HYDRAULIC EXCAVATOR

SHOP MANUAL model SK25SR SK30SR SK35SR

This is the shop manual for KOBELCO hydraulic excavator. Contained is the necessary technical data concerning the maintenance and repair of this model. The manual is divided into the following four major sections ; GENERAL, SYSTEMS, COMPONENTS and PROCEDURE.

When checking or repairing the machine we suggest that you refer to this manual carefully. We hope that reference to this manual will help to maintain a hight level of working efficiency and reliability. For further details on maintenance and cheks refer to the "OPERATORS MANUAL" which has been supplied with the machine.

Although all data was correct at the time of printing, due to continual design changes and improvements, some contents may not conform to the actual machine. Take special care to order parts only after confirming the validity of the part number in the "PARTS MANUAL".

If you notice any explanatory discrepancies, after consulting one of our representatives, please updata your manual according to the latest data. However, in the event of any specification changes, we will issue revised edition.

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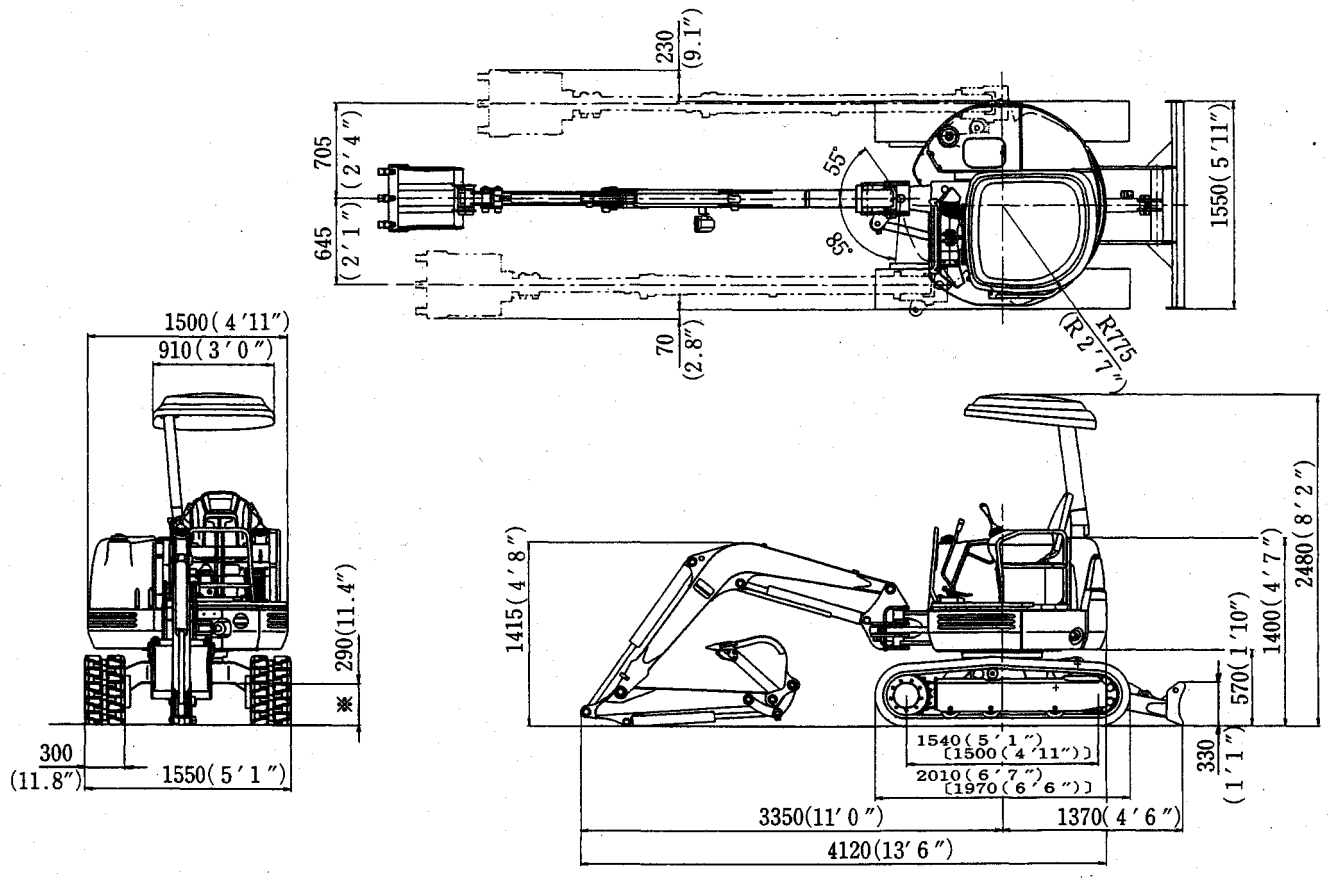
KOBELCO

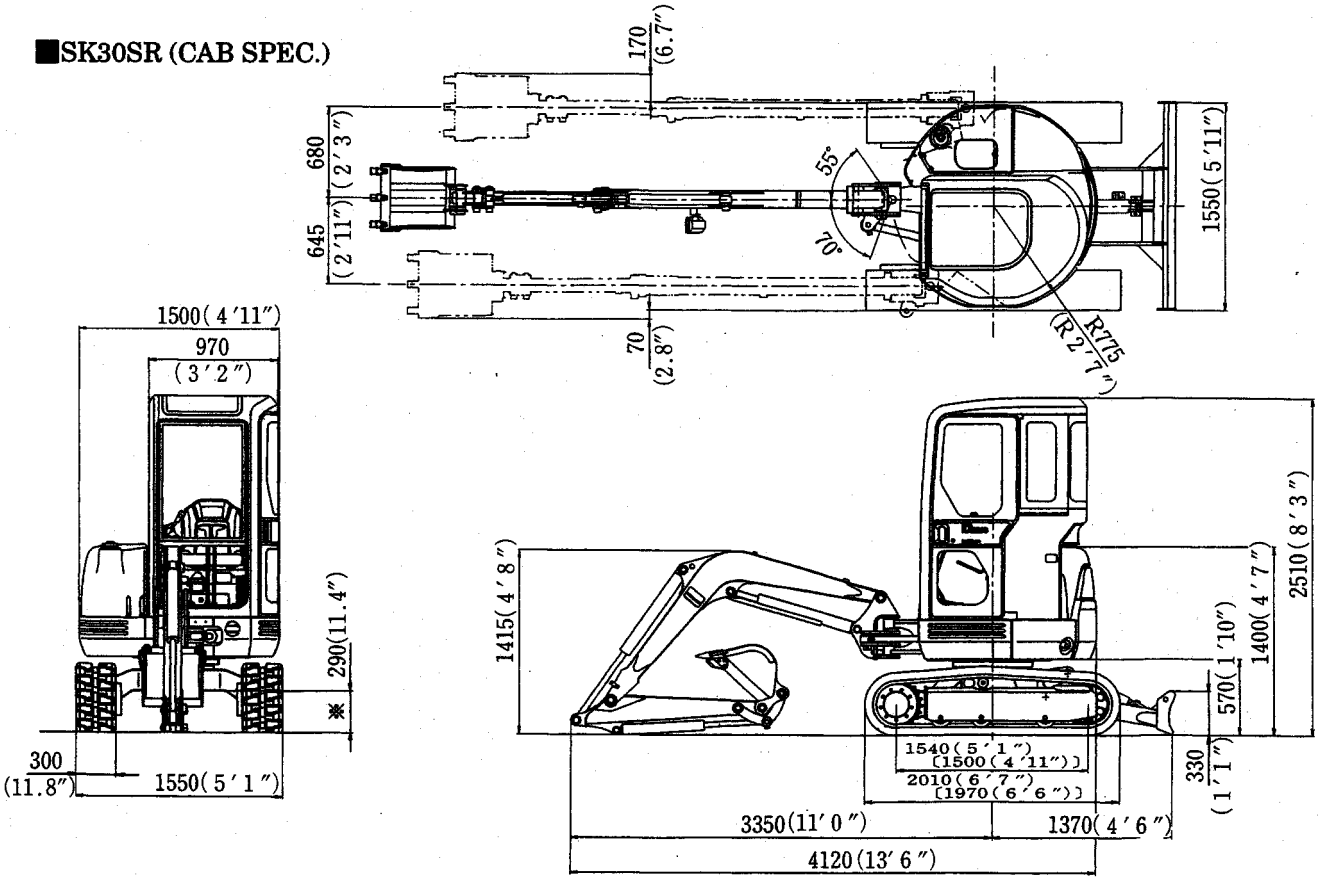
Book code No. S5PW0001E②

■SK30SR (CANOPY SPEC.)

Unit : mm (ft·in)



■SK30SR (CAB SPEC.)



NOTE : Numerical values marked ※ do not include the height of the shoe lug.
Numerical values enclosed in parentheses 〔 〕 indicate steel crawler specifications.

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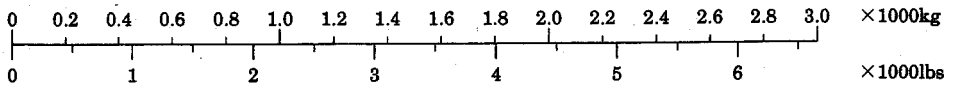
4. TYPE OF SHOES

Model	Applicable Machines	Type	Shoe Width mm (ft·in)	Total Width of Crawler mm (ft·in)	Ground Pressure kg·f/cm² (PSI)		Weight kg (lbs)
					Canopy	Cab	
SK25SR	PV10001~ PV12000	Rubber Shoe	300 (11.8")	1,500 (5'1")	0.27(3.8)	0.29(4.1)	120(260)
		Steel Shoe			0.28(4.0)	0.30(4.3)	140(310)
	PV12001~	Rubber Shoe	300 (11.8")	1,500 (5'1")	0.28(4.0)	0.30(4.3)	125(280)
		Steel Shoe			0.29(4.1)	0.30(4.3)	140(310)
SK30SR	PW07001~ PW09500	Rubber Shoe	300 (11.8")	1,500 (5'1")	0.30(4.3)	0.31(4.4)	126(280)
		Steel Shoe			0.31(4.4)	0.32(4.6)	147(320)
	PW09501~	Rubber Shoe	300 (11.8")	1,500 (5'1")	0.30(4.3)	0.31(4.4)	131(290)
		Steel Shoe			0.30(4.3)	0.31(4.4)	147(320)
SK35SR	PX05001~ PX06500	Rubber Shoe	350 (13.8")	1,700 (5'7")	0.26(3.7)	0.27(3.8)	150(330)
		Steel Shoe			0.27(3.8)	0.28(4.0)	195(430)
	PX06501~	Rubber Shoe	350 (13.8")	1,700 (5'7")	0.26(3.7)	0.27(3.8)	160(350)
		Steel Shoe			0.27(3.8)	0.28(4.0)	195(430)

5. TYPE OF BUCKETS

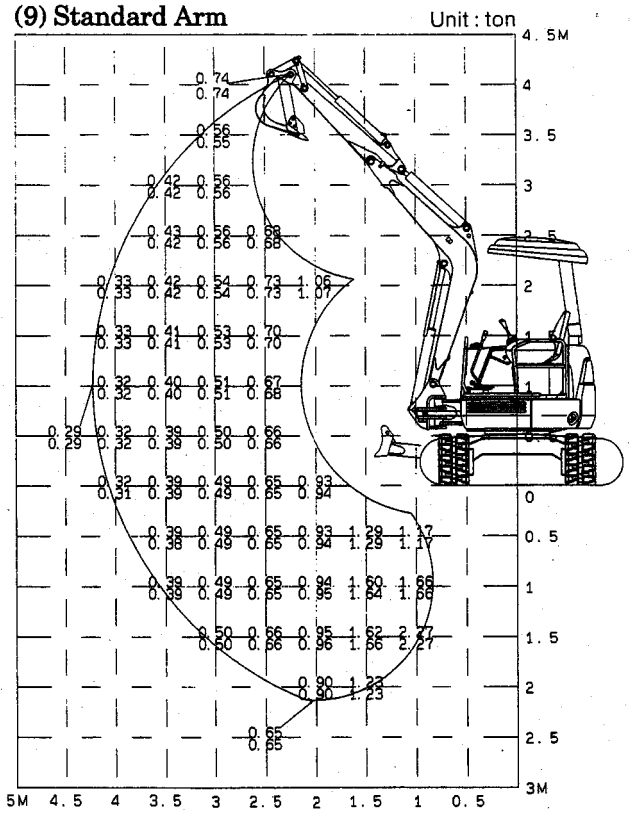
Model	Heaped Capacily m³ (cu.yd)	Outside Width of Bucket mm (ft·in)		Number of teeth	Weight kg (lbs)	Remarks
		With side cutters	Without side cutters			
SK25SR	0.035 (0.045)	300(11.8")	235(9.3")	3	38(84)	
	0.080 (0.105)	500(1'8")	435(1'5")	3	46(101)	
	0.080 (0.105)	500(1'8")	435(1'5")	4	51(112)	Standard
	0.088 (0.115)	600(2'0")	540(1'9")	4	51(112)	Heavy duty Type
SK30SR	0.050 (0.065)	350(1'2")	280(11")	3	60(132)	
	0.070 (0.092)	450(1'6")	380(1'3")	3	68(150)	
	0.090 (0.118)	500(1'8")	430(1'5")	3	71(157)	Standard
	0.090 (0.118)	500(1'8")	430(1'5")	4	75(165)	Heavy duty Type
	0.10 (0.131)	600(2'0")	530(1'9")	4	79(174)	
SK35SR	0.044 (0.058)	350(1'2")	280(11")	3	63(139)	
	0.063 (0.082)	450(1'6")	380(1'3")	4	71(157)	
	0.11 (0.144)	600(2'0")	530(1'9")	4	82(165)	Standard
	0.11 (0.144)	600(2'0")	530(1'9")	5	86(190)	Heavy duty Type
	0.12 (0.157)	700(2'4")	630(2'1")	4	89(196)	



■SK30SR (CANOPY SPEC)

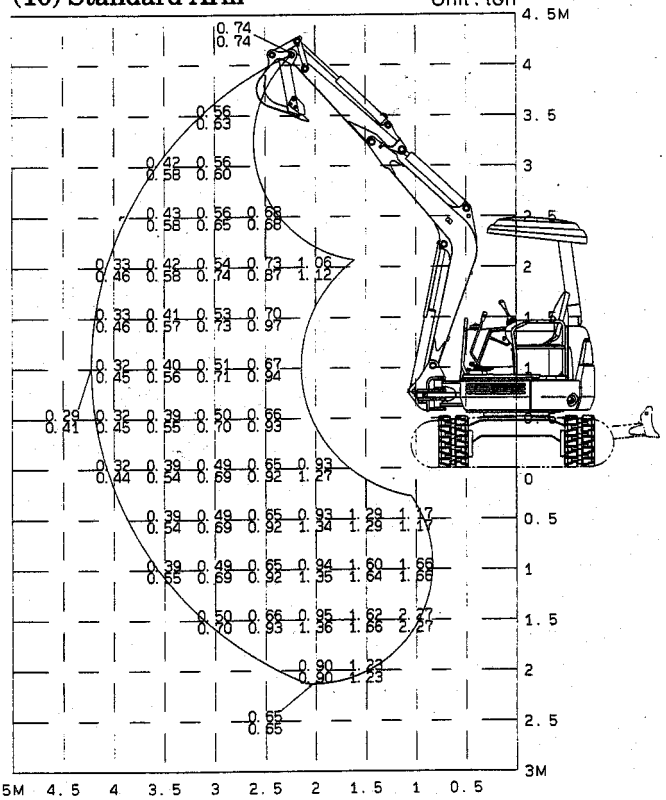
(9) Standard Arm

Unit : ton



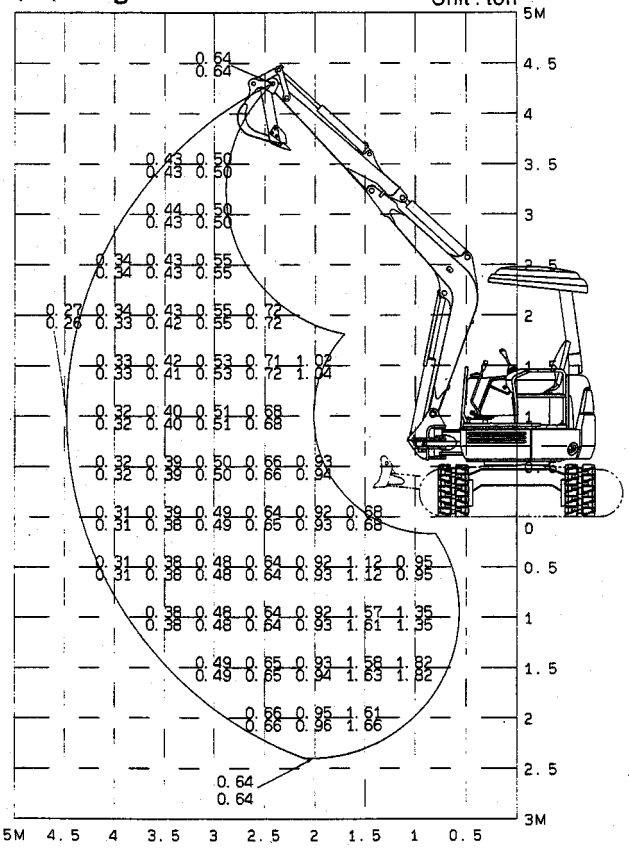
(10) Standard Arm

Unit : ton



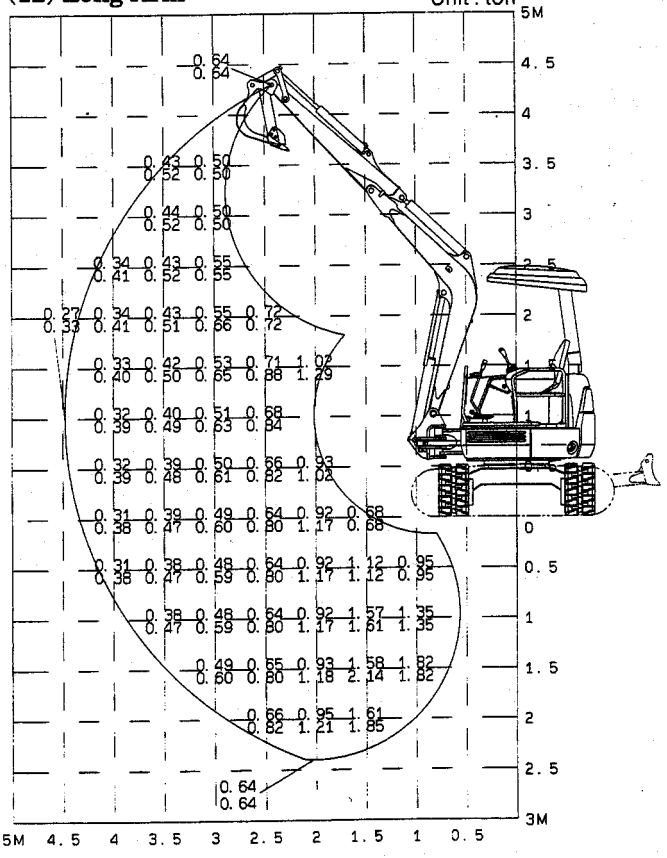
(11) Long Arm

Unit : ton



(12) Long Arm

Unit : ton



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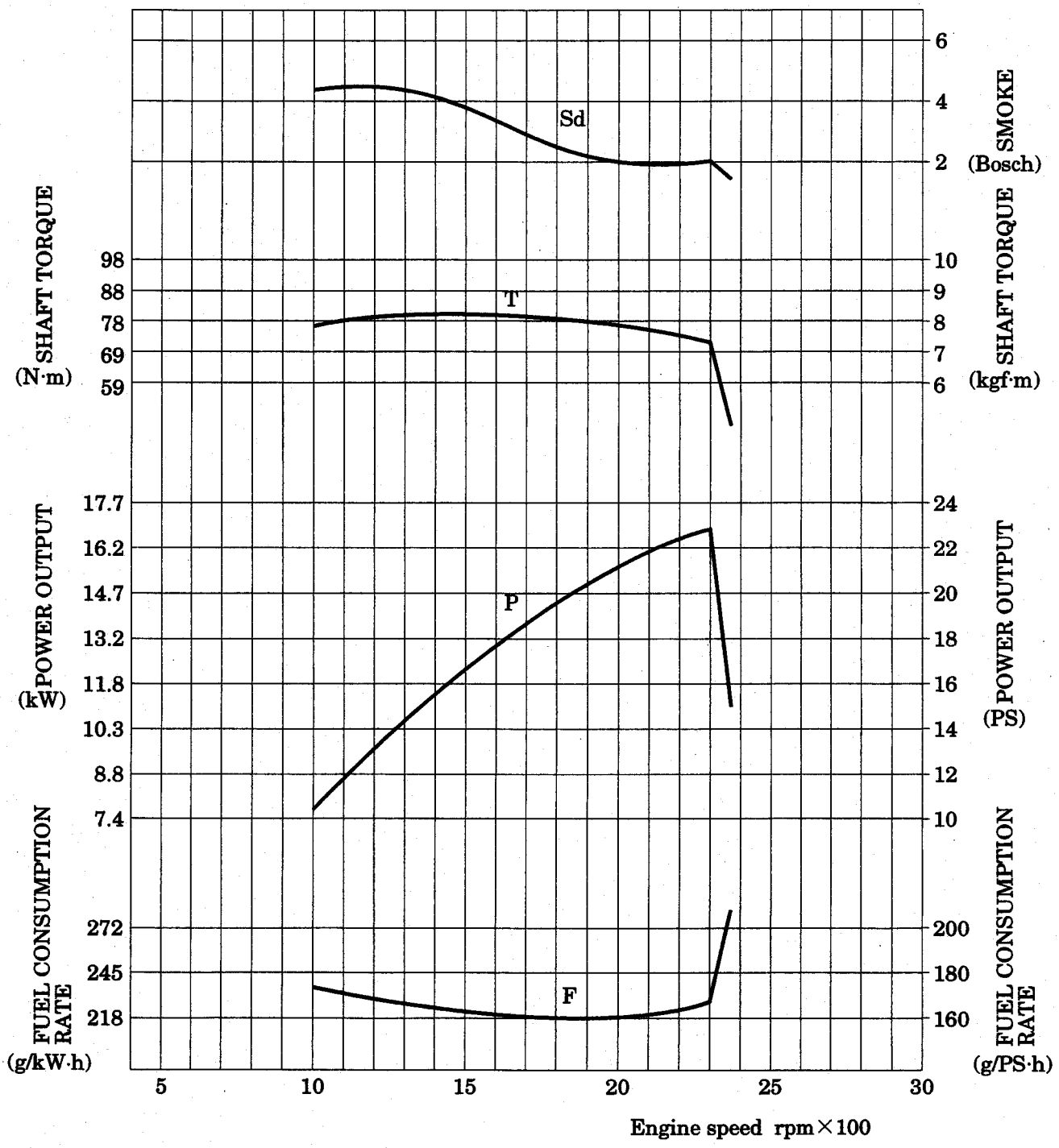
■SK30SR

Applicable Machine : PW07001~

Model : 3TNE82A-YB

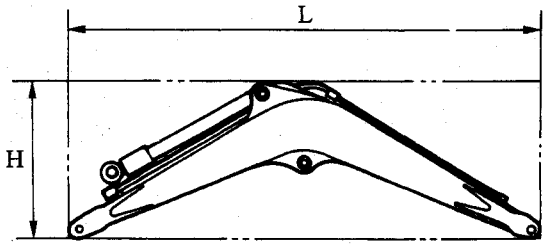
Rated Output : 23ps/2,300rpm (16.9kw/2,300min^{-1})



3. WEIGHT OF ATTACHMENTS

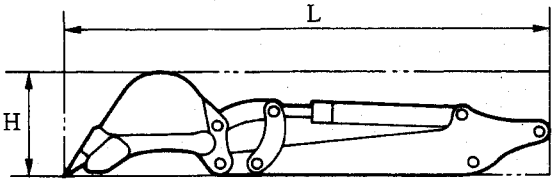
3.1 OVERALL SPECIFICATIONS OF BOOM

Model	SK25SR	SK30SR	SK35SR
Total length× Total height× Total width L×H×W mm (ft·in)	2235×805×200 (7'4"×2'8"×7.9")	2390×830×200 (7'10"×2'9"×7.9")	2575×885×200 (8'5"×2'11"×7.9")
Weight kg (lbs)	115(254)	139(306)	154(340)



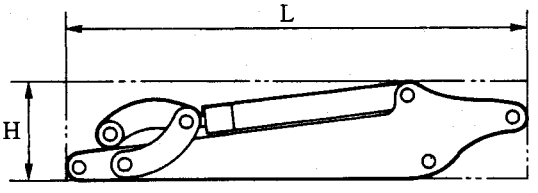
3.2 OVERALL SPECIFICATIONS OF ARM+BUCKET

Model	SK25SR	SK30SR	SK35SR
Arm+Bucket	1.13m+0.08m³ (3'8"+0.105cu.yd)	1.18m+0.09m³ (3'10"+0.118cu.yd)	1.28m+0.11m³ (4'2"+0.144cu.yd)
Total length× Total height× Total width L×H×W mm (ft·in)	2055×400×500 (6'9"×1'4"×1'8")	2170×465×500 (7'1"×1'6"×1'8")	2330×445×500 (7'8"×1'6"×1'8")
Weight kg (lbs)	116(256)	155(342)	179(395)



3.3 OVERALL SPECIFICATIONS OF ARM

Model	SK25SR	SK30SR	SK35SR
Total length× Total height× Total width L×H×W mm (ft·in)	1465×300×200 (4'10"×11.8"×7.9")	1530×310×200 (5'0"×1'0"×7.9")	1650×355×200 (5'5"×1'2"×7.9")
Weight kg (lbs)	70(154)	93(205)	97(214)



Model						SK35SR			
Applicable machines						PX05001~PX05600		PX05601~PX06500 PX06501~	
Pos.	Item				Unit	Standard value	Reference value for remedy	Standard value	Reference value for remedy
Cylinders	Cylinder speed	Boom	Canopy	Ext.	Sec.	2.5±0.5	3.5	2.9±0.5	3.9
				Ret.		$2.2^{+0.8}_{-0.2}$	3.2	2.7±0.5	3.7
			Cab	Ext.		2.5±0.5	3.5	2.7±0.5	3.7
				Ret.		$2.2^{+0.8}_{-0.2}$	3.2	2.2±0.5	3.2
		Arm		Ext.		$3.2^{+0.8}_{0}$	4.2	4.1±0.5	5.1
				Ret.		$3.2^{+1.8}_{-0.2}$	5.2	3.7±0.5	4.7
		Bucket		Ext.		$3.1^{+0.4}_{-1.1}$	4.6	3.4±0.5	4.4
				Ret.		$2.5^{+1.8}_{-0.3}$	4.6	2.4±0.5	3.4
		Swing		Ext.		$7.0^{0}_{-2.0}$	9.0	6.2±0.5	8.0
				Ret.		$7.0^{0}_{-2.0}$	9.0	4.8±0.5	8.0
		Dozer blade		Ext.		$2.2^{+0.3}_{-1.2}$	3.7	2.5±0.5	3.5
				Ret.		$1.6^{+0.9}_{-0.6}$	3.1	1.8±0.5	3.8
	Natural Cylinder drop	Boom			mm (in)	10^{0}_{-10} ($0.39^{0}_{-0.39}$)	20 (0.79)	10^{0}_{-10} ($0.39^{0}_{-0.39}$)	22 (0.87)
		Arm				4^{0}_{-4} ($0.16^{0}_{-0.16}$)	8 (0.31)	4^{0}_{-4} ($0.16^{0}_{-0.16}$)	8 (0.31)
		Bucket				2^{0}_{-2} ($0.08^{0}_{-0.08}$)	4 (0.16)	2^{0}_{-2} ($0.08^{0}_{-0.08}$)	4 (0.16)
		Swing				5^{0}_{-5} ($0.20^{0}_{-0.20}$)	10 (0.39)	5^{0}_{-5} ($0.20^{0}_{-0.20}$)	10 (0.39)
		Dozer blade				2^{0}_{-2} ($0.08^{0}_{-0.08}$)	4 (0.16)	2^{0}_{-2} ($0.08^{0}_{-0.08}$)	4 (0.16)
		Bucket tip				125^{0}_{-125} ($4.9^{0}_{-4.9}$)	250 (9.8)	125^{0}_{-125} ($4.9^{0}_{-4.9}$)	250 (9.8)
Slew bearing	Bucket tip play				mm (in)	50^{0}_{-50} ($2.0^{0}_{-2.0}$)	100 (3.9)	50^{0}_{-50} ($2.0^{0}_{-2.0}$)	100 (3.9)
	Slew bearing play					0.7±0.4 (0.03±0.02)	1.5 (0.06)	0.7±0.4 (0.03±0.02)	1.5 (0.06)
Crawler	Crawler tention	Steel			mm (in)	118~128 (4.6~5.0)		118~128 (4.6~5.0)	
		Rubber				60~70 (2.4~2.8)		60~70 (2.4~2.8)	

1. TIGHTENING TORQUES FOR CAPSCREWS AND NUTS

Tables 1 and 2 indicate tightening torques applicable to cases where no special note is given.
Overtightening of bolts may result in a twist-off and a fracture under load.
Insufficient tightening may lead to a loosening or loss of bolts. Always tighten bolts to proper torques.

Table 1 Standard tightening torques for metric coarse screw threads unit : kgf·m (ft·lbs)

Classification	4	T	7	T	10	T
Nominal size	No lubrication	Oil lubrication	No lubrication	Oil lubrication	No lubrication	Oil lubrication
M 6 P=1	0.45±0.05 (3.3±0.4)	0.38±0.04 (2.7±0.3)	0.98±0.1 (7.1±0.7)	0.83±0.08 (6.0±0.6)	1.77±0.18 (13±1)	1.5±0.15 (11±1)
M 8 P=1.25	1.09±0.11 (7.9±0.8)	0.92±0.09 (6.7±0.7)	2.4±0.2 (17±1)	2.0±0.2 (14±1)	4.3±0.4 (32±3)	3.6±0.4 (26±3)
M10 P=1.5	2.2±0.2 (16±1)	1.83±0.18 (13±1)	4.7±0.5 (34±4)	4.0±0.4 (29±3)	8.5±0.9 (61±7)	7.2±0.7 (52±5)
M12 P=1.75	3.7±0.4 (27±3)	3.2±0.3 (23±2)	8.1±0.8 (59±6)	6.8±0.7 (49±5)	14.6±1.5 (110±11)	12.3±1.2 (89±9)
M14 P=2	5.9±0.6 (43±4)	5.0±0.5 (36±4)	12.8±1.3 (93±9)	10.8±1.1 (78±8)	23±2 (170±14)	19.5±1.9 (140±14)
M16 P=2	9.0±0.9 (65±7)	7.6±0.7 (55±5)	19.5±2.0 (140±14)	16.4±1.6 (120±12)	35±4 (250±29)	29±3 (210±22)
M18 P=2.5	12.4±1.2 (90±9)	10.5±1.0 (76±7)	27±3 (200±22)	23±2 (170±14)	49±5 (350±36)	41±4 (300±29)
M20 P=2.5	17.5±1.7 (130±12)	14.7±1.4 (110±10)	38±4 (270±29)	32±3 (230±22)	68±7 (490±51)	57±6 (410±43)
M22 P=2.5	23±2 (170±14)	19.6±2.0 (140±14)	51±5 (370±36)	43±4 (310±29)	92±9 (670±65)	77±8 (560±58)
M24 P=3	30±3 (220±22)	24±3 (170±22)	65±7 (470±51)	53±5 (380±36)	118±12 (850±87)	96±10 (690±72)
M27 P=3	44±4 (320±29)	36±4 (260±29)	96±10 (690±72)	78±8 (560±58)	173±17 (1300±120)	140±14 (1000±100)
M30 P=3.5	60±6 (430±43)	50±5 (360±36)	131±13 (950±94)	110±11 (800±80)	235±24 (1700±170)	198±20 (1400±140)
M33 P=3.5	81±8 (590±58)	68±7 (490±51)	176±18 (1300±130)	148±15 (1100±110)	317±32 (2300±230)	266±27 (1900±200)
M36 P=4	105±10 (760±72)	88±9 (640±65)	227±23 (1600±170)	190±19 (1400±140)	409±41 (3000±300)	343±34 (2500±250)

Table 2 Standard tightening torques for metric fine screw threads unit : kgf·m (ft·lbs)

Classification	4	T	7	T	10	T
Nominal size	No lubrication	Oil lubrication	No lubrication	Oil lubrication	No lubrication	Oil lubrication
M 8 P=1	1.15±0.11 (8.3±0.8)	0.97±0.1 (7.0±0.7)	2.5±0.2 (18±1)	2.1±0.2 (15±1)	4.5±0.4 (33±3)	3.8±0.4 (27±3)
M10 P=1.25	2.3±0.2 (17±1)	1.91±0.19 (14±1)	4.9±0.5 (35±4)	4.2±0.4 (30±3)	8.9±0.9 (64±7)	7.5±0.7 (54±5)
M12 P=1.25	4.0±0.4 (29±3)	3.4±0.3 (25±2)	8.7±0.9 (63±7)	7.3±0.7 (53±5)	15.7±1.6 (110±12)	13.2±1.3 (95±9)
M16 P=1.5	9.4±0.9 (68±7)	7.9±0.8 (57±6)	20±2 (140±14)	17.2±1.7 (120±12)	37±4 (270±29)	31±3 (220±22)
M20 P=1.5	19±1.9 (140±14)	15.8±1.6 (110±12)	41±4 (300±29)	34±3 (250±22)	74±7 (540±51)	62±6 (450±43)
M24 P=2	32±3 (230±22)	27±3 (200±22)	70±7 (510±51)	58±6 (420±43)	126±12 (910±87)	105±10 (760±72)
M30 P=2	65±6 (470±43)	54±5 (390±36)	142±14 (1000±100)	118±12 (850±87)	255±26 (1800±190)	212±21 (1500±150)
M36 P=3	109±11 (790±80)	91±9 (660±65)	238±23 (1700±170)	198±20 (1400±140)	428±43 (3100±310)	357±36 (2600±260)

KOBELCO

Book Code No. S5PW12 01E②

SK25SR
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SHOP MANUAL

PW1

HYDRAULIC SYSTEM

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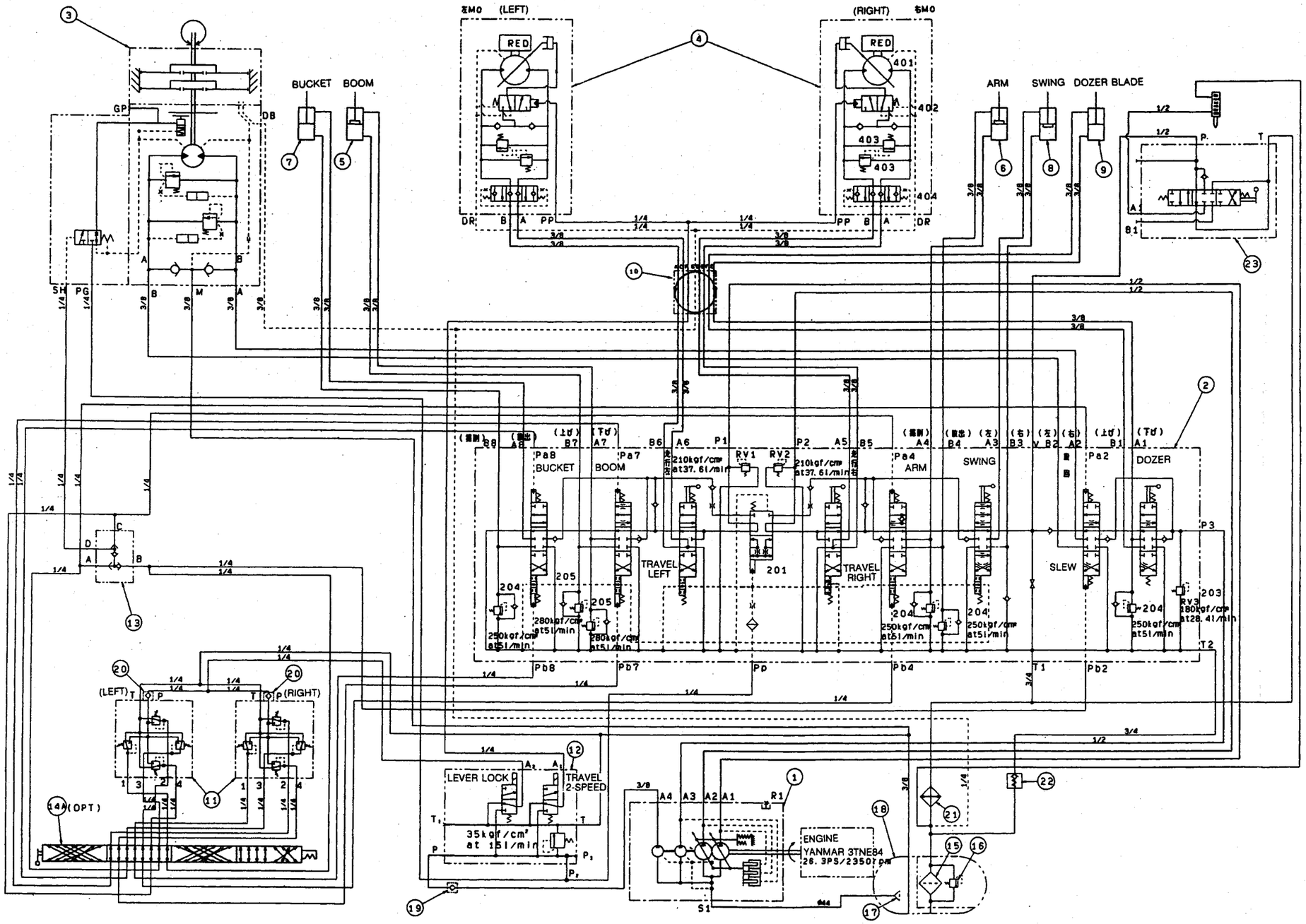
KOBE STEEL, LTD.

2.8 BREAKER SPECIFICATION

■SK35SR Applicable machines : PX05001~PX05124



No	NAME	MODEL No.
1	PUMP	AP2D18
2	CONTROL VALVE	BCV-35
3	SLEW MOTOR	MSG-27P-19
4	TRAVEL MOTOR	PHV-300
5	BOOM CYLINDER	φ85×φ45×5751
6	ARM CYLINDER	φ80×φ45×590
7	BUCKET CYLINDER	φ70×φ40×4901
8	SWING CYLINDER	φ80×φ45×476
9	DOZER BLADE CYLINDER	φ90×φ45×150
10	SWIVEL JOINT	YV-7090A
11	PILOT VALVE	TH40M1011A
12	SOLENOID VALVE	2KWE5A-20
13	SHUTTLE VALVE	–
※ 14A	MULTI CONTROL VALVE	K16AR6-11
15	RETURN FILTER	Y-25021
16	RELIEF VALVE	Y-1740
17	SUCTION STRAINER	Y-1405
18	HYDRAULIC TANK	–
19	LINE FILTER	Y-410200
20	FILTER	–
21	OIL COOLER	–
22	CHECK VALVE	LV08-35
※ 23	CONTROL VALVE	BCV-35

※marked items are option.

Note : This is for reference only, because the model number might be changed due to improvement.

Fig. 7-1 Hydraulic diagram

3.8 SWING OPERATING CIRCUIT

The operation is conducted by the operation pedal which is connected to the link mechanism. The circuits for swing and arm are made in parallel.

3.8.1 Swing (left) Operating Circuit

(1) Swing Operation

At stepped down the left swing operation pedal for toe side (front side), it shifts the swing valve spool in control valve(2) through the link mechanism. Since the pilot oil pressure is not utilized for it, as same case as the dozer, it is actuated regardless to the lever lock.

(2) Main Circuit

1) Supply Circuit for Cylinder(8)

The oil discharged from the P2 port on variable pump enters into the P2 port on control valve(2). The pressurized oil came out from the A3 port through swing valve is supplied to the R side of cylinder(8) to actuate the swing (left). Because of the throttle effect provided in the passage in swing valve, the oil flow into the cylinder (8) is restricted to make the swing motion slowly and stably for both swings for leftward and rightward.

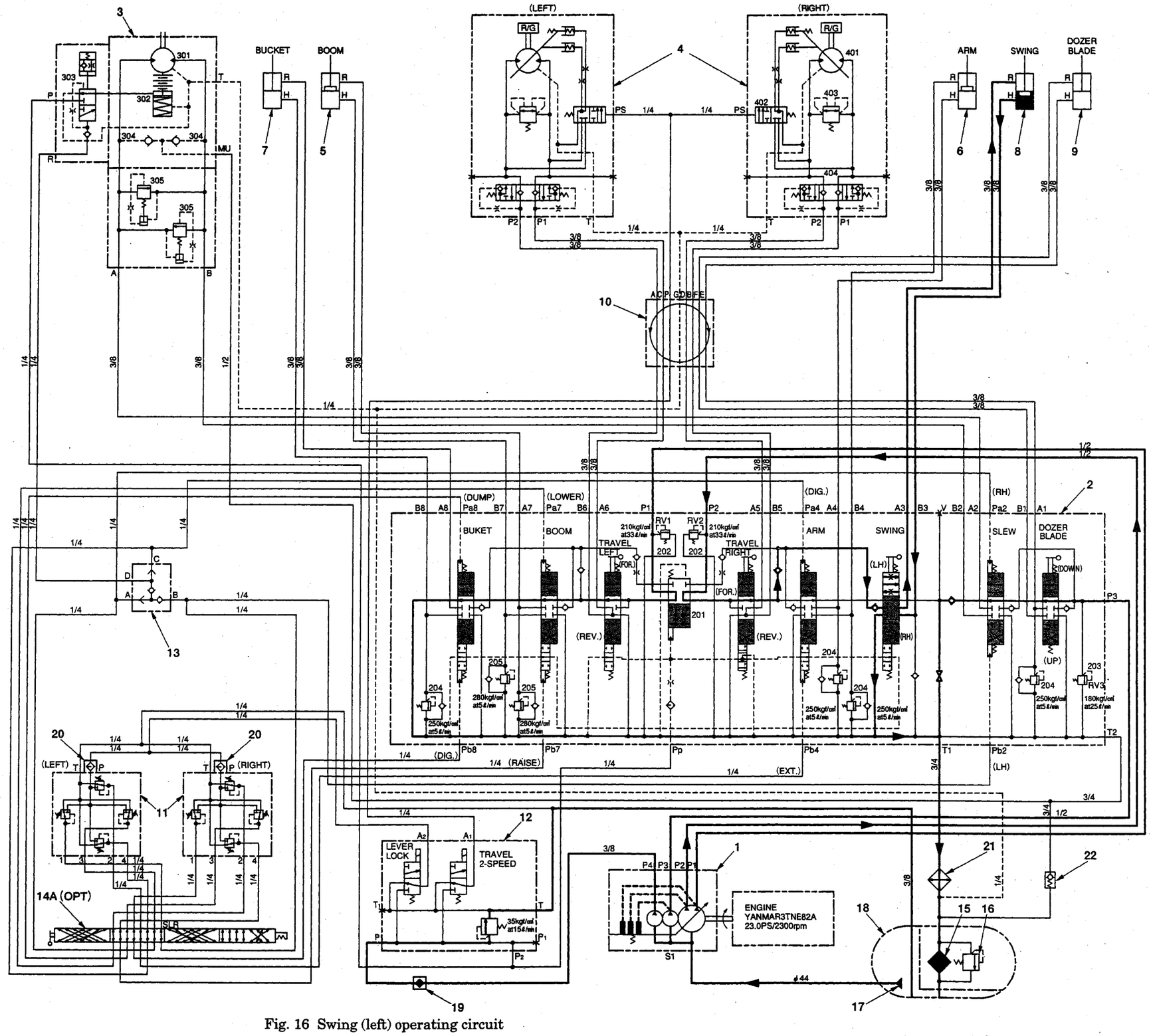
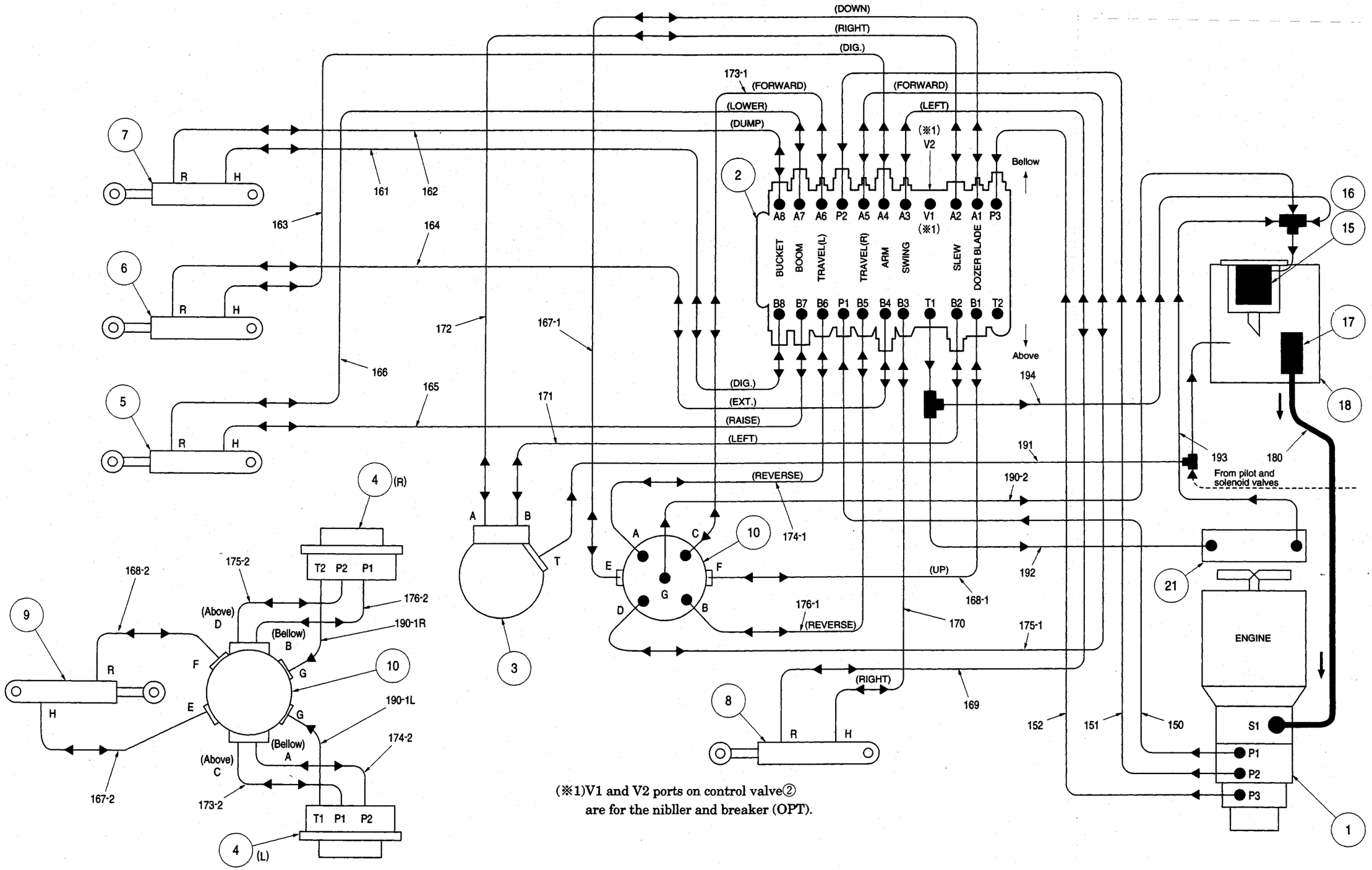


Fig. 16 Swing (left) operating circuit

■SK30SR Applicable machines : PW07001~PW07244



(※1)V1 and V2 ports on control valve② are for the nibller and breaker (OPT).

Fig. 21 Main piping diagram

1. CANOPY OR CAB (OPT)

1.1 REMOVAL AND INSTALLATION OF CANOPY ASSY

Fig. 1-1 shows the constitution of canopy assy. Carry out the removal and installation referring to Fig. 1-1 and Table 1-1.
Weight of canopy : 38kg (84lbs)

Component parts

No.	NAME	Q'TY	
		A	B
1	CANOPY	1	1
2	SUPPORT	1	1
3	SEMS BOLT	4	4
4	CAPSCREW	4	4
5	SEMS BOLT	10	5
6	HAND RAIL	1	4
7	HAND RAIL	1	4
※8	RUBBER	(1)	—
9	RUBBER	1	1
10	LOCK WASHER	4	4
11	WASHER	4	4
14	LOCK WASHER	—	4
15	WASHER	—	4
16	CAPSCREW	—	4
17	HOOK	—	1
18	RUBBER	—	1

Note 1 : For the quantity of A and B, refer to the following table for the aplicable machine number.

	SK25SR	SK30SR	SK35SR
A	PV10001~10618	PW07001~07992	PX05001~05196
B	PV10619~	PW07993~	PX05197~

Note 2 :※ No. 8 RUBBER has disused for the following machine numbers and after.

PV10239~	PW07421~	PX05003~

Table 1-1 Tightening torque

No.	Hex. (㎜)	Torque : kgf·m (ft·lbs)
3, 5, 16	17	3.5±0.4(25±3)
4	19	6.1±0.6(44±4)

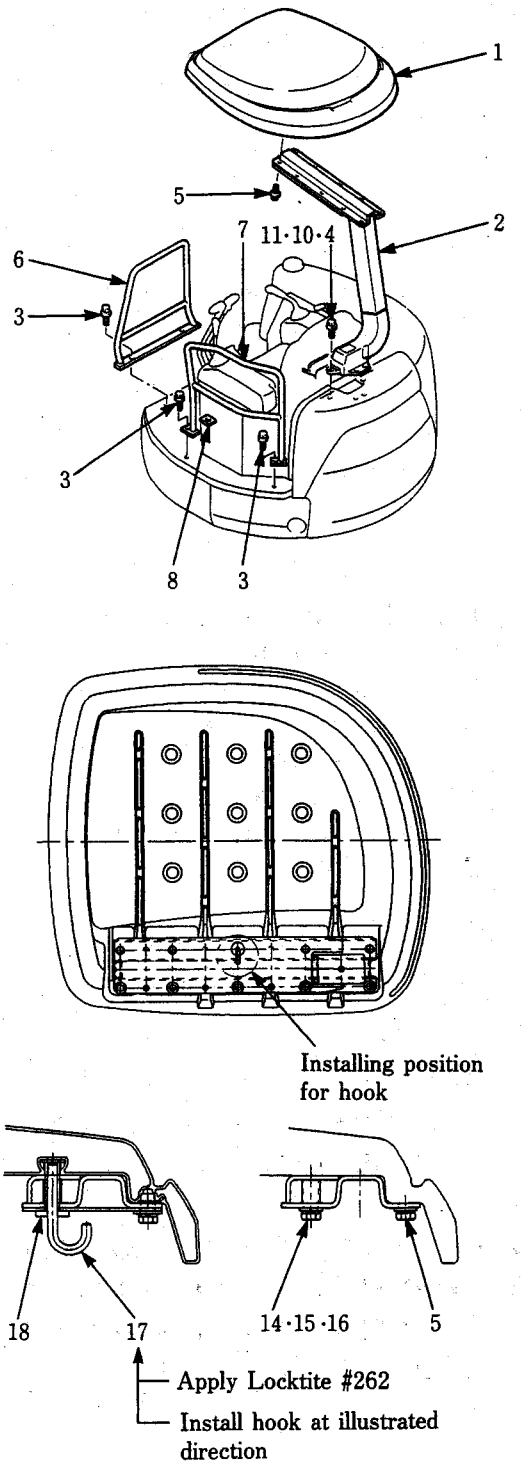


Fig. 1-1 Removal and installation of canopy assy

3) Install the bracket (A2) together with the control valve with the capscrews (A3) (A4).
: 17mm, Tightening torque : 7.2±0.7kgf·m (52±5ft·lbs)

4) Reconnect the hoses to their original positons.

Tightening torque Unit : kgf·m (ft·lbs)

Thread size	Hex (mm)	O-ring Type	30° Flare Type
PF 1/4	19	3.5±0.5 (25±4)	$2.5^{+0.5}_{0}$ (18^{+4}_{0})
PF 3/8	22	5.5±0.5 (40±4)	$5.0^{+0.5}_{0}$ (36^{+4}_{0})
PF 1/2	27	6.5±0.5 (47±4)	$6.0^{+0.5}_{0}$ (43^{+4}_{0})
PF 3/4	26	12.0±0.5 (87±4)	$12.0^{+0.5}_{0}$ (87^{+4}_{0})

5) Tighten up the drain plug (13).
: 27mm, Tightening torque: 6.5±0.5kgf·m (47±4ft·lbs)

6) Refill the specified hydraulic oil, and tighten the oil filling port plug (9) confirming the oil level with the oil level gauge (12).

7) Start up the engine keeping to open the plug (10) of hydraulic oil tank. After the engine operation for 2 to 3 minutes at low idling, operate each cylinder several times to bleed air in the lines.

8) Pressurize the hydraulic oil tank. Extend each cylinder up to their stroke ends to take the machine the posture shown in Fig. 5-3. While keeping this posture, tighten up the plug (10). The tank is pressurized by means of retracting the rod of cylinder while operating the attachment.
: 22mm, Tightening torque: 3±0.3kgf·m (22±2ft·lbs)

9) Again take the machine the posture shown in Fig. 5-1, and stop the engine. Reconfirm the hydraulic oil volume and no leakages on each portion.

5.3 REMOVAL AND INSTALLATION OF FUEL TANK

(1) Removal

1) Open the filler cap (3), and loosen the drain plug (26-2) to empty the remaining oil.
2) Disconnect two hoses, and plug the bores.
3) Disconnect the wiring for level sensor (11) at the connector.
4) Remove the capscrews (6) (B5) (B10) that are fixing the tank. Apply a rope to the tank to lift it up.
: 17mm

Table 5-1 Tightening torque

No.	Hex. (mm)	Torque : kgf·m (ft·lbs)
2	55	12±1(87±7)
5	17	4.7±0.5(34±4)
10	22	3±0.3(22±2)
12	17	1.8±0.2(13±1.4)
13	27	6.5±0.5(47±4)
A3, A4	17	7.2±0.7(52±5)

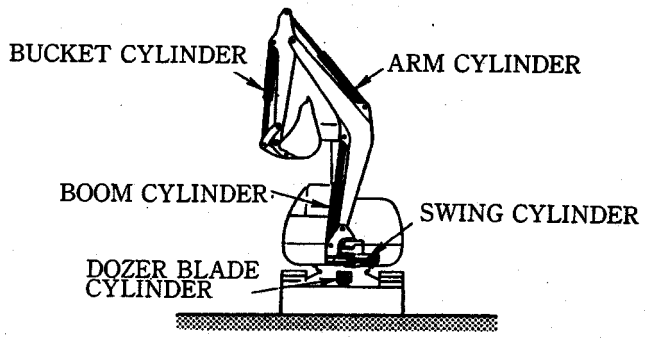


Fig. 5-3 Pressuring posture for hydraulic oil tank

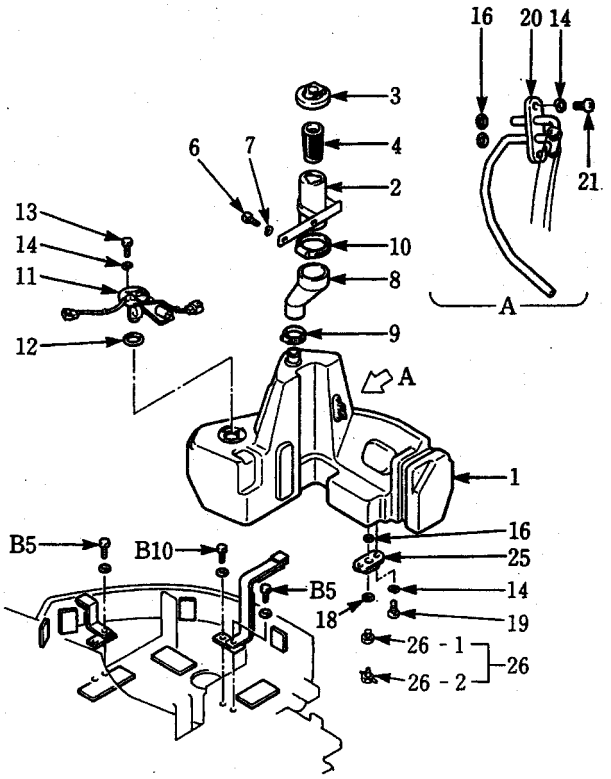


Fig. 5-4 Removal and installation of fuel tank

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4) Install the plate assay with the sems bolts (26) and wing bolt (22).
: 13㎜
5) Fill cooling water up to the specified level.
6) After reconnecting the battery, operate the engine for about 10 minutes to confirm no leakages.
7) Install the components around the radiator assy such as covers, counterweight and so on, to their original positions.

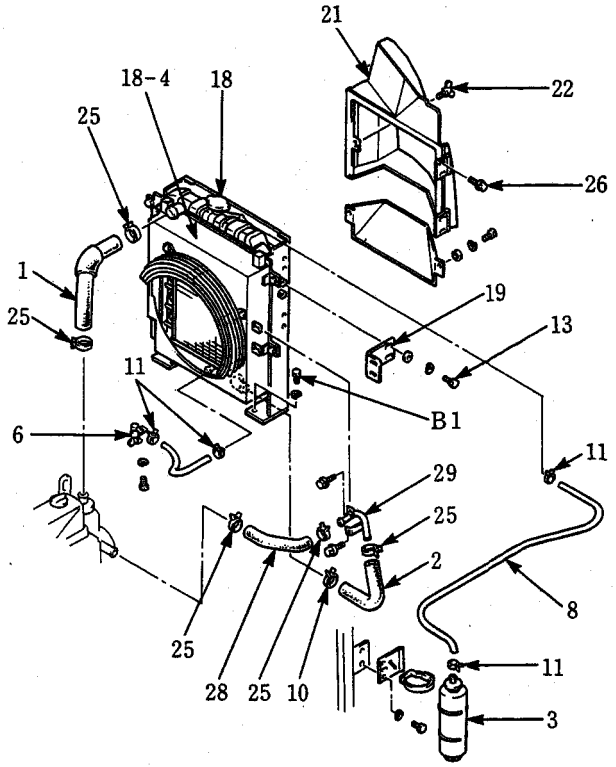
■SK35SR (Fig. 11-2)

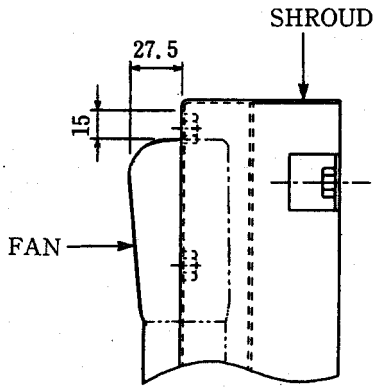
(1) Removal

1) Disconnect the radiator hoses (1) (2) (28), sub-tank hose (8) and the hydraulic oil pipings connected to the oil cooler.
2) Remove the wing bolt (22) and seas bolt (26), then remove the plate assy (21).
: 13㎜
3) Remove the capscrews (13), then remove the support (19).
: 17㎜
4) Apply a rope sling to the radiator assy, and give a slight tension on the rope.
5) Remove the capscrews (B1) that are fixing the legs portion, then lift up the radiator assy paying attention not to get touch with the shroud (18-4) and engine fan.
Weight of radiator assy : Approx. 22kg (49lbs)
: 17㎜

(2) Installation

1) Lift up the radiator assy to put it to the desired position. Fix it with the capscrews (B1) confirming the evenness for the clearance against the fan and shroud. (Refer to Fig. 11-2)
: 17㎜
2) Install the support (19) with the capscrews (13).
: 17㎜
3) Reconnect the connecting hoses for the radiator and oil cooler.
4) Install the plate assay with the sems bolts (26) and wing bolt (22).
: 13㎜
5) Fill out cooling water up to the specified level.
6) After reconnecting the battery, operate the engine for about 10 minutes to confirm no leakages.
7) Install the components around the radiator assy such as covers, counterweight and so on, to their original positions.





Set-up Criteria for Fan and Shroud

Fig. 11-2 Removal and installation of radiator assy

Major component parts

No.	NAME	Q'TY	No.	NAME	Q'TY
1	HOSE	1	18	RADIATOR ASSY	1
2	HOSE	1	19	SUPPORT	1
3	SUB-TANK	1	21	PLATE ASSY	1
6	DRAIN COCK	1	22	WING BOLT	1
8	HOSE	1	25	CLIP	5
9	HOSE	1	26	SEMS BOLT	6
10	CLIP	1	28	HOSE	1
11	CLIP	4	29	TUBE	1
13	CAPSCREW	5	B1	CAPSCREW	4

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1. CRAWLER

1.1 PROCEDURE FOR REMOVING AND INSTALLING RUBBER CRAWLER

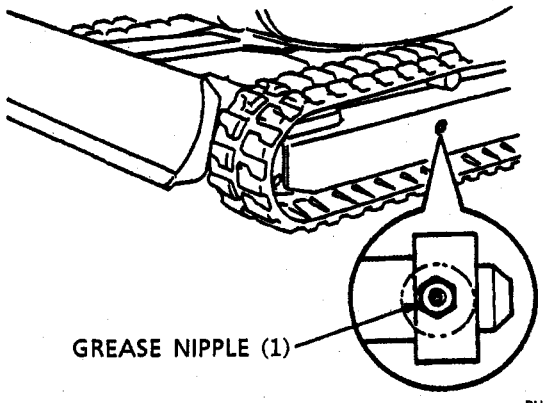
(1) Removing

1) Loosen grease nipple (1) for crawler adjuster to loosen tension of crawler.
: 19mm

⚠ Use care that high-pressured grease is not spouted or the nipple is not come out by turning nipple abruptly or overloosening.

⚠ One turn of grease nipple for adjuster is enough to discharge grease, however, if the discharge is poor, move the machine back and forth.

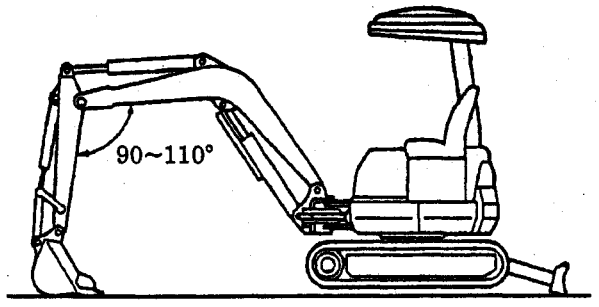
⚠ The rubber crawler is an endless type. When it is confirmed that grease has been discharged and that the rubber crawler has slackened, open the grease nipples and discharge the grease till the idler is pushed to the deepest end.



PH-B83

Fig. 1 Adjusting crawler tension

2) Lift the one side of machine with front attachment, as shown in Fig. 2, and place square timber or equivalent under lower frame to support machine.

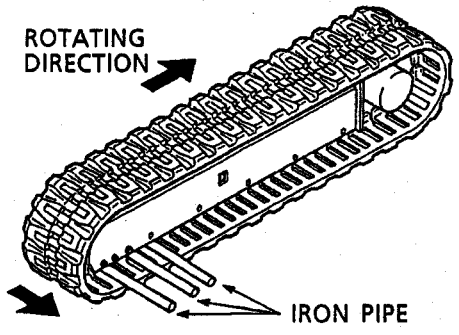


PH-B83

Fig. 2 Supporting machine

⚠ When lifting up the body, adjust the angle of boom and arm to 90°~110°, and support the face of bucket bottom.

3) When the idler has been pushed to the deepest end, put an iron pipe in the rubber crawler, turn the sprocket backward slowly and when the rubber crawler has floated off the idler, slide it sideways and remove it.



YRm-3-26

Fig. 3 Removing rubber crawler

Weight of rubber crawler (one side)

SK25SR	117kg(260lbs)
SK30SR	123kg(270lbs)
SK35SR	135kg(300lbs)

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3. LOWER ROLLER

3.1 REMOVAL AND INSTALLATION

(1) Removing

1) Slightly loosen capscrews fasten lower roller assy with the track frame.
   : 22mm

2) Loosen the crawler tension by the crawler adjuster.
   : 19mm

3) Lift the machine to remove the lower roller, using the front attachment and dozer blade.

4) After lifting the track frame to a proper level and place square wooden blocks under the lower frame to stabilize the machine.

⚠ Always place square wooden blocks so they support the front and rear lower frames, in order to stabilize the machine. Lower the front attachment on the ground, stop the engine and proceed to work.

5) Loosen the capscrews fastening the lower roller and remove the lower roller.
   : 22mm
   Weight of lower roller assy
   : about10kg(22lbs)

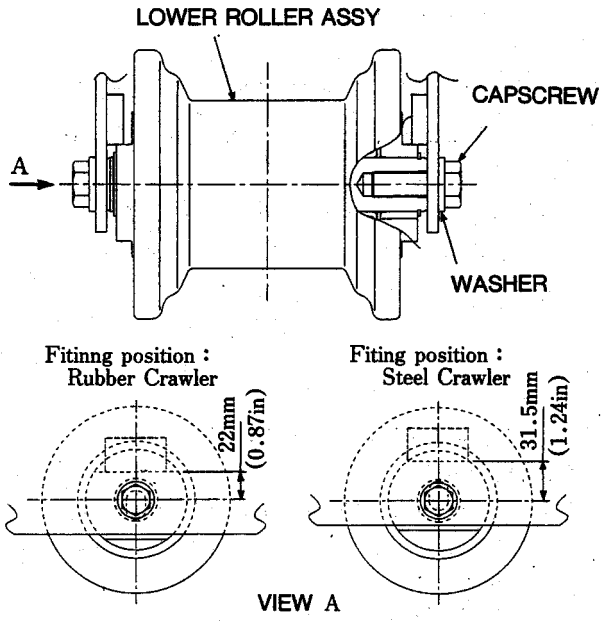

Fig. 32 Lower roller assy

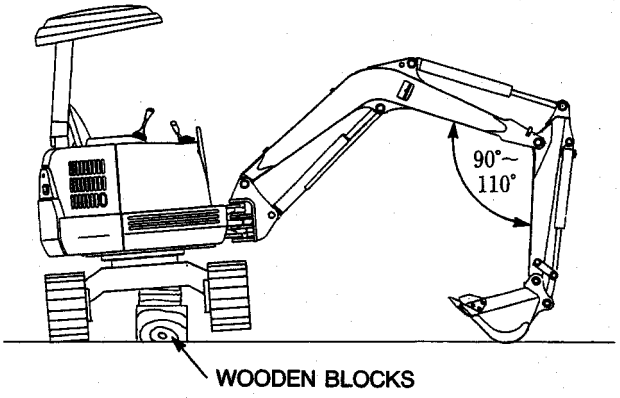

Fig. 33 Supporting machine

(2) Installing

1) Coat the mounting capscrews with Locktite #262 in advance. Align the capscrews with the bolt holes and fasten them temporarily.
   • Refer to Fig.32 for the fiting position depending on the kind of crawler.

2) Lower the machine in full contact with the ground and tighten the capscrews (2).
   : 22mm,
   Tightening torqre : 18.5±2kgf•m
   (134±14ft•lbs)

3) Tighten the grease nipple of the crawler adjuster, adjust the crawler tension.
   : 19mm
   Tightening torque : 6±1kgf•m
   (43±7ft•lbs)

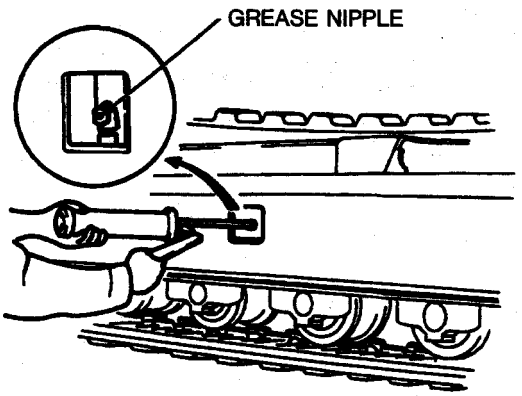

Fig. 34 Adjusting crawler tention

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9) Lower the hydraulic jack slowly till the spring is extended to its free length. Remove the retainer plate and take off bracket (4). Measure the free length of the spring and check it with the value given in the maintenance standard.

: 30mm

Free length of the spring :
345mm(13.6in)

10) Put lifting nut (W) at the end of grease cylinder (2). Place a wire sling to it and remove with spring (3).

11) Remove grease cylinder (2) from spring (3).

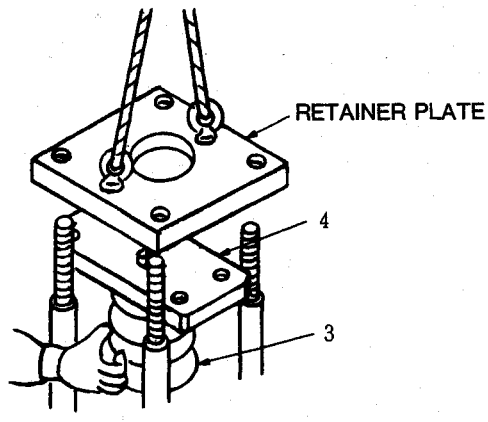

Fig. 59 Removing retainer plate

(2) Installing

Installing is done in the reverse order of removing.

1) Install spring (3) to grease cylinder (2) and stand it in the center of the jig (V) upright.

2) Install bracket (4) on top of spring (3). Align the rod of grease cylinder (2) with the holes in bracket (4). Install the retainer plate and put four nuts. Tighten the nuts evenly all round and fix the idler adjuster assy to the jig body.

: 30mm

3) Raise the hydraulic jack, compress spring (3) to a set length and tighten nut (5) to the threaded part at the end of grease cylinder (2).

Set length	Umit:mm(in)
SK25SR	296(11.7)
SK30SR	287(11.3)
SK35SR	274(10.8)

4) Tighten nut (5) till the holes for locking spring pin (9) are aligned. Then fit spring pin (9).

: 36mm

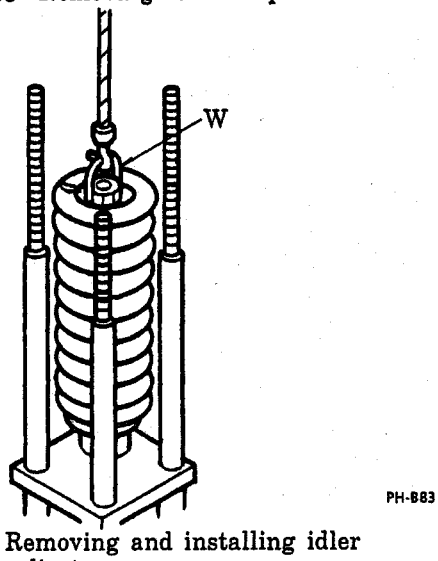

Fig. 60 Removing and installing idler adjuster assy

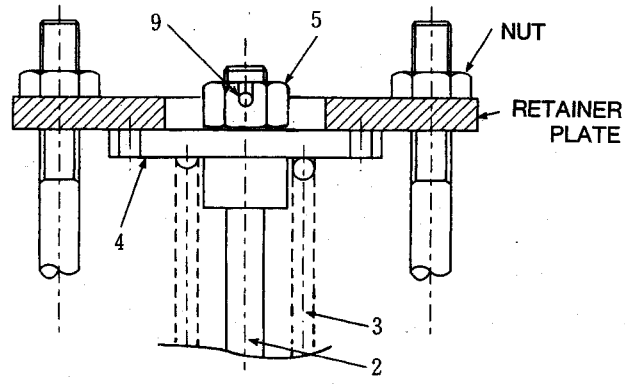

Fig. 61 Installing idler adjuster assy to jig body

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4) Install plug (9) to outer race (1) confirming the direction and the position of the hole for taper pin (8).

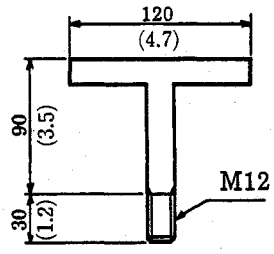
5) Drive taper pin (8) and caulk the head of the taper pin with a punch.

6) Confirm that grease nipple (7) is normal. Apply grease (NLGI−2) and confirm that the outer race rotates smoothly.

9.3.2 MAINTENANCE STANDARD

Regarding the maintenance standard for the wear of the slewing bearing, refer to Maintenance Standard and Test Procedure and Measuring Slewing Performance that are explained in a separate manual.

9.3.3 TOOLS AND JIGS

No.	ITEM	SKETCH
y	T-Bolt	

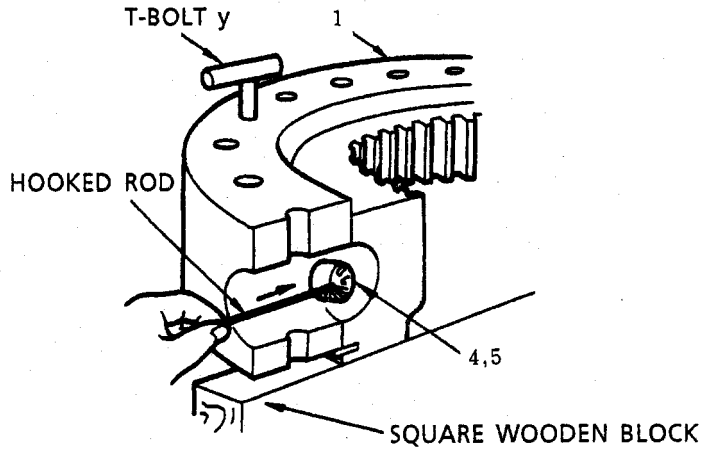


Fig. 87 Fitting spacer (4), (5)

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2.2 CONSTRUCTION

(1) Applicable Machines ■SK25SR : PV10001~PV12000
■SK30SR : PW07001~PW09500
■SK35SR : PX05001~PX06500

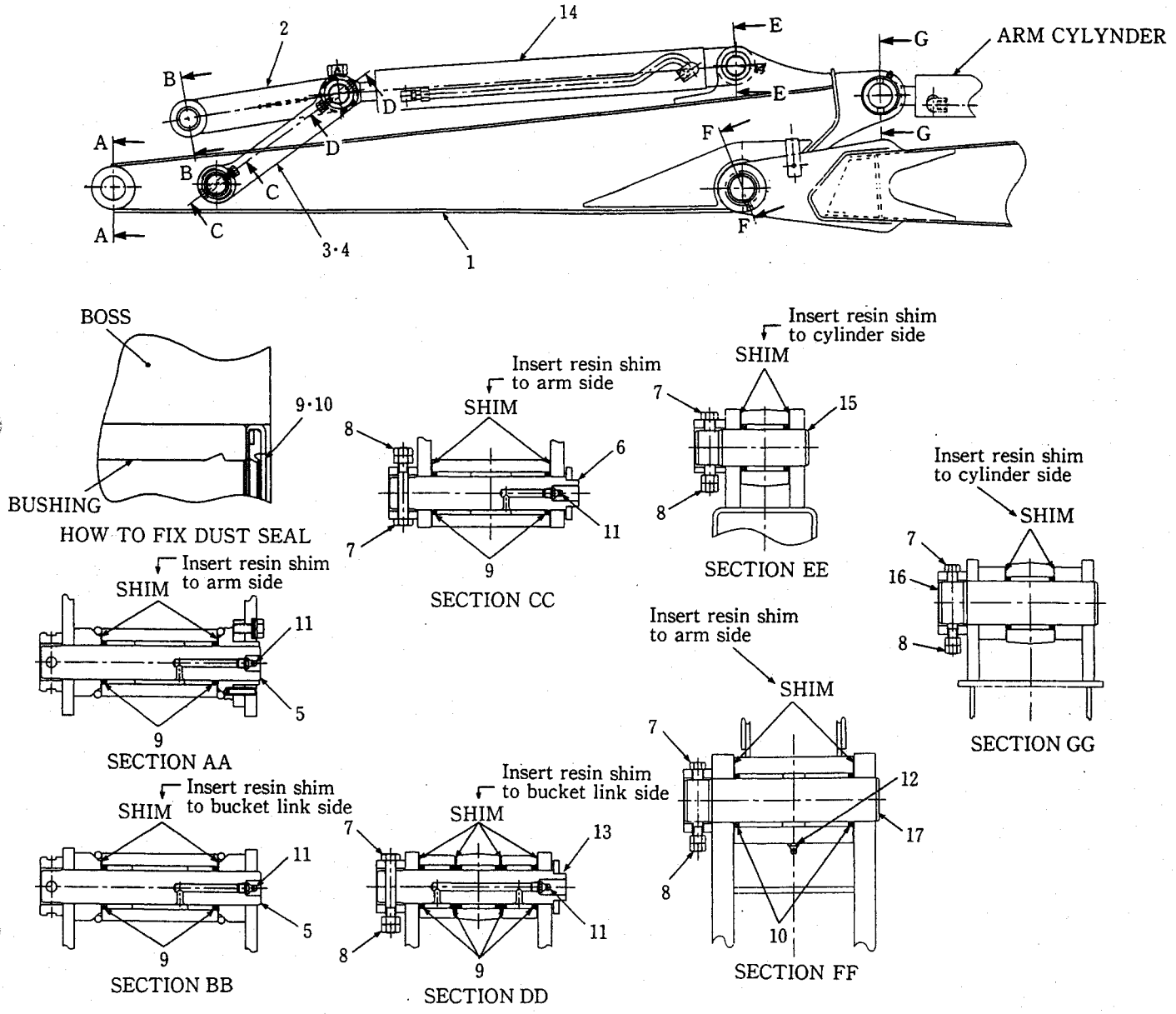

Fig. 15 Construction of arm

No.	NAME	Q'TY	No.	NAME	Q'TY	No.	NAME	Q'TY
1	ARM ASSY	1	6	PIN	1	12	GREASE NIPPLE	1
	(With Bushing and Collar)		7	CAPSCREW M10	5	13	PIN	1
2	BUCKET LINK	1		(Each dimension in length)		14	BUCKET CYLINDER	1
	(With Bushing)		8	NUT M10	10	15	PIN	1
3	LINK(RH)	1	9	DUST SEAL	10	16	PIN	1
4	LINK(LH)	1	10	DUST SEAL	2	17	PIN	1
5	PIN	2	11	GREASE NIPPLE	4	—	SHIM(t=1.0,0.5,0.2)	SELECT

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■SK30SR Applicable Machines PW09501~ Unit : mm (in)

Pos.	Item		Standard dimension		Shim adjusted clearance X (total of both sides)			Pin length		Remedy
			Code	Dimension	Standard value	Reference value for remedy	Serviceability limit	Code	Dimension	
A	Arm point	Arm	L1	$122^{-0.2}_{-0.4}$ ($4.803^{-0.008}_{-0.016}$)	0.1~1.0 (0.004~0.039)	1.5 (0.059)	2.0 (0.079)	ℓ1	252 (9.92)	Shim adjustment
		Bucket		$124^{+0.2}_{-1.2}$ ($4.882^{+0.008}_{-0.047}$)						
B	Bucket link	Link side	L2	$122^{-0.2}_{-0.4}$ ($4.803^{-0.008}_{-0.016}$)	0.6~1.0 (0.024~0.039)			ℓ2	252 (9.92)	
		Bucket		$124^{+0.2}_{-1.2}$ ($4.882^{+0.008}_{-0.047}$)						
C	Idler link (Connected part of arm)	Arm	L3	$122^{-0.2}_{-0.4}$ ($4.803^{-0.008}_{-0.016}$)	Less than 0.5 (0.020)			ℓ3	214 (8.43)	
		Link side		— (—)						
D	Bucket link (Rod side)	Rod side	L4	$45^{0}_{-0.5}$ ($1.772^{0}_{-0.020}$)	0.6~1.0 (0.024~0.039)			ℓ5	214 (8.43)	
		Link side		$48^{\pm 0.5}$ ($1.890^{\pm 0.020}$)						
	Bucket link (Idler link side)	Bucket link	L5	$122^{+0.2}_{-0.8}$ ($4.803^{+0.008}_{-0.031}$)						
		Idler link		— (—)						
E	Bucket cylinder (Head side)	Head side	L6	$45^{0}_{-0.5}$ ($1.772^{0}_{-0.020}$)	0.6~2.0 (0.024~0.079)	2.5 (0.098)	3.0 (0.118)	ℓ6	112 (4.41)	
		Arm		$47^{+1.0}_{0}$ ($1.850^{+0.039}_{0}$)						
F	Arm foot	Arm	L7	$123^{-0.2}_{-0.4}$ ($4.843^{-0.008}_{-0.016}$)	Less than 0.5 (0.020)	1.5 (0.059)	2.0 (0.079)	ℓ7	190 (7.48)	
		Boom		$125^{+1.0}_{0}$ ($4.921^{+0.039}_{0}$)						
G	Arm cylinder (Rod side)	Rod side	L8	$50^{0}_{-0.5}$ ($1.969^{0}_{-0.020}$)	0.6~2.0 (0.024~0.079)	2.5 (0.098)	3.0 (0.118)	ℓ8	121 (4.76)	
		Arm		$52^{+1.0}_{0}$ ($2.008^{+0.039}_{0}$)						

■SK35SR Applicable Machines PX06501~ Unit : mm (in)

Pos.	Item		Standard dimension		Shim adjusted clearance X (total of both sides)			Pin length		Remedy
			Code	Dimension	Standard value	Reference value for remedy	Serviceability limit	Code	Dimension	
A	Arm point	Arm	L1	$125^{-0.2}_{-0.4}$ ($4.921^{-0.008}_{-0.016}$)	0.1~1.0 (0.004~0.039)	1.5 (0.059)	2.0 (0.079)	ℓ1	255 (10.0)	Shim adjustment
		Bucket		$127^{+1}_{+0.5}$ ($5.000^{+0.039}_{+0.020}$)						
B	Bucket link	Link side	L2	$125^{-0.2}_{-0.4}$ ($4.921^{-0.008}_{-0.016}$)	0.6~1.0 (0.024~0.039)			ℓ2	255 (10.0)	
		Bucket		$127^{+1}_{+0.5}$ ($5.000^{+0.039}_{+0.020}$)						
C	Idler link (connected part of arm)	Arm	L3	$125^{-0.2}_{-0.4}$ ($4.921^{-0.008}_{-0.016}$)	Less than 0.5 (0.020)			ℓ3	221 (8.70)	
		Link side		— (—)						
D	Bucket link (Rod side)	Rod side	L4	$45^{0}_{-0.5}$ ($1.772^{0}_{-0.020}$)	0.6~1.0 (0.024~0.039)			ℓ5	221 (8.70)	
		Link side		$48^{\pm 0.5}$ ($1.890^{\pm 0.020}$)						
	Bucket link (Idler link side)	Bucket link	L5	$125^{+0.2}_{-0.5}$ ($4.921^{+0.008}_{-0.020}$)						
		Idler link		— (—)						
E	Bucket cylinder (Head side)	Head side	L6	$45^{0}_{-0.5}$ ($1.772^{0}_{-0.020}$)	0.6~2.0 (0.024~0.079)	2.5 (0.098)	3.0 (0.118)	ℓ6	116 (4.57)	
		Arm		$47^{+1.0}_{0}$ ($1.850^{+0.039}_{0}$)						
F	Arm foot	Arm	L7	$130^{-0.2}_{-0.4}$ ($5.118^{-0.009}_{-0.016}$)	Less than 0.5 (0.020)	1.5 (0.059)	2.0 (0.079)	ℓ7	197 (7.76)	
		Boom		$132^{+1.0}_{0}$ ($5.197^{+0.039}_{0}$)						
G	Arm cylinder (Rod side)	Rod side	L8	$55^{0}_{-0.5}$ ($2.165^{0}_{-0.020}$)	0.6~2.0 (0.024~0.079)	2.5 (0.098)	3.0 (0.118)	ℓ8	131 (5.16)	
		Arm		$57^{+1.0}_{0}$ ($2.244^{+0.039}_{0}$)						

■SK30SR Applicable Machines PW07001～PW09500 Unit : mm (in)

Pos.	Item		Standard dimension		Shim adjusted clearance X (total of both sides)			Pin length		Remedy
			Code	Dimension	Standard value	Reference value for remedy	Serviceability limit	Code	Dimension	
A	Boom foot	Boom	L1	$178\ ^{-0.2}_{-0.4}$ ($7.008\ ^{-0.008}_{-0.016}$)	Less than 0.5 (0.020)	1.0 (0.039)	1.5 (0.059)	ℓ 1	275 (10.83)	Shim adjustment
		Swing bracket		$180\ ^{+1.0}_{0}$ ($7.087\ ^{+0.039}_{0}$)						
B	Boom cylinder (Head side)	Boom cylinder	L2	$55\ ^{0}_{-0.5}$ ($2.165\ ^{0}_{-0.020}$)	0.6~1.0 (0.024~0.039)	1.5 (0.059)	2.0 (0.079)	ℓ 2	248 (9.76)	
		Swing bracket		$61\ ^{+1.0}_{0}$ ($2.402\ ^{+0.039}_{0}$)						
C	Arm cylinder (Head side)	Arm cylinder	L3	$50\ ^{0}_{-0.5}$ ($1.969\ ^{0}_{-0.020}$)				ℓ 3	160 (6.30)	
		Boom		$51\ ^{+1.0}_{0}$ ($2.008\ ^{+0.039}_{0}$)						
D	Boom cylinder (Rod side)	Boom cylinder	L4	$55\ ^{0}_{-0.5}$ ($2.165\ ^{0}_{-0.039}$)	0.6~2.0 (0.024~0.079)	2.5 (0.098)	3.0 (0.118)	ℓ 4	160 (6.30)	
		Boom		$56\ ^{+1.0}_{0}$ ($2.205\ ^{+0.039}_{0}$)						
※[A]	Boom foot	Boom	L1	$178\ ^{-0.2}_{-0.4}$ ($7.008\ ^{-0.008}_{-0.016}$)	0.2~0.7 (0.008~0.028) w/out Shim	1.0 (0.039)	1.5 (0.059)	ℓ 1	302 (11.89)	
		Swing bracket		※$178\ ^{+0.3}_{0}$($7.008^{+0.012}_{0}$)						
※[B]	Boom cylinder (Head side)	Boom cylinder	L2	$55\ ^{0}_{-0.5}$ ($2.165\ ^{0}_{-0.020}$)	0.6~1.0 (0.024~0.039)	1.5 (0.059)	2.0 (0.079)	ℓ 2	197 (7.76)	
		Swing bracket		※$61\ ^{+2}_{0}$ ($2.402\ ^{+0.079}_{0}$)						

(Note) •The ※ marked Pos. [A] and [B] are applicable for the machine number PW08508～09500.

■SK35SR Applicable Machines PX05001～06500 Unit : mm (in)

Pos.	Item		Standard dimension		Shim adjusted clearance X (total of both sides)			Pin length		Remedy
			Code	Dimension	Standard value	Reference value for remedy	Serviceability limit	Code	Dimension	
A	Boom foot	Boom	L1	$178\ ^{-0.2}_{-0.4}$ ($7.008\ ^{-0.008}_{-0.016}$)	Less than 0.5 (0.020)	1.0 (0.039)	1.5 (0.059)	ℓ 1	275 (10.83)	Shim adjustment
		Swing bracket		$180\ ^{+1.0}_{0}$ ($7.087\ ^{+0.039}_{0}$)						
B	Boom cylinder (Head side)	Boom cylinder	L2	$60\ ^{0}_{-0.5}$ ($2.362\ ^{0}_{-0.020}$)	0.6~1.0 (0.024~0.039)	1.5 (0.059)	2.0 (0.079)	ℓ 2	242 (9.53)	
		Swing bracket		$61\ ^{+1.0}_{0}$ ($2.402\ ^{+0.039}_{0}$)						
C	Arm cylinder (Head side)	Arm cylinder	L3	$55\ ^{0}_{-0.5}$ ($2.165\ ^{0}_{-0.020}$)				ℓ 3	160 (6.30)	
		Boom		$56\ ^{+1.0}_{0}$ ($2.205\ ^{+0.039}_{0}$)						
D	Boom cylinder (Rod side)	Boom cylinder	L4	$60\ ^{0}_{-0.5}$ ($2.362\ ^{0}_{-0.020}$)	0.6~2.0 (0.024~0.079)	2.5 (0.098)	3.0 (0.118)	ℓ 4	160 (6.30)	
		Boom		$61\ ^{+1.0}_{0}$ ($2.402\ ^{+0.039}_{0}$)						
※[A]	Boom foot	Boom	L1	$178\ ^{-0.2}_{-0.4}$ ($7.008\ ^{-0.008}_{-0.016}$)	0.2~0.7 (0.008~0.028) w/out Shim	1.0 (0.039)	1.5 (0.059)	ℓ 1	302 (11.89)	
		Swing bracket		※$178\ ^{+0.3}_{0}$($7.008^{+0.012}_{0}$)						
※[B]	Boom cylinder (Head side)	Boom cylinder	L2	$60\ ^{0}_{-0.5}$ ($2.362\ ^{0}_{-0.020}$)	0.6~1.0 (0.024~0.039)	1.5 (0.059)	2.0 (0.079)	ℓ 2	197 (7.76)	
		Swing bracket		※$61\ ^{+2}_{0}$ ($2.402\ ^{+0.079}_{0}$)						

(Note) •The ※ marked Pos. [A] and [B] are applicable for the machine number PX05601～06500.

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■SK25SR Applicable machines : PV10927~PV12000 Unit : mm (in)

No.	Item	Pin parts No.	Standard dimension			Clearance			Remedy
			Pin dia	Tolerance on pin dia	Tolerance on bushing bore dia	Standard value	Reference value for remedy	Serviceability limit	
A	Swing cylinder (Rod side)	PM02B01156P1	φ35 (φ1.3780)	−0.050~−0.075 (-0.0020~-0.0030)	+0.25~+0.05 (+0.0098~+0.0020)	0.10~0.33 (0.0039~0.0130)	1.0 (0.04)	1.5 (0.06)	Replace bushing or pin
B	Swing cylinder (Head side)	PM02B01117P1		−0.06~−0.09 (-0.0024~-0.0035)		0.11~0.34 (0.0043~0.0134)			
C1	Swing center (Upper side)	PV02B01170P1	φ60 (φ2.3622)	−0.030~−0.060 (−0.0012~−0.0024)	+0.17~+0.06 (+0.0067~+0.0024)	0.09~0.23 (0.0035~0.0091)			
C2	Swing center (Lower side)	PW02B01142P1							

(Note) •The tolerance for bushing inside diameter means the dimension after insertion of it into the place.
•The part number for pins may be changed due to improvement, use them only for reference.

■SK30SR Applicable machines : PW07001~PW08507
■SK35SR Applicable machines : PX05001~PX05600 Unit : mm (in)

Pos.	Item	Pin parts No.	Standard dimension			Clearance			Remedy
			Pin dia	Tolerance on pin dia	Tolerance on bushing bore dia	Standard value	Reference value for remedy	Serviceability limit	
A	Swing cylinder (Rod side)	PW12B01055D5	φ45 (φ1.7717)	−0.06~−0.09 (-0.0024~-0.0035)	+0.20~+0.05 (+0.0079~+0.0020)	0.11~0.29 (0.0043~0.0114)	1.0 (0.04)	1.5 (0.06)	Replace bushing or pin
B	Swing cylinder (Head side)	PW02B01079P1							
C1	Swing center (Upper side)	PW02B01076D2	φ60 (φ2.3622)		+0.17~+0.06 (+0.0028~+0.0024)	0.12~0.26 (0.0047~0.0102)			
C2	Swing center (Lower side)	PW02B01076D1							

(Note) •The tolerance for bushing inside diameter means the dimension after insertion of it into the place.
•The part number for pins may be changed due to improvement, use them only for reference.

■SK30SR Applicable machines : PW08508~PW09500
■SK35SR Applicable machines : PX05601~06500 Unit : mm (in)

Pos.	Item	Pin parts No.	Standard dimension			Clearance			Remedy
			Pin dia	Tolerance on pin dia	Tolerance on bushing bore dia	Standard value	Reference value for remedy	Serviceability limit	
A	Swing cylinder (Rod side)	PW02B01136P1	φ45 (φ1.7717)	−0.050~−0.075 (-0.0020~-0.0030)	+0.20~+0.05 (+0.0079~+0.0020)	0.10~0.28 (0.0039~0.011)	1.0 (0.04)	1.5 (0.06)	Replace bushing or pin
B	Swing cylinder (Head side)	PW02B01079P1		−0.06~−0.09 (-0.0024~-0.0035)		0.11~0.29 (0.0043~0.0114)			
C1	Swing center (Upper side)	PW02B01133P2	φ60 (φ2.3622)	−0.030~−0.060 (−0.0012~−0.0024)	+0.17~+0.06 (+0.0028~+0.0024)	0.09~0.23 (0.0035~0.0091)			
C2	Swing center (Lower side)	PW02B01142P1							

(Note) •The tolerance for bushing inside diameter means the dimension after insertion of it into the place.
•The part number for pins may be changed due to improvement, use them only for reference.

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(2) Installation of Cylinder

1) Replace the worn-out pins and bushing and the dust seal at every removal to new one referring to the "Maintenance Standard" for each section of boom, swing and dozer blade. For the installing direction of dust seal, refer to "How to fix Dust Seal" in "Construction" of each section.
2) Check the clearance for thrust direction on attaching portion of each pin to determine the thickness of shim, referring to aforesaid "Maintenance Standard."
   • Preliminary carry out the adjustment for the clearance with a resin shim. then insert an iron shim.
3) Lift up the cylinder applying a rope to the center of gravity, and align pin bore on the head side cylinder.

⚠ When aligning the pin bore, do it visually, and never put finger into the bore.

4) Apply grease on the shims whose thickness was determined by the above 2) and pin, then insert them, and install the loose-out prevention capscrew and nuts. (Refer to Fig. 40)
   : 17㎜
5) Align the bore on rod side cylinder, apply grease on the connecting pin, insert it into the place, then install the loose-out prevention capscrew and nuts. For the head side boom cylinder, install the loose-out prevention plate and tighten it with two capscrews.
   : 17㎜, 19㎜
6) Connect the hydraulic hose to the cylinder.
   : 19㎜, 22㎜

Tightening Torque Unit : kgf·m (ft·lbs)

Thread Size	Hex. ㎜	O-ring Type	30° Flare Type
PF 1/8	—	2.0±0.2 (14±1)	1.0 $^{+0.5}_{0}$ (7 $^{+4}_{0}$)
PF 1/4	19	3.5±0.5 (25±4)	2.5 $^{+0.5}_{0}$ (18 $^{+4}_{0}$)
PF 3/8	22	5.5±0.5 (40±4)	5 $^{+0.5}_{0}$ (36 $^{+4}_{0}$)
PF 1/2	27	6.5±0.5 (47±4)	6 $^{+0.5}_{0}$ (43 $^{+4}_{0}$)

7) Tighten the air drain plug on hydraulic oil tank.
   Tightening torque : 3.0±0.3kgf·m(22±2ft·lbs)

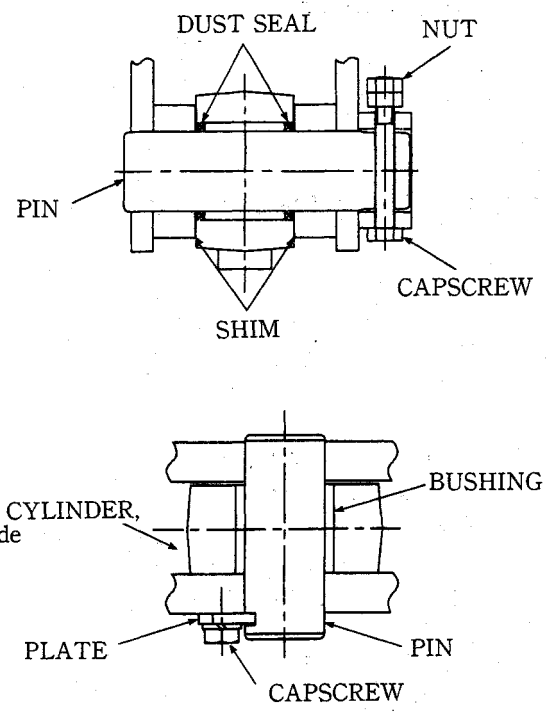

Fig. 39 Section at cylinder installing portion

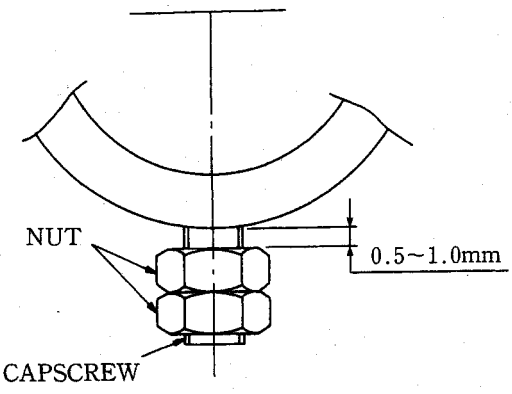

Fig. 40 Tightening procedure for nuts

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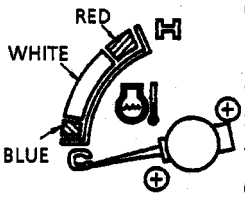
(19) Antenna (Spec. by country)

The antenna is contained in the left rear cab. The antenna can be extended to 60cm over from the cab, so contract it during transportation, etc. to prevent it from breaking.

(20) Monitor panel display

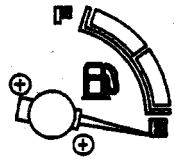
(21) Engine coolant temperature



This indicates the temperature of engine coolant. While operating, if the indicating needle is in the range of white zone, it is in normal condition.

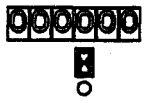
If the needle indicates in the range of red zone, change the engine to low idling and wait until the needle indicates in the range of white zone.

(22) Fuel level gauge



This shows the remainder of fuel tank. The indication may move up after a while from the key switch ON. This phenomenon does not mean the failure.

(23) Hour meter

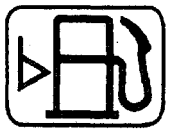


This indicates the total cumulative operating time of engine. The hour meter advances if the engine only is operating even though the vehicle does not move.

While the engine is rotating, the operation pilot lamp on the meter section indicates that the meter is advancing.

It operates on the operating time of the alternator regardless of the engine speed. Regard it as a reference for inspection and maintenance.

(24) Fuel level alarm lamp



When the remaining fuel level in the fuel tank arrives at about 10%, the lamp lights for 30 seconds and then the alarm buzzer sounds for 10 seconds.

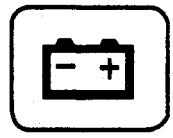
Replenish fuel before fuel is exhausted.

(25) Engine hydraulic pressure lamp

This warns that there is an abnormal drop of engine lubricating oil pressure.

When the lamp lights up, stop the engine and check for the engine oil level.

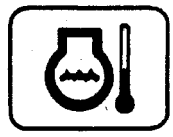
(26) Battery charge lamp



This battery charge lamp lights up by the starter switch "ON", and after starting engine the lamp goes off when the battery starts charging.

If the lamp does not go off after a while from the engine starting, check the charging system.

(27) Engine coolant temperature lamp



This warns that the engine coolant temperature is in the range of red zone. When the lamp goes on, stop operation immediately, change the engine speed to idling, wait until the temperature lowers to the range of white zone, stop the engine, then check for the coolant level, tension of fan belt, and on radiator core for clogging, etc.

(28) 2nd-speed travel lamp

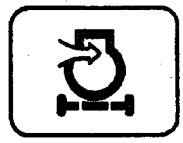
This indicates that the travel speed change switch is placed on the high speed side.

The travel speed selector switch is located on the grip of the right travel lever. The speed automatically returns to low (1st.) speed when the starter switch is set to "OFF".

(29) Glow lamp

If you turn the starter switch to "HEAT", the glow lamp lights, whereupon the air heater of the engine is heated. (For others, refer to Starting the Engine.)

(30) Air cleaner clog lamp



This warns that the element of air cleaner is clogged. When the lamp lights up, stop the engine and check or clean the element.

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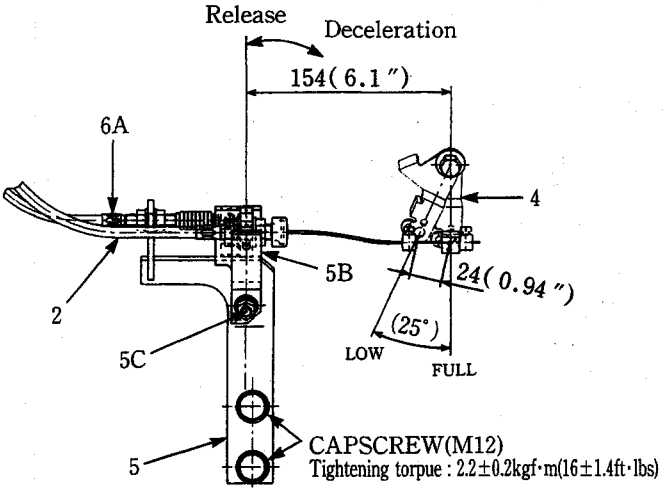
(3) Deceleration control

■ SK35SR

Applicable machines:PX05001～05600

When the decel (deceleration) switch on the monitor panel is pushed down, the decel relay is excited. and the decel (governor) motor (6) is actuated. The inner cable of cable (6A) acts to link lever (5B) to rotate it to rightward making the pin (5C) as the fulcrum (Fig. 12 Details F). Then the outer casing of control cable (2) that is attached to the link lever (5B) with two nuts, moves to rightward together with the inner cable, and the control lever of governor is moved to decel side (low idling sdie), leaving the throttle lever at its original position.

When the decel switch is again pushed down, the decel relay is de-excited, and the motor moves to return direction to release the deceleration.



DETAIL F

No.	NAME	Q'TY	No.	NAME	Q'TY
1	THROTTLE LEVER	1	5B	LINK LEVER	(1)
2	CONTROL CABLE	1	5C	PIN	(1)
4	CONTROL LEVER (E/G side)	(1)	6	DECEL MOTOR	1
5	LINK ASSY	1	6A	DECEL MOTOR CABLE	(1)
5A	BRAKET	(1)			

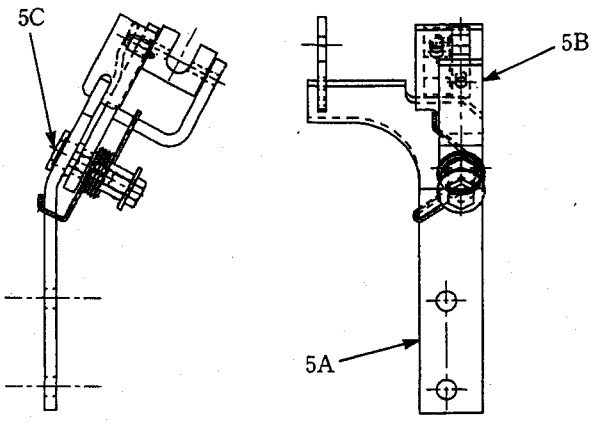


Fig. 11 Link assy

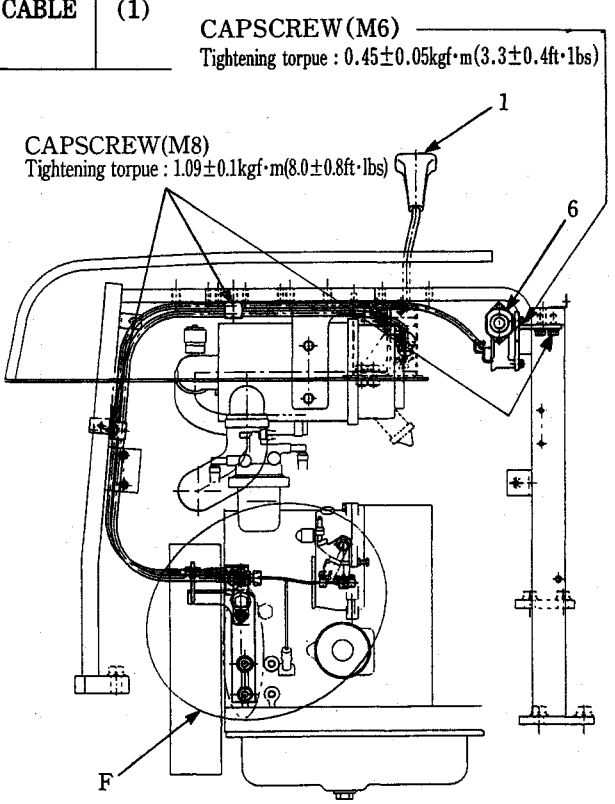
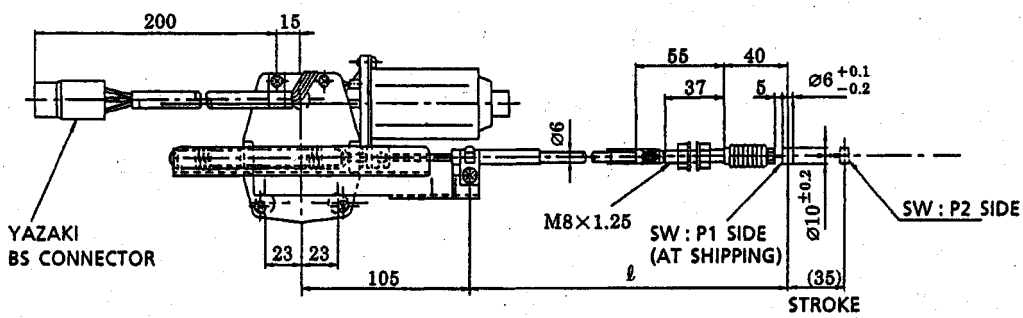


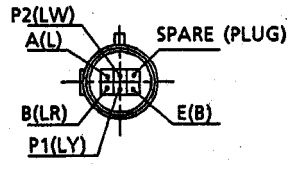
Fig. 12 Deceleration control

File No. Name of part Part No. Use Applicable Machine	Specification	Description
M-4 (A):25SR/30SR/35SR (B):35SR		
Motor		
(A):PW20S00001P1 (B):PX20S00002P1		
Deceleration (OPT)		
(A) {PV10001~ PW07001~ PX05601~ (B) : PX05001~05600		



ℓ =650(25.6″):M−4(A)
ℓ =1150(45.3″):M−4(B)

Rated voltage	12V
Operating force	15kg(33lbs) or more
Spring tension	At setting 16±2kg(35±4lbs)
Operating time	Less than 1 sec
Stroke	$35^{+1.0}_{-0.4}$mm($1.38^{+0.04}_{-0.02}$in)



Arrangement of BS connector terminals

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KOBELCO

Book Code No. S5PW25 01E①

SK25SR
SK30SR
SK35SR

SHOP MANUAL

ELECTRIC SYSTEM

TABLE OF CONTENTS

PW2

KOBE STEEL, LTD.

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MAIN HARNESS CONNECTION TABLE

(SK25SR · SK30SR)

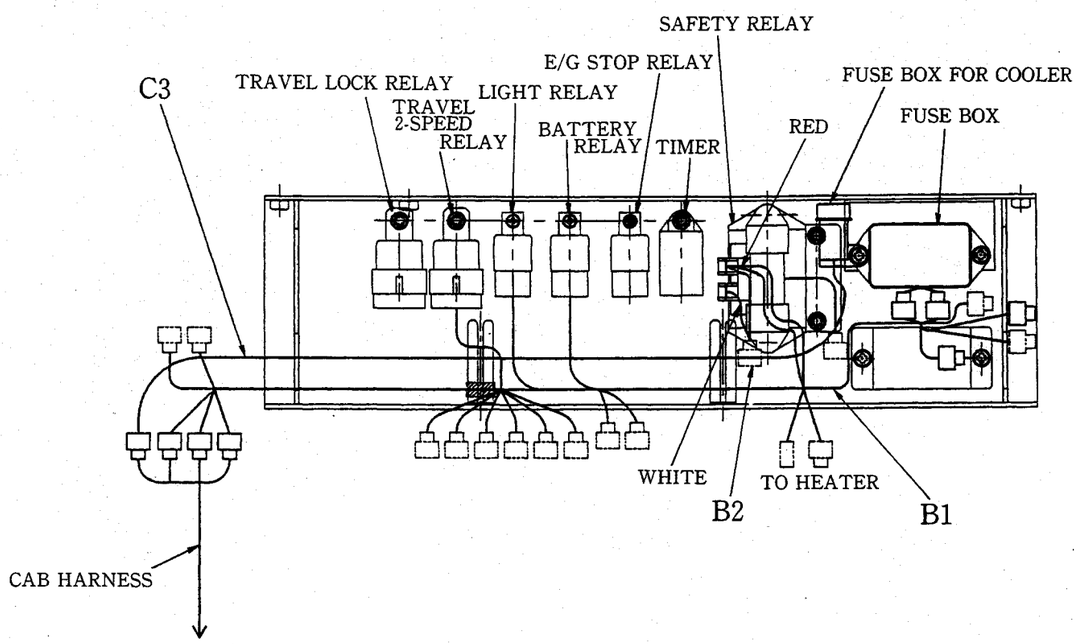
線番 WIRE NO	線色 WIRE COLOR	線種・サイズ WIRE SIZE	FROM	接続 CONNECTION	TO	機能 FUNCTION
2A	Y	AVSS0.75sq	CN-305F		CN-322F	FUSE-BOX → DECEL RELAY
2B	Y	AVSS0.75sq	CN-301F		CN-332F	FUSE-BOX → TRAVEL LOCK MOTOR
3	RW	AVSS0.75sq	CN-301F		CN-331F	FUSE-BOX → DECELE MOTOR
5A	RL	AVS2sq	CN-303F		CN-340F	FUSE-BOX → J/C-GREEN
5B	RL	AVSS0.75sq	CN-306F		CN-340F	E/G STOP SOL ← J/C-GREEN
5C	RL	AVSS0.75sq	CN-321F		CN-340F	TIMER UNIT ← J/C-GREEN
5D	RL	AVS2sq	CN-320F		CN-340F	E/G STOP RELAY ← J/C-GREEN
6A	WG	AVSS0.75sq	CN-301F		CN-340F	FUSE-BOX → J/C-GREEN
6B	WG	AVSS0.75sq	CN-323F		CN-340F	SAFETY RELAY ← J/C-GREEN
6C	WG	AVSS0.75sq	CN-306F		CN-340F	ALTERNATOR ← J/C-GREEN
8	R	AVS8sq	CN-334F		CN-327M	SAFETY RELAY → FUSIBLE LINK
9	R	AVS8sq	CN-327M		CN-304M	FUSIBLE LINK → ALTERNATOR
11	WY	AVSS0.75sq	CN-323F		CN-306F	SAFETY RELAY → ALTERNATOR
13	BW	AVSS0.75sq	CN-301F		CN-323F	KEY SW → SAFETY RELAY
14	W	AVS3sq	CN-304M		CN-334F	STARTER MOTOR → SAFETY RELAY
15A	Y	AVSS0.75sq	CN-326F	DOUBLE SPLICE	CN-321F	DIODE ← TIMER UNIT
15B	Y	AVSS0.75sq	CN-320F		CN-321F	E/G STOP RELAY ← TIMER UNIT
16A	RW	AVSS0.75sq	CN-326F	DOUBLE SPLICE	CN-321F	DIODE ← TIMER UNIT
16B	RW	AVSS0.75sq	CN-320F		CN-321F	E/G STOP RELAY → TIMER UNIT
17	PB	AVSS0.75sq	CN-301F		T-2	HORN SW → HORN
33	O	AVSS1.25sq	CN-301F		F-3	LIGHT RELAY → WORK LIGHT
39A	Sb	AVSS0.75sq	CN-301F	DOUBLE SPLICE	CN-328F	CONTROL CUT LS (LEFT) → CONTROL CUT SOL
39B	Sb	AVSS0.75sq	CN-301F		CN-324F	CONTROL CUT LS (LEFT) → TRAVEL LOCK RELAY
41	BrW	AVSS0.75sq	CN-301F		CN-329F	TRAVEL 2-SPEED RELAY → TRAVEL 2-SPEED SOL
45	BW	AVSS0.75sq	CN-302M		F-1	CLUSTER GAUGE → TRAVEL 2-SPEED SW
46	WB	AVSS0.75sq	CN-302M		F-2	CLUSTER GAUGE → TRAVEL 2-SPEED SW
47	L	AVS5sq	CN-303F		CN-304M	KEY SW → AIR HEATER
48	LgB	AVSS0.75sq	CN-302M		CN-306F	CLUSTER GAUGE ← ALTERNATOR
50	GB	AVSS0.75sq	CN-302M		CN-306F	CLUSTER GAUGE ← HYD. SW
51	YB	AVSS0.75sq	CN-302M		CN-306F	CLUSTER GAUGE ← E/G THERMO SW
52	YR	AVSS0.75sq	CN-302M		CN-306F	CLUSTER GAUGE ← E/G THERMO SENSOR
53	RG	AVSS0.75sq	CN-302M		CN-306F	CLUSTER GAUGE ← AIR CLEANER ALARM SW
55	YW	AVSS0.75sq	CN-305F		CN-101F	FUSE-BOX ← FUEL SENSOR
56	YG	AVSS0.75sq	CN-302M		CN-101F	CLUSTER GAUGE ← FUEL SENSOR
60	GL	AVSS0.75sq	CN-322F		CN-331F	DECELE RELAY → DECELE MOTOR
61	LB	AVSS0.75sq	CN-302M		CN-322F	CLUSTER GAUGE → DECELE RELAY
63	BY	AVSS0.75sq	CN-322F		CN-331F	DECELE RELAY → DECELE MOTOR
64	L	AVSS0.75sq	CN-322F		CN-331F	DECELE RELAY → DECELE MOTOR
65	GL	AVSS0.75sq	CN-324F		CN-332F	TRAVEL LOCK RELAY → TRAVEL LOCK MOTOR
66	BY	AVSS0.75sq	CN-324F		CN-332F	TRAVEL LOCK RELAY → TRAVEL LOCK MOTOR
67	L	AVSS0.75sq	CN-324F		CN-332F	TRAVEL LOCK RELAY → TRAVEL LOCK MOTOR
70	R	AVS2sq	CN-320F		CN-304M	E/G STOP RELAY → E/G STOP SOL
75	RW	AVSS0.75sq	CN-305F		CN-328F	COOLER → POWER SHIFT SOL

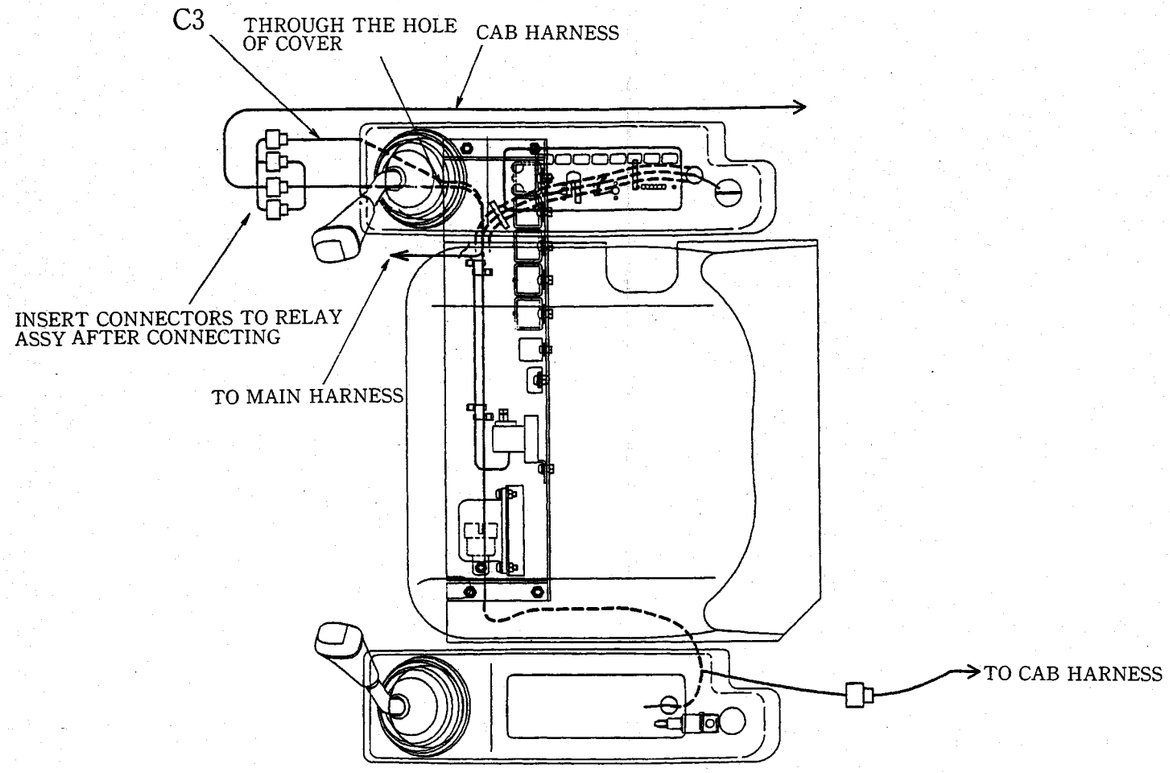
線番 WIRE NO	線色 WIRE COLOR	線種・サイズ WIRE SIZE	FROM	接続 CONNECTION	TO	機能 FUNCTION
E1	B	AVSS1.25sq	CN-305F		CN-340F	INST-HARNESS → J/C-GREEN
E2	B	AVSS0.75sq	CN-321F		CN-340F	TIMER UNIT → J/C-GREEN
E3	B	AVSS0.75sq	CN-323F		CN-340F	SAFETY RELAY → J/C-GREEN
E6	B	AVSS0.75sq	CN-101F		CN-340F	FUEL SENSOR → J/C-GREEN
E7	B	AVSS0.75sq	CN-306F		CN-340F	AIR CLEANER ALARM SW → J/C-GREEN
E8	B	AVSS0.75sq	CN-328F	DOUBLE SPLICE	P-4	CONTROL CUT SOL → BODY EARTH
E9	B	AVSS0.75sq	CN-329F		P-4	TRAVEL 2-SPEED SOL → BODY EARTH
E10	B	AVS1.25sq	M-1		CN-340F	WORK LIGHT → J/C-GREEN
E12	B	AVS3sq	P-2	DOUBLE SPLICE	CN-305F	BODY EAETH ← INST HARNESS
E13	B	AVS2sq	P-2		CN-306F	BODY EAETH ← E/G STOP SOL
E14	B	AVSS1.25sq	P-1	DOUBLE SPLICE	CN-340F	BODY EARTH ← J/C-GREEN
E15	B	AVSS1.25sq	P-1		CN-340F	BODY EARTH ← J/C-GREEN
E16	B	AVSS1.25sq	CN-302M		CN-340F	INST HARNESS → J/C-GREEN
E17	B	AVSS0.75sq	CN-331F		CN-340F	DECELE MOTOR → J/C GREEN
E5	B	AVSS0.75sq	T-1	DOUBLE SPLICE	P-3	HORN → BODY EARTH
E18	B	AVSS0.75sq	CN-332F		P-3	TRAVEL LOCK MOTOR → BODY EARTH
E19	B	AVSS0.75sq	CN-324F		CN-340F	TRAVEL LOCK RELAY → J/C-GREEN
E20	B	AVSS0.75sq	CN-328F		CN-340F	POWER SHIFT SOL → J/C-GREEN

CONNECTORS SELECTION TABLE

コネクタ名 (ピン数) CONNECTOR NAME (PIN NUM.)	メーカー MANUFUC.	部品番号 (PART. NUMBER) ハウジング HOUSING	ターミナル TERMINAL	ハーネスシール HARNESS SEAL	リテーナ RETAINER Dロックプレート LOCK PLATE	ウメ栓 SEALING PULG
2PAF-HW	SUMITOMO	6189-0129	1500-0106	7165-0118	6918-0322	
						7161-9787
2PAF-090	SUMITOMO	6180-2321	1500-0110	7160-8234		
2PAM-090	SUMITOMO	6187-2311				
2PAF-D	YAZAKI	7123-6026-60	7116-2871		7157-6222-50	
2PAF-L(BLUE)	YAZAKI	7123-4129-90	7116-3251 7116-3250		7157-6421-80	
2PAF-L(RED)	YAZAKI	7123-4125-50	7116-3251 7116-3250		7157-6421-80	
2PAM-L	YAZAKI	7122-4125-50	7114-3250		7157-6420-80	
3PAF-090H	SUMITOMO	6180-3261	1500-0110	7160-8234	7160-9465	
4PAF	YAZAKI	7123-2446	7116-2090			
4PAM-312	YAZAKI	7282-3040	7114-6041 7114-6042			
4PAF-X	YAZAKI	7123-6244-40	7116-2873	7157-3570	7157-6740-30	
4PAF-P&B	P&B AMP	VCF7-1000	280756-4 42281-1			
5PAM-P&B	P&B PACKARD	VCF4-1003	12015865			
6PAF	YAZAKI	7123-2262	7116-2092 7116-2020			
6PAF-X	YAZAKI	7219-3460	7116-1050	7157-3290		7157-9740
6PAM-BS	YAZAKI	7118-3460	7187-3290			7157-9740
10PAF	YAZAKI	7123-2800	7116-2090			
CA104	YAZAKI	7120-8012	7113-1020			
CB104	YAZAKI	7120-1010	7115-1050			
CB104-L	YAZAKI	7120-2010	7115-2020			
J/C-GREEN	SUMITOMO	6400-0013 6409-0072	8240-4422			

(5) CASE OF COOLER SPEC. (OPT)





No.	NAME	Q'ty	REMARKS
B1	INST. HARNESS	1	
B2	HARNESS (FOR SAFETY RELAY)	1	
B3	HARNESS (FOR HEATER SW.)	1	HEATER SPEC.
B4	HARNESS (FOR WIPER & RADIO)	1	CAB SPEC.
B6	JAMPER CONNECTOR	1	CAB SPEC.
C3	HARNESS (FOR COOLER)	1	COOLER SPEC.

1. OUTLINE

Troubleshooting provides process locating for the cause of trouble in the order that trouble occurred. This manual describes how to solve the specific phenomenon systematically as early as possible. For troubleshooting concerning the inside of equipment, refer to troubleshooting for each manual of equipment.

1.1 JUDGMENT OF ACTUAL THING AT SITE

(1) Get to the site as quickly as possible.
Verify model, serial number, situation of trouble and field, and notify person of arrival time.

(2) Verify background of trouble occurred.

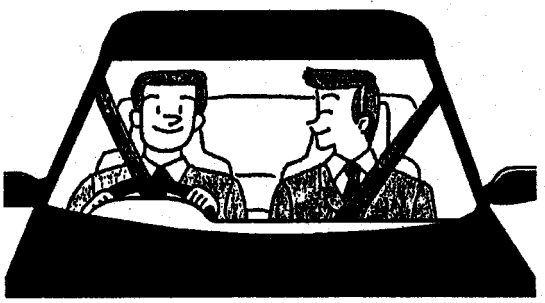
1) Model name and serial number
2) Kind of attachment
3) Operating time by hour-meter
4) History of trouble occurred and additional works
5) Recurrence of past trouble, or problems on the additional works

(3) How to diagnose trouble

1) Verify defective part.
2) Make the condition of trouble again.
3) Where defective parts can not be verified, surmise causes systematically.
4) Verify reasons for surmise.
5) Report methods, procedure, and period for repairing to user.

(4) Explanation of the cause of trouble

1) Explain the cause of trouble to clients. For example, oil leak through piston is caused by flaws on the piston rod. And the method of using the machines should be explained so that the same kind of trouble does not reoccur.
2) Treatment of damaged parts
The damaged parts to be claimed and returned are evidence so they should be handled with care. Protect them from entry of water, soils, etc. into port of hydraulic unit, etc. and return them. And also use care not to flaw and damage those surfaces.



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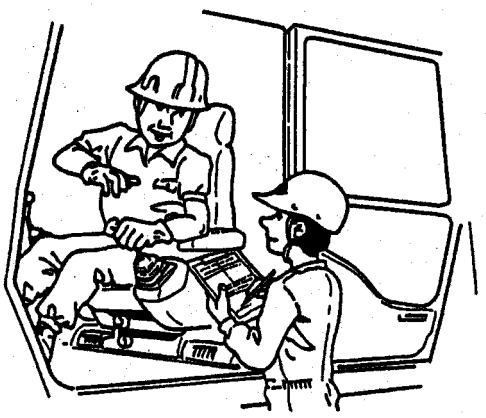
Attending the field to verify actual thing.



YR-B76

Verifying background of trouble occurred.

YR-B76

Diagnosing failure by means of troubleshooting.

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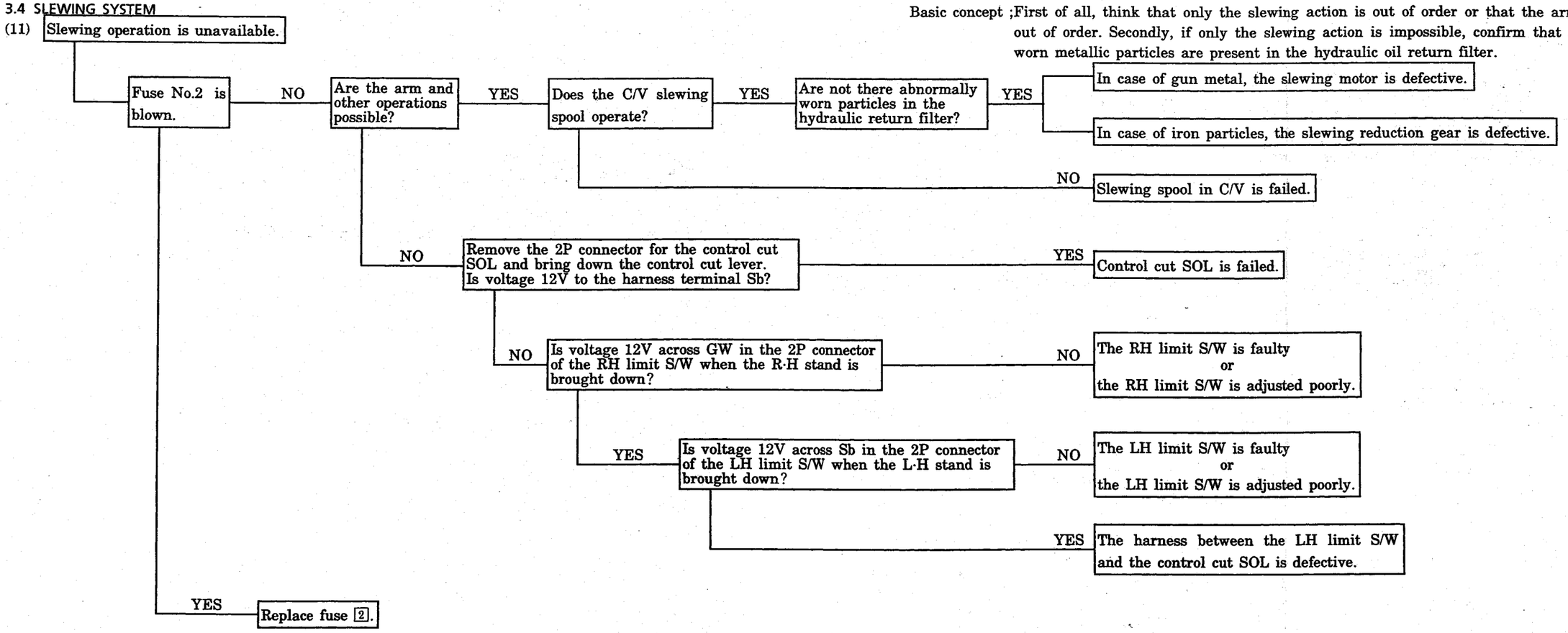
3.4 SLEWING SYSTEM

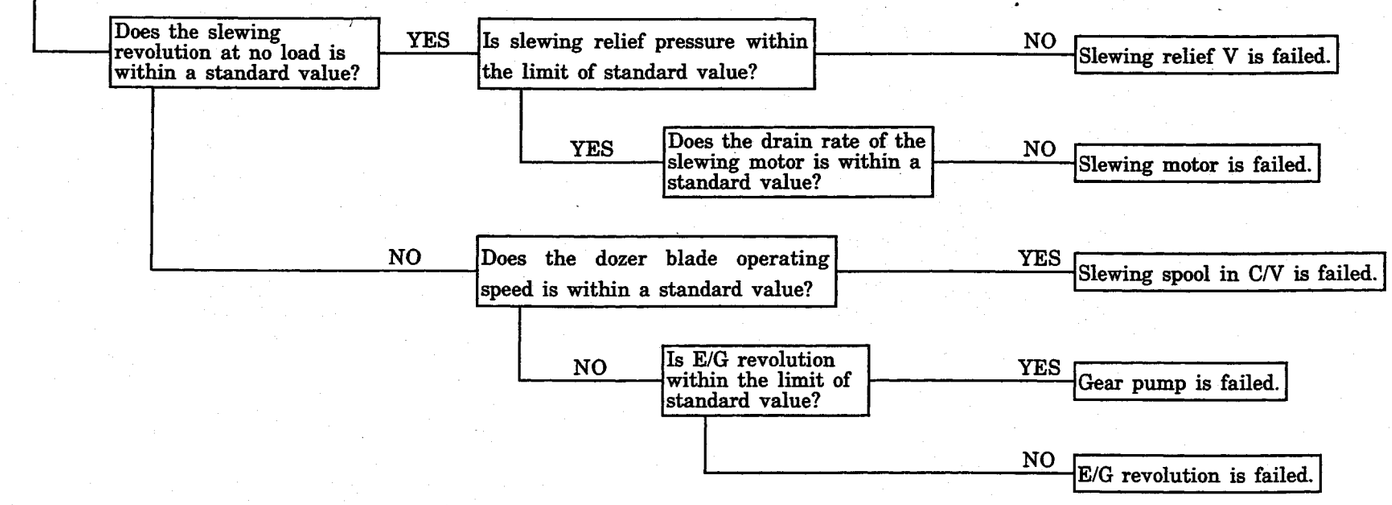
(11) Slewing operation is unavailable.

Basic concept ;First of all, think that only the slewing action is out of order or that the arm action is out of order. Secondly, if only the slewing action is impossible, confirm that abnormally worn metallic particles are present in the hydraulic oil return filter.



(12) Slewing speed is slow.

Basic concept ;If the speed is low, it means that the flow rate is lower than standard; check to see that the oil flow to the slewing motor is low or that standard flow is utilized effectively by the slewing motor.



2. CONSTRUCTION AND OPERATION

2.1 CONSTRUCTION

■SK25SR

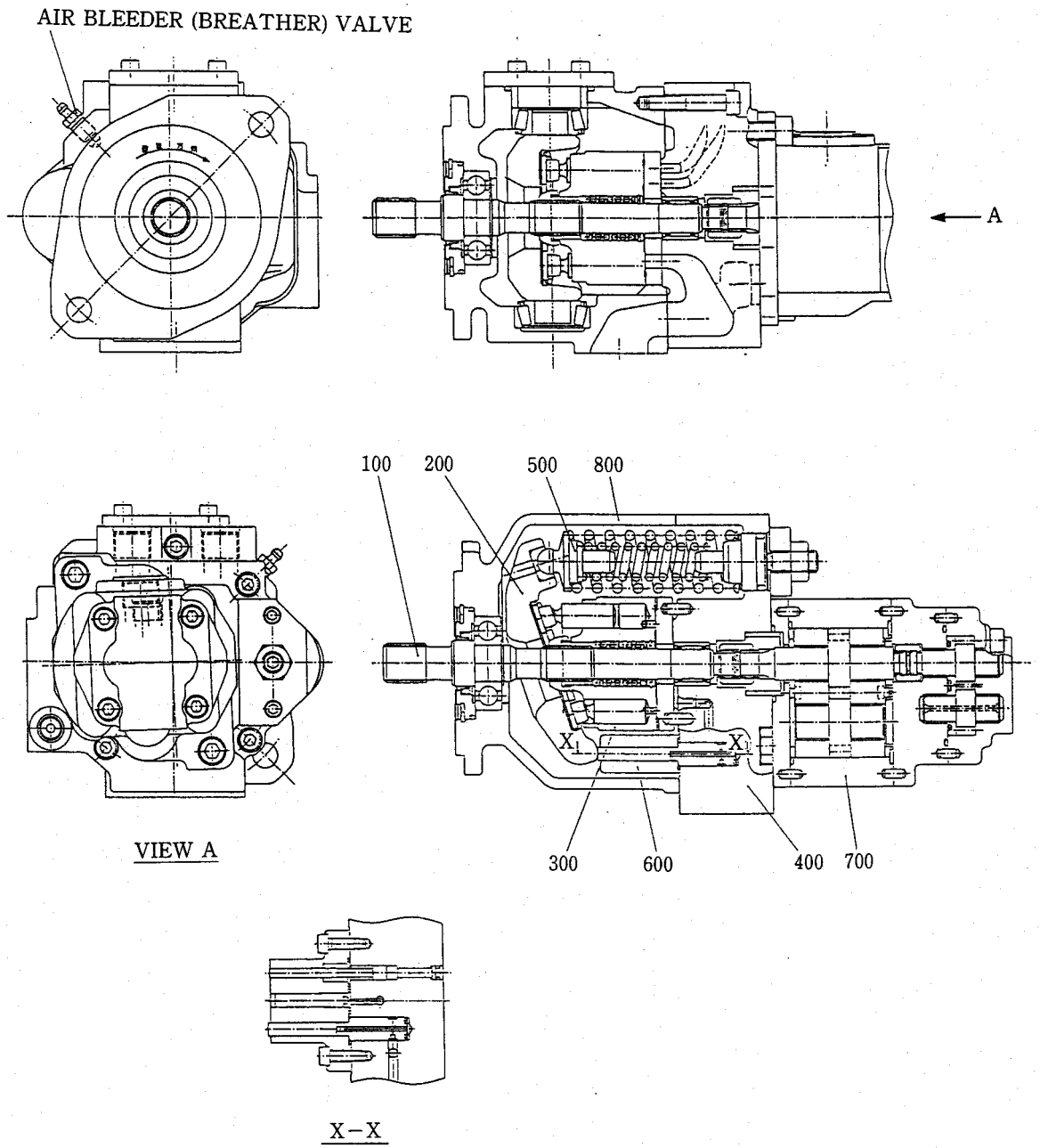


Fig. 2-1 Pump

No.	NAME	Q'TY	No.	NAME	Q'TY
100	DRIVE SHAFT SECTION	1	500	CONTROL SPRING SECTION	1
200	HANGER SECTION	1	600	CONTROL PISTON SECTION	1
300	ROTARY GROUP SECTION	1	700	GEAR PUMP SECTION	1
400	COVER SECTION	1	800	HOUSING SECTION	1

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3. REMOVAL AND INSTALLATION

3.1 TOOLS AND JIGS

(1) Tools

NAME	Q'TY	NOMINAL DIMENSION	NAME	Q'TY	NOMINAL DIMENSION
Allen wrench	each 1	HEX 3,5,6,8,10	Screw driver	2	Medium size
Spanner	1	HEX 17	Torque wrench	—	For the specified torque.
Plastic hammer	1	Medium size	Grease	small Q'TY	
Snap ring plier	1	For hole (Snapring 72)	Adhesive	small Q'TY	Locktite #270
Snap ring plier	1	For shaft (Snapring 28, 30)			

(2) Jigs

1) Work bench for removal and installation
This is a plate to put the pump downward. If the shaft ends don't contact it, square timber or an equivalent can be used to replace it.

Unit : mm(in)

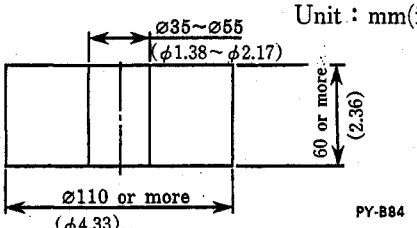

Fig. 15

2) Bearing built in jig

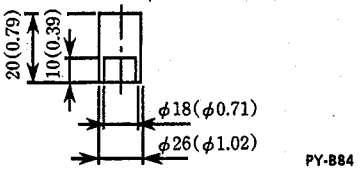

Fig. 16

3.2 REMOVAL AND INSTALLATION

3.2.1 GENERAL PRECAUTIONS

(1) Before removing, clarify the purpose and understand fully the internal structure of pump.

(2) After the oil in the pump has been drained, clean the pump, remove or install it on the work bench on rubber mat is placed. Then select proper tools, take care not to damage parts while working and take measures to prevent the entry of foreign matter.

3.2.2 REMOVAL

⚠ Precautions

1) Do not adjust the adjusting screw, unless otherwise required. The movement of adjusting screw changes the setting horse power.
2) While removing, take care not to damage any part.

(1) Removing gear pump.

1) Remove two socket bolts (736) M10×25 and remove gear pump (700).
: 8mm

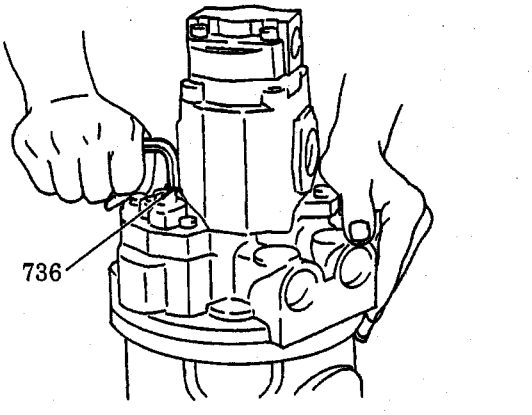

Fig. 17 Removing gear pump assy (700)

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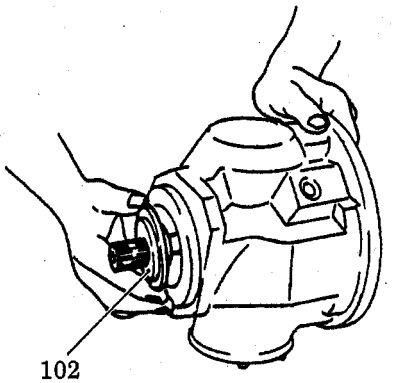
(7) Install seal casing (102) with oil seal (107) in housing (800) straight along axis.

● Apply grease on oil seal lip.



PY-B84

Fig. 53 Installing casing (102)

(8) Fix snap ring (109) to housing (800) and fix shaft (101).

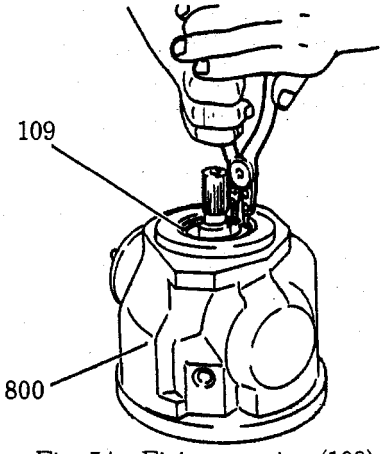


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Fig. 54 Fixig snap ring (109)

(9) Install pistons (301) in retainer (304) of rotary group (300).

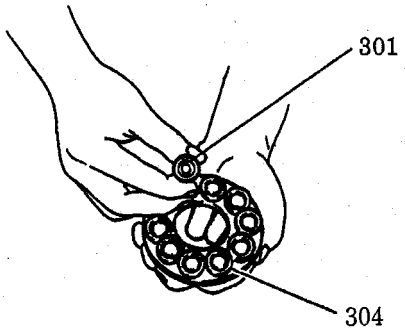

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Fig. 55 Installing piston (301)

(10) Apply grease on three parallel pins (308), fit it in the cylinder block (302).

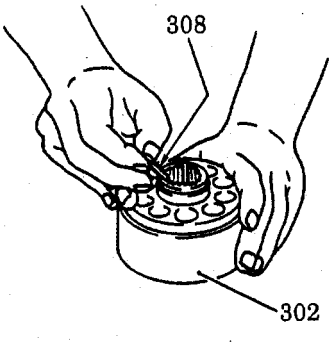

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Fig. 56 Fitting parallel pin (308)

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KOBELCO

Book Code No. S5 12039 7E

SHOP MANUAL

Applicable Model : SK30SR

HYDRAULIC PUMP

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KOBE STEEL, LTD.

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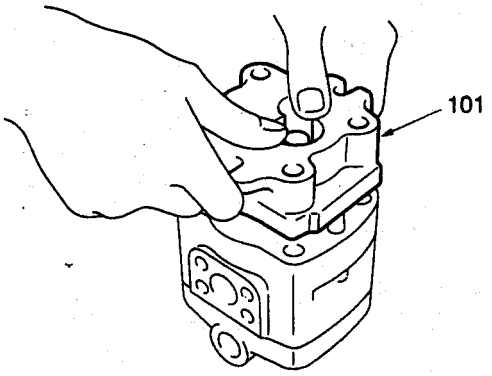
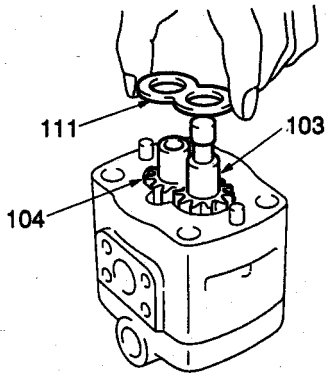
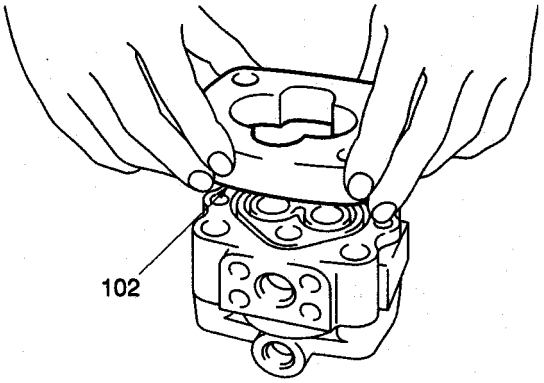
b. Remove the front cover (101).



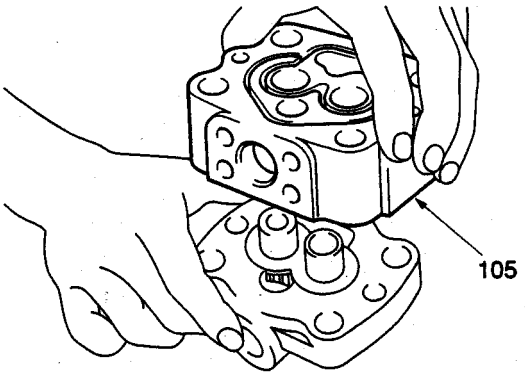
c. Remove the bushing (111).
d. Remove the drive gear (103) and driven gear (104).



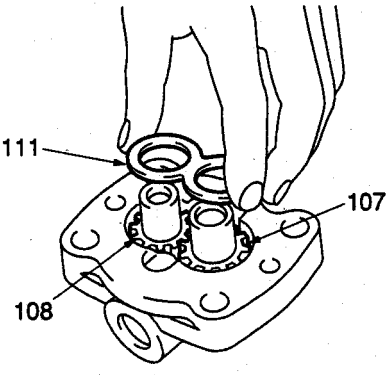
e. Remove the gear case (102).



f. Remove the gear case (105).



g. Remove the bushing (111), drive gear (107) and driven gear (108).



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1. SPECIFICATION

1.1 GENERAL VIEW

T=Tightening torque

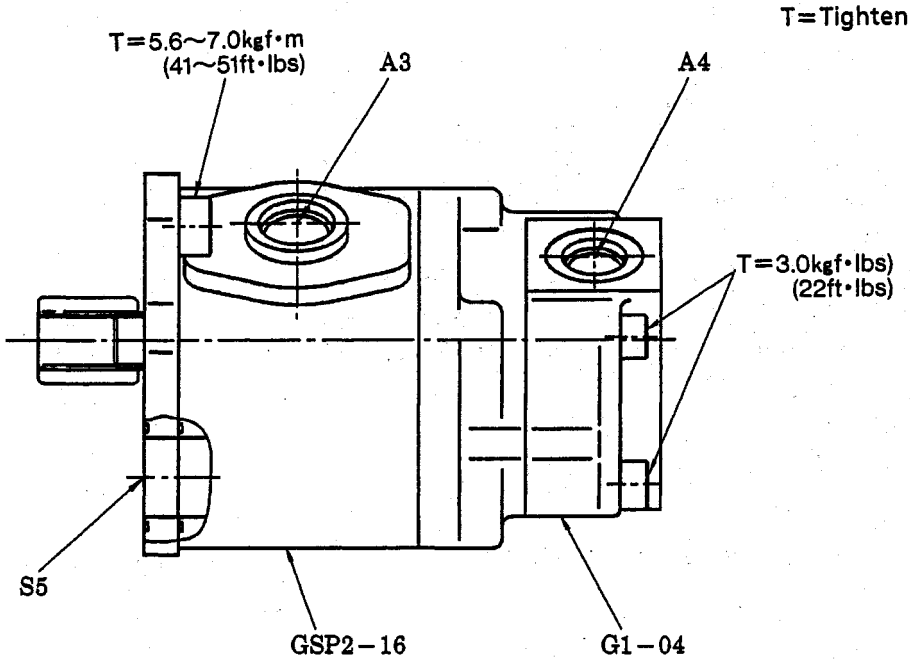
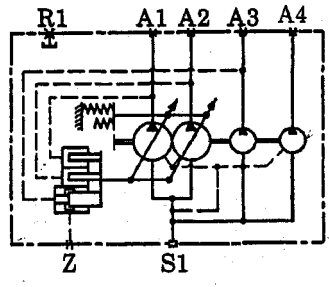


Fig. 1

No.	PORT NAME	SIZE
A3	Dozer blade & Slewing delivery port	PF1/2
P4	Pilot delivery port	PF3/8
S5	Suction port	–



HYDRAULIC CIRCUIT

PY-884

1.2 SPECIFICATIONS

Table 1

Item \ Type		Specification 1		Specification 2	
Applicable Model		SK25SR		SK35SR	
Type of each single pump		GSP2-08	G1-04	GSP2-12	G1-04
Working pressure	kgf/cm²(psi)	180(2,560)	40(570)	180(2,560)	40(570)
Displacement capacity	cc/rev(cu·in/rev)	8.6(0.52)	4.5(0.27)	12.1(0.74)	4.5(0.27)
Amount of delivery	ℓ/min(gal/min)	20.2(5.3)	10.6 (2.8)	28.4(7.5)	10.6(2.8)
Rated revolution	rpm	2,350		2,350	

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21) Install gear pump (GSP2) to gear pump (G1) with four capascrews M10 (735).

: 17mm,Tightening torque:6kgf·m (43ft·lbs)

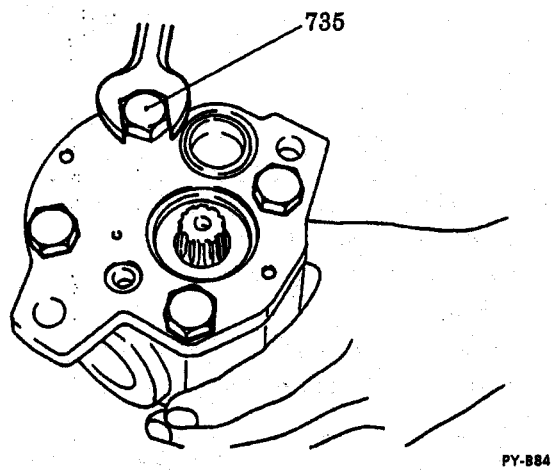

Fig. 33 Installing the gear pumps

22) Fit O ring (739) to front frame (720).

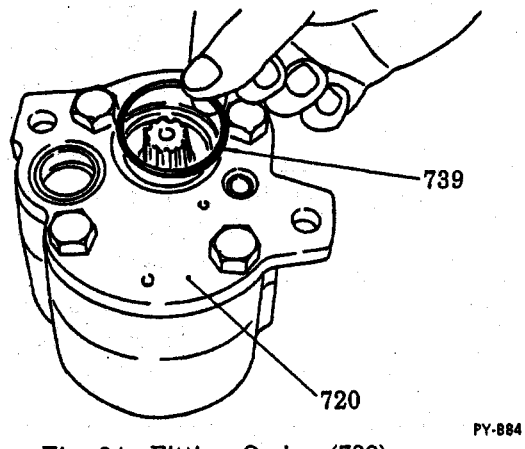

Fig. 34 Fitting O ring (739)

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(7) TRAVEL (RIGHT) ASSY (SECTION F-F)

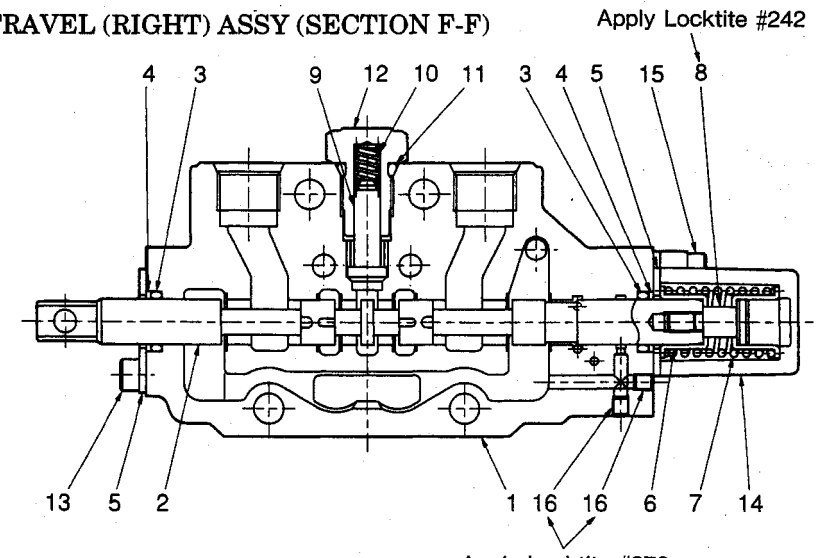

Fig. 9

No.	Tightening torque kgf·m(ft·lbs)
8	0.4~0.5(2.9~3.6)
13 15	0.6~0.7(4.3~5.1)
12	4(29)

No.	NAME	Q'TY	No.	NAME	Q'TY	No.	NAME	Q'TY
1	BODY	1	7	SPRING	1	13	SOCKET BOLT	2
2	SPOOL	1	8	SPOOL END	1	14	COVER	1
3	O-RING	2	9	POPPET (CHECK VALVE)	1	15	SOCKET BOLT	2
4	DUST WIPER	2	10	SPRING	1	16	PLUG	2
5	SEAL PLATE	2	11	O-RING	1			
6	SPRING SEAT	2	12	PLUG	1			

(8) SUPPLY & TRAVEL STRAIGHT ASSY (SECTION G-G)

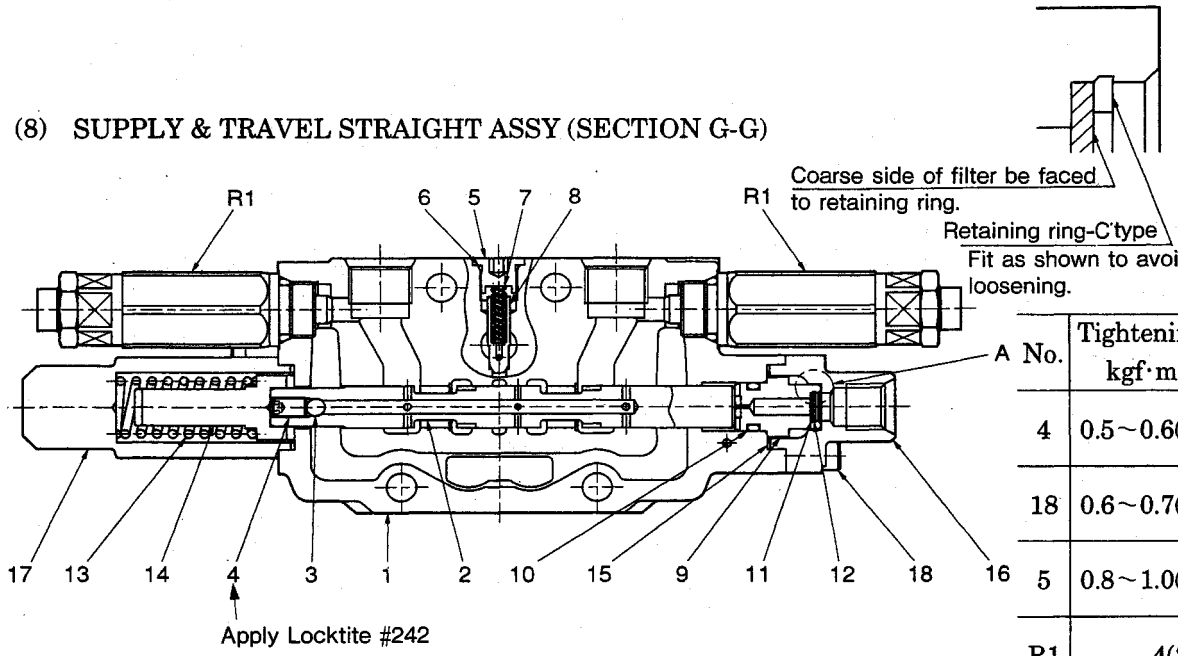

Fig. 10

No.	Tightening torque kgf·m(ft·lbs)
4	0.5~0.6(3.6~4.3)
18	0.6~0.7(4.3~5.1)
5	0.8~1.0(5.8~7.2)
R1	4(29)

No.	NAME	Q'TY	No.	NAME	Q'TY	No.	NAME	Q'TY
1	BODY	1	7	SPRING	2	13	SPRING	1
2	SPOOL	1	8	POPPET (CHECK VALVE)	2	14	STOPPER	1
3	STEEL BALL	1	9	FILTER CASE	1	15	O-RING	2
4	PLUG	1	10	O-RING	1	16	COVER	1
5	PLUG	2	11	FILTER	1	17	COVER	1
6	O-RING	2	12	RETAINING RING	1	18	SOCKET BOLT	4

※Main relief valve(R1) is included in overall component parts.

3.3 REMOVAL

3.3.1 Pulling off Procedures for Spool

- Precaution for Replacement of Spool
  If replacement of spool is required, do not remove the spool, but replace it to new one at assembly.

Put the valve on the working bench making the cylinder port upwards.

(A) In case of Hydraulic Pilot Changeover Type
(based on Fig. 2 Slewing spool, Section B-B for an example - Fig. 29)

1) Remove the two socket bolts (14).
   : 4mm
2) Remove the cover (13).
3) Remove the spool assy from the body (1) by means of pulling the spring (4) for axial direction.
   - At that time, confirm that if the O-ring (11) is left at the bottom of the cover (12) in opposite side.

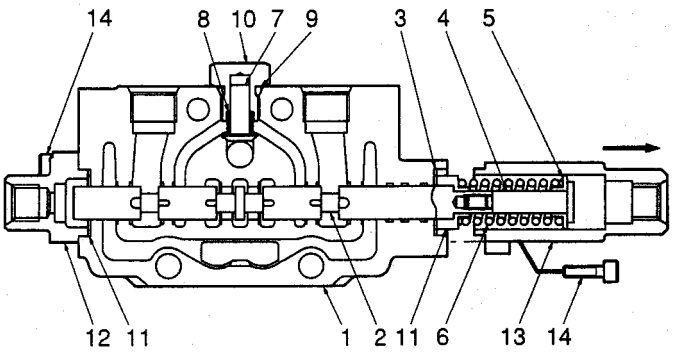

Fig. 29 Slewing spool
(hydraulic pilot changeover type)

(B) In case of Manual Changeover Type
(based on Fig. 2 Dozer spool, Section A-A for an example - Fig. 30)

1) Remove two socket bolts (15).
   : 4mm
2) Remove the cover (14).
3) Remove the spool assy from the body (1) by means of pulling the spring (4) for axial direction.
   - At that time, pay special attention not to damage the lip of spool seal [dust wiper (4) and O-ring (3)] of the opposite side. Because the spool seal tends to move to the spool edge.

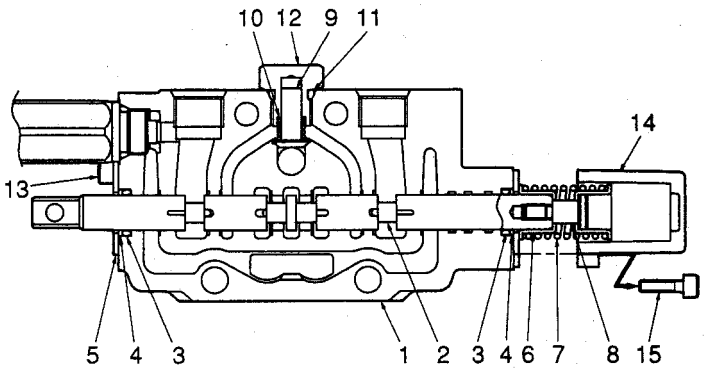

Fig. 30 Dozer spool (manual changeover type)

(C) In case of Travel Straight Spool
(based on Fig. 2 Supply & travel straight assy, Section G-G for an example - Fig. 31)

1) Remove two socket bolts (18).
   : 4mm
2) Remove the cover (17).
3) Remove the spring (13) and stopper (14).
4) Holding the edge of the spool, pull off the spool assy (2~4) from the body (1).
   - At that time, confirm that if the O-ring (15) is left in the place.
5) Remove the bolt (18) of the opposite side.
6) When the cover (16) is removed, the filter case assy (9~12) is now possible to remove.

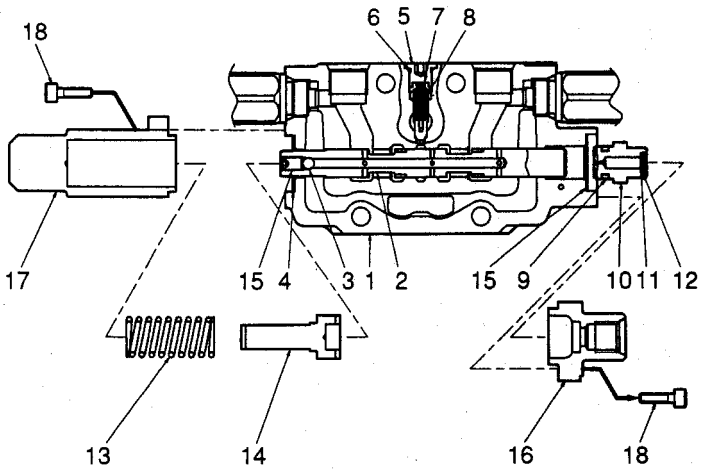

Fig. 31 Suppy & travel straight parts

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5.2 RELIEF VALVE

The relief valve is the most important parts in terms of function and safety. Since it is extremely difficult to reset the pressure of it, always replace the assy in case such faults as shown below should occur.

Trouble	Cause	Remedy
1. No pressure rise at all.	Plunger of each relief valve The poppet is stuck and left open or dirt is included in the valve seat.	• Check for foreign matter on each valve. • Make sure that each part slides freely.
2. Unstable relief pressure.	Damaged poppet of relief valve. Piston sticks against plunger valve.	• Replace damaged parts. • Clean all parts thoroughly. • Smooth surface damage.
3. Irregular relief pressure.	1) Wear due to foreign matter. 2) Loosened lock nut or adjusting screw. • Broken or deformed spring. 3) Malfunctioning relief valve and port relief valve. Refer to item 1. 1) above.	1) Replace assy 2) Adjust pressure. • Replace assy 3) Measure port relief valve and port relief valve pressure. Refer to item 1. 1) above.
4. Oil leak.	1) Damaged seat. Worn out O ring. 2) Sticking component due to foreign matter.	1) Replace damaged or worn component. Confirm that each component operates smoothly before reassembling. 2) Confirm that there are no scratches, scores, or foreign matter present before installing.

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4. MAINTENANCE STANDARDS

4.1 PARTS REPLACEMENT STANDARD

1) Replace O rings and other seals at each removal and installation.
2) Replace worn parts if leaks affects the operating system.
3) Replace spools having excessive wear on their moving areas.
4) Replace a push rod that is worn to 1mm (0.04in) or over on its top end. (See Fig. 12.)
5) Replace operating lever and pins that have a gap of 2mm (0.08in) or over.
6) Replace such parts that arise abnormal sounds, hunting and drops in the primary pressure.

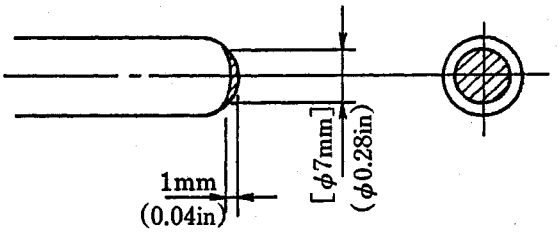

Fig. 12 Wear of push rod

5. TROUBLESHOOTING

Trouble	Cause	Remedy
Secondary pressure does not rise.	1) Primary pressure is insufficient. 2) Springs (241-1, 241-2) are broken or fatigued. 3) Clearance between spool (201-1, 201-2) and valve body (101) is abnormally large. 4) Lever has a gap.	1) Secure primary pressure. 2) Replace with new ones. 3) Replace assembly. 4) Disassembly and reassembly or replace lever section.
Secondary pressure is unstable.	1) Sliding parts are caught. 2) Tank line pressure varies. 3) Air has mixed into pipeline.	1) Correct. 2) Bring pressure directly to oil tank. 3) Let air off.
Secondary pressure is high	1) Tank line pressure is high. 2) Sliding parts are caught.	1) Bring pressure directly to oil tank. 2) Correct.

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4. MAINTENANCE STANDARDS

4.1 PARTS REPLACEMENT STANDARD

1) Replace O rings and other seals at each removal and installation.
2) Replace worn parts if leaks affects the operating system.
3) Replace spools having excessive wear on their moving areas.
4) Replace a push rod that is worn to 1mm (0.04in) or over on its top end. (See Fig. 12.)
5) Replace operating lever and pins that have a gap of 2mm (0.08in) or over.
6) Replace such parts that arise abnormal sounds, hunting and drops in the primary pressure.

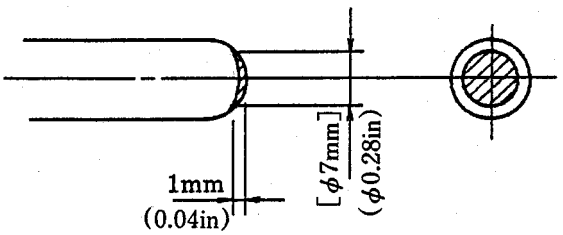

Fig. 12 Wear of push rod

5. TROUBLESHOOTING

Trouble	Cause	Remedy
Secondary pressure does not rise.	1) Primary pressure is insufficient. 2) Springs (241-1, 241-2) are broken or fatigued. 3) Clearance between spool (201-1, 201-2) and valve body (101) is abnormally large. 4) Lever has a gap.	1) Secure primary pressure. 2) Replace with new ones. 3) Replace assembly. 4) Disassembly and reassembly or replace lever section.
Secondary pressure is unstable.	1) Sliding parts are caught. 2) Tank line pressure varies. 3) Air has mixed into pipeline.	1) Correct. 2) Bring pressure directly to oil tank. 3) Let air off.
Secondary pressure is high	1) Tank line pressure is high. 2) Sliding parts are caught.	1) Bring pressure directly to oil tank. 2) Correct.

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1. SPECIFICATION

1.1 GENERAL VIEW

No.	PORT NAME	PORT SIZE
A	MAIN PORT	PF3/8
B	MAIN PORT	PF3/8
T	TANK PORT	PF3/8
DR	DRAIN PORT	PF1/4
PP	PARKING BRAKE RELEASE COMMAND PORT	PF1/4
PB	PARKING BRAKE RELEASE PRESSURE PORT	PF1/4

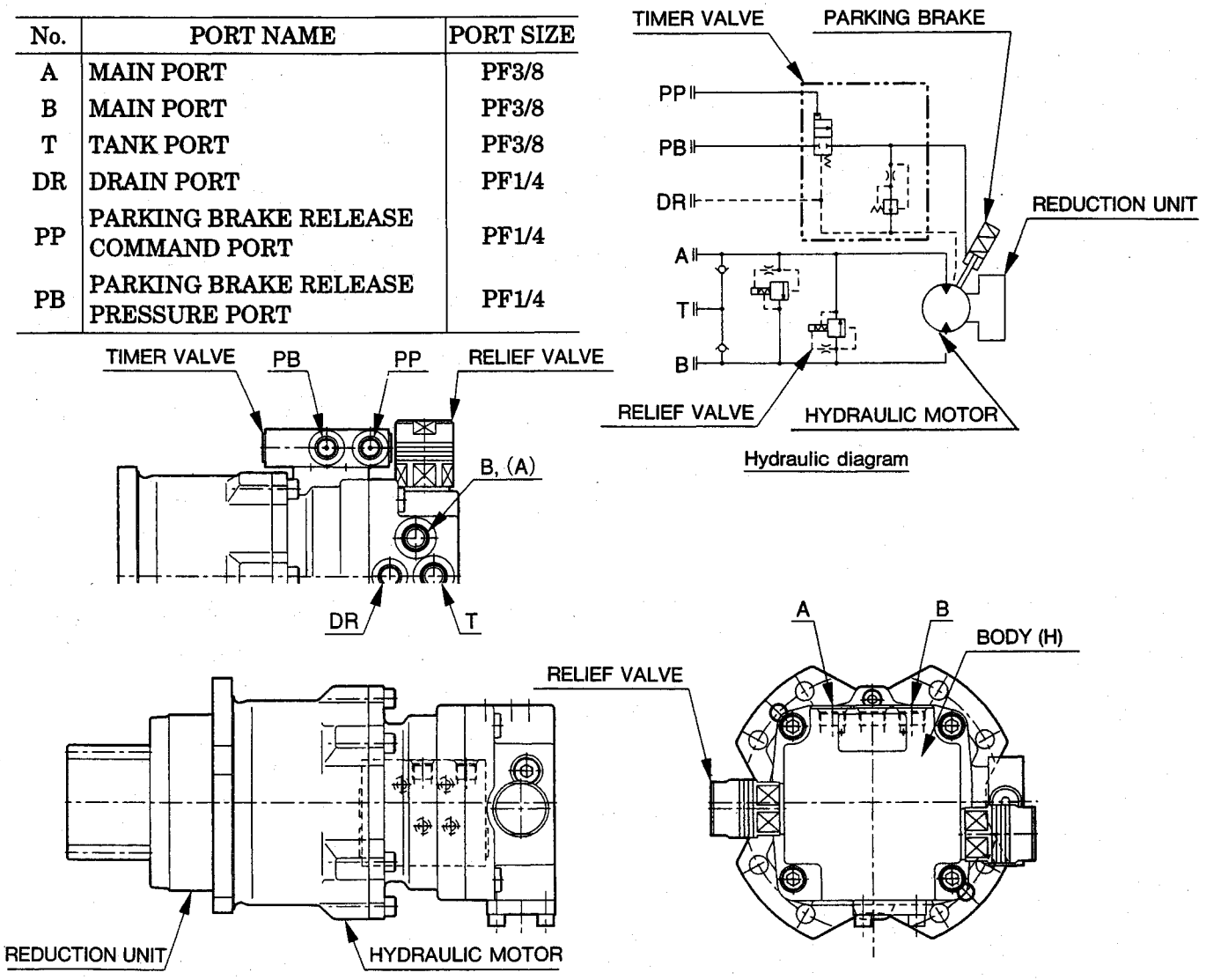

Fig. 1 General view of slewing motor unit

1.2 SPECIFICATIONS

Table 1

Item				Specification
Model				PCL-50-21B-1FS2-8563A
Reduction unit	Theoretical torque		kgf·m (ft·lbs)	61(441)
	Gear ratio			1/20.7
	Rotational direction (viewed from shaft end)			Inlet A port : cw, Inlet B port : ccw
Hydraulic motor	Displacement		cc/rev (cu·in/rev)	13.3(0.81)
	Rated flow		ℓ /min (gal/min)	20.0(5.28)
	Parking brake	Brake torque	kgf·m (ft·lbs)	4.1(30)
		Release pressure	kgf/㎠ (psi)	Min 35(500) Max 90(1280)
Relief valve	Set pressure		kgf/㎠ (psi)	140(1990) at 20 ℓ /min (5.3gal/min)
	Cracking pressure		kgf/㎠ (psi)	115(1640) or more at 11 ℓ /min (2.9gal/min)
Set time of hydraulic timer			Sec	4±2 〔Oil temperature 50°C (122°F)〕
Weight (with Reduction unit)			kg (lbs)	29(64)

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12) Remove shaft (203) and swash plate (210).

- In case the shaft is hard to remove, tap it lightly from the end face of the opposite side by means of a plastic hammer.
- Ball bearing (216) is press fitted to the shaft ; do not remove the shaft except where the ball bearing is replaced.

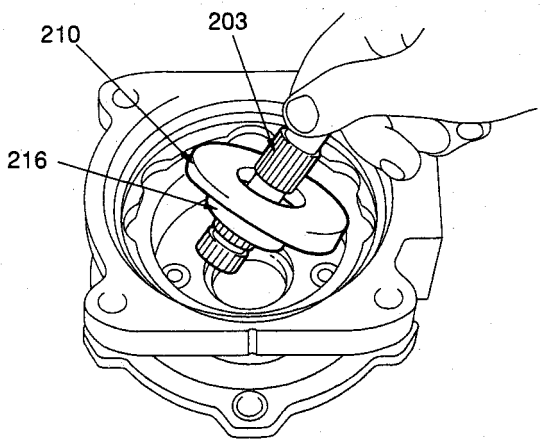


Fig. 23 Removing shaft (203) and swash plate (210)

13) Remove two filters (214) and parallel pin (215).

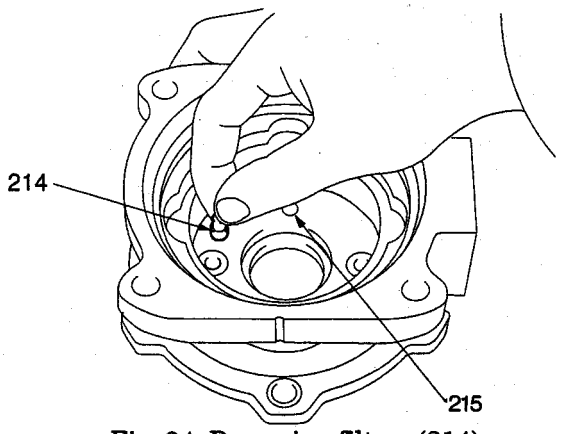


Fig. 24 Removing filters (214) and parallel pin (215)

3.2.2 Removal of reduction unit

1) Remove the s2 gear (108), then remove the carrier assy 2 (103) and carrier assy (102) in turn.

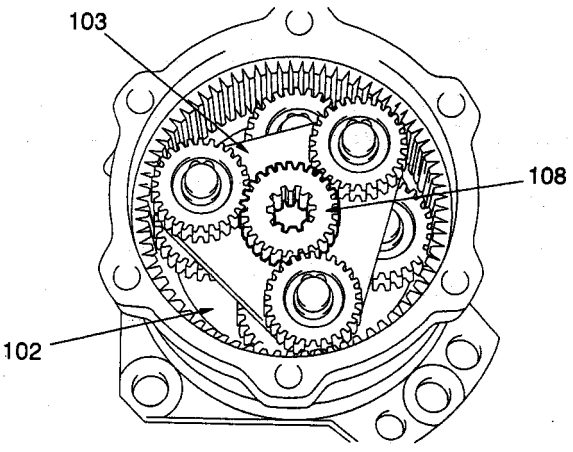


Fig. 25 Removing s2 gear (108) and carrier assy

5) Press-fit the outer race of the taper roller bearing (121) into the body (101). Then fill grease in the installing portion of the hearing.

- Volume of grease filled in : approx. 80% of the space.

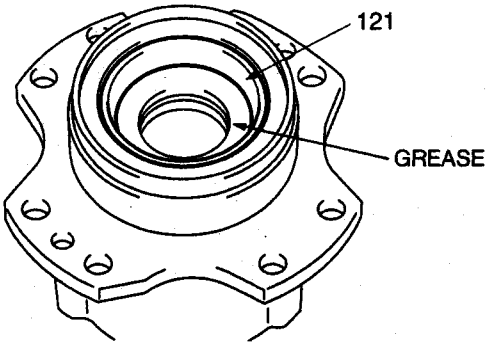
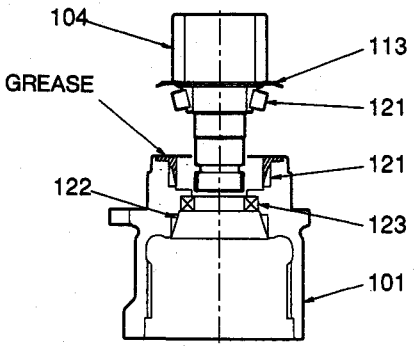


Fig. 61 Press-fitting outer race of the roller bearing (121)

6) Insert the pinion shaft (104) assy into the body (101).

- Pay attention not to give any damages on the lip of oil seal (123).



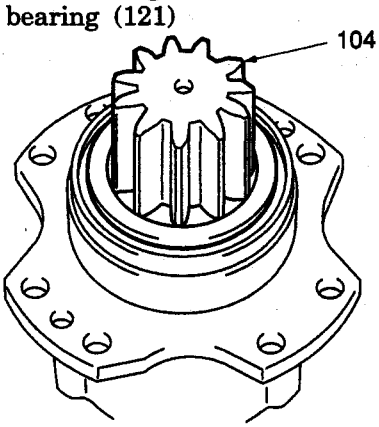


Fig. 62 Installing shaft (104)

7) Turn over the body (101), and press-fit the inner race of the taper roller bearing (122) into the pinion shaft (104).

- Prior to the press-fitting of the inner race, warm it up to the temperature of ambient temperature plus 50°C(122°F).

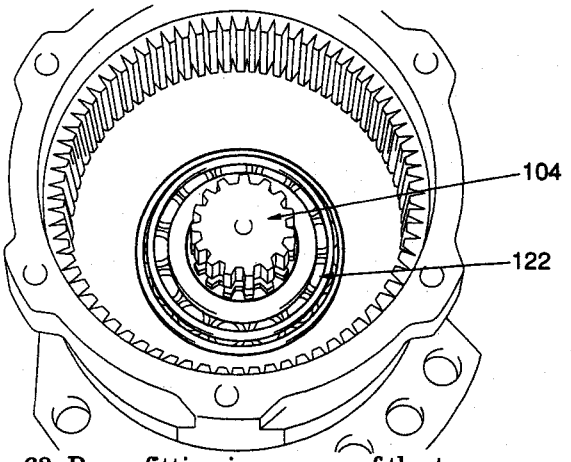
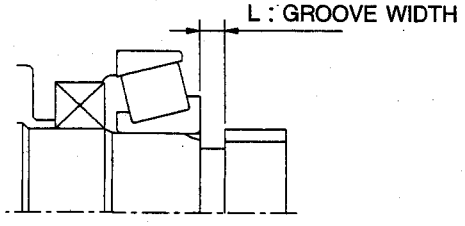


Fig. 63 Press-fitting inner race of the taper roller bearing (122)

8) Install the pre-load collar (119) to the pinion shaft (104).

- Adjust the thickness of the pre-load collar (119) at O to +0.05㎜ (0.002 in) against the actual measurement for the groove width L that is the clearance between both the end faces of bearing (122) and groove of pinion shaft (104) side.



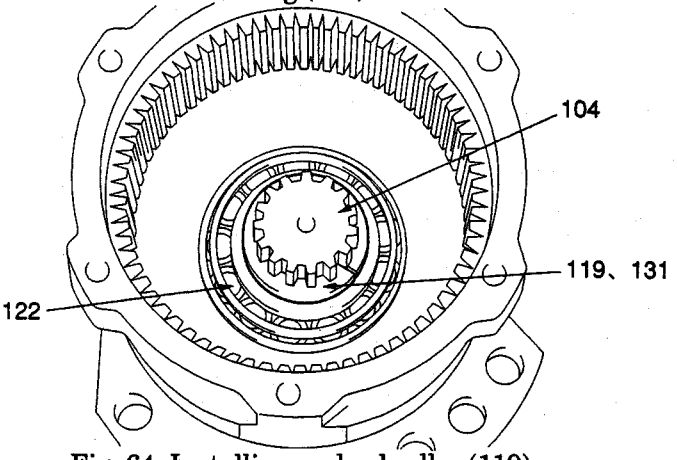


Fig. 64 Installing preload coller (119)

2. CONSTRUCTION AND OPERATION

2.1 CONSTRUCTION (Spec. 1)

(1) Hydraulic Motor

■Applicable machines : PW07001~PW07244

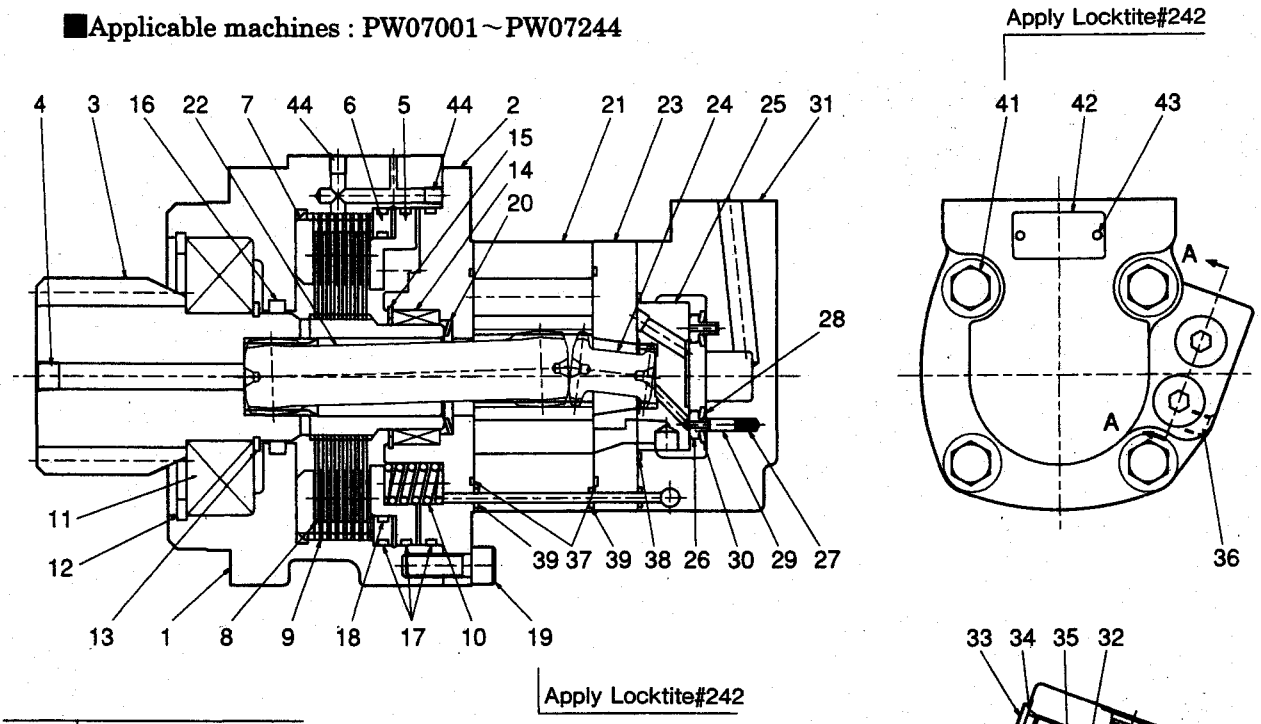


Fig. 2 Hydraulic motor

No.	Tightening torque kgf·m (ft·lbs)
4	3 (22)
19	5.6 (41)
33	6 (43)
36	1 (7)
41	7 (51)
44	0.6 (4.3)

No.	NAME	Q'TY	No.	NAME	Q'TY	No.	NAME	Q'TY
M1	HOUSING	1	M16	X-RING	1	M31	VALVE HOUSING	1
M2	FLANGE	1	M17	O-RING	3	M32	STEEL BALL	2
M3	PINION GEAR	1	M18	O-RING	1	M33	PLUG	2
M4	PLUG	1	M19	SOCKET BOLT	8	M34	O-RING	2
M5	PISTON	1	M20	SHAFT FACE SEAL	1	M35	SPRING	2
M6	RING	1	M21	GEROLLER	1	M36	PLUG	1
M7	PLATE	1	M22	DRIVE	1	M37	O-RING	2
M8	DISK PLATE	7	M23	VAVLE PLATE	1	M38	O-RING	1
M9	STEEL PLATE	7	M24	VALVE DRIVE	1	M39	O-RIG	2
M10	SPRING	12	M25	VAVLE	1	M40	O-RING	1
M11	BEARING (FR)	1	M26	BALANCING RING	1	M41	CAPSCREW	4
M12	SNAP RING	1	M27	SPRING	2	M42	NAME PLATE	1
M13	SNAP RING	1	M28	INNER FACE SEAL	1	M43	RIVET	2
M14	BEARING (RE)	1	M29	PIN	2	M44	PLUG	2
M15	SNAP RING	1	M30	OUTER FACE SEAL	1			

6) Remove the valve (M25).

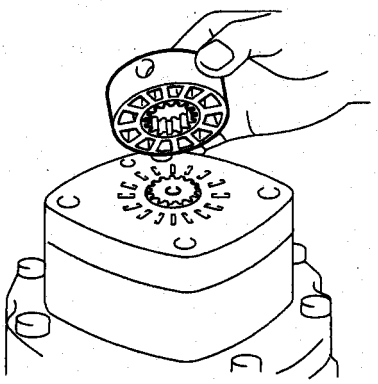


Fig. 17

7) Remove the valve plate (M23) and valve drive (M24)

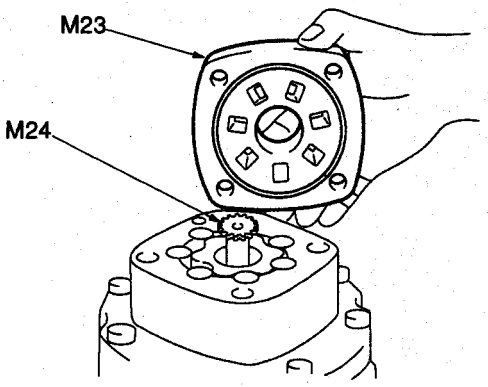


Fig. 18

8) Remove the geroller (M21) and drive (M22).

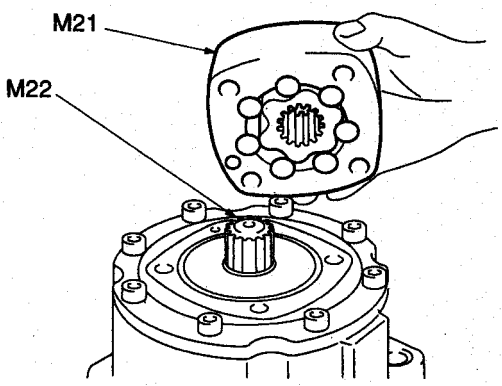


Fig. 19

9) Remove the socket bolts (M19), then remove the flange (M2) and springs (M10).
: 8mm

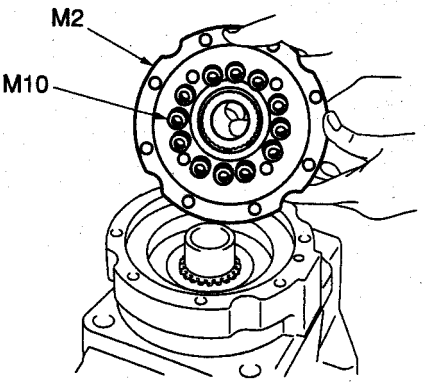


Fig. 20

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23) Install the O-rings (V20) to the relief valve body (V1). And tighten up the relief valve assy with the socket bolts (V19).
: 6㎜
Tightening torque: 3.5kgf·m (25ft·lbs)

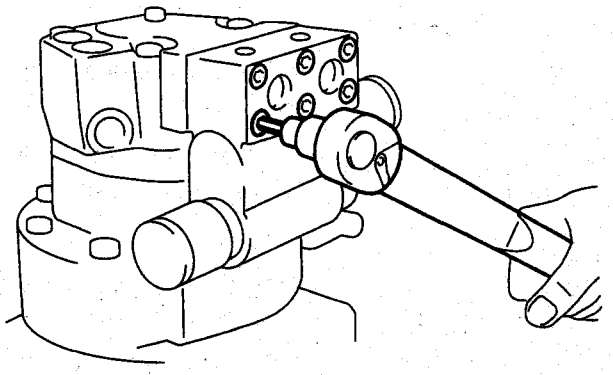

Fig. 57

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2.2 FUNCTION AND OPERATION

(1) Hydraulic Motor

This hydraulic motor is of an axial piston motor type (rotating cylinder slant swash plate type), and to convert the hydraulic energy to the rotating motion.

Nine pistons are incorporated in the cylinder block. And the end face of the cylinder block gets in contact with the two crescent shaped port A and B (a distributor valve for high/low pressure).

〈Principle of Torque Generation〉

When highly pressurized oil (pressurized oil P) is led to the A port, it pushes up the pistons at the force of (F=P×A/piston; where A is the cross sectional area of piston), and this force acts to the swash plate. On the other hand, the piston receives a reaction force from the swash plate, and an element for the rotating direction is generated against such reaction force. And a rotating force is generated on the cylinder block due to the sum of the element for the rotating direction on the pistons being at the high pressure side . The torque comes from the rotating force being transmitted to the shaft through the spline , and rotates the shaft.

Conversely, when highly pressurized oil is led to the B port, the cylinder block is reversely rotated.

The rotating torque and speed are calculated from the following formula.

◎ Output Torque (T)

$$T=\frac{P\times D\times i\times \eta m\times \eta G}{2\times \pi \times 100}$$

◎ Rotating Speed (N)

$$N=\frac{Q\times 1000\times \eta v}{D\times i}$$

Where ; D : Total Displacement (cc/rev)
P : Effective Driving Pressure (cc/cm²)
Q : Oil Flow Rate (ℓ /min)
η m: Mechanical Efficiency (motor) (%×10^{-2})
η v : Volumetric Efficiency (motor) (%×10^{-2})
i : Reduction Gear Ratio
η G: Efficiency on Reduction Gear (%×10^{-2})

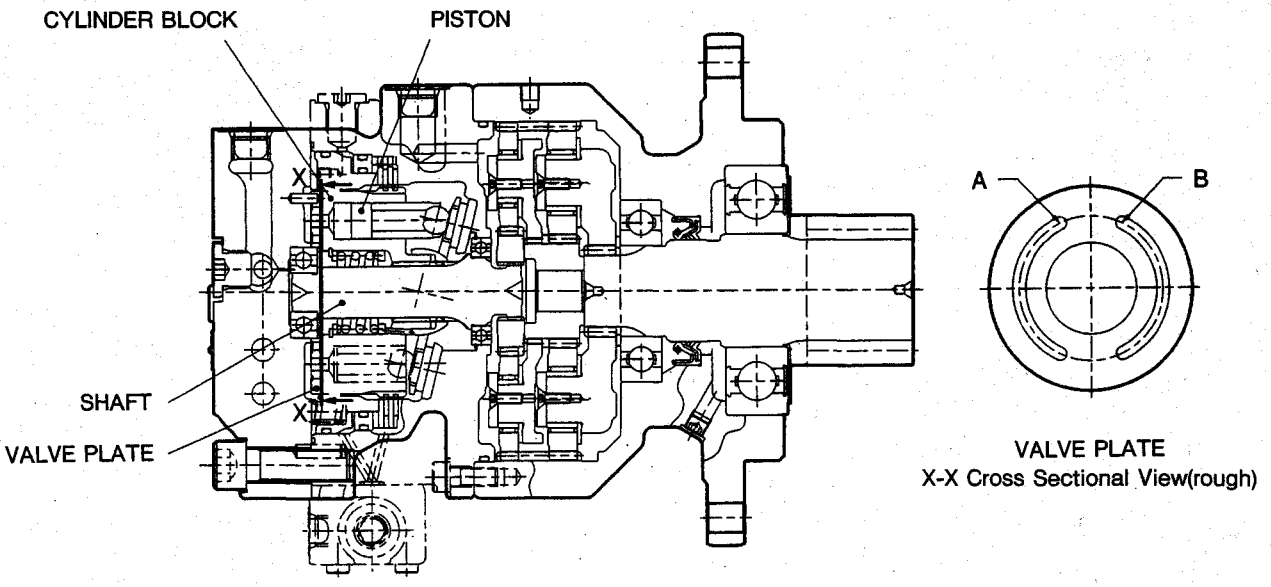

Fig.5 Construction of motor

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7-4) Remove the cylinder block (103), friction plate (126), disk plates (127) and other parts.

- Cylinder block (103)
- Collar (114)
- Spring (115)
- Washer (116)
- Snap ring (117)
- Piston assy (106)
- Retainer plate (107)
- Retainer holder (108)
- Pin (113)
- Friction plate (126)
- Disk plate (127)

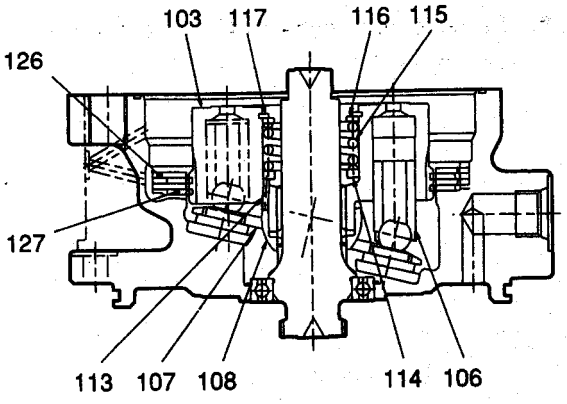

Fig. 22 Removal of cylinder block (103) and others

7-5) Remove the retainer plate (107) and piston assy (106).

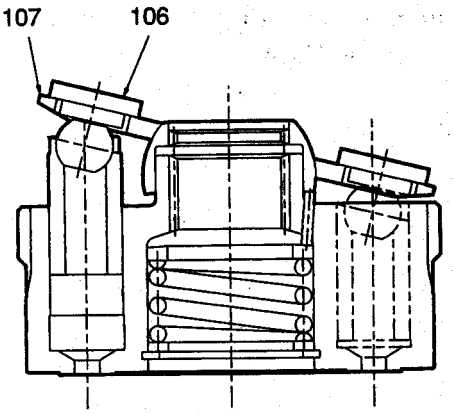

Fig. 23 Removal of piston (106)

7-6) Remove the retainer holder (108), then remove the pins (113)

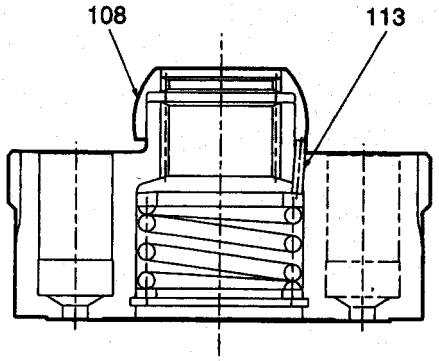

Fig. 24 Removal of retainer holder (108)

7-7) Pushing the washer (116) with a jig, remove the snap ring (117).
Tool: Snap ring plier (No. 26)
Jig (No. 48)

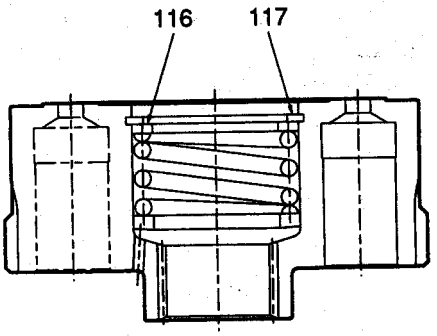

Fig. 25 Removal of snap ring (117)

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4-13) Install 22 pcs. of the spring (128) and O-ring (122)

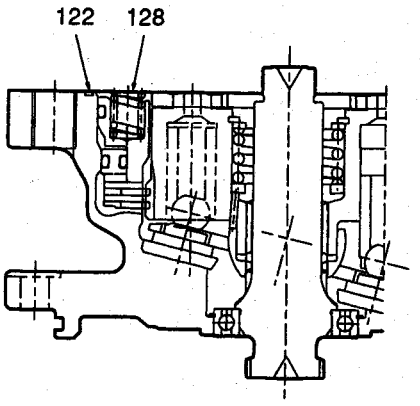


Fig. 60 Installation of spring (128) and O-ring (122)

4-14) Press fit the bearing (112) into the valve unit (102) using the jig and press machine.
Tool : Jig (No. 41)
Press machine (No. 34)

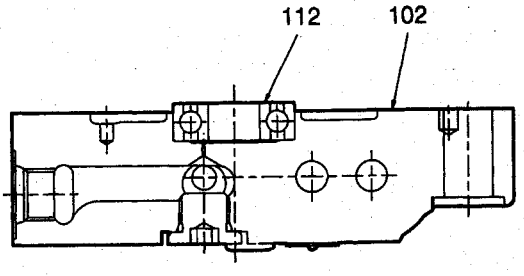
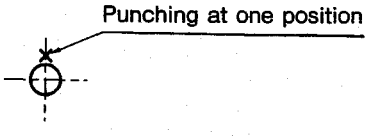


Fig. 61 Pressing fit of bearing (112)

4-15) Set the pin (119), and lock it with a punch.



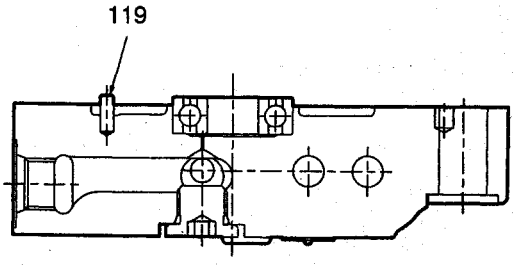


Fig. 62 Setting of pin (119)

4-16) Applying grease to back side of the valve plate (105), install it to the valve unit (102) aligning the recess to the pin (119).

4-17) Set the pins (118) to the valve unit (102).

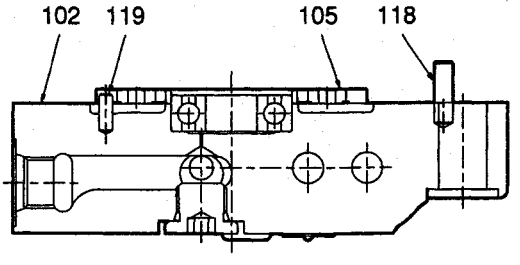


Fig. 63 Installation of valve plate (105), and pin (118)

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5.2 FOR FUNCTION OF VALVES INTEGRATED IN MOTOR

Condition	Possible Causes	Remedial Action
a) Motor does not rotate or speed is low.	1. Mal-function on any of equipment other than valve (integrated in motor), piston motor, or reduction gear.	Check for oil pressure at valve inlet, then check and repair damaged equipment.
	2. Due to damage on O-ring or seal in relief valve, internal relief is increased.	Repalace damaged O-ring or back-up ring to new one.
	3. Due to defective sealing in valve or piston, leakage is increased.	Retouch damaged condition or repalce relief valve and valve body to new one.
	4. Defect on seat in make-up valve causing mal-function.	
	1) Foreign matters are caught on seat.	Remove foreign matters, retouch damages, make them clean, then reassemble it. If scores are deep causing much oil leakage, replace it.
	2) Sliding face on check valve (102) becomes rough or damaged.	Retouch sliding face, or replace check valve to new one.
	3) Snapping off of spring.	Replace spring. At that time, remove foreign matters, retouch damages, make them clean, then reassemble. If scores are deep causing much oil leakage, replace it.
	5. Defective seat on relief valve.	
	1) Foreign matters are caught on seat.	Remove foreign matters, retouch damages, make them clean, then reassemble it. If scores are deep causing much oil leakage, replace it.
	2) Snapping off of spring.	Replace relief valve assy to new one.
	6. Lowering cracking pressure on relief valve	
	1) Setting on spring.	Replace relief valve assy to new one.
	2) Clogging on poppet orifice.	Make clean orifice with cleaning oil, then reassemble poppet.

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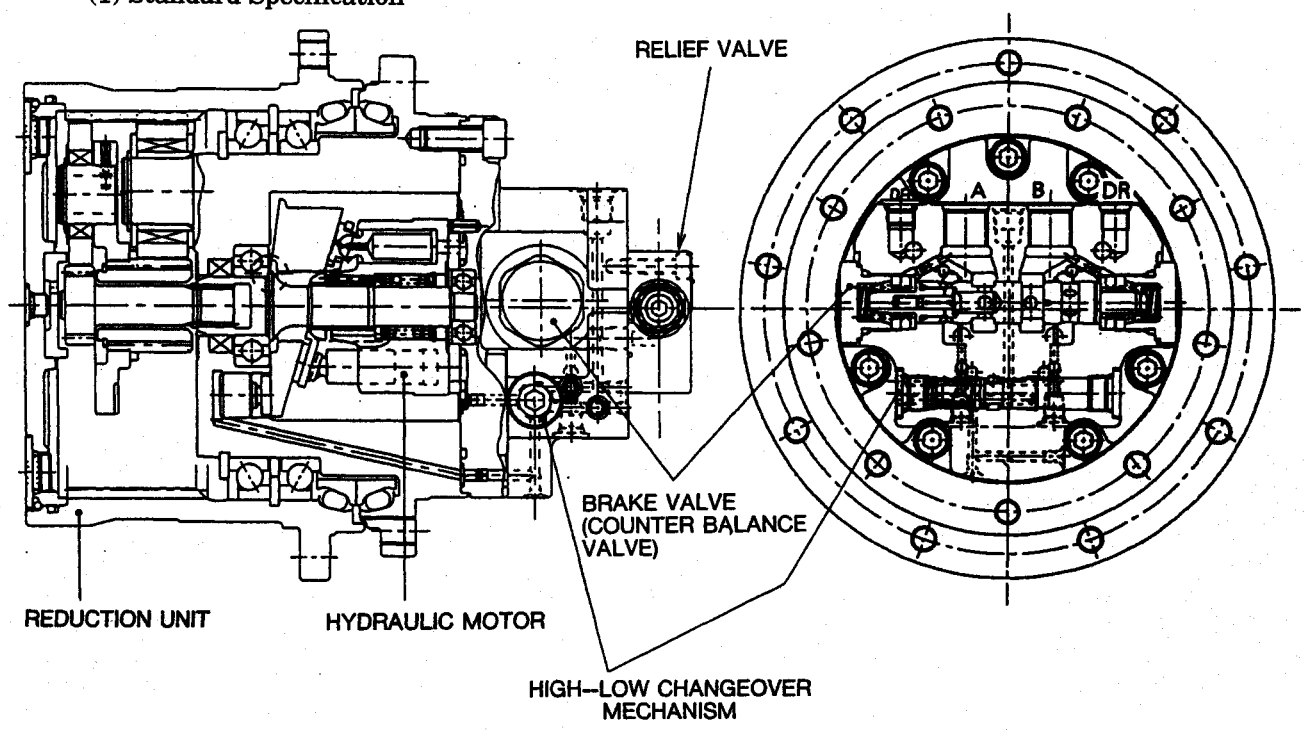
2. CONSTRUCTION AND FUNCTION

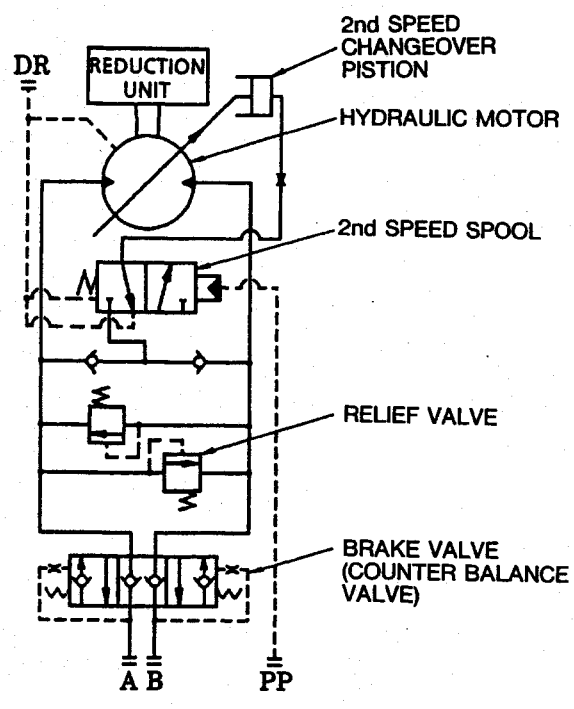
2.1 CONSTRUCTION

2.1.1 BASIC CONSTRUCTION

(1) Standard Specification

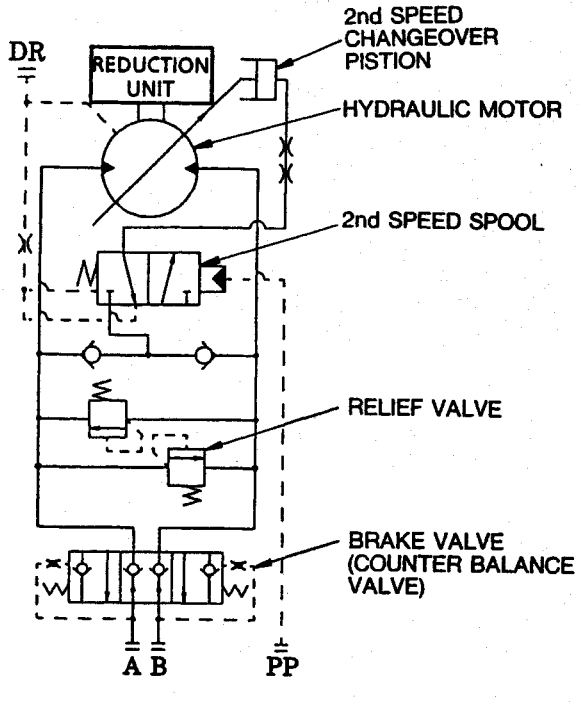


■ Applicable Machines SK25SR : PV10001~PV12000
SK35SR : PX05001~PX06500



Hydraulic diagram

■ Applicable Machines SK25SR : PV12001~
SK35SR : PX06501~



Hydraulic diagram

Fig. 2 Basic construction of travel motor

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3. REMOVAL AND INSTALLATION

3.1 GENERAL PRECAUTIONS TO BE EXERCISED AT REMOVAL

1) Because hydraulic components are precision finished in general, handle them in a clean place. Use clean tools, cleaning oil and dry compressed air. Avoid using rag and paper.
2) Plug each of the ports of the travel motor removed from the machine and clean all dirt and oil completely from outside the motor before proceeding to disassembly operation.
3) Leave matching marks on the mating surface of parts, as required. Arrange removed parts in order during operation, exercising care so as not to damage parts and not to lose them
4) Sealing parts, such as, O rings and backup rings can not be reused once removed.
   Check prearranged parts against "Parts Manual" to prepare for reassembly.
5) Some parts can not be supplied singly and can only be supplied in subassy.
   Prepare such parts in advance, referring to "Parts Manual".

- Do not remove the parts (bearings, pins, etc.) marked "Press Fit" in the manual, as a rule.
- The numbers in parentheses after part names represent the structure drawings (Fig. 3, 4 and 5)

3.2 CLASSIFICATION OF REMOVING ITEMS

The travel motor assy consists of a hydraulic motor, a reduction unit and a brake valve all put together in one piece.
Removal consists roughly of the following : Refer to installation of necessary items for each of the hydraulic motor, the reduction unit and the brake valve, and perform removal.

- Avoid removing unnecessary portions.

The removal is roughly grouped as follows : For details, refer to Installation.

(1) Preparation before removal.
 1) Cleaning
 2) Installing the travel motor assy onto a work bench
 3) Draining out oil
(2) Removing the reduction unit
(3) Removing relief valve assy
(4) Removing motor cover
(5) Removing body (202)
(6) Rough cleaning of parts
(7) Each parts of finish cleaning and dry

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9) Place thrust collar (115) so it contact with four gear B1 evenly.

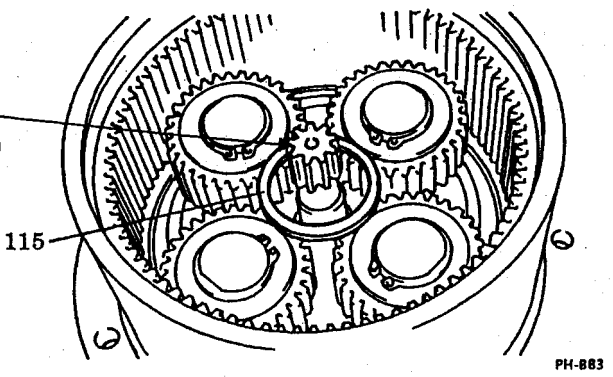

Fig. 40 Installing thrust color (115)

10) Install the carrier II assy so it mates with four gear B1 (106) and shaft (203). Fit O ring (129) to casing (101).
- In case of SK25SR
  Install the S2 gear (109).

Thereafter, fill in lube oil.
Lubricant oil : API class CD SAE30
Oil : SK25SR : 600cc(37cu·in)
SK35SR : 700cc(43cu·in)

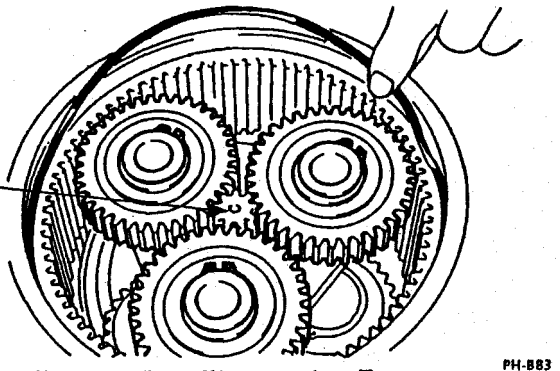

Fig. 41 Installing carrier II assy and fitting O ring (129)

11) Install the slide ring (116) to the cover (102).

- Apply grease to fix it.
- Place the larger chamfer side on the cover side.

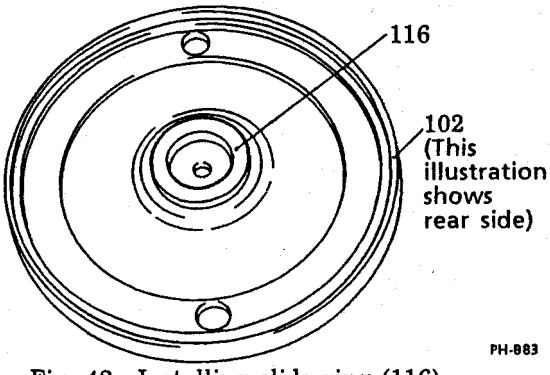

Fig. 42 Installing slide ring (116)

12) Install the cover (102) on the body.

- Coat the O ring with grease and fit it level so as not to score it.
- Align the upper and lower threaded holes (PF3/8) with the notch of the casing and install it.

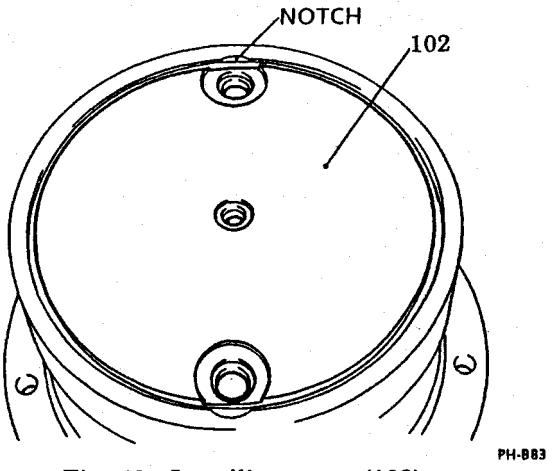

Fig. 43 Installing cover (102)

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2.1.4 RELIEF BLOCK ASSY

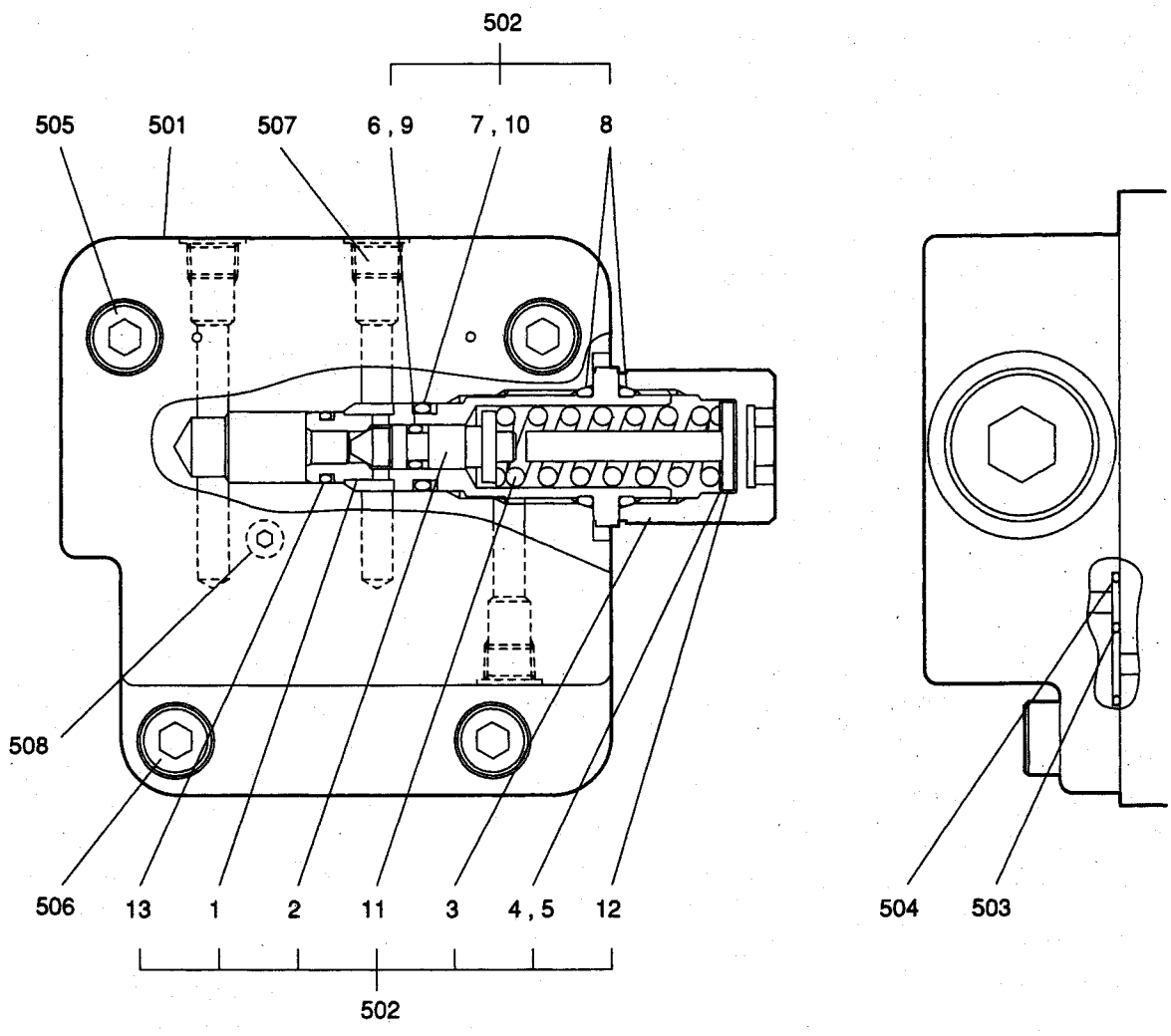

Fig. 5 Section of relief valve assy

Component parts

No.	NAME	Q'TY	No.	NAME	Q'TY	No.	NAME	Q'TY
501	VALVE BODY	1	- 6	O-RING	1	- 13	O-RING	1
502	VALVE ASSY	1	- 7	O-RING	1	503	O-RING	3
- 1	VALVE BODY	1	- 8	O-RING	2	504	O-RING	2
- 2	POPPET	1	- 9	BACK-UP RING	1	505	SOCKET BOLT	2
- 3	PLUG	1	- 10	BACK-UP RING	1	506	SOCKET BOLT	2
- 4	SHIM A	3	- 11	SPRING	1	507	PLUG	3
- 5	SHIM B	3	- 12	SPRING HOLDER	1	508	PLUG	2

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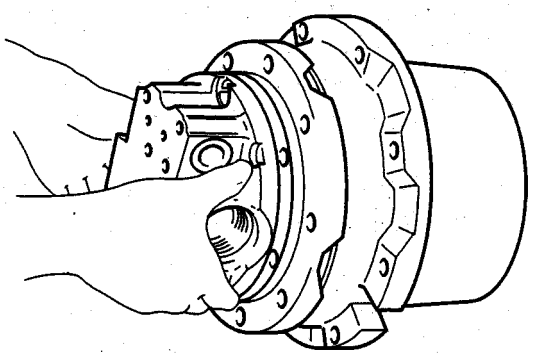
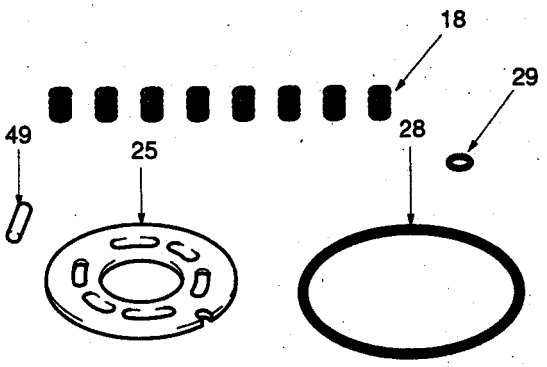
(9) Remove the base plate (30).
- Pay attention not to let the cylinder block come out.
- If it is difficult to remove, tap it lightly with a plastic hammer for the removal direction, or wrench it lightly with a screw driver.



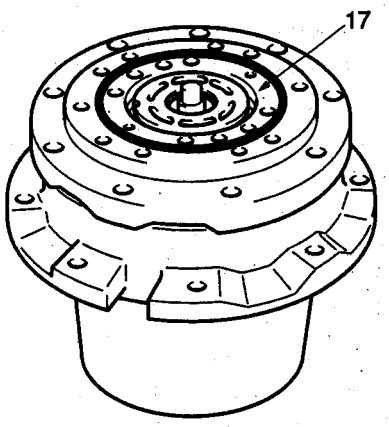
(10) Reprove the pins (49), valve plate (25) and O-rings (28) and (29).

■ For the machine with parking brake:
Remove the springs (18).



■ For the machine with parking brake:

(11) Remove the brake piston (17).
- Apply compressed air to the parking brake releasing port on the flange holder (101) to remove it.



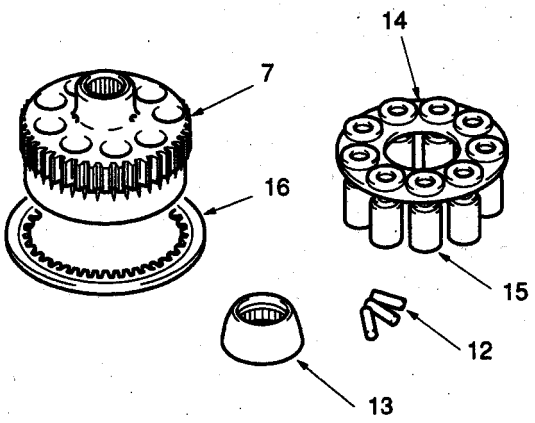
(12) Remove and disassemble the cylinder block assy (7).

a. Remove the pins (12) and retainer holder (13) from the cylinder block (7).

b. Remove the retainer plate (14) and pistons (15) from the cylinder block (7).
- Pay attention not to give any scores on the sliding surface on the cylinder block .

■ For the machine with parking brake:

c. Remove the disk (16).



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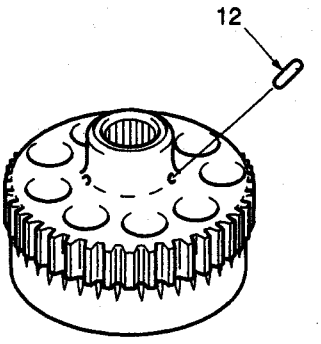
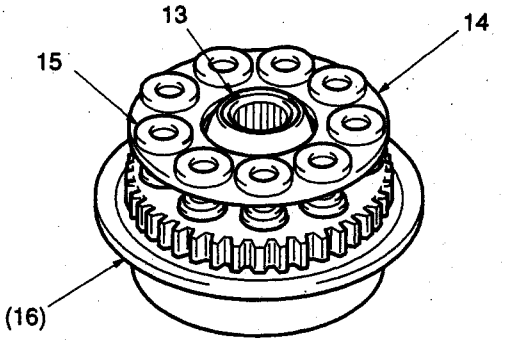
c. Install the pins (12) to each of three bores on the cylinder block.
   • Apply grease to the pins.



d. Install the retainer holder (13), retainer plate (14) and piston assy's (15).
   • Apply hydraulic oil to the bores on the cylinder block.

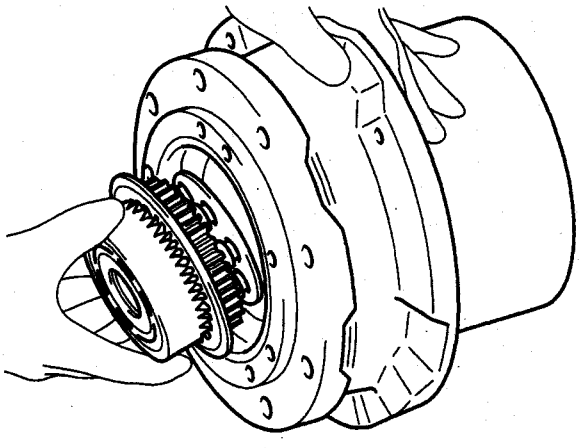


■ For the machine with parking brake:

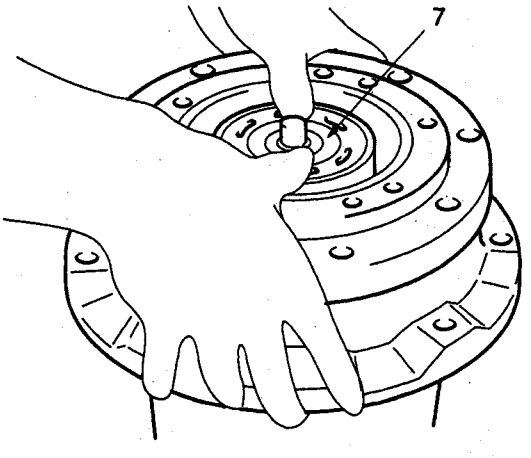
e. Install the disk (16).

(22) Install the cylinder block assy.

a. Install it making the spline on the shaft as a guide.



b. Confirm the action of springs by means of pushing up the cylinder block (7) with hands.
   • Apply hydraulic oil to the sliding surface on the cylinder block.



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KOBELCO

Book Code No. S5160123E

SHOP MANUAL

SWIVEL JOINT

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KOBE STEEL, LTD.

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KOBELCO

Book Code No. S5 17024 1E①

SHOP MANUAL

Applicable Models :
SK25SR
SK35SR (except swing cylinder)

HYDRAULIC CYLINDER

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KOBE STEEL, LTD.

3. REMOVAL AND INSTALLATION

3.1 PREPARATION BEFORE REMOVAL

Before removal, it is necessary to keep a dustfree workshop and facilities.

3.1.1 Work Area

The following working area is required for removal.

(1) Ample space

For removal of the hydraulic cylinder, the cylinder tube and the piston rod must be extracted.

Therefore, the first prerequisite is that the working area must have sufficient space for such work. It is also necessary that the working area has amply space widthwise to accommodate removal, cleaning and measuring facilities.

(2) Suitable working environment

The hydraulic cylinder is a precision-machined product incorporating seals and packings made of rubber and plastic materials. For this reason, care should be used so that the hydraulic cylinder is free from dust, dirt, sand, metal chips,weld slag and other hard substance. If the hydraulic cylinder is assembled without being aware of hard particles stuck on the cylinder tube and the piston rod, the tube inner surface and the rod surface may be scratched as the cylinder operates, thereby disabling it in worst cases. Damage to the piston seals and the rod seals will result in oil leaks. For this reason, grinding and welding operation should be avoided near the working area to keep it clean.

3.1.2 Apparatus

The following equipment are required for removal

(1) Hoist or crane

The hoist or crane must be capable of carrying the cylinder in an assembled condition. It must also be capable of performing level and linear movement under load for inserting and extending the piston rod and the tube.

(2) Work bench

The work bench must have strength and rigidity capable of accommodating the total length of the cylinder in its most retracted condition and of withstanding the reactive force of the tightening torques of the cylinder head and the piston nut. Since a vise is to be attached to the bench, the width of the work bench must be sufficiently large.

(3) Support stand

If the fixing pin side of the piston rod is fully extended in a free condition, the bushing and the seals may be damaged as the rod bushing and the piston are twisted due to the weight of the rod. A stand is required to support the rod to prevent such troubles.

(4) Hydraulic source

A hydraulic source is required for removal and installation of the cylinder head and piston nut and for oil leak tests after completion of installation.

(5) Jet air source

It is used for drying after oil draining and cleaning of the cylinder.

(6) Cleaning bath, cleaning oil and detergent

(7) Oil pan and oil reservoir

An oil pan is necessary to contain oil drained from the cylinder and oil spilt during work. An oil reservoir is required to collect oil spilt on the floor and waste oil.

(8) Others

Oil extracting hoses, wooden skids, rag and sawdust in which oil soaked are also necessary.

4.2 SERVICE LIMITS

Service limits represent the limits of wear on the sliding surfaces of the cylinder tube and the piston rod that have no such faults as may degrade the sealing effect.

(1) Clearance between piston rod and rod bushing :
Replace the bushing if the clearance between the piston rod and the rod bushing exceeds 0.25㎜ (0.01in).

(2) Bend of piston rod:
The allowable bend of the rod is maximum 1㎜ / 1m(0.04 in/39.4 in). For measurement, support both ends of the parallel section of the piston rod with V-blocks, set a dial indicator in the center between the two V-blocks turn the piston rod, and read the difference between the maximum and minimum oscillations on the dial indicator.

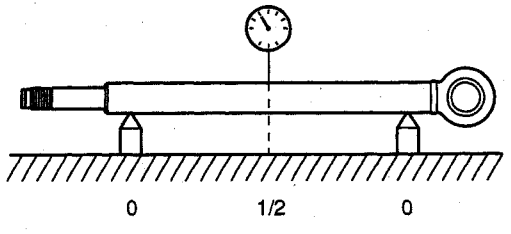


Fig. 32 Measuring method

Table 4 shows an example of measurement.

Table 4 Example of measurement

Distance between V-blocks m(in)	Deflectional value of the dial gauge ㎜(in)	Remedy
1(39.4)	1(0.04)	Replace
2(78.7)	2(0.08)	Replace

- Even if the bend is within the tolerable limit, the cylinder may not operate smoothly because of localized bend. Beware of it during function test after installation. Replace the rod if the cylinder makes a squeeking noise or dose not operate smoothly.

4.3 TIGHTENING TORQUE

A : CYLINDER HEAD
B : PISTON ASSY
C : SETSCREW

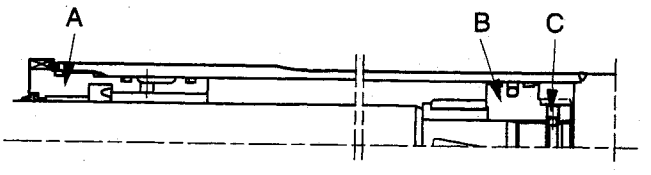


Fig. 33 Applicable portions for tightening torque

Table 5 Tightening torque

Unit: kgf·m(ft·lbs)

Model	SK25SR			SK35SR		
Cylinder	A	B	C	A	B	C
Boom	39(280)	70(510)	0.7(5.1)	50(360)	150(1080)	1.65(11.9)
Arm	↑	↑	↑	46(330)	110(800)	
Bucket	31(220)	45(330)	↑	39(280)	55(400)	0.7(5.1)
Swing	43(310)	70(510)	1.65(11.9)	—	—	—
Dozer	46(330)	110(800)	↑	59(430)	120(870)	1.65(11.9)

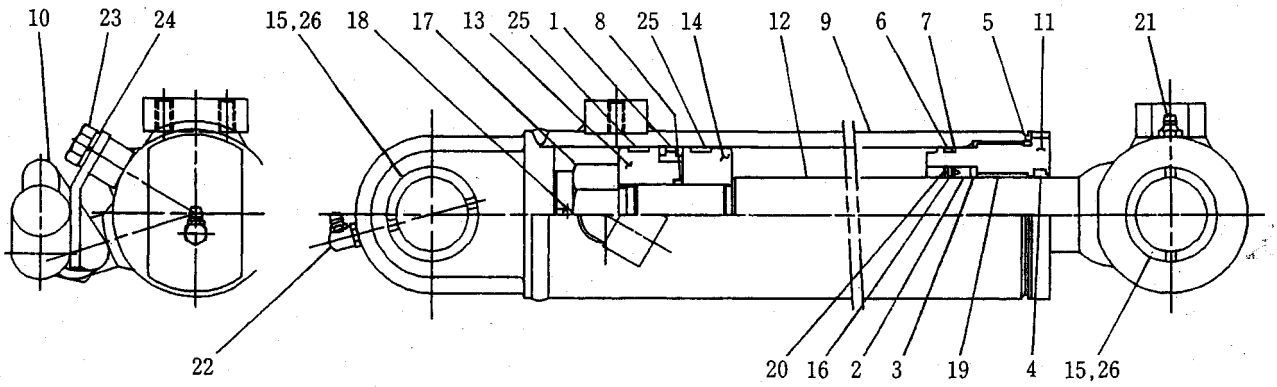
4.4 INSPECTION AFTER INSTALLATION

1) Place the cylinder on the work bench, and check its operating conditions by means of applying load to extend and retract the piston rod several times by each stroke end.

2) Hold the hydraulic pressure for 3 minutes at extended and retracted positions respectively to check leakage on piston rod and cylinder head as well as the welded portions.

(3) Bucket cylinder

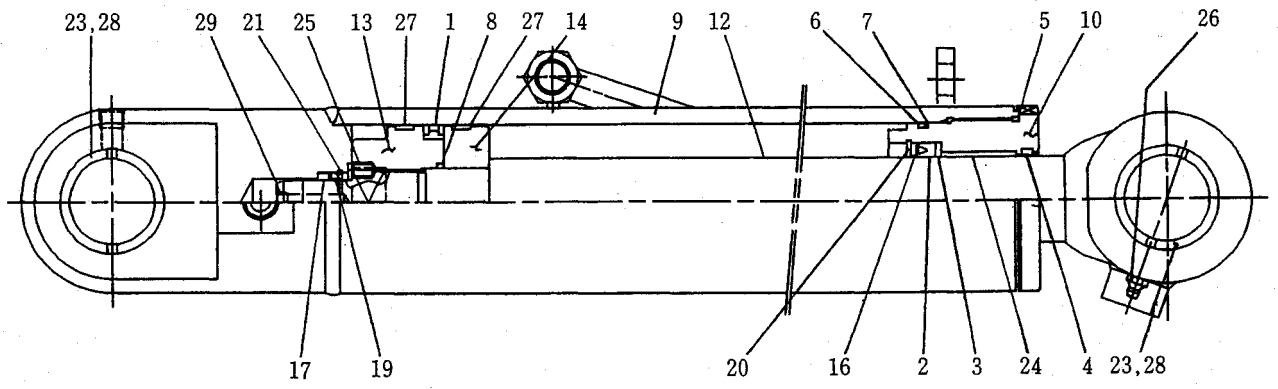
■SK30SR



No.	NAME	Q'TY	No.	NAME	Q'TY	No.	NAME	Q'TY
1	PISTON PACKING	1	10	PIPE	1	19	BUSHING	1
2	ROD PACKING	1	11	ROD COVER	1	20	SNAP RING	1
3	BACK-UP RING	1	12	PISTON ROD	1	21	GREASE NIPPLE	1
4	DUST SEAL	1	13	PISTON	1	22	GREASE NIPPLE	1
5	O-RING	1	14	PACKING HOLDER	1	23	CAPSCREW	1
6	O-RING	1	15	BUSHING	2	24	SPRING WASHER	1
7	BACK-UP RING	1	16	PACKING HOLDER	1	25	WEAR RING	2
8	O-RING	1	17	NUT	1	26	DUST SEAL	4
9	TUBE	1	18	SPLIT PIN	1			

(4) Swing cylinder

■SK30SR · SK35SR



No.	NAME	Q'TY	No.	NAME	Q'TY	No.	NAME	Q'TY
1	PISTON PACKING	1	10	ROD COVER	1	23	BUSHING	2
2	ROD PACKING	1	12	PISTON ROD	1	24	BUSHING	1
3	BACK-UP RING	1	13	PISTON	1	25	SETSCREW	1
4	DUST SEAL	1	14	PACKING HOLDER	1	26	GREASE NIPPLE	1
5	O-RING	1	16	PACKING HOLDER	1	27	WEAR RING	2
6	O-RING	1	17	CUSHION SEAL	1	28	DUST SEAL	4
7	BACK-UP RING	1	19	SPACER	1	29	ORIFICE	1
8	O-RING	1	20	SNAP RING	1			
9	TUBE	1	21	STOPPER	1			

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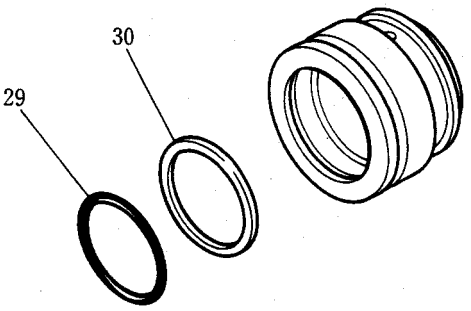
2) Install the O-ring (29) and back-up ring (30) to the outer periphery of retainer.



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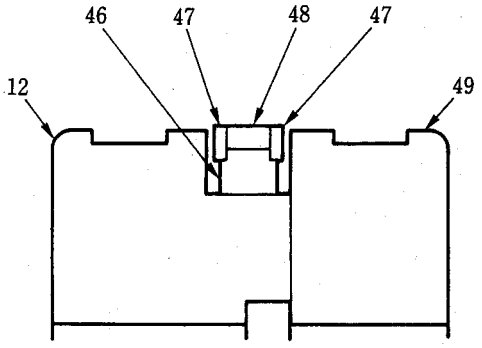
(4) Installation of piston:

1) Install the back rings (46), back-up ring (47) and slipper ring (48) to the piston (12).



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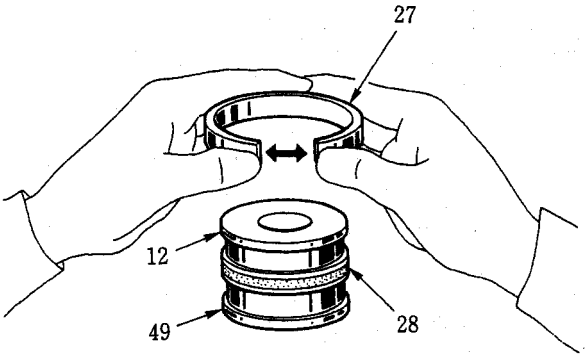
2) Install the wear ring (27) to the piston (12) and packing holder (49).
   - Expand the split on the wear ring (27) as minimum as required to install it from the axial direction.



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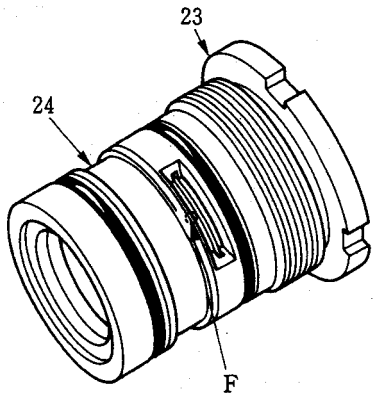
(5) Installation of piston rod assy:

1) Set up the rod cover (23) and retainer (24).
   - Aligning the recess on the rod cover (23) to the bore (F) on the retainer (24), insert the retainer (24) into the rod cover (23).



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1. SUMMARY

1.1 GENERAL PRECAUTIONS

(1) Applications of Breaker or Nibbler & Breaker

- Breaker Piping
  Applicable when a breaker is mounted.
- Nibbler & Breaker Piping
  Applicable when nibbler and a breaker are mounted.

(2) Modification Work

There are some specific precautions to be followed to use the breaker or nibbler & breaker. Therefore, when the machine is to be modified at our service shop, contact to the nearest breaker and nibbler manufacturer's office to obtain instructions for the correct piping and handling of them.

(3) Difference between Hydraulic Pipings for Nibbler and Breaker

- Piping for Breaker
  The oil flow to the breaker is a single flow circuit. The discharged oils from P2 and P3 pumps which join together in the main control valve, flow to the breaker through the control valve for breaker. The return oil directly flows into the tank from the breaker.
- Piping for Nibbler
  The oil flow to the nibbler is a twin flow circuit. The discharged oils from P2 and P3 pumps join together in the main control valve, and the flowing direction of oil is changed over in the control valve for nibbler to operate it.

(4) Operation of Pedal

The operation of breaker and nibbler is conducted by the optional pedal of left front of driver's seat.

Operation of Pedal

Stepping Direction of Pedal	Breaker Spec.	Nibbler & Breaker Spec.	
		Breaker	Nibbler
Toe stepping (front)	—	—	Close (grasp)
Heel stepping(rear)	Operated	Operated	Open (release)

⚠
- Do not put your foot on the pedal unless otherwise the operation, to avoid any mis-operation.
- Lock the pedal with the pedal locking device, while the breaker or nibbler is not used.

1.2 BASIC DISPOSITION TO BE TAKEN AT MOUNTING OF BREAKER OR NIBBLER & BREAKER

When mounting the breaker or nibbler & breaker, always put the following items into effect.

(1) Tighten up the set screw on the discharge block of main control valve to shut off oil passage to the tank and allow oil flowing to the carry-over port.

(2) Return the low pressure line of breaker (return line) directly to the hydraulic oil tank.

⚠ If the return oil from breaker is put into the control valve, it causes for the damages on the machine due to transmission of pulsatory motion to the oil cooler.

(3) Install the pedal for breaker or nibbler & breaker and the control valve which is operated by the link system.

- Control Valve
  for Breaker : Without Overload Relief
- Control Valve
  for Nibbler & Breaker: With Overload Relief

(4) On the machine with the nibbler & breaker, install the selector valve to change over each oil flow for the nibbler or breaker.

(5) Reinforce the arm with a plate to mount the nibbler & breaker.

⚠ Make sure to reinforce the arm, otherwise it causes for the breakage of it.

(6) For the case of not using our genuine parts but using the piping materials of breaker manufacturer, make sure to carry out the above items.

(7) For the arm whose length is longer than the one on the standard machine, the breaker and nibbler & breaker are not applicable.

3.4 RETURN HYDRAULIC PIPING

3.4.1 Additional Parts

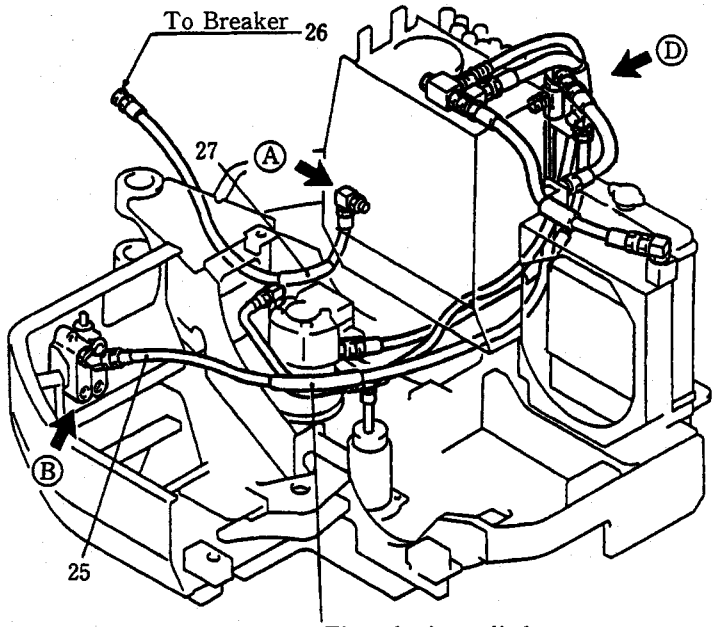
Install the additional parts shown in the Table 7 to the hydraulic piping on the standard machine in accordance with the Fig. 13.

Note : • Confirm the preparations for the required parts prior to setting about the modification work.
• At assembly, pay attention not to allow dropping off of O-ring.

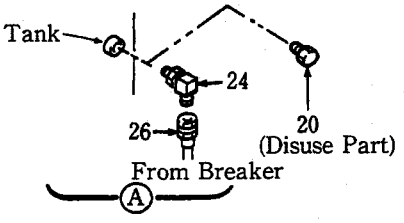
Table 7 Additional Parts for Breaker Specification

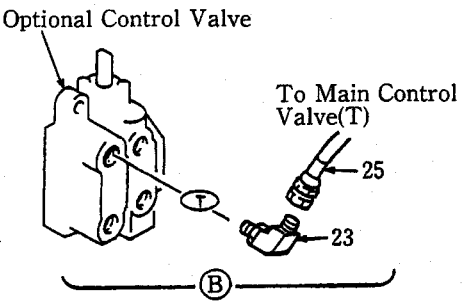
No.	PART NO.	NAME	Q'TY	REMARK	No.	PART NO.	NAME	Q'TY	REMARK
	PV32H00003F2	RETURN HYDRAULIC PIPING		SK25SR	24	HH35S08008G1	ELBOE	1	
	PW32H00005F2	RETURN HYDRAULIC PIPING		SK30SR	25	HX22L08150DX	HOSE (L=1500)	1	
	(PX32H00003F2)	RETURN HYDRAULIC PIPING		(SK35SR)	26	PW32H01009D3	HOSE (L=1870)	1	
	PX32H00004F2	RETURN HYDRAULIC PIPING		SK35SR	27	YN20M01046D5	TUBE	2	
23	HH45S08008G1	CONNECTOR	1		28	HH25S08012G1	CONNECTOR	1	

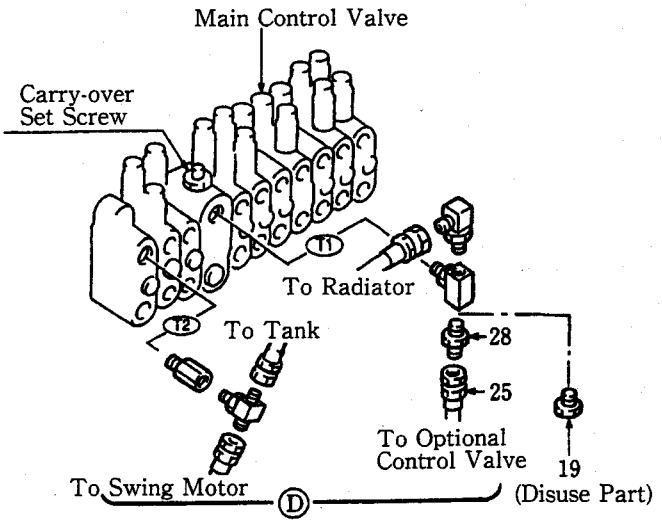
Note : • The part numbers are subject to change due to improvement or modification. Use them for your reference only.
• The numbers are corresponding to the numbers in Parts Catalog for SK25SR, SK30SR and SK35SR.



27 : The tube is applied to the contacted portion with slewing motor.







3.4.2 Disuse Parts

The parts shown in the Table 8 which were used on the standard machine are not used anymore. (refer to Fig. 13)

Table 8

NO.	PART NO.	NAME	Q'TY
19	ZE72X12000	PLUG	1
20	ZE72X08000	PLUG	1

Fig. 13 Return Hydraulic Piping (This Fig. shows the case for SK30SR)

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5.1.4 Arm Hydraulic Piping

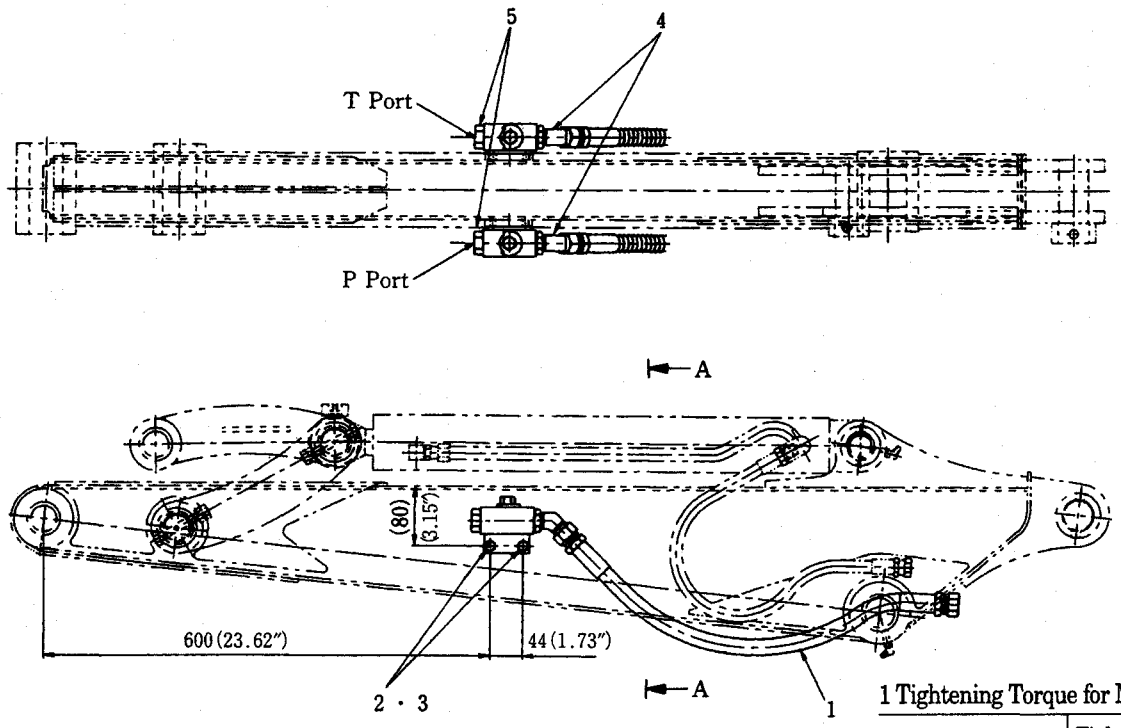
Install the additional parts shown in the Table 17 to the plate which was attached to the arm as per the above 5.1.3, in accordance with the Fig. 22.

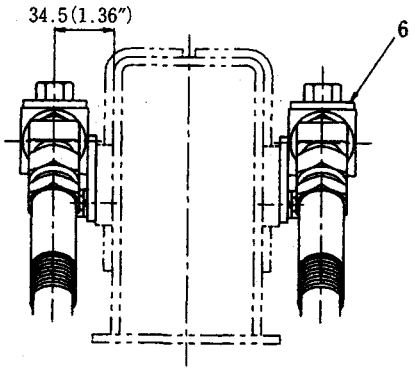
Note : • At assembly, pay attention not to allow dropping off of O-ring.
• Apply the locktite #242 to the cap screw to fix the stop valve.

Table 17 Additional Parts for Arm Hydraulic Piping

No.	PART NO.	NAME	Q'TY	No.	PART NO.	NAME	Q'TY
	PV46H00004F1	ARM HYDRAULIC PIPING		4	HH45S08008G1	ELBOW 45°	2
1	PV68H01006D7	HOSE (L=600)	2	5	ZE72X08000	PLUG	2
2	ZS18C08016	CAP SCREW (M8×16)	4	6	PV46H01001P1	STOP VALVE	2
3	ZW26X08000	LOCK WASHER (M8)	4				

Note : The part numbers are subject to change due to improvement or modification.
Use them for your reference only.





1 Tightening Torque for Metric Thread

Thread Size	Tightening Torque kgf · m (ft · lbs)
M8	3.6±0.4 (26±3)

2 Tightening Torque for PF Thread

Thread Size	Tightening Torque kgf · m (ft · lbs)
PF1/2	6.5±0.5 (47±4)

3 Tightening Torque for Flare Type Hose

Thread Size	Tightening Torque kgf · m (ft · lbs)
PF1/2	$6.0^{+0.5}_{0}$ (43^{+4}_{0})

Fig. 22 Arm Hydraulic Piping (SK25SR)

7. PRECUATIONS TO USE NIBBLER & BREAKER

7.1 OPERATION OF CARRY-OVER FUNCTION

To operate the nibbler or breaker, it is necessary to use the function of carry-over in the main control valve. The function of carry-over is activated by the following preparations.

• Working Procedures

(1) Remove the protective tube (1).

(2) Loosen the lock nut (2).
: 13mm

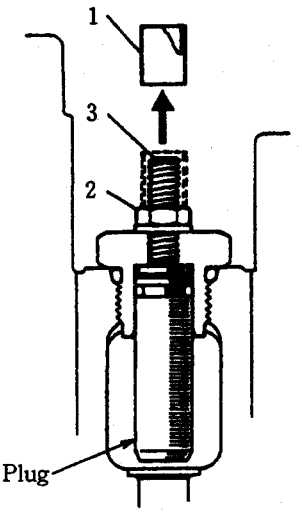
(3) Screw up the set screw (3).
: 4mm
Tightening Torque : 1.4kgf·m (10 ft·lbs)

(4) Lock the set screw with the lock nut (2).
: 13mm
Tightening Torque: 1 kgf·m (7.2 ft·lbs)

(5) Check for the correct set dimension. Then install the protective tube.

Note :
A loose tightening of the set screw (3) and lock nut (2) might cause for a possibility that the plug in the control valve does not seal the seat sufficiently or, once it seals the seat, the seat is occasionally opened, leaking oil into the tank port. Therefore, make sure to tighten them at the specified torque, and check for the L dimension.

Note :
1.The L dimension for the set screw (3) is 21mm (0.83") when the function of carry-over is not used.
2.The L dimension for the set screw (3) is 14±1 mm (0.55±0.04") when the function of carry-over is used.



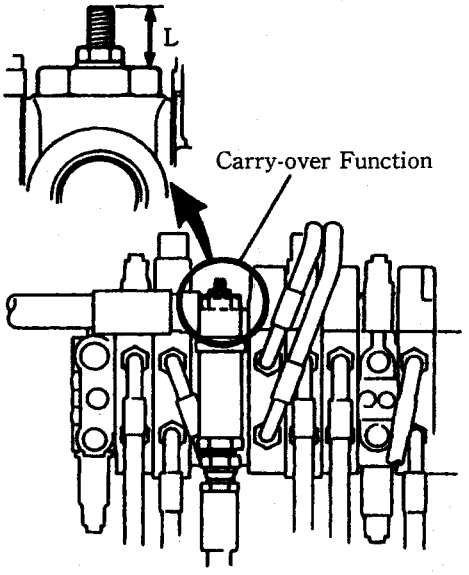


Fig. 33 Operation of Carry-over Function

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CONTENTS

1-5 3TNE82A

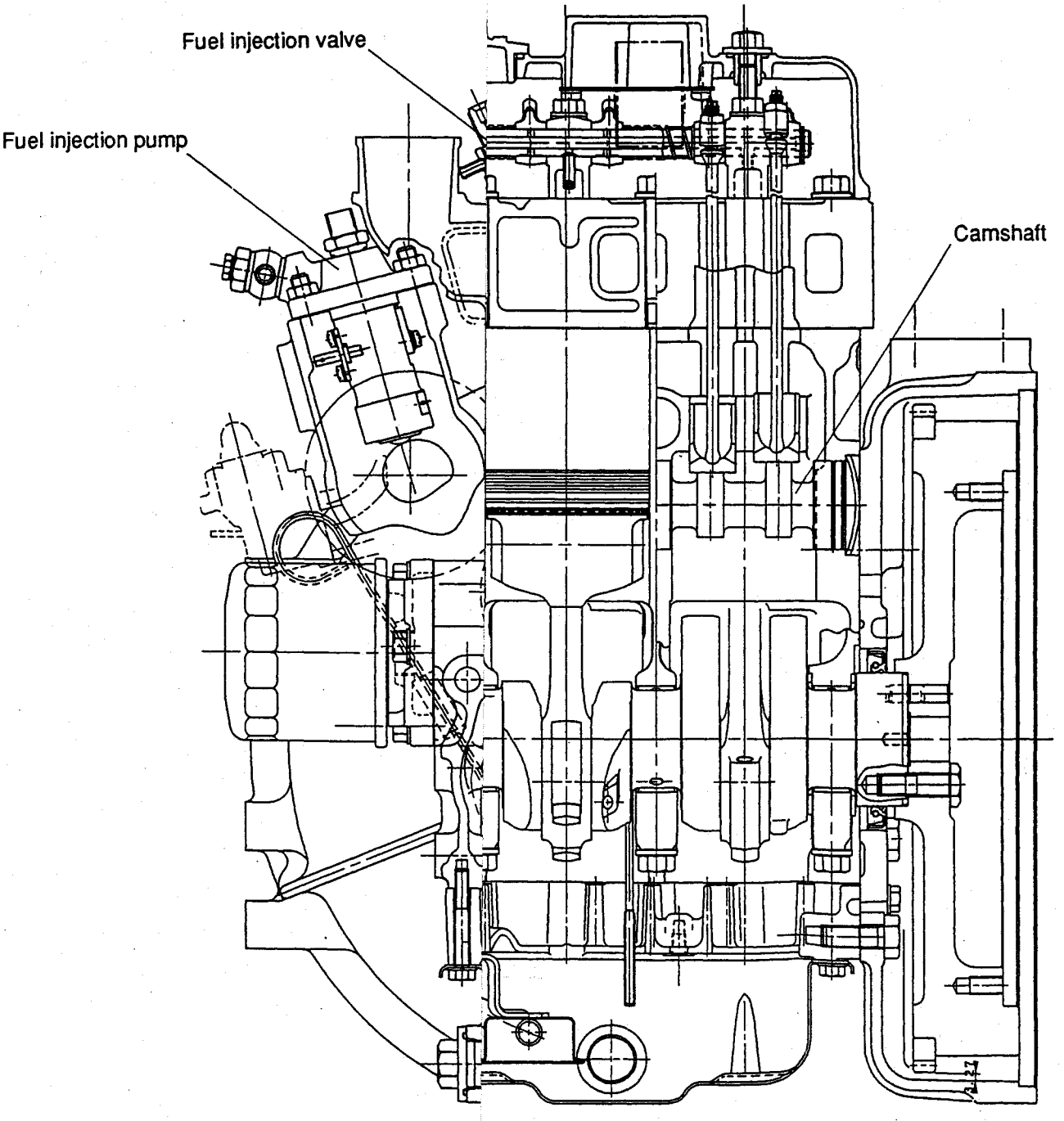
*** Output conditions:** Intake back pressure ≤ 250 mmAq, Exhaust back pressure ≤ 550 mmAq, other conditions complying with JIS D 1005–1986. After minimum 30 hour's run-in.

Item			Model / Unit	3TNE82A							
SPECIFICATIONS	Application		—	CL		VM					
	Type		—	Vertical, 4-cycle water-cooled diesel engine							
	Combustion system		—	Direct injection system							
	No. of cylinders – Bore × Stroke		mm	3 – 82 × 84							
	Displacement		ℓ	1.330							
	Firing order		—	1 – 3 – 2 – 1							
	Revolution speed		rpm	1500	1800	2000	2200	2400	2600	2800	3000
	Output*	Continuous rating	kW(HP)	9.9 (13.3)	12.0 (16.1)	—	—	—	—	—	—
		Max. rating	kW(HP)	11.0 (14.8)	13.2 (17.7)	14.6 (19.6)	16.0 (21.5)	17.5 (23.5)	19.0 (25.5)	20.5 (27.5)	21.9 (29.4)
	Max. revolution speed at no load		rpm	1575^{+50}_{0}	1870^{+50}_{0}	2180^{+50}_{0}	2375^{+50}_{0}	2570^{+50}_{0}	2780^{+50}_{0}	2970^{+50}_{0}	3180^{+50}_{0}
	Min. revolution speed at no load			≤1200		≤800					
	Direction of rotation		—	Counterclockwise (viewed from flywheel)							
	Power take off		—	Flywheel							
	Compression ratio		—	18.0							
	Fuel injection timing (FID, b.T.D.C.)		deg	10±1		12±1		14±1		16±1	
	Compression pressure		MPa (kgf/cm²)	3.04±0.1 (31±1), at 250 rpm							
	Fuel injection pressure		MPa (kgf/cm²)	$19.6^{+1.0}_{0}$ (200^{+10}_{0})							
	Recommended diesel gas oil		—	ISO 8217 DMA, BS 2869 A1 or A2 (Cetane No. 45 min.)							
	Lubrication system		—	Forced lubrication with trochoid pump							
	Lubricating oil capacity Max/Effective		ℓ	3.6/1.3		5.0/1.7					
	Recommended lubricating oil		—	API grade CC class or higher							
	Cooling system		—	Liquid cooling/Radiator							
	Cooling water capacity		ℓ	1.8 (for engine only)							
	Cooling fan No. of blade × dia.		mm	Pusher type, 6 × ϕ335							
	Crank V-pulley dia./ Fan V-pulley dia.		mm	ϕ120/ϕ90		ϕ110/ϕ110					
	Governor		—	Mechanical centrifugal governor (All speed type)							
	Starting system		—	Electrical							
	*1 Dimensions L × W × H		mm	553 × 489 × 565		520.5 × 489 × 565 / 528 × 489 × 565					
	*1 Dry weight		kg	138		112/128					
PERFORMANCE	Governing perform-ance (full speed range)	Transient speed difference	%	≤10	≤8	≤12					
		Steady state speed band	%	≤5	≤4	≤9	≤8	≤7		≤6	
		Recovery time	sec	≤5		≤6					
		Fluctuation of revolution	rpm	≤15		≤25					
	L.O. press.	Rated operation	MPa (kgf/cm²)	0.25 ± 0.05 (2.5 ± 0.5)	0.29±0.05 (3.0±0.5)						
		Idling		≥0.06 (≥0.6)							

*1. Designation of engine dimension and dry weight in numerals.
CL/CH application: engine with flywheel housing
VM/VH application: engine with back plate/with flywheel hausing

2. Cross Sectional Vi

2-1. Special Swirl Pre-co
(Indirect Inj



4. Troubleshooting

4-1. Trouble causes and remedies

The following table summarizes the symptoms and causes of general troubles. If any symptom of trouble is found, a corrective action shall be taken before the said symptom develops into a serious accident.

Carefully read Chapter 6, Measurement, Inspection and Adjustments, and Chapter 7, Measuring Procedures, Service Data and Countermeasures. Familiarize yourself with Chapter 6 and Chapter 7, which practice is extremely important for extending the service life of the engine.

	Cause \ Symptom of trouble	Fails to start				Insufficient engine output			Poor exhaust color		High knocking sound during combustion	Abnormal engine noise	Uneven combustion sound	Hunting		Large engine vibration	Poor return to low speed	Excessive fuel consumption	Lubricating oil				Much blow-by gas	Cooling water		Air intake		Exhaust temperature rise				Corrective action
		Engine will not start.	Engine starts but stops soon			Exhaust color			During work					During idling	During work				Excessive consumption	Diluted by fuel oil	Mixture with water	Low L.O. pressure		Overheat	Low water temperature	Pressure drop	Pressure rise					
			Exhaust smoke																													
			Nil	Less	More	Regular	White	Black	White	Black																						
Engine System	Improper clearance of intake/exhaust valve	○	○			○						○														○		○				Adjust valve clearance (Refer to Chapter 6, 6-2.)
	Compression leakage from the valve seat					○		○		○		○						○					○			○		○				Rap valve seat (Refer to Chapter 7, 7-1-2.)
	Seized intake/exhaust valve	○			○	○		○		○		○			○	○				○			○			○						Correct or replace.
	Blowout of cylinder head gasket					○															○			○								Replace the gasket. (Refer to Chapter 8, 8-2-(10))
	Seized or broken piston ring	○			○		○		○			○		○		○			○	○			○	○				○				Replace the piston ring. (Refer to Chapter 7, 7-4-3, 4, (5))
	Worn piston ring, piston and cylinder	○			○		○		○										○	○			○									Make honing and use oversize parts. (Refer to Chapter 7, 7-2-3. & 7-4-(8))
	Seized crank pin metal and bearing	○	○									○		○	○	○							○									Repair or replace.
	Improper arrangement of piston ring joints		○				○												○				○									Correct the ring joint positions. (Refer to Chapter 7, 7-4-(5))
	Reverse assembly of the piston ring						○		○										○				○									Properly reassemble. (Refer to Chapter 7, 7-4-(5))
	Worn crank pin and journal metal					○						○		○	○	○						○										Measure and replace . Refer to Chapter 7, 7-5-3. and 7-7-(5))
	Loosened connecting rod bolt											○				○						○										Tighten bolt to the specified torque. (Refer to Chapter 10, 10-1.)
	Foreign matter trapped in combustion chamber	○										○							○				○									Disassemble and repair the combustion chamber. Eliminate foreign matter.
	Excessive gear backlash											○																				Adjust meshing of gears. (Refer to Chapter 7, 7-8-(2))
	Worn valve guide of intake/exhaust valves						○												○				○									Measure and replace. (Refer to Chapter 7, 7-1-(3))
	Poor governor		○											○	○	○	○															Repair and adjust. (Refer to Chapter 13.)
	Improper open/close timing of intake/exhaust valves	○					○	○	○	○		○																				Adjust valve clearance (refer to Chapter 6, 6-2) and check intake/exhaust valve timing (Refer to Chapter 9, 9-1)
Turbocharger	Dirty blower						○		○																○							Clean the blower.
	Waste gate malfunction						○		○																○							Disassemble and inspect the waste gate.
	Worn journal bearing						○		○																							Disassemble and inspect the journal bearing.
Cooling Water System	Cooling effect of radiator, excessive							○										○						○								Malfunction of thermostat (kept closed). (Refer to Chapter 6, 6-9)
	Cooling effect of radiator, insufficient						○																○					○				Malfunction of thermostat (kept opened). (Refer to Chapter 6, 6-9) Slipping fan belt (Refer to Chapter 6, 6-3)
	Insufficient cooling water level						○																○					○				Check water leakage from Cooling water system (Refer to Chapter 6, 6-7) and clean cooling water system (Refer to chapter 3, 3-1)
	Cracked water jacket																				○	○		○								Repair and replace.
	Slackened fan belt tension						○																○					○				Adjust fan belt tension. (Refer to Chapter 6, 6-3)
	Poor thermostat						○																○	○								Check or replace. (Refer to Chapter 6, 6-9)

6. Measurement, Inspection and Adjustment

6-1. Measuring the compression pressure

1. Measuring Procedure

(1) Warm up the engine. Remove the fuel injection pipe and fuel injection valve from the cylinder to be measured.

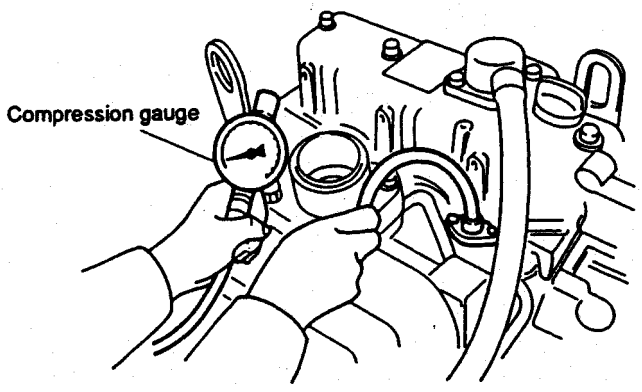
(2) Crank the engine before attaching the compression gauge adapter.

✱ : *1. Crank the engine when the regulator handle has been turned to "STOP" position (no injection state).*

2. For the compression gauge and compression gauge adapter, refer to Chapter 5, 5-2.

(3) Attach the compression gauge adapter and compression gauge to the cylinder to be measured.

✱ : *Never fail to attach the gasket to the tip of the adapter.*



Measuring the compression pressure

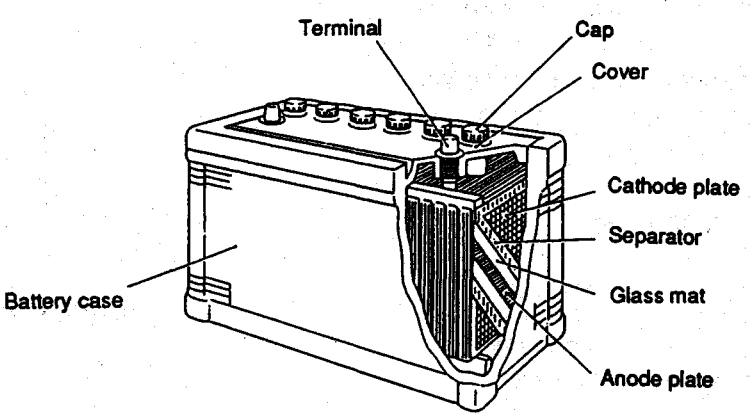
(4) Crank the engine by the starting moter until the reading of the compression gauge is stabilized, by taking steps shown in (2), ✱1.

[Reference: List of Engine Compression Pressures]

Model	Compression pressure at 250 rpm (kgf/cm²)		Dispersion of compression pressure among cylinders (kgf/cm²)
	Standard	Limit	
2TNE68	33 ± 1	25	2 ~ 3
3TNE68	33 ± 1	25	2 ~ 3
3TNE74	35 ± 1	27	2 ~ 3
3TNE78A	32 ± 1	25	2 ~ 3
3TNE82A	31 ± 1	24	2 ~ 3
3TNE82	31 ± 1	24	2 ~ 3
3TNE84	33 ± 1	25	2 ~ 3
3TNE88	35 ± 1	27	2 ~ 3
4TNE82	31 ± 1	24	2 ~ 3
4TNE84	33 ± 1	25	2 ~ 3
4TNE88	35 ± 1	27	2 ~ 3
3TNE84T	30 ± 1	24	2 ~3
4TNE84T	30 ± 1	24	2 ~3

6-8. Checking the battery

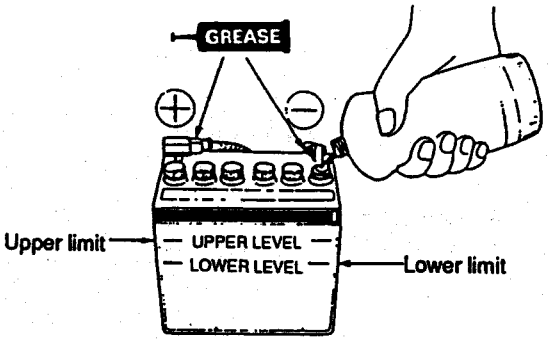
1. Structure of the battery

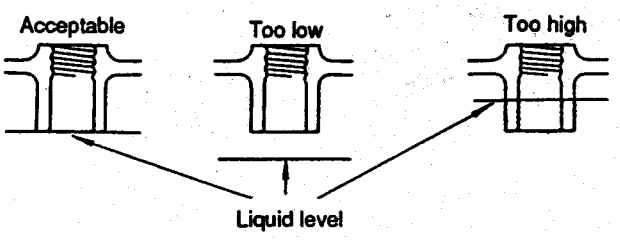


2. Checking the battery

(1) Electrolyte level

Check the electrolyte level in each cell. If the level is low, add deionized water to bring the level to the UPPER level as illustrated below.





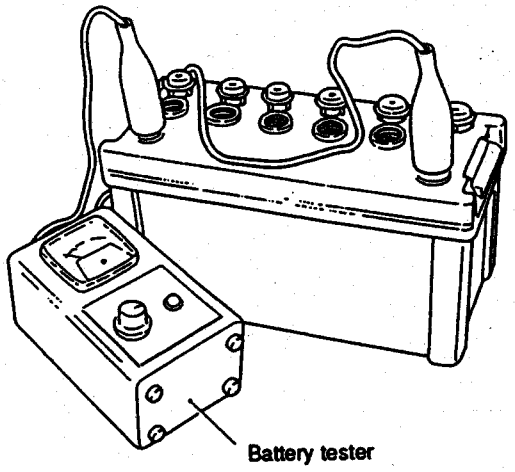
(2) Battery charge

Using a battery tester or hydrometer, check the state of the battery. If the battery is discharged, recharge it.

○ **Measurement with a battery tester**

To check the battery with a battery tester, securely hold the ⊕ terminal of the battery with the red clip of the battery tester and the ⊖ terminal with the black clip. Judge battery charge level from the indicator position:

Green zone:	normal
Yellow zone:	somewhat discharged
Red zone:	abnormal or much discharged



(**Measuring the battery charge with battery tester**)

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[Replacing the Valve Guide]

(1) Extract the valve guide from the cylinder head using the valve guide extraction tool.

* *For the valve guide extraction tool, refer to Chapter 5, 5-1.*

(2) In a container containing liquefied nitrogen, ether or alcohol together with dry ice, put the valve guide to cool it. Then hit the sufficiently cooled valve guide to fit into the cylinder head using the valve guide insertion tool.

* *For the valve guide insertion tool, refer to Chapter 5, 5-1.*

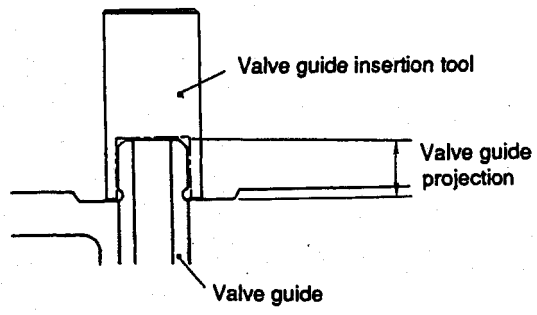
(3) After inserting the valve guide, finish the inside of the valve guide with a reamer.

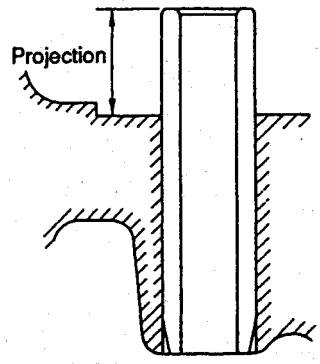
(4) Check the projection of the valve guide.

(mm)

	2/3TNE68		3TNE74	
	Standard	Wear limit	Standard	Wear limit
Valve guide projection	7	—	9	—

	3TNE78A 3TNE82A		3/4TNE82, 3/4TNE84(T), 3/4TNE88	
	Standard	Wear limit	Standard	Wear limit
Valve guide projection	12	—	15	—





(Valve guide projection)

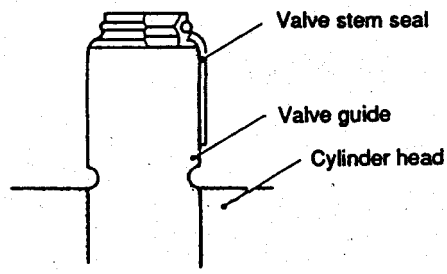
4. Valve stem seal

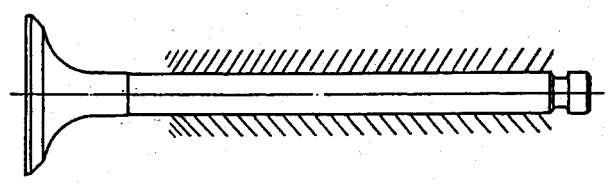
[Time of Replacement]

(1) When oil loss is found excessive
(2) When the valve stem seal is removed
(3) When intake/exhaust valves are removed

[Precautions on Installation]

Make sure that the entire surface of valve stem is smooth, and sufficiently apply lubricating oil to the valve stem before reassembling intake/exhaust valves.

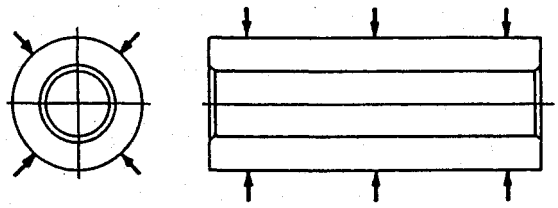




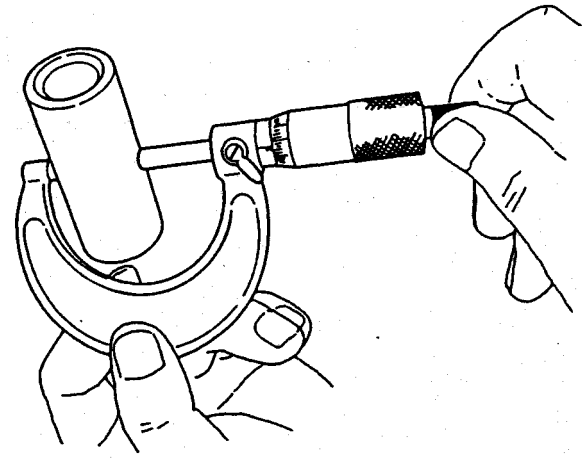
(Hatched portion indicates where to apply lubricating oil.)

6. Measuring the outside diameter of the piston pin and the pin hole diameter

Measure outside diameter of the piston pin and pin hole diameter. Replace the piston pin if the wear limit is exceeded.
Apply lubricating oil to the piston pin before inserting it into the piston.



(Measuring point of the piston pin O. D.)

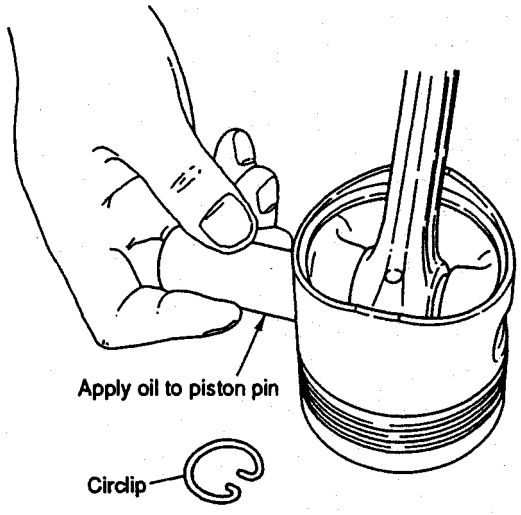


(Measuring the piston pin outside diameter)

(mm)

		2/3TNE68		3TNE74	
		Standard	Wear limit	Standard	Wear limit
Piston and piston pin	Piston pin outside diameter	19.991 ~20.000	19.90	20.991 ~21.000	20.90
	Piston pin hole dia.	20.000 ~20.008	20.02	21.000 ~21.008	21.02
	Oil clearance	0.000 ~0.017	0.12	0.000 ~0.017	0.12

		3TNE78A 3TNE82A		3/4TNE82, 3/4TNE84(T), 3/4TNE88	
		Standard	Wear limit	Standard	Wear limit
Piston and piston pin	Piston pin outside diameter	22.991 ~23.000	22.90	25.987 ~26.000	25.90
	Piston pin hole dia.	23.000 ~23.008	23.02	26.000 ~26.009	26.02
	Oil clearance	0.000 ~0.017	0.12	0.000 ~0.022	0.12



(Insertion of piston pin)

7. [Reference] Top clearance

(mm)

	2/3TNE68		3TNE74	
	Standard	Wear limit	Standard	Wear limit
Top clearance	0.610 ~0.730	—	0.658 ~0.778	—

	3TNE78A 3TNE82A		3/4TNE82, 3/4TNE84(T), 3/4TNE88	
	Standard	Wear limit	Standard	Wear limit
Top clearance	0.650 ~0.770	—	0.660 ~0.780	—

7-8. Gears

1. Checking gears

Inspect the gears and replace if the teeth are damaged, worn, or chipped.

2. Measuring the backlash

Apply a dial gauge onto the pitch circle of the gear, and measure the backlash.

(mm)

		2/3TNE68, 3TNE74	3TNE78A/82A, 3/4TNE82, 3/4TNE84(T), 3/4TNE88
Back-lash	Crankshaft gear, Camshaft gear, Idle gear and Fuel injection pump drive gear	0.04~0.12	0.07~0.15
	L.O. pump gear	0.11~0.19	

3. Checking and measuring the idling gear shaft and idling gear

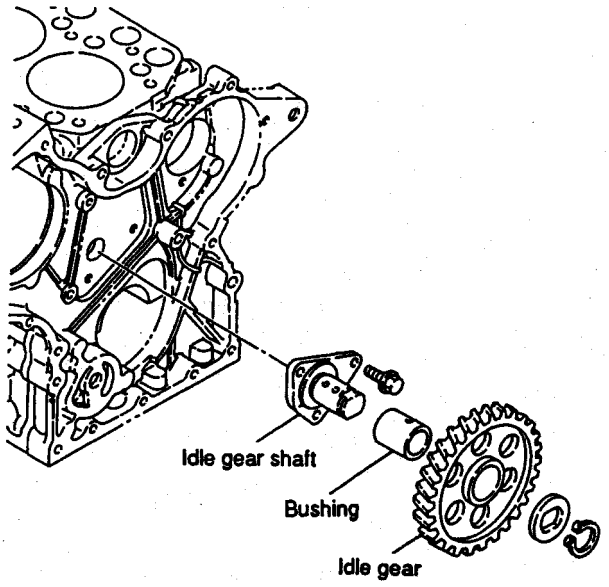
(1) Measure the bushing inside diameter and the idle gear shaft outside diameter, and replace the bushing or idling gear shaft if the oil clearance exceeds the wear limit.

(mm)

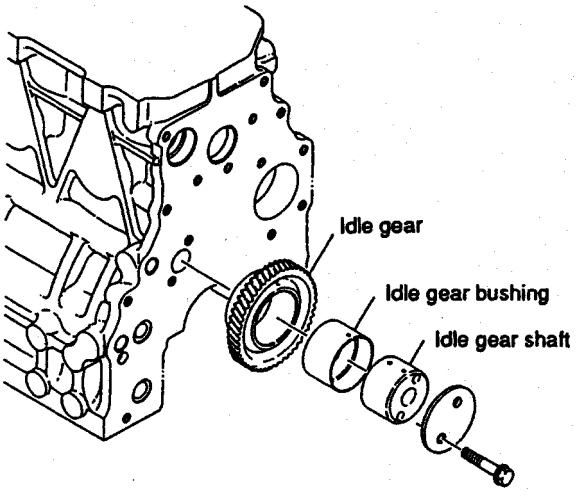
		2/3TNE68, 3TNE74		3TNE78A/82A, 3/4TNE82, 3/4TNE84(T), 3/4TNE88	
		Standard	Wear limit	Standard	Wear limit
Idle gear	Shaft outside dia.	19.959 ~19.980	19.93	45.950 ~45.975	45.93
	Bushing inside dia.	20.000 ~20.021	—	46.000 ~46.025	46.08
	Oil clearance	0.020 ~0.062	0.15	0.025 ~0.075	0.15

(2) Make sure that the oil hole of the idle gear shaft and bushing is a through hole.

(Indirect injection system)



(Direct injection system)



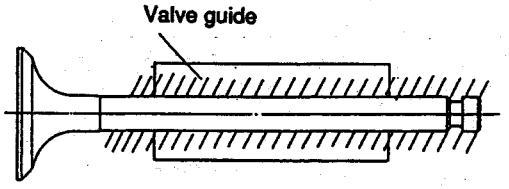
(5) Where to use liquid packings

1. Between the cylinder block and gear case flange
2. Between the gear case flange and gear case cover
3. Between the cylinder block and oil seal case (indirect injection system only)
4. Oil pan installation surface

** Use Three Bond No. 005 (Yanmar part code:97777-001212) as the liquid packing.*

** Apply the liquid packing so as not to form any break on the midway. Otherwise, oil leakage, etc., may result.*

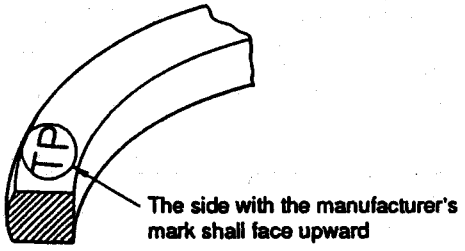
(6) Coating the lubricating oil on intake/exhaust valve stem



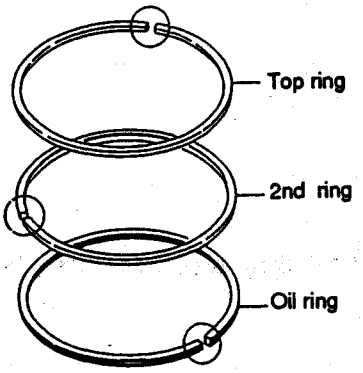
Apply lubricating oil down to the lower surface (hatched portion in the figure) of the valve guide before reassembling the valve stem.

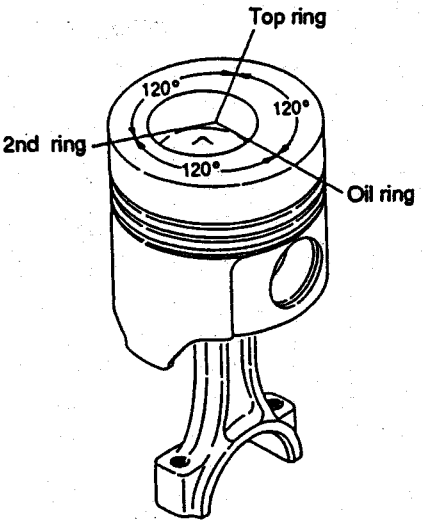
(7) Reassembly of the piston ring

1. Insert the piston ring into the ring groove, where the side with the manufacturer's mark on the matching ends facing up (to the combustion chamber side), using a piston ring replacer. After fitting the piston ring, make sure it moves easily and smoothly.



2. Assemble the piston rings to the cylinder, staggering the piston rings joints at 120° intervals, making sure that they are not aligned along the piston. Apply lube oil to the circumference of the piston.





10. Tightening Torque

10-1 Main bolt/nut

(Unit: kgf-m)

No.	Item	Model / Torque	2/3TNE68	3TNE74	3TNE78A 3TNE82A	3/4TNE82, 3/4TNE84(T), 3/4TNE88
1	Cylinder head bolt	Lubricating oil applied (Thread dia. × pitch)	3.8~4.2 (M8 × 1.25)	6.0~6.5 (M9 × 1.25)	6.8~7.2 (M9 × 1.25)	8.7~9.3 (M10 × 1.25)
2	Connecting rod bolt	Lubricating oil applied (Thread dia. × pitch)	2.3~2.8 (M7 × 1.0)	2.3~2.8 (M7 × 1.0)	3.8~4.2 (M8 × 1.0)	4.5~5.5 (M9 × 1.0)
3	Flywheel clamping bolt	Lubricating oil applied (Thread dia. × pitch)	8.2~8.8 (M10 × 1.25)	8.0~9.0 (M10 × 1.25)	8.5~9.0 (M10 × 1.25)	8.5~9.0 (M10 × 1.25)
4	Metal cap clamping bolt	Lubricating oil applied (Thread dia. × pitch)	5.3~5.7 (M9 × 1.25)	8.0~8.5 (M10 × 1.25)	7.8~8.2 (M10 × 1.5)	9.8~10.2 (M12 × 1.5)
5	Crankshaft V-pulley clamping bolt	Lubricating oil applied (Thread dia. × pitch)	S48C:11.5~12.5 FC25: 8.5~9.5 (M12 × 1.5)	S48C:11.5~12.5 FC25: 8.5~9.5 (M12 × 1.5)	11.5~12.5 (M14 × 1.5)	11.5~12.5 (M14 × 1.5)
6	Fuel injection nozzle nut	Lubricating oil not applied (Thread dia. × pitch)	5.0~5.4 (M20 × 1.5)	5.0~5.4 (M20 × 1.5)	0.7~0.9 (M6 × 1.0)	0.7~0.9 (M6 × 1.0)
7	Timer clamping nut	Lubricating oil not applied (Thread dia. × pitch)	—	—	6.0~7.0 (M12 × 1.75)	6.0~7.0 (M12 × 1.75)
8	Glow plug	Lubricating oil not applied (Thread dia. × pitch)	1.5~2.0 (M10 × 1.25)	1.5~2.0 (M10 × 1.25)	—	—
9	Stub shaft bolt	Lubricating oil not applied (Thread dia. × pitch)	5.5~6.5 (M10 × 1.5)	5.5~6.5 (M10 × 1.5)	—	—
10	Governor weight support nut	Lubricating oil not applied (Thread dia. × pitch)	7.0~7.5 (M12 × 1.25)	7.0~7.5 (M12 × 1.25)	4.5~5.0 (M12 × 1.25)	4.5~5.0 (M12 × 1.25)
11	High pressure pipe sleeve clamping nut	Lubricating oil not applied (Thread dia. × pitch)	3.0~3.5 (M12 × 1.5)	3.0~3.5 (M12 × 1.5)	3.0~3.5 (M12 × 1.5)	3.0~3.5 (M12 × 1.5)

10-2 Standard bolt and nut

*** : Lubricating oil not applied**

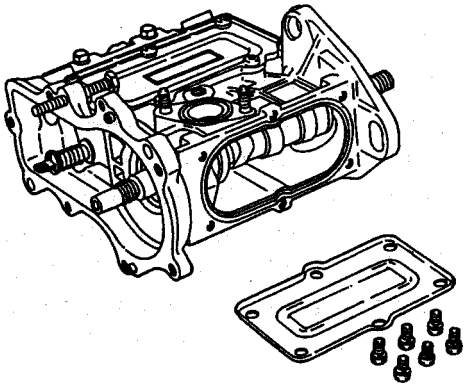
(Unit: kgf-m)

Item	Thread dia. × pitch	Tightening torque	Remarks
Hexagon headed bolt (7T) and nut	M6 x 1	1.0~1.2	1) When bolting the aluminum parts, tighten the bolts with 80% of the tightening torque specified in the Table. 2) 4T bolt and lock nut should be tightened with 60% of the torque shown in the table.
	M8 x 1.25	2.3~2.9	
	M10 x 1.5	4.5~5.5	
	M12 x 1.75	8.0~10.0	
PT plug	1/8	1.0	———
	1/4	2.0	
	3/8	3.0	
	1/2	6.0	
Pipe joint bolt	M8	1.3~1.7	———
	M12	2.5~3.5	
	M14	4.0~5.0	
	M16	5.0~5.5	

12-3. Disassembly

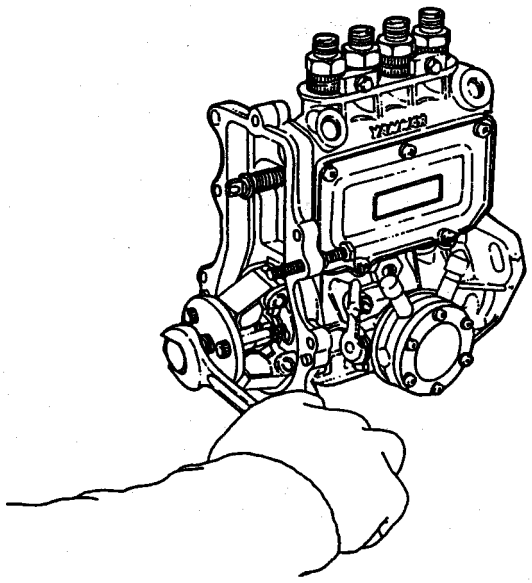
(1) Remove the bottom cover from the fuel injection pump to drain lubricating oil from the fuel injection pump.

(2) Turn the fuel injection pump upside down to drain fuel oil.



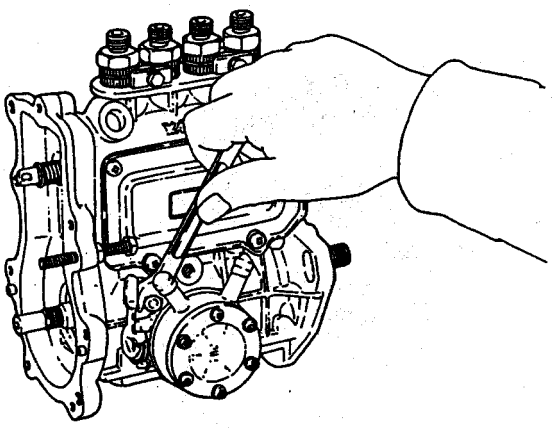
(3) Take out the governor weight assembly using the governor weight extractor tool (special service tool)

* *For separating the governor assembly from the fuel injection pump, refer to Chapter 13, 13-3.*

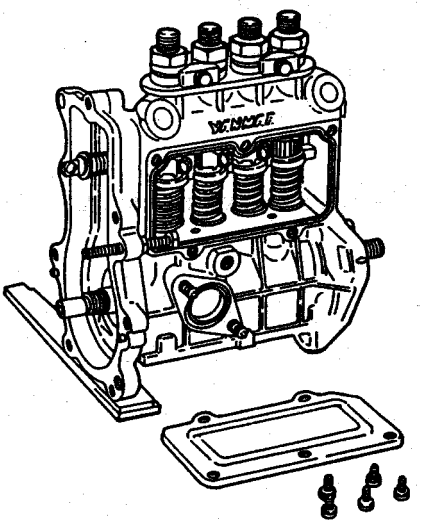


(4) Remove the fuel feed pump.

* *Do not disassemble the fuel feed pump.*



(5) Remove the fuel injection pump side cover.



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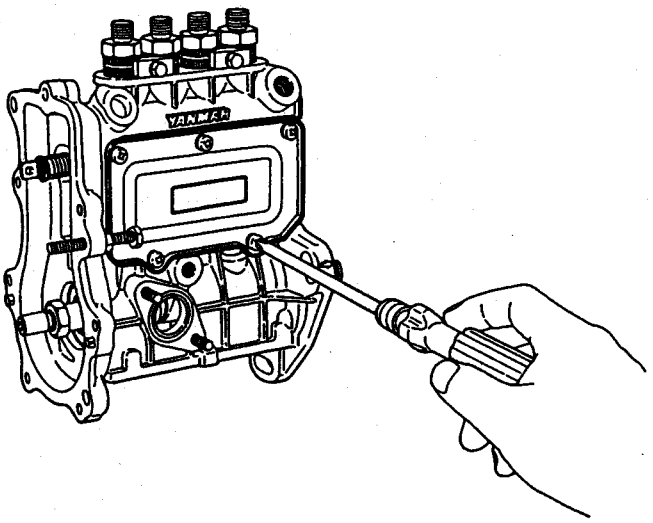
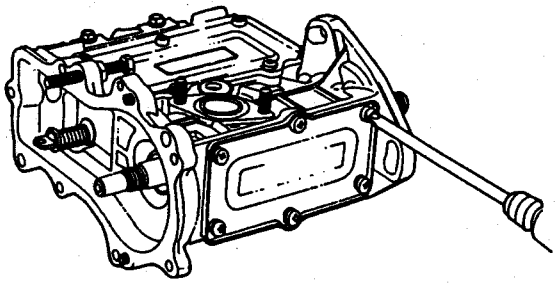
(17) Mount the fuel injection pump side cover.



(18) Mount the fuel injection pump bottom cover.

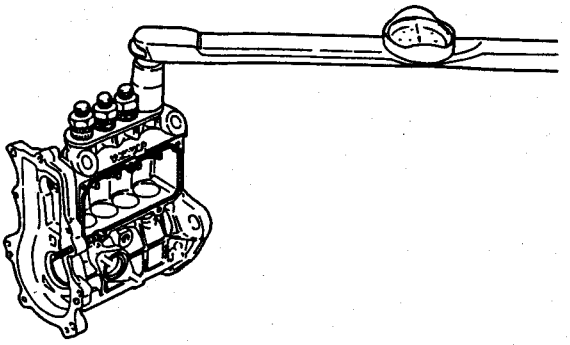


(19) Tighten the delivery valve spring holder to the specified torque. (kgf-m)

	All models
Tightening torque	3.5 ~ 4.0

*1. *Tighten the delivery valve spring holder by handas far as possible. If the bolt get hard to turn part way, the packing or delivery valve may be out of position. Remove, correct, and start tighten again.*

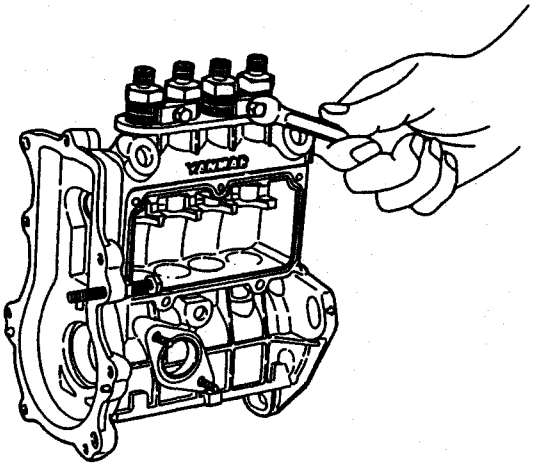
*2. *Never tighten the delivery valve holder excessively. Excessive tightening causes the control rack to malfunction.*



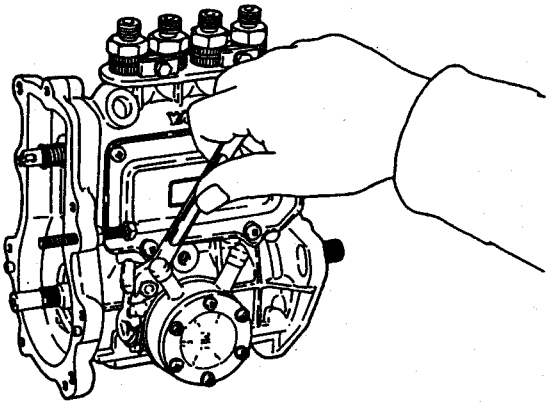
(20) Tighten the holder stopper to the specified torque. (kgf-m)

	All models
Tightening torque	0.3

* *Never tighten the delivery holder excessively. Otherwise, it upsets, causing oil to leak through it.*



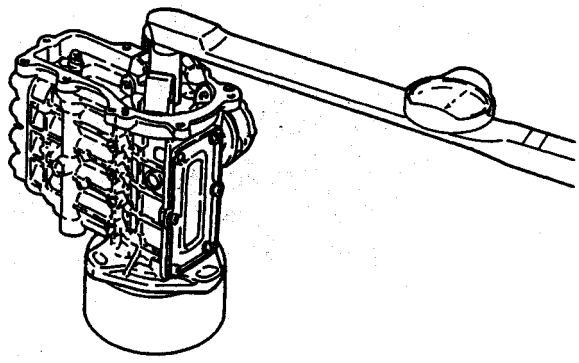
(21) Mount the fuel feed pump.



13-5. Reassembly

Inspect all parts after disassembly and replace any parts as necessary. Before starting reassembly, clean all parts and put them in order.
Make sure to readjust the unit after reassembly to obtain the specified performance.

(1) Fix the bearing holder with a vise to hold the fuel injection pump camshaft. Insert the governor weight assembly in the taper portion at the end of the fuel injection pump camshaft. Mount the washer, and tighten the governor weight support nut with the specified torque.

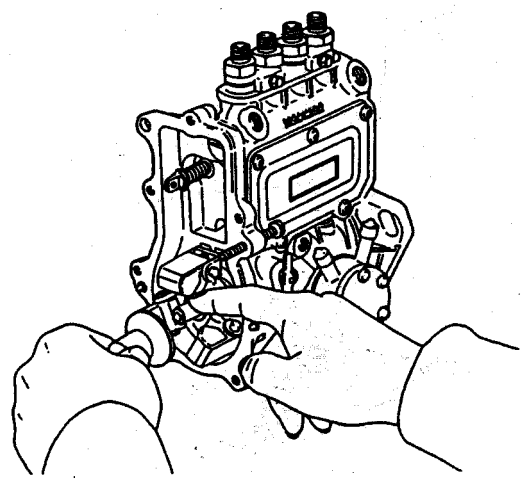


(kgf-m)

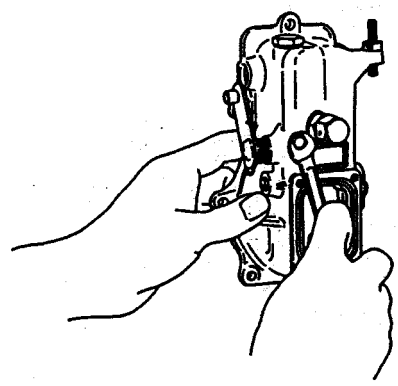
	Governor weight support nut tightening torque
Indirect injection system	7.0 ~ 7.5
Direct injection system	4.5 ~ 5.0

(2) Open the governor weight to the outside, and insert the sleeve in the end of the fuel injection pump camshaft.

* *Make sure that the sleeve moves smoothly after inserting it.*



(3) After the stop lever is disassembled, mount the stop lever return spring on the stop lever, tap the stop lever lightly with a wooden hammer to insert it, and tighten the stop lever stop pin. (DI only)



(4) After the control lever shaft is removed, lightly tap and insert the control lever shaft and washer from inside the governor case, using an appropriate plate.

(5) If the governor lever has been disassembled, tap in the spring pin.

4/4

15. Service Information for CARB ULG regulation

Introduction

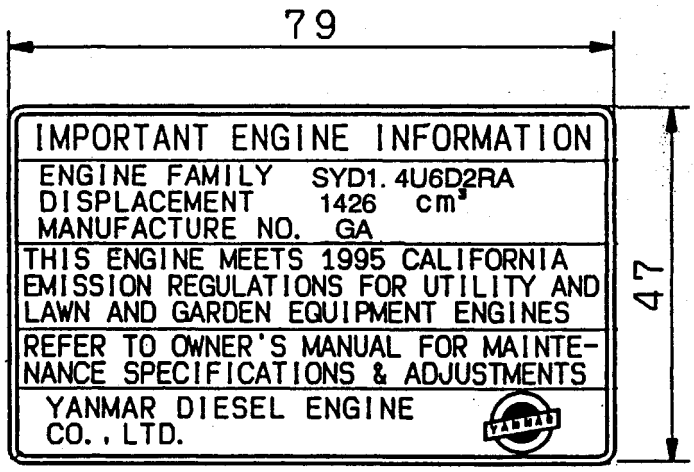
This chapter describes only the items designated as special specifications for servicing the TNE engine under 25 HP that complies with CARB ULG regulation (Regulation for small Utility engines and Lawn & Garden from California Air Resource Board, effects to the engines manufactured on Jan. 1st 1995 and later).

15-1. Emission control label

15-1-1. Content of the label

Size and contents of the label are as shown below.

[Example]



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