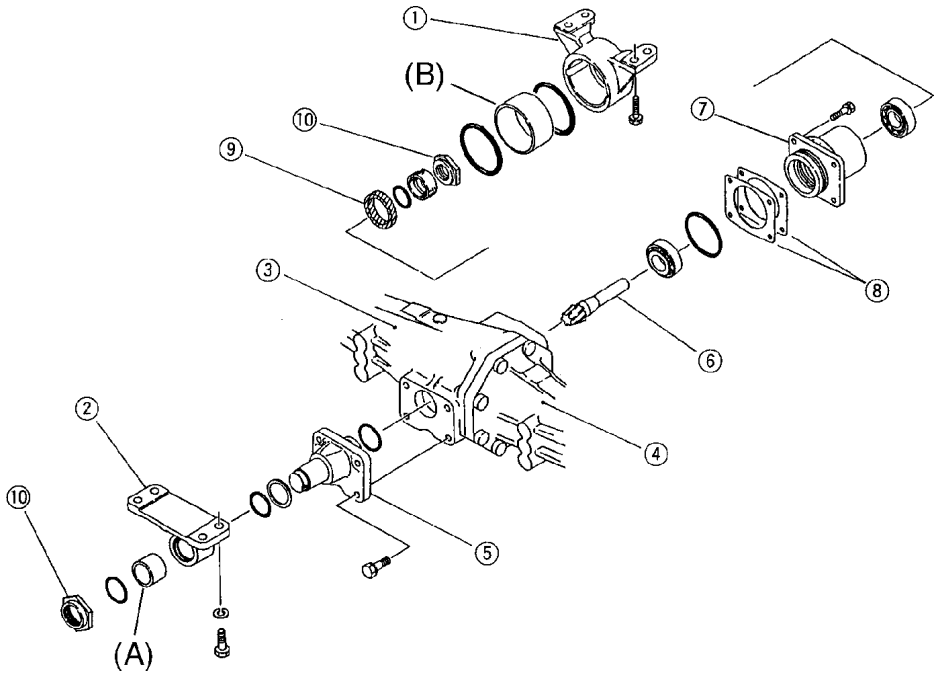
*Reassemble front axle with reverse procedure of disassembling.

(1) FRONT AXLE ASSEMBLY

*Reassemble holder assy with reverse procedure of disassembling.

*Special tool for bushing (A) and (B) insullation.

Parts number MA-19619032000 for (A)
MA-19619031000 for (B)



(1)REAR BRACKET
(2)FRONT BRACKET
(3)CENTER CASE R.H.
(4)CENTER CASE L.H.
(5)HOLDER
(6)PINION SHAFT
(7)BEARING CASE
(8)SHIM
(9)OIL SEAL
(10)NUT

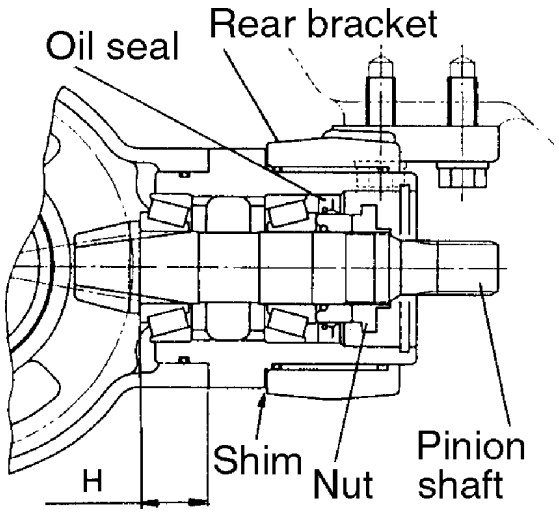
*Use following values for adjustment and service standard of reassembling.

1. Apply the lithium grease to o-rings for assembling.

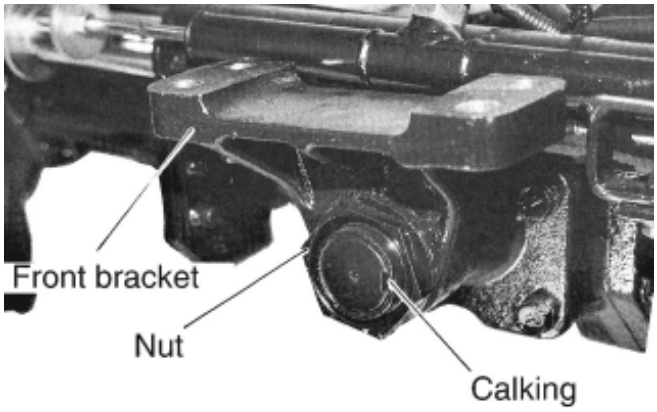
2. Adjust the turning torque of pinion shaft to [6.51~8.68 lbf•ft] by tightening the nut.

3. Select the shim by calculating the shim thickness as follows and install between axle center case and holder.

Shim thickness = H - 28

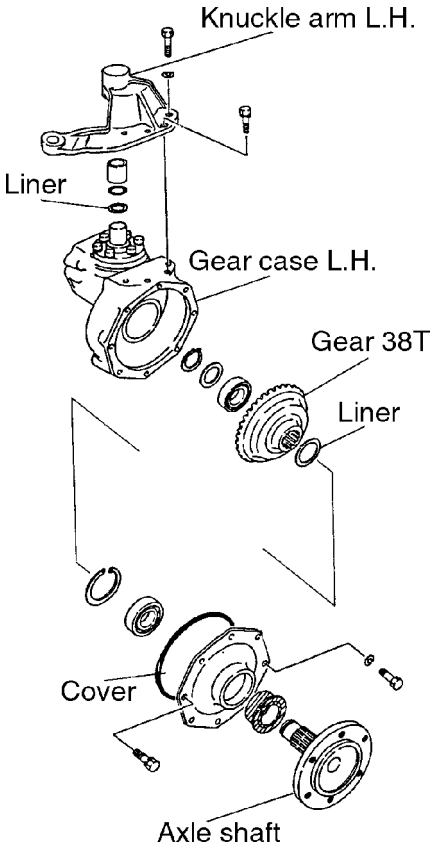


3. Tighten the nut until no play is produced but bracket can be turned lightly.



(2) KNUCLE ARM AND FINAL CASE REASSEMBLING

*Reassemble knuckle arm and final case with reverse procedure of disassembling.

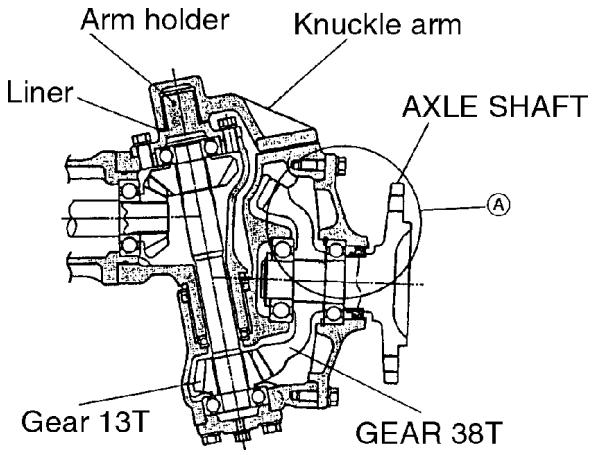


Use following values for reassembling of knuckle arm and final case as adjustment and service standard.

1. Apply lithium grease to o-ring and lip of oil seal for assembling.

2. Apply liquid packing (threebond #1208D) to installation surface of arm holder (*marked).

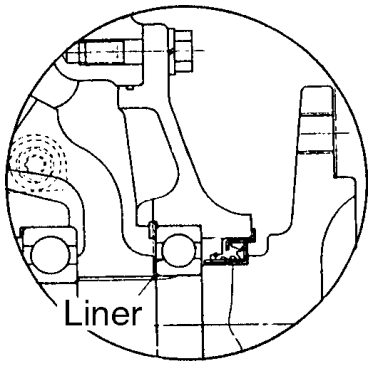
3. Select the liner that the clearance between arm holder and knuckle arm to be [0.002~0.008 in.].



NOTE

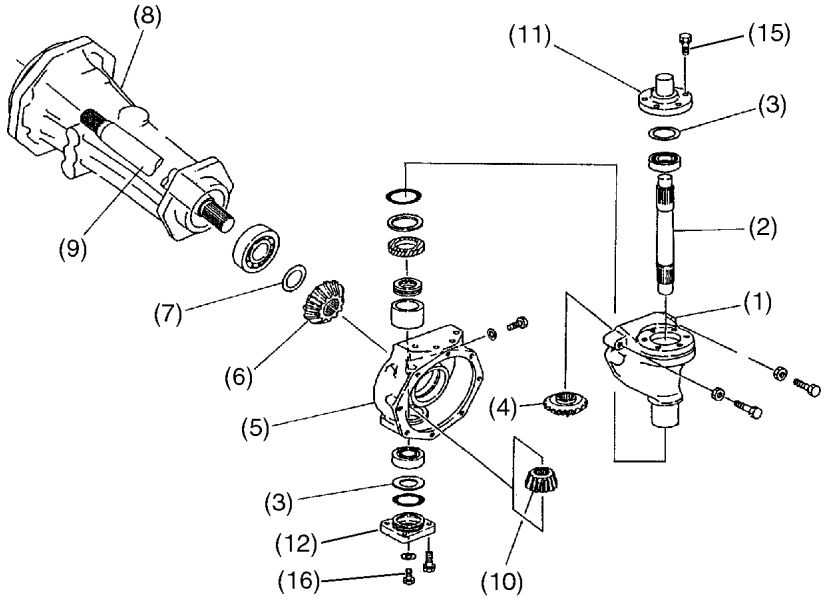
Fill the grease at pivot of knuckle arm.

4. Adjust backlash between gear 13T and gear 38T to [0.008~0.016 in] by liner.



(3) KING PIN CASE REASSEMBLING

*Reassemble king pin case with reverse procedure of disassembling.



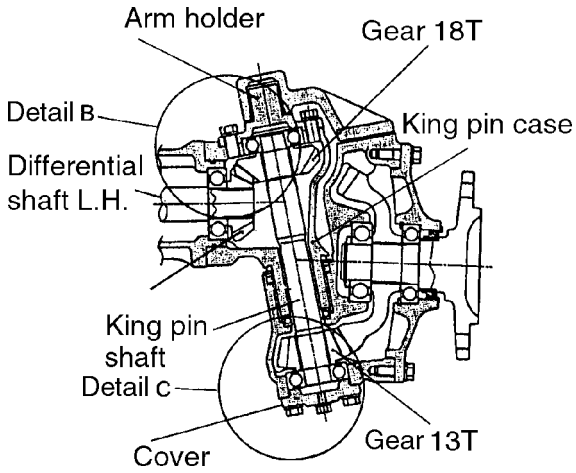
Use following values for reassembling of king pin case as adjustment and service standard.

1. Apply lithium grease at o-ring and oil seal.

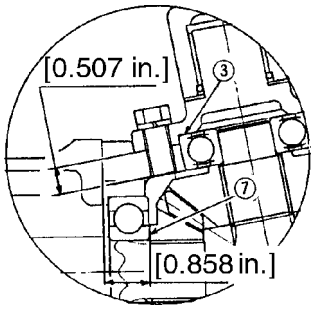
2. Wind seal tape to fixing bolts (15) of arm holder.

3. Tightening torque of plug (16). [8.68~12.3lbf•ft]

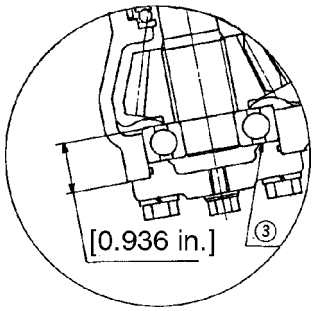
4. King pin case assembling
   Adjust the dimensions as shown in the drawing by liner (3).



DETAIL B



DETAIL C

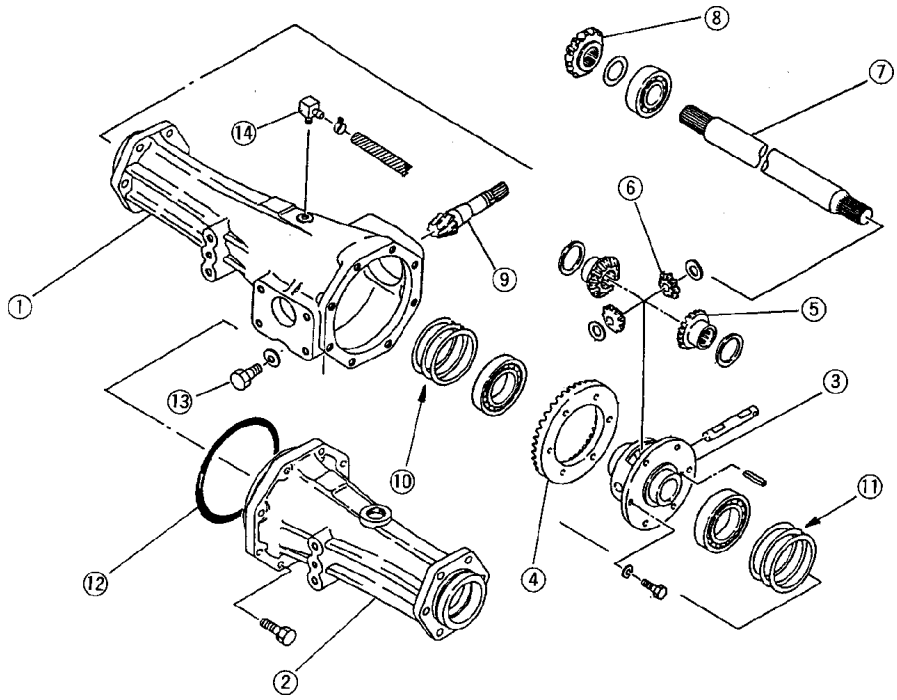


5. Adjust backlash between gear 14T and gear 18T to [0.0078~0.0157 in.] by liner (7).

(4) CENTER CASE AND DIFF. CASE

REASSEMBLING

*Reassemble center case and diff. case with reverse procedure of disassembling.



(1)CENTER CASE R.H.
(2)CENTER CASE L.H.
(3)DIFFERENTIAL CASE
(4)RING GEAR
(5)SIDE GEAR
(6)PINION
(7)DIFFERENTIAL SHAFT
(8)GEAR 14T
(9)PINION SHAFT
(10)LINER
(11)LINER
(12)O-RING
(13)DRAIN PLUG
(14)JOINT

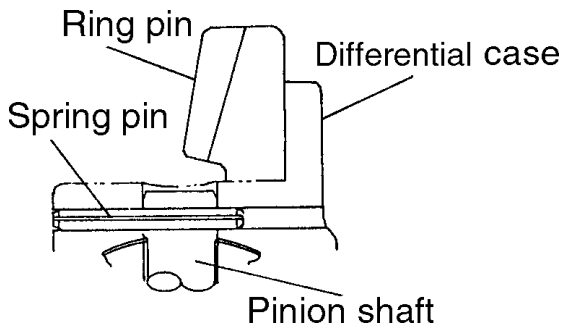
Use following value for reassembling of center case and diff. case as adjustment and service standard.

1. Apply lithium grease to o-ring.

2. Tightening torque of drain plug (13).
[28.93~57.86 in.]

3. Diff. case assy assembling
1) Make sure the backlash between pinion and side gear is in the range of [0.0004~0.0118in.]
2) Apply threebond #1374 to tightening torque of ring gear fixing bolts. Tightening torque of ring gear fixing bolts is; [50.63~57.86 in.]

3) Install the spring pin with direction as shown below.

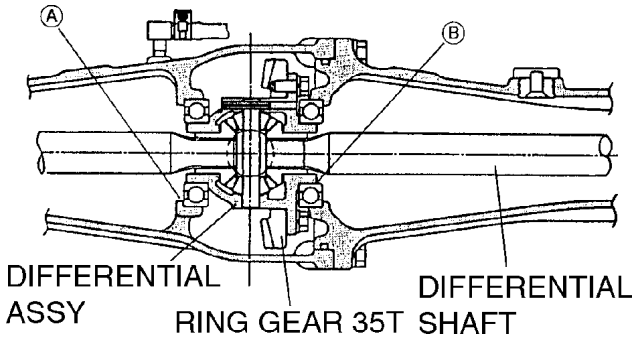


4) Apply heat resistant grease sliding surface.

4. Diff. case installation

1) Adjust the backlash between ring gear and pinion shaft to [0.0098~0.0138 in.] by liner at (A).

2) Adjust end play of diff. case assy to [0~0.004 in.] by liner at (B).



8-3. FRONT AXLE CHECK AND MAINTENANCE

(1) BACKLASH

1. Check the backlash of diff. case assy and end play. In case that the measurement value is out of standard, readjust it.

Item	Standard value (in.)
Backlash of side gear and pinion	0.004~0.012
End play of diff. assy	0~0.004
Backlash between pinion shaft and ring gear	0.0098~ 0.0138

2. Check the backlash of bevel gears. In case that the backlash is out of standard, readjust it.

Item	Standard value (in.)
Backlash between bevel gear14T and 18T	0.008~0.0157
Backlash between bevel gear 13T and 38T	0.008~0.0157

(2) CLEARANCE AT BUSHING

1. Check the clearance between front bracket / rear bracket and bushing. In case that the clearance is out of service limit, replace the bushing.

Item	Standard value(in.)	Service limit (in.)
Clearance between holder and front bracket	0.0012~0.0026	0.0008
Clearance between case and rear bracket bushing	0.0012~0.0032	0.0008

2. Check the clearance at bushing of final gear case L.H./R.H.. In case that the clearance is out of service limit, replace the bushing.

Item	Standard value(in.)	Service limit(in.)
Clearance between king pin case and bushing	0.00118 ~0.00315	0.0079

(3) CLEARANCE BETWEEN KNUCKLE ARM HOLDER AND BUSHING

1. Check the clearance between knuckle arm holder and bushing. In case that the clearance is out of service standard,replace it.

Item	Standard value(in.)	Service limit(in.)
Clearance between holder and bushing	0.00118~ 0.00236	0.0079

(4) CLEARANCE BETWEEN HOLDER AND KNUCKLE ARM

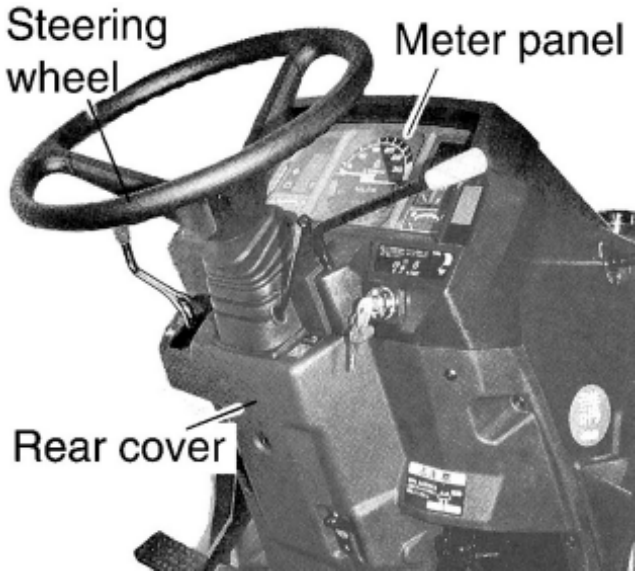
Check the clearance between holder and knuckle arm. In case that the clearance is out of standard value, adjust it by liner.

Item	Standard value (in.)
Clearance between holder and knuckle arm	0.00197~ 0.00787

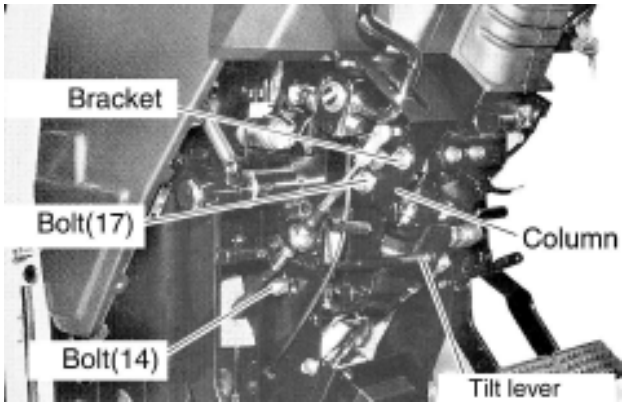
9. STEERING

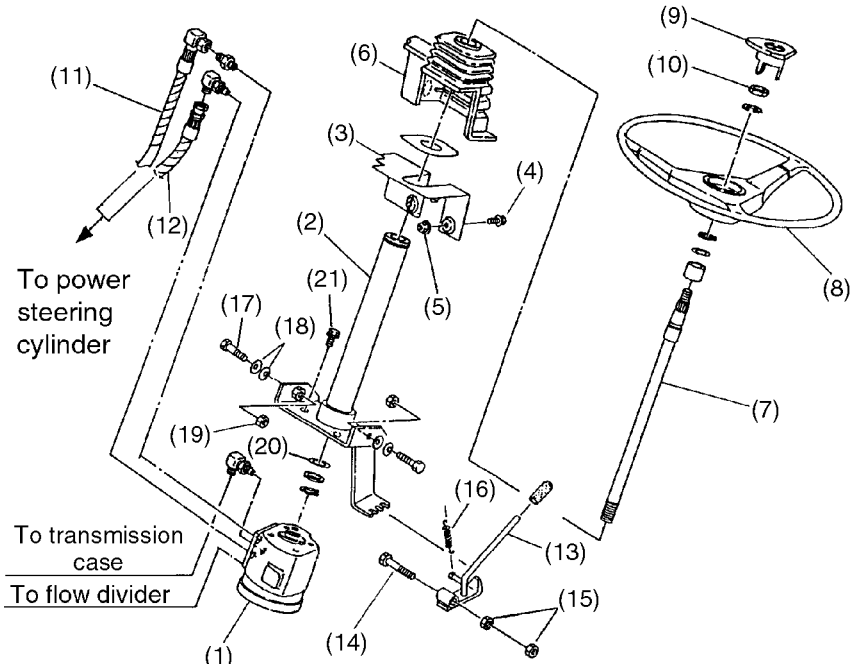
9-1. OPERATOR CONTROL AREA REMOVAL

(1) STEERING WHEEL REMOVAL



1) Remove fixing screws of rear cover and remove rear cover.
2) Remove fixing bolts (4) and nuts (5) of plate (3).
3) Disconnect the wire of engine control lever and shuttle lever.
4) Remove fixing bolts of bracket and remove bracket and levers.
5) Remove lock nut (18),column fixing bolts (17) , disk spring (18) (Bothsides) and column (2) .
6) Remove spring (16), lock nut (15) , tilt lever fixing bolt (14) and tilt lever (13).
7) Remove hose L (11), R (12), P and return hose from steering unit.





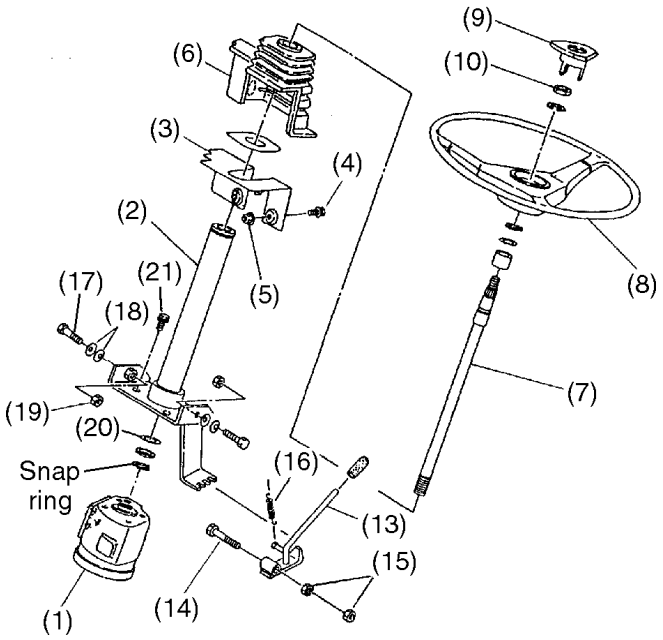
(1)STEERING UNIT
(2)COLUMN
(3)PLATE
(4)BOLT
(5)NUT
(6)BOOT
(7)SHAFT
(8)STEERING WHEEL
(9)CENTER PAD
(10)NUT
(11)HOSE L (RED TAPE)
(12)HOSE R
(13)TILT LEVER
(14)BOLT
(15)NUT
(16)SPRING
(17)BOLT
(18)DISK SPRING
(19)NUT
(20)LINER
(21)BOLT

(2) STEERING WHEEL DISASSEMBLING

1. Remove steering unit fixing bolts and remove steering unit (1) from column.

2. Remove cap (9) , nut (10) and washer and remove steering wheel (8) from shaft (7).

3. Remove boot (6) with plate (3) and remove snap ring , liner (20) and shaft (7) from column (2).

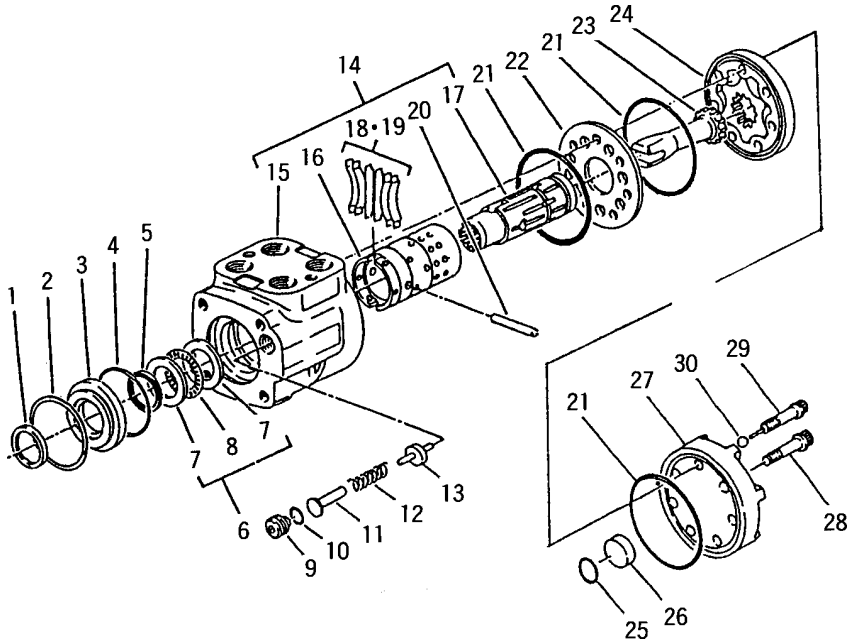


9-2. STEERING UNIT DISASSEMBLING

(1) STEERING UNIT REMOVAL

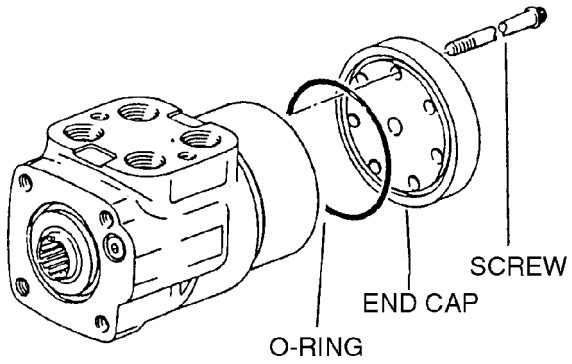
Remove steering unit fixing bolt and remove steering unit from column.

(2) STEERING UNIT DISASSEMBLING

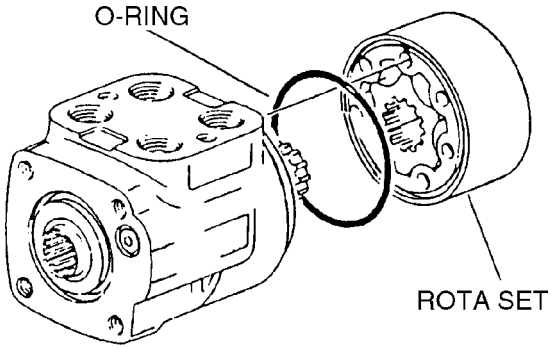


(1)DUST SEAL
(2)RETAINING NUT
(3)SEAL GRAND BUSHING
(4)O-RING
(5)OIL SEAL (X-RING)
(6)NEEDLE BEARING KIT
(7)RELEASE BEARING
(8)THRUST NEEDLE
(9)RELIEF VALVE ADJUSTER
(10)O-RING
(11)COLER
(12)SPRING
(13)POPPET
(14)CONTROL PARTS ASSY
(15)HOUSING
(16)CONTROL SLEEVE
(17)CONTROL SLEEVE
(18)FLAT SPRING
(19)CENTERING SPRING
(20)PIN
(21)O-RING
(22)SPACER
(23)DRIVE
(24)ROTA SET
(25)O-RING
(26)SPACER
(27)END CAP
(28)RETAINER SCREW
(29)CHECK VALVE RETAINER SCREW
(30)BALL

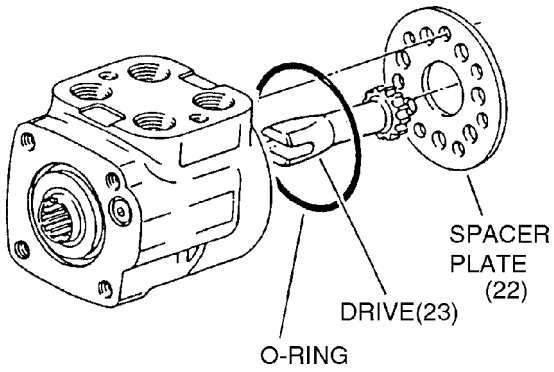
1. Rotary disassembling
   1) Remove screw 28 (6 pieces), retainer screw 29 (1 piece) and end cap (27).
   2) Remove o-ring (21) from end cap (27).



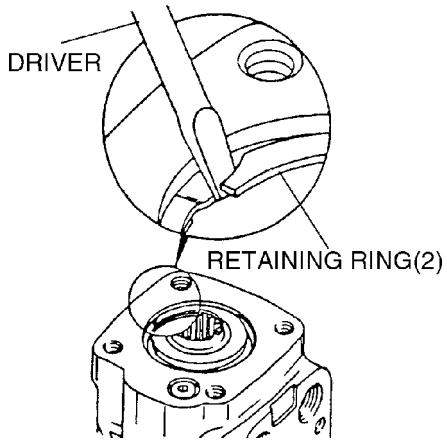
2. Remove rota set (24) and o-ring (21)



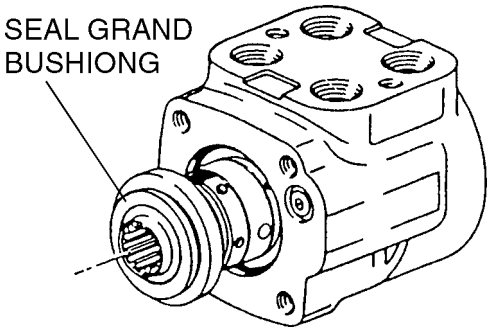
3. Remove drive (23) and spacer plate (22).
4. Remove o-ring from housing.



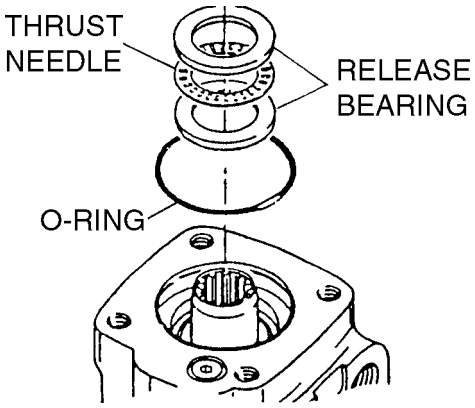
2. Controls disassembling
   1) Remove retaining ring (2) from housing.



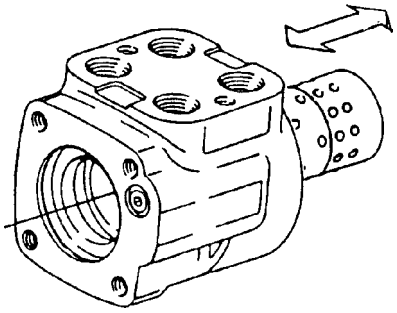
   2) Turn spool (17) and sleeve (16) until pin (20) comes to horizontal. Push spool (17) and sleeve (16) and remove seal grand bushing (3) from housing.



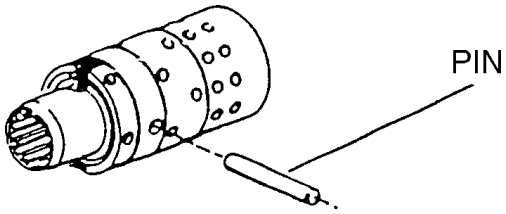
   3) Remove release bearing (7) and thrust needle (8) from spool (17) and sleeve(16) .



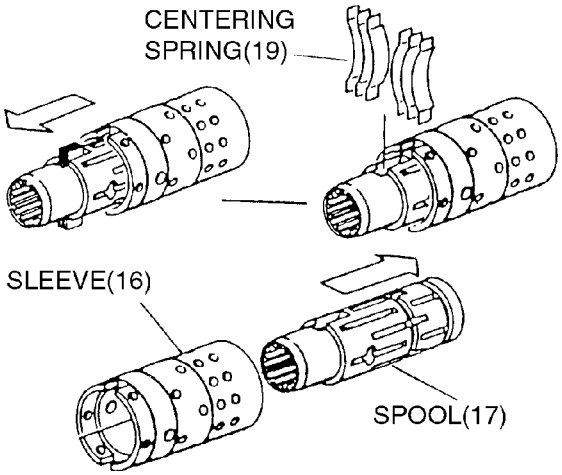
4) Pull out spool(17)and sleeve(16)from housing.
(Pull them out to opposite side of flange.)



5) Remove pin (20) from spool (17) and sleeve (16) assy.



6) Push spool in the sleeve slightly as shown and remove centering springs (19) (6 pieces) from spool.
Remove spool (17) from sleeve (16) by pulling to opposite direction of centering spring (19) removal.



CAUTION

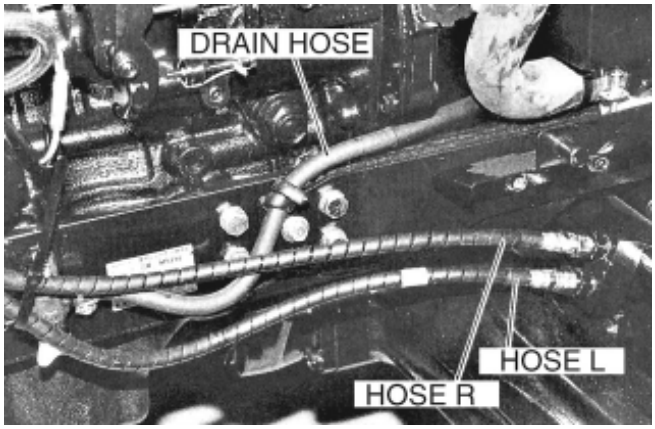
Do not disassemble or adjust the adjust plug for relief pressure setting at dealer.

9-3 HYDRAULIC CYLINDER DISASSEMBLING

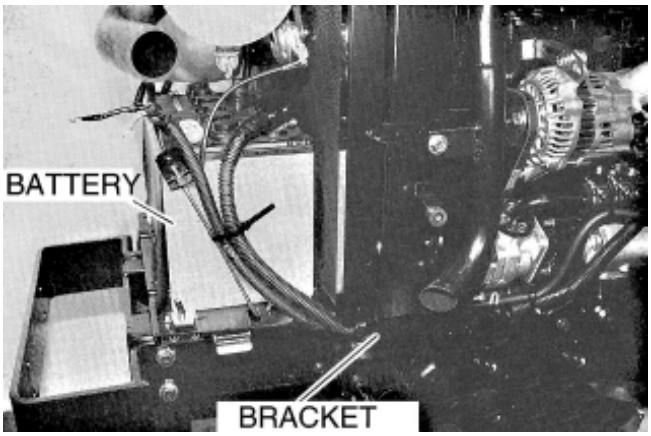
(1) HYDRAULIC CYLINDER ASSY REMOVAL

1. Remove hydraulic hoses (2 hoses) from hydraulic cylinder.

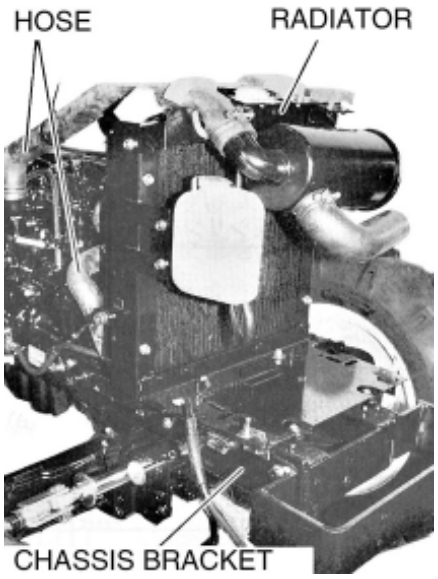
2. Drain coolant from radiator and remove radiator drain hose.



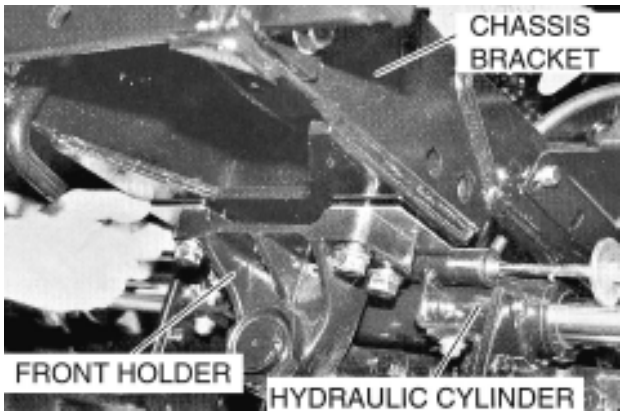
3. Disconnect battery negative code and positive code. Remove battery.



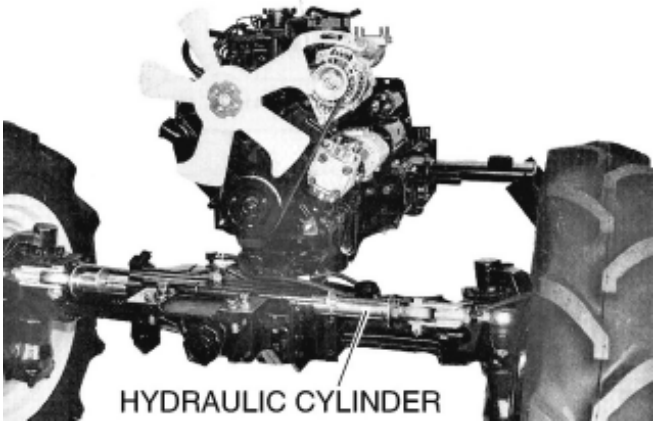
4. Remove radiator hoses and air cleaner hose from engine.



5. Remove fixing bolts of front holder.



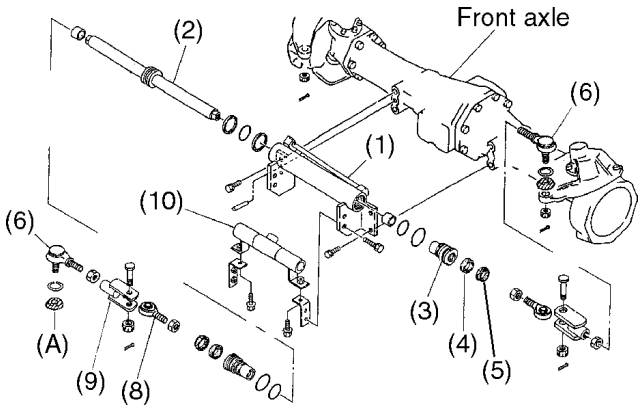
6. Remove chassis and radiator.
7. Remove hydraulic cylinder assy.



(2) HYDRAULIC CYLINDER ASSY DISASSEMBLING

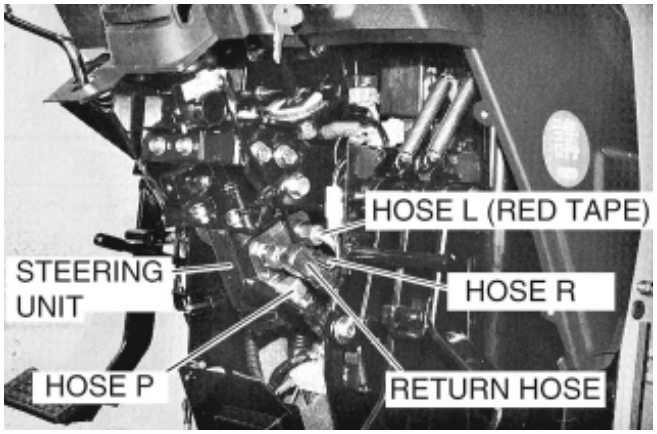
1. Remove tie rod end (6) , rod (9), rod end (8) and packing case (3).

2. Remove cylinder rod (2) from cylinder tube (1).



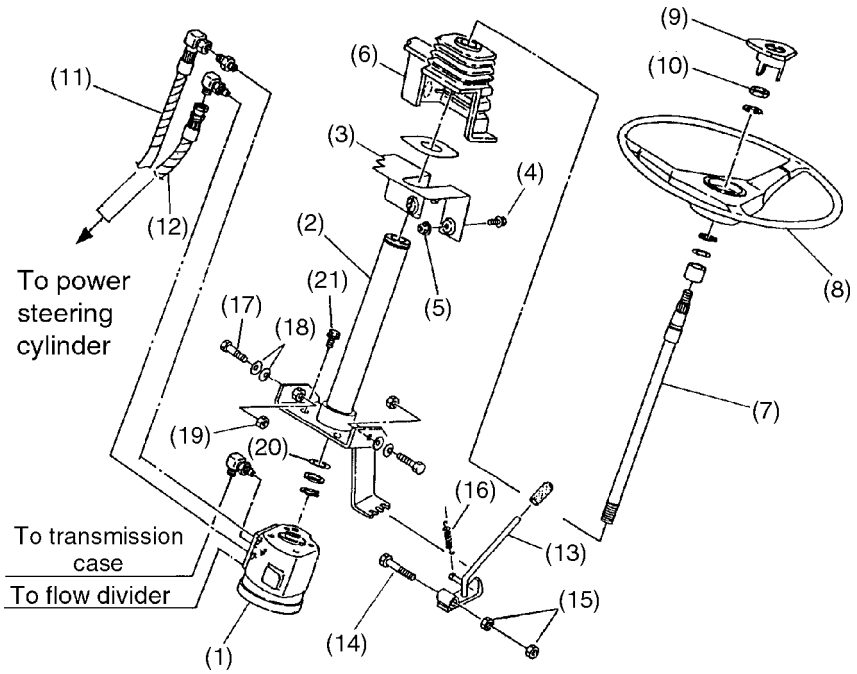
9-4. OPERATOR CONTROL AREA REASSEMBLING

*Reassemble operator control area with reverse procedure of disassembling.



(1) STEERING WHEEL REINSTALLATION

*Reinstall steering wheel with reverse procedure of removal. Use following values as adjustment and service standard.



(1)STEERING UNIT
(2)COLUMN
(3)PLATE
(4)BOLT
(5)NUT
(6)BOOT
(7)SHAFT
(8)STEERING WHEEL
(9)CENTER PAD
(10)NUT
(11)HOSE L (RED TAPE)
(12)HOSE R
(13)TILT LEVER
(14)BOLT
(15)NUT
(16)SPRING
(17)BOLT
(18)DISK SPRING
(19)NUT
(20)LINER
(21)BOLT

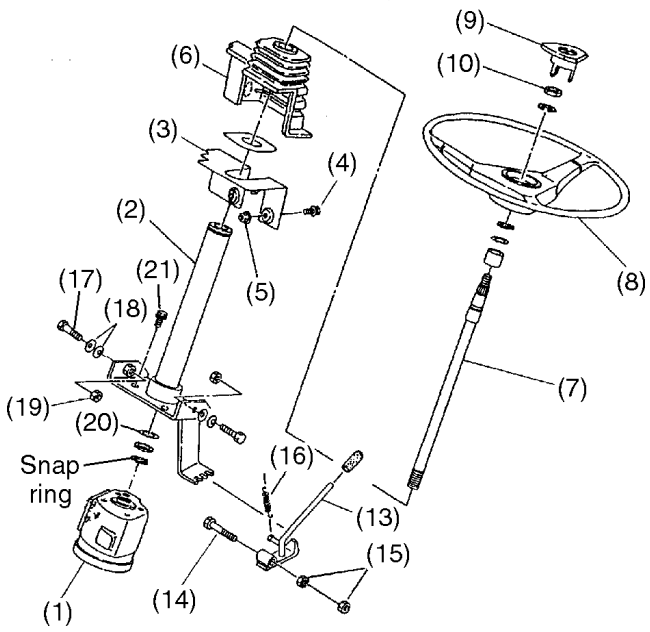
1. Adjustment of tilt lever
   1) Tighten the bolts (17) until locking the steering column..
   2) Loosen the bolts (17) of L.H. side and R.H. side equally until tilt force at steering wheel comes to [21.7~108.5 lbf•ft] and lock them by lock nut (19).
   3) Check the tilt force at steering wheel after lock the lock nut (19).
   4) Check the tilt amount at steering wheel which is approximate [0.827 in.] and side play which should be less than [0.079 in.].

2.

Tightening torques	[36.17lbf•ft]
Hoses	[18.08lbf•ft]

(2) STEERING WHEEL REASSEMBLING

*Reassemble steering wheel with reverse procedure of removal. Use following values as adjustment and service standard.

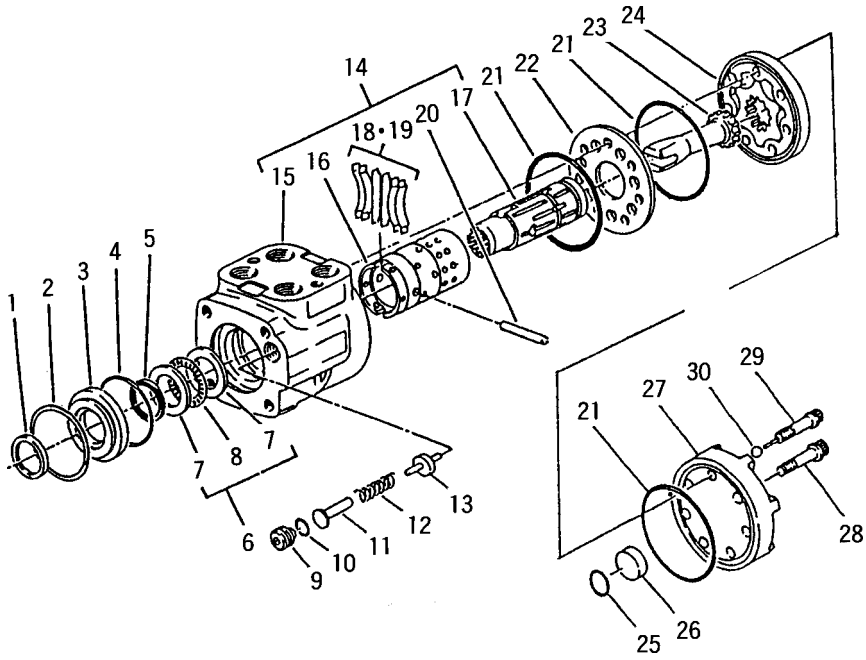


1. Apply grease to spline of the shaft.
2. Adjust the end play at shaft to be less than [0.0197 in.] by liner.
3. Tightening torque of steering wheel fixing nut [28.93~32.55 lbf •ft]

9-5 STEERING UNIT REASSEMBLING

*Reassemble steering unit with reverse procedure of disassembling.

(1) STEERING UNIT REASSEMBLING



(1)DUST SEAL
(2)RETAINING NUT
(3)SEAL GRAND BUSHING
(4)O-RING
(5)OIL SEAL (X-RING)
(6)NEEDLE BEARING KIT
(7)RELEASE BEARING
(8)THRUST NEEDLE
(9)RELIEF VALVE ADJUSTER
(10)O-RING
(11)COLER
(12)SPRING
(13)POPPET
(14)CONTROL PARTS ASSY
(15)HOUSING
(16)CONTROL SLEEVE
(17)CONTROL SLEEVE
(18)FLATE SPRING
(19)CENTERING SPRING
(20)PIN
(21)O-RING
(22)SPACER
(23)DRIVE
(24)ROTA SET
(25)O-RING
(26)SPACER
(27)END CAP
(28)RETAINER SCREW
(29)CHECK VALVE RETAINER SCREW
(30)BALL

1. Rotary reassembling

1) Install o-ring (21) to end cap (24) and tighten with screws (28, 29).

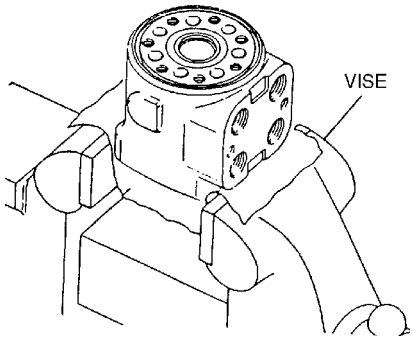
2) Tightening torque of screws
[15.19 lbf•ft]

NOTE

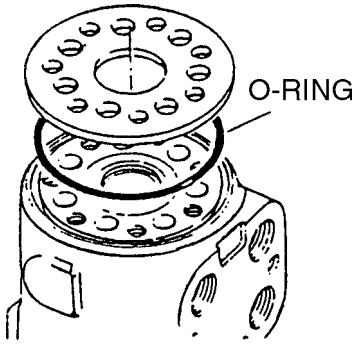
Make sure of location for installation of screw (29).

3) Apply grease at o-ring.

4) When hold the flange of housing (15) by vise, do not hold too tight.



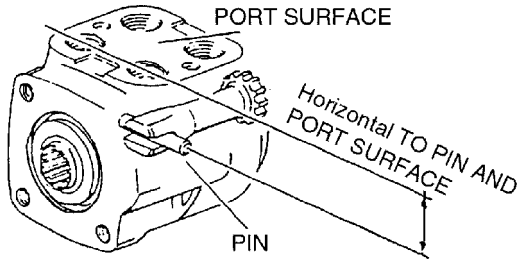
5) Install o-ring (21) to housing (15).
Put spacer plate (22) and aline bolt hole of plate and tapped hole of housing.



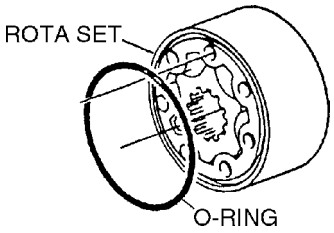
6) Turn spool (17) and sleeve (16) assy to parallel the pin (20) and port surface of housing (15).
Insert the drive (23) and engage the yoke of drive and pin.

CAUTION

Put the mark (line) at spline end surface of drive (23) to ensure the position.



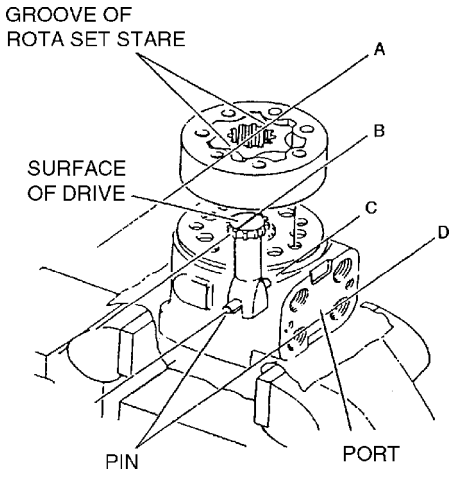
7) Install o-ring (21) to rota set (24).



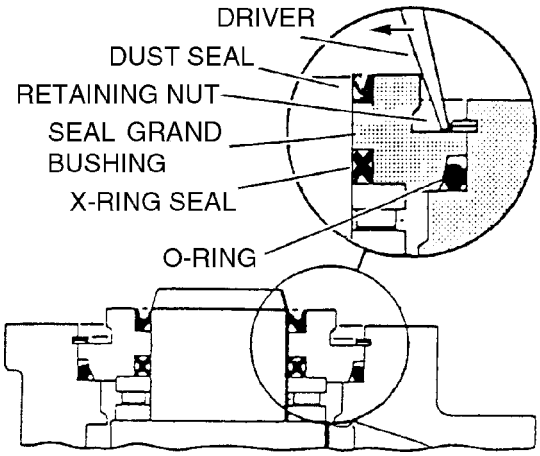
8) Face o-ring groove side of rota set (24) to spacer plate (22) and aline bottom of star piece and line B. Make sure the line A (line between bottoms of star piece), B, C and D as shown below.

NOTE

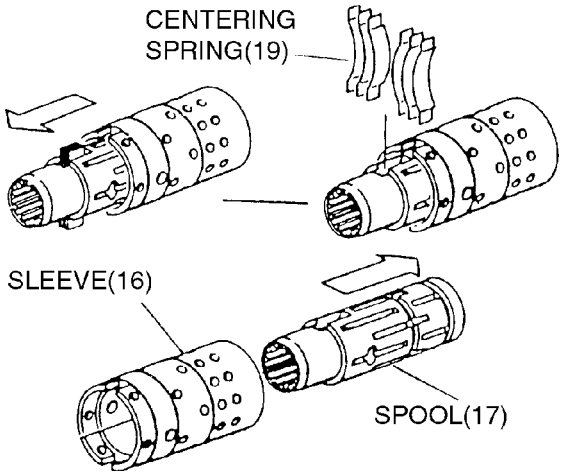
Aline the bolt hole of rota set (24) while keeping the connection of drive and star piece of rota.



9) Install retaining ring to housing groove. Make sure that the retaining ring is completely dropped in the groove.
10) Install dust seal and X-ring seal to seal grand bushing (3) and insert spool (17) as shown below.



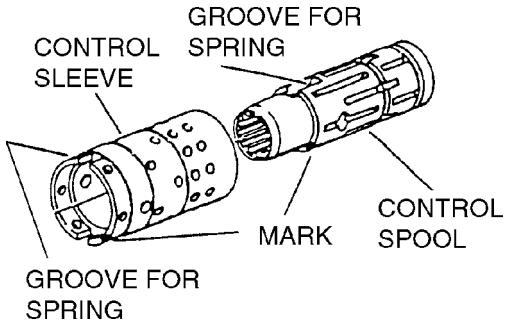
2) Make sure that the spool (17) can be turned smoothly.
3) In case that the sleeve and spool have aliment mark, aline the mark.
4) Put together 3 springs and other 3 springs back to back and install them to spool and sleeve.. Use special tool for their installation as shown below.

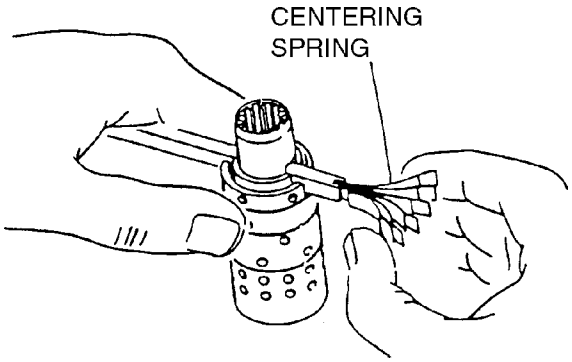


NOTE

Make sure that seal grand bushing is contacting to bearing race (7).

1) Assemble the spool and sleeve that the groove for spring is alined.





9-6. HYDRAULIC CYLINDER ASSY REASSEMBLING

*Reassemble the hydraulic cylinder assy with reverse procedure of disassembling.

(1) HYDRAULIC CYLINDER ASSY REASSEMBLING

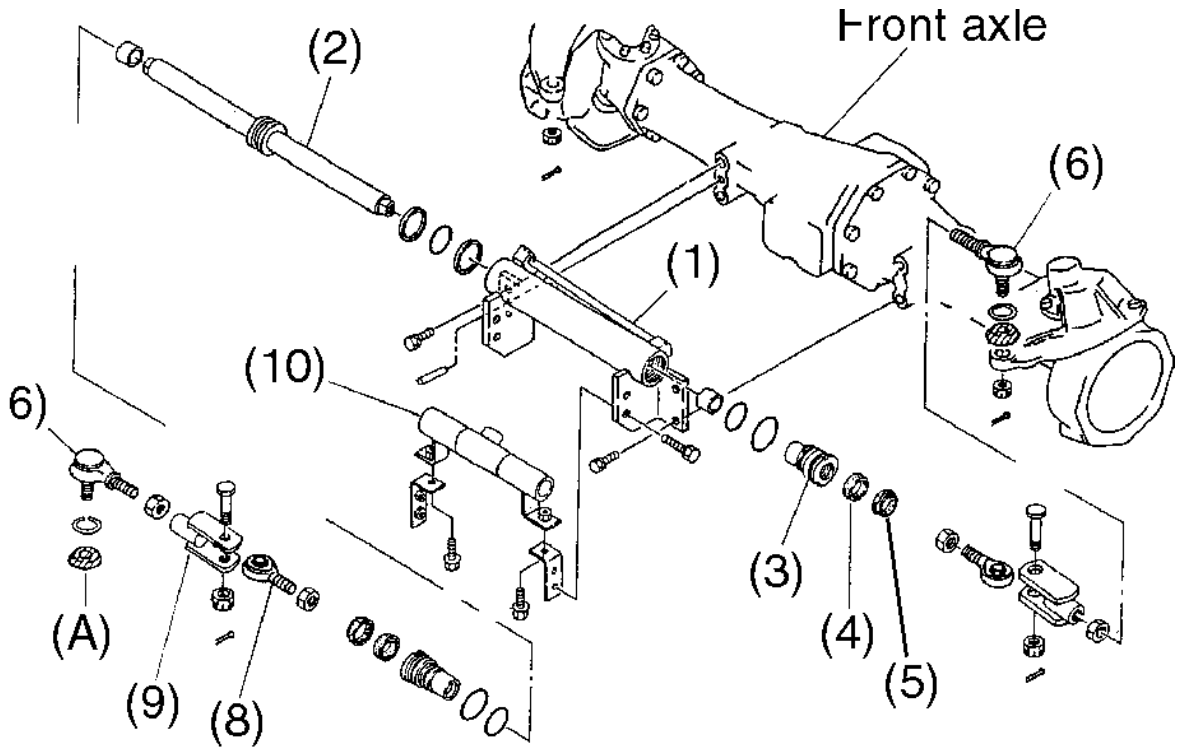
*Reassemble hydraulic cylinder assy with reverse procedure of disassembling. Use following values for reassembling as adjustment and service standard.

1. Packing case tightening torque ; [72.33lbf•ft]
(Apply the threebond #1901 to thread.)

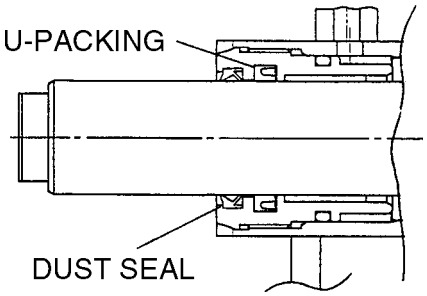
N O T E

In case of removing the hose, take the following procedure for air removal

1) Set the engine speed to [1500~2000 rpm].
2) Turn the steering wheel upto maximum steering angle and relief the relief valve for approximate 3 seconds.
3) Turn the steering to left and right by turns and repeat it 3 to 4 times.



2. Direction of installation of dust seal and U packing is as shown in the following drawing.
3. After tighten the packing case, calk the packing case of both sides.

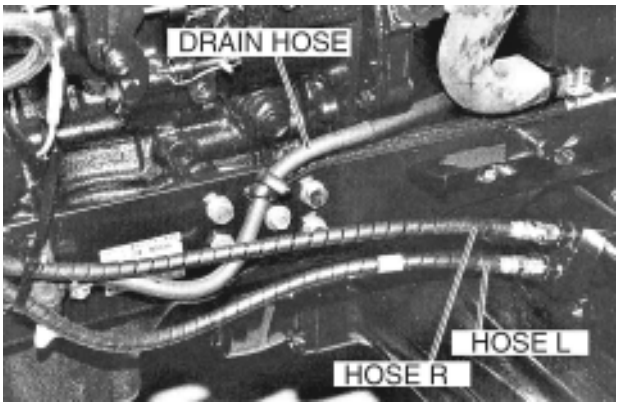


(2) HYDRAULIC CYLINDER ASSY REINSTALLATION

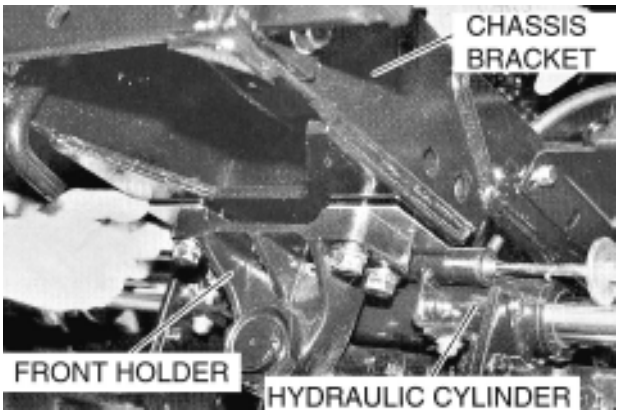
*Install the hydraulic cylinder assy with reverse procedure of removal. Use following values for reinstallation as adjustment and service standard.

1. Install the hose with red tape winded to lower port.

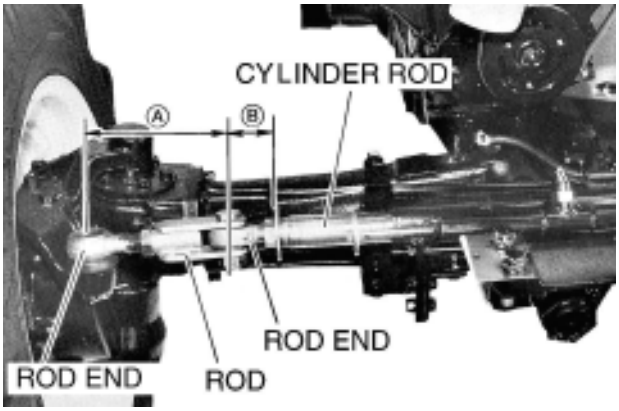
Tightening torque of hose [18.08 lbf•ft]



2. Turn the steering wheel to left and check the tire is turning to left.
3. There is liner between chassis and front bracket. (See page 14)
   1) Tightening torque of front bracket [61.48~68.71lbf•ft]
   2) Tightening torque of chassis [61.48~68.71lbf•ft]



4. Installation procedure of hydraulic cylinder assy.
   1) Set the length (B) of rod end (cylinder side) to [1.693~1.772 in.]
   2) Set the length (A) of rod end (knuckle side) to [5.906 in.]
   3) Adjust the toe-in by turning the rod L.H. and R.H. equally. (See page 152)



   4) Check the cylinder stroke and steering angle.Cylinder stroke should be [8.898 in.] and steering angle should be 48°~ 50°. Steering angle can be set by set bolt. Set length of set bolt is [0.906 in.].

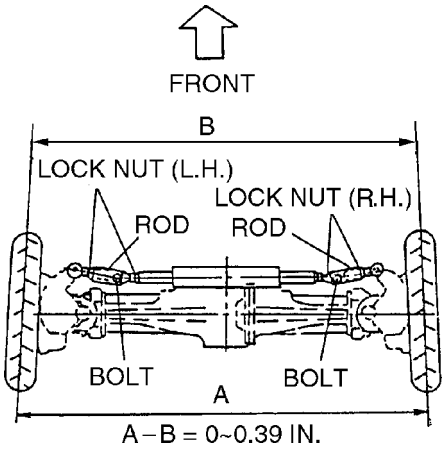
9-7. CHECK AND MAINTENANCE

(1) TOE-IN ADJUSTMENT

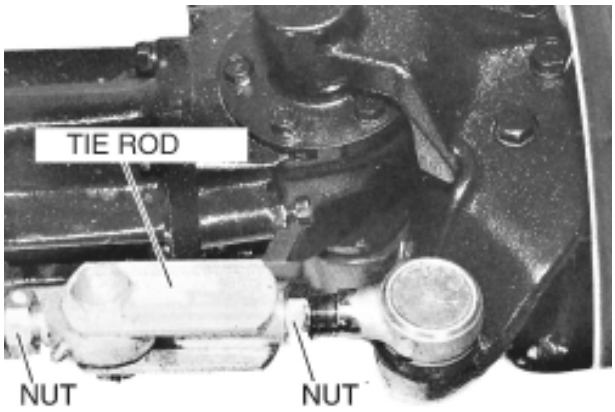
1. Set the tire pressure to [22.335 psi]

2. Set the front tire to straight ahead. Measure the distance between left and right tire center at front (B) and rear (A) side of tire.

Toe-in = A - B = [0~0.394 in.]



3. If toe-in is out of standard, readjust the toe-in by adjusting the rod length.



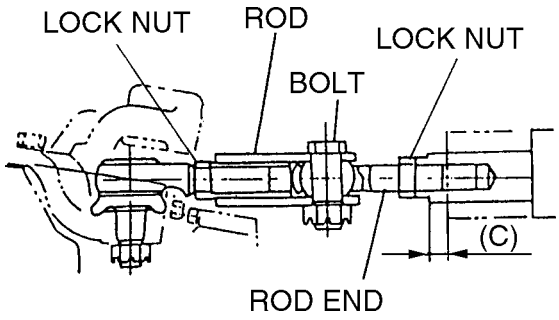
4. For toe-in adjustment, turn the left side and right side of rods to be equalized dimension C and lock the lock nut..

Tightening torque of lock nut;

[108.50~122.96lbf•ft]

N O T E

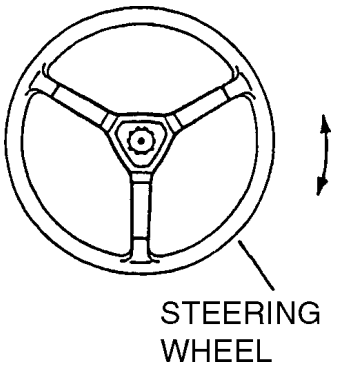
Bolt head of rod bolt should be set to upper side.



(2) STEERING WHEEL FREE PLAY

1. Measure the free play at out side of steering wheel. Free play should be as shown below.

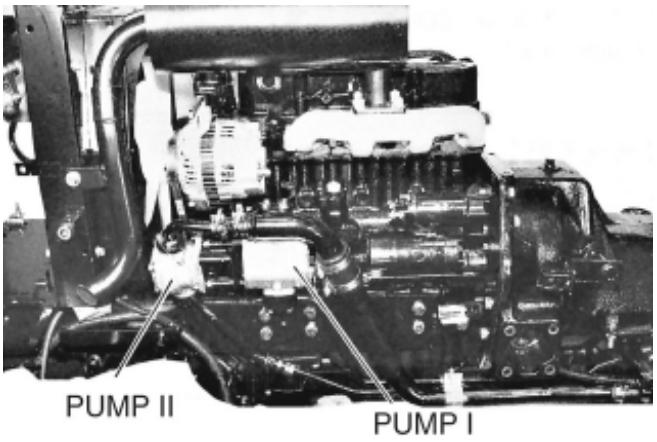
Item	Standard value(in.)
Steering Wheel free play when stopping engine.	1.18~3.15
at Engine 1000 r.p.m	0.79~1.18



In case that the free play exceeds above value, check the oil leakage at cylinder and hoses, check for air in the hydraulic line.

If no leakage and no air are found,check steering unit.

10. HYDRAULICS

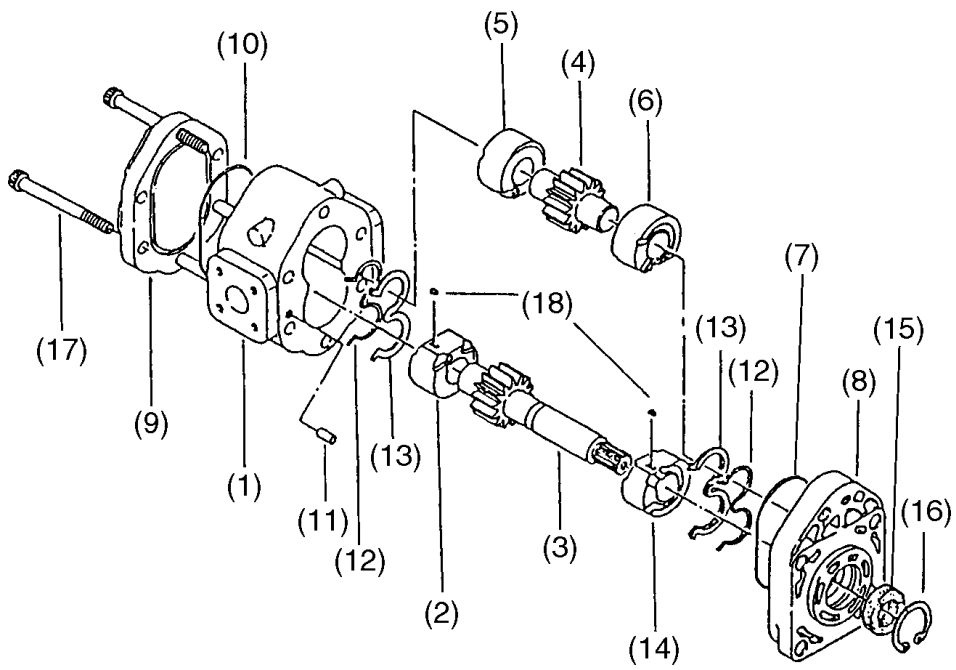


10-1. MAIN HYDRAULICS DISASSEMBLING

(1) HYDRAULIC PUMP DISASSEMBLING

1. Hydraulic pump removal
   1) Remove suction and pressure pipes from pumps.
   2) Remove fixing nuts and bolts of pumps and remove pumps.
   3) Pump I is supplying hydraulics to hitch and pump II is supplying hydraulics to power steering and PTO clutch.

2. Pump I disassembling

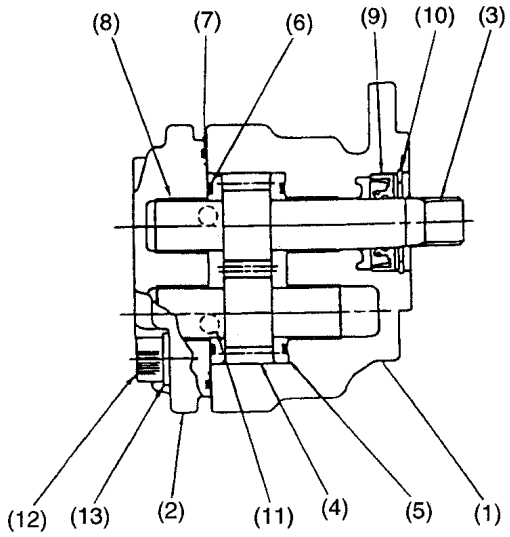


(1)HOUSING
(2)BUSHING
(3)DRIVE GEAR
(4)DRIVEN GEAR
(5)BUSHING
(6)BUSHING
(7)O-RING
(8)FRENGE
(9)COVER
(10)O-RING
(11)KNOCK PIN
(12)BACK UP ELEMENT
(13)SEAL ELEMENT
(14)BUSHING
(15)OIL SEAL
(16)C-RING
(17)BOLT
(18)KEY

1) Remove fixing bolts (17) and remove cover (9), housing (1), backup elements (12), seal elements (13), busing (2), drive gear (3), bushing (14), bushing (5),driven gear (4), bushing (6) ,o-rings (10),(7) and keys (18).

2) Remove snap ring (16) and oil seal (15) from flange (8).

3. Pump II disassembling

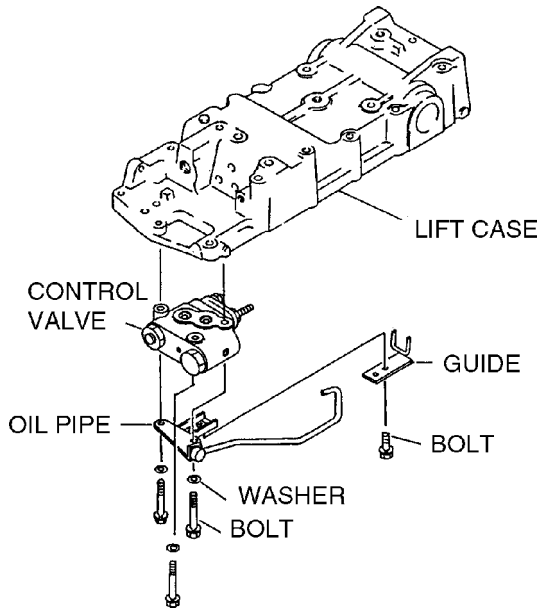


1) Remove fixing bolts (12) and remove cover (2), gasket (7), gear A (3), gear B (4), snap ring (10), and oil seal (9) from body (1).

(2) CONTROL VALVE DISASSEMBLING

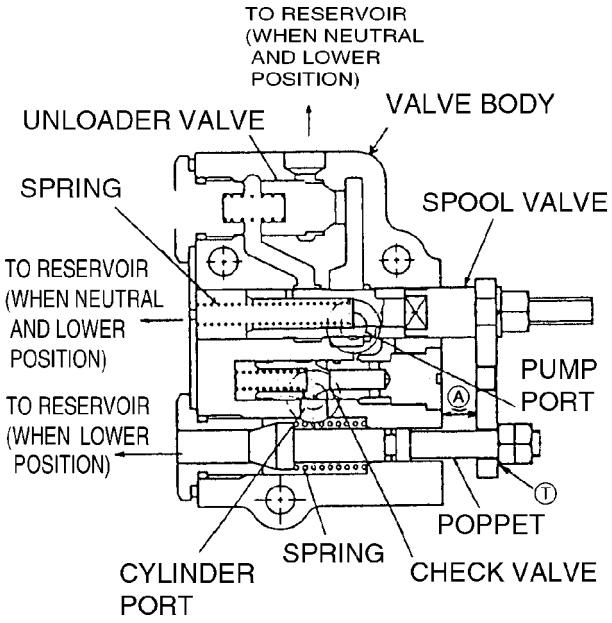
1. Control valve removal

Disconnect the linkage at control valve spool and remove fixing bolts of control valve (3 bolts) and ,lubrication pipe, guide and control valve.



2. Control valve disassembling

1) Remove plug at unload valve and remove spring and unload valve.
2) Remove plug at poppet and remove plate and spring at spool.
3) Remove nuts at poppet and spool. Remove spool, poppet and spring.
4) Remove plug at check valve and remove check valve and spring.



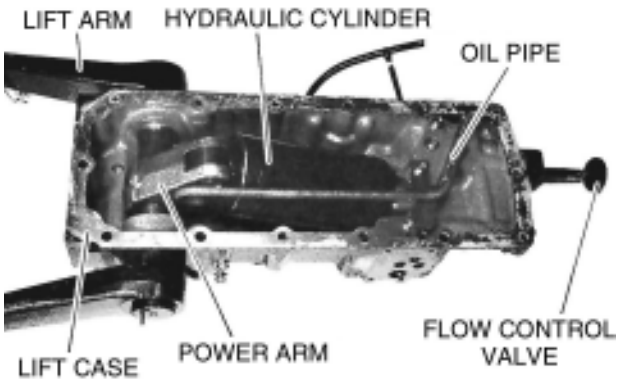
10-2. HYDRAULIC LIFT DISASSEMBLING

(1) LIFT SHAFT AND CYLINDER DISASSEMBLING

1. Cylinder disassembling

1) Remove fixing bolt of pin (19) and remove pin (19), piston rod (10).

2) Remove fixing bolts of cylinder (14) and remove cylinder (14). Remove piston (12).



2. Lift shaft disassembling

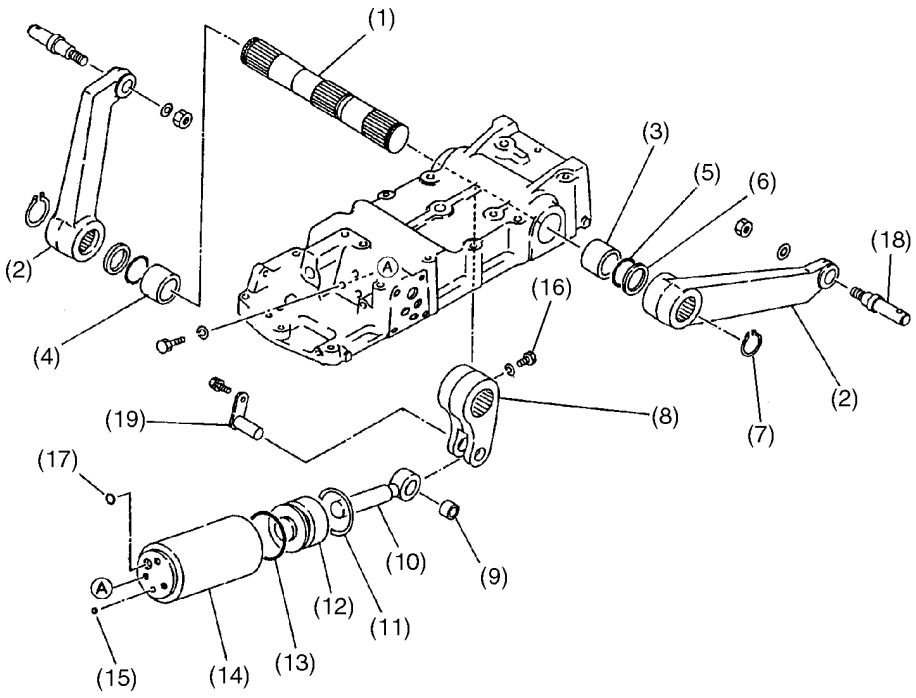
1) Remove snap rings and remove lift arms (2).

2) Remove colors (6) and o-rings (5).

3) Remove set bolt and washer at power arm (8) and remove lift shaft (1) with bushing (3).

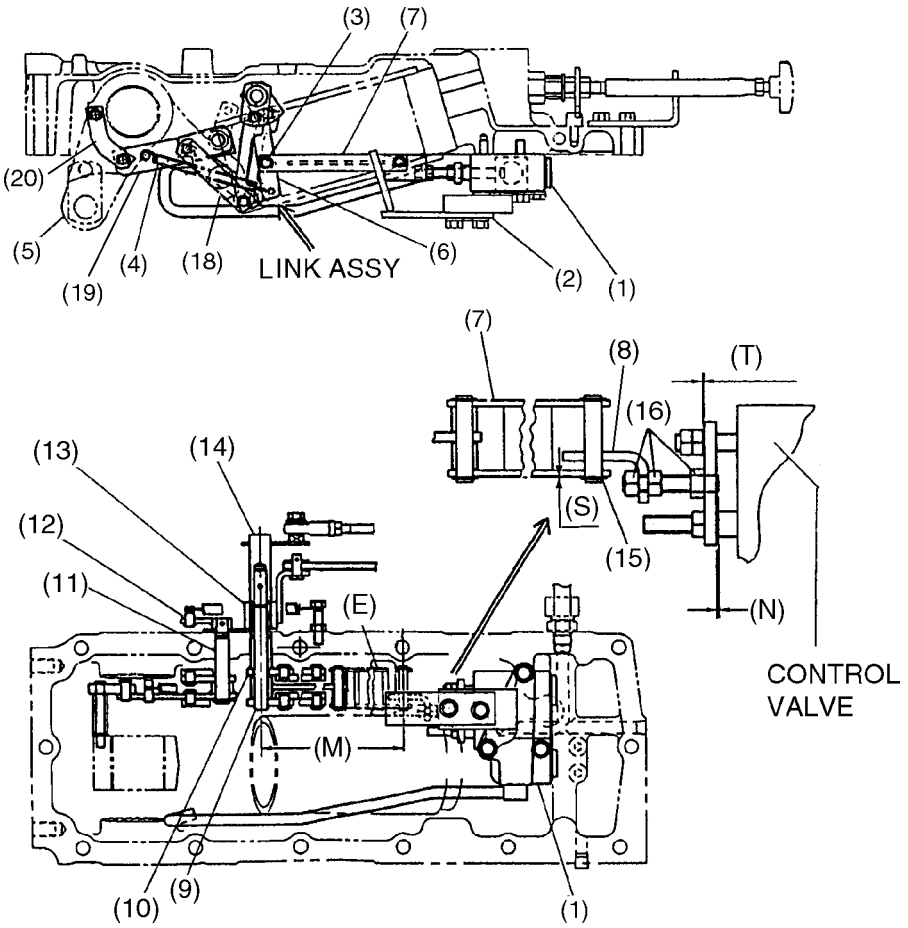
CAUTION

Do not hit shaft with hammer for removal.



(1)SHAFT
(2)LIFT ARM
(3)BUSHING
(4)BUSHING
(5)O-RING
(6)COLER
(7)SNAP RING
(8)POWER ARM
(9)BUSHING
(10)PISTON ROD
(11)BACK UP RING
(12)PISTON
(13)O-RING
(14)HYDRAULIC CYLINDER
(15)STEEL BALL
(16)SET BOLT
(17)O-RING
(18)LIFT ARM PIN
(19)PIN

(2) HYDRAULIC LINKAGE DISASSEMBLING

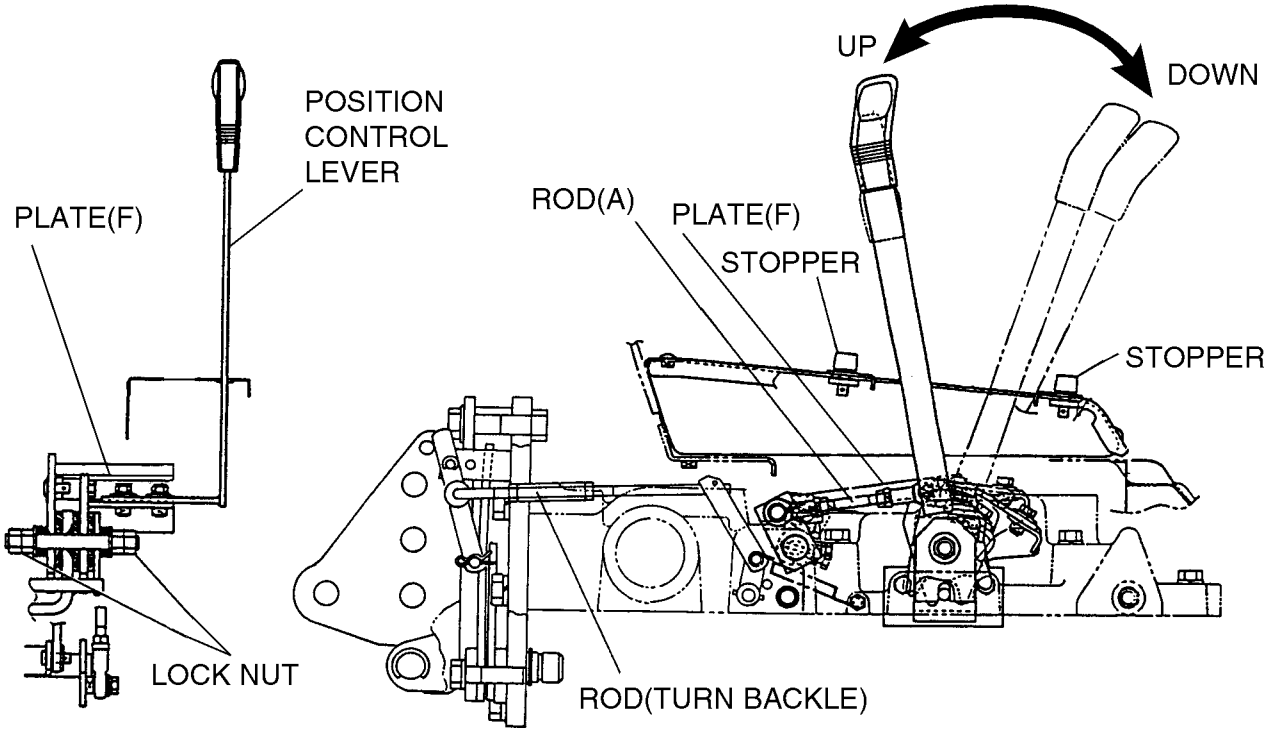


(1)CONTROL VALVE
(2)GUIDE
(3)ROLLER
(4)SPRING
(5)POWER ARM
(6)LINK
(7)LINK H
(8)PLATE
(9)POSITION SHAFT
(10)DRAFT SHAFT
(11)SHAFT
(12)ARM
(13)LEVER B
(14)LEVER A
(15)LINER
(16)NUT
(17)LINK B
(18)LINK J
(19)LINK
(20)LINK E

1. Control valve removal
   1) Remove snap ring on the pin at plate (8) and disconnect the control valve (1) and link H (7).
   2) Remove fixing bolts of control valve and remove control valve (1), lubrication pipe, and guide.
   3) Loosen lock nuts (16) and remove plate (8) from control valve.
2. Hydraulic linkage removal
   1) Remove spring pin at lever A (14) and remove lever A (14) and lever B (13).
   2) Remove snap ring at link H (7) and link (6) and remove link H (7), pin and collars (3).
   3) Remove spring (4).
   4) Remove snap ring at position shaft (9) and draft shaft (10) and disconnect from link B (17).
   5) Remove snap rings at link J (18) and remove link J (18).
   6) Remove snap rings at link E (20) and remove link E (20).
   7) Remove spring pin at arm (12) and remove arm (12), shaft (11) and link (19).
   8) Remove pin from power arm.

(3) POSITION CONTROL LEVER REMOVAL

1) Remove piston control lever.
2) Remove rod A.
3) Remove plate (F)

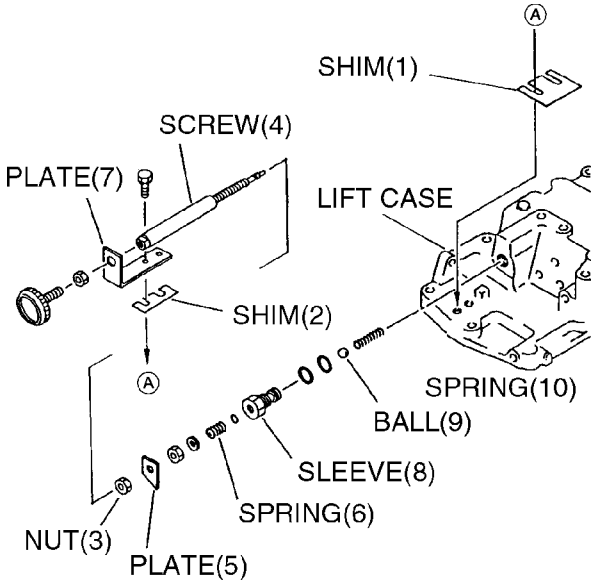


(4) FLOW CONTROL VALVE DISASSEMBLING

1. Loosen lock nuts (3) and remove screw (4), plate (5), washer and spring (6) .

2. Remove sleeve (8), ball (9) and spring(10).

3. Remove fixing bolts of plate (7) and remove plate (7), shims(1) and (2).

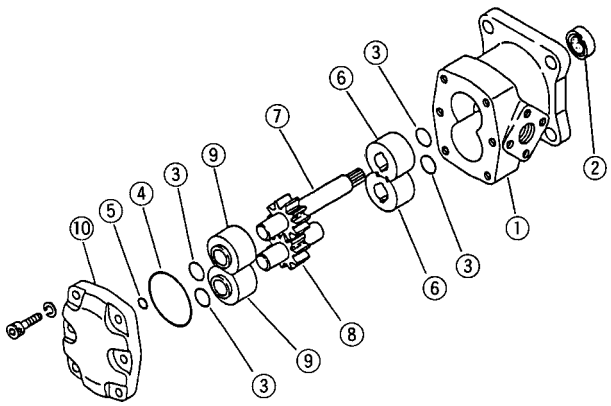


10-3. MAIN HYDRAULICS REASSEMBLING

*Reassemble the main hydraulics with reverse procedure of disassembling.

(1) HYDRAULIC PUMPS REASSEMBLING

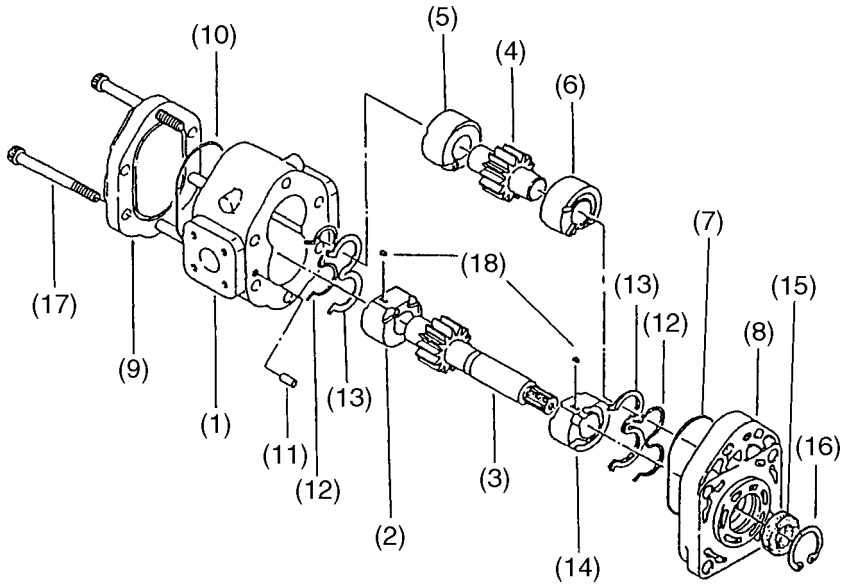
*Reassemble pump I and II with reverse procedure of disassembling. Use following values as adjustment and service standard of reassembling.



1.

Tightening torque of pump bolts.
[18.08~21.7 lbf•ft]

2. Apply oil at o-rings and oil seals for the assembling.

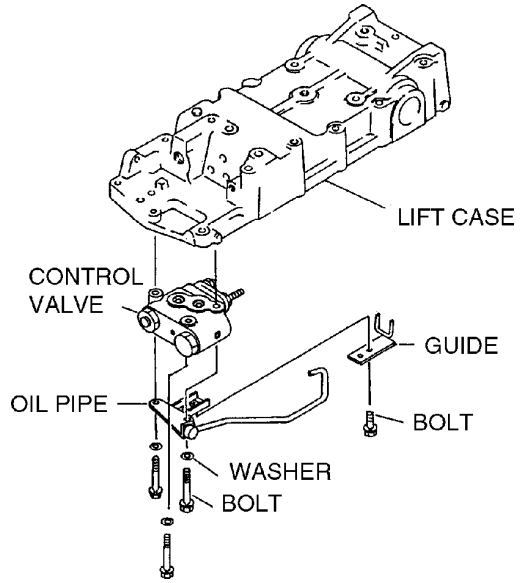


(1)HOUSING
(2)BUSHING
(3)DRIVE GEAR
(4)DRIVEN GEAR
(5)BUSHING
(6)BUSHING
(7)O-RING
(8)FRENGE
(9)COVER
(10)O-RING
(11)KNOCK PIN
(12)BACK UP ELEMENT
(13)SEAL ELEMENT
(14)BUSHING
(15)OIL SEAL
(16)C-RING
(17)BOLT
(18)KEY

(2) CONTROL VALVE ASSEMBLING

*Reassemble and reinstall the control valve with reverse procedure of the disassembling and removal. Use followin value for reassembling and reinstallation of control valve as adjustment and service standard.

1. Make sure orings are installed on the control valve before valve installation and apply oil at o-ring.



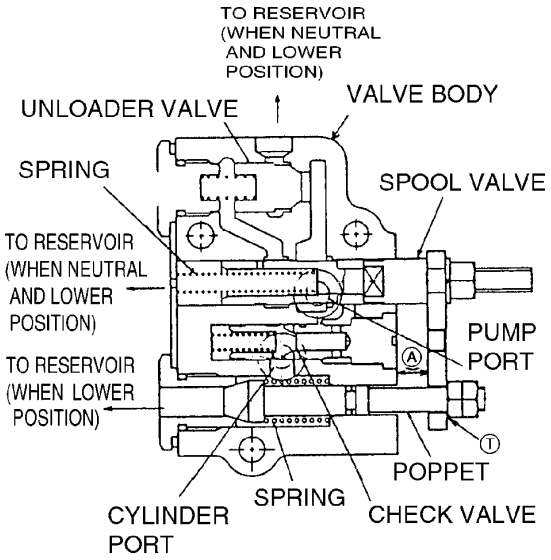
2. Valve neutral adjustment

1) Put the air nozzle to pump port of valve and send the air to pump port. Move spool and find the spool position to start to come out the air from cylinder port. This position is neutral position of spool.
[Dimension (A) is 0.386~0.394 in.]

2) Adjust clearance between nut and plate (dimension T) to 0.3~0.6 mm at neutral position of spool and lock the nuts .

3) Tightening torques

Plug at poppet	: 50.63~69.1 lbf•ft
Plug at check valve	: 36.17~43.4 lbf•ft
Plug at unloader valve	: 50.63~69.1 lbf•ft
Nut at poppet	: 13.02~15.91lbf•ft



10-4. HYDRAULIC LIFT REASSEMBLING

*Reassemble hydraulic lift with reverse procedure of disassembling.

(1) LIFT SHAFT AND CYLINDER REASSEMBLING

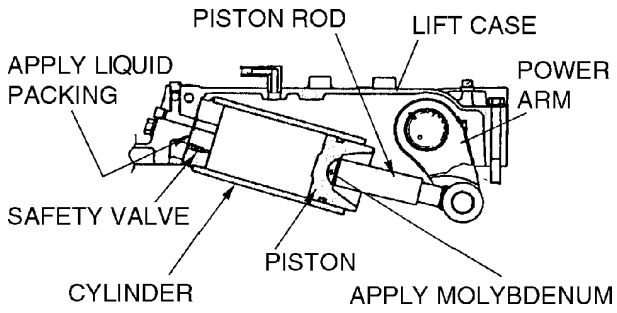
*Reassemble the lift shaft and cylinder with reverse procedure of disassembling. Use following values for reassembling as adjustment and service standard.

1. Cylinder reassembling

1) Apply oil at o-ring for the assembling.

2) Apply liquid packing (threebond #1208D) to mating surface of the cylinder and housing .

3) Apply molybdenum(MoS2) to piston.

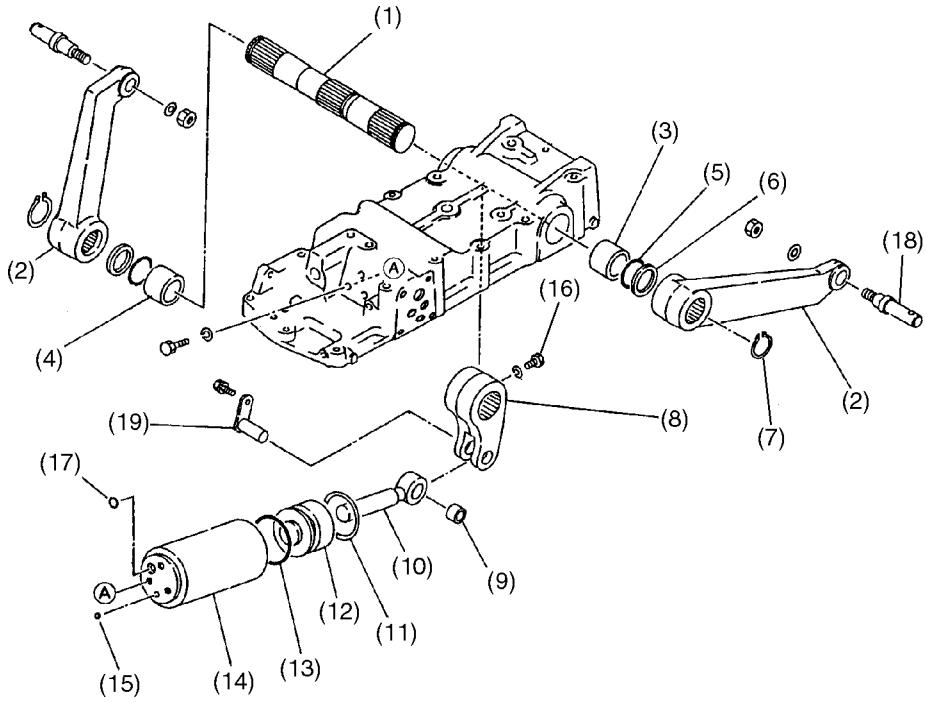


2. Lift shaft reassembling

1) Aline the bolt hole for lock bolt on the power arm and lift shaft.

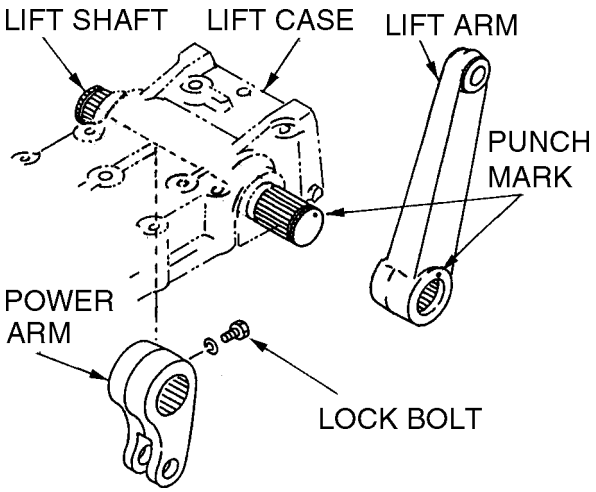
Tightening torque of lock bolt
8.68~12.3lbf•ft

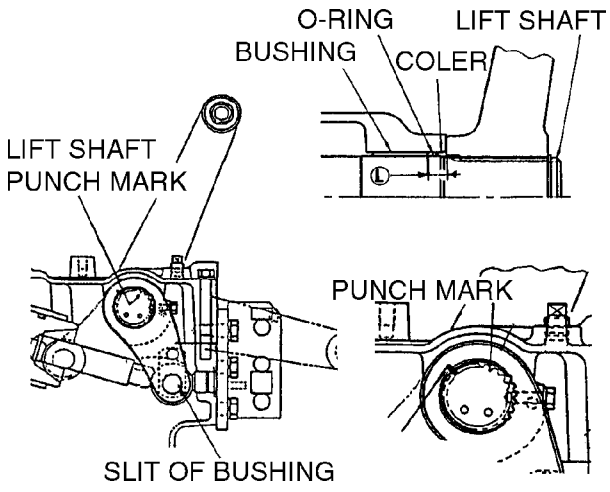
2) Aline the punch mark on the lift shaft and lift arm.



3) Install the bushing (9) to piston rod (10). Bushing should be placed with its slit coming as shown in the following drawing.
4) Install the bushings (3) to lift case. Bushing should be placed with its seam coming as shown in the following drawing.

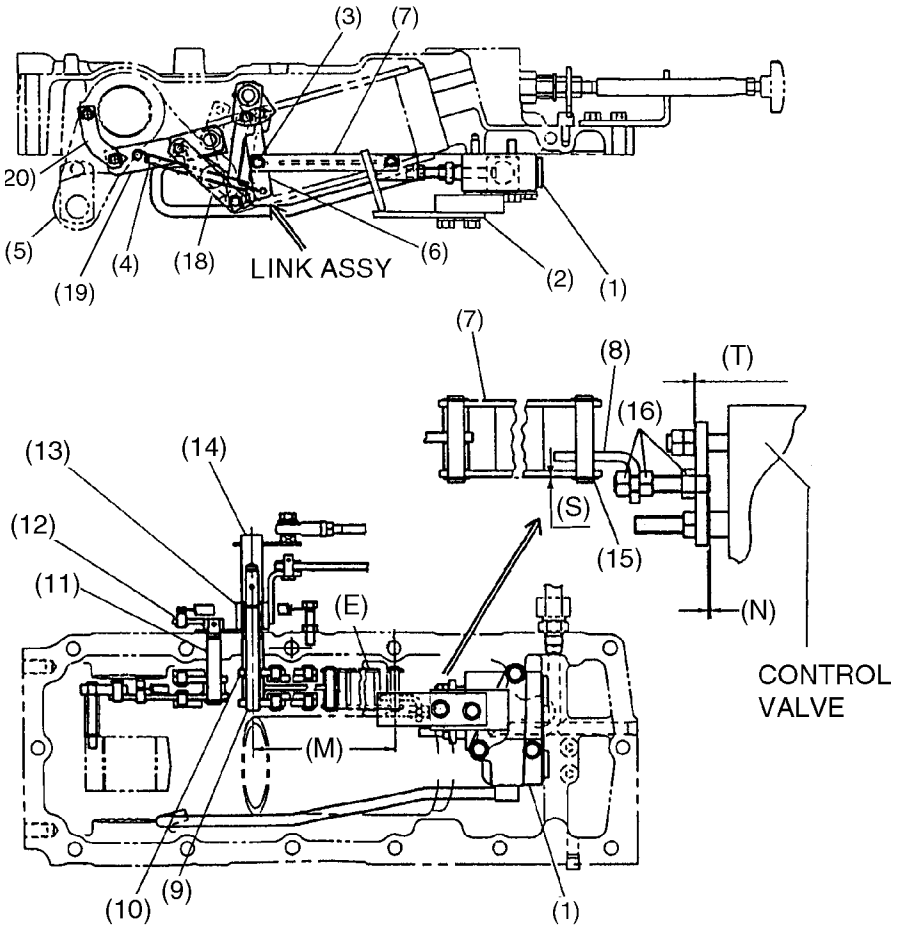
5) Drive in bushing at lift shaft to [0.374~0.394 in.] deep as shown in the following drawing.
6) Apply molybdenum(MoS2) to spline of lift shaft.
*Special tool for bushing (3) and (4) insullation.
Parts number 19619021000 and 19619025000 for (3) and (4).





(2) HYDRAULIC CONTROL LINKAGE
REASSEMBLING

*Reassemble the hydraulic control linkage with reverse procedure of disassembling. Use following values as adjustment and service standard for reassembling.

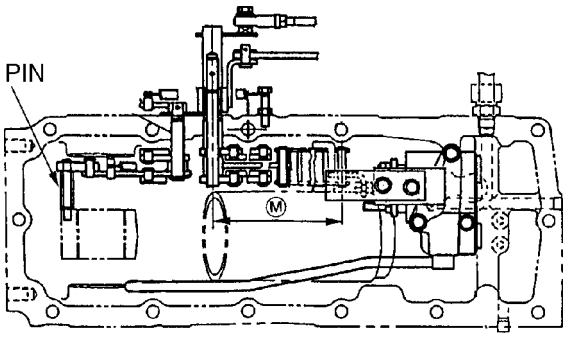


(1)CONTROL VALVE
(2)GUIDE
(3)ROLLER
(4)SPRING
(5)POWER ARM
(6)LINK
(7)LINK H
(8)PLATE
(9)POSITION SHAFT
(10)DRAFT SHAFT
(11)SHAFT
(12)ARM
(13)LEVER B
(14)LEVER A
(15)LINER
(16)NUT
(17)LINK B
(18)LINK J
(19)LINK
(20)LINK E

1. Control valve installation

1) After install the control valve, adjust the dimension (M) to 132.2~132.8 mm with pushing the spool to make [0.0118~0.0354 in] of clearance at (T) by adjusting position of plate (8).

2) Sticking out amount (N) of screw on plate (8) should not exceed [0.039in.] from valve plate.



3)After adjustment of plate position , lock the all three nuts (16).

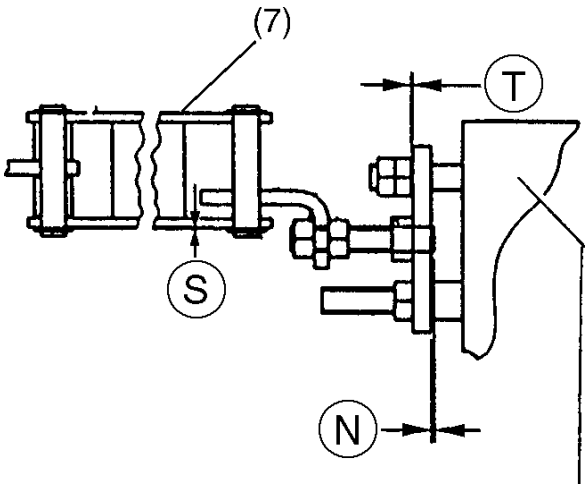
2. Control linkage installation

1) O-ring installation to shafts

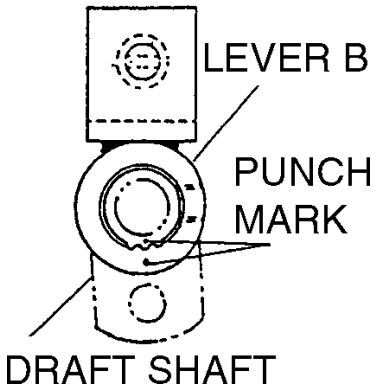
Fit the draft shaft (10) and shaft (11) in the housing and pull it out until o-ring groove comes to out side of housing. Fit the o-ring in the groove, apply grease and pull in the shaft.

Drawing from 4501 7-53

2) Adjust side play (S) at link H (7) to be less than [0.0118in.] by liner.

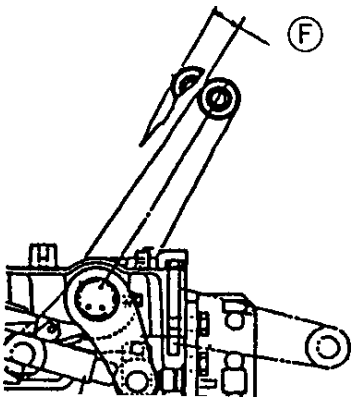


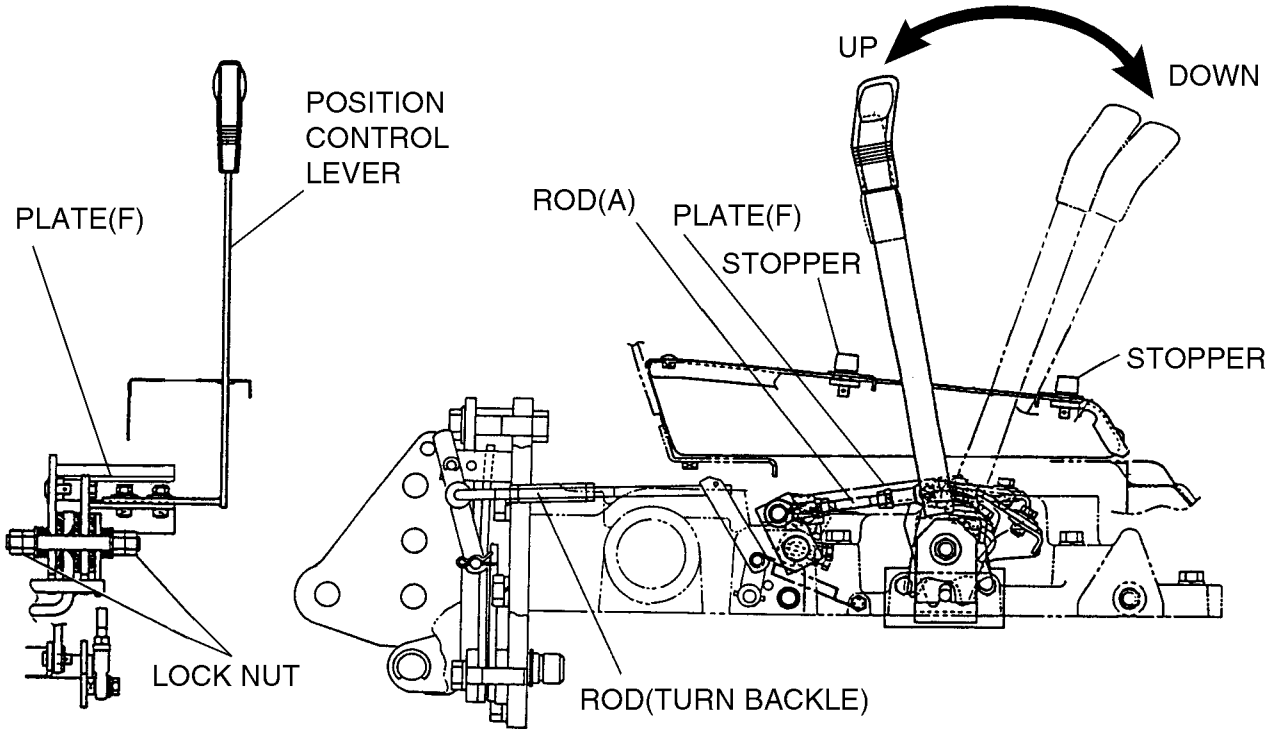
3) Aline the punch mark of lever B (13) and draft shaft (10).



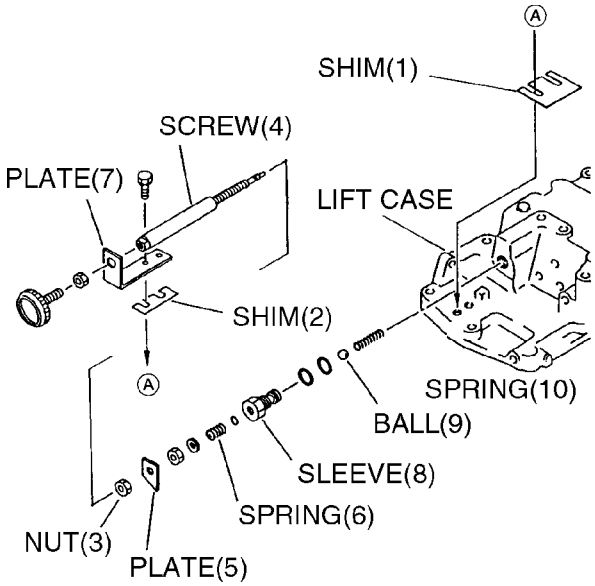
4) Install link H (7) that the side of linkage plate touches lightly to guide (2). Make sure linkage H (7) can move parallel to the cylinder.

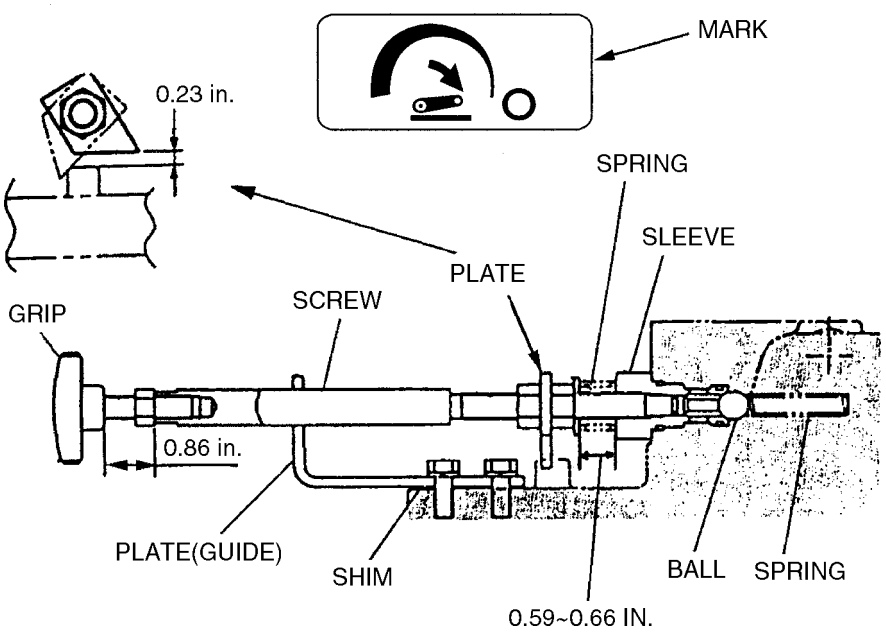
3. Position control lever reassembling
   1) Fix the handle stopper and place the position control lever to the highest position.
   2) Adjust the play Fat top position of lift arm to be [0.197~0.394in.] by adjusting the rod (A) length.

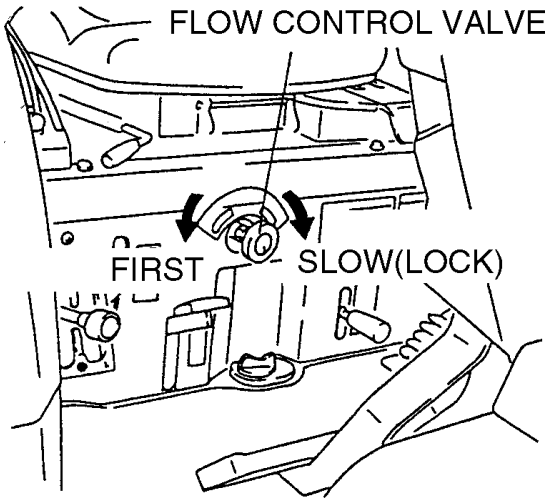




4. Flow control valve reassembling
   1) Adjust the height of plate (7) by shim (1 and 2) to turn the screw (4) smoothly.
   2) Tightening torque of sleeve (8) [61.48~68.71lbf•ft]
   3) Adjust the position of plate (5) to obtain the length of spring (6) to be [0.591~0.669 in.] at the flow control lock position.
   4) Set the clearance between plate (5) and housing to be [0.236 in.] as shown in the following drawing.

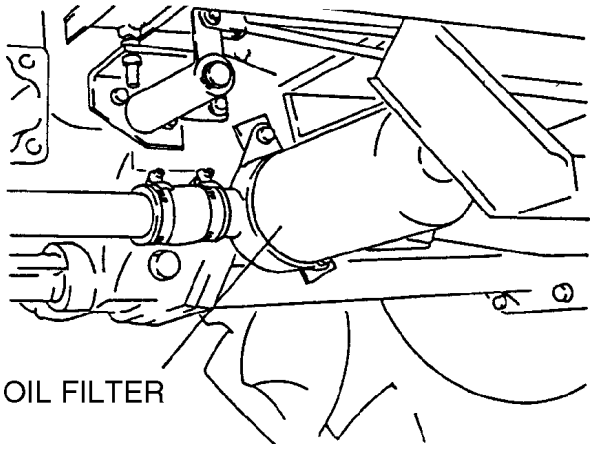




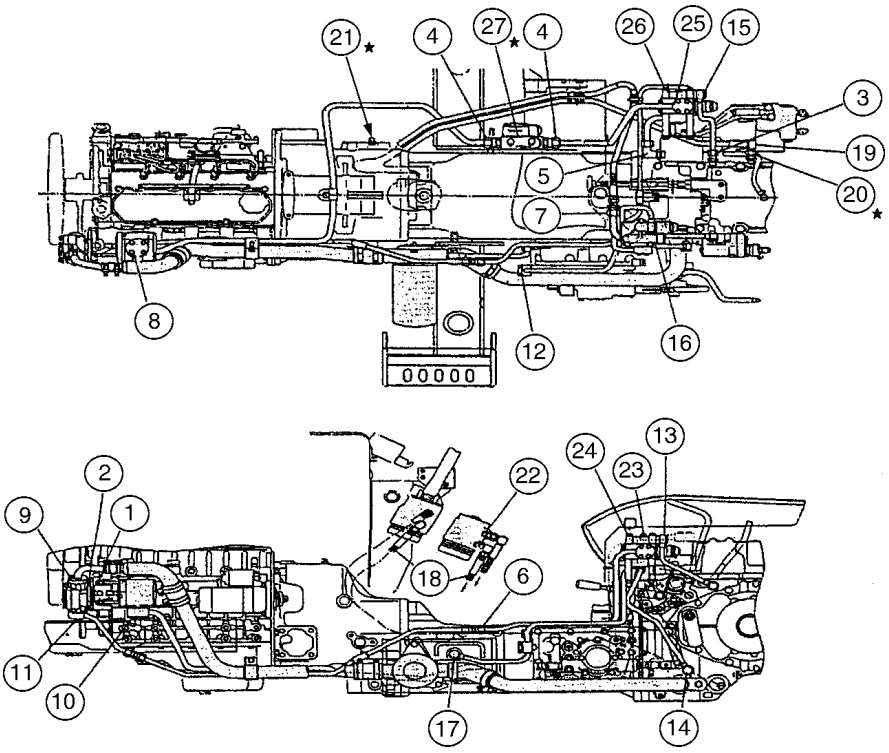


10-5. HYDRAULIC LINE CHECKING

1. During the installation
   1) Apply oil to o-rings and install them not to stick out.
   2) Assemble the parts with care not to get contamination to the hydraulic ports.
2. Filter installation
   1) Wipe the installation surface of filter base and apply the oil to the packing of filter for the installation.
   2) Turn 2/3 ~ 3/4 further at the point of filter packing touch to installation surface of filter base by hand.



3. Tightening torques of hydraulic line



(1)STANDARD BOLT TORQUES

	Bolt Grade (Indicated on Bolt Head)			
Bott Size	4T	6T	7T	8T
5mm	1.5 to 2 lb ft (2 to 3 Nm)	3 to 4 lb ft (4 to 5 Nm)	4 to 4.5 lb ft (5 to 6 Nm)	4.5 to 5 lb ft (6 to 7 Nm)
6mm	4 to 5 lb ft (5 to 7 Nm)	6 to 7.5 lb ft (8 to 10 Nm)	7.5 to 9 lb ft (10 to 12 Nm)	9 to 10.5 lb ft (12 to 14 Nm)
8 mm	9 to 12.5 lb ft (12 to 17 Nm)	15 to 18.5 lb ft (20 to 25 Nm)	18.5 to 21.5 lb ft (25 to 29 Nm)	21.5 to 25 lb ft (29 to 34 Nm)
10 mm	15 to 21.5 lb ft (20 to 29 Nm)	29 to 36 lb ft (39 to 49 Nm)	36 to 43.5 lb ft (49 to 59 Nm)	43.5 to 50 lb ft (59 to 69 Nm)
12 mm	32.5 to 40 lb ft (44 to 54 Nm)	50 to 58 lb ft (69 to 78 Nm)	61 to 68.5 lb fl (83 to 93 Nm)	69 to 79 lb ft (93 to 107 Nm)
14 mm	47 to 58 lb ft (64 to 78 Nm)	72.5 to 87 lb ft (98 to 118 Nm)	87 to 97.5 lb ft (118 to 132 Nm)	97.5 to 108.5 lb ft (132 to 147 Nm)
16 mm	65 to 80 lb ft (88 to 108 Nm)	94 to 108.5 lb ft (127to 147 Nm)	112 to 127 lb ft (152 to 172 Nm)	130 to 144.5 lb ft (176 to 196 Nm)
18 mm	87 to 101 lbft (118to 137 Nm)	123 to 136.5 lb ft (167 to 185 Nm)	152 to 173.5 lb ft (206 to 235 Nm)	181 to 203 lb ft (245 to 275 Nm)
20 mm	108.5 to 123 lb ft (147 to 167 Nm)	144.5 to 159.5 lb ft (196 to 216 Nm)	173.5 to 203 lb ft (235 to 275 Nm)	23l to 260.5 lb ft (314 to 353 Nm)

(2)STANDARD TORQUE DATA FOR REPLACEMENT NUTS AND BOLTS

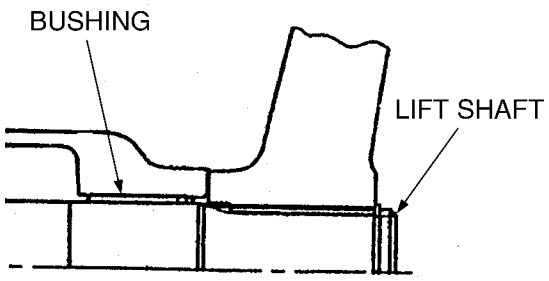
Torque Specifications +/- 10%		
SIZE	GRADE 8.8	GRADE 10.9
5 mm	4 lb ft (5.5 Nm)	5.5 lb ft (7.5 Nm)
6mm	7 lb ft (9 Nm)	9 lb ft (12.5 Nm)
8 mm	17 lb ft(22.5 Nm)	23 lb ft (31.5 Nm)
10 mm	32.5 lb ft (44 Nm)	46 lb ft (62 Nm)
12 mm	57 lb ft (77.5 Nm)	81 lb ft (110 Nm)
14 mm	88.5 lb ft (120 Nm)	125.5 lb ft (170 Nm)
16 mm	140 lbft (190 Nm)	196 lb ft (265 Nm)
18 mm	192 lb ft (260 Nm)	269.5 lb ft (365 Nm)

10-6. HYDRAULICS CHECK AND MAINTENANCE

(1) HYDRAULIC LIFT SYSTEM CHECKING

1. Clearance of bushing
   1) Measure the outer of diameter of lift shaft and power arm pin.
   2) Measure the inner diameter of bushings and calculate the clearances.
   3) In case that clearance is out of service limit, replace the parts.

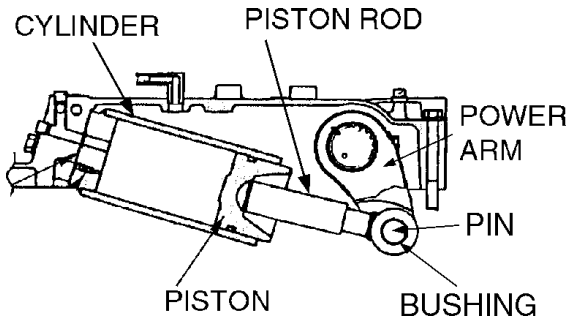
Item	Standard value (in.)	Service standard (in.)
Clearance between lift shaft and bushing	0.000984 ~ 0.003504	0,011811
Clearance between piston rod and bushing	0.000787 ~ 0.003268	0,011811



Check the Shaft and replace it if seized.
Replace bushing if the inside coating (gray color) is worn out.

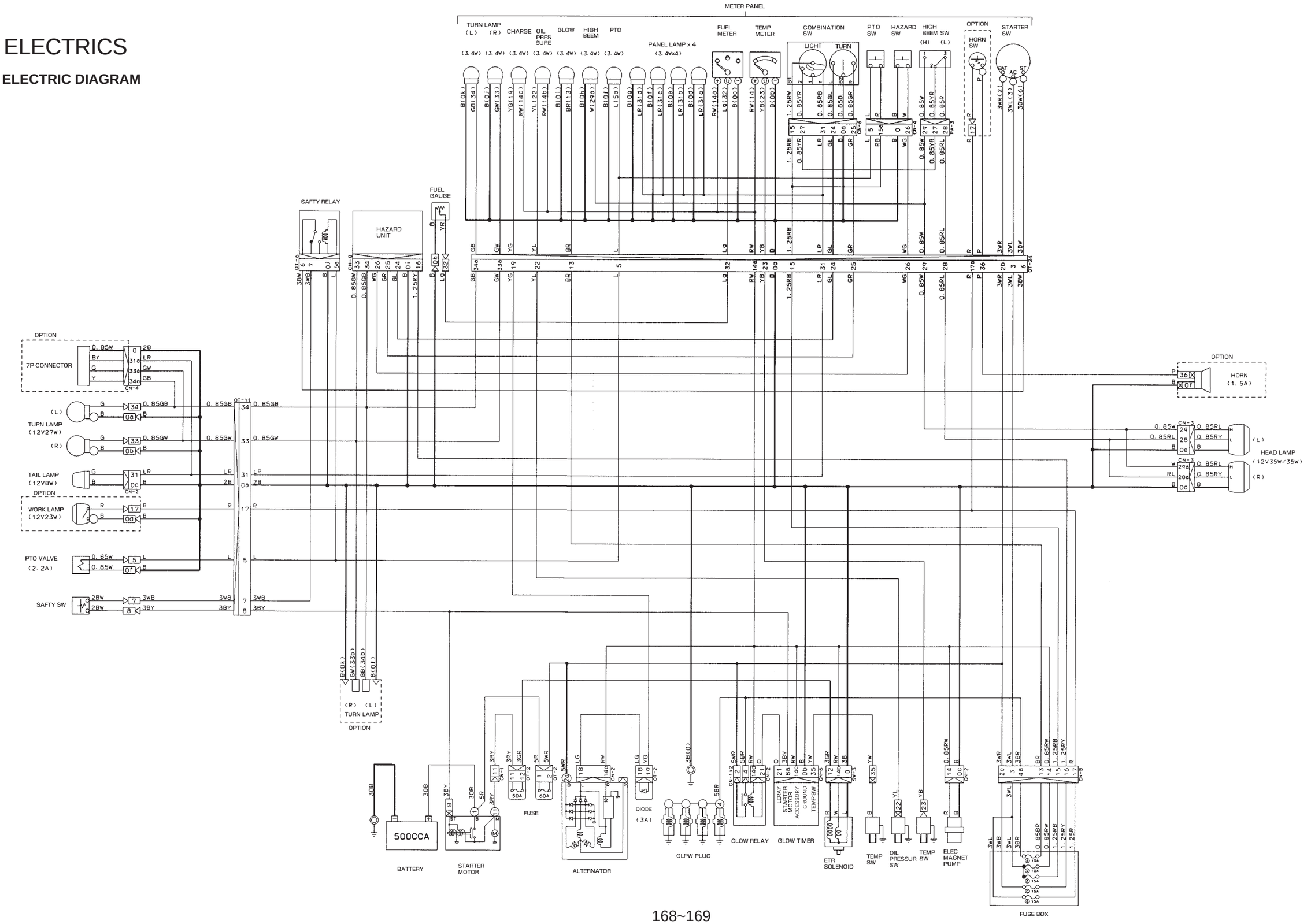
(2) CLEARANCE BETWEEN CYLINDER AND PISTON
   1) Measure the outer diameter of piston and inner diameter of cylinder. Calculate the clearance between piston and cylinder.
   2) In case that clearance is out service limit, replace the parts.

Item	Standard value (in.)	Service limit (in.)
Clearance between cylinder and piston	0.00236~ 0.00386	0.00787



11. ELECTRICS

11-1. ELECTRIC DIAGRAM



11-2. SPECICATIONS

Electrical System

Type of System	12 Volt, Negative Ground
Battery	12 Volt, 500 CCA Group 22F, Top Stud Terminals
Alternator	12 Volt, 50 Ampere Output
Voltage Regulator	IC Built in Alternator
Starter Motor	12 Volt, 2 kw with Solenoid Switch
Head Lamp	35 Watt
Flasher Lamp	23 Watt
Rear Red Lamp	20 Watt
Panel Lamp	3.4 Watt
Turn Indicator Lamp	3.4 Watt
Indicator Lamp	3.4 Watt