CASE CONSTRUCTION

SERVICE MANUAL

COMPACT CRAWLER EXCAVATOR

CX27B
TIER 4

S5PV0019E01 EN-US

Issued 01Sep 08

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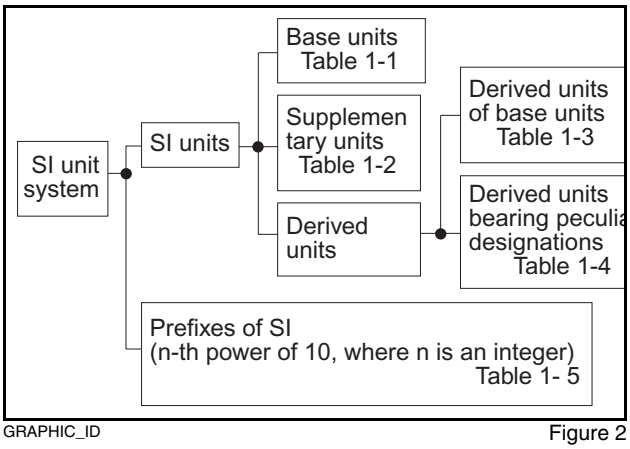
Revision History				
Issue	Issue Date	Applicable Machines	Form Number	Remarks
First Edition	09-2008	CX27B	5-16780	

INTERNATIONAL UNIT SYSTEM

INTRODUCTION

Although this manual uses the SI units system. Outline of SI units system is described here.
Given below are an excerpt of the units that are related to this manual :

1. Etymology of SI Units
   English : International System of units
2. Construction of SI Unit System



GRAPHIC_ID Figure 2

1. Basic Units

Table 1		
QUANTITIES	**DESIGNATION**	**SIGN**
Length	Meter	m
Mass	Kilogram	kg
Time	Second	s
Current	Ampere	A
Thermodynamic temperature	Kelvin	K
Gram molecule	Mol	mol
Luminous intensity	Candela	cd

2. Supplementary Units

Table 2		
QUANTITIES	**DESIGNATION**	**SIGN**
Plain angle	Radian	rad
Solid angle	Steradian	sr

3. Derived Units of Basic Units

Table 3		
QUANTITIES	**DESIGNATION**	**SIGN**
Area	Square meter	m^2
Volume	Cubic meter	m^3
Velocity	Meter per second	m/s
Acceleration	Meter per second / second	m/s^2
Density	Kilogram per cubic meter	kg/m^3

4. Derived Units bearing Peculiar Designations

Table 4			
QUANTITY	**UNIT**	**SYMBOL**	**FORMULA**
Frequency	hertz	Hz	1Hz=1/s
Force	newton	N	$kg \bullet m/s^2$
Pressure and Stress	pascal	Pa	N/m^2
Energy, Work and Quantity of heat	joule	J	Nm
Power	watt	W	J/s
Quantity of electricity	coulomb	C	A•s
Electric potential difference, Voltage, and Electromotive force	volt	V	W/A
Quantity of static electricity and Electric capacitance	farad	F	C/V
Electric resistance	ohm	Ω	V/A
Celcius temperature	celcius degree or degree	°C	(t+273.15)K
Illuminance	lux	lx	$l\ m/m^2$

5. Prefixes of SI

Table 5		
PREFIX		**POWER**
DESIGNATION	SIGN	
Giga	G	10^9
Mega	M	10^6
Kilo	k	10^3
Hecto	h	10^2
Deca	da	10
Deci	d	10^{-1}
Centi	c	10^{-2}
Milli	m	10^{-3}
Micro	m	10^{-6}
Nano	n	10^{-9}
Pico	p	10^{-12}

MACHINE AND COMPONENTS WEIGHT (DRY)

Unit :kg (lb)

MODEL	CX27B			
	RUBBER SHOE		IRON SHOE (OPT)	
	CANOPY	CAB	CANOPY	CAB
COMPLETE MACHINE	2,490 (5490)	2,630 (5800)	2,620 (5780)	2,760 (6080)
UPPER FRAME ASSEMBLY (ASSY OF FOLLOWINGS)	1,310 (2890)	1,450 (3200)	1,310 (2890)	1,450 (3200)
UPPER FRAME	265 (584)	←	←	←
CANOPY / CAB	85 (187)	220 (485)	85 (187)	←
ENGINE	130 (287)	←	←	←
HYDRAULIC PUMP	18 (40)	←	←	←
RADIATOR	3 (7)	←	←	←
HYDRAULIC TANK	30 (66)	←	←	←
FUEL TANK	4 (9)	←	←	←
SWING BRACKET	59 (130)	←	←	←
SWING CYLINDER	23 (51)	←	←	←
SLEWING MOTOR	32 (71)	←	←	←
CONTROL VALVE	24 (53)	←	←	←
COUNTERWEIGHT	290 (639)	←	←	←
GUARD • HOOD	97 (214)	←	←	←
BOOM CYLINDER	24 (53)	←	←	¨
LOWER FRAME ASSEMBLY (ASSY OF FOLLOWINGS)	830 (1830)	←	960 (2120)	←
LOWER FRAME	328 (723)	←	←	←
SLEWING BEARING	36 (79)	←	←	←
TRAVEL MOTOR	27 ×2 (60×2)	←	←	←
LOWER ROLLER	6 ×8 (13×8)	←	←	←
FRONT IDLER	17×2 (37×2)	←	←	←
IDLER ADJUSTER	11×2 (24×2)	←	←	←
SPROCKET	5×2 (11×2)	←	←	←
250mm (9.8in.) RUBBER CRAWLER SHOE	80 (176) ×2	←	—	—
250mm (9.8in.) IRON SHOE	—	—	147 (324) ×2	←
SWIVEL JOINT	11 (24)	←	←	←
DOZER	117 (260)	←	←	←
DOZER CYLINDER	20 (44)	←	←	←
ATTACHMENT ASSEMBLY (ASSY OF FOLLOWINGS)	300 (662)	←	←	←
BOOM ASSEMBLY	125 (276)	←	←	←
BOOM	88 (194)	←	←	←
ARM CYLINDER	28 (62)	←	←	←
ARM ASSEMBLY	95 (209)	←	←	←
ARM	51 (112)	←	←	←
BUCKET CYLINDER	17 (37)	←	←	←
BUCKET LINK	6 (13)	←	←	←
IDLER LINK	2×2 (4×2)	←	←	←
BUCKET ASSEMBLY (STD)	64 (141)	←	←	←
FLUIDS (ASSY OF FOLLOWINGS)	50 (110)	←	←	←
HYDRAULIC OIL	24 (53)	←	←	←
FUEL	22 (49)	←	←	←
COOLANT	4 (9)	←	←	←

NOTE: *Bucket weight is shown with Japanese standard bucket weight.*

NOTES

BUCKET

Bucket Dimensional Drawings

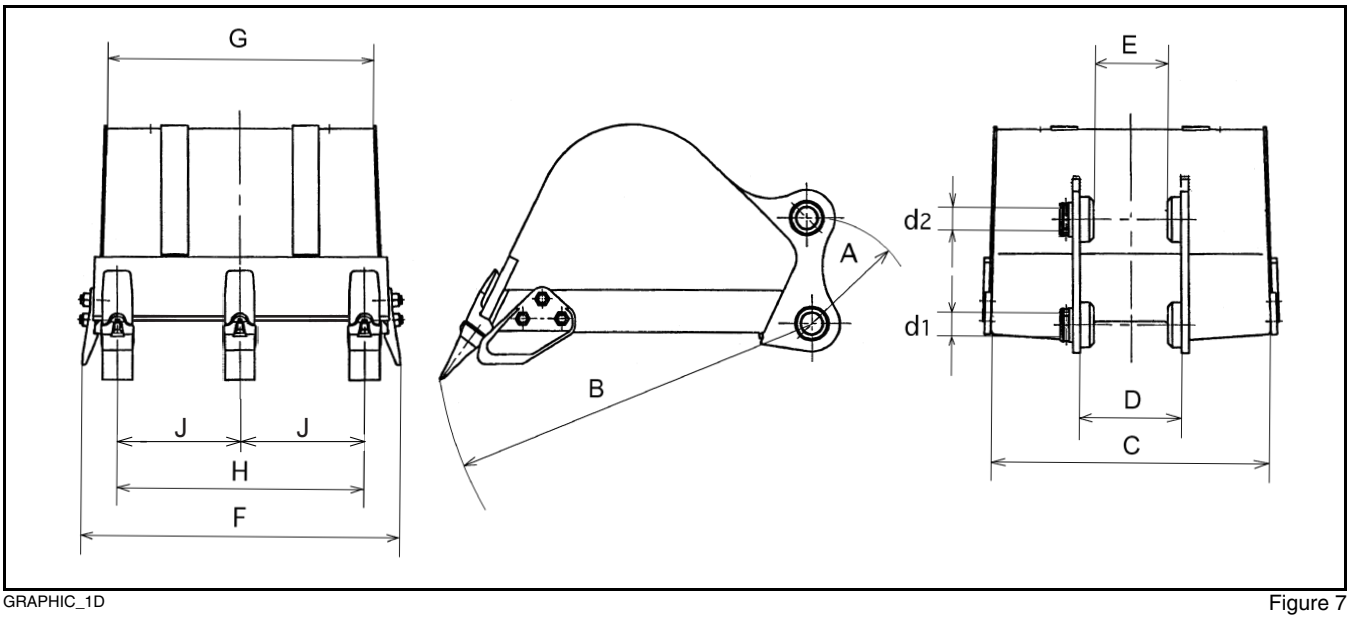


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Figure 7

Unit : mm (ft-in)

No.	Model	CX27B
	Heaped Capacity m^3 (cu.yd)	0.08 (0.105)
A	Distance between pin and bracket	180 (7.09in)
B	Distance between bucket pin and tooth end	R655 (2ft-1.79in)
C	Inner width of bucket top end	435 (1ft-5.13in)
D	Inner width of lug	165 (6.50in)
E	Inner width of bracket	123 (4.84in)
F	Outer width of side cutter	492 (1ft-7.37in)
G	Outer width of bucket bottom plate	399 (1ft-3.71in)
H	Outer tooth distance	374 (1ft-2.72in)
J	Pitch between teeth	187 (7.36in)
d1	Pin dia.	ø35 (1.38in)
d2	Pin dia.	ø35 (1.38in)

NOTE: *Standard bucket.*

NOTES

Unit : Nm (pound-ft)

Classification		4.8T		7T		10.9T	
Nominal size		No lubrication	Oil lubrication	No lubrication	Oil lubrication	No lubrication	Oil lubrication
M30	P=3.5	588±59 (434±44)	490±49 (361±36)	1285±127 (948±94)	1079±108 (796±80)	2300±235 (1700±173)	1940±196 (1430±145)
M33	P=3.5	794±78 (586±58)	667±69 (492±51)	1726±177 (1270±131)	1451±147 (1070±108)	3110±314 (2290±232)	2610±265 (1930±195)
M36	P=4	1030±98 (760±72)	863±88 (637±65)	2226±226 (1640±167)	1863±186 (1370±137)	4010±402 (2960±297)	3360±333 (2480±246)

Metric fine thread standard tightening torque values. Make certain to tighten all capscrews and nuts to proper torque values.

Torque value Unit : Nm (pound-ft)

Classification		4.8T		7T		10.9T	
Nominal size		No lubrication	Oil lubrication	No lubrication	Oil lubrication	No lubrication	Oil lubrication
M8	P=1.0	11.3±1.1 (8.3±0.8)	9.5±1.0 (7.0±0.7)	24.5±2.0 (18.1±1.5)	20.6±2.0 (15.2±1.5)	44.1±3.9 (32.5±2.9)	37.3±3.9 (27.5±2.9)
M10	P=1.25	22.6±2.0 (16.7±1.5)	18.7±1.9 (13.8±1.4)	48.1±4.9 (35.5±3.6)	41.2±3.9 (30.3±2.9)	87.3±8.8 (64.4±6.5)	73.5±6.9 (54.2±5.1)
M12	P=1.25	39.2±3.9 (28.9±2.9)	33.3±2.9 (24.6±2.1)	85.3±8.8 (62.9±6.5)	71.6±6.9 (52.8±5.1)	154±16 (114±12)	129±13 (95.2±9.6)
M16	P=1.5	92.2±8.8 (68.0±6.5)	77.5±7.8 (57.2±5.8)	196±20 (145±15)	169±17 (125±13)	363±39 (268±29)	304±29 (224±21)
M20	P=1.5	186±19 (137±14)	155±16 (114±12)	402±39 (297±29)	333±29 (246±21)	726±69 (535±51)	608±59 (448±44)
M24	P=2	314±29 (232±21)	265±29 (195±21)	686±69 (506±51)	569±59 (420±44)	1240±118 (915±87)	1030±98 (760±72)
M30	P=2	637±59 (470±44)	530±49 (391±36)	1390±137 (1030±101)	1157±118 (853±87)	2500±255 (1840±188)	2080±206 (1530±152)
M33	P=2	853±88 (629±65)	706±70 (521±52)	1860±186 (1370±137)	1550±155 (1140±114)	3350±334 (2470±246)	2790±275 (2060±203)
M36	P=3	1070±108 (789±80)	892±88 (658±65)	2330±226 (1720±167)	1940±196 (1430±145)	4200±422 (3100±311)	3500±353 (2580±260)

NOTES

GROUP No.		EQUIPMENT PORTION	WORK TO BE DONE	UNIT	REMARKS	UNIT : HOUR
03 Upper structure	73	•Pilot delivery oil hose	Rem. / Inst.	1 pc.		0.1
	74	•Suction hose	Rem. / Inst.	1 pc.		0.2
	75	•Suction tube (pump side)	Rem. / Inst.	1 pc.		0.2
	76	•Main pump delivery hose	Rem. / Inst.	3 pcs.		0.3
	77	•Pump fixing bolt	Rem. / Inst.	2 pcs.		0.2
	78	Pump ASSY	O / H	1 pc.		3.0
		Other necessary works	Feed	1 pc.	Hyd. oil in pump	0.1
	80	Radiator portion			Refer to Radiator Removal	
	81	Radiator ASSY	Rem. / Inst.	1 pc.		1.2
	82	•Coolant (LLC)	Replace	1 pc.		0.2
	83	•• Coolant density	Measuring	1 pc.		0.2
	84	•Reserve tank hose	Rem. / Inst.	1 pc.		0.1
	85	•Radiator hose	Rem. / Inst.	2 pcs.		0.2
	86	•Cooler hose	Rem. / Inst.	2 pcs.		0.2
	87	•Radiator fixing bolt	Rem. / Inst.	3 pcs.		0.1
	88	•Radiator lifting or slinging	Rem. / Inst.	1 pc.		0.1
		Other necessary works	Rem. / Inst.	1 pc.	Counterweight	0.4
			Rem. / Inst.	1 set	Covers	0.2
			Rem. / Inst.	1 pc.	Duct	0.1
	90	Engine (E / G) Installing portion			Refer to Engine Removal	
	91	Engine ASSY	Rem. / Inst.	1 pc.		1.0
	92	•Fuel hose	Rem. / Inst.	4 pcs.	For injection pump - 2 pcs. & For feed pump - 2 pcs.	0.2
	93	•Harness, connector and cable	Rem. / Inst.	1 set		0.3
	94	•Engine fixing nut	Rem. / Inst.	1 pc.		0.2
	95	•Engine slinging	Rem. / Inst.	1 set		0.2
		Other necessary works	Rem. / Inst.	1 set	Covers	0.2
			Rem. / Inst.	1 pc.	Canopy	0.2
			Rem. / Inst.	1 set	Control stand	1.0
			Rem. / Inst.	1 pc.	Counterweight	0.4
			Rem. / Inst.	1 pc.	Air cleaner	0.2
			Rem. / Inst.	1 pc.	Muffler	0.4
			Rem. / Inst.	1 pc.	Pump	1.2
			Rem. / Inst.	1 pc.	Radiator	1.2
			Rem. / Inst.	1 pc.	Battery negative terminal	0.1
	100	Control valve portion			Refer to Control Valve Removal	
	101	Control valve ASSY	Rem. / Inst.	1 pc.		1.6
	102	•Piping connector, hose	Rem. / Inst.	1 set	Include attaching hose's tag and plug	1.0
	103	•Control cable, Yoke	Rem. / Inst.	1 set		0.2
	104	•Fixing bolt	Rem. / Inst.	1 set		0.1
	105	Control valve ASSY	O / H	1 pc.		3.0
		Other necessary works	Rem. / Inst.	1 set	Covers	0.1
			Rem. / Inst.	1 set	Hoses	0.2
	110	Slewing motor portion			Refer to Slewing Motor Removal	
	111	Slewing motor ASSY	Rem. / Inst.	1 pc.		1.0

Table1 (2/2)

Model						CX27B	
Applicable machine						PV13-33292~	
Div.	Item				Unit	Standard value	Repairable value
Slew	Slew time per 2–revolution				sec.	14.1±0.7	18
	Overrun when slewing stops				mm (in)	99±25 (3.9±0.98)	115
	Drift due to gravity					0	—
Cylinders	Cylinder speed	Boom	Canopy	Ext.	sec.	2.5±0.4	3.2
				Ret.		2.5±0.4	3.2
			Cab	Ext.		2.4±0.4	3.1
				Ret.		2.4±0.4	3.1
		Arm		Ext.		2.9±0.4	3.7
				Ret.		2.0±0.4	2.6
		Bucket		Ext.		2.8±0.4	3.6
				Ret.		1.9±0.4	2.4
		Swing		Ext.		5.1±0.8	6.6
				Ret.		4.1±0.6	5.3
		Dozer		Ext.		3.3±0.5	4.3
				Ret.		2.4±0.4	3.1
	Cylinder Gravity move	(10 min)	Boom		mm (in)	12^{0}_{-12} ($0.47^{0}_{-0.47}$)	24 (0.94)
			Arm			5^{0}_{-5} ($0.20^{0}_{-0.20}$)	10 (0.39)
			Bucket			3^{0}_{-3} ($0.12^{0}_{-0.12}$)	6 (0.24)
			Dozer			3^{0}_{-3} ($0.12^{0}_{-0.12}$)	6 (0.24)
			Bucket tip			150^{0}_{-150} ($5.9^{0}_{-5.9}$)	300 (12)
		(5 min)	Swing			3^{0}_{-3} ($0.12^{0}_{-0.12}$)	6 (0.24)
Slew bearing	Bucket tip play				mm (in)	30±15	60
	Slew bearing play					0.6~1.8 (0.024~0.071)	2.6 (0.10)
Crawler	Crawler tension		Rubber		mm (in)	80~90 (3.15~3.54)	—
			Iron			115~130 (4.53~5.12)	—

MEASURING ATTACHMENT OPERATING PERFORMANCES

TEST PROCEDURES

Measure 3-time each.

Apply average data of the above for judgement.

Cylinder Speed

(1)Boom Cylinder Speed

Engine : High Idle

Hydraulic Oil Temp. : 50 ~ 60 °C(122 ~ 140 °F)

Measurement Posture : Completely retract the arm cylinder, fully extend the bucket cylinder and place the dozer blade on the ground.

Then measure the time required for the bucket to reach its highest point (lowest point) from its lowest point (highest point) placing on the ground. (Do not include the cushioning time.)

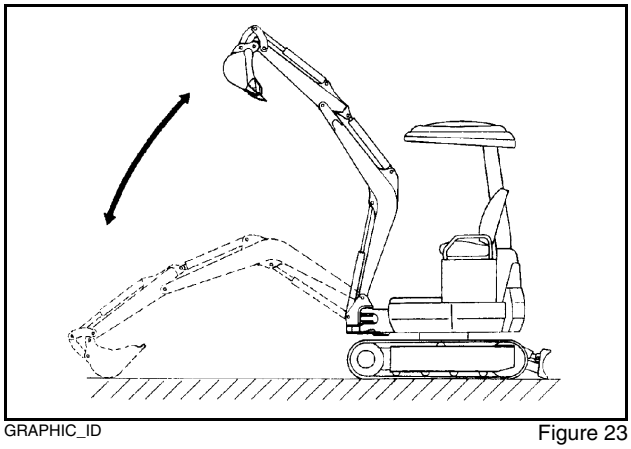

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Figure 23

(2)Arm Cylinder Speed

Engine : High Idle

Hydraulic Oil Temp. : 50 ~ 60 °C(122 ~ 140 °F)

Measurement Posture : Completely retract the arm cylinder, fully extend the bucket cylinder, position the arm horizontally and place the dozer blade on the ground.

Then measure the time required for the arm cylinder to completely retract (extend) from a fully extended state (retracted state).

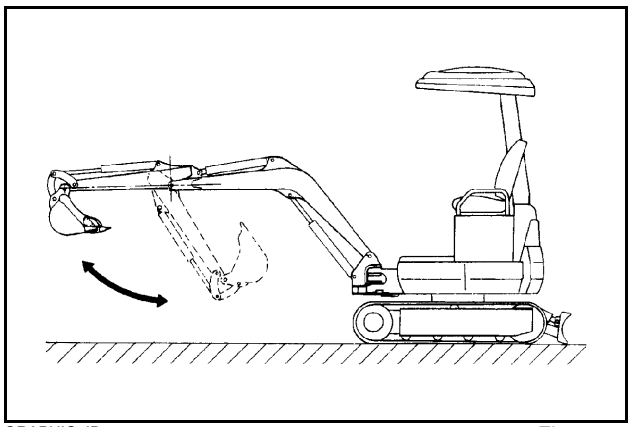

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Figure 24

3. Bucket Cylinder Speed

Engine : High Idle

Hydraulic Oil Temp. : 50 ~ 60 °C(122 ~ 140°F)

Measurement Posture : Completely retract the arm cylinder, position the arm horizontally and place the dozer blade on the ground.

Then measure the time required for the bucket cylinder to completely retract (extend) from a fully extended state (retracted state).

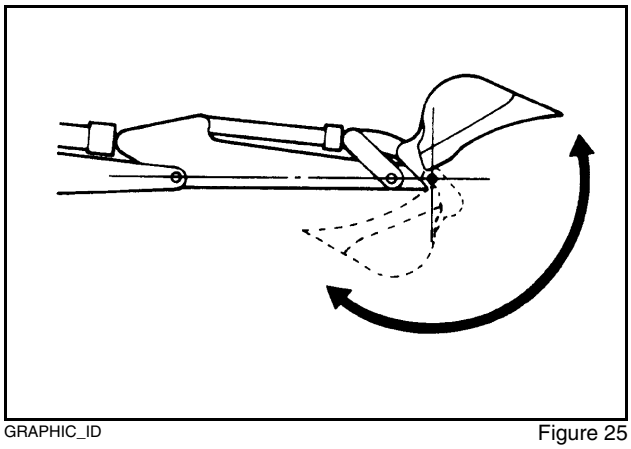

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Figure 25

NOTES

TRAVEL OPERATING CIRCUIT

Pilot oil hydraulic system with operating lever

22.3.3.1 2nd Speed Operating Circuit (Independent-forward travel)

(1)Pilot Circuit

1. Shifting signal for 2nd speed travel
   When the "Rabbit and Turtle" mark (at the power cut-off, it automatically takes back for 1st speed) on the knob of travel right lever is pushed down, it actuates the 1st and 2nd speed travel shifting valve of solenoid valve (13).
   The pressurized oil signal for 2nd speed is generated from the A1 port of solenoid valve(13), and led to the Ps port on travel motor (4) through swivel joint (10), and shifts the 2-speed shifting valve (404).
2. Changing travel valve spool
   The pilot secondary pressure is generated from pilot valve (12) by the operation for travel forward. The pressurized oil is led to the Pb7 and Pb6 ports on control valve (2) to shift the travel valve spool.

(2)Main Circuit

1. Circuit up to Travel Motor (4)
   The delivered oil from A1 and A2 ports on variable pump enters into the P1 and P2 ports of control valve (2), and led to the B7 and B6 ports through the travel valve.
   Then it is led to the P1and P2ports on left and right travel motors respectively through the swivel joint (10).
2. Travel Motor
   A. The pressurized oil supplied to the travel motor shifts the spool of the counterbalance valve (brake valve) (405), releases the parking brake (403), and rotates the travel motor.
      It actuates the speed shifting valve (404) when the 2nd speed signal is sent. The pressurized oil passes the speed change valve (404), actuates the 2-speed shifting piston (401) and provides the motor with high speed and low torque.
   B. When the motor reaches near to a self-running condition (over-running) at going down a slope and so on, the oil pressure of supply side gets down to lower pressure, and the counter balance valve [brake valve] (408) spool moves to the neutral position with the spring force.
      As the results, the passage in return oil side is throttled, and the motor speed is suppressed by a back-pressure, then the motor is controlled to the speed corresponding to the supplied oil volume of the pump.
   C. The counterbalance valve spool is so designed that it is gradually shifted by a throttle effect to stop or start the motor absorbing shock at the start and stop of the machine.
   D. Auto two speed change mechanism
      When load increases during high speed travel, the speed automatically shifts to the 1st speed, resulting in low speed and high torque.

SWING OPERATING CIRCUIT

Cable driving system with operating pedal

Swing (Left) Operating Circuit

(1)Swing Operation

When depress the left side of swing pedal, the swing valve spool in control valve (2) is shifted by the cabling mechanism. Since the pilot oil pressure is not utilized for it is activated regardless to the safety lock lever.

(2)Main Circuit

1. Supply Circuit for Cylinder (8)
   The delivered oil from A2 port on variable pump enters into P2 port on control valve (2), and comes out from A5 port through swing valve, and is supplied to the head side of cylinder (8) to activate the swing (left).

   A. At activation of the swing valve spool for both left and right swing motions, a part of appropriate volume of oil is returned to the tank through the P2 bypass circuit due to the throttle effect on the spool.
      Then supplying volume of oil to the cylinder is restricted to ensure the slow and stable swing motions for both leftward and rightward.

SECTION 3 - SYSTEMS
CHAPTER 1 - HYDRAULIC SYSTEM

SCHEMATIC PIPING FOR HYDRAULIC SYSTEM

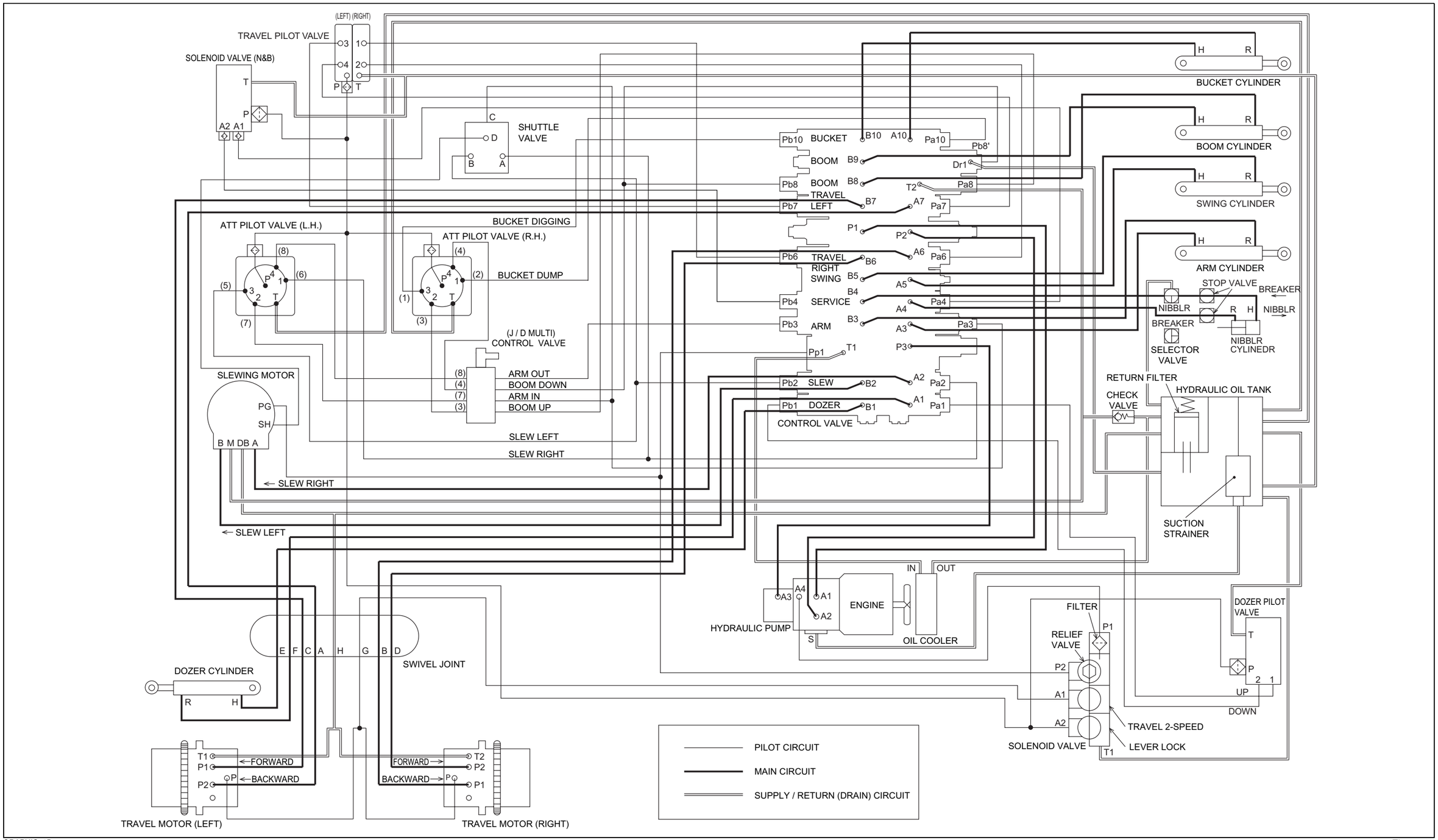

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Figure 14

Harness and Cable List

Code	Name	Part No.	Remarks
H-1	Inst • Main Harness	PM14E01038P1	
H-2	Proportional N&B Harness	PH14E01041P1	
H-3	Engine Harness	PM16E01026P2	
H-4	Starter Cable (+)	PM13E01088D1	
H-5	Battery Ground Cable (–)	PM13E01098D1	
H-6	Engine Ground Cable	PM13E01081D1	
H-7	Boom Harness	PM15E01012D3	
H-8	Key Switch Harness	PW50E01002P1	
H-9	Canopy Work Light Harness	PW11E01026D4	
H-10	Boom Work Light Extension Harness	PW14E01034D1	
H-11	Connection Harness with Cab	PW14E01041P1	(OPT.)
H-12	Cab Work Light Harness	PW80E01003D1	(OPT.)
H-13	Travel Alarm Harness	PW13E01069P1	(OPT.)
H-14	Alarm Extension Harness	PM13E01095P1	(OPT.)
H-15	Heater Harness	PW13E01068P1	(OPT)
H-16	Air Filter Restriction Sw. Harness	PW11E01044D3	

NOTE: *The part number may be changed per modifications. Use them only as a reference.*

Engine Portion ; PM16E00005F1 , PM11E00005F1

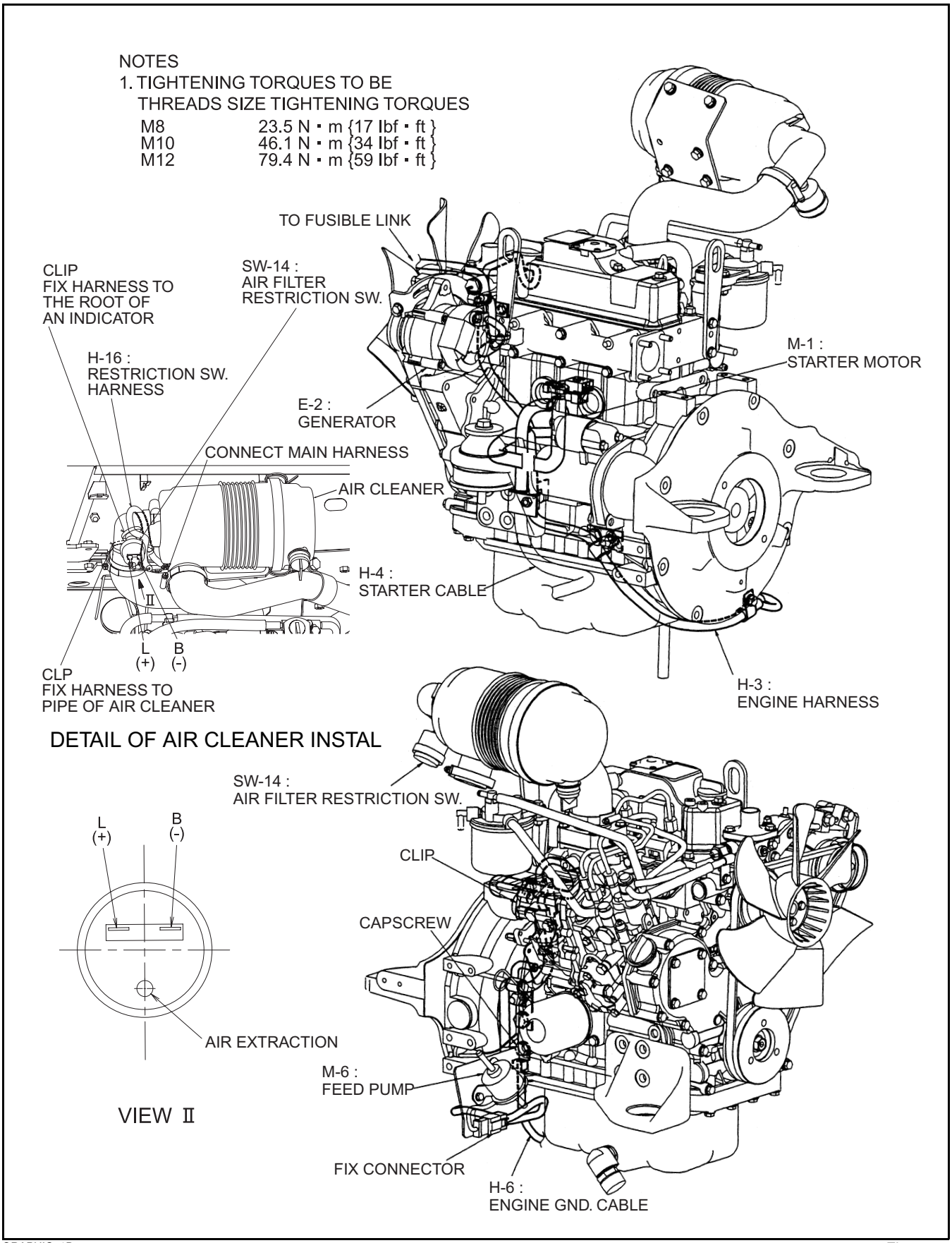

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Figure 10

ENGINE PORTION (1/3)

Travel Alarm Portion (OPT) ; PM53E00005F1

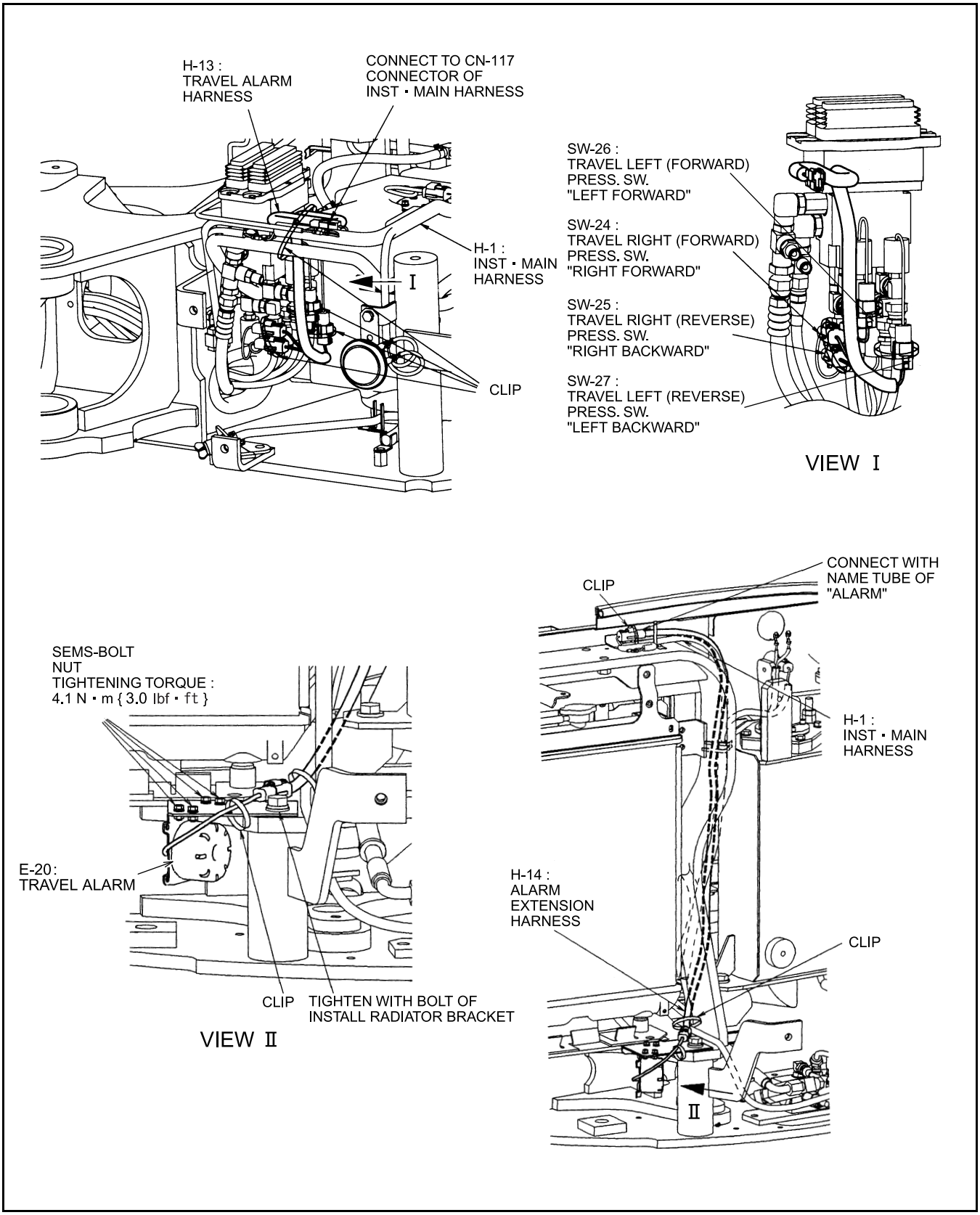

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Figure 20

HARNESS CONNECTING TABLE (1/3)

WIRE NO	WIRE COLOR	WIRE SIZE	FROM	CONNECTION	TO
1A	WY	AVSS1.25sq	CN-20F		CN-15F
1B	WY	AVSS1.25sq	CN-41F	DOUBLE SPLICE	CN-15F
1C	WY	AVSS1.25sq	CN-41F		CN-2F
1D	WY	AVSS0.75sq	CN-42F	DOUBLE SPLICE	CN-15F
1E	WY	AVSS0.75sq	CN-42F		CN-3F
1F	WY	AVS0.5sq	CN-19F		CN-15F
1G	WY	AVS0.5sq	CN-42M		CN-42M
2A	YB	AVSS1.25sq	CN-20F	DOUBLE SPLICE	CN-15F
2B	YB	AVSS1.25sq	CN-20F		CN-15F
2C	YB	AVS0.5sq	CN-109F		CN-15F
2D	YB	AVS0.5sq	CN-76F		CN-15F
2E	YB	AVS0.5sq	CN-79F	DOUBLE SPLICE	CN-15F
2F	YB	AVS0.5sq	CN-79F		CN-61F
2G	YB	AVSS0.75sq	F-4		CN-15F
2J	YB	AVS0.75sq	CN-314F		CN-15F
2K	YB	AVSS0.75sq	CN-6F	DOUBLE SPLICE	CN-15F
2L	YB	AVS0.5sq	CN-6F	DOUBLE SPLICE	CN-71F
2M	YB	AVS0.5sq	CN-38F		CN-71F
3A	YG	AVS2sq	CN-20F	DOUBLE SPLICE	CN-75F
3B	YG	AVSS0.75sq	CN-37F		CN-75F
4A	RG	AVS0.5sq	CN-2F		CN-17F
4B	RG	AVSS1.25sq	CN-2F		CN-17F
4C	RG	AVSS1.25sq	CN-20F	DOUBLE SPLICE	CN-17F
4D	RG	AVSS1.25sq	CN-20F		CN-33F
4E	RG	AVSS1.25sq	CN-2F		CN-33F
4F	RG	AVS0.5sq	CN-36F		CN-33F
4G	RG	AVS0.5sq	CN-46F		CN-33F
5	W	AVS5sq	CN-20F		CN-334F
6B	WG	AVSS1.25sq	CN-17F		CN-20F
6C	WG	AVS0.5sq	CN-17F		CN-44F
6D	WG	AVS0.5sq	CN-17F		CN-10F
6E	WG	AVS0.5sq	CN-17F		CN-1F
6F	WG	AVS0.5sq	CN-17F		CN-16F
6G	WG	AVS0.5sq	CN-17F		CN-29F
6H	WG	AVSS0.75sq	CN-17F		CN-14F
6J	WG	AVSS0.75sq	CN-61F		CN-14F
6K	WG	AVS0.5sq	CN-27F		CN-14F
6L	WG	AVS0.5sq	CN-27F		CN-14F
6M	WG	AVS0.5sq	CN-27F		CN-14F
6P	WG	AVS0.5sq	T-2		CN-14F
6V	WG	AVS0.5sq	CN-22F		CN-14F
6W	WG	AVSS1.25sq	CN-60F		CN-14F
8A	R	AVS2sq	CN-20F		CN-26F
8B	R	AVS5sq	CN-20F		
8C	R	AVS3sq	CN-10F		
8D	R	AVS0.5sq	CN-78F		
8E	R	AVS5sq	CN-25F		
8F	R	AVS3sq	CN-45F		
8G	R	AVS5sq	CN-32M		
11	WY	AVSS0.75sq	CN-44F		CN-61F

HARNESS CONNECTING TABLE (2/3)

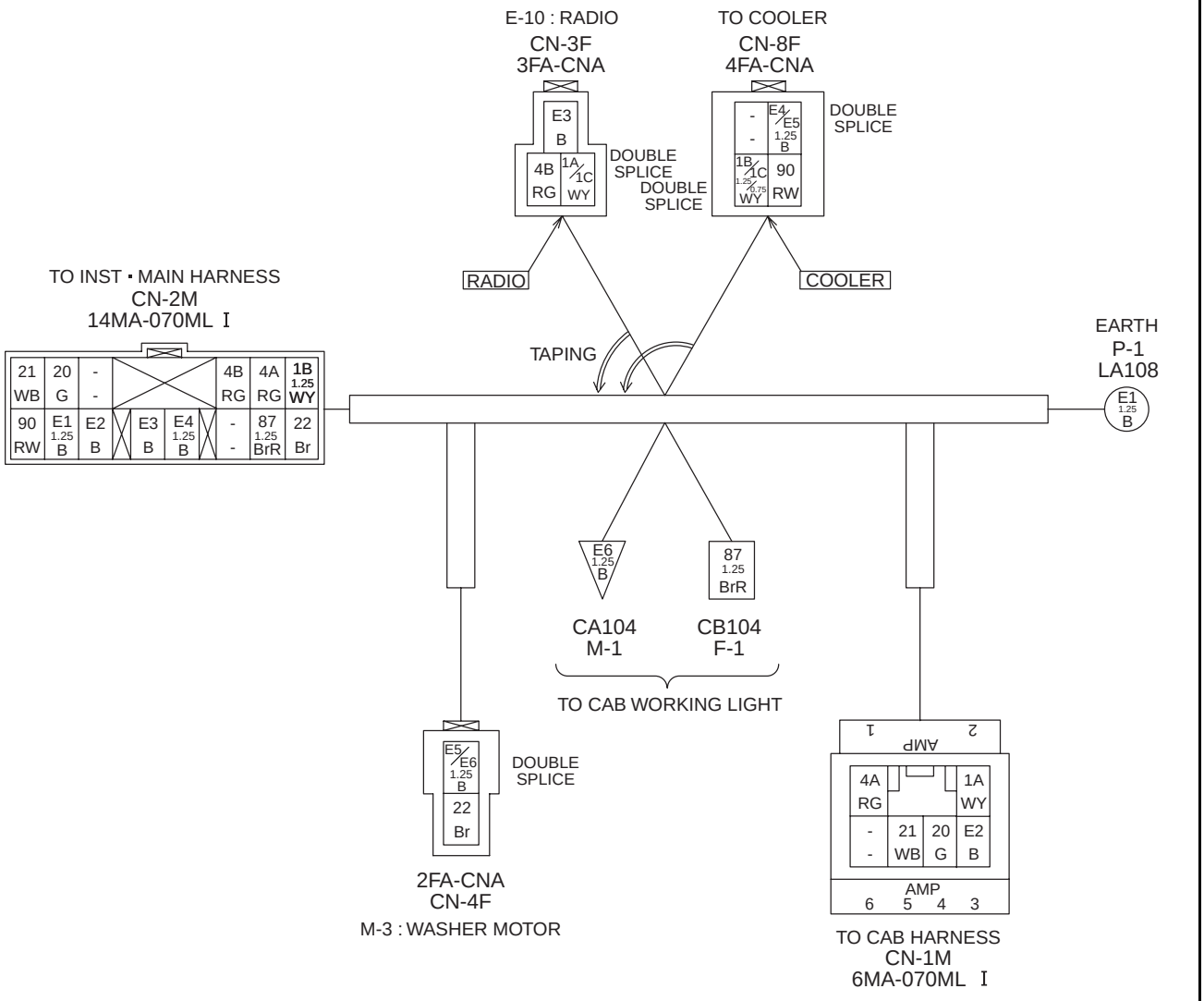
WIRE NO	WIRE COLOR	WIRE SIZE	FROM	CONNECTION	TO
13A	GB	AVSS1.25sq	CN-26F	DOUBLE SPLICE	CN-78F
13B	GB	AVSS1.25sq	CN-26F		CN-83F
13C	GB	AVSS1.25sq	CN-83F	DOUBLE SPLICE	CN-78F
13D	GB	AVSS1.25sq	CN-83F		CN-44F
13E	GB	AVSS1.25sq	CN-83M		CN-83M
14	WR	AVS3sq	CN-45F		CN-60F
15A	YG	AVS0.5sq	CN-22F	DOUBLE SPLICE	CN-9F
15B	YG	AVS0.5sq	CN-22F		CN-12F
16A	RW	AVS0.5sq	CN-22F	DOUBLE SPLICE	CN-9F
16B	RW	AVS0.5sq	CN-22F		CN-12F
17A	PB	AVS0.5sq	T-5	DOUBLE SPLICE	CN-115F
17B	PB	AVS0.5sq	T-5		CN-33F
17C	PB	AVS0.5sq	CN-36F		CN-33F
17D	PB	AVS0.5sq	CN-14F		CN-33F
17E	PB	AVS0.5sq	CN-14F		CN-78F
17F	PB	AVS0.5sq	CN-14F		CN-46F
18	LY	AVS0.5sq	CN-41F		CN-40F
19	LB	AVS0.5sq	CN-41F		CN-40F
20	G	AVS0.5sq	CN-2F		CN-3F
21	WB	AVS0.5sq	CN-2F		CN-3F
22	Br	AVS0.5sq	CN-2F		CN-3F
39A	GW	AVS0.5sq	M-4	DOUBLE SPLICE	CN-83F
39B	GW	AVS0.5sq	CN-78F		CN-83F
39C	GW	AVS0.5sq	CN-78F	DOUBLE SPLICE	CN-83F
39D	GW	AVS0.5sq	CN-15F		CN-83F
39E	GW	AVS0.5sq	CN-15F		CN-79F
39G	GW	AVS0.5sq	CN-15F		CN-108F
39H	GW	AVS0.5sq	CN-83M		CN-83M
43A	Lg	AVS0.5sq	CN-109F		CN-17F
43B	Lg	AVS0.5sq	CN-1F		CN-17F
43C	Lg	AVS0.5sq	CN-39F		CN-17F
45	BW	AVS0.5sq	CN-1F		CN-38F
46	WB	AVS0.5sq	CN-1F		F-5
47	LY	AVX3sq	CN-25F		P-32
48	LgB	AVS0.5sq	CN-16F		CN-27F
49	P	AVS0.5sq	CN-16F		T-1
50	GW	AVS0.5sq	CN-61F		CN-27F
51	YG	AVS0.5sq	CN-61F		CN-27F
52	YR	AVS0.5sq	CN-61F		CN-27F
54	PL	AVS0.5sq	CN-42F		CN-117F
55	YL	AVSS0.75sq	CN-117F		CN-315F
56	YB	AVS0.5sq	CN-101F		CN-27F
57	LB	AVS0.5sq	CN-39F		CN-27F
58	GB	AVS0.5sq	CN-101F		CN-27F
60	GY	AVSS0.75sq	CN-314F		CN-6F
61A	LB	AVS0.5sq	CN-17F		CN-1F
61B	LB	AVS0.5sq	CN-17F		CN-6F
61C	LB	AVS0.5sq	CN-17F		CN-38F
63	BY	AVSS0.75sq	CN-314F		CN-6F
64	LW	AVSS0.75sq	CN-314F		CN-6F
70	BR	AVS3sq	CN-335F		CN-60F
71	Y	AVS3sq	CN-20F		CN-10F

GRAPHIC_1D

Figure 29

INST • MAIN HARNESS (NO. H-1) — (7/8)

Connection Harness with Cab (No. H-11 ;PW14E01041P1) (OPT)



HARNESS CONNECTION TABLE

WIRE NO	WIRE COLOR	WIRE SIZE	FROM	CONNECTION	TO
1A	WY	AVSS0.75sq	CN-3F	DOUBLE SPLICE	CN-1M
1C	WY	AVSS0.75sq	CN-3F	DOUBLE SPLICE	CN-8F
1B	WY	AVSS1.25sq	CN-2M		CN-8F
4A	RG	AVSS0.75sq	CN-1M		CN-2M
4B	RG	AVSS0.75sq	CN-3F		CN-2M
20	G	AVSS0.75sq	CN-1M		CN-2M
21	WB	AVSS0.75sq	CN-1M		CN-2M
22	Br	AVSS0.75sq	CN-4F		CN-2M
87	BrR	AVSS1.25sq	F-1		CN-2M
90	RW	AVSS0.75sq	CN-8F		CN-2M
E1	B	AVSS1.25sq	P-1		CN-2M
E2	B	AVSS0.75sq	CN-1M		CN-2M
E3	B	AVSS0.75sq	CN-3F		CN-2M
E4	B	AVSS1.25sq	CN-8F	DOUBLE SPLICE	CN-2M
E5	B	AVSS1.25sq	CN-8F	DOUBLE SPLICE	CN-4F
E6	B	AVSS1.25sq	M-1		CN-4F

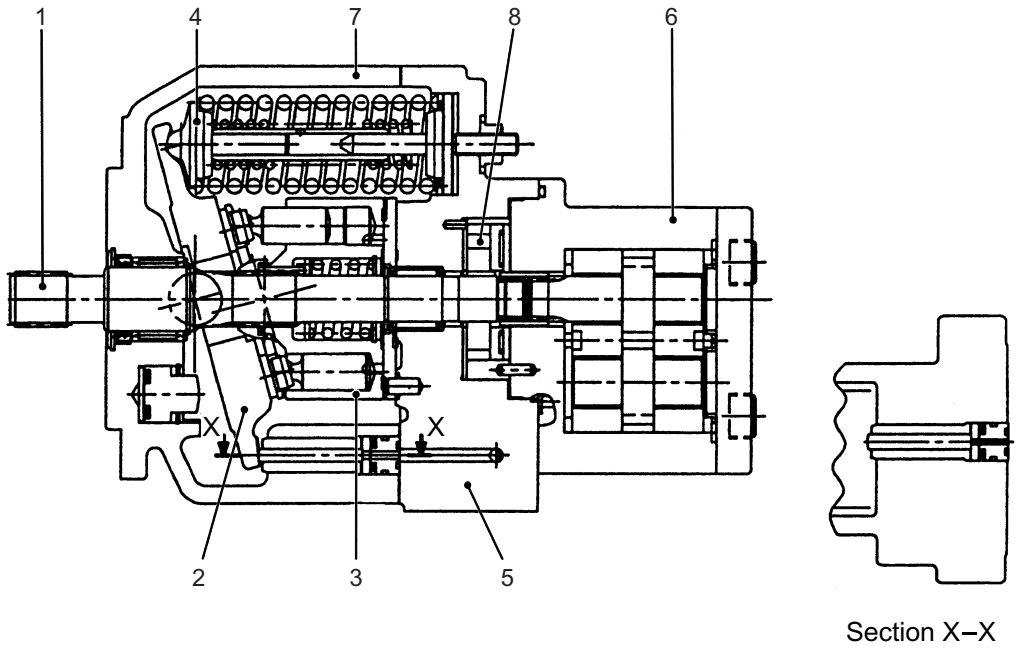
CONNECTORS SELECTION TABLE

CONNECTOR NAME (PIN NUM.)	MANUFUC.	PART. NUMBER	
		HOUSING	TERMINAL
2FA-CNA	AMP	172130-1	170032-2
3FA-CNA	AMP	172132-1	170258-1
4FA-CNA	AMP	172134-1	
CA104	AMP	170887-1	170002-5
CB104	AMP	170889-1	170003-5
6MA-070MLI	AMP	175657-1	173645-1
14MA-070MLI	AMP	174934-1	173645-1

GRAPHIC_1D

Figure 41

Construction and Function



No.	NAME	No.	NAME
1	Shaft assy	6	Gear pump assy
2	Swash plate (hanger) assy	7	Housing assy
3	Rotary group	8	Trochoid pump assy
4	Spring assy		
5	Cover assy		

GRAPHIC_1D

Figure 2

(1)Piston pump

•This pump is a variable displacement double piston pump which delivers two equal flows with one cylinder block., and has only one inlet port, but the flow is separated into two flows by the control plate on the cover and is led to two delivery ports provided on the cover.

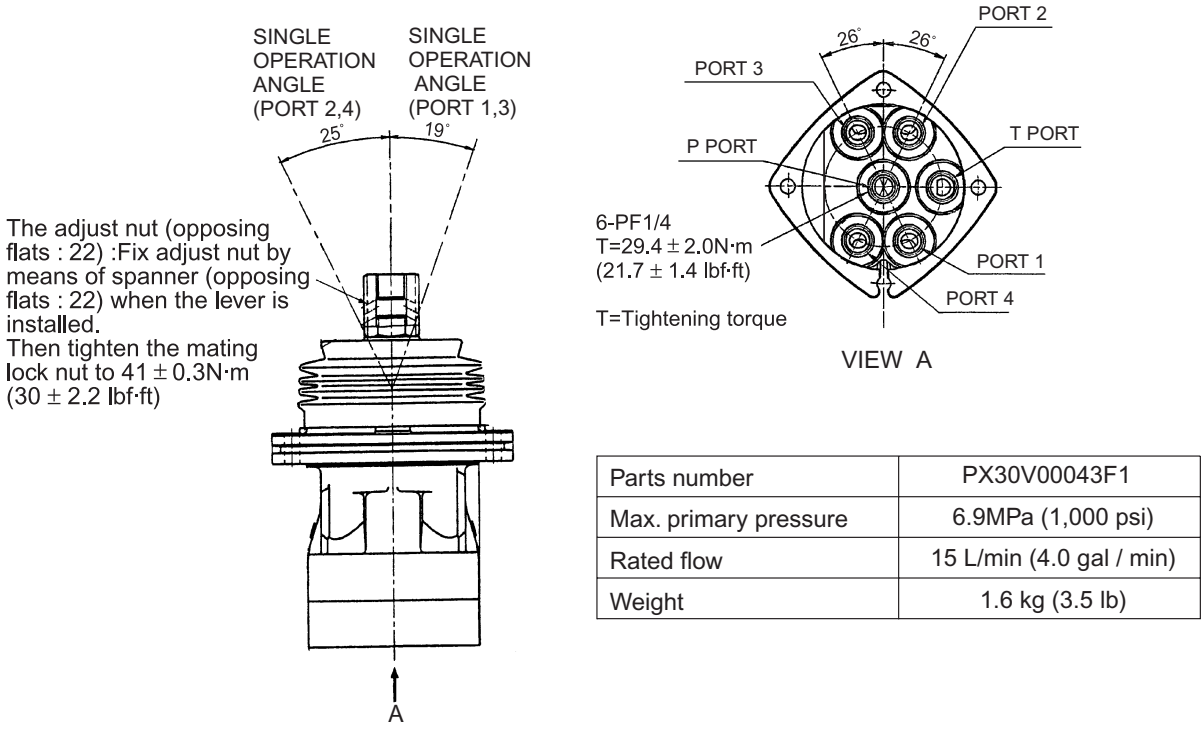
•The hydraulic pressure produced by the delivery oil acts on the hanger, resists the spring force, and tilts the hanger. As the piston stroke is changed by the tilting of the hanger, the flow rate varies.

•The 3rd pump or pilot pump is installed on the same shaft with a coupling.

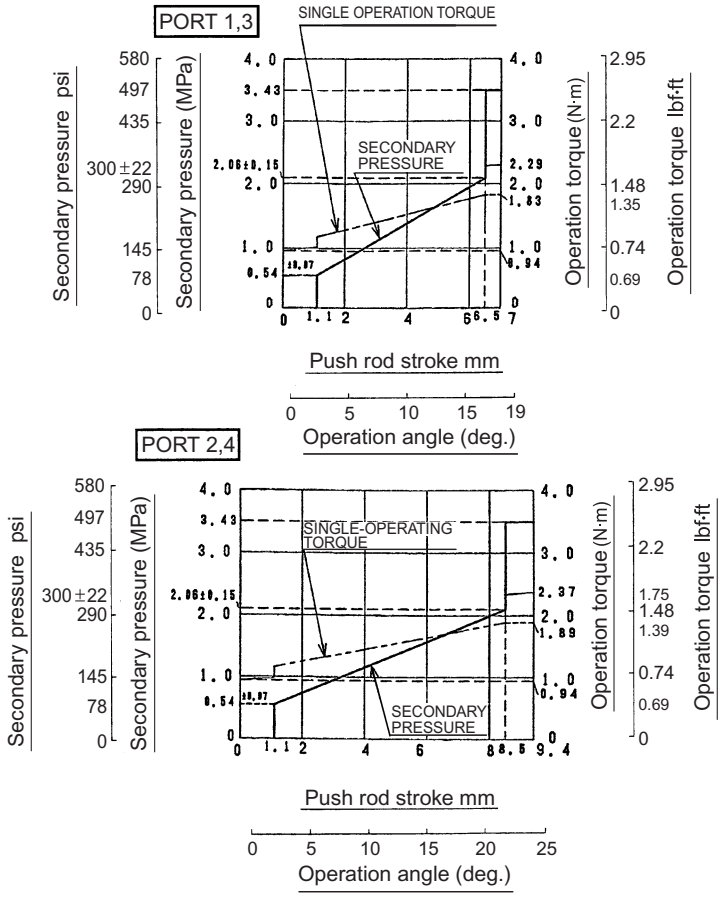
PILOT VALVE (ATT)

Summary

(1)General view



Parts number	PX30V00043F1
Max. primary pressure	6.9MPa (1,000 psi)
Rated flow	15 L/min (4.0 gal / min)
Weight	1.6 kg (3.5 lb)



GRAPHIC_1D

Figure 14

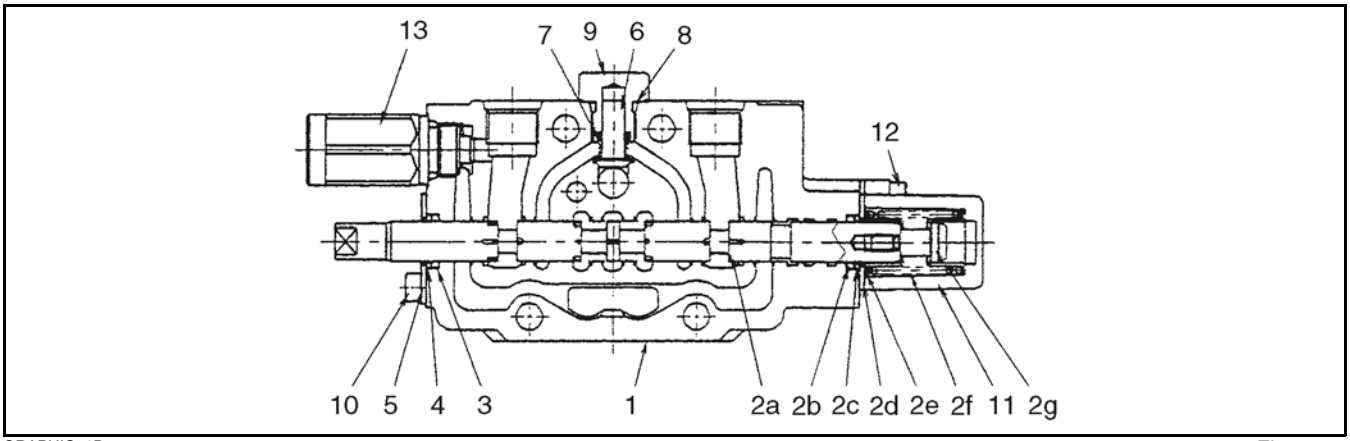
(2)Component Parts

The control valve is roughly classified into the following four sections.

- •Manual operation section : Swing
- •Pilot operation section : Travel right and left, boom, arm, bucket, slewing, independent travel and conflux, dozer blade, service(nibbler & breaker)
- •Accessory section : P1 and P2 inlets, and P3 inlet (common with independent travel and conflux)
- •Accessory section (valve) : P1, P2, P3 main relief, overload relief, anti cavitation, boom lock

NOTE: ** For respective operation section, only a typical example is described.*

1. Manual operation: Swing (No.6)

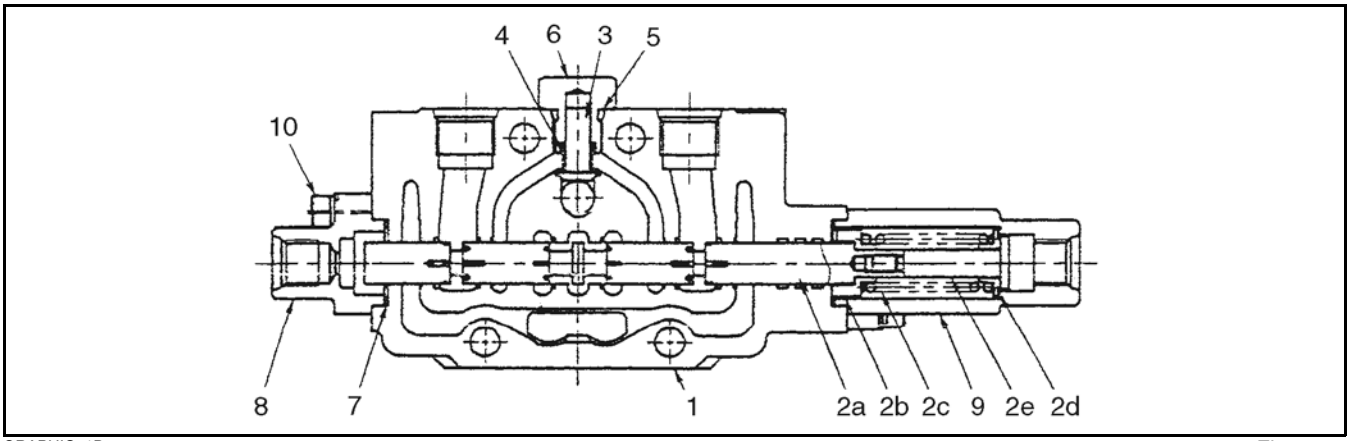


GRAPHIC_1D

Figure 28

No.	Name	Qty	No.	Name	Qty	No.	Name	Qty
1	Body	1	2g	Spool end	1	9	Plug (for check valve)	1
2a	Spool	1	3	O-ring 1A P12	1	10	Socket bolt M5x10	2
2b	O-ring 1A P12	1	4	Dust wiper	1	11	Cover	1
2c	Dust wiper	1	5	Oil seal retainer	1	12	Socket bolt M5x18	2
2d	Oil seal retainer	1	6	Load check valve	1	13	Anti cavitation valve	1
2e	Spring seal	2	7	Spring (for check valve)	1	-		
2f	Spring	1	8	O-ring 1B P11	2	-		

2. Pilot operation: Slewing (No.2)



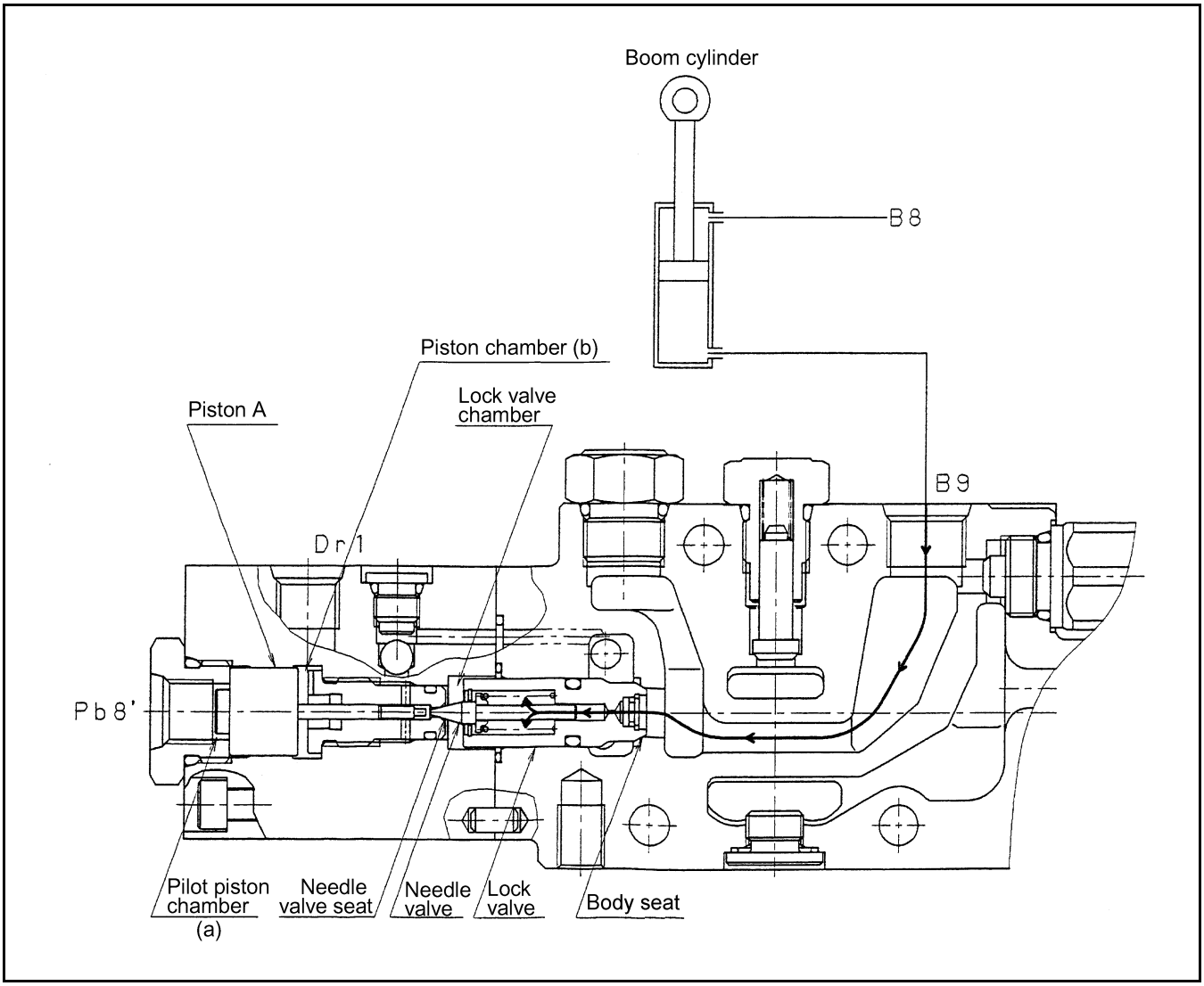
GRAPHIC_1D

Figure 29

No.	Name	Qty	No.	Name	Qty	No.	Name	Qty
1	Body	1	2e	Spool end	1	7	O-ring 1B S22	2
2a	Spool	1	3	Load check valve	1	8	Pilot cover	1
2b	Spring seat	1	4	Spring (for check valve)	1	9	Pilot cover	1
2c	Spring	1	5	O-ring 1B P11	1	10	Socket bolt M5x20	4
2d	Spring seat	1	6	Plug (for check valve)	1	-		

(6) Function of Lock Valve

1. Piston Holding
   When the boom spool is at neutral position, the pilot piston chamber (a) is connected to the drain passage through the pilot port (Pb8') for releasing lock valve. And the piston chamber (b) is also connected to the drain passage through the drain port (Dr1).
   Therefore the piston (A) is held at the position shown in the figure.
   And the hydraulic pressure to hold the boom cylinder is applied to the lock valve chamber as shown in the figure, pressing the needle valve and lock valve to their seats respectively. Then it prevents leakage on the head side of boom cylinder, and also prevents the arm cylinder from its movement due to leakage.

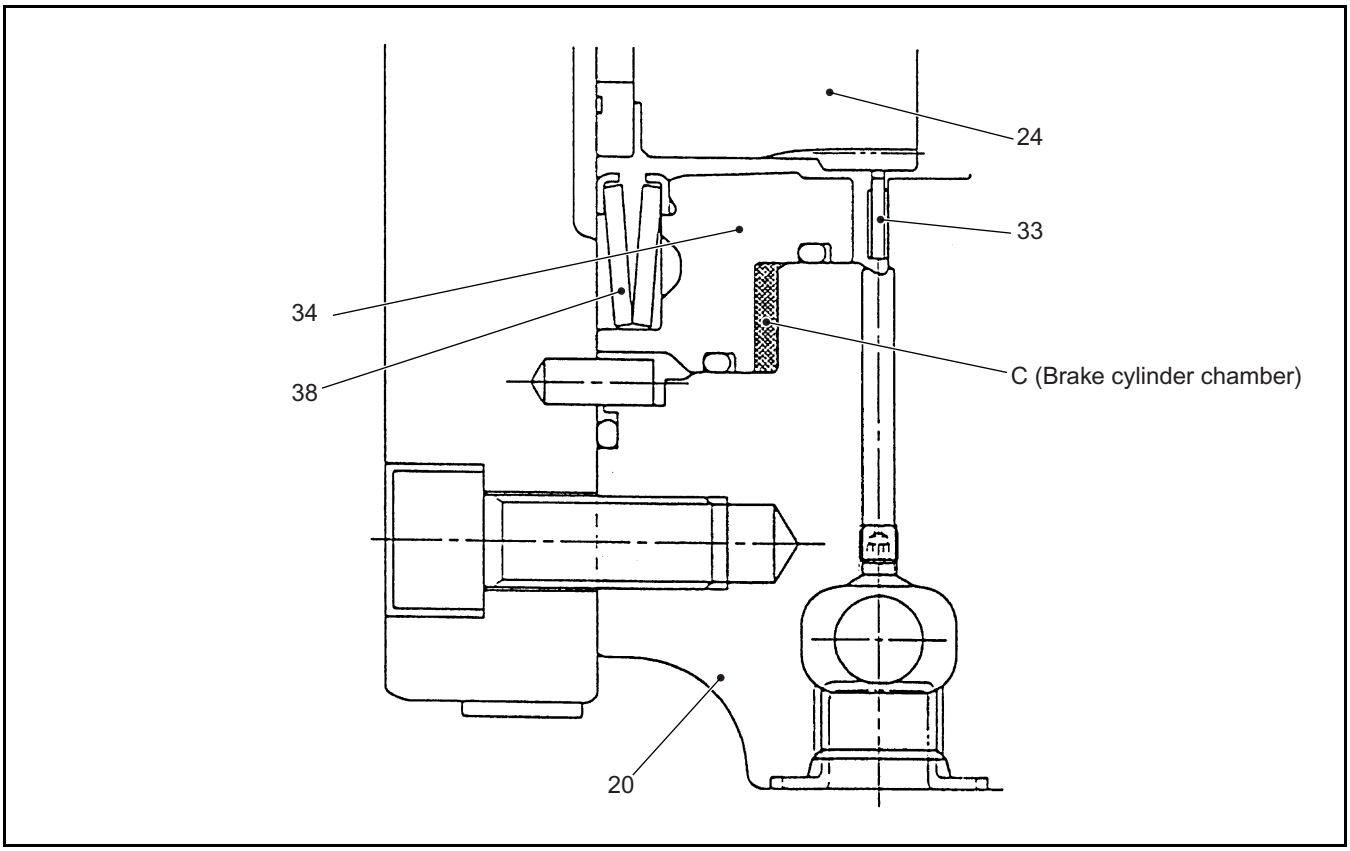


GRAPHIC_1D

Figure 38

FUNCTION OF LOCK VALVE (PISTON HOLDING)

PG (Brake releasing pressure) ON



GRAPHIC_1D

Figure 51

PARKING BRAKE IS OFF CONDITION

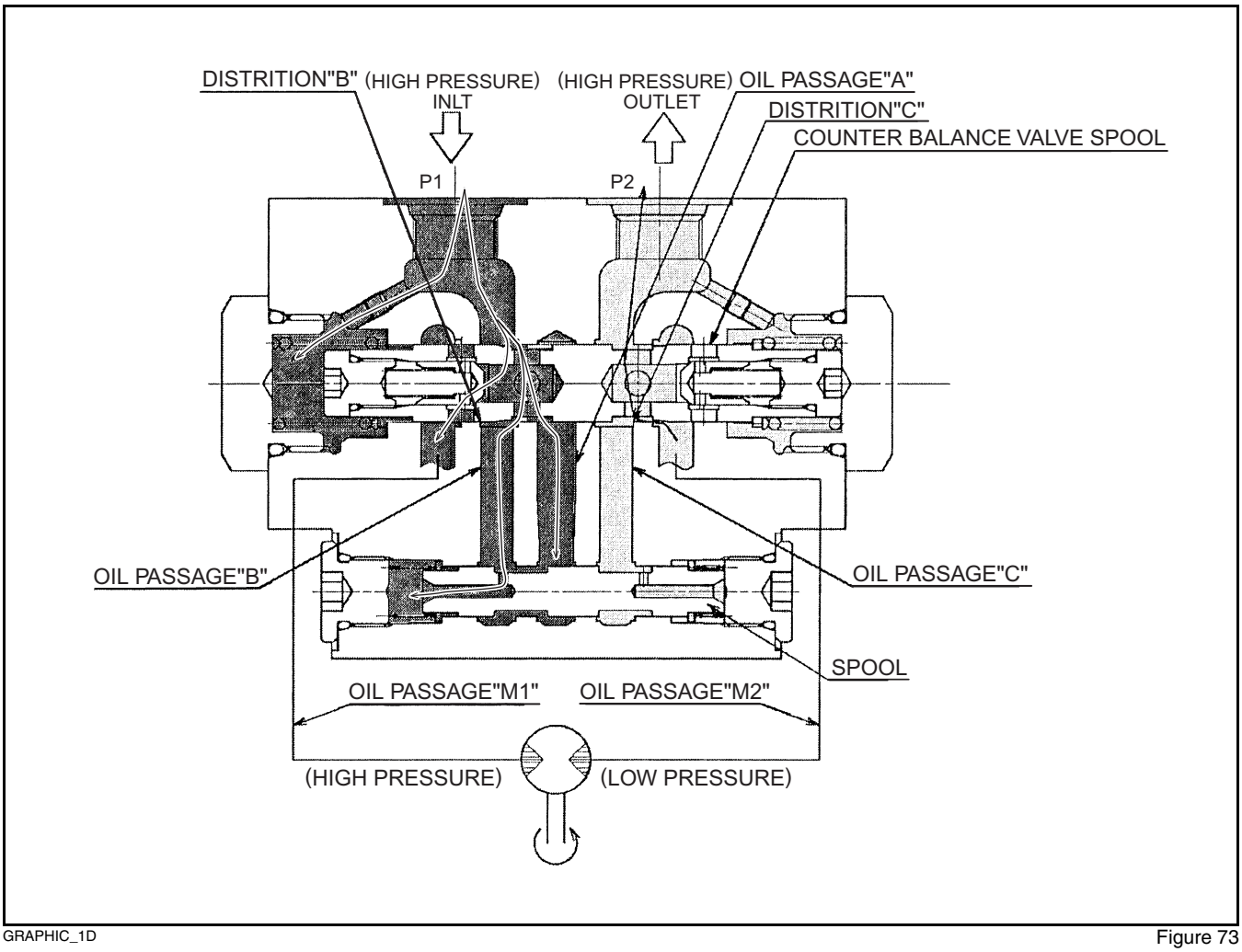
No.	NAME	Qty	No.	NAME	Qty
1	Flange holder	1	49	Backup ring	1
2	Floating seal	2	50	O-ring	1
3	Angular bearing	1	51	Backup ring	1
4	Ring nut	1	52	Valve plate	1
5	Plug	2	53	Pin	1
6	Housing	1	54	Ball bearing	1
7	Steel ball	109	55	O-ring	1
8	Plug (PT 1/8)	2	56	O-ring (1B P7)	4
9	Planetary gear B	4	57	Base plate	1
10	Needle bearing	4	58	Plunger assy	1
11	Inner race	4	58–1	Plunger	1
12	Thrust washer	4	58–2	Chech valve	2
13	Thrust plate	1	58–3	Spring	2
14	Screw	4	58–4	Plug	2
15	Sun gear	1	58–5	O-ring (1A S8)	2
16	Sna pring	1	63	Spring seat	2
17	Holder	1	64	Spring	2
18	Planetary gear A	3	65	Cap	2
19	Needle bearing	3	66	O-ring (1B P24)	2
20	Inner race	3	67	Orifice	2
21	–	–	68	Spool	1
22	Drive gear	1	70	Spring	1
23	Thrust plate (Select one of them)	1	71	Plug	3
23	Thrust plate (Select one of them)	1	72	O-ring (1B P11)	4
23	Thrust plate (Select one of them)	1	73	Plug (NPTF 1/6)	3
24	Cover	1	74	Plug	1
25	O-ring (1B P130)	1	75	Orifice	4
26	Wire	1	76	Socket bolt (M8×20)	6
27	Plug (PF 1/4)	2	77	Pin	2
28	O-ring (1B P11)	2	78	Valve assy	1
29	Shaft	1	78–1	Valve body	1
30	Ball bearing	1	78–2	Spool	1
31	Oil seal	1	78–3	Spring	2
32	Swash plate	1	78–4	Spring seat	2
33	Steel ball	2	78–5	Plug (PF 3/8)	2
34	Cylinder block	1	78–6	O-ring (1B P14)	2
35	Spring seat	1	78–7	O-ring (1B P10)	3
36	Spring	1	78–8	O-ring (1B P7)	1
37	Washer	1	78–9	Socket bolt	3
38	Sna pring	1	87	Name plate	1
39	Pin	3	88	Drive screw	2
40	Retainer holder	1	91	Plug	2
41	Retainer plate	1	92	Plug	2
42	Piston assy	9	93	O-ring (1B P8)	2
43	Disc	1	94	Plug (PT 1/4)	1
44	Brake piston	1	95	Pin	2
45	Spring	10	96	Orifice	1
46	Piston assy	2			
47	Spring	2			
48	O-ring	1			

Working Principle of Anti Cavitation Valve

Anti cavitation valve is always working with counter balance valve.

(1)From stopping to starting

Counter balance valve spool is moved to right position by the force of spring when port P1 is pressurized. According as the movement of spool, "P1" connects to "M1" and "M2" connects to "P2".
Consequently the motor work. At the same time, oil passage "A" is selected high pressure, however, there is no oil flow to oil passage "C" because of the movement of spool.

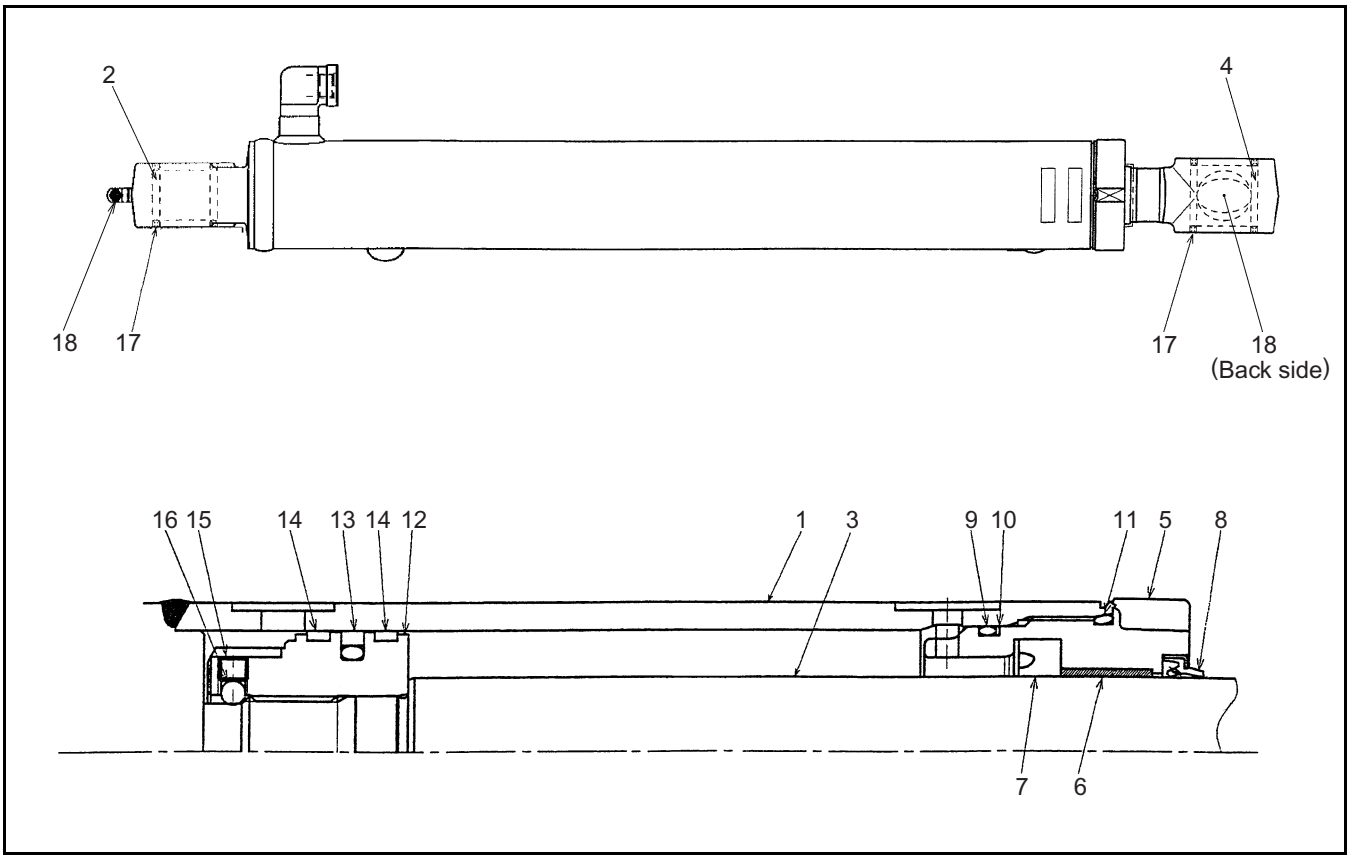


GRAPHIC_1D

Figure 73

ANTI CAVITAIION VALVE (FROM STOPPING TO STARTING)

(3)Bucket cylinder



GRAPHIC_1D

Figure 85

No.	NAME	Qty	No.	NAME	Qty	No.	NAME	Qty
1	CYLINDER TUBE ASSY	1	8	WIPER RING	1	15	SETSCREW	1
2	PIN BUSHING	1	9	O-RING	1	16	STEEL BALL	1
3	PISTON ROD ASSY	1	10	BACKUP RING	1	17	DUST SEAL	4
4	PIN BUSHING	1	11	O-RING	1	18	GREASE NIPPLE	2
5	CYLINDER HEAD	1	12	PISTON	1			
6	BUSHING	1	13	SEAL RING ASSY	1			
7	U-RING	1	14	SLIDE RING	2			

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Parts Name
Parts No.
Use
Applicable Machine</th><th>Specifications</th><th>Description</th></tr>
<tr><td>E-8
Air heater
129120-77501
E/G starter

PM08-08501~
PV11-30001~
PW12-40001~
PX13-15001~
PV12-31001~
PV13-33001~
PV13-33292~</td><td>
<table>
<tr><td>YANMAR Part No.</td><td>129120-77501</td></tr>
<tr><td>Rated voltage</td><td>DC11V</td></tr>
<tr><td>Rated current</td><td>36.5A</td></tr>
<tr><td>Rated output</td><td>400W</td></tr>
<tr><td>Insulation resistance</td><td>3MΩor more / 500V megger</td></tr>
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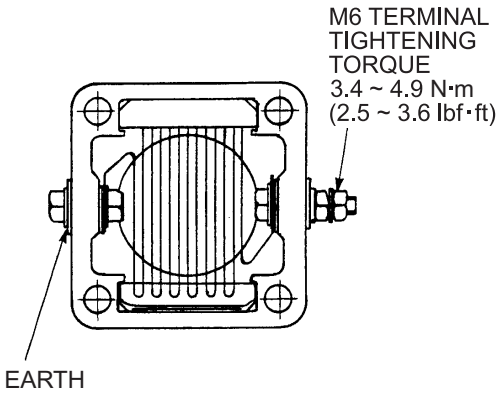
</td><td> 
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Tuner
PY54S00001P1
Radio (OPT)

PM08-08501~
PV11-30001~
PW12-40001~
PX13-15001~
PV12-31001~
PV13-33001~
PV13-33292~</td><td>
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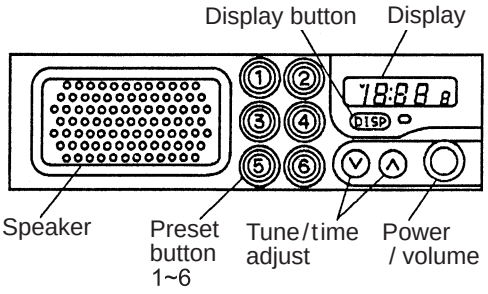
</td><td> 
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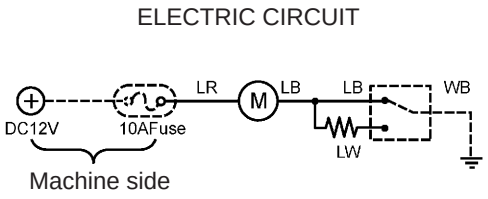
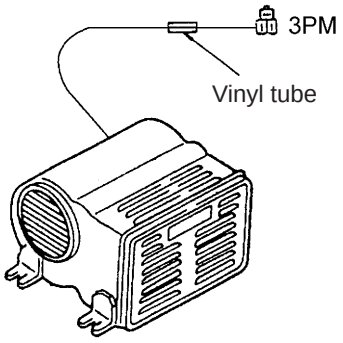
<tr><td>E-12
Heater
PM21M00005F1
Heating (OPT)

PM08-08501~
PV11-30001~
PW12-40001~
PX13-15001~
PV12-31001~
PV13-33001~
PV13-33292~</td><td> 
</td><td> 
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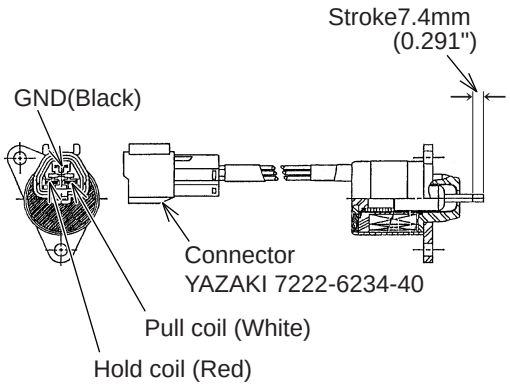
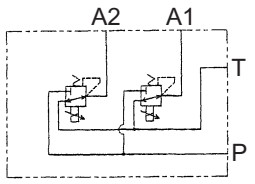
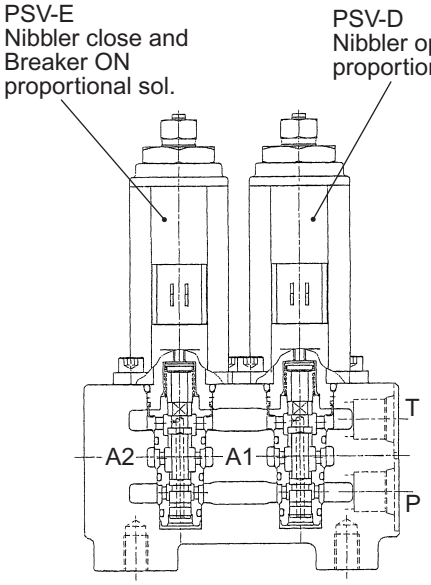
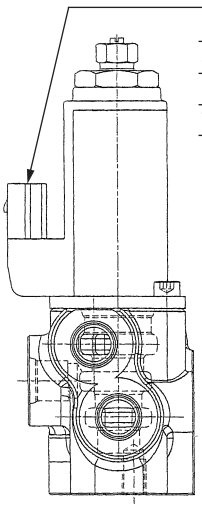
</table>

Code No. Parts Name Parts No. Use Applicable Machine	Specifications	Description
SV-3 Solenoid 119233-77932 E/G stop PV10-27001~ PM08-08501~ PV11-30001~ PW12-40001~ PX13-15001~ PV12-31001~ PV13-33001~ PV13-33292~	YANMAR P/No. 119233-77932 Rated voltage DC 12V Rated current Pull coil : 36.5Amps Hold coil : 0.49Amps	
PSV-D, E Solenoid PW35V00002F1 Nibbler open/close Breaker ON PW14-45964~ PX15-20658~ PV13-33292~ PJ06-08890~	Rated voltage 12V Retad current 1600mA Coil resistance 3.2 ± 0.5 Ω Max. working press. 7MPa (1,015psi) Flow rate 10L/min (2.72gal/min) per 1 spool	 HYDRAULIC SYMBOL Cnnector shape Equivalent to AMP eco seal J mark Ⅱ (+) cap hausing Cap hausing : 174354-2 Terminal : 173706-1



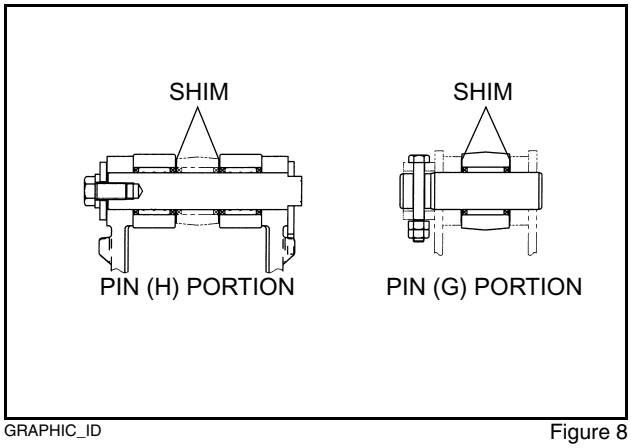


NOTES

(10)Removal of Bucket Cylinder

1. Remove the capscrew that is preventing the rod pin (H) from coming out, then pull off the pin (H).
2. Remove the capscrew and nuts that are preventing the head pin (G) from coming out, then pull off the pin (G).
3. Apply a nylon sling to the tube of bucket cylinder, and remove the cylinder.

   Weight: approx. 17kg (37 lbs)



GRAPHIC_ID Figure 8

Installation

Installation is performed in the reverse order of removal, including the following workings.

⚠ WARNING ⚠

When aligning the pin position, do not put your finger in the pin holes in any circumstances, but align them visually.

(1)Make the welded area clean to inspect any cracks there.

(2)Check the dust seal for damages, and replace the faulty dust seal to new one (referring to Fig. 9 for the installing procedures).

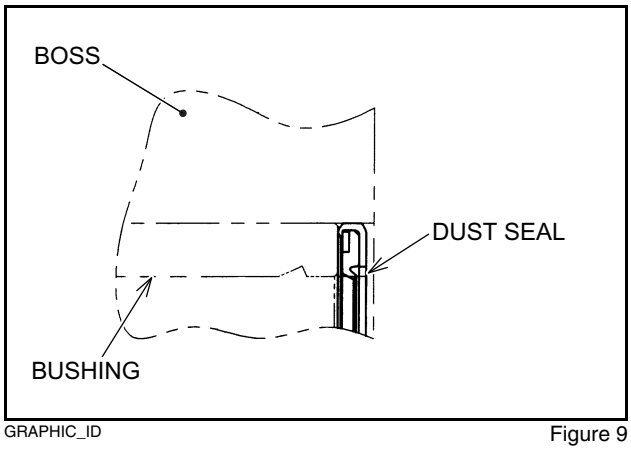
(3)Referring to the Section "ATTACHMENT DIMENSIONS" of Specifications, replace the worn-out pin and bushing to new ones.

(4)Before installing the pin, apply grease to the shaft area.

(5)Referring to Fig. 10, install the capscrew and nuts to prevent the pin from coming out.

(6)Make sure to provide an appropriate clearance for thrust direction at the installation of pin referring to Fig. 10.

(7)For the adjustment for clearance, insert resin (plastic) shim first, then adjust the clearance with steel shims.



GRAPHIC_ID Figure 9

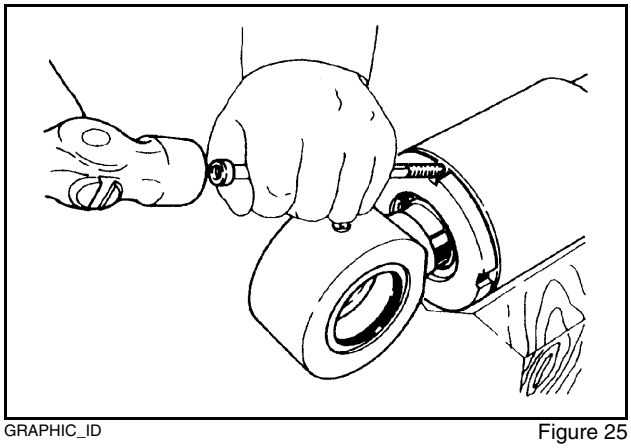
3. Make straight the locking fin for the cylinder head (4).

   Use cautions bending / straightening of locking fin, because locking fin and cylinder tube are made with one-piece.

4. Loosen the cylinder head (4).

   Prior to loosening the cylinder head, pull out the piston rod (3) by 100 ~ 200 mm (4 ~ 8 in).

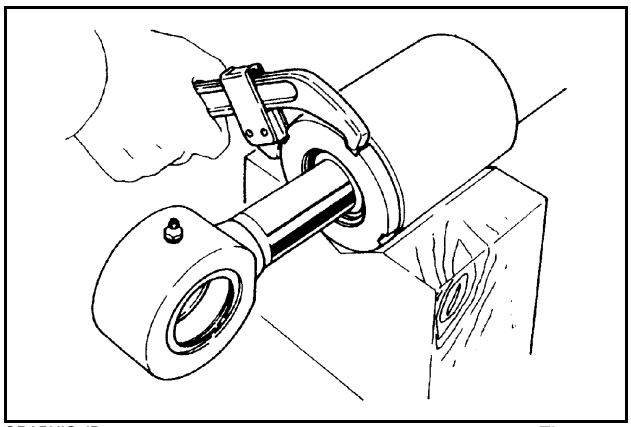
   Cover the rod with an appropriate material to prevent it from unexpected dents.



GRAPHIC_ID Figure 25

5. Pull off the piston rod assembly from the tube.

   Pull the piston rod in straight not to give any damages on the sliding surface.



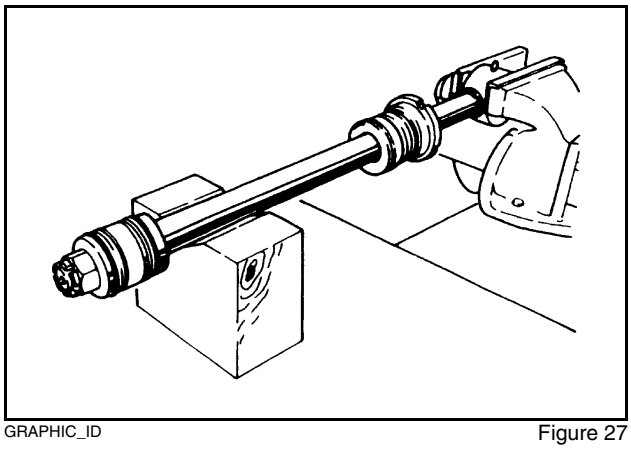
GRAPHIC_ID Figure 26

(2)Disassembly of piston rod assembly

1. Fix the piston rod assembly in level.
2. Disassembly of the piston
   A. Remove the setscrew (19), then remove the steel ball (20).

      Since the setscrew (19) is caulked at two positions with a punch, take off the caulked portion with a hand drill.

   B. Remove the piston (16) assembly.
   C. Remove the cushion bearing (21) (for boom and arm cylinders only).



GRAPHIC_ID Figure 27

Maintenance Standards

(1)Inspection after disassembly

1. Inspection item

Parts Name	Inspecting Portion	Inspection Item	Remedy
Piston rod	1. Neck of rod	Presence of crack	Replace
	2. Stepped part to which piston is attached	Presence of crack	Replace
	3. Threads	Presence of seizure, etc.	Recondition or replace
	4. Bend	Measure amount of bend	Refer to Rod Bend
	5. Plated surface	1.Wearing off of plating 2.Rust on plating 3.Presence of defect	1.Replace 2.Replace 3.Recondition or replace
	6. Rod	Wear of outside	Recondition or replace
	7. Bushing at mounting part	Wear of inside	Replace
Cylinder tube	1. Welded part of bottom	Presence of crack	Replace
	2. Tube at mounting part	Presence of crack	Replace
	3. Tube inside	Presence of defect	Replace if oil leak is seen
	4. Bushing at mounting part	Wear of inside	Replace
Cylinder head	1.Bushing	1.Wear of inside 2.Defect of inside	Replace

(2)Repair procedure

Replace sliding parts and seal parts according to the followings.

1	Bushing	Where 1/4 of circumference is worn in copper color.
2	Seals and slide rings	Replace them when cylinder is disassembled.
3	Pin bushing	Where severe scuffing is appeared.
4	Piston rod	Where the bent 0.5 mm/m (0.02 in/3.3 ft) or more is appeared.

(3)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 mm (0.01 in).
2. Bend of piston rod :
   The allowable bend of the rod is maximum 0.5 mm / 1 m (0.02 in / 3.3ft). 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 values on the dial indicator.

   Even if the bend is within the allowable 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 squeaking noise or dose not operate smoothly.

Distance between V-blocks m (ft)	Deflectional value of the dial gauge mm (in)	Remedy
1 (3.3)	1 (.04)	Replace
2 (6.6)	2 (0.08)	Replace

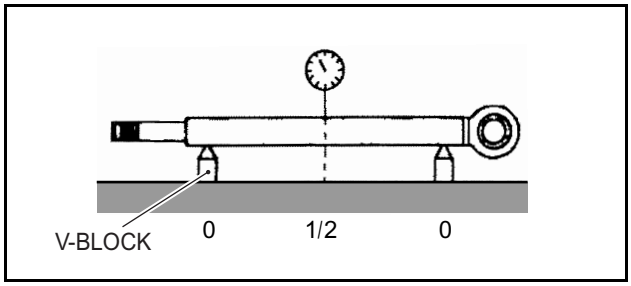


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Figure 56

MEASURING METHOD

Installation

Install the above assemblies in reverse order of the removal.
Tighten the capscrews to the torque specified below :
M8 : Tightening torque: 24 Nm (18 pound-ft)
M10 : Tightening torque: 46 Nm (34 pound-ft)
(Exclude item 23 with * mark)
M12 : Tightening torque: 79 Nm (59 pound-ft)
M16 : Tightening torque: 191 Nm (141 pound-ft)

Item 23 with * mark : Tightening torque: 19.6~24.5 Nm (15~18 pound-ft)

Installation

(1)Install the control valve in reverse order of the removal.

(2)Attach the capscrews (4).

Clean the mounting surface and take care to prevent deformation of the valve.
Tightening torque : 65.7 Nm (48 pound-ft)

(3)Attach the capscrew (2).
Tightening torque : 65.7 Nm (48 pound-ft)

(4)Tighten the hose fittings to the following torque :

		Tightening torque: Nm (pound-ft)	
Thread size (PF)	Spanner used (mm)	O-ring type fitting	30° flare type fitting
1/4	19	36.3 (26)	29.4 (22)
3/8	22	73.5 (54)	49.0 (36)
1/2	27	108 (80)	78.5 (58)
3/4	36	162 (119)	118 (87)
1	41	255 (188)	-

(5)Operate the attachment to check the performance.

(6)Check the tank and piping for oil leakage and oil level.

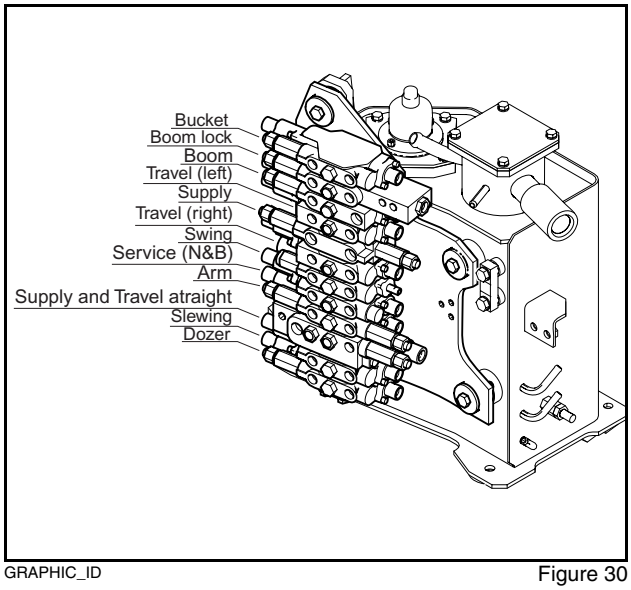

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Figure 30

AIR CLEANER

Disassembly Preparation

Open the rear hood assembly.

Disassembly

(1)Pull out two connectors of the harness from the indicator on the air-cleaner (1).

If the indicator is not equipped with a switch, this work is not required.

(2)Loosen the clip (5) to remove the air hoses (2) and (3).

(3)Loosen four M8× 16 (13) sems-bolts to remove the air cleaner assembly (1).

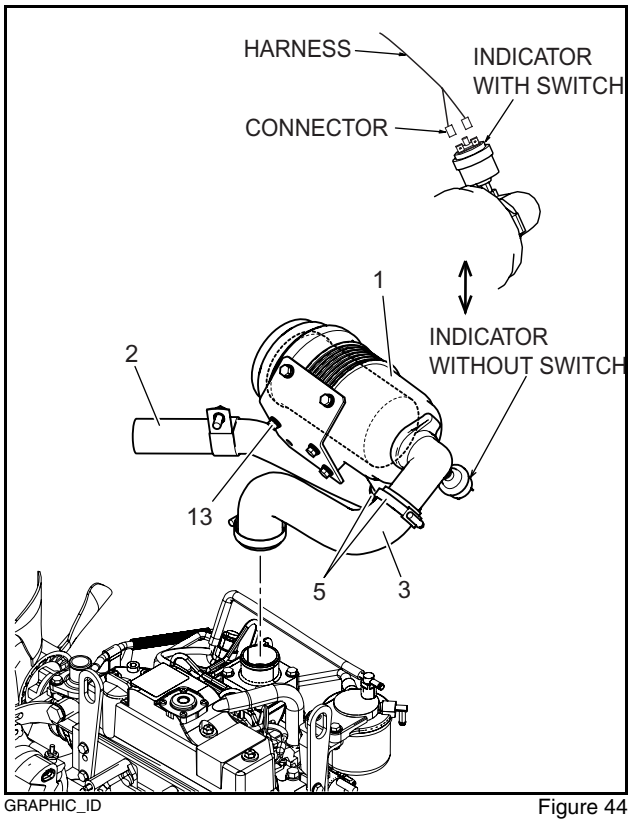

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Figure 44

Assembly

Assemble the air cleaner in reverse order of the disassembly.

Tightening torque
Capscrews (13) : 17.7 Nm (13 pound-ft)

Assembly

(1) Assembly the radiator in reverse order of the disassembly.

(2) Apply Loctite #262 on the capscrews (B3) to fix the radiator by them.

(3) Apply Loctite Hi-Tack gasket sealant to the fittings of radiator hoses (A2) and (A3) prior to the connection.

(4) Install the fan and shroud, adjusting their positions according to Figure 63.

Tightening torque for related parts:

Item	Name	Tool (mm)	Torque Nm (pound-ft)
A18, B6	Capscrew (M8)	13	23.5 (17)
B3	Capscrew (M10)	17	46.1 (34)

(5) Feed cooling water (LLC : Long Life Coolant) See Maintenance section of the OPERATION & MAINTENANCE MANUAL for the mixing ratio of LLC.

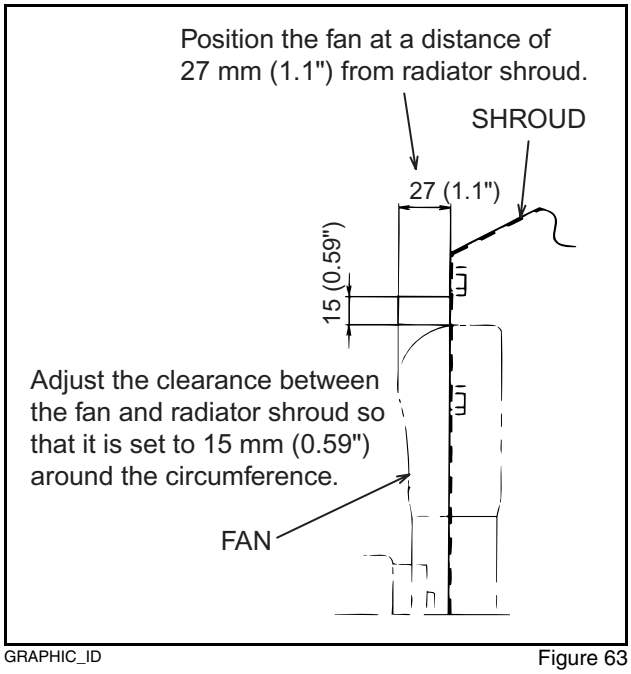

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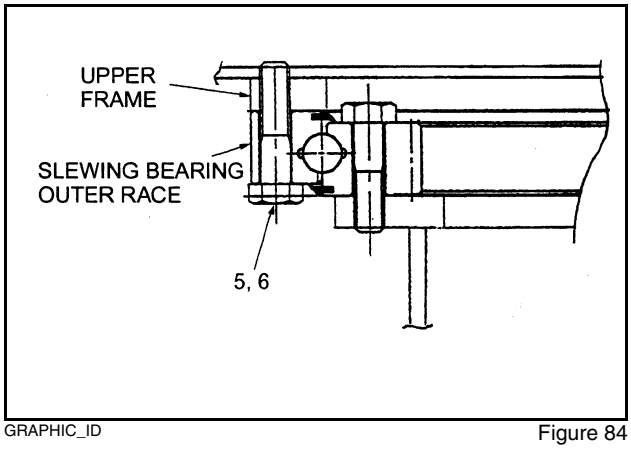
Figure 63

Installation

(1)Install the upper frame in reverse order of the removal

2)Cleaning contact surface

Clean the bottom surface of the upper frame and the top surface of the slewing bearing.



GRAPHIC_ID Figure 84

(3)Lifting method

1. Apply wire ropes to the upper frame and lift up horizontally.
2. Check the match marks provided at the disassembly.
3. Slowly lower the upper frame while aligning the match marks and watching the engaging condition between the slewing pinion gear and the internal gear of the inner race of slewing bearing.

(4)Installing slewing bearing and upper frame

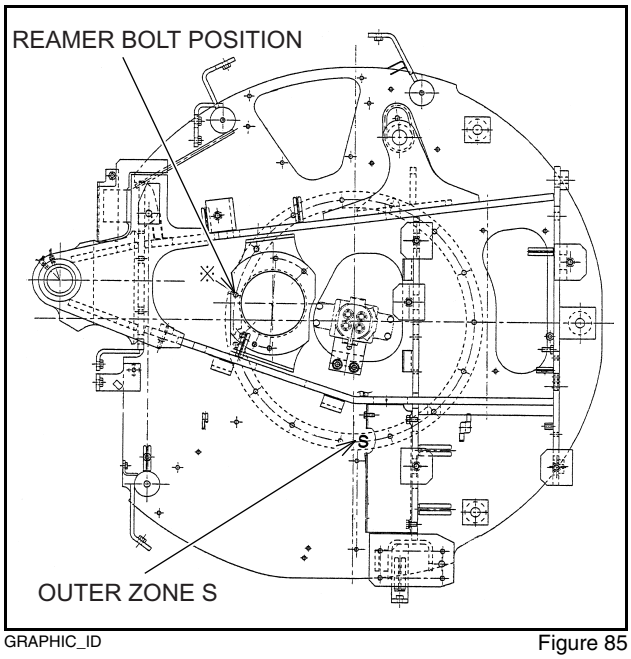
1.Apply Loctite #262 on a reamer bolt (6) and fourteen capscrews (5) and temporarily tighten them.

2. Tighten the reamer bolt and capscrews to the specified torque at the front, rear, right and left positions facing each other in order alternately.

Tightening torque: 115 Nm (85 pound-ft)

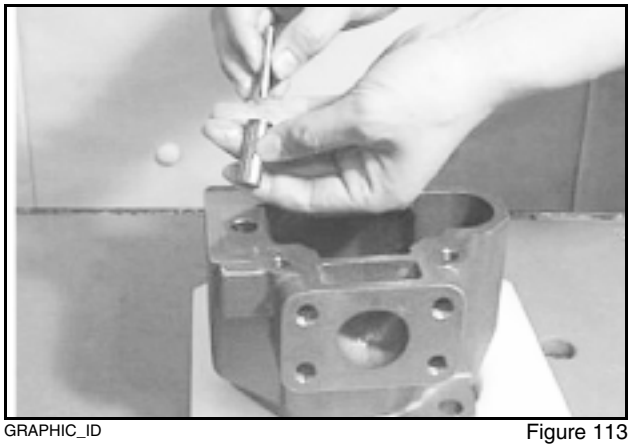
NOTE: *Apply Loctite #262 to the bolt and capscrews.*

(5)Install the components removed in the above removal preparation to the original position and check the performance.



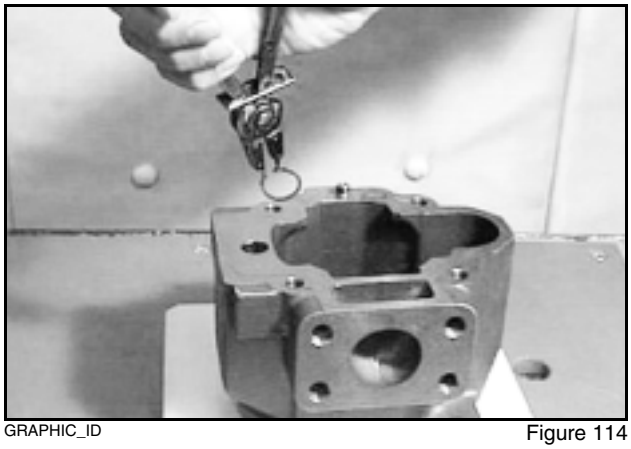
GRAPHIC_ID Figure 85

B. Remove the parallel pin and sleeve (ø5) .



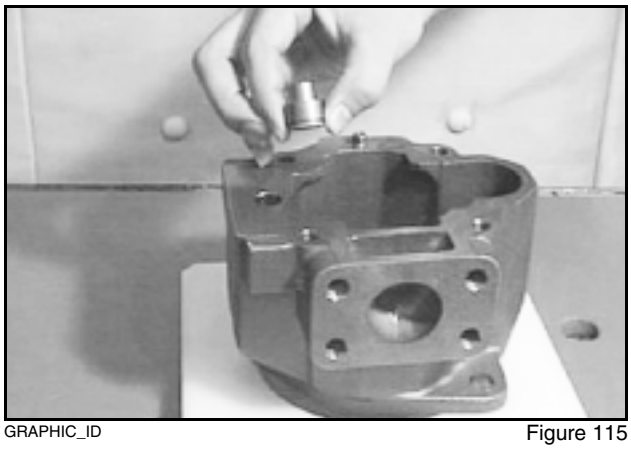
GRAPHIC_ID Figure 113

C. Removing minimum flow stopper
Remove the snap ring (22 for hole).
Snap ring plier (for snap ring 22 for hole)



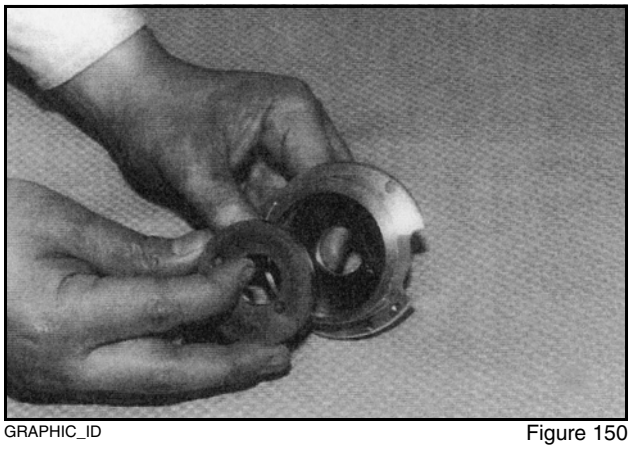
GRAPHIC_ID Figure 114

D. Remove the guide, disk spring , distance piece and shim.



GRAPHIC_ID Figure 115

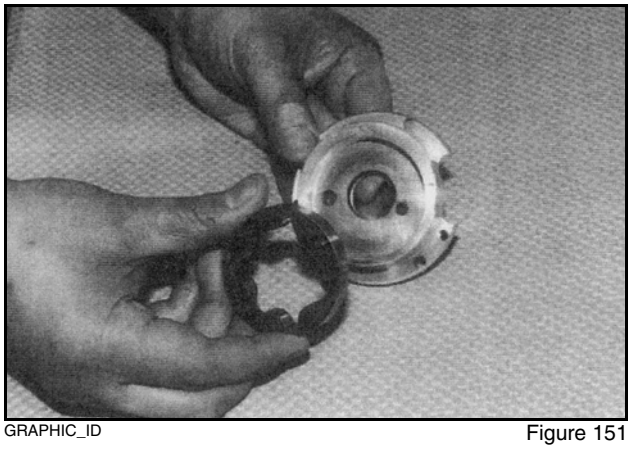
D. Install the side plate (A) into the casing.



GRAPHIC_ID Figure 150

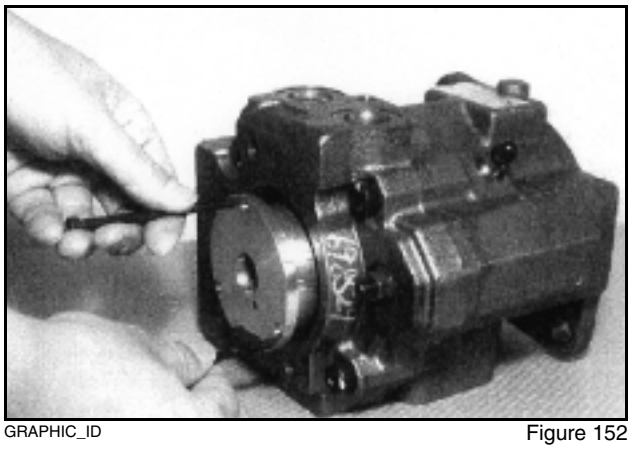
E. Install the gear (outer rotor) into the casing.

Direct the matchmark side to the side plate (B) side.



GRAPHIC_ID Figure 151

F. Install the casing to the cover.



GRAPHIC_ID Figure 152

Precautions for Disassembly

Precautions (These precautions must be observed for safety.)

The disassembly and assembly is fundamentally to be carried out at the manufacturer's plant, but when they are unavoidably necessary, observe the following precautions.

(1)All hydraulic equipment is machined in precision and consequently the clearance of each part is very small. Therefore when disassembling and assembling, place the machine in the clean area to prevent it from the entry of dust, earth and sand.

(2)Before disassembly, prepare the valve construction drawing to understand the construction clearly.

(3)When removing the control valve from the machine, never forget to cap every port to prevent dust, etc. from entering. And before disassembly, recheck that every post is capped and clean the outer surface of the assembly. The work should be carried out on the appropriate work bench which is covered by clean paper or rubber mat.

(4)When it is required to leave it in the removed condition, apply rust preventives or seal them to protect them from rusting.

(5)The control valve should be transported or moved holding the main body. Especially, after removing the pilot cover, carefully handle it paying attention not to touch the exposed surfaces.

(6)Even when the movement is not smooth, never strike it.

(7)In addition, after assembly of equipment, various tests {relief setting, leak test, flow resistance (pressure loss) test} are required, but these tests require hydraulic test equipment. Therefore, don't remove the equipment which is impossible to adjust through respective test, even if the disassembly is possible technically.

Required Tools and Others

Preliminary preparation of the following tools is required for the disassembly and the assembly of the control valve. In addition, the following tools are necessary for the disassembly and the assembly of this valve, but the tools necessary for the disassembly and the assembly of the port connection and the link joint are not included.

Tools	Qty	Remarks
Allen wrench	One each	4, 5, 6, 8 mm
Spanner	One each	13, 19, 21, 22, 26 mm
Socket wrench	One each	13, 19, 21, 22, 26 mm
Torque wrench	1	1.96 ~ 19.6 Nm (1.4 ~ 14 pound-ft)
Torque wrench	1	19.6 ~ 98.1 Nm (14 ~ 72 pound-ft)
Magnet	1	
Pliers	1	
Screw driver (–)	1	
Tweezer	1	

Prepare wash oil, hydraulic oil, grease, Loctite #242, tag and marker (felt-tip pen) beforehand.

IMPORTANT: *At the time, don't tighten 2 socket bolts at a time, but tighten them slightly and alternately several times to make uniform.*

And, fit O-ring (3), dust wiper (4) and oil seal retainer (5) in order on the spool prevented from the opposite end of the main frame of the switching section, and tighten socket bolt (10) with Allen wrench of 4 mm.
Tightening torque: 5.9~6.9 Nm (4.3~5.1 pound-ft)
At this time, pay attention to the direction of the dust wiper (direct the lip outward.)
And, don't tighten socket bolts at one time, but tighten 2 socket bolts slightly so that oil seal presser is inserted in parallel.

C. In case of P3 supply and independent travel spools.
Ensure that the independent travel spool (2) and the spool hole for the main frame of switching section (1) are free from dust, and that the O-rings (12) are securely fitted in the flange bottom of the main frame of the P3 supply section (two places in front and back of the main frame of supply section). Then install the filter case assembly for the flange section of the main frame in the correct orientation.
Then fit the pilot cover (14) to the flange section for the main frame of switching section securely and tighten sems-bolts (15) with an Allen wrench of 4 mm at the specified torque.
Tightening torque: 5.9~6.9 Nm (4.3~5.1 pound-ft)
Further apply a small amount of hydraulic oil to the spool to insert the independent travel spool (2) into the spool hole at the opposite of the side where the filter case assembly has been installed while taking care not to mistake the longitudinal orientation.

IMPORTANT: *Do not use excessive force to push in the spool if it is sticking.*

Then install the spring seat (18) and spring (11).
Further fit the pilot cover (13) in the flange section of the main frame securely, and tighten the sems-bolt (15) with an Allen wrench of 4 mm at the specified torque to fix the install the cover to the main frame.
Tightening torque: 5.9~6.9 Nm (4.3~5.1 pound-ft)

6. Assembling lock valve
If the lock valve became abnormal, replace it with new assembly.
The assembling procedures described below are only for reference after disassembling to investigate the cause for abnormality.
At first, fix the lock valve cover (1) with a vise at the side faces other than the port face.
After fixing, insert the piston A1 (14) into the bore on piston guide (13) paying attention to its direction. Then insert the piston B (15) into the bore on the lock valve cover paying attention for its direction. After that, tighten the bush (17) with 26 mm wrench (or socket wrench) to the specified torque.
Tightening torque: 58.8~68.6 Nm (43~51 pound-ft)

IMPORTANT: *At that time, confirm the fact that the O-ring (16) has been surely installed to the bush.*

IMPORTANT: *If the pistons (A1 and B) are difficult to insert, do not try to insert them by force. It may lead to malfunction.*
After the insertion of pistons (A1 and B), confirm smooth movement of them by taking them in and out with hand for several times.
If the movement is not so smooth, replace the pistons (A1 and B) to new ones together with the lock valve cover as assembly.

After setting the ø7 steel ball to the place, tighten up the ball retainer (19) at the specified torque.
Tightening torque: 7.8~9.8 Nm (5.8~7.0 pound-ft)

IMPORTANT: *At that time, confirm the fact that the O-ring (12) has been surely installed to the ball retainer.*

(12)Remove the O-ring (214) and seal (213) from the plug (211). Remove the seal (213) using a small flat screwdriver and so on.

(13)Cleaning parts

1. Clean the parts in a rough cleaning container containing white kerosene (rough cleaning).

   Immerse the parts in the kerosene to facilitate the removal of dust and oil. Otherwise the parts may be damaged due to using excessive force.

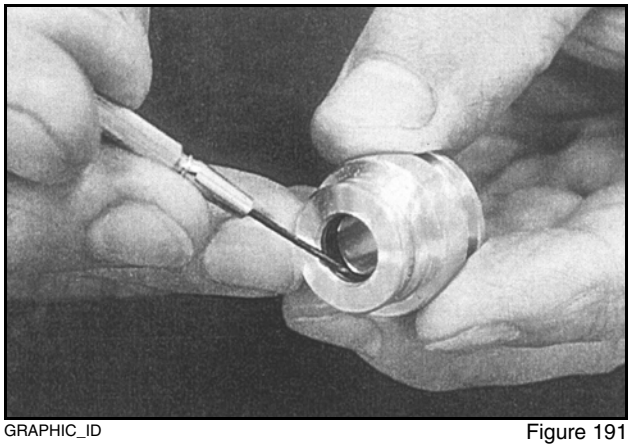
   Check the white kerosene for contamination and use clean one. Otherwise the parts may be damaged, leading to performance deterioration after reassembling.

   Do not dry the parts with compressed air. Otherwise the parts may be damaged by dust or moisture in air or rust may be produced.

2. Put a part in a finish cleaning container containing white kerosene and turn the part slowly to sufficiently clean the part including its interior (finish cleaning).
   Dry parts by wiping off kerosene with clean rag.

3. Rust prevention of parts
   Apply rust preventive agent to the parts.

NOTE: *Do not leave the parts without applying rust preventive agent. Otherwise rust may be produced, leading to malfunction after assembly*



GRAPHIC_ID

Figure 191

(9)Place damping spring (336) in casing (102).

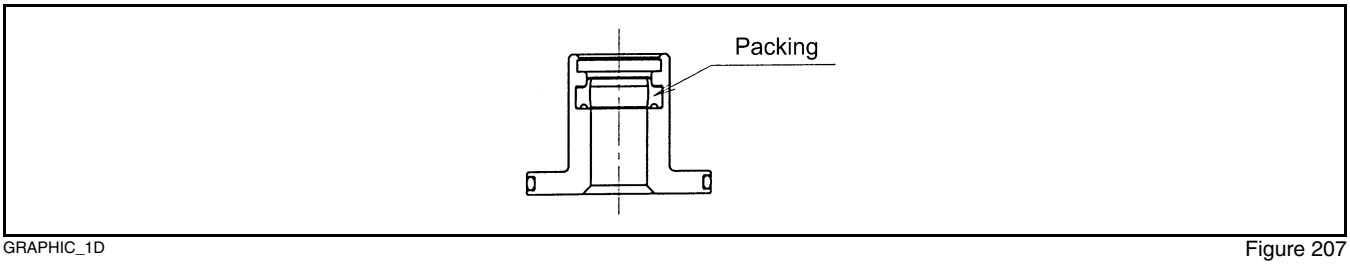
(10)Install piston (224).

(11)Place O-ring (212) in plug (202).

(12)Place packing (210) in plug (202).

Pay attention to the direction when placing the packing in.

Apply grease slightly before placing packing in.



GRAPHIC_1D

Figure 207

(13)Place grease cup (203) in plug (202).

(14)Install push rod (214) on plug (202).

(15)Place the push rod subassembly which is assembled by the procedures in par. 11) to 14) in casing (102).

(16)Put cover (201) on the flat work bench, press bushing (414) with special jig 1, and press fit the bushing striking lightly.

(17)Fix the lower cover assembly which is assembled by the procedures in paragraph 2) to 6) with vise, and install the upper cover assembly which is assembled by the procedures in paragraph 7 to 15) on it.

(18)Install cover (201) on casing (102).

(19)Tighten socket bolt (271) to the specified torque.

(20)Install cam (420) on cover (201).

(21)Insert cam shaft (413) from the outside pressing cam (420).

(22)Apply Loctite #241 or equivalent to the thread of socket bolt.

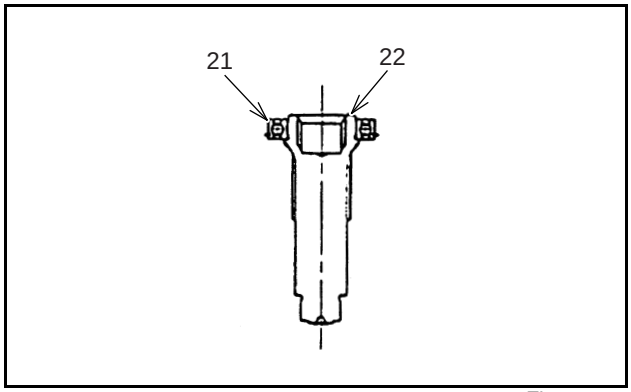
(23)Tighten socket set bolt (472) to the specified torque.

(24)Incline cam (420), apply grease to the top end of push rod (214), and fill grease cup (203) of plug (202) with grease.

(25)After fitting the top end of bellows (501) in cam (402), fit the lower side in the groove of cover (201).

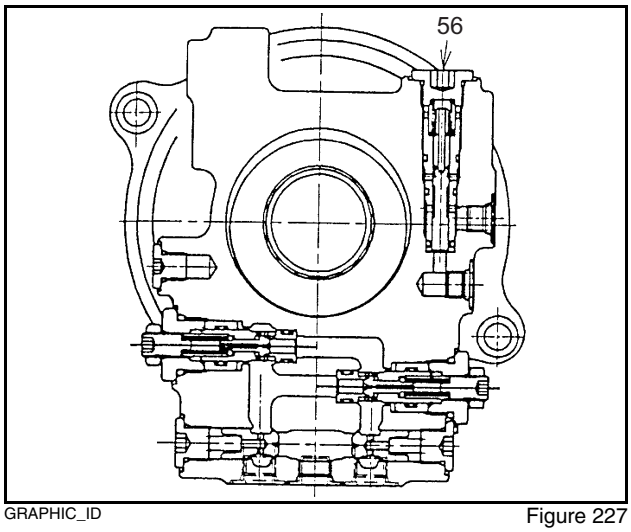
15. Remove ball bearing (21) and shaft (22).

NOTE: *Don't reuse the removed ball bearing.*



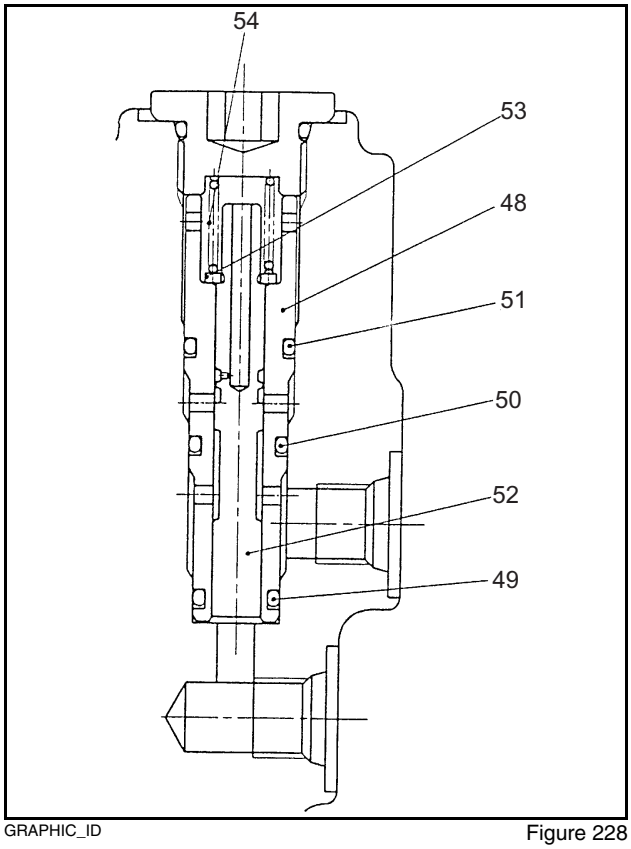
GRAPHIC_ID Figure 226

16. Disassembling timer valve
    A. Remove plug (56).



GRAPHIC_ID Figure 227

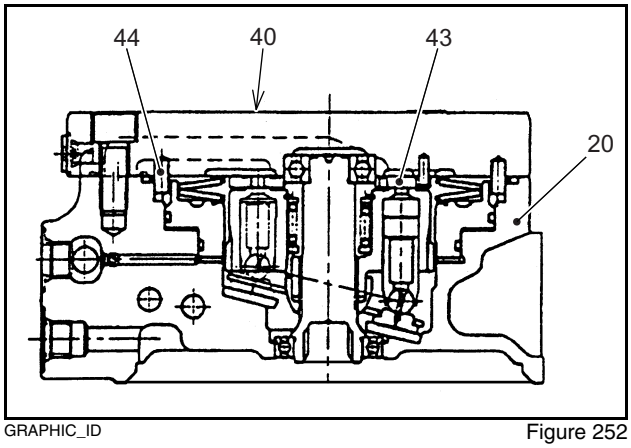
    B. Remove spring (54), washer (53) and spool (52).
    C. Remove sleeve (48).



GRAPHIC_ID Figure 228

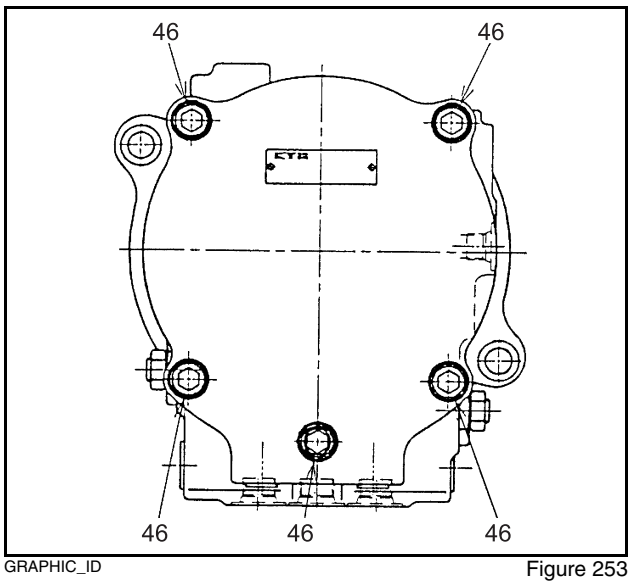
22. Install cover (40), etc. on casing (20) without mistaking the position of pin (44).

NOTE: *Be careful not to drop pin (44) and valve plate (43).*



GRAPHIC_ID Figure 252

23. Tighten 5 socket bolts (46) temporarily, and then tighten it to the specified torque with a torque wrench.
    Tightening torque: 128 ± 7 Nm (94 ± 5 pound-ft)

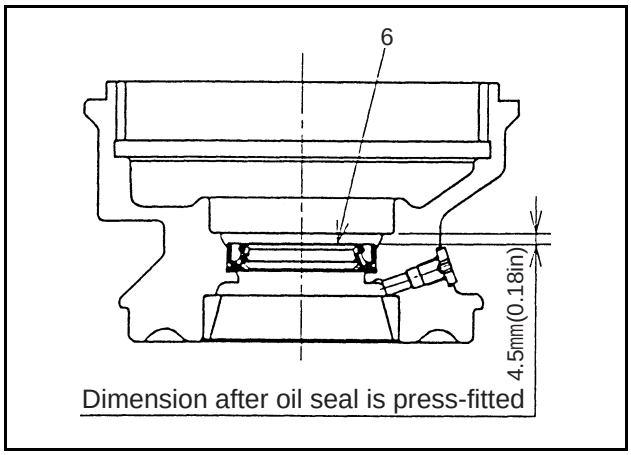


GRAPHIC_ID Figure 253

(2)Assembling reduction unit

1. Press fit oil seal (6).

NOTE: *Apply grease to the oil seal fitting section of housing (1) and around the oil seal before press fitting.*



GRAPHIC_ID Figure 254

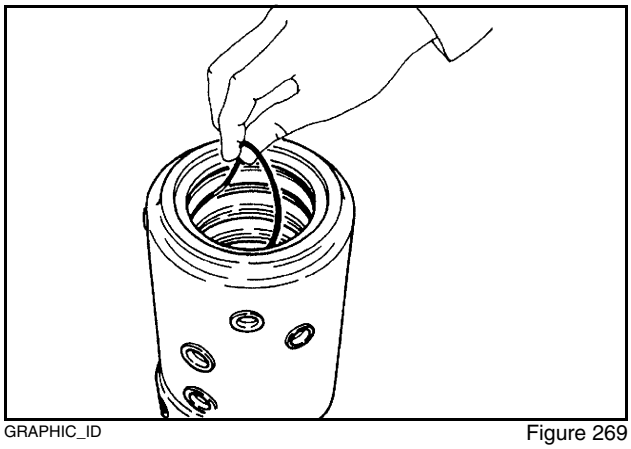
Assembly

(1)Insert seals in the body.

Check the seal position referring to the construction drawing.

Ensure that O-rings are free from twisting.

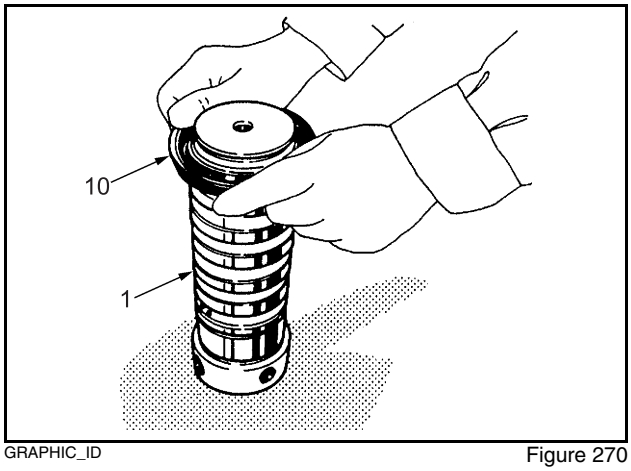
Don't deform or bend the slipper seal extremely.



GRAPHIC_ID Figure 269

(2)Install dust seal (10) to shaft (1).

Apply enough grease to the lip section of the dust seal.

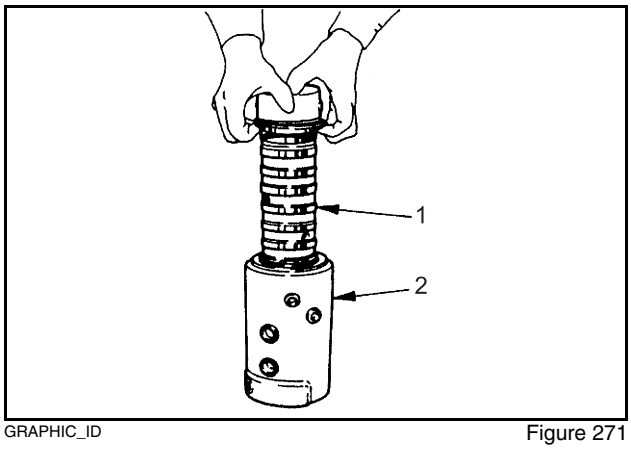


GRAPHIC_ID Figure 270

(3)Install shaft (1) to body (2).

Apply hydraulic oil or grease around the shaft lightly.

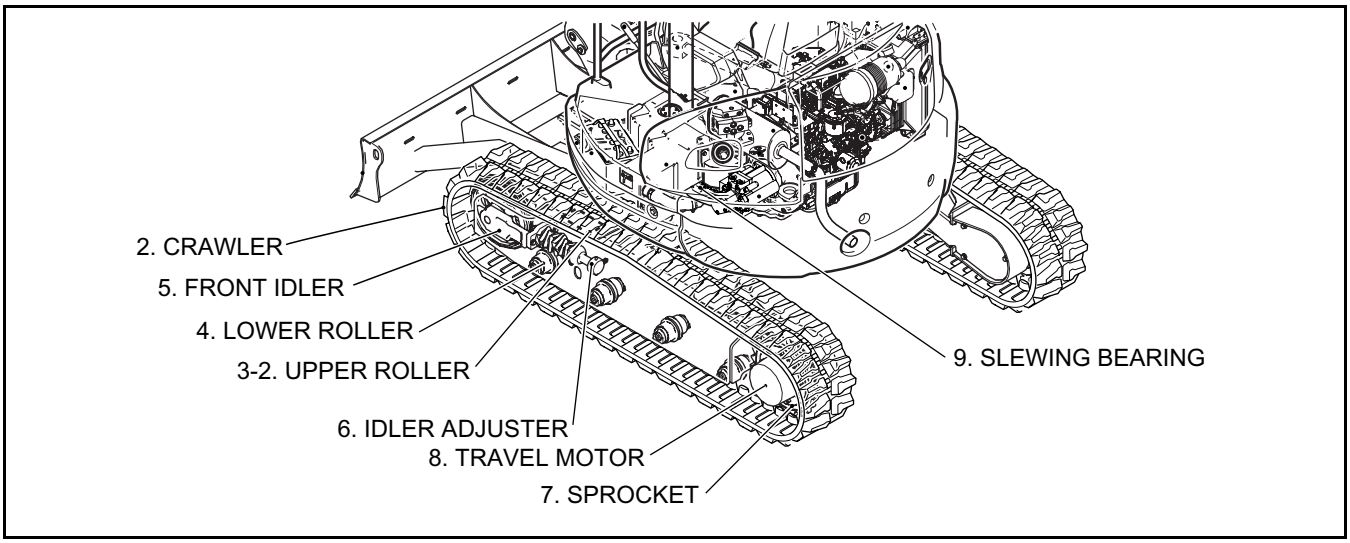
Strike the shaft with a plastic hammer carefully not to damage seal.



GRAPHIC_ID Figure 271

REMOVING AND INSTALLING

COMPONENTS OF TRAVEL SYSTEM



GRAPHIC_1D

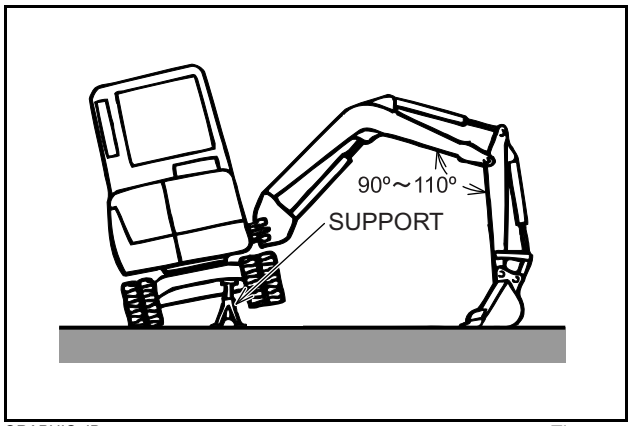
Figure 1

NAME AND LOCATION OF PARTS

CRAWLER

Removing Rubber Crawler

(1) Lift the one side of machine with attachment, as shown, and place support under lower frame to support machine.



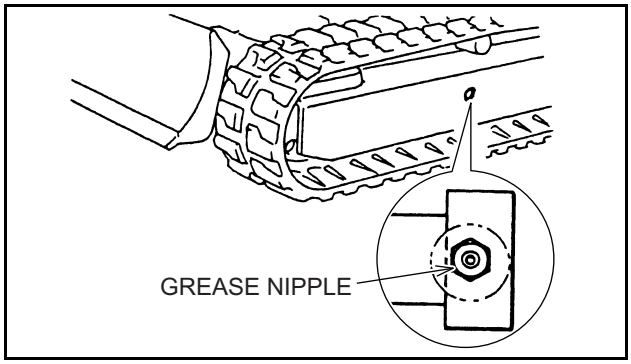
GRAPHIC_ID

Figure 2

(2) Loosen grease nipple for crawler adjuster, discharging grease in cylinder, and release tension of crawler.

When loosening the grease nipple of the adjuster, do not loosen it more than one turn.

Where grease does not come out well, drive the crawler forward / reverse. The over loosening of grease nipple will cause it to jump out incurring danger of injury. So be careful not to over loosen the grease nipple. Keep body and face away from the grease nipple for safety.



GRAPHIC_ID

Figure 3

(2)Installation

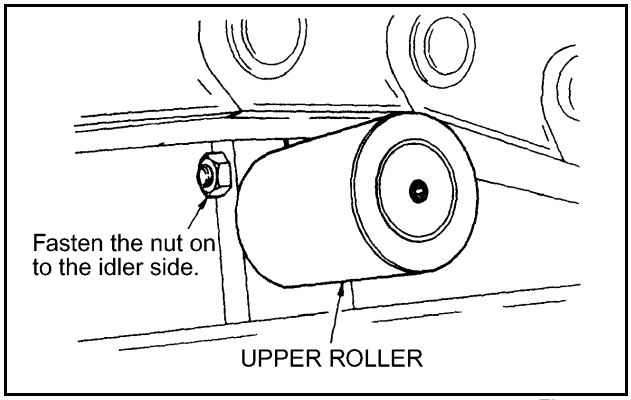
IMPORTANT: *Before installing the upper roller, make sure that sufficient oil is filled in and that the upper roller rotates smoothly by hand. If the oil volume is insufficient, refill oil, or if the upper roller does not rotate smoothly or oil is leaking, check the bearing and the seals and replace them where necessary.*
Oil : Gear oil SAE#90, API GL-4grade
Volume : 45cc (2.7cu•in)

1. Insert the shaft of the upper roller assembly into the lower frame.
2. Coat mounting capscrews with Loctite #262 and tighten it to the torque.
   Tightening torque : 66 Nm (49 pound-ft)

   Install it so the nut is located on the idler side.

   At installation, support the crawler with wooden blocks the same way as it was dismantled so it does not disturb the work.
3. After installing upper roller, tighten grease nipple for crawler adjuster, grease it, and adjust crawler tension.

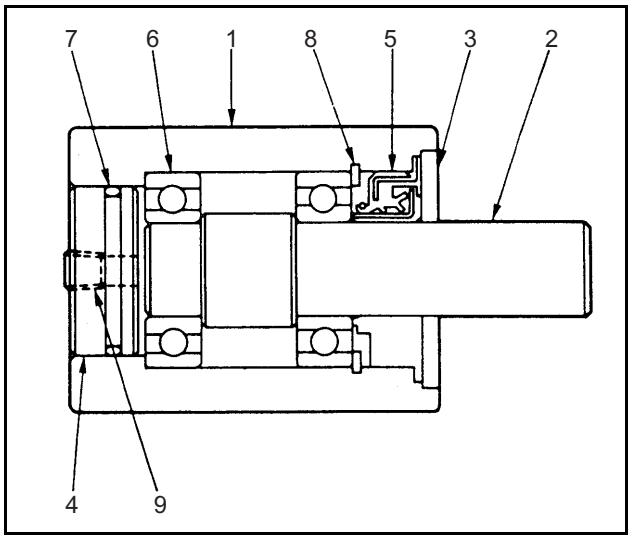
   Tightening torque : 74 Nm (55 pound-ft)



GRAPHIC_ID Figure 29

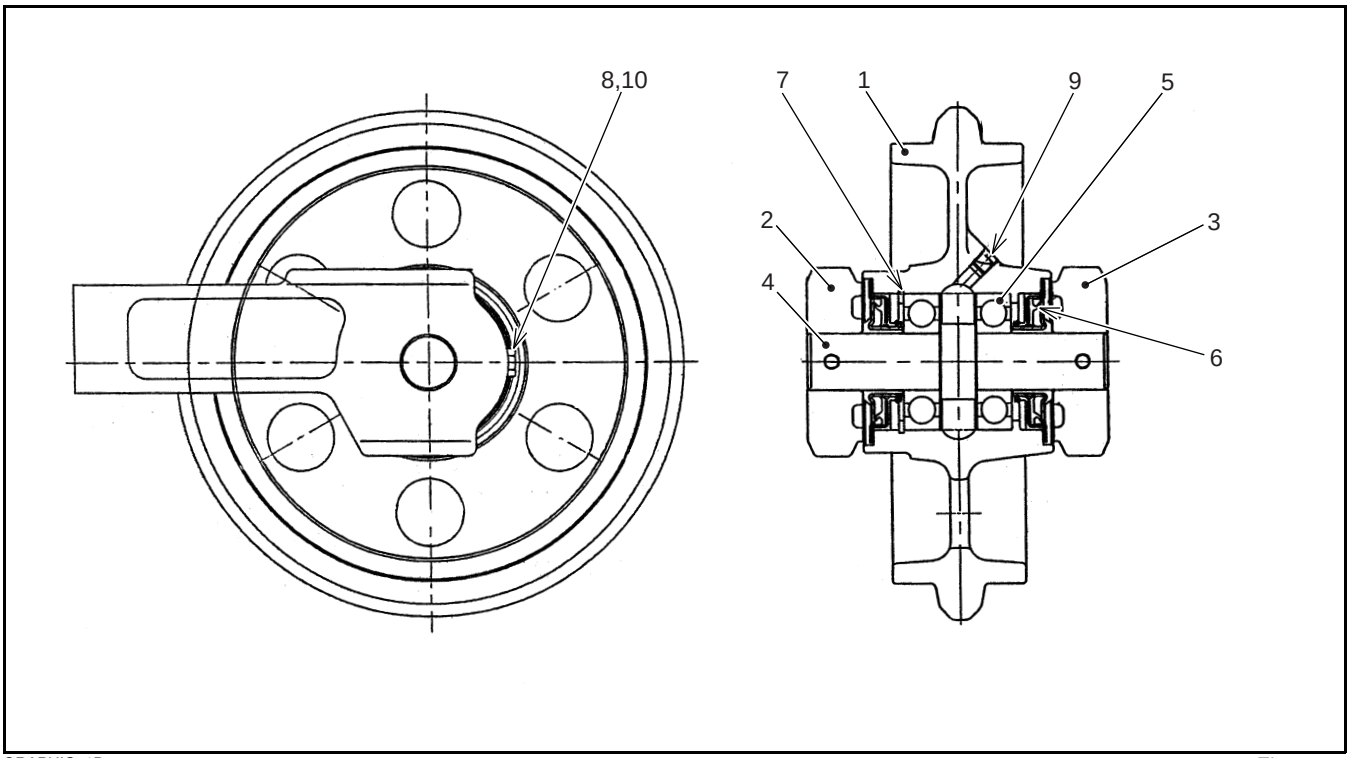
Construction

No.	Name	Qty
1	Roller	1
2	Shaft	1
3	Seal Cover	1
4	Cover	1
5	Seal	1
6	Bearing	2
7	O-ring	1
8	Snap Ring	1
9	Plug	1



GRAPHIC_ID Figure 30

Construction



GRAPHIC_1D

Figure 52

No.	NAME	QTY	No.	NAME	QTY
1	Idler	1	6	Oil seal	2
2	Collar	1	7	Snap ring	1
3	Collar	1	8	Capscrew	2
4	Shaft	1	9	Plug : PT 1/8	1
5	Bearing	2	10	Washer	2

Disassembly

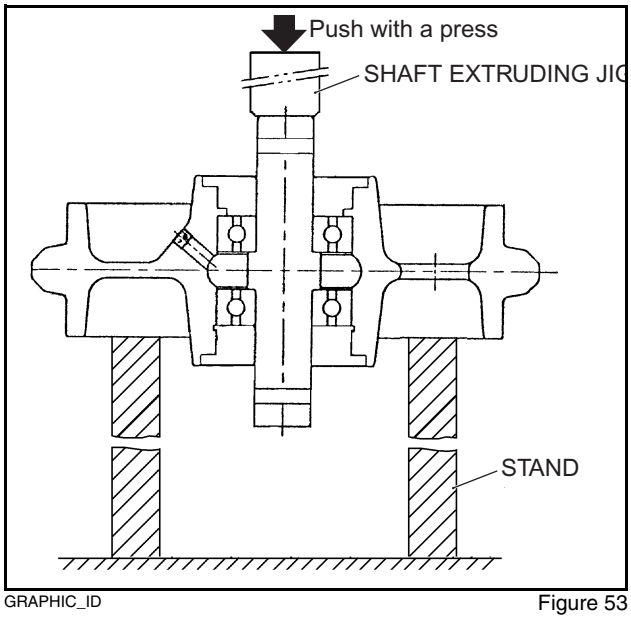
(1)Remove the plug (9) and drain the oil. [Approx. 45cc (2.7 cu•in)]

(2)Remove the capscrew (8) for preventing coming off, and pull of the collars (2) and (3) from the shaft.

(3)Remove the seals (6) and snap ring (7).

(4)Supporting the idler (1) with the supporting stand, apply the shaft extruding jig to the shaft (4), and push it out together with the bearing (5) using a pressing machine.

IMPORTANT: *Except in the case that replacement of the bearing (5) is necessary, do not remove the bearing from the shaft (4).*



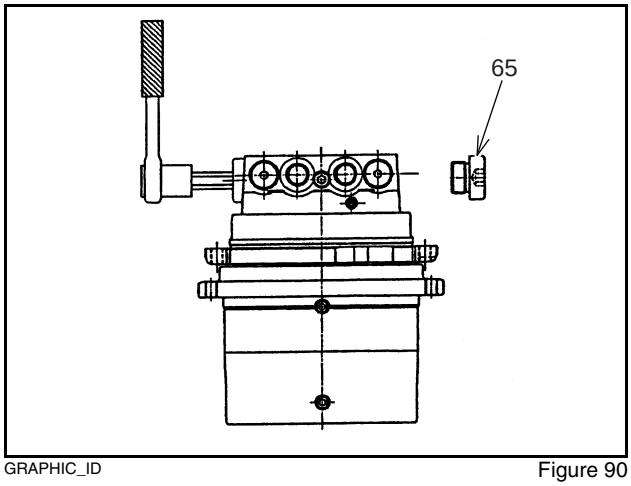
GRAPHIC_ID

Figure 53

Maintenance Standards

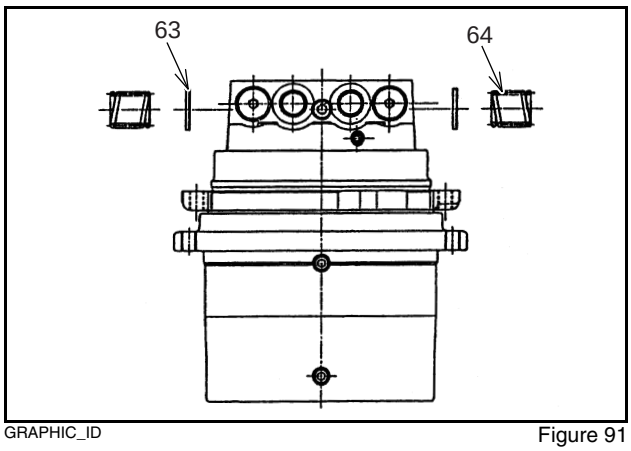
	ITEM	SPEC.
TIGHTENING TORQUE	Sprocket fixing Capscrew M10	Apply Loctite #262 59 Nm (44 pound-ft)
	Travel motor fixing Capscrew M10	
OIL	Spec. and grade	Gear oil SAE#90 GL–4
	Volume	350cc (21.4 cu•in)

3. Remove cap (65).



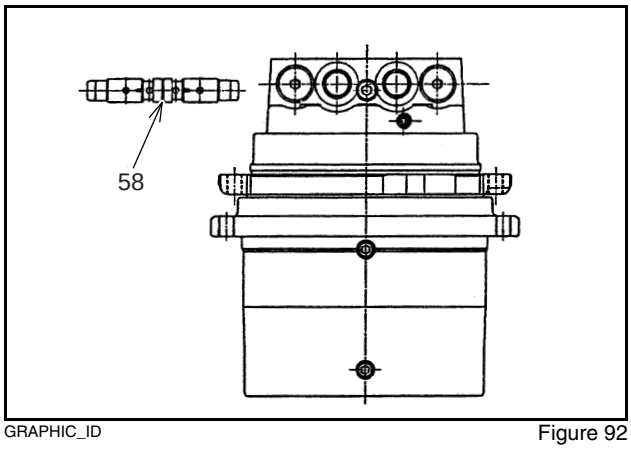
GRAPHIC_ID Figure 90

4. Take out spring (64) and spring seat (63).



GRAPHIC_ID Figure 91

5. Remove plunger sub-assy (58) turning slowly. Be careful not to damage around the plunger.



GRAPHIC_ID Figure 92

Precautions for Assembly

(1)Wash all parts is treated oil, and remove metal pieces and foreign substances.
Ensure that there are no burrs or bruise.

(2)Replace seals, bearings and pins with new in principle.

(3)Take care not to damage seals at time of reassembly. (Apply grease prior to installation.)

(4)Protect all cleaned parts from dusts, flaws and other damages. Handle them with extreme.

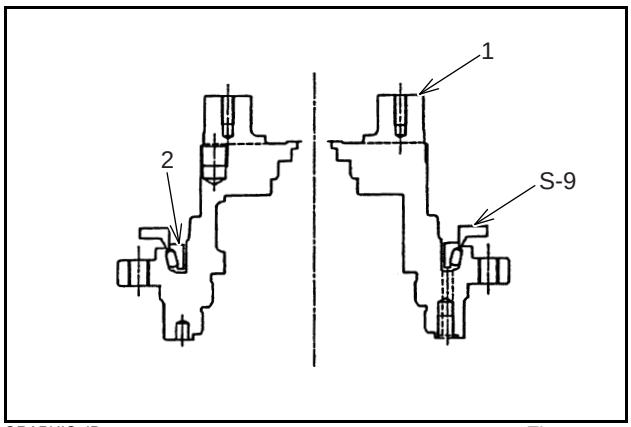
(5)Tighten bolts with specified tightening torque.

(6)Plug all ports with shipping plug to protect dusts from entering.

Assembly

(1)Assembling motor section.

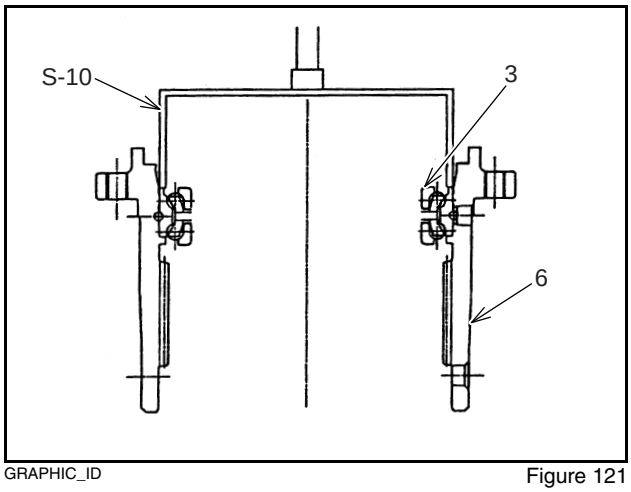
1. Apply grease to floating seal (2) and install flange holder (1).
Jig : S-9



GRAPHIC_ID

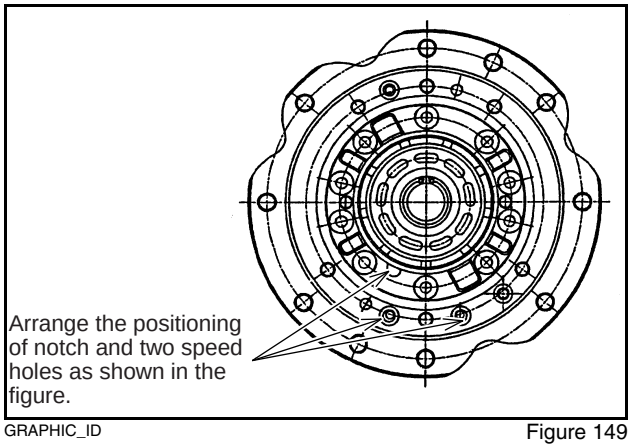
Figure 120

2. Press fit angular bearing (3) in housing (6).
Jig : S10



GRAPHIC_ID

Figure 121

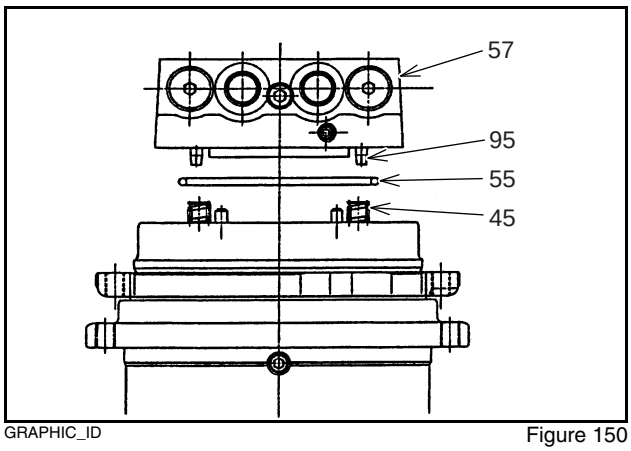


GRAPHIC_ID Figure 149

10. Install springs (45), O-ring (55) and base plate (57).

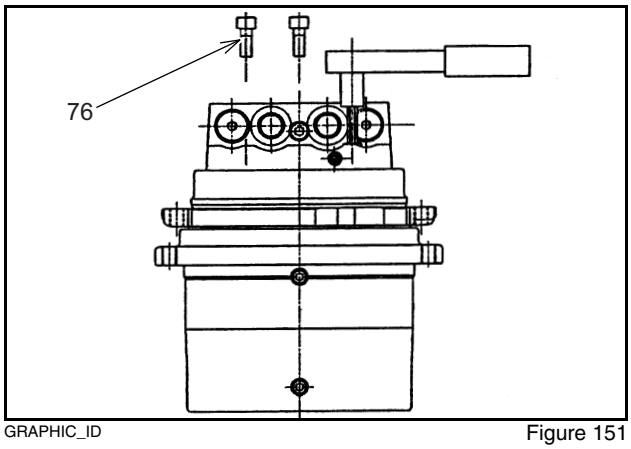
    Be careful of installing as springs (45) don't fall dawn.

    It's difficult to fall down by greased them.



GRAPHIC_ID Figure 150

11. Tighten socket bolt (76).
    Tightening torque: 37 Nm (27 pound-ft)



GRAPHIC_ID Figure 151

CNH America LLC reserves the right to make improvements in design or changes in specifications at any time without incurring any obligation to install them on units previously sold.

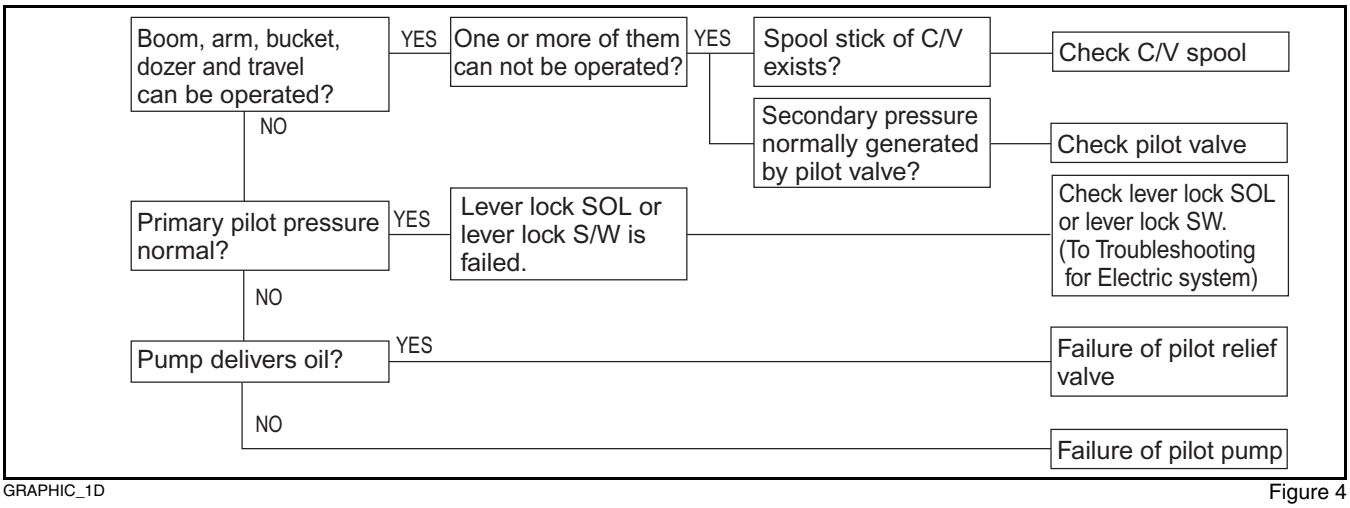
All data given in this publication is subject to production variations. Dimensions and weights are only approximate. Illustrations do not necessarily show products in standard condition. For exact information about any particular product, please consult your Dealer

Revision History				
Issue	Issue Date	Applicable Machines	Form Number	Remarks
First Edition	09-2008	CX27B	5-16940	

TROUBLESHOOTING

Attachment

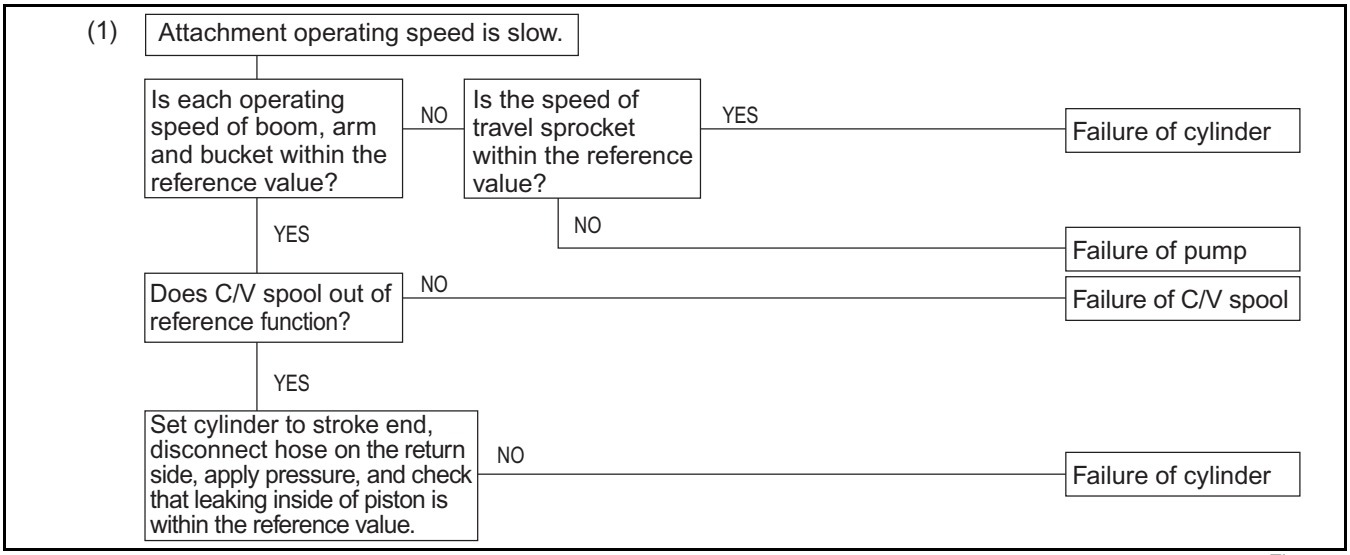
Attachment operational failure (Excluding swing operations)



GRAPHIC_1D

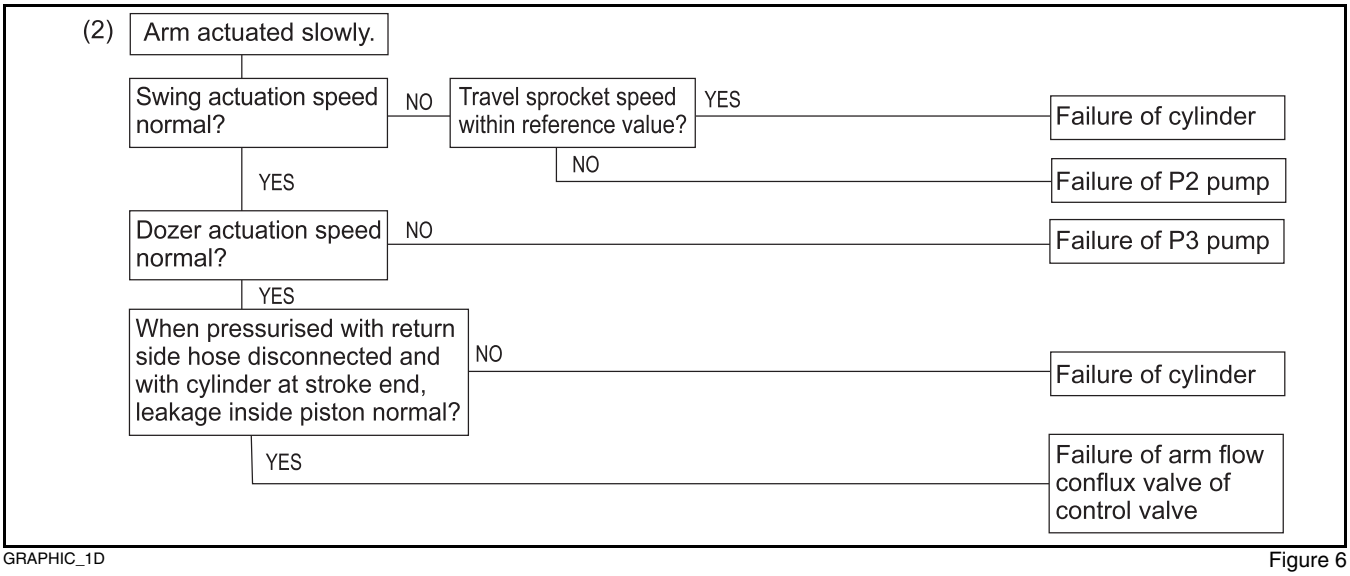
Figure 4

Attachment speed is slow



GRAPHIC_1D

Figure 5



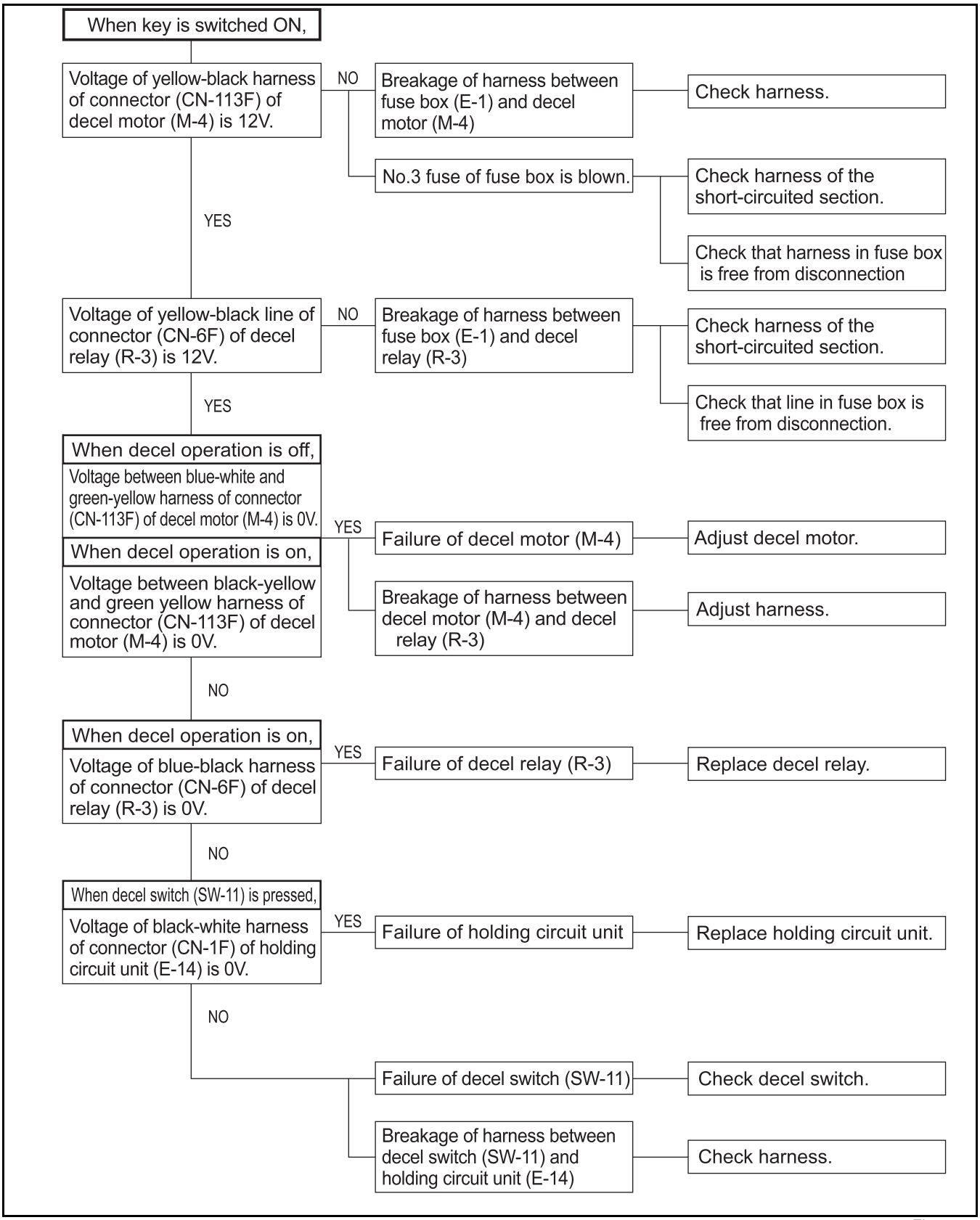
GRAPHIC_1D

Figure 6

NOTES

Deceleration

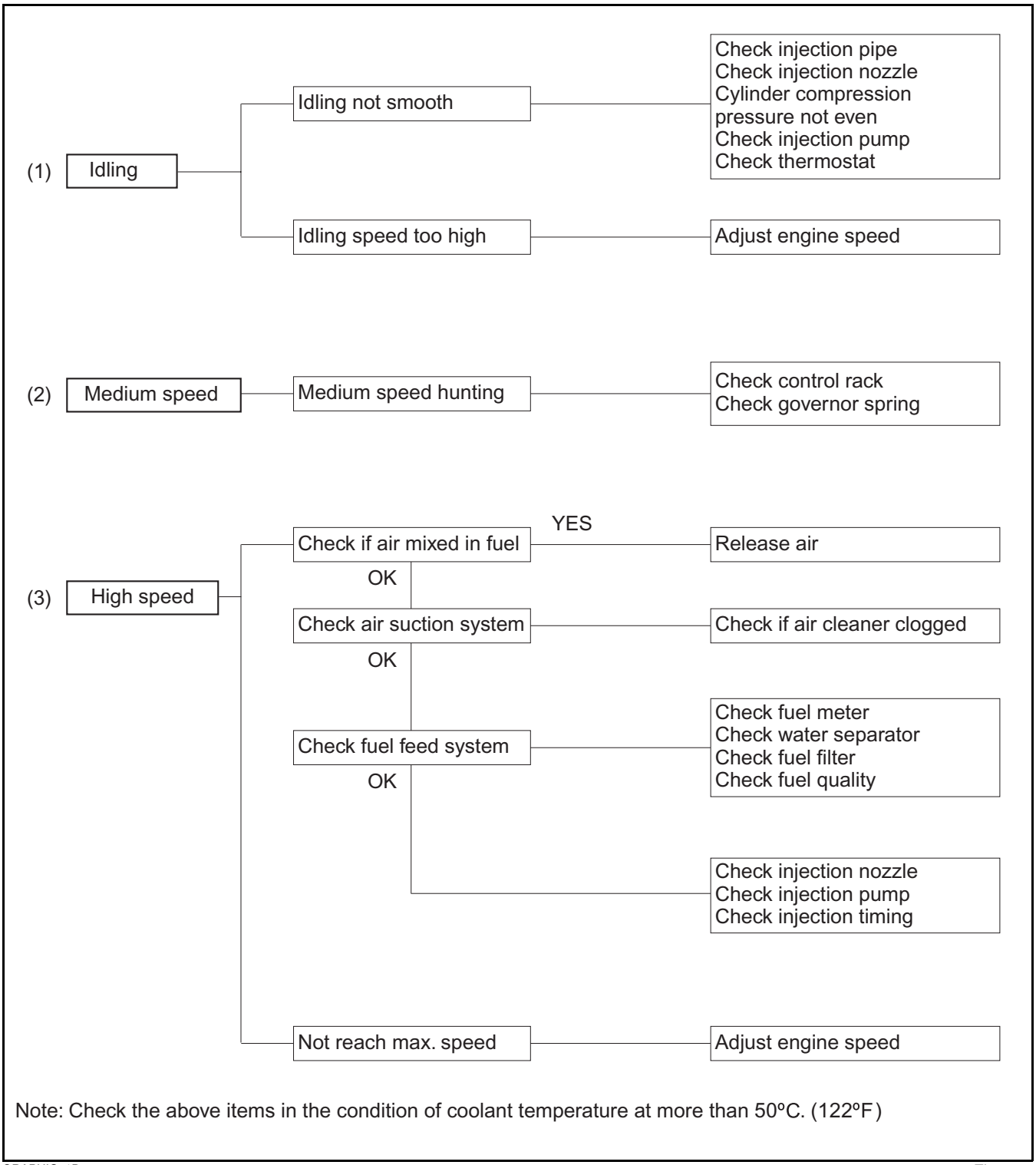
Decel change operation in option can not be carried out.



GRAPHIC_1D

Figure 13

E/G Rotation Trouble



Note: Check the above items in the condition of coolant temperature at more than 50ºC. (122ºF)

GRAPHIC_1D

Figure 3

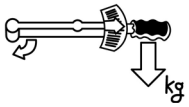
CNH America LLC reserves the right to make improvements in design or changes in specifications at any time without incurring any obligation to install them on units previously sold.

All data given in this publication is subject to production variations. Dimensions and weights are only approximate. Illustrations do not necessarily show products in standard condition. For exact information about any particular product, please consult your Dealer

Revision History				
Issue	Issue Date	Applicable Machines	Form Number	Remarks
First Edition	09-2008	CX27B	5-16990	

(5) FASTENER TORQUE

⚠ WARNING



● Torqueing Fasteners

Always follow the torque values and procedures as designated in the service manual. Incorrect values, procedures and or tools may cause damage to the engine and or personal injury.

(6) Electrical

⚠ WARNING

● Short Circuits

Always disconnect the (-) Negative battery cable before working on the electrical system. An accidental “short circuit” may cause damage, fire and or personal injury. Remember to connect the (-) Negative battery cable (back onto the battery) last.
Fasten the terminals tightly.

⚠ WARNING

● Charging Batteries

Charging wet celled batteries produces hydrogen gas. Hydrogen gas is extremely explosive. Keep sparks, open flame and any other form of ignition away. Explosion may occur causing severe personal injury.

⚠ WARNING

● Battery Electrolyte

Batteries contain sulfuric acid. Do NOT allow it to come in contact with clothing, skin and or eyes, severe burns will result.

(7) WASTE MANAGEMENT

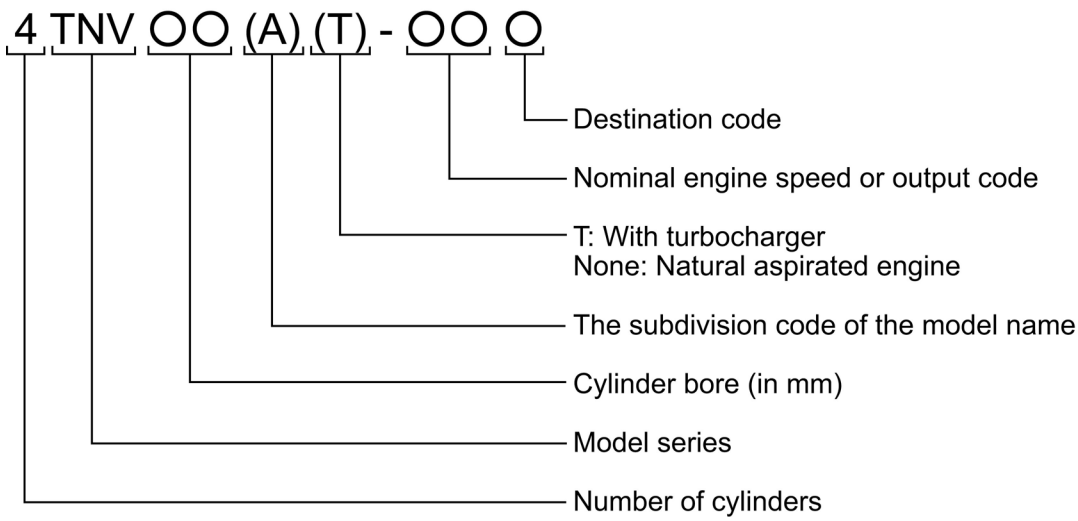
⚠ CAUTION

Observe the following instructions with regard to hazardous waste disposal. Negligence of these will have a serious impact on environmental pollution concerns.

1) Waste fluids such as lube oil, fuel and coolant shall be carefully put into separate sealed containers and disposed of properly.
2) Do NOT dispose of waste materials irresponsibly by dumping them into the sewer, overland or into natural waterways.
3) Waste materials such as oil, fuel, coolant, solvents, filter elements and batteries, must be disposed of properly according to local ordinances. Consult the local authorities or reclamation facility.

1. General

1.1 Engine Nomenclature



The engine specification class

Classification	Load	Engine speed	Available engine speed (min^{-1})
CL	Constant load	Constant speed	1500/1800
VM	Variable load	Variable speed	2000-3000

※ The engine specification class (CL or VM) is described in the specifications table.

1.2 Specifications

NOTE:

1) The information described in the engine specifications tables (the next page and after) is for "standard" engine. To obtain the information for the engine installed in each machine unit, refer to the manual provided by the equipment manufacturer.
2) Engine rating conditions are as follows (SAE J1349, ISO 3046/1)
   - Atmospheric condition: Room temp. 25℃, Atmospheric press. 100 kPa (750mm Hg), Relative humidity 30%
   - Fuel temp: 25℃ (Fuel injection pump inlet)
   - With cooling fan, air cleaner, exhaust silencer (Yanmar standard parts)
   - After running-in hours. Output allowable deviation: ±3%

(10) 4TNV98T

Engine name		Unit	4TNV98T						
Engine specification class		-	CL		VM				
Type		-	Vertical, in-line, 4-cycle, water-cooled diesel engine						
Combustion chamber		-	Direct injection						
Number of cylinders		-	4						
Cylinder bore×stroke		mm×mm	88×110						
Displacement		L	3.318						
Continuous rating	Revolving speed	Min^{-1}	1500	1800	-				
	Output	kW (hp)	37.9 (51.5)	45.6 (62.0)	-				
Rated output	Revolving speed	Min^{-1}	1500	1800	2000	2200	2400	2500	2600
	Output	kW (hp)	41.9 (57.0)	50.4 (68.5)	50.7 (69.0)	55.5 (75.5)	60.3 (82.0)	62.5 (85.0)	64.0 (87.0)
Max. no-load speed (±25)		min^{-1}	1600	1895	2180	2400	2590	2700	2810
Ignition order		-	1-3-4-2-1(No.1 cylinder on flywheel side)						
Power take off		-	Flywheel						
Direction of rotation		-	Counterclockwise (viewed from flywheel)						
Cooling system		-	Radiator						
Lubrication system		-	Forced lubrication with trochoid pump						
Starting system		-	Electric						
Applicable fuel		-	Diesel oil-ISO 8217 DMA, BS 2869 A1 or A2 (cetane No.45 min.)						
Applicable lubricant		-	API grade class CD or CF						
Lubricant capacity (oil pan) *	Total	L	10.2						
	Effective	L	4.5						
Coolant water capacity (engine only)		L	4.2						
Engine dimensions ** (with flywheel housing)	Overall length	mm	715						
	Overall width	mm	575						
	Overall height	mm	779						
Engine mass (dry) ** (with flywheel housing)		kg	258 (equivalent to SAE#3)		245 (equivalent to SAE#4)				
Cooling fan (std.)		mm	430 mm O/D, 8 blades suction type						
Crankshaft V pulley diameter & Fun V pulley diameter (std.)		mm	130×130						

* Engine oil capacity may differ from the above depending on an engine installed on a machine unit.
** Engine mass and dimensions without radiator

(4) Perform maintenance without fail.

Note: Inspections to be carried out by the user and by the maker are divided and set down in the “List of Periodic Inspections” and should be checked carefully.

(5) Maintenance period and Quality guarantee period for exhaust emission related parts

The maintenance of the parts related to the exhaust emission must be carried out in the maintenance period as shown in the below table.

A guarantee period is that either the operation hours or years shown in the table come first in the condition that the maintenance inspection was carried out based on the “List of Periodic Inspections”.

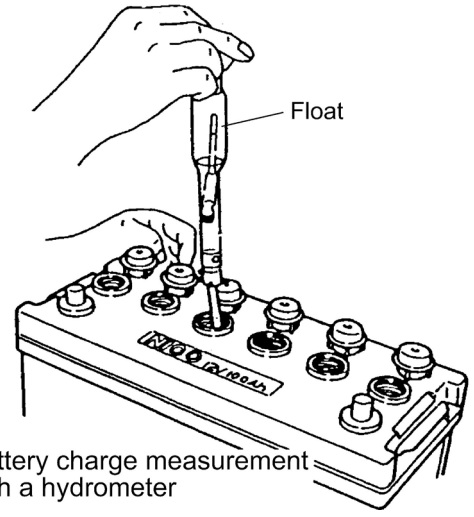
	Maintenance period		Quality Guarantee Period
Parts / Power Rating	● Fuel nozzle cleaning	Adjustment, cleaning, repairs for fuel nozzle, fuel pump, turbocharger, electronic control unit etc.	For nozzle, fuel pump, turbocharger
37 <= kW < 130	Every 1500 hours (applied from Tier 2)	Every 3000 hours (applied from Tier 2)	3000 hours / 5 years
19 <= kW < 37 except constant speed engines >= 3000min^{-1}	Every 1500 hours	Every 3000 hours	3000 hours / 5 years
KW < 19 And constant speed engines beyond 3000min^{-1} under 37kW	Every 1500 hours	Every 3000 hours	1500 hours / 2 years

(b) Measurement with hydrometer

When using a hydrometer, the measured specific gravity must be corrected according to the temperature at the time of measurement. The specific gravity of battery electrolyte is defined with 20℃ as the standard. Since the specific gravity increases or decreases by 0.0007 when the temperature varies by 1℃, correct the value according to the equation below.

$$S20 = St + 0.007(t-20)$$

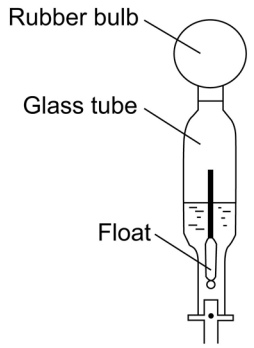
- St: Specific gravity at measurement
- t: Electrolyte temperature at measurement
- S20: Converted specific gravity at 20℃



Battery charge measurement with a hydrometer

(c) Specific gravity and remaining battery charge

Specific gravity (20℃)	Discharged quantity of electricity (%)	Remaining charge (%)
1.28	0	100
1.26	10	90
1.24	20	80
1.23	25	75



Hydrometer structure

(3) Terminals

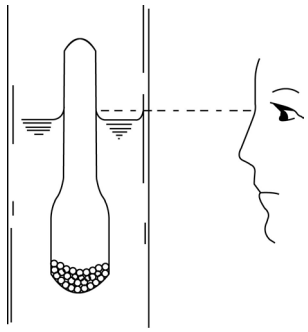
Clean if corroded or soiled.

(4) Mounting bracket

Repair or replace it if corroded.
Retighten if loosened.

(5) Battery appearance

Replace the battery if cracked or deformed.
Clean with fresh water if contaminated.



How to read hydrometer

The cylinder to be adjusted first does not have to be the No.1 cylinder. Select and adjust the cylinder where the piston is the nearest to the top dead center after turning, and make adjustment for other cylinders in the order of ignition by turning the crankshaft 240° each time.

The adjustment method of reducing the flywheel turning numbers (for reference):
For 3 cylinder engines
Set No.1 cylinder to the compression T.D.C.and adjust the clearance of the ● mark of the below table. Next, turn the flywheel once (the suction / exhaust valve of No.1 cylinder is in the position of the overlap T.D.C. at this time), and adjust the clearance of the ○ mark.

Ignition order of 3 cylinder engines: 1⟶3⟶2

Cylinder No.	1		2		3		
Valve	Suction	Exhaust	Suction	Exhaust	Suction	Exhaust	
No.1 compression T.D.C	●	●	●			●	The first time
No.1 overlap T.D.C				○	○		The second time

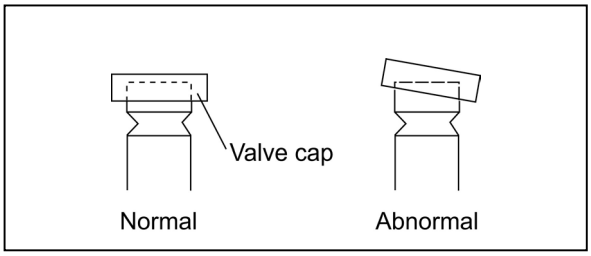
For 4 cylinder engines
Set No.1 cylinder to the compression T.D.C. and adjust the clearance of the ● mark of the bottom table. Next, turn the flywheel once, and adjust the clearance of the ○ mark.

Ignition order of 3 cylinder engines: 1⟶3⟶4⟶2

Cylinder No.	1		2		3		4		
Valve	Suction	Exhaust	Suction	Exhaust	Suction	Exhaust	Suction	Exhaust	
No.1 compression T.D.C	●	●	●			●			The first time
No.4 compression T.D.C				○	○		○	○	The second time

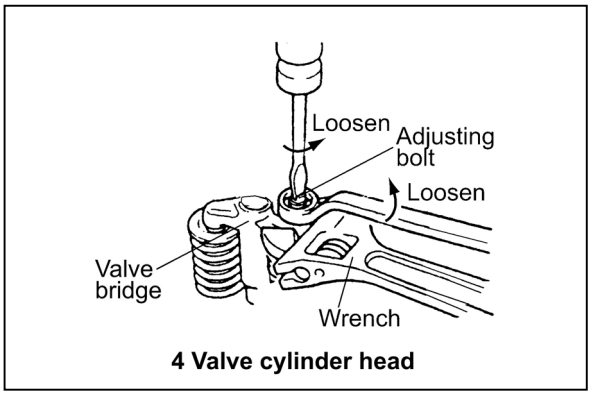
(b) Valve clearance inspection and adjustment

1) Loosen adjusting bolts
In case of 2-valve cylinder head loosen the lock nut and adjusting screw, and check the valve for any inclination of valve cap, entrance of dirt or wear.



In case of 4-valve cylinder head loosen the lock nut and adjusting screw of rocker arm. Be careful that excessive tension isn't applied to the valve bridge, and loosen a locknut of valve bridge.

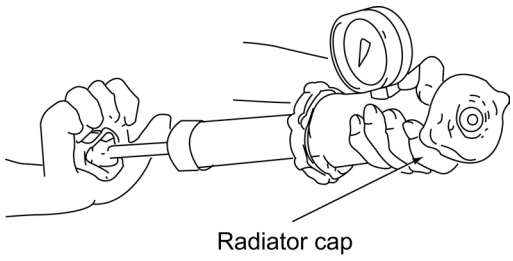
[NOTICE]
When loosening a locknut of a valve bridge, loosen the locknut while fixing the valve bridge with a wrench so that the valve may not lean.



4 Valve cylinder head

2.6 Radiator cap inspection

Install the radiator cap on the cap tester. Set the tester pressure to 0.09±0.015MPa (0.9±0.15kgf/cm^2) and see that the cap is opened. If the cap does not open, replace the cap since it is abnormal.



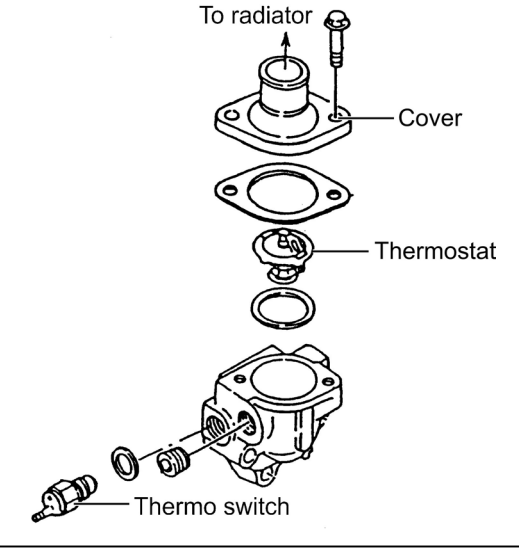
Radiator cap inspection

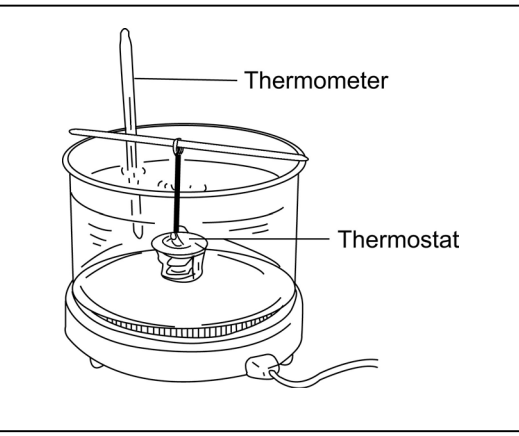
2.7 Thermostat Inspection

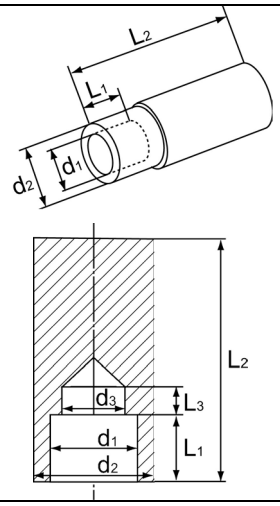
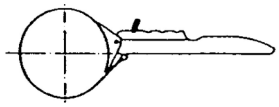
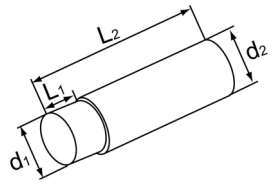
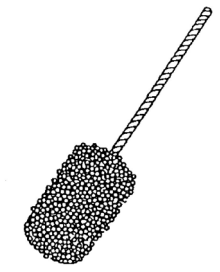
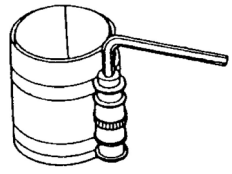
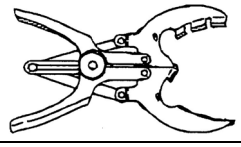
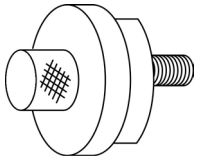
Place the thermostat in a container filled with water. Heat it while measuring the water temperature, and see that the thermostat is actuated at temperature of following table.

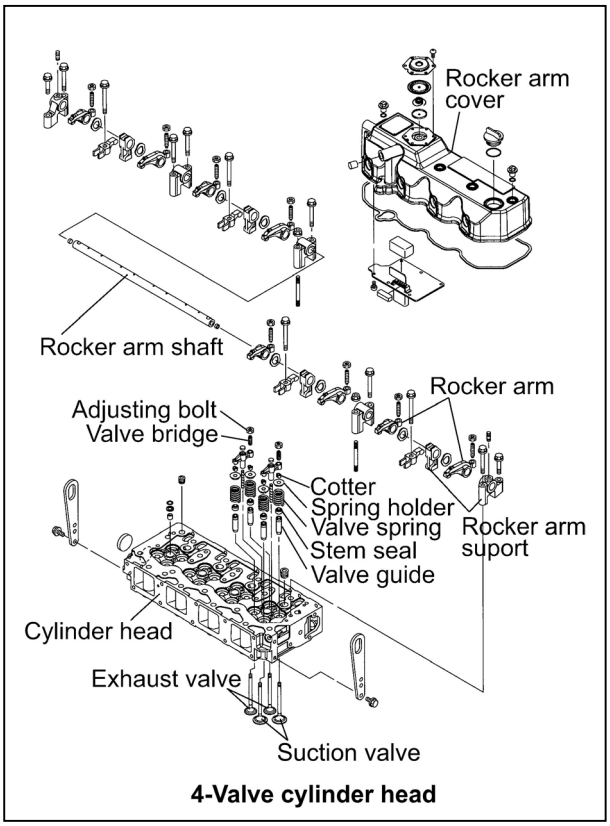
Model	Valve opening Temperature (deg C)*	Full open lift (Temperature) (mm)
All models	69.5～72.5	8 or more (85deg C)

* Valve opening temperature is carved on the flange.

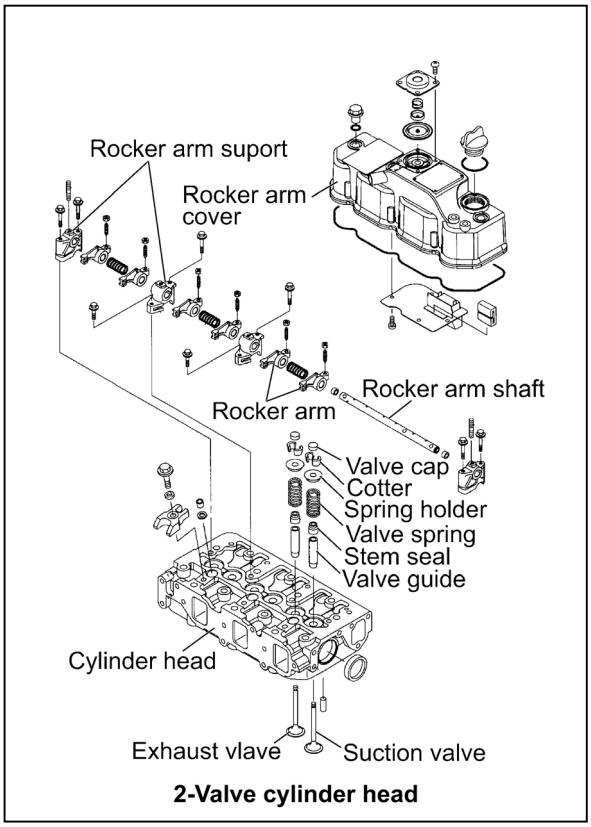




<table>
<tr><th>No.</th><th>Tool name</th><th>Applicable model and tool size</th><th>Illustration</th></tr>
<tr><td>5</td><td>Stem seal inserter
(for inserting stem seal)</td><td>mm
<table><tr><th>Model</th><th>d1</th><th>d2</th><th>d3</th><th>L1</th><th>L2</th><th>L3</th></tr><tr><td>3TNV82A</td><td>15.2</td><td>21</td><td>12</td><td>15.8</td><td>65</td><td>4</td></tr><tr><td>4TNV84
3TNV84(T)
4TNV88</td><td>16.2</td><td>22</td><td>13.5</td><td>18.8</td><td>65</td><td>4</td></tr><tr><td>4TNV84T</td><td>12.9</td><td>19</td><td>11.5</td><td>10.0</td><td>65</td><td>4</td></tr><tr><td>4TNE94l･98</td><td>15.2</td><td>21</td><td>12</td><td>11.8</td><td>65</td><td>4</td></tr><tr><td>4TNE106(T)</td><td>15.2</td><td>21</td><td>12</td><td>15.5</td><td>65</td><td>4</td></tr></table>※Locally manufactured</td><td>  </td></tr>
<tr><td>6</td><td>Filter wrench
(for removal / installation of L.O. filter)</td><td>Available on the market</td><td>  </td></tr>
<tr><td>7</td><td>Camshaft bushing tool
(for extracting camshaft bushing)</td><td>mm
<table><tr><th>Model</th><th>L1</th><th>L2</th><th>d1</th><th>d2</th></tr><tr><td>TNV82A～88</td><td>18</td><td>70</td><td>45</td><td>48</td></tr><tr><td>4TNV94L･98</td><td>18</td><td>70</td><td>50</td><td>53</td></tr><tr><td>4TNV106(T)</td><td>18</td><td>70</td><td>58</td><td>61</td></tr></table>Allowance: $d1^{-0.3}_{-0.6}$ $d2^{-0.3}_{-0.6}$
※Locally manufactured</td><td>  </td></tr>
<tr><td>8</td><td>Flex-Hone
(For re-honing of cylinder liner)</td><td><table><tr><th>Model</th><th>Parts No.</th><th>Cylinder bore (mm)</th></tr><tr><td>TNV82A～</td><td>129400-92420</td><td>78～84</td></tr><tr><td>TNV88～4TNV94L</td><td>129400-92430</td><td>83～95</td></tr><tr><td>4TNV98</td><td>129400-92440</td><td>89～101</td></tr><tr><td>4TNV106(T)</td><td>129400-92450</td><td>95～108</td></tr></table></td><td>  </td></tr>
<tr><td>9</td><td>Piston insertion tool
(for inserting piston)</td><td>Yanmar code No. 95550-002476
※The above piston insertion tool is applicable to 60-125 mm diameter pistons.</td><td>  </td></tr>
<tr><td>10</td><td>Piston ring replacer
(for removal / installation of piston ring)</td><td>Available on the market</td><td>  </td></tr>
<tr><td>11</td><td>Crankshaft pulley installing tool</td><td>Locally manufactured
(for 4TNV94L)
(Refer to 4.3.6 in detail)</td><td>  </td></tr>
</table>



4-Valve cylinder head



2-Valve cylinder head

4.2.3 Reassembly procedure:

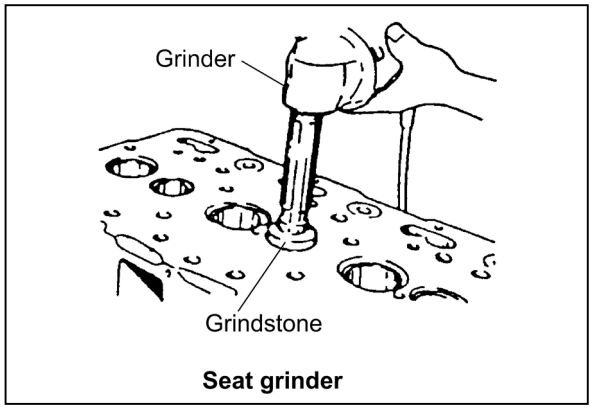
Reverse order of the disassembly procedure.

4.2.7 Valve guide replacement

1) Use a valve guide extraction tool(12.1-1 in Chapter 12) and extract the valve guide from the cylinder head.
2) Put liquid nitrogen or ether (or alcohol) with dry ice added in a container and put the valve guide for replacement in it for cooling. Then insert it in with a valve guide inserting tool (Refer to No.2 of 4.1.2 in Chapter 4).

⚠ CAUTION

Do not touch the cooled valve guide with bare hands to avoid skin damage.

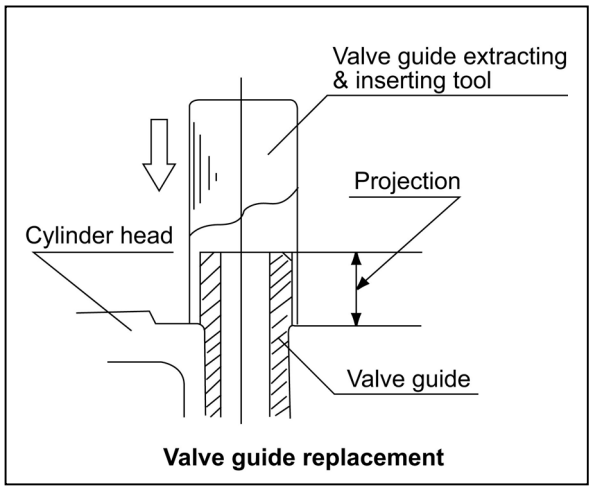


Seat grinder

3) Check the inside diameter and finish to the standard inside diameter as required with a reamer.
4) Check the projection from the cylinder head.

mm

Model	Number of valves	Projection
3TNV82A	2 valves	11.7∼12.0
4TNV84 3TNV84(T) 4TNV88		14.7∼15.0
4TNV84T	4 valves	8.2∼8.5
4TNV94L 4TNV98(T)		9.7∼10.
4TNE106(T)		13.4∼13.6



Valve guide replacement

4.4.4 Servicing points

Point1: Oil pan

[Disassemble]

- Sealant is applied to the oil pan mounting surface on the block. Carefully operate soas not to damage or distort the bonding surface.

[Reassemble]

- Apply sealant (code No.977770-01212) before reassembly.

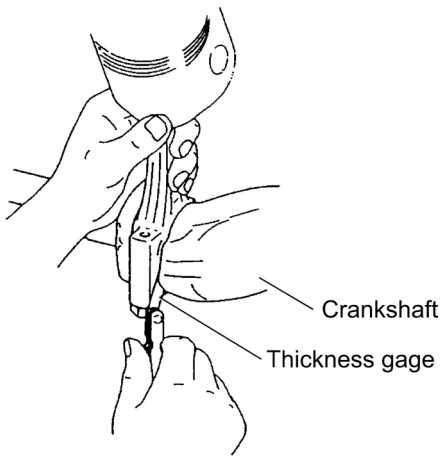
Point2: Piston w/rod

[Disassemble]

- Measure the connecting rod side gap.

mm

Standard	0.20～0.40



Connecting rod side gap

- Carefully remove the carbon deposit on top of the cylinder so as not to damage the inner side of the cylinder.
- Set the piston at the BDC position and remove the connecting rod cap. Then set the piston at the TDC position, and push the connecting rod big end with the wooden shaft of a hammer. Proceed carefully so as not to cause the cylinder block catch the rod big end. Set the rod caps and crankpin metals in their correct combinations.

[Reassemble]

- Apply oil especially carefully to the sliding contact surfaces of the pistons, rods and rings.
- Use the piston insertion tool (see 12.1-9 in Chapter 12) to insert each piston w/rod in the cylinder block and install the bearing metal cap.

Rod bolt tightening torque N·m(kgf-m)

Model	Standard (apply lube oil)
3TNV82A	37.2～41.2 (3.8～4.2)
TNV84～88	44.1～49.0 (4.5～5.0)
4TNV94L·98	53.9～58.8 (5.5～6.0)
4TNV106(T)	78.5～83.4 (8.0～8.5)

Point3: mounting flange

[Disassemble]

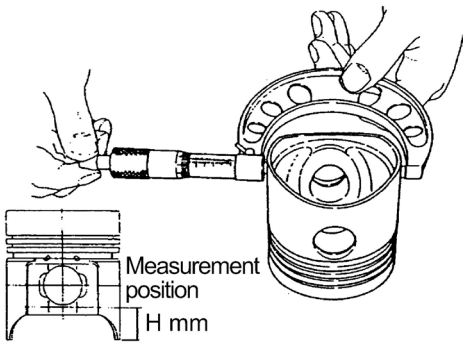
Place the engine on a stable base with the cylinder block upper surface facing down, and remove the mounting flange carefully so as not to damage the combustion surface.

(4) Piston

Especially clean the combustion surface, circumference, ring grooves and piston pin bosses, and check after removing any carbon deposit. Any burr at a ring groove or snap ring groove shall be removed. If crack is suspected, inspect by color check.

(a) Piston outside diameter measurement

Measure the long diameter at H mm from the bottom end of the piston of the oval hole in the vertical direction to the piston pin hole.



Piston outside diameter

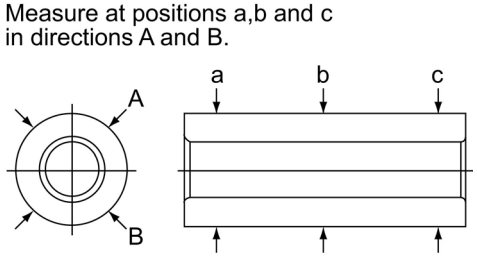
Piston outside diameter mm

Model	Outside diameter Standard	Limit	Clearance between piston and cylinder	Measurement position (H)
3TNV82A	81.950～81.980	81.905	0.035～0.065	22～25
3,4TNV84(T)	83.945～83.975	83.900	0.040～0.070	
3,4TNV88	87.945～87.975	87.900		
4TNV94L	93.945～93.955	93.900	0.050～0.080	22
4TNV98(T)	97.940～97.950	97.895		22
4TNV106(T)	105.930～105.960	105.880		30

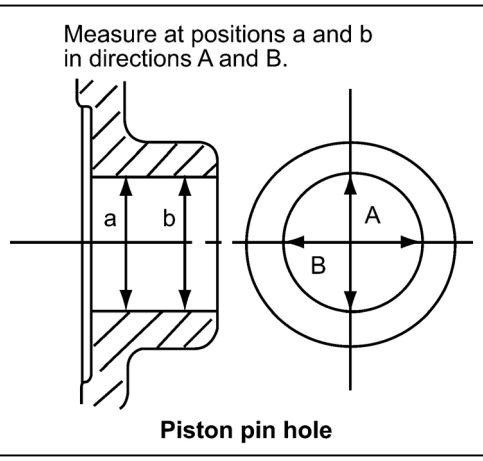
If the clearance between piston and cylinder exceeds the limit, use an oversized piston. (Refer to the tables of oversized pistons, oversized piston rings and cylinder boring dimension on 4.4.5(1)(c) in chapter 4.)

(b) Piston pin hole measurement

Measure the outside diameter of piston pin and the inside diameter of piston pin hole. Calculate the clearance between piston pin and piston pin hole. If any data exceeds the limit, replace the part with a new one.



Piston pin outside diameter



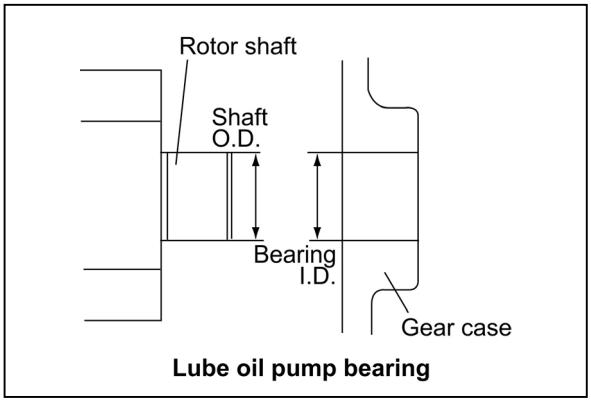
Piston pin hole

mm

Model	Item	Standard	Limit
3TNV82A	Pin I.D.	23.000～23.009	23.039
	Pin O.D.	22.995～23.000	22.965
	Clearance	0.000～0.014	0.074
TNV84～88	Pin I.D.	26.000～26.009	26.039
	Pin O.D.	25.995～26.000	25.965
	Clearance	0.000～0.014	0.074
4TNV94L・ 4TNV98(T)	Pin I.D.	30.000～30.009	30.039
	Pin O.D.	29.989～30.000	29.959
	Clearance	0.000～0.020	0.080
4TNV106(T)	Pin I.D.	37.000～37.011	37.039
	Pin O.D.	36.989～37.000	36.959
	Clearance	0.000～0.022	0.080

(3) Rotor shaft clearance (4TNV94L/98/106)

Measure the outside diameter of rotor shaft and the shaft hole diameter of gear case. Calculate the clearance from that difference.

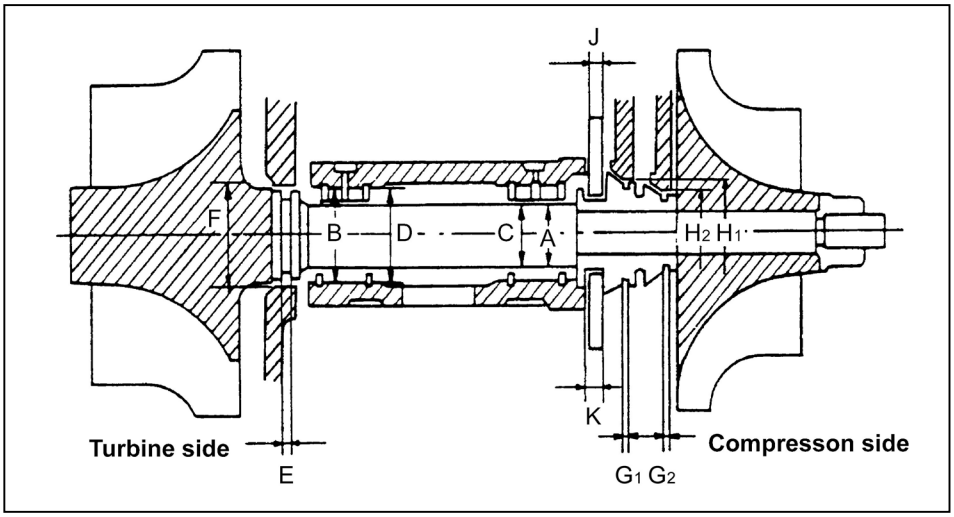


Lube oil pump bearing

Model	Inspection item	Standard	Limit
4TNV94L/ 98	Gear case bearing I.D.	12.980～13.020	13.05
	Rotor shaft O.D.	12.955～12.970	12.945
	Rotor clearance	0.035～0.065	0.105
4TNV106(T)	Gear case bearing I.D.	13.000～13.020	13.05
	Rotor shaft O.D.	12.955～12.965	12.945
	Rotor clearance	0.035～0.065	0.105

8.2 Service Standards and Tightening Torque

8.2.1 Service standards



(1) RHF5 type

Unit: mm

		Standard dimension	Wear limit
Turbine shaft	Turbine shaft journal outside diameter (A)	7.99~8.00	7.98
	Turbine shaft seal ring groove width (E)	1.25~1.28	1.29
	Compressor side seal ring groove width (G1)	1.22~1.23	1.31
	Compressor side seal ring groove width (G2)	1.02~1.03	1.11
	Turbine shaft run-out	0.002	0.011
Bearing	Journal bearing inside diameter (C)	8.01~8.03	8.04
	Journal bearing outside diameter (D)	12.32~12.33	12.31
	Bearing housing inside diameter (B)	12.40~12.41	12.42
Thrust bearing	Thrust bearing width (J)	3.99~4.01	3.98
	Thrust bushing groove dimension (K)	4.04~4.05	4.07
Seal ring fixing area	Turbine side (bearing housing)(F)	15.00~15.02	15.05
	Compressor side (seal ring)(H1)	12.40~12.42	12.45
	Compressor side (seal ring)(H2)	10.00~10.02	10.05
Rotor play in axial direction		0.03~0.06	0.09
Rotor play in radial direction		0.08~0.13	0.17

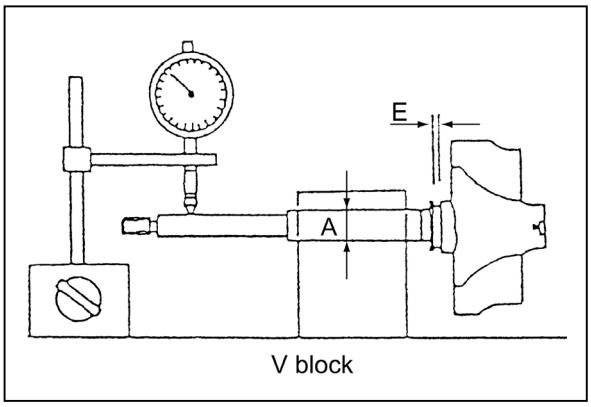
8.5.2 Inspection procedure

(1) Compressor housing 7
Inspect the compressor housing for any contact trace with the compressor impeller, surface defect, dent or crack at joint surface, and replace it if defective.

(2) Turbine housing 11
Inspect any trace of contact with the turbine wheel, exfoliation due to degradation by oxidation of the cast surface, thermal deformation or crack.
Replace with a new one of defective.

(3) Compressor impeller 18
Inspect any contact trace, chipping, corrosion or deformation.
Replace with a new one if defective.

(4) Turbine shaft 1
1) Inspect any contact trace, chipping, thermal discoloration or deformation at the turbine wheel. Check the shaft portion for bend, the journal portion for thermal discoloration or abnormal wear, and the seal ring groove for surface defect or wear. Replace with a new one if defective.
2) Measure the turbine shaft journal outside diameter (A) and seal ring groove width (E). Replace with a new turbine shaft if beyond the wear limit.



V block

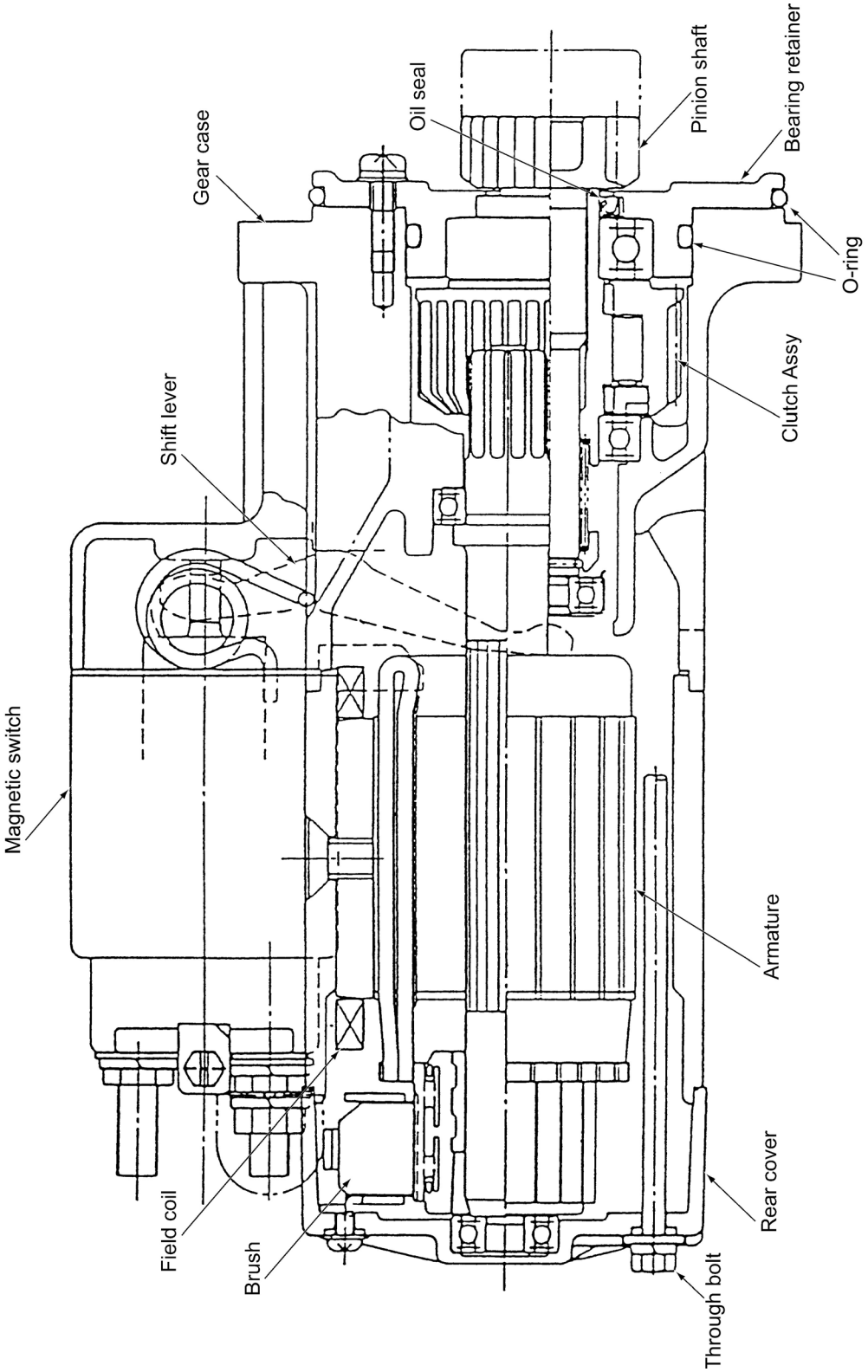
Wear limit of journal outside diameter (A)
RHF5 ····· 7.98mm
RHB51 ····· 7.98mm
RHB31 ····· 6.25mm

Wear limit of ring groove width (E)
RHF5 ····· 1.29mm
RHB51 ····· 1.29mm
RHB31 ····· 1.07mm

3) Measure the turbine shaft run-out, and replace with a new turbine shaft if it exceeds 0.011 mm.

(5) Heat insulating plate 20
Inspect the heat insulating plate for any contact trace, thermal deformation or corrosion Replace with a new one if defective.

9.1.2 Components



(b) Series coil continuity test
Check continuity between the S and M terminals. Good if continuity exists.

If no continuity (coil disconnection), replace the magnetic switch.

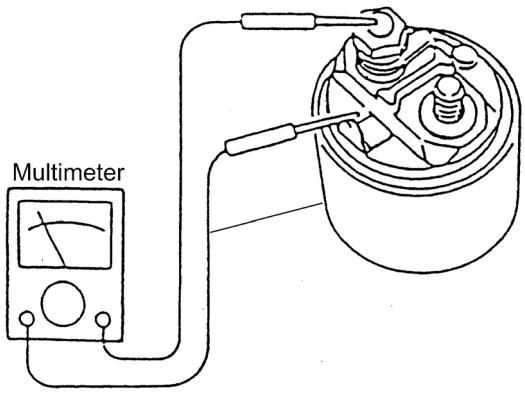


Fig. 22

(c) Contact continuity test
Depress the magnetic switch with the plunger at the bottom. Check continuity between the B and M terminals with a multimeter. Good if continuity exists.

If no continuity (coil continuity defect), replace the magnetic switch.

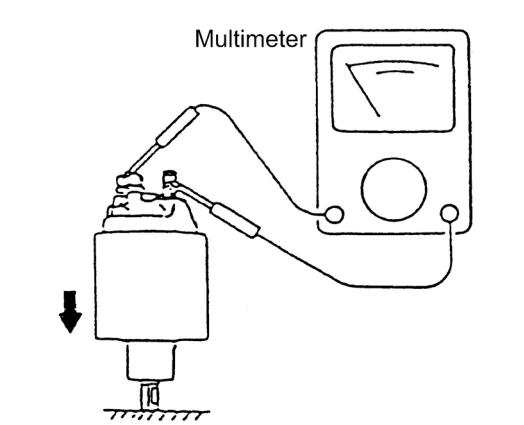


Fig. 23

(6) Pinion clutch

(a) Pinion inspection
Manually rotate the pinion. Inspect if it is rotated smoothly in the driving direction, and is locked in the opposite direction. Replace the pinion clutch if abnormal.

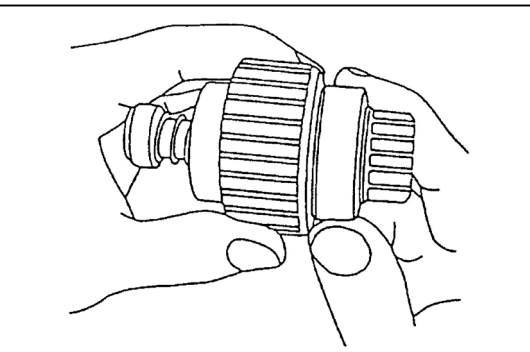
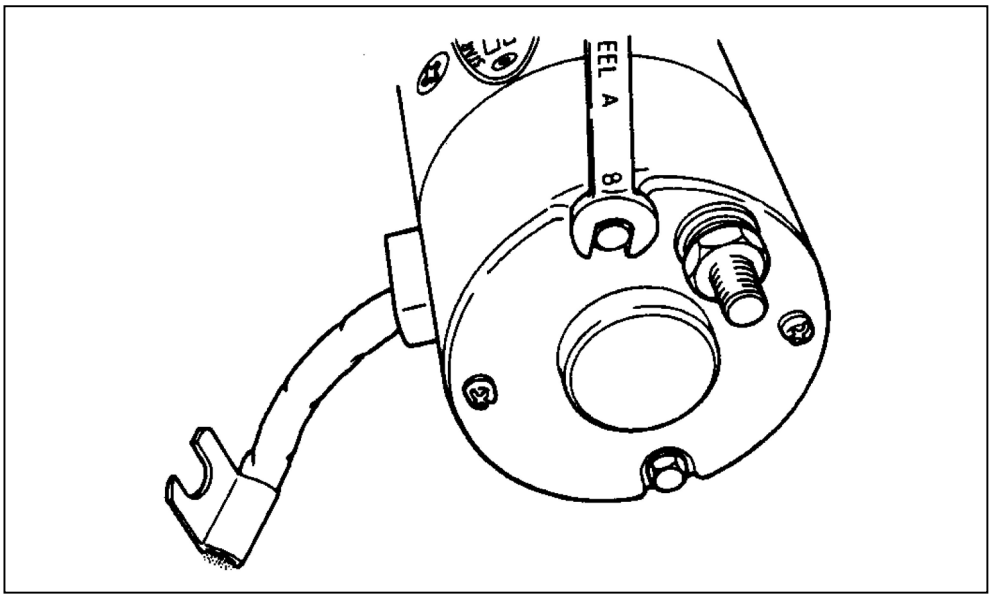
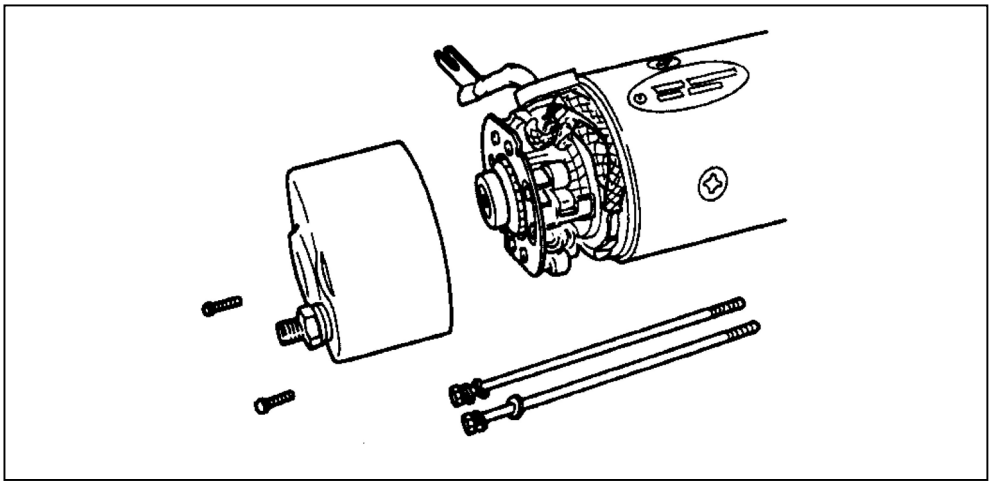


Fig. 24

(3) Removal of rear cover

Remove the brush holder tightening screws (4mmϕ×2) and the M5 through bolts (×2).
Next, disconnect the rear cover from the yoke using a – screwdriver.

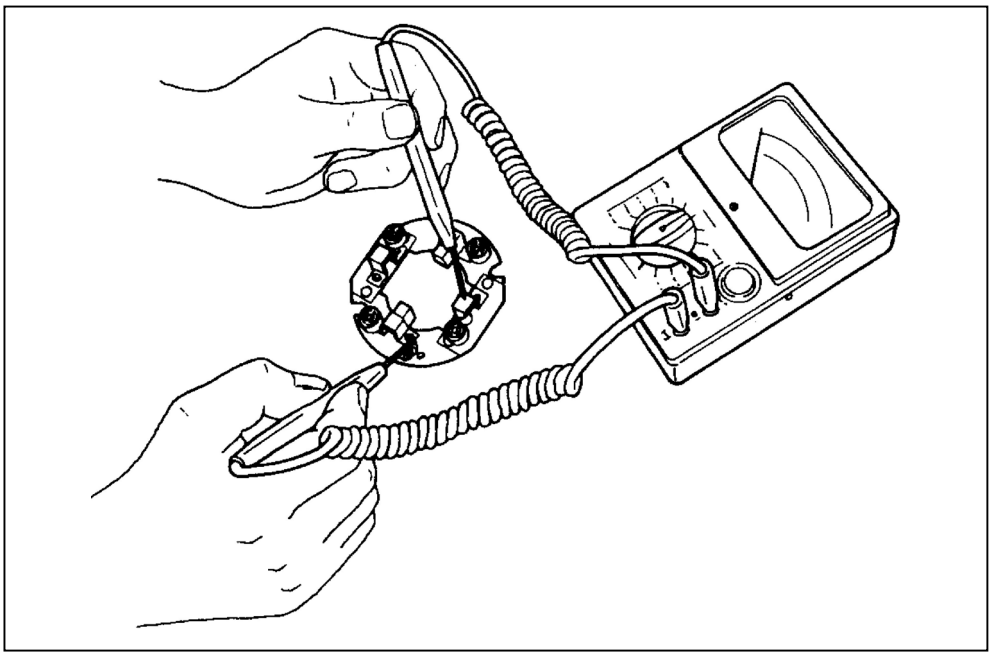




2) Check of brush movement
If the brush does not move smoothly, inspect the brush holder for bending and the brush holder sliding surface for dirt. Repair or clean as needed.

3) Check the continuity between the insulated brush holder (positive (+)) and the brush holder base (negative (-)).

If they are electrically continuous, replace since the holder is grounded.



11.2 PRECAUTION ON ELECTRIC WIRING

11.2.1 Alternator

In the cases listed below the warranty shall not be deemed to apply. Please be sure to read these conditions carefully when planning to use it with other equipment. Also be certain to give appropriate guidance on usage to the user.

(1) When the battery cable can be connected backwards

The alternator diode will be damaged and recharging made impossible if the plus and minus ends of the battery cable are confused. The stator coil will also be burned as a result. To prevent this, supply the user with a cable of such a length or structure that the plus and minus ends cannot be confused. Also warn the user not to connect the cable backwards.

(2) When charging output voltage is used for control purposes

The engine speed at starting is not proportional to the output voltage of the alternator, so this output voltage must not be used for any control systems. It is especially wrong to use it for the control signal of the safety relay for cutting the starter motor because this will damage the starter motor and cause engine starting failure.

(3) When the L line is used for control purposes

Consult with Yanmar first before connecting any load other than the charge lamp to the L line. Damage to the alternator and related equipment will not be warranted without such prior consultation.

(4) Non-use of the Yanmar wiring diagram

Use without prior consultation of any wiring diagram other than that provided by Yanmar removes any breakdown of any electrical equipment from the warranty.

(5) Regarding lamp control

Once the charge lamp goes out after the start of charging, it does not come on again even if the engine speed falls and charging is insufficient. The lamp will not light again if the charging circuit is normal. The lamp only comes on during operation if the alternator itself is broken or the drive V-belt breaks. However, when an LED is used for the charge lamp, the LED will shine faintly even during normal operation. This is due to the control system for the alternator lamp and is not an abnormality.

(6) Use of a non-specified V-belt

Use of a non-specified V-belt will cause inadequate charging and shorten the life of the belt. Use a belt of the specified type.

(7) Direct high pressure washing is prohibited

Water will enter the brush if the alternator is washed directly at high pressure, causing inadequate charging. Warn users not to use direct, high-pressure washing.

(8) Use of agricultural or other chemicals (direct contact or airborne)

Adhesion of agricultural and other chemicals, especially those with high sulfur content, to the IC regulator corrodes the conductor on the substrate, leading to over-charging (battery boiling) and charging malfunctions. Consult with Yanmar prior to use in such an environment. Use without prior consultation removes any breakdown from the warranty.

(2) Crankshaft

mm

Inspection item			Standard	Limit	Reference page
Bending (1/2 the dial gauge reading)			-	0.02	4.4.5.(2)
Crank pin	3TNV82A	Pin outside diameter	42.952～42.962	42.902	
		Metal inside diameter	43.000～43.042	-	
		Metal thickness	1.487～1.500	-	
		Clearance	0.038～0.090	0.150	
	TNV84～88	Pin outside diameter	47.952～47.962	47.902	
		Metal inside diameter	48.000～48.026	-	
		Metal thickness	1.492～1.500	-	
		Clearance	0.038～0.074	0.150	
	4TNV94L･98	Pin outside diameter	57.952～57.962	57.902	
		Metal inside diameter	58.000～58.026		
		Metal thickness	1.492～1.500	-	
		Clearance	0.038～0.074	-	
	4TNV106(T)	Pin outside diameter	63.952～63.962	0.150	
		Metal inside diameter	64.016～64.042	63.902	
		Metal thickness	1.984～1.992	-	
		Clearance	0.054～0.090	0.150	
Crank journal	3TNV82A	Journal outside diameter	46.952～46.962	46.902	
		Metal inside diameter	47.000～47.032	-	
		Metal thickness	1.987～2.000	-	
		Clearance	0.038～0.080	0.150	
	TNV84～88 Selective pairing	Journal outside diameter	53.952～53.962	53.902	
		Metal inside diameter	54.000～54.020	-	
		Metal thickness	1.995～1.990	-	
		Clearance	0.038～0.068	0.150	
	4TNV94L･98 Selective pairing	Journal outside diameter	64.952～64.962	64.902	
		Metal inside diameter	65.000～65.020	-	
		Metal thickness	1.995～2.010	-	
		Clearance	0.038～0.068	0.150	
	4TNV106(T) Selective pairing	Journal outside diameter	75.952～75.962	75.902	
		Metal inside diameter	76.014～76.034	-	
		Metal thickness	2.488～2.503	-	
		Clearance	0.052～0.082	0.150	