CONTENTS

(4) Hose screw

Thread size (piping screw)	Tightening torque N·m kgf·m		Wrench size
	Union nut section	Taper thread section	
1/8”	7.8 ~ 11.8 N·m 0.8 ~ 1.2 kgf·m	14.71 ~ 19.61 N·m 1.5 ~ 20 kgf·m	17 mm
1/4”	24.5 ~ 29.4 2.5 ~ 3.0	36.3 ~ 44.1 3.7 ~ 4.5	19 mm
3/8”	49.0 ~ 53.9 5.0 ~ 5.5	49.0 ~ 68.6 5.0 ~ 7.0	22 mm
1/2”	58.8 ~ 63.7 6.0 ~ 6.5	83.4 ~ 88.3 8.5 ~ 9.0	27 mm
3/4”	117.7 ~ 127.5 12.0 ~ 13.0	127.5 ~ 147.1 13.0 ~ 15.0	36 mm
1”	137.3 ~ 147.1 14.0 ~ 15.0	147.1 ~ 166.7 15.0 ~ 17.0	41 mm

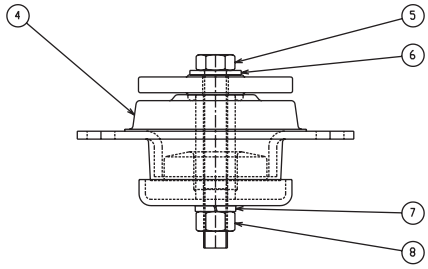
Metric Size Hose

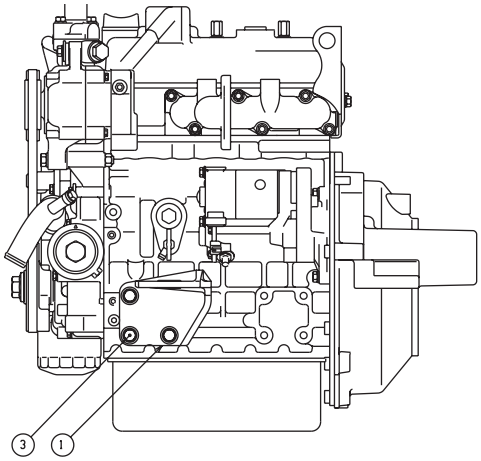
Thread size (piping screw)	Torque N·m kgf·m
M12 × 1.5	20 ~ 30 2.0 ~ 3.1
M14 × 1.5	20 ~ 30 2.0 ~ 3.1
M16 × 1.5	30 ~ 50 3.1 ~ 5.1
M18 × 1.5	30 ~ 50 3.1 ~ 5.1
M22 × 1.5	40 ~ 60 4.1 ~ 6.1

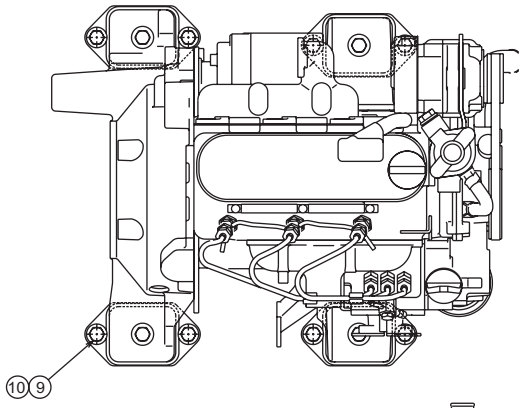
(5) Joint bodies

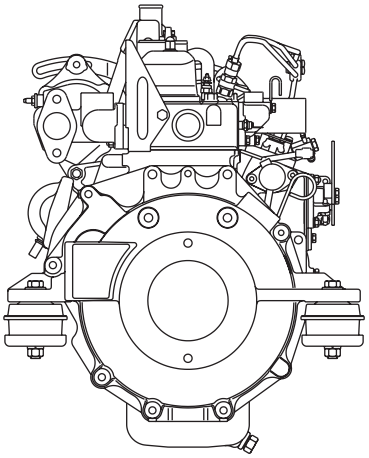
Thread size (piping screw)	Tightening torque N·m kgf·m		Spanner size (reference)	Remarks Steel pipe (OD)	
	R (tapered thread)	G (straight thread)			
1/8”	19.6 ~ 29.4 N·m 2.0 ~ 3.0 kgf·m	—	17 mm	When in steel pipe is in use.	8 mm
1/4”	36.3 ~ 44.1 3.7 ~ 4.5	W/O-ring *Joint Torque* 58.8 ~ 78.5 6 ~ 8	19 mm		12 mm
3/8”	39.2 ~ 49.0 4.0 ~ 5.0	W/O-ring *Joint Torque* 78.5 ~ 98.1 8 ~ 10	23 mm		15 mm
1/2”	49.0 ~ 68.6 5.0 ~ 7.0	W/O-ring *Joint Torque* 117.7 ~ 137.3 12 ~ 14	26 mm		16 mm

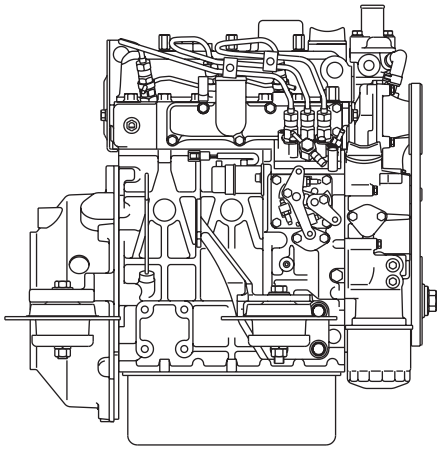
b. Engine mount

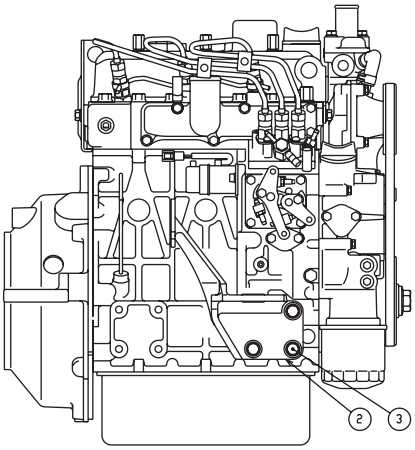










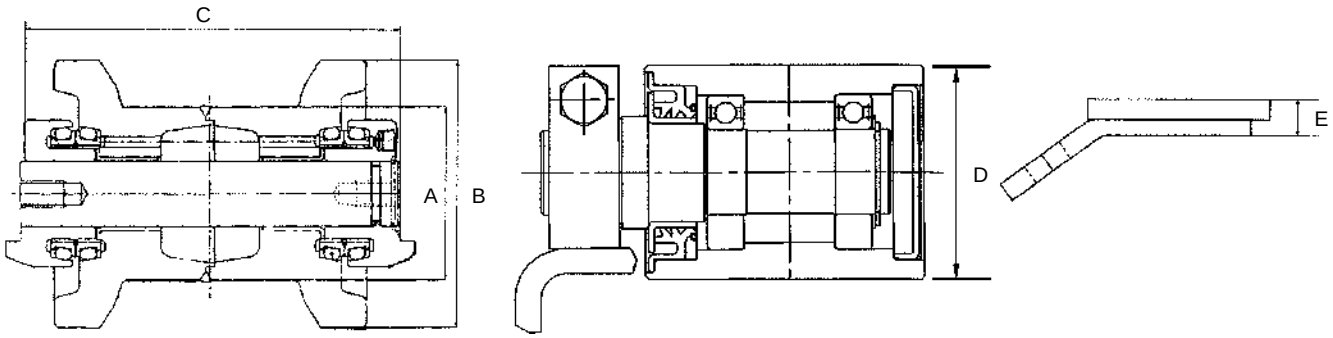


No.	PART NAME
1	Bracket (1, Engine)
2	Bracket (2, Engine)
3	Bolt
4	Rubber, cussionLock
5	Bolt
6	Washer, plain
7	Washer, spring
8	Nut
9	Bolt
10	Spring, plate

[5] Track roller, idler, and sprocket

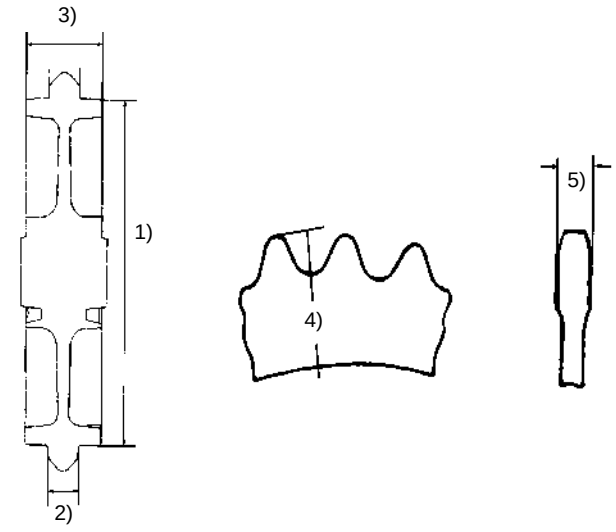
		Unit	U20-3	U25-3		Remarks
A : Guide width	(A)/(B)	mm	63 / 59	80 / 76		
B : Outer diameter	(A)/(B)	mm	107 / 103	124 / 120		
C : Roller width	(A)/(B)	mm	150 /	175 /		
D : Upper roller diameter	(A)/(B)	mm	76.3 /	76.3 /		
E : Sliding plate thickness	(A)/(B)	mm	22 / 11	22 / 11		

(A)New machine reference value
(B)Allowable limit

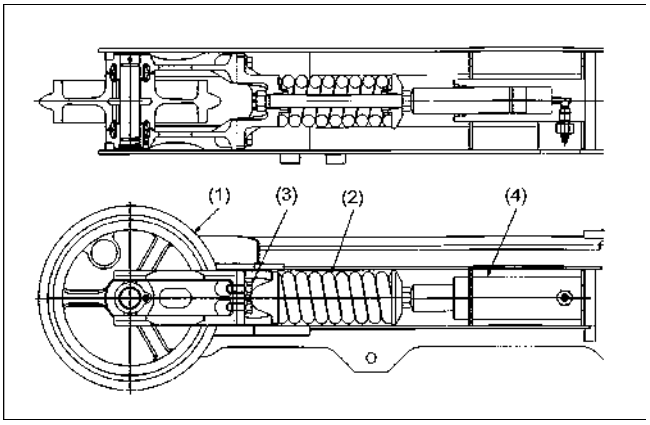


		Unit	U20-3	U25-3		Remarks
1) Idler O.D.	(A)/(B)	mm	238 / 230	272 / 264		
2) Guide width	(A)/(B)	mm	24 / 20	30 / 26		
3) Idler width	(A)/(B)	mm	88 / 84	113 / 109		
4) Sprocket wheel O.D.	(A)/(B)	mm	316 / 308	356 / 348		
5) Sprocket wheel width	(A)/(B)	mm	23 / 19	30 / 26		

(A)New machine reference value
(B)Allowable limit



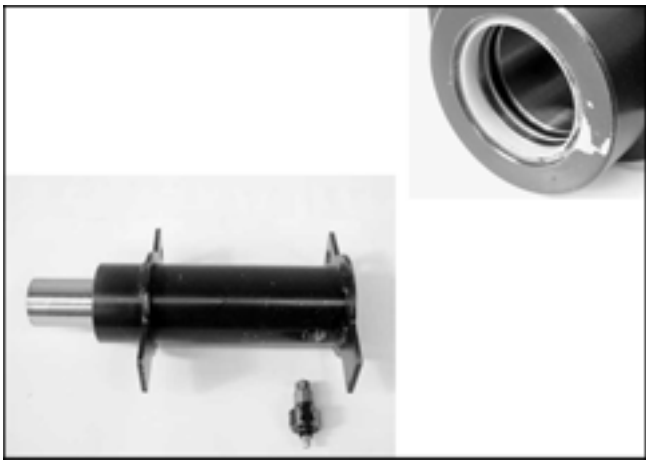
c Track tension device



1) Assembling procedure

1. Make sure the unit slides smoothly in the track frame.
2. Tightening torque of idler assembly and tension spring plate:
   77.5~90.2N·m(7.9~9.2kgf·m)
   Apply screw LOCTITE. (Loctite 547)
3. Idler lubricant amount Engine Oil Release controller SAE#30CD U-20-3:35cc·U-25-3:75cc
4. Engine Oil Make the setting at split pin position nearest to 174.3±0.5 mm.
5. Parts list

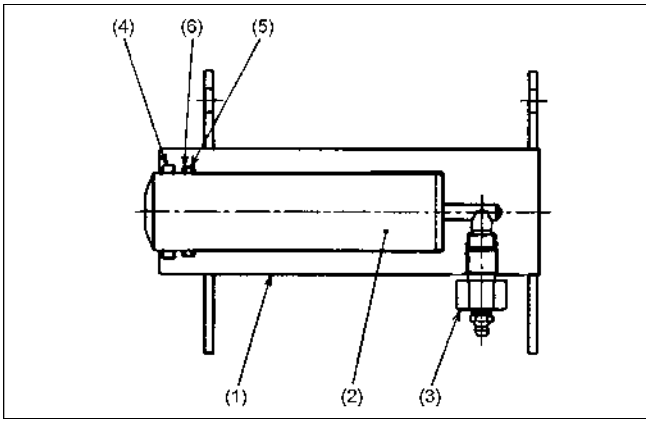
No.	Part No.	Part name	Q'ty	Remarks
1	RB411-2130Δ	Idler, assembly	2	U-20-3
	RB511-2130Δ	Idler, assembly	2	U-25
2	RB411-2140Δ	Spring, assembly	2	U-20-3
	RB511-2140Δ	Spring, assembly	2	U-25
3	01133-61230	Bolt	8	M12×1.25
4	RB411-2150Δ	Cylinder, assembly	2	



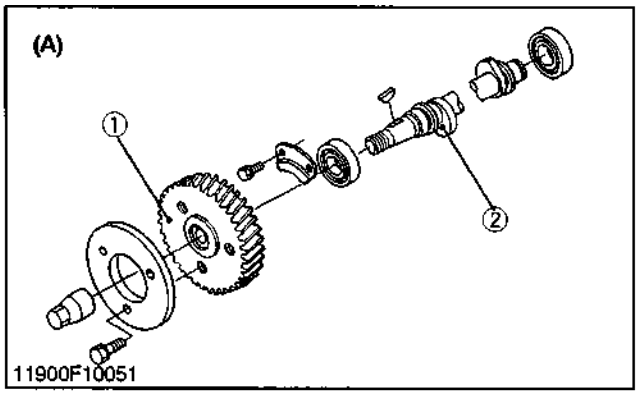
2) Tension cylinder

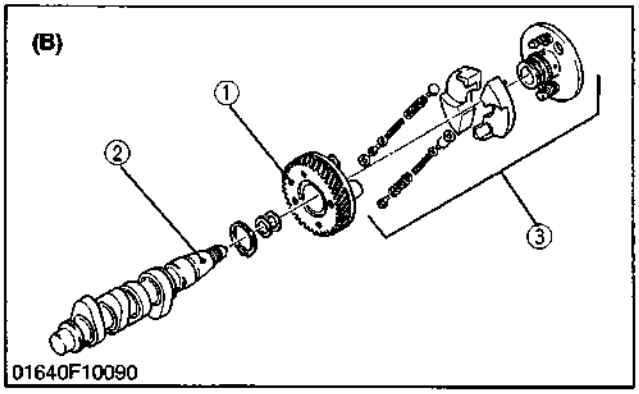
1. Tightening torque of nipple:
   98~107.8N·m(10~11kgf·m)
2. If the cylinder has been detached, check the rod (rod seal, O-ring side) for grease leak.
3. If the nipple has been detached, check the tube and nipple seat for scratches and dust deposits.
4. In detaching the nipple, keep in mind that the nipple may pop out because of the inner pressure of the cylinder.

No.	Part No.	Part name	Q'ty
1	RB411-2151Δ	Cylinder tube	1
2	RC101-21571	Rod	1
3	RC101-21553	Nipple, assembly	1
4	68241-21551	Rod seal	1
5	04810-00400	O-ring	1
6	68051-62371	Backup ring	1



[8] Fuel camshaft





The fuel camshaft (2) controls the reciprocating movement of the injection pump.

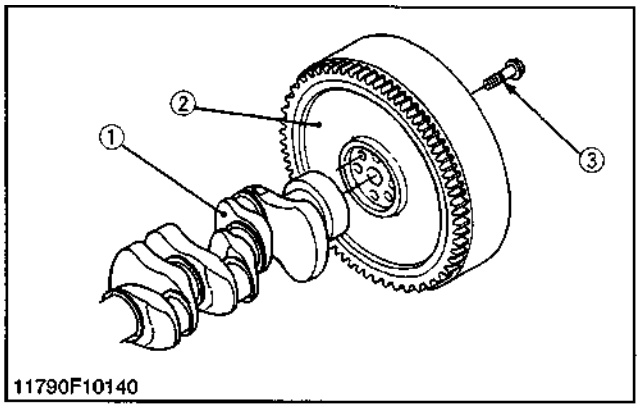
The fuel camshaft is made of carbon steel and the cam sections are quenched and tempered to provide greater wear resistance.

(1) Injection Pump Gear
(2) Fuel Camshaft
(3) Automatic Advance Timer (not included in the basic model)

(A) Without Timer
(B) With Timer

11900M10061

[9] Flywheel



The flywheel stores the rotating force in the combustion stroke as inertial energy, reduces crankshaft rotating speed fluctuation and maintains the smooth rotating conditions.

The flywheel periphery is inscribed with the marks showing fuel injection timing angle lines and top dead center mark **TC**.

The flywheel has gear teeth around its outer rim, which mesh with the drive pinion of the starter.

(1) Crankshaft
(2) Flywheel
(3) Flywheel Screw

11900M10081

Piston · Piston Ring

Item		Factory Specification	Allowable Limit
Piston Pin Bore		22.000 to 22.013 mm 0.8661 to 0.8687 in.	22.03 mm 0.8673 in.
Clearance between Compression Ring 2 and Ring Groove		0.085 to 0.112 mm 0.0033 to 0.0044 in.	0.20 mm 0.0079 in.
Clerance between Oil Ring and Ring Groove		0.020 to 0.055 mm 0.0008 to 0.0021 in.	0.15 mm 0.0059 in.
Ring Gap Compression Ring 1	D905-B (E) V1205-B (E)	0.25 to 0.40 mm 0.0098 to 0.0157 in.	1.25 mm 0.0492 in.
	D1005-B (E) V1305-B (E) D1105-B (E) V1505-B (E)	0.30 to 0.45 mm 0.0118 to 0.0170 in.	1.25 mm 0.0492 in.
	D1105-T-B (E) V1205-T-B (E) V1505-T-B (E)	0.20 to 0.35 mm 0.0079 to 0.0138 in.	1.20 mm 0.047 in.
Compression Ring 2	D905-B (E) V1205-B (E)	0.25 to 0.40 mm 0.0098 to 0.0157 in.	1.25 mm 0.0492 in.
	D1005-B (E) V1305-B (E) D1105-B (E) V1505-B (E)	0.30 to 0.45 mm 0.0118 to 0.0170 in.	1.25 mm 0.0492 in.
	V1205-T-B (E)	0.20 to 0.35 mm 0.0079 to 0.0138 in.	1.20 mm 0.047 in.
	D1105-T-B (E) V1505-T-B (E)	0.40 to 0.55 mm 0.0157 to 0.0217 in.	1.20 mm 0.047 in.
Oil Ring	D905-B (E) D1005-B (E) V1205-B (E) V1205-T-B (E) V1305-B (E) D1105-B (E) V1505-B (E)	0.25 to 0.40 mm 0.0098 to 0.0157 in.	1.25 mm 0.0492 in.
	D1105-T-B (E) V1505-T-B (E)	0.30 to 0.55 mm 0.0118 to 0.0217 in.	1.25 mm 0.0492 in.

Connecting Rod

Connecting Rod Alignment	-	0.05 mm 0.0020 in.
Clearance between Piston Pin and Small end Bushing	0.014 to 0.038 mm 0.0006 to 0.0015 in.	0.15 mm 0.0059 in.
Piston Pin O.D.	22.002 to 22.011 mm 0.8662 to 0.8666 in.	–
Small End Bushing I.D.	22.025 to 22.040 mm 0.8671 to 0.8677 in.	–

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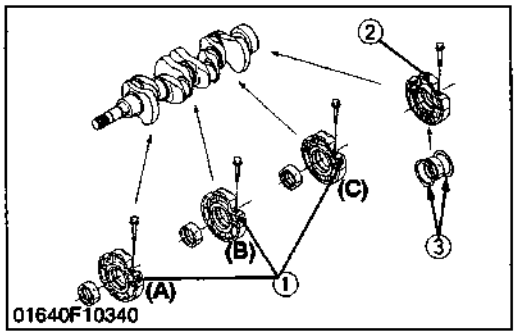

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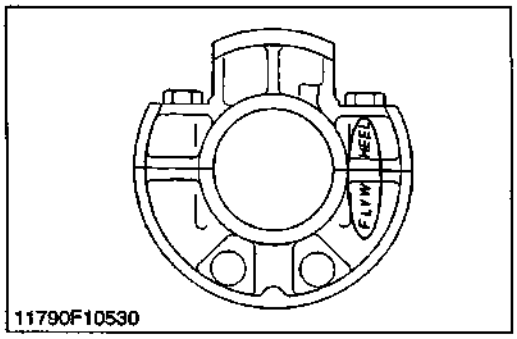

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Main Bearing Case Assembly

1. Remove the two main bearing case screws 1, and remove the main bearing case assembly (2), being careful with the thrust bearing (3) and crankshaft bearing 2.
2. Remove the main bearing case assembies 1, 2 and 3 as above.

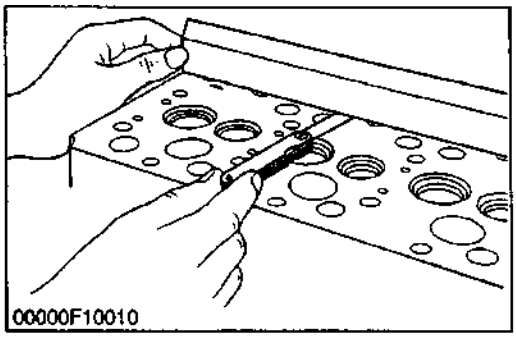
(When reassembling)

- Clean the oil passage in the main bearing case.
- Apply clean engine oil on the crankshaft bearing 2 and thrust bearings.
- Since diameters of main bearing case vary, install them in order of makings (**A, B, C**) from the gear case side.
- When installing the main bearing case assemblies 1, 2 and 3, face the mark **"FLYWHEEL"** to the flywheel.
- Be sure to install the thrust bearing with its oil groove facing outward.

(1) Main Bearing Case Assembly 1, 2 and 3
(2) Main Bearing Case Assembly
(3) Thrust Bearing

11900S10251

SERVICING
[1] Cylinder head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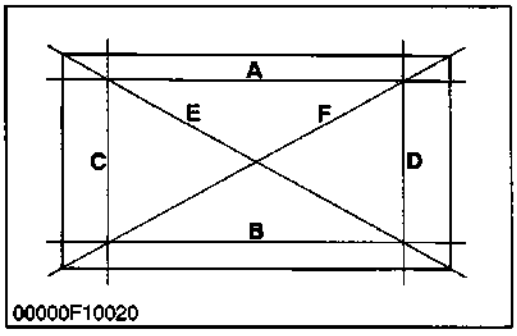

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Cylinder Head Surface Flatness

1. Thoroughly clean the cylinder head surface.
2. Place a straightedge on the cylinder head's four sides and two diagonal as shown in the figure.
   Measure the clearance with a feeler gauge.
3. If the measurement exceeds the allowable limit, correct it with a surface grinder.

■ IMPORTANT

- **Do not place the straight edge on the combustion chamber.**
- **Be sure to check the valve recessing after correcting.**

00000S10011

B.Hydraulic system specifications

Machine model			U20-3	U25-3
Engine RPM			2,200	2,400
Pump	Maker		Fujikoshi	Fujikoshi
	Type		PVD-OB-24P-6G3-4694A	PVD-OB-24P-8G3-4837B
			Variable Displacement Pump	Variable Displacement Pump
			+Gear Pump	+Gear Pump
	Delivery rate	P1, P2	23.0 L / min	28.8 L / min
		P3	12.8 L / min	19.2 L / min
		P_P	5.9 L / min	6.5 L / min
Control valve	Maker		KAYABA	KAYABA
	Type		KVSE-36-10	KVSE-36-10
	Main relief pressure	P1, P2	21.6 MPa	21.6 MPa
		P3	20.6 MPa	17.2 MPa
		P_P	3.9 MPa	3.9 MPa
Swivel motor	Maker		Eaton Fluid Power	Eaton Fluid Power
	Type		25PB20A1124-C	25PB25A1125-C
			VNS200S310A	VNS165S320A
	Equivalent capacity		195 cm^3/rev	244 cm^3/rev
	Relief pressure		19.6 MPa	16.2 MPa
	Swivel speed		8.9 rpm	9.2 rpm
	Torque Theoretical		609 N·m	629 N·m
Travel motor	Maker		Fujikoshi	KAYABA
	Type		PHV-190-39-1-8944A	MAG-18V-230E
	Equivalent capacity		628/328 cm^3/rev	774/430 cm^3/rev
	Speed (R)		2.2/4.2 km/h	2.5/4.5 km/h
Cylinder	Boom	Bore dia.	65	70
		Rod dia	35	40
		Stroke	490	476
	Arm	Bore dia.	65	70
		Rod dia	40	40
		Stroke	450	484
	Bucket	Bore dia.	60	65
		Rod dia	35	35
		Stroke	416	416
	Swing	Bore dia.	60	60
		Rod dia	35	35
		Stroke	420	420
	Dozer	Bore dia.	80	90
		Rod dia	40	45
		Stroke	138	126
	Truck	Bore dia.	60	—
		Rod dia	30	—
		Stroke	215	—

b. Operating principle of motor

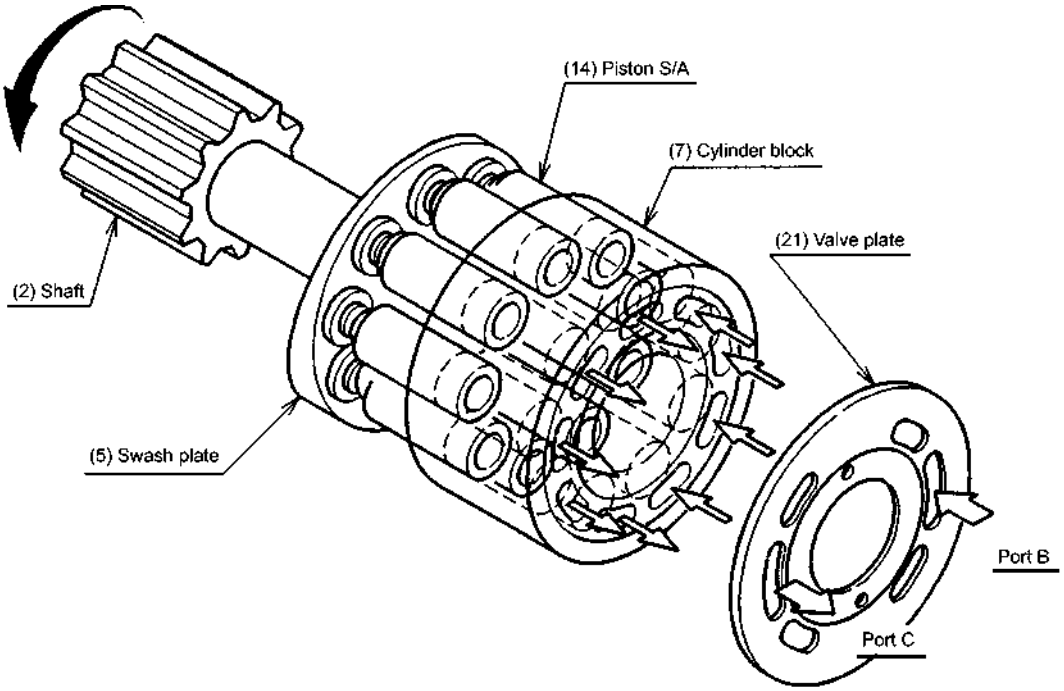


Fig. 2 Structural drawing of swash-plate-type axial piston motor

The cylinder block (7) incorporates nine piston S/As (14).
The end face of the cylinder block (7) is in contact with the valve plate (21) having two semicircular ports B and C (high-low change valve).
When the high pressure oil (pressure P) is supplied to the port B, it presses the swash plate (5) with a force of "F = P·A" (A: Pressure-applied area of piston) per piston S/A (14). The piston S/A (14) receives a reaction force against this force, which produces a turning force (Ft). The sum of the turning forces produced through the piston S/As (14) on the high pressure side makes the cylinder block (7) rotate, which torque is transmitted to the shaft (2) through the splines, making the shaft (2) rotate.
The output torque and revolution of the piston motor obtained based on the above-mentioned operating principle are determined by the supplied pressure (P) and the supply flow rate (Q) and calculated from the following expression.

$$T = \frac{P \times D \times \eta m}{2 \times \pi \times 10^2}$$

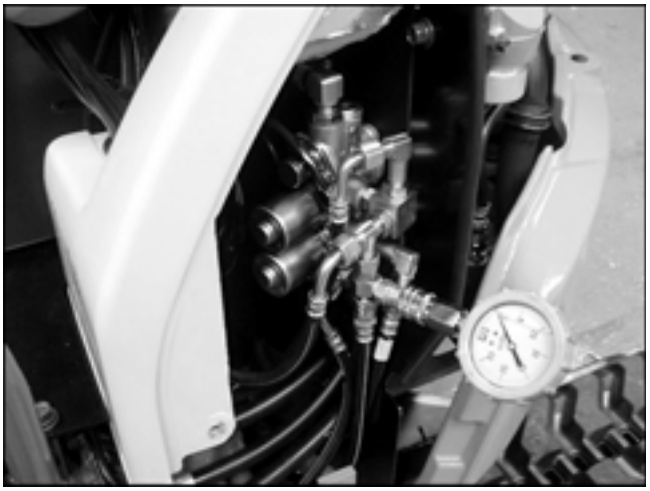
$$N = \frac{Q \times 10^3 \times \eta v}{D}$$

T : Output torque	(kgf-m)
N : Revolutions	(rpm)
P : Working pressure	(kgf/cm^2)
Q : Supply flow rate	(L / min)
D : Theoretical displacement	(cc/rev)
ηm : Mechanical efficiency	
ηv : Volumetric efficiency	

b. Hydraulics

Problem	Cause	Correction
The entire hydraulic system fails or responds too slow or too weak.	(1) Hydraulic oil too short in the tank or oil degraded.	Add or change the hydraulic oil.
	(2) Suction line (suction filter) clogged.	Check the suction line and replace the suction filter as required.
	(3) Pump coupling defective.	Repair or replace the pump coupling.
	(4) Pump drive shaft broken.	Replace the shaft.
	(5) Pump internal parts seized or damaged.	Repair or replace the pump.
The boom, arm, bucket and swivel mechanism fail or respond too slow or too weak.	(1) Hydraulic pilot filter or hydraulic pilot line filter clogged.	Clean or replace the pilot filter.
	(2) Selector valve defective.	Overhaul or replace the selector valve.
	(3) Pilot pump internal parts seized or damaged.	Replace the pilot pump.
The boom, bucket and right-travel mechanism fail or respond too slow or too weak.	(1) Main relief valve (P1) not at specified pressure.	Check the main relief valve (P1) and readjust as required.
	(2) P1 or P2 line pump internal parts seized or damaged if the arm, service port and left-travel mechanism fail too.	Overhaul or replace the pump.
The arm, service port and left-travel mechanism fail or respond too slow or too weak.	(1) Main relief valve (P2) not at specified pressure.	Check the main relief valve (P2) and readjust as required.
	(2) P1 or P2 line pump internal parts seized or damaged if the boom, bucket and right-travel mechanism fail too.	Overhaul or replace the pump.
The swing, dozer and swivel mechanism fail or respond too slow or too weak.	(1) Main relief valve (P3) not at specified pressure.	Check the main relief valve (P3) and readjust as required.
	(2) P3 line pump internal parts seized or damaged.	Overhaul or replace the pump.
The boom alone fails or responds too slow or too weak.	(1) Boom overload relief valve not at specified pressure.	Check the overload relief valve and repair as required.
	(2) Control valve or boom section spool malfunctioning.	Check the spool and repair as required.
	(3) Pilot valve defective.	Measure the secondary pressure and check the pilot valve.
	(4) Boom cylinder rod packing broken.	Overhaul the cylinder and replace the sealing.
The arm alone fails or responds too slow or too weak.	(1) Arm overload relief valve not at specified pressure.	Check the overload relief valve and repair as required.
	(2) Control valve or arm section spool malfunctioning.	Check the spool and repair as required.
	(3) Pilot valve defective.	Measure the secondary pressure and check the pilot valve.
	(4) Arm cylinder rod packing broken.	Overhaul the cylinder and replace the sealing.
The bucket alone fails or responds too slow or too weak.	(1) Bucket overload relief valve not at specified pressure.	Check the overload relief valve and repair as required.
	(2) Control valve or bucket section spool malfunctioning.	Check the spool and repair as required.
	(3) Pilot valve defective.	Measure the secondary pressure and check the pilot valve.
	(4) Bucket cylinder rod packing broken.	Overhaul the cylinder and replace the sealing.

[5] Swivel brake release valve

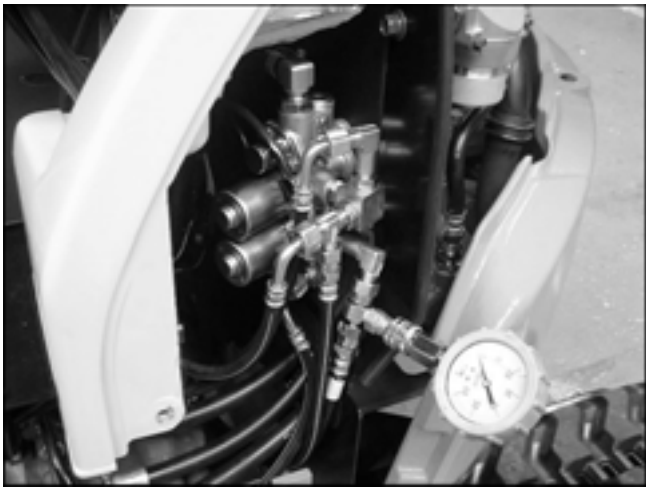


1) Measuring procedure

1. Stop the engine, disconnect the swivel brake release hose of the selector valve using a vacuum pump and set the pressure gauge.
2. With the engine running at maximum rpm, unlock the lever (to bring it to operating position) and measure the pressure.
3. Repeat the pressure measurement 3 times, obtain the average and adopt it as measured value.

* Measure the pressure at oil temperature of 50±5°C.

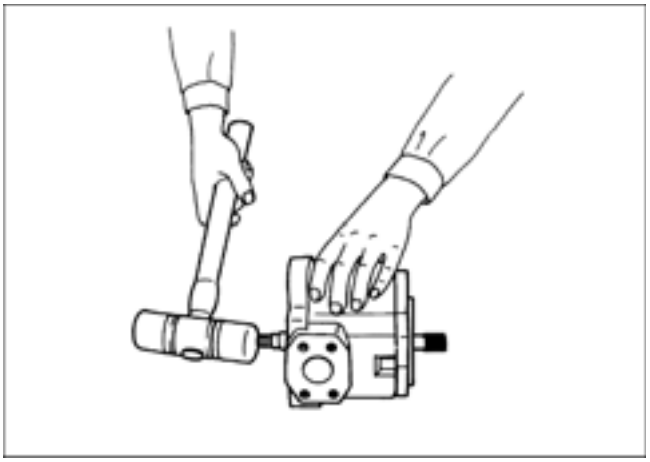
[6] Travel two-speed selector pressure



1) Measuring procedure

1. Stop the engine, disconnect the travel two-speed selector hose of the selector valve using the vacuum pump and set the pressure gauge.
2. With the engine running at maximum rpm, step on the two-speed pedal and measure the pressure.
3. Repeat the pressure measurement 3 times, obtain the average and adopt it as measured value.

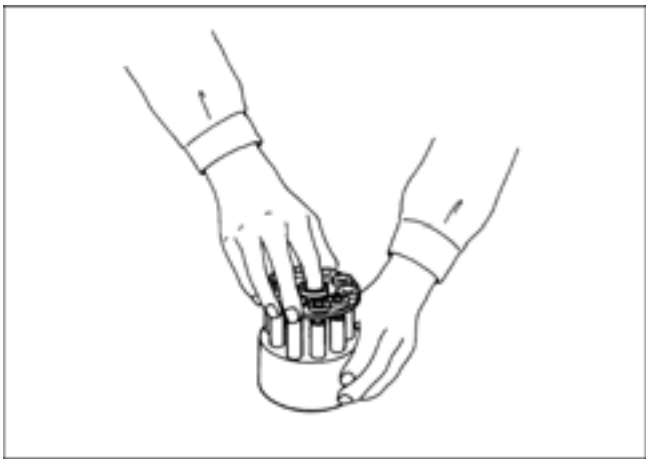
* Measure the pressure at oil temperature of 50±5°C.



Using a plastic hammer, tap on the opposite end of the shaft, and the oil seal (32) and the shaft (with bearing (30)) can be removed.

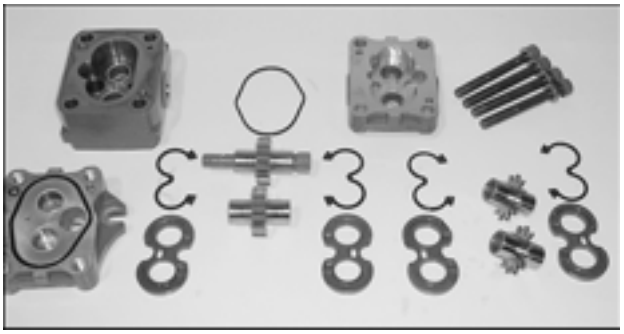
6. Disassembling the body H kit

When the hex socket lock screw (60) is screwed in the hex socket lock screw hole of the body H (2), the spring guide (19) can be taken out.

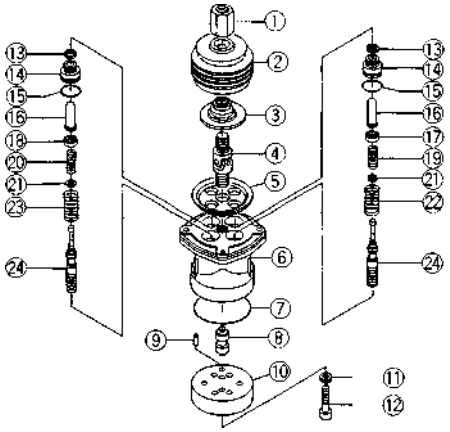


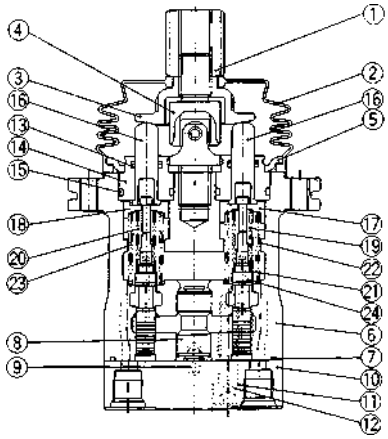
7. Disassembling the cylinder barrel kit

Remove the shoe holder (8), to which the piston shoe assemblies (6) and (7) are mounted, out of the cylinder barrel kit, and dismount the barrel holder (9) and needle valve (11) in this order.
Then, remove the snap ring (35), retainer (24), spring C (14) and retainer (24), in this order, out of the cylinder barrel (4).



	Procedure	Precautions
13	Remove the folding-purpose spring (246) and spring seat (218) from the push rod (212). [Photo 7-16]	
14	Draw the push rod (212) out of the plug (211). [Photo 7-17]	
15	Remove the O-ring (214) and seal (213) from the plug (211). Use a small bladed screwdriver or the like to take out the seal (213). [Photos 7-18 and 7-19]	
16	Clean up the parts. 1) Put the parts one by one in a rough-washing container with kerosene. (Rough washing) 2) Put the parts one by one in a finish-washing container with kerosene. Slowly turn them and wipe them clean thoroughly inside and out. (Finish washing) Using clean waste cloth, wipe kerosene away from the parts.	* Do not wipe dirty parts in kerosene from the beginning because otherwise they might get scratched. Keep them dipped until dirt, fat and grease become loose enough off the parts. * Be attentive to keep the kerosene clean enough. Otherwise the parts may get scratched, leading to poor performance when reassembled. * Do not dry up the parts with compressed air. Dust and moisture in the air may damage the parts or get them rusty later.
17	Keep the parts against rust. Apply rust-preventive to the specified parts.	* Do not leave the parts without rust-preventive. Rust may build up, causing malfunction later.



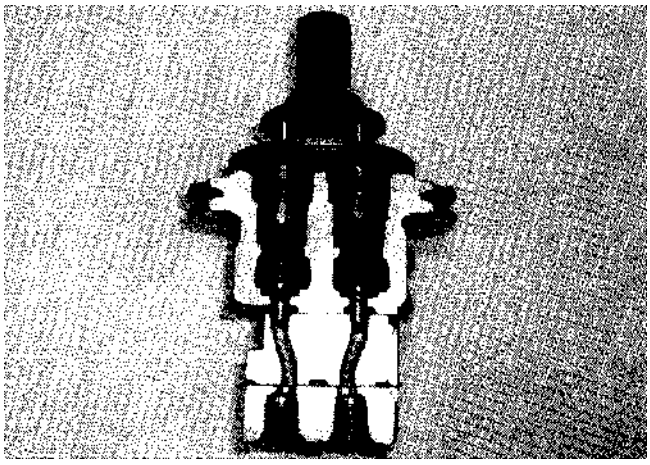


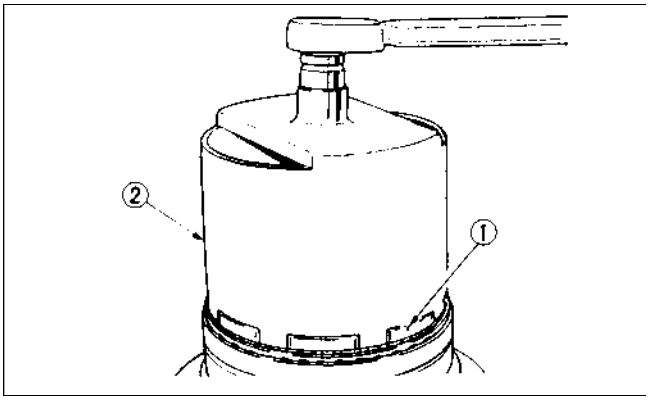
No.	Part name	No.	Part name
1	Nut (Adjusting)	13	Seal
2	Bellows	14	Plug
3	Nut (Disk)	15	O-ring
4	Joint	16	Bush rod
5	Plate	17	Seat (Spring)
6	Valve body	18	Seat (Spring)
7	O-ring	19	Spring
8	Bush	20	Spring
9	Spring pin	21	Washer 2
10	Plate (Port)	22	Spring
11	Sealing washer	23	Spring
12	Hex socket bolt	24	Spool

2. Reassembling procedure

(1) Apply grease to the following parts.
- Rotating part of joint (4)
- Top of push rod (16)

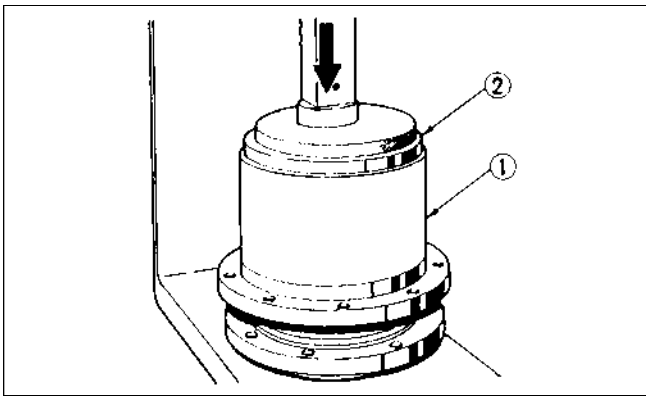
(2) Cut model of pilot valve





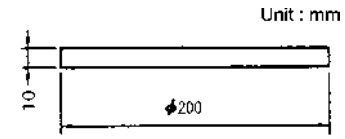
4. Using the tightening jig, tighten the ring nut so as to leave no clearance between the ring nut and angular bearing.
   • For the tightening jig, refer to V17.

(1) Ring nut
(2) Tightening jig

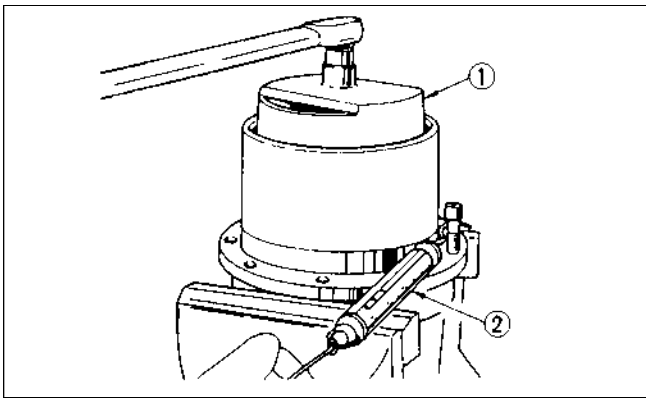


5. Using the press-fitting jig (see the figure below), press-fit the housing onto the angular bearing.

(1) Housing
(2) Press-fitting jig

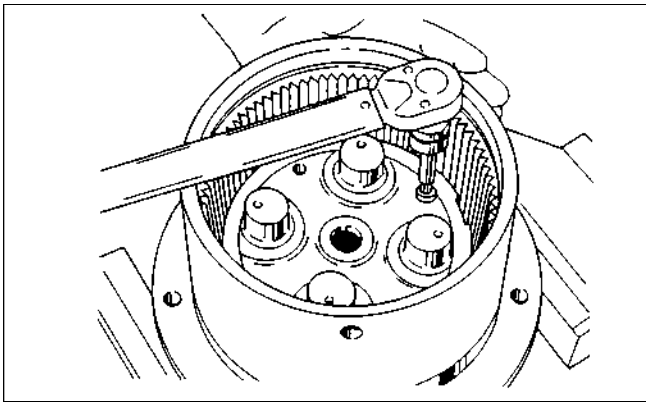


Material: Equivalent of S35C, C0.1



6. Tighten the ring nut using the tightening jig.
   • When the ring nut is tightened so as to leave no clearance between the ring nut and angular bearing, measure the load after turning the housing several turns. The load (starting load) measured at this time is assumed to be F kgf.
   • Tighten the ring nut so that the starting load becomes F + (1.7-2.5) kgf.

(1) Tightening jig
(2) Spring scale



7. Tighten the plug.
   • No seal tape is needed.