Models

1GM10(C)
2GM20(F)(C)
3GM30(F)(C)
3HM35(F)(C)

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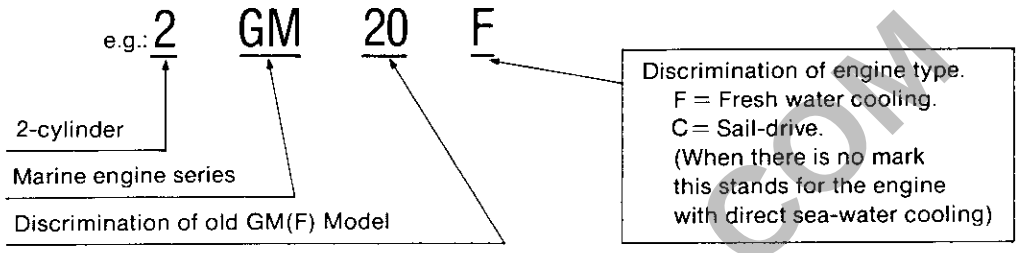
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A. Engine Model Name

The nomenclature of the New GM(F)/HM(F) series follows the order shown below.



B. Engine Model Name Plate and Clutch Model Name Plate

To every engine model described in this manual, an engine model name plate and clutch model name plate are fitted as shown in the following figures. In addition, the engine serial number is stamped on the cylinder body.
Specifications of the engine and clutch to be shipped are recorded and filed using the numbers marked on the engine model name plate and clutch model name plate.

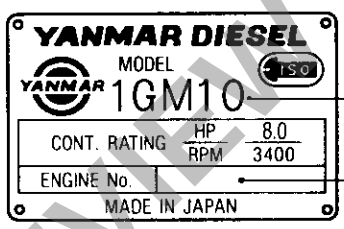
The specifications or components of the engine or clutch may have been partially altered to improve performance, and the components involved may not necessarily be interchangeable.
Therefore, when parts are ordered, please furnish the item description in the blank spaces shown in the figures, using the descriptions given on these plates.

B-1 Item descriptions on the model name plates and information to be forwarded to us

[Item descriptions on Model name plates]

[Information to be forwarded to us]

Engine model name plate

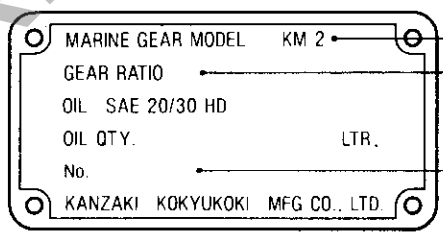


Your engine model

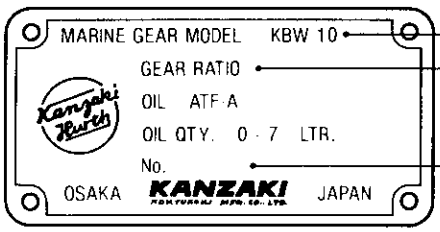
Your engine number

Clutch model name plate

GM-series



HM-series



Your clutch model

Your clutch gear ratio

Your clutch number

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1. Specifications

1-1. Direct Sea Water Cooling Type

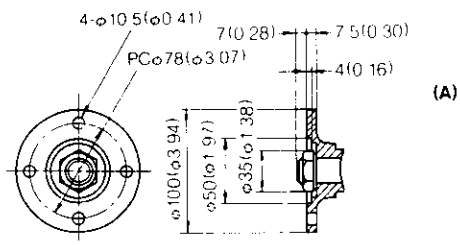
Model			1GM10	2GM20	3GM30	3HM35
Type			Vertical 4-cycle water cooled diesel engine			
Combustion chamber			Swirl pre-combustion chamber			
Number of cylinders			1	2	3	3
Bore x stroke		mm (in.)	75 x 72 (2.95 x 2.83)			80 x 85 (3.15 x 3.35)
Displacement		ℓ(in.^{3})	0.318 (19.40)	0.636 (38.81)	0.954 (58.21)	1.282 (78.23)
Continuous rating output (DIN6270A)	Output/Crankshaft speed	kW/rpm(HP/rpm)	5.9/3400(8.02/3400)	11.8/3400(16.0/3400)	17.7/3400(24.1/3400)	22.4/3200(30/3200)
	Brake mean effective pressure	kgf/cm^2 (lb/in.^{2})	6.66 (94.71)			6.58 (93.57)
	Piston speed	m/sec. (ft/sec.)	8.16 (26.77)			9.07 (29.76)
One hour rating output (DIN6270B)	Output/crankshaft speed	kW/rpm(HP/rpm)	6.7/3600(9.1/3600)	13.4/3600(18.2/3600)	20.1/3600(27.3/3600)	25.4/3400(34/3400)
	Brake mean effective pressure	kgf/cm^2 (lb/in.^{2})	7.07 (100.54)			7.02 (99.82)
	Piston speed	m/sec. (ft/sec.)	8.64 (28.35)			9.63 (31.59)
Compression ratio			23.0			24.8
Fuel injection timing (FID)		degree	b.TDC15±1	b.TDC15±1	b.TDC18±1	b.TDC21±1
Fuel injection pressure		kgf/cm^2 (lb/in.^{2})	170±5 (2347~2489)			160±5 (2204~2347)
Main power take off			at Flywheel side			
Front power take off			at Crankshaft V-pulley side			
Direction of rotation	Crankshaft		Counter-clockwise viewed from stern			
	Propeller shaft (Ahead)		Clockwise viewed from stern			
Cooling system			Direct sea water cooling (rubber impeller water pump)			
Lubrication system			Complete enclosed forced lubrication			
Starting system			Electric and manual			Electric
Clutch	Model		KM2C		KM3A	KBW10E
	Type		Mechanical cone clutch with single stage for both ahead and astern			Wet multi-disc mechanical type
	Reduction ratio (Ahead/A stern)		2.21/3.06 / 2.62/3.06 / 3.22/3.06	2.21/3.06 / 2.62/3.06 / 3.22/3.06	2.36/3.16 / 2.61/3.16 / 3.20/3.16	2.14/2.50 / 2.83/2.50
	Propeller speed DIN.A rating (Ahead/Astern)	rpm	1540/1113 / 1298/1113 / 1055/1113	1540/1113 / 1298/1113 / 1055/1113	1441/1076 / 1303/1076 / 10631/1076	1498/1280 / 1129/1280
	Lubricating oil capacity	ℓ(in.^{3})	0.25 (15.26)		0.3 (18.31)	0.7 (42.72)
	Clutch weight	kg (lb.)	9.5 (20.95)		11.0 (24.26)	17.5 (38.58)
Dimensions	Overall length	mm (in.)	547 (21.53)	638 (25.12)	735 (28.94)	786 (30.94)
	Overall width	mm (in.)	410 (16.14)	455 (17.91)	455 (17.91)	485 (19.09)
	Overall height	mm (in.)	485 (19.09)	495 (19.50)	495 (19.50)	617 (24.29)
Lubricating oil capacity (rake angle 8°)	Total	ℓ(in.^{3})	1.3 (79.33)	2.0 (122.05)	2.6 (158.65)	5.4 (329.51)
	Effective	ℓ(in.^{3})	0.6 (36.61)	1.3 (79.33)	1.6 (97.63)	2.7 (164.75)
Engine weight with cluth (dry)		Kg (lb.)	76 (168)	106 (234)	130 (287)	158 (348)

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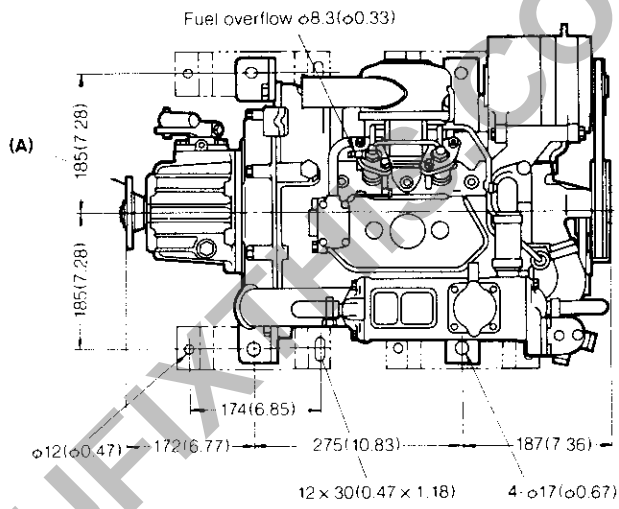
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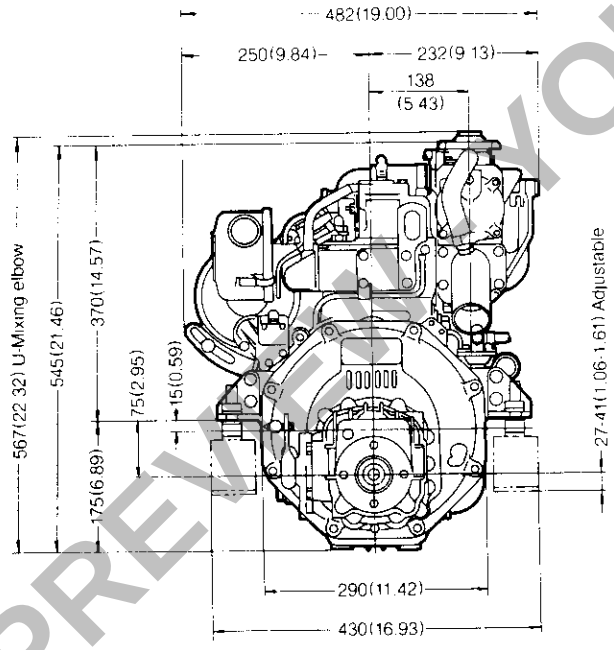
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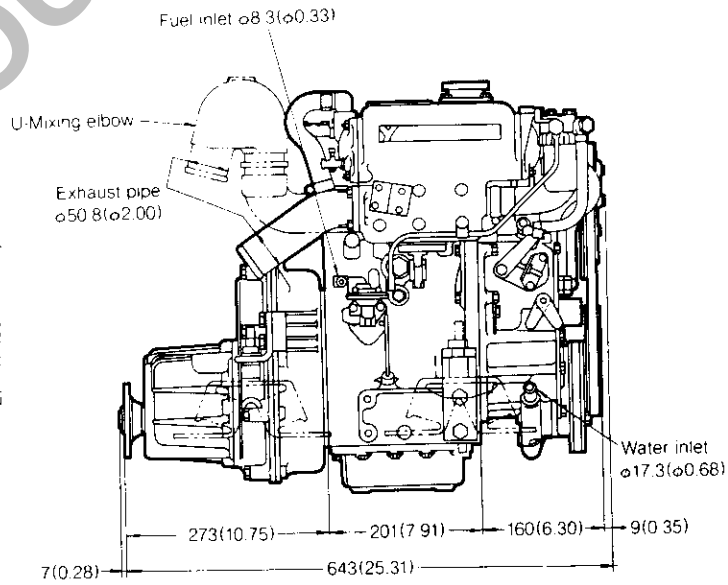
6-5 2GM20F



Detail of coupling (A)





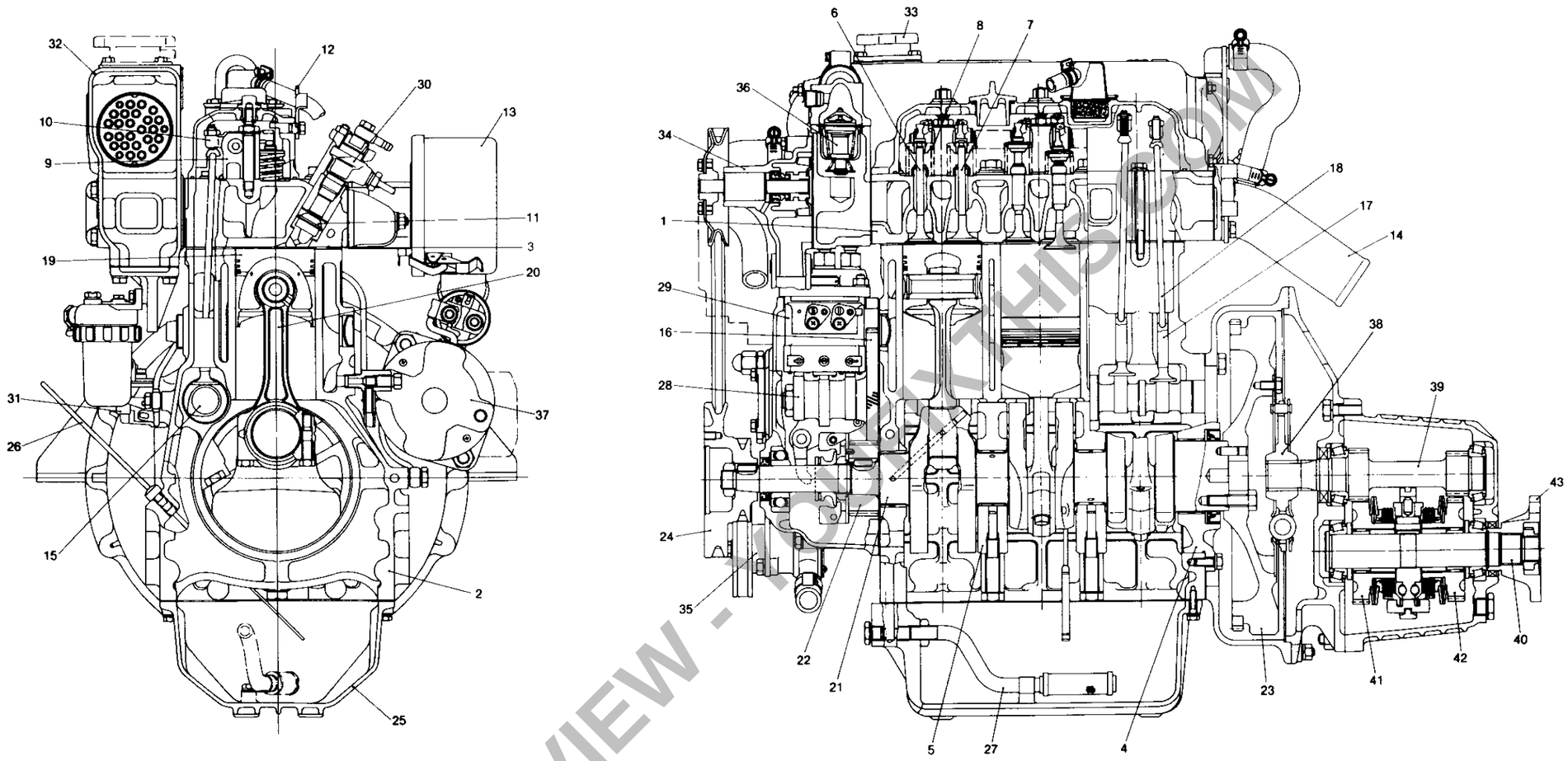


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5-7 3HM35F

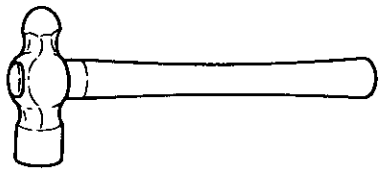
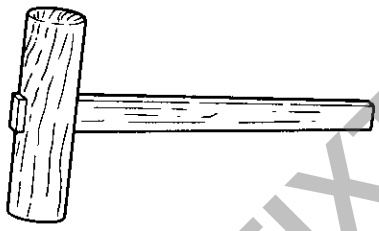
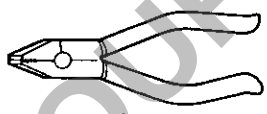
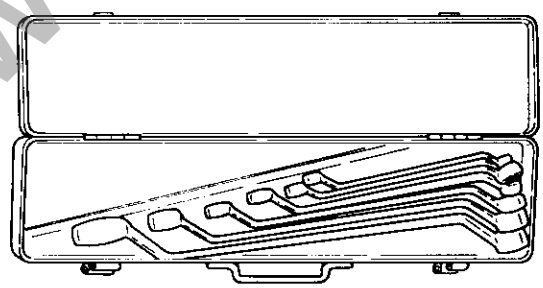
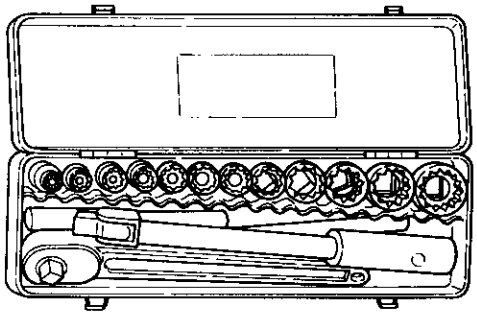


1. Cylinder head
2. Cylinder body
3. Cylinder head gasket
4. Main bearing housing
5. Intermediate main bearing housing
6. Exhaust valve
7. Intake valve
8. Valve spring
9. Valve rocker arm support
10. Valve rocker arm
11. Precombustion chamber
12. Decompression lever
13. Intake silencer
14. Mixing elbow
15. Camshaft
16. Camshaft gear
17. Tappet
18. Push rod
19. Piston
20. Connecting rod
21. Crankshaft
22. Crankshaft gear
23. Flywheel
24. Crankshaft V-pulley
25. Oil pan
26. Dipstick
27. Lubricating oil inlet pipe
28. Fuel injection pump cam
29. Fuel injection pump
30. Fuel injection nozzle
31. Fuel feed pump
32. Heat exchanger & exhaust manifold
33. Pressure control valve
34. Cooling fresh water pump
35. Cooling sea water pump
36. Thermostat
37. Starter motor
38. Damper disc
39. Input shaft
40. Output shaft
41. Forward large gear
42. Reverse large gear
43. Output shaft coupling

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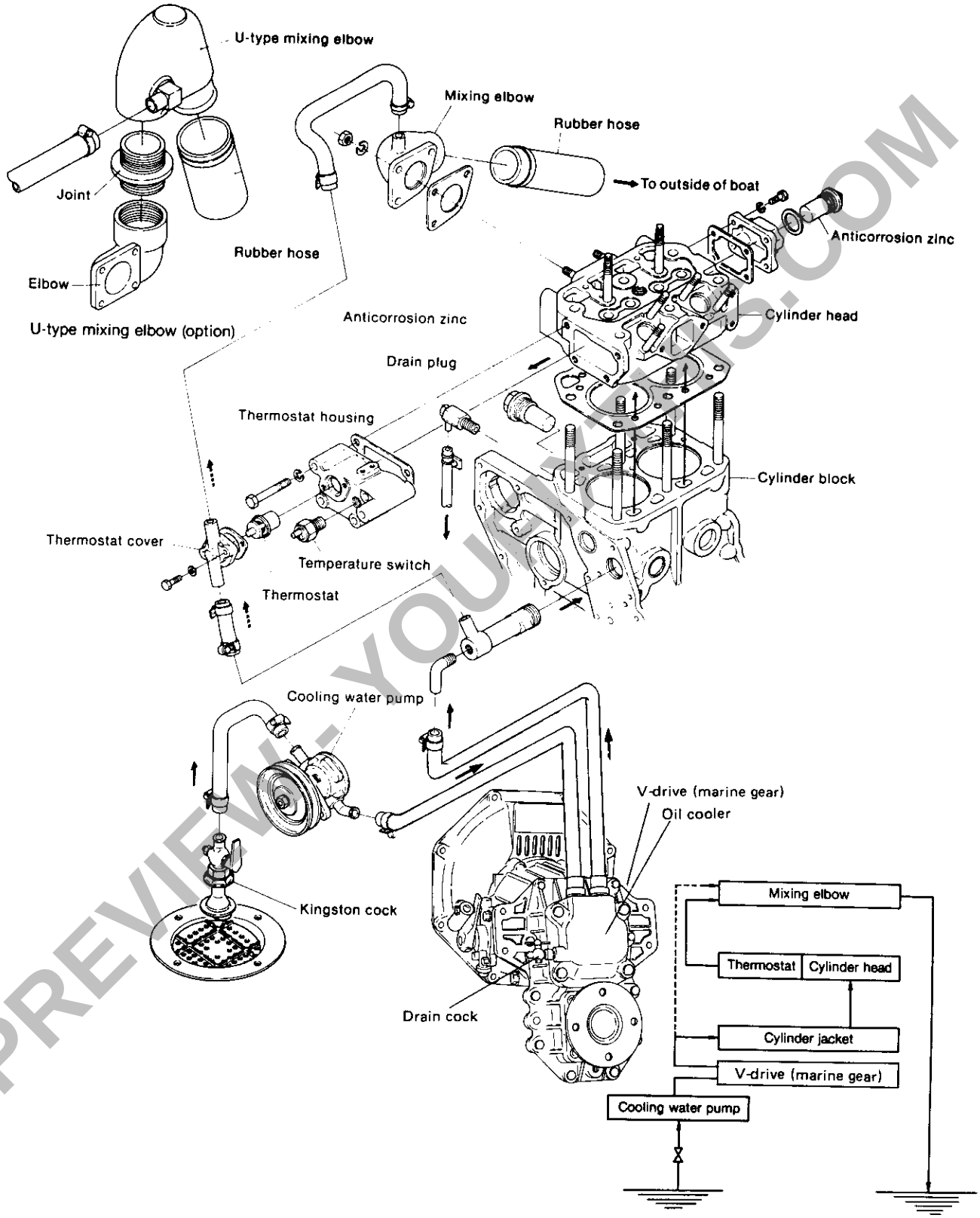
Name of tool	Illustration	Remarks
Steel hammer		Local supply
Copper hammer		Local supply
Mallet		Local supply
Nippers		Local supply
Pliers		Local supply
Offset wrench		Local supply 1 set
Box spanner		Local supply 1 set

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4-2 Cooling water passage of engine model 2GM20V and 3GM30V



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(6) IC regulator

Connect the variable resistance, two 12V batteries, resistor, and voltmeter as shown in the diagram.

1) Use the following measuring devices.

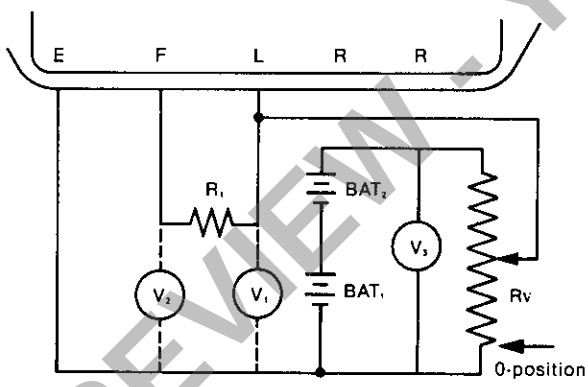
Resistor (R_1)	100Ω, 2W, 1pc.
Variable resistor (Rv)	0—300Ω, 12W, 1pc.
Battery (BAT_1, BAT_2)	12V, 2pcs.
DC voltmeter	0—30V, 0.5 class 1pc. (to measure at 3 points)

2) Check the regulator in the following sequence, according to the diagram.

a) Check V_3 (BAT_1 + BAT_2 voltage). If the voltage is 20—26V, both BAT_1 and BAT_2 are normal.

b) While measuring V_2 (F-E terminal voltage), move Rv gradually from the 0-position. Check if there is a point where the V_2 voltage rises sharply from below 2.0V to over 2.0V. If there is no such point, the regulator is defective. Replace the regulator. If there is a sharp voltage rise when testing, return the Rv to the 0-position, and connect the voltmeter to the V_1 position.

c) While measuring V_1 (voltage between L-E terminals), move Rv gradually from the 0-position. There should be a point where the voltage of V_1 rises sharply by 2—6V. Measure the voltage of V_1 just before this sharp voltage rise. This is the regulating voltage of the regulator. If this voltage of V_1 is within the standard limit, the regulator is normal. If the voltage deviates from the limit, the regulator is defective. Replace the regulator.



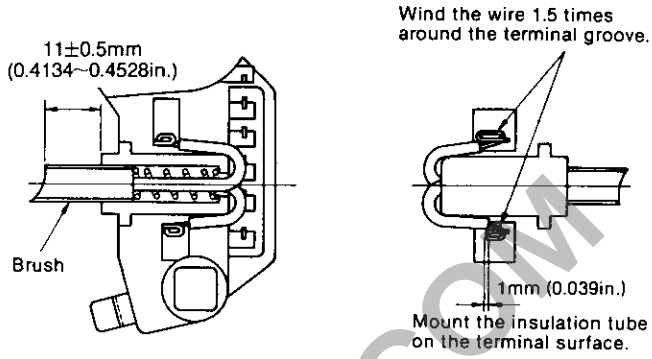
4-9 Reassembling the alternator

Reassembly is done in the reverse order of diassembly. For reassembly, be careful of the following points. (Refer to 4—7 disassembling alternator).

(1) Assembling the brush regulator

1) Solder the brushes.

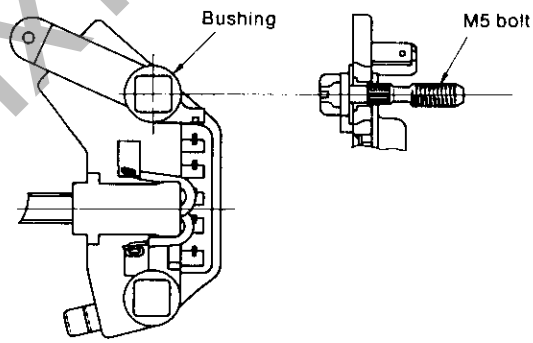
Position the brush as shown in the drawing and solder it. Be careful not to let the solder drip into the pig tail (lead wire).



NOTES: 1. Use non-acid type paste.
2. The soldering iron temperature is 300 ~ 350°C.

2) Mount the IC regulator on the brush holder as illustrated, and press in the M5 bolt. Do not forget to assemble the bushing and the connecting plate at the same time.

(If the bushing is left out, the output terminal will be earthed and the battery short-circuited).



NOTES: 1. Insertion pressure is 100kg (220.5 lbs.)
2. Insert vertically.

(2) Connecting the brush regulator assembly and diode

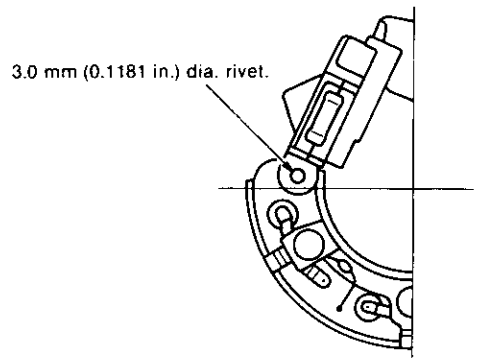
1) Check the rivets

Place the rivets as shown in the figure, and then calk them using the calking tool.

Calking torque	500kg (1102 lbs.)

2) Connect the brush to the diode.

Insert the brush side terminal into the diode terminal, calk it, and then solder into place.



Rivetting pressure	500kg (1102 lbs.)

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3-10 Various problems and their remedies

(1) Pinion fails to advance when the starting switch is closed

Problem	Cause	Corrective action
Wiring	Open or loose battery or switch terminal	Repair or retighten
Starting switch	Threaded part connected to pinion section of armature shaft is damaged, and the pinion does not move	Repair contacts, or replace switch
Starter motor	Threaded part connected to pinion section of armature shaft is damaged, and the pinion does not move	Replace
Magnetic switch	Plunger of magnetic switch malfunctioning or coil shorted	Repair or replace

(2) Pinion is engaged and motor rotates, but rotation is not transmitted to the engine

Problem	Cause	Corrective action
Starting motor	Overrunning clutch faulty	Replace

(3) Motor rotates at full power before pinion engages ring gear

Problem	Cause	Corrective action
Starter motor	Torsion spring permanently strained	Replace

(4) Pinion engages ring gear, but starter motor fails to rotate

Problem	Cause	Corrective action
Wiring	Wires connecting battery and magnetic switch open or wire connecting ground, magnetic switch and motor terminals loose	Repair, retighten, or replace wire
Starter motor	Pinion and ring gear engagement faulty Motor mounting faulty Brush worn or contacting brush spring faulty Commutator dirty Armature, field coil faulty Field coil and brush connection loose	Replace Remount Replace Repair Repair or replace Retighten
Magnetic switch	Contactor contact faulty Contactor contacts pitted	Replace Replace

(5) Motor fails to stop when starting switch is opened after engine starts

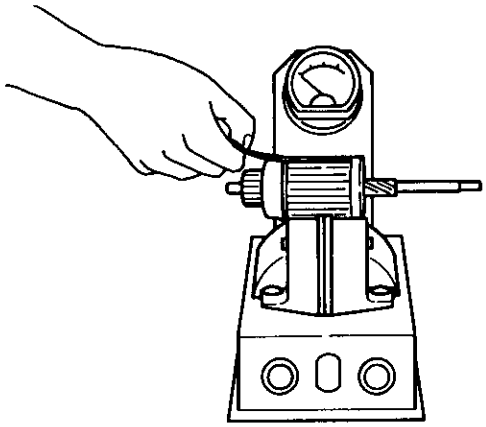
Problem	Cause	Corrective action
Starting switch	Switch faulty	Replace
Magnetic switch	Switch faulty	Replace

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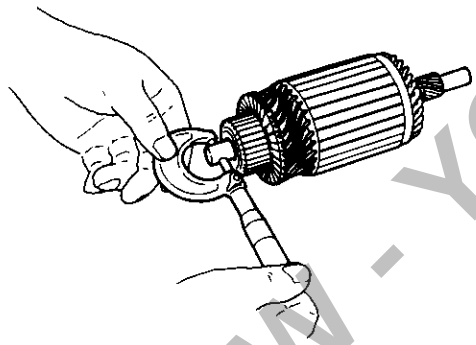
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Checking armature windings for insulation faults.

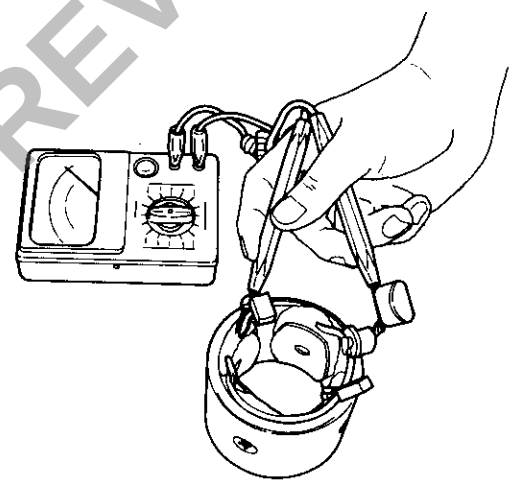


(4) Armature shaft outside diameter
Measure the outside diameter of the armature shaft at four locations: front, center, end, and pinion. Replace the armature if the shaft is excessively worn.
Check the bend of the shaft; replace the armature if the bend exceeds 0.08mm (0.0031in.)



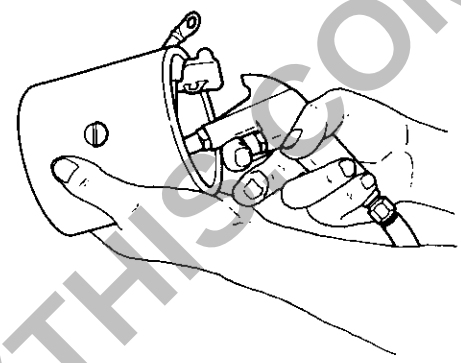
3-6.2 Field coil

(1) Open test
Check for continuity between the terminals connecting the field coil brushes. Continuity indicates that the coil is open and that the coil must be replaced.



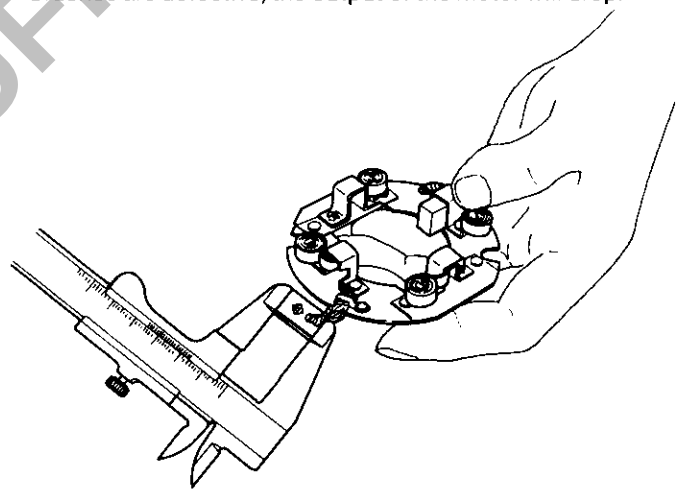
(2) Short test
Check for continuity between the yoke and any field coil terminal. Continuity indicates that the coil is shorted and that it must be replaced.

(3) Cleaning the inside of the yoke
If any carbon powder or rust has collected on the inside of the yoke, blow the yoke out with dry compressed air.
*Do not remove the field coil from the yoke.

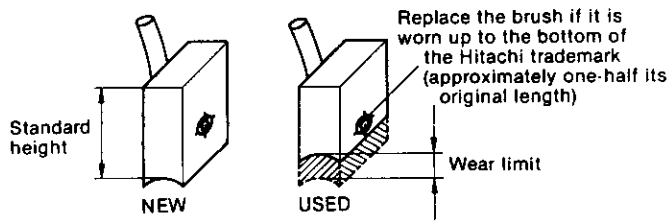


3-6.3 Brush

The brushes are quickly worn down by the motor. When the brushes are defective, the output of the motor will drop.



(1) Brush dimensions
Replace brushes which have been worn beyond the specified wear limit.



mm (in.)

	S114-303	S12-77A
Brush standard height	16 (0.6299)	22 (0.8661)
Wear limit	4 (0.1575)	8 (0.3150)

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2-7 Adjusting intake and exhaust valve head clearance

Adjustment of the intake and exhaust valve head clearance governs the performance of the engine, and must be performed accurately. The intake and exhaust valve head clearance must always be checked and readjusted, as required, when the engine is disassembled and reassembled, and after every 300 hours of operation. Adjust the valve head clearance as described below.

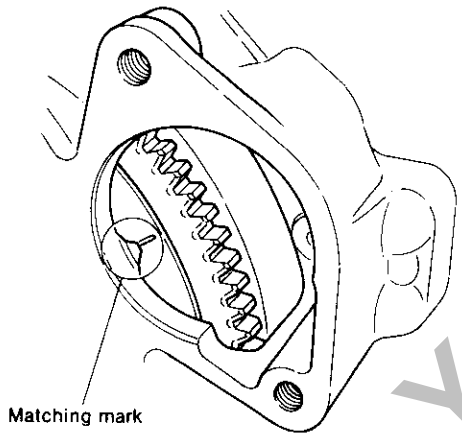
2-7.1 Adjustment

Make this adjustment when the engine is cold.

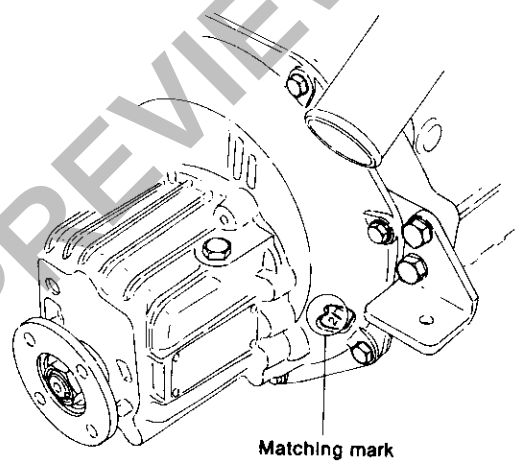
(1) Remove the valve rocker arm cover.

(2) Crank the engine and set the piston to top dead center (TDC) on the compression stroke.

The matching mark is made at the setting hole of the starter motor on all models.

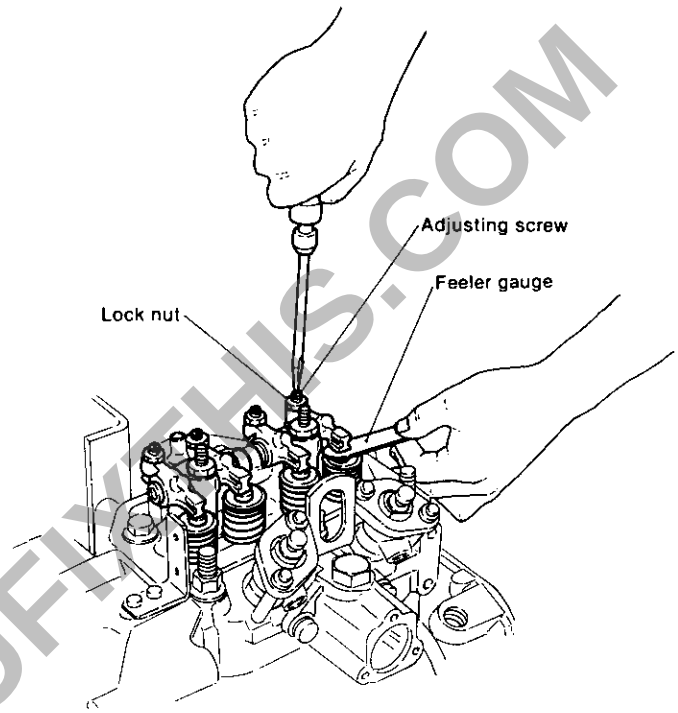


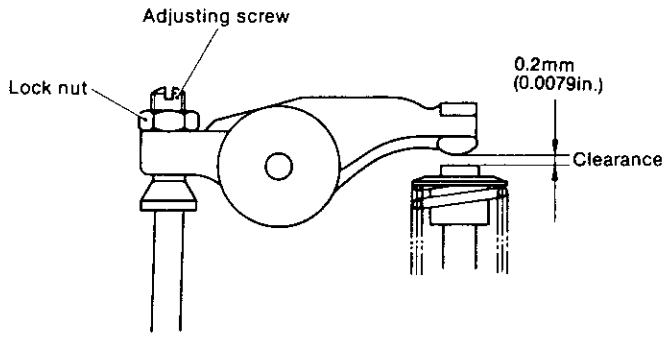
With respect to models 1GM10(C), 2GM20(F)(C) and 3GM30 .(F)(C) only, a projection which serves as the matching mark is provided in the cast hole of the clutch housing.



NOTE: Set to the position at which the valve rocker arm shaft does not move even when the crankshaft is turned to the left and right, centered around the matching mark.

(3) Check and adjust the intake and exhaust valve head clearances of the No. 1 piston.
Loosen the valve clearance adjusting screw lock nut, adjust the clearance to the maintenance standard with a feeler gauge, and retighten the lock nut.





	All models
Intake and exhaust valve head clearance:	0.2mm (0.0079in.)

In the case of 2GM20(F)(C), adjust the valve head clearance of the No. 2 cylinder in the same manner after turning the crankshaft 180°.

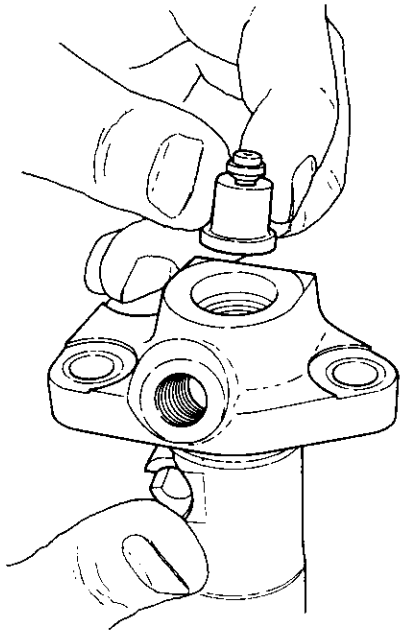
In the case of 3GM30(F)(C), 3HM35(F)(C), adjust the valve head clearance on the No. 3 cylinder in the same manner after turning the crankshaft 240° and then adjust the No. 2 cylinder after turning the crankshaft another 240°.

NOTE: If you adjust the valve head clearance of the No. 2 cylinder first, turn the crankshaft 540°. Adjust the clearance of the No. 1 cylinder in the same manner on a 2 cylinder engine.

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(2) Attach the delivery valve seat and the delivery valve to the main unit.



Attaching the delivery valve to the main unit

NOTE: If the delivery valve tip projects noticeably above the top of the main unit of the pump, the plunger barrel has been installed incorrectly, and must be re-attached.

(3) Attach the delivery valve packing and the delivery valve spring to the main unit and carefully tighten the delivery valve holder.

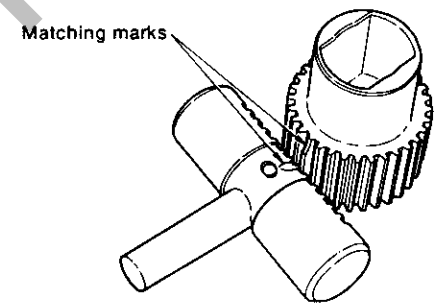
NOTE: Tighten the delivery valve holder with a torque wrench after attaching the plunger and while checking the fuel control rack for sliding motion.

1GM(10(C)	kgf-m(ft-lb)
Tightening torque	4.0 ~ 4.5 (28.92 ~ 32.54)

(4) With the matching mark of the fuel control rack directed towards the lower part of the main unit of the pump, attach the fuel control rack to the main unit.

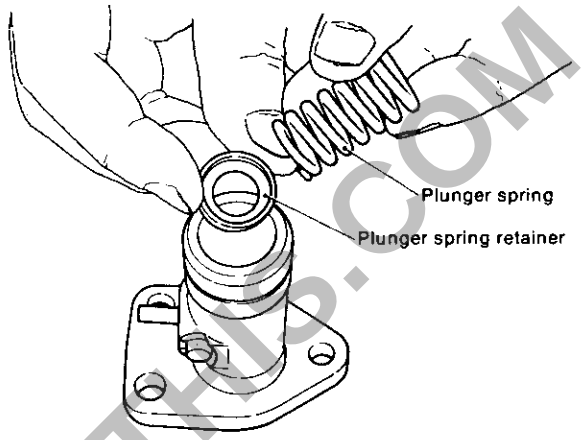
NOTE: Make sure the fuel control rack moves smoothly along its entire stroke.

(5) By aligning the matching mark on the fuel control pinion with that on the fuel control rack, attach the fuel control pinion to the main unit.



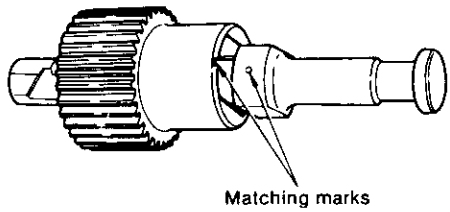
NOTE: After attaching the fuel control pinion to the main unit, check its meshing by moving the fuel control rack.

(6) Insert the plunger spring retainer and attach the plunger spring to the main unit.



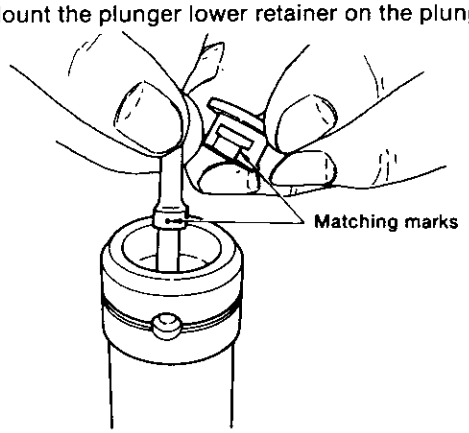
NOTE: The plunger spring retainer should face the underside of the pump.

(7) After aligning the matching mark on the plunger flange with that on the fuel control pinion, attach the plunger to the main unit.



NOTE: Invert and stand the main unit of the pump upright and attach the plunger to it carefully.

(8) Mount the plunger lower retainer on the plunger.



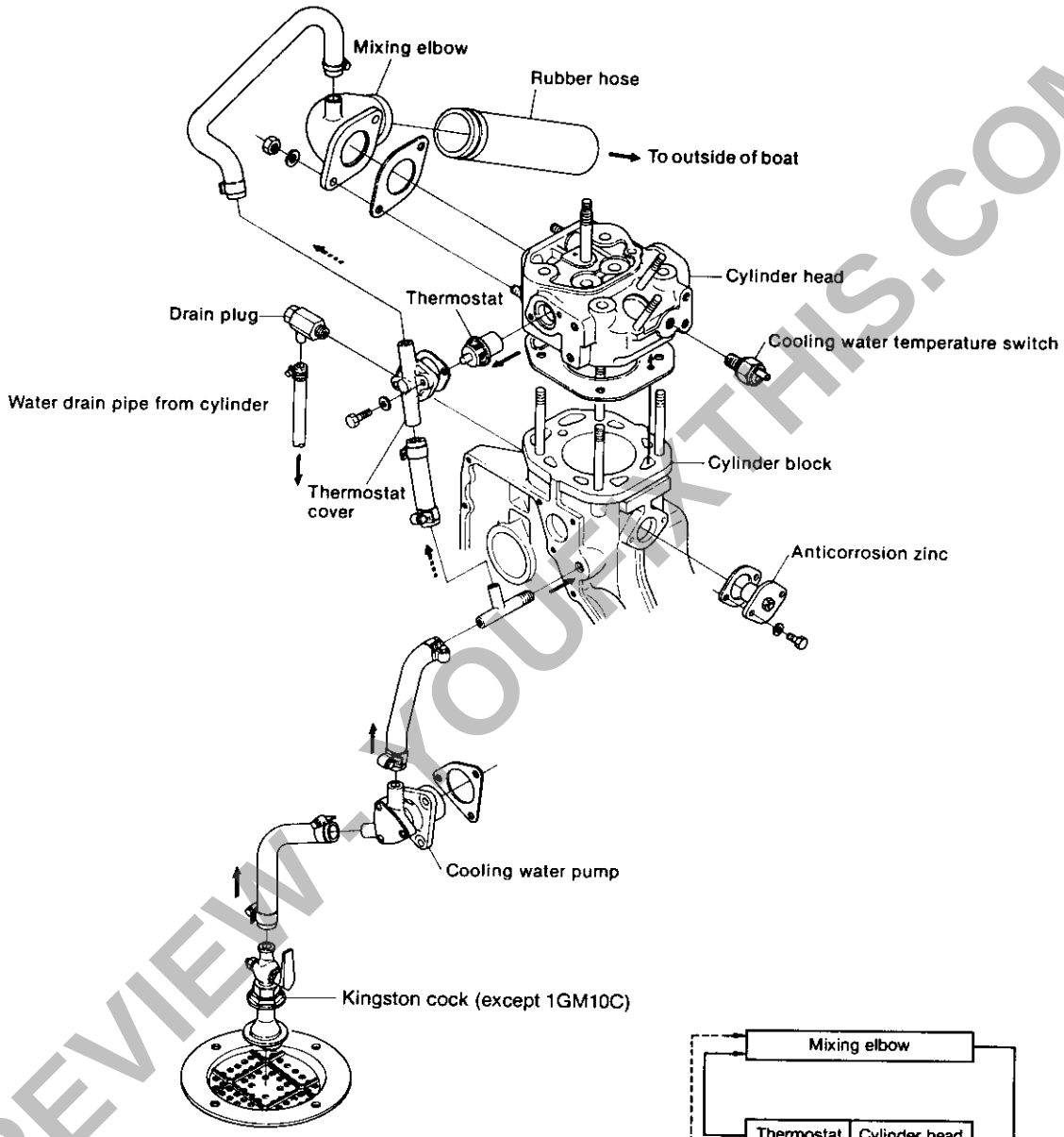
(9) Insert the plunger adjusting shims.

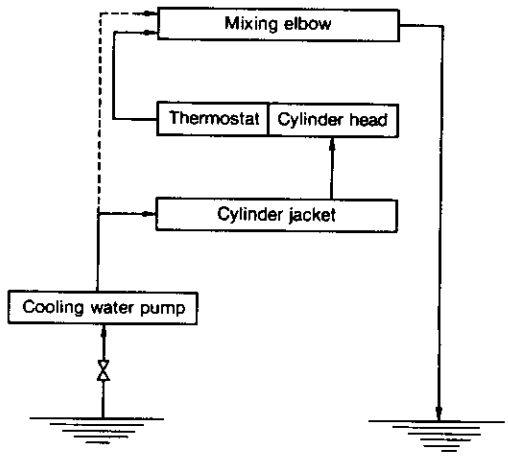
NOTE: Insert the same number of shims with the same thickness as those inserted before disassembling the pump. After re-assembling the pump, measure and adjust the top clearance of the plunger.

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1-2.1 Cooling water passage of engine model 1GM10(C)



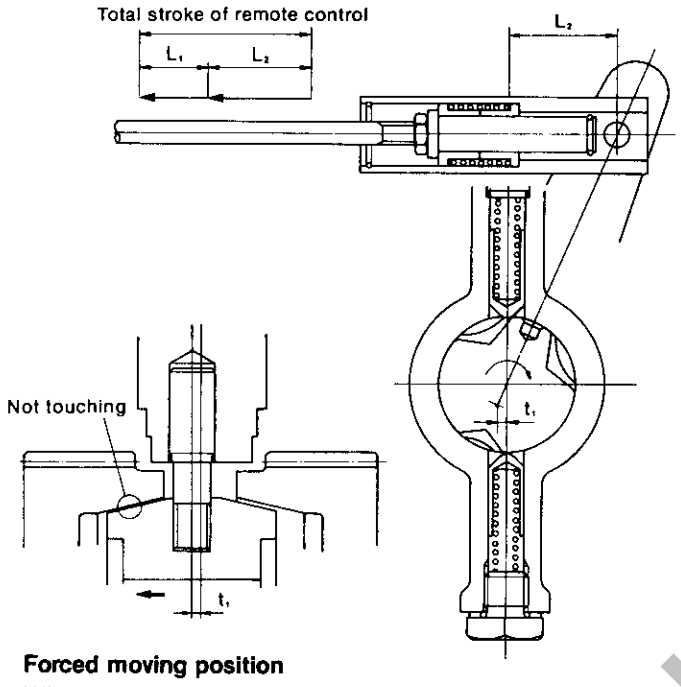


← When the cooling water is at the correct temperature
←··· When the cooling water temperature is lower than the correct temperature

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By pushing the remote control joint the holder moves, and the shift lever and the shift lever shaft also move to disengage the notch from the neutral position.



Forced moving position

When the shift lever is forcibly moved through distance L_2 the shifter moves distance t_1. In this position, the drive cone has not yet made contact. However, notches (A) and (B) are disengaged from the neutral notch slot, and notch (A) is positioned on the tapered surface.

The shift lever shaft is turned by the movement of the remote control joint. When the notch touches the tapered part of the forward setting slot, it is pushed by the notch spring force and turns the shift lever forward. At the same time, as the remote control joint is fixed by the two retainers of the spring joint being in contact with each other, the holder is moved by the spring reaction so that the shift lever is pushed forward.

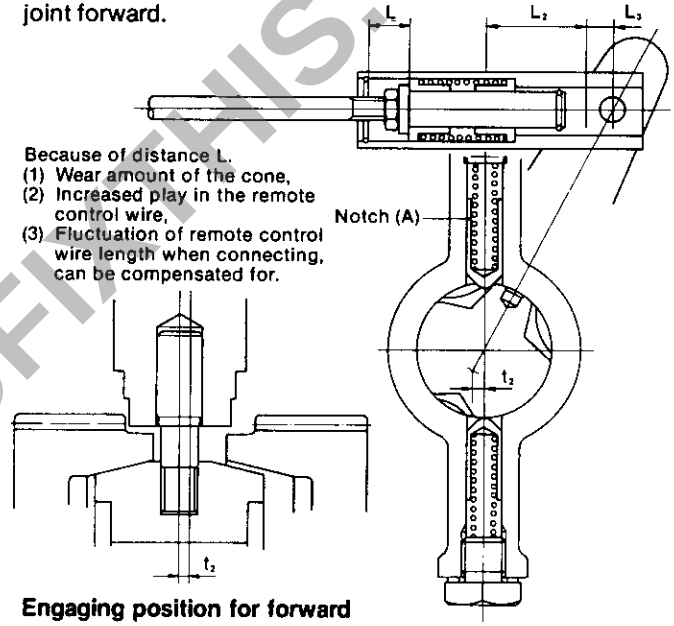
By the actions of the notch spring and spring joint, the shifter maintains pressure on the drive cone.

Engaging position for forward

By means of the shift lever shaft turning force which is caused by the spring in the joint and the notch (A), the shifter is moved distance L_3 and engagement is complete. Pressure is maintained on the drive cone after engagement.

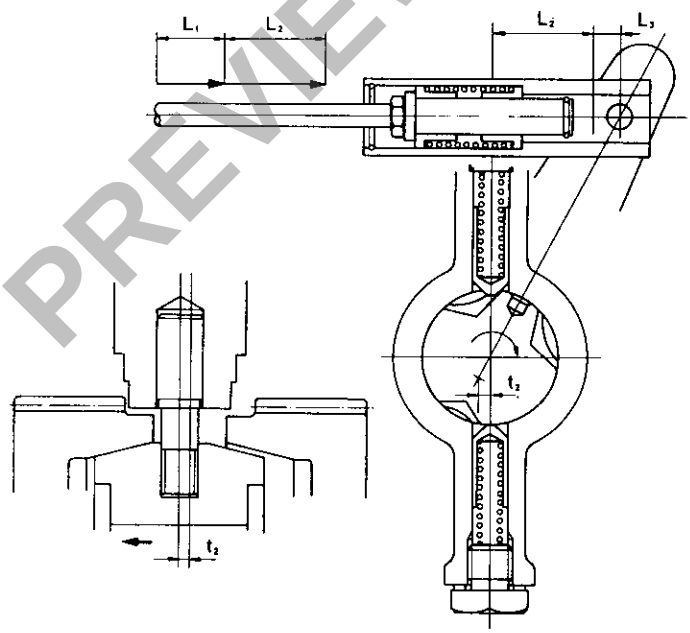
2-2.2 Engagement from forward to neutral

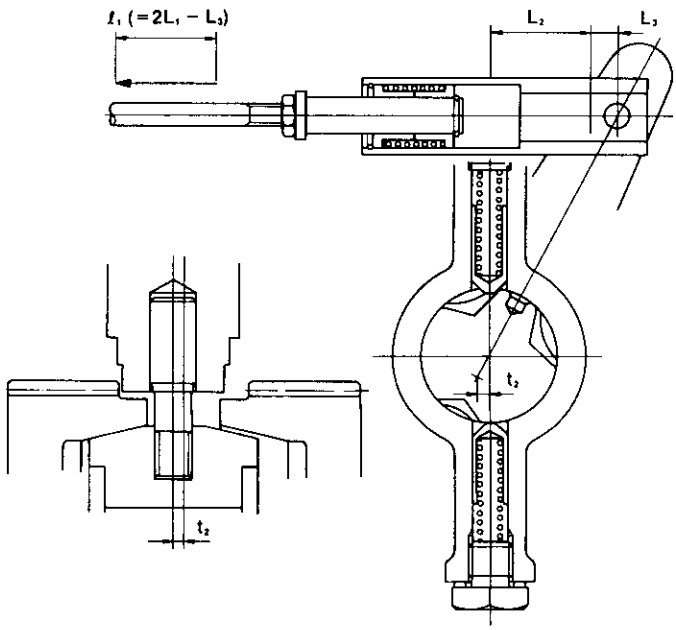
Engagement for reverse is the same as for forward, that is, return to the neutral position and move the remote control joint forward.



Engaging position for forward

The drive cone, which is moved by the spring in the joint and notch (A), is kept under force until distance L becomes zero even when the cone is worn.





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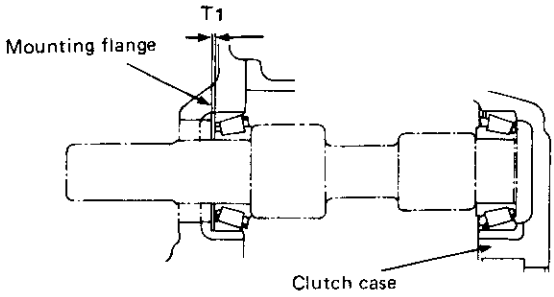
(1)Shim thickness (T1) measurement of input shaft

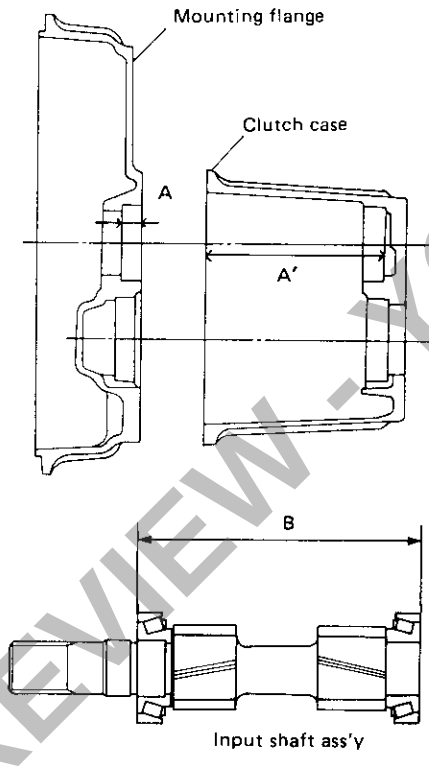
(a)Measure the bearing insertion hole depth (A) of the mounting flange, and the bearing insertion hole depth (A') of the clutch case.

(b)Measure the length (B) between the bearing outer races of the input shaft assembly.

(c)Obtain the (T1) thickness by the following formula:

$T_1 = A + A' - B$ (T1: Clearance ± 0.05mm)



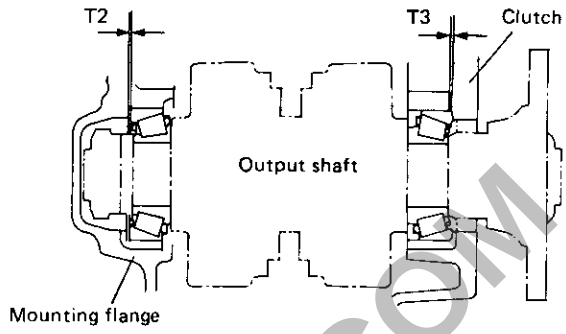


(2)Shim thickness (T2, T3) measurement of output shaft

(a)Measure the bearing insertion hole depth (C) of the mounting flange, and the bearing insertion hole depth (C') of the clutch case.

(b)Measure the length (D) between the bearing outer races.

NOTE: Tighten the mounting flange nut of the output shaft assembly with the specified torque. Press-fit the inner race of the clutch case roller bearing to the large gear side.



(c)Measure the (F) and (E) length from the outer race end of the clutch case bearing included in the output shaft assembly.

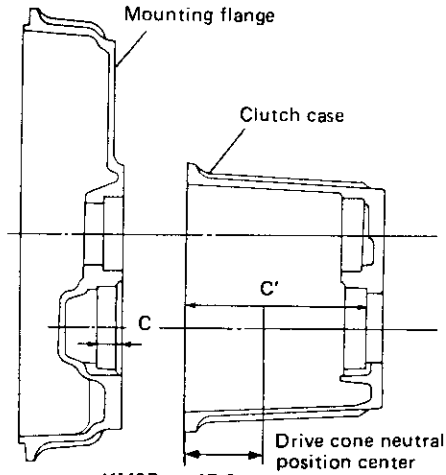
NOTE. Before measuring the (F) and (E) length, press the forward large gear and the reverse large gear to the drive cone until there is no clearance among them.

(d)Obtain the (T2) and (T3) thickness by the following formulas:

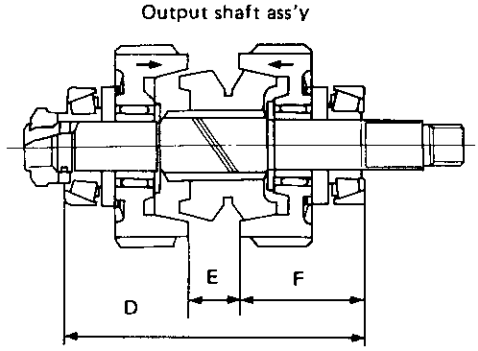
$T_2 = C + C' - D - T_3$ (Clearance $\pm^{0.1mm}_{0}$)

T_3 (KM2P) $= C' - 48.3 - \frac{E}{2} - F$ (Clearance ±0.05mm)

T_3 (KM3P) $= C' - 47.3 - \frac{E}{2} - F$ (Clearance ±0.05mm)



Output shaft ass'y

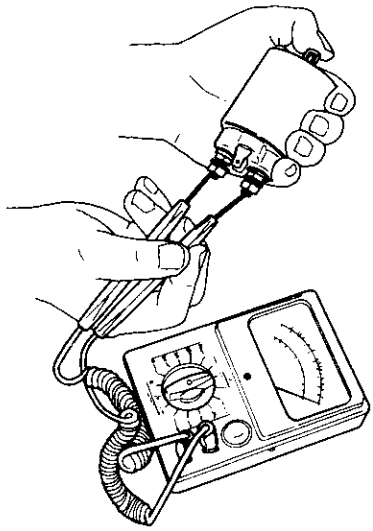


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(3) Contactor contact test
Push the plunger with your finger and check for continuity between the M terminal and B terminal. Continuity indicates that the contact is faulty and that the contactor must be replaced.



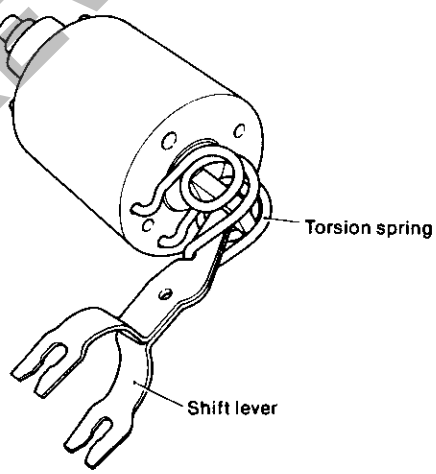
3-6.5 Pinion

(1) Inspect the pinion teeth and replace the pinion if the teeth are excessively worn or damaged.
(2) Check if the pinion slides smoothly; replace the pinion if faulty.
(3) Inspect the springs and replace if faulty.
(4) Replace the clutch if it slips or seizes.

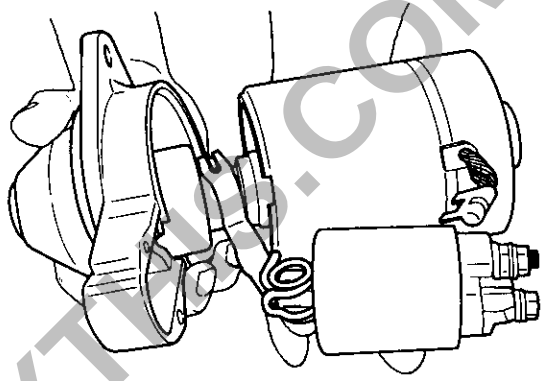
3-7 Reassembly precautions

Reassemble the starter motor in the reverse order of disassembly, paying particular attention to the following:

(1) Torsion spring and shift lever
Hook the torsion spring into the hole in the magnetic switch and insert the shift lever into the notch in the plunger of the magnetic switch through the torsion spring.



(2) Mounting the magentic switch
Attach the shift lever to the pinion; assemble the gear case as shown below.
Do not forget to install the dust cover before assembling the gear case.
After reassembly, check by conducting no-load operation.



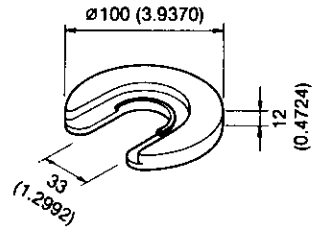
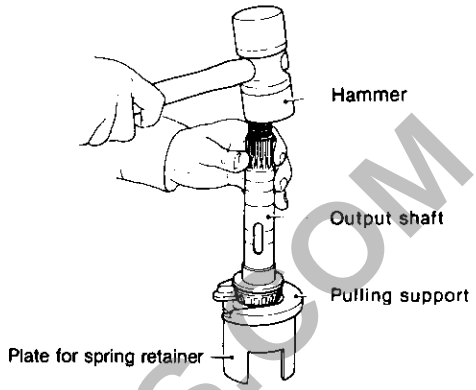
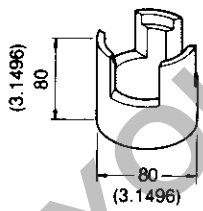
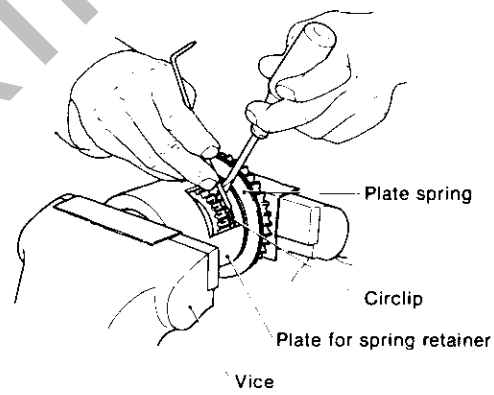
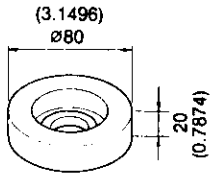
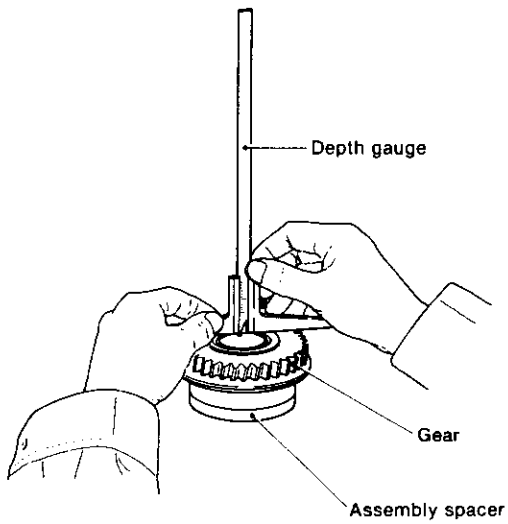
(3) Lubrication
Lubricate each bearing and spline (points indicated in the figure below) with high quality "Hitachi Electrical Equipment Grease A".
The following lubricants may be used in place of Hitachi Electrical Equipment Grease A.

Magnetic switch plunger	Shell	Aeroshell No. 7
Bearing and spline	Shell	Albania Grease No. 2

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Name of tool	Shape and size	Application
Pulling support for 3HM35(F)	mm (in.)  Code no.; 177099-09030	 For removing the needle bearing inner race, thrust collar and thrust bearing of the output shaft (forward gear side).
Plate for spring retainer for 3HM35(F)	mm (in.)  Code no.; 177095-09070	 For removing and installing the plate spring, retainer and circlip of the large gears (forward and reverse).
Assembly spacer for 3HM35(F)	mm (in.)  Code no.; 177090-09010	 For determining the thickness of the adjusting plate.

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