3. SPECIFICATIONS AND PERFORMANCE

1. SPEED AND GRADEABILITY

Type		Rubber crawler shoe	
Slewing Speed		9.0 rpm	
Travel Speed		Low (1st)	High (2nd)
		2.0km/h (1.2mph)	3.5km/h (2.2mph)
Gradeability	% (degree)	58 % (30°)	

2. BOOM SWING & DOZER BLADE

Type		Boom swing by hydraulic cylinder
Boom Swing Angle	Right	50°
	Left	85°
Stroke of Dozer(above/below) mm(in)		210 / 270 (8.3 / 10.6)

3. ENGINE

Model	YANMAR 3TNE74
Type	Water-cooled, 4-cycle type Swirl chamber type diesel engine
Number of cylinders-Bore x Stroke	3 - 74mm X 78mm (2.91in X 3.07in)
Total Displacement	1.01 liters (61.6 cu.in)
Output Rating	15 PS / 2,000rpm {11.0kW / 2,000min^{-1}}
Maximum Torque	6.2kgf•m / 1,600rpm {45 lbf•ft/1,600rpm}
Starting Motor	12V / 1.0 kW
Generator	12V / 20 A

4. HYDRAULIC COMPONENTS

Hydraulic Pump	Variable displacement axial piston + gear pump
Hydraulic Motor	Orbit motor
Hydraulic Motor w/Reducer (Travel)	Axial piston, 2-Speed motor
Control Valve	10-spool multiple control valve
Cylinder (Boom, Arm, Swing, Bucket, Dozer, Frame width)	Double action cylinder
Return Filter	Safety valve containing/Filter Type (30μ)

5. NOISE LEVEL

Sound Power Level	92dB (A)

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2.1-2 HYDRAULIC CIRCUITS DIAGRAM

■ **SK16**

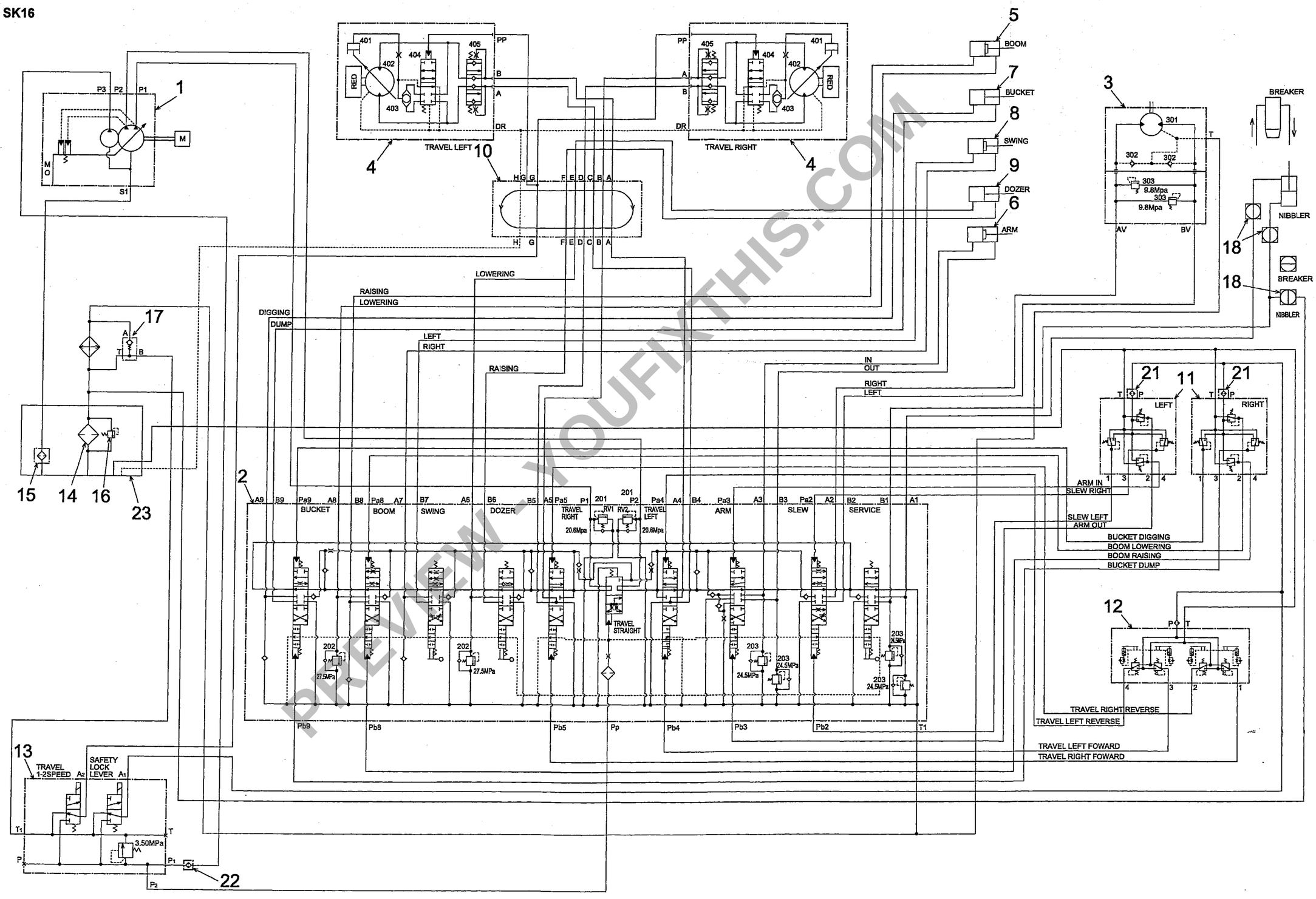
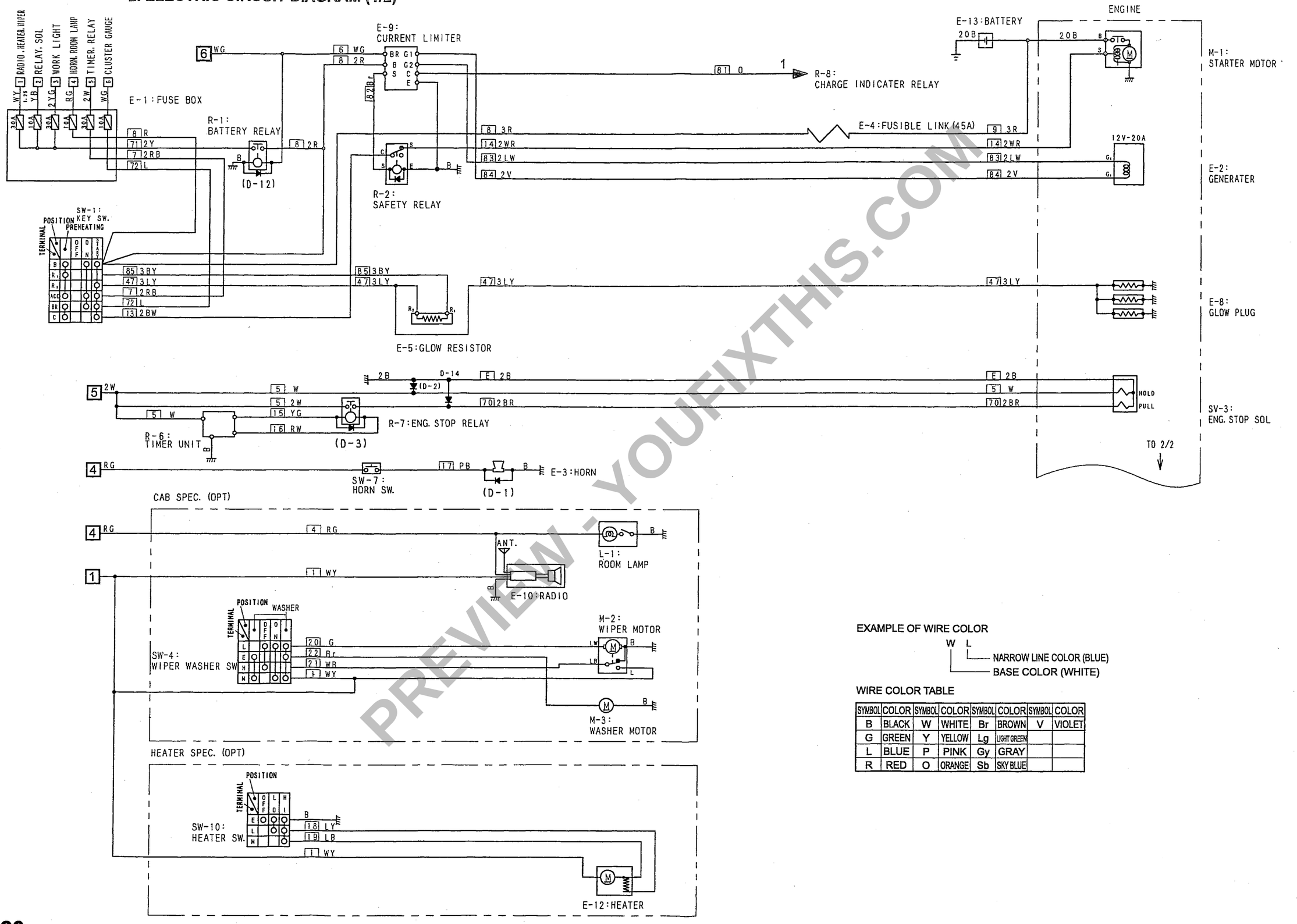


Fig.1 Hydraulic circuit diagram

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2. ELECTRIC CIRCUIT DIAGRAM (1/2)



EXAMPLE OF WIRE COLOR

W L
- L — NARROW LINE COLOR (BLUE)
- W — BASE COLOR (WHITE)

WIRE COLOR TABLE

SYMBOL	COLOR	SYMBOL	COLOR	SYMBOL	COLOR	SYMBOL	COLOR
B	BLACK	W	WHITE	Br	BROWN	V	VIOLET
G	GREEN	Y	YELLOW	Lg	LIGHT GREEN		
L	BLUE	P	PINK	Gy	GRAY		
R	RED	O	ORANGE	Sb	SKY BLUE		

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2. BUCKET

2.1 REMOVAL OF BUCKET

(1) Operate the operating lever and place the bucket on the ground, so the bucket and arm connecting pins are not loaded.

(2) Move the O-rings (3)toward the bucket bosses using a spatula.

(3) In order to remove pin (K) which links arm and bucket, remove the ring (2) and the pin (1) by means of minus driver, and draw out pin (K).

- If the pin does not come off easily, the pin is loaded. Take off the load by manipulating the operating lever.
- Take care so the dust seal between the arm and the bucket bosses is not damaged.

(4) Adjust the bucket by manipulating the operating lever so the pin (J) between the bucket link and the bucket is not loaded.

(5) Remove the ring (2) and pin (1) then pull out the pin (J).

(6) Remove bucket assy.
Weight of bucket assy : Standard type
33 kg (73 lb)

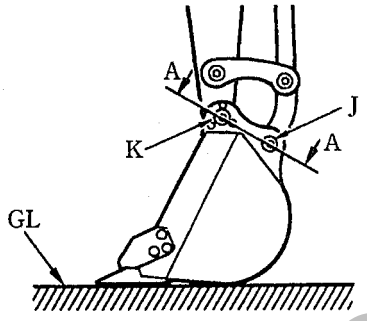


Fig. 2-2 To place Bucket on ground

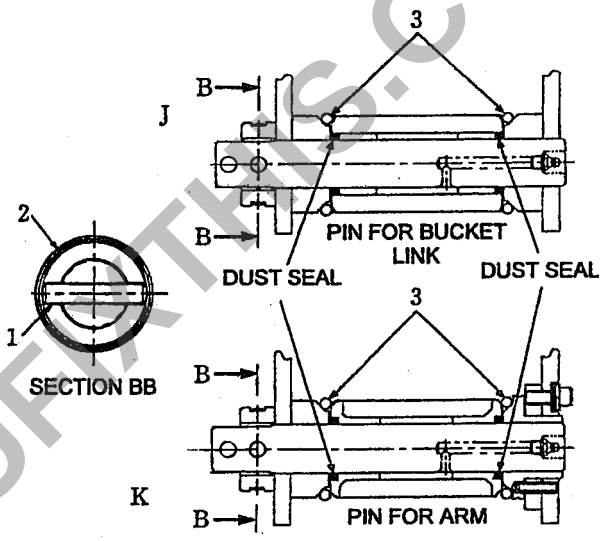


Fig. 2-3 Assembly of pin (SECTION A-A)

2.2 INSTALLATION OF BUCKET

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

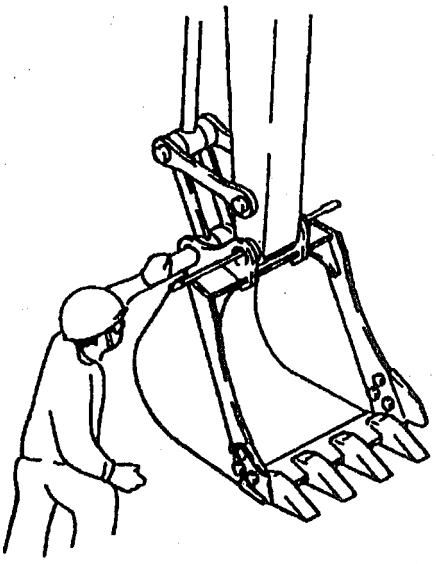
⚠ • When aligning the pin holes, do not put your finger in the pin holes in any circumstances, but align them visually.

(1) Clean the welded part of the structures and check that there is no crack on the part.

(2) Check that the dust seal is not damaged, and replace a faulty one if necessary.

(3) Adjust the clearance between the bucket and the arm according to Item 2.3.

(4) Replace the weared pins and bushings according to the Section "ATTACHMENT DIMENSIONS" of "SPECIFICATIONS".


Fig. 2-4 Installation of bucket

(5) When inserting the pin, coat the shaft with grease.

- The bucket can be mounted easily if the bucket link is installed in the beginning.

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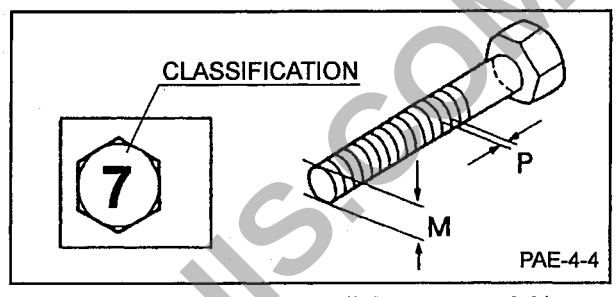
1. TORQUE SPECIFICATIONS FOR CAPSCREWS & NUTS

The following Torque Specifications are provided for use when actual torque value of a fastener is not known. Check the capscrews and nuts for their looseness and dropping off before the start of daily work and at the periodical maintenance. Retighten the loosened ones, and install new ones for the dropped off. For the new machine, the check and retightening of them must be carried out at first 50 hours operation. For the replacement of them, make sure to use the same size of KOBELCO genuine parts.

Refer to the table below for the tightening and retightening of capscrews.

- The table below is not applicable for the capscrews to fix the cover, etc., made of plastic. For the tightening torque for such capscrews, consult with an authorized KOBELCO Distributor. Over-tightening may cause damages on the parts to be fixed.
- In case that the tightening torque is specified in the manual, use such torque values regardless to the table below.

- Numerical indication on the capscrew head shows the classification for strength (e.g., 7 = 7 T). No indication is provided for smaller size of capscrews, M 5 or less.



1. Metric Coarse Thread Standard Tightening Torque Values. Make certain to tighten all Capscrews & Nuts to proper torque values.

Classification	4.8 T		7 T		10.9 T	
NOMINAL SIZE	NO LUBRICATION	OIL LUBRICATION	NO LUBRICATION	OIL LUBRICATION	NO LUBRICATION	OIL LUBRICATION
M6 P=1	0.45±0.05(3.2±0.4)	0.38±0.04(2.7±0.3)	0.98±0.1(7.1±0.7)	0.83±0.08(6.0±0.6)	1.77±0.18(12.8±1.3)	1.5±0.15(10.8±1.1)
M8 P=1.25	1.09±0.11(7.9±0.8)	0.92±0.09(6.6±0.7)	2.4±0.2(17.3±1.4)	2.0±0.2(14.4±1.4)	4.3±0.4(31±2.9)	3.6±0.4(26±2.9)
M10 P=1.5	2.2±0.2(15.9±1.4)	1.83±0.18(13.2±1.3)	4.7±0.5(34±3.6)	4.0±0.4(29±2.9)	8.5±0.9(61±6.5)	7.2±0.7(52±5.1)
M12 P=1.75	3.7±0.4(27±2.9)	3.2±0.3(23±2.2)	8.1±0.8(59±5.8)	6.8±0.7(49±5.1)	14.6±1.5(105±10.8)	12.3±1.2(89±8.7)
M14 P=2	5.9±0.6(43±4.3)	5.0±0.5(36±3.6)	12.8±1.3(93±9.4)	10.8±1.1(78±7.9)	23±2(166±14.5)	19.5±1.9(140±13.7)
M16 P=2	9.0±0.9(65±6.5)	7.6±0.7(55±5.1)	19.5±2(140±14.4)	16.4±1.6(118±11.5)	35±4(252±29)	29±3(209±22)
M18 P=2.5	12.4±1.2(90±8.7)	10.5±1.0(76±7.2)	27±3(195±22)	23±2(166±14.5)	49±5(354±36)	41±4(296±29)
M20 P=2.5	17.5±1.7(126±12.3)	14.7±1.4(106±10.1)	38±4(274±29)	32±3(231±22)	68±7(491±51)	57±6(412±43)
M22 P=2.5	23±2(166±14.5)	19.6±2(142±14.5)	51±5(368±36)	43±4(310±29)	92±9(665±65)	77±8(557±58)
M24 P=3	30±3(217±22)	24±3(173±22)	65±7(470±51)	53±5(383±36)	118±12(852±87)	93±10(673±72)
M27 P=3	44±4(318±29)	36±3(260±22)	96±10(694±72)	78±8(563±58)	173±17(1250±123)	140±14(1010±100)
M30 P=3.5	60±6(433±43)	50±5(361±36)	131±13(948±94)	110±11(796±79)	235±24(1700±174)	198±20(1430±145)
M33 P=3.5	81±8(585±58)	68±7(491±51)	176±18(1270±130)	148±15(1070±110)	317±32(2290±230)	266±27(1920±195)
M36 P=4	105±10(758±72)	88±9(636±65)	227±23(1640±170)	190±19(1370±140)	409±41(2960±300)	343±34(2480±250)

TORQUE VALUE UNIT-kgf·m (lbf·ft)

2. Metric Fine Thread Standard Tightening Torque Values. Make certain to tighten all Capscrews & Nuts to proper torque values.

Classification	4.8 T		7 T		10.9 T	
NOMINAL SIZE	NO LUBRICATION	OIL LUBRICATION	NO LUBRICATION	OIL LUBRICATION	NO LUBRICATION	OIL LUBRICATION
M8 P=1.0	1.15±0.11(8.3±0.8)	0.97±0.1 (7.0±0.7)	2.5±0.2 (18.0±1.4)	2.1±0.2 (15.2±1.4)	4.5±0.4 (33±2.9)	3.8±0.4 (27±2.9)
M10 P=1.25	2.3±0.2 (16.6±1.4)	1.91±0.19(13.8±1.4)	4.9±0.5 (35±3.6)	4.2±0.4 (30±2.9)	8.9±0.9 (64±6.5)	7.5±0.7 (54±5.1)
M12 P=1.25	4.0±0.4 (29±2.9)	3.4±0.3 (25±2.2)	8.7±0.9 (63±6.5)	7.3±0.7 (53±5.1)	15.7±1.6 (114±11.6)	13.2±1.3 (95±9.4)
M16 P=1.5	9.4±0.9 (68±6.5)	7.9±0.8 (57±5.8)	20±2 (144±14.5)	17.2±1.7 (124±12.3)	37±4 (268±29)	31±3 (224±22)
M20 P=1.5	19±1.9 (137±13.7)	15.8±1.6 (114±11.6)	41±4 (296±29)	34±3 (246±22)	74±7 (535±51)	62±6 (448±43)
M24 P=2	32±3 (231±22)	27±3 (195±22)	70±7 (506±51)	58±6 (420±43)	126±12 (911±87)	105±10 (759±72)
M30 P=2	65±6 (470±43)	54±5 (391±36)	142±14(1030±100)	118±12 (852±87)	255±26 (1840±188)	212±21 (1530±150)
M36 P=3	109±11 (788±79)	91±9 (658±65)	238±23(1720±166)	198±20 (1430±145)	428±43 (3100±310)	357±36 (2580±260)

TORQUE VALUE UNIT-kgf·m (lbf·ft)

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1. TROUBLE DIAGNOSIS : HYDRAULIC

Classification	Group No.		Probable Cause / Component / Trouble	Engine speed	Pump: Pump P1	Pump: Pump P2	Pump: Pump P3	Pump: Pilot relief valve	Control valve: Travel spool	Control valve: Slewing spool	Control valve: Boom spool	Control valve: Arm spool	Control valve: Bucket spool	Control valve: Load check valve	Slewing motor: Motor	Travel motor: Motor	Travel motor: Counter balance valve	Travel motor: Check valve for counter balance valve	Travel motor: 1st/2nd speed shifting valve	Cylinder: Boom cylinder	Cylinder: Arm cylinder	Cylinder: Bucket cylinder	Cylinder: Travel lock cylinder	Other valves: Swivel joint	Other valves: Pilot valve	Other valves: 1st / 2nd travel speed solenoid valve	Other valves: Lever lock solenoid valve	Filter: Inline filter	Filter: Suction strainer	Filter: Bypass check valve	Filter: Return filter	Relief valve: Main relief valve	Relief valve: Boom down	Relief valve: Arm digging	Relief valve: Slewing
Attachment operation	1	(1)	Incapable of attachment operation				○	○			○	○	○											○		○					○			
		(2)	Attachment force small	○	○	○	○	○			○	○	○	○						○	○	○			○						○	○	○	
		(3)	Attachment speed low	○	○	○	○	○			○	○	○	○						○	○	○			○						○	○	○	
Travel operation	2	(1)	Incapable of travel operation				○	○	○							○	○	○					(*)											
		(2)	Traction force small	○	○	○			○					○		○	○	○						○								○			
		(3)	Travel speed low	○	○	○			○					○		○	○	○	○					○								○			
		(4)	Incapable of shifting 1st / 2nd speed				○	○								○			○					○		○									
		(5)	Deviation in single (independent) operation	○	○	○			○					○		○	○	○																	
Slewing operation	3	(1)	Incapable of slewing operation				○	○	○						○										○										
		(2)	Slewing speed low	○		○	○	○	○					○	○										○										○
		(3)	Slewing force small	○		○	○	○	○					○	○										○										○
Pump	4	(1)	Malfunction of pump		○	○	○																						○					

Note : (*) Marked items are not applied for SK16 and SK17 which provide Pilot Valve instead of travel lock cylinder

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S5PF0304E 2003-4				ATTACHMENT DIMENSIONS	PF03
S5PF1104E 2003-4			MAINTENANCE	TOOLS	PF11
S5PF1204E 2003-4				STANDARD MAINTENANCE TIME TABLE	PF12
S5PF1304E 2003-4				MAINTENANCE STANDARDS AND TEST PROCEDURES	PF13
—			SYSTEM		
S5PF2204E 2003-4				HYDRAULIC SYSTEM	PF22
S5PF2304E 2003-4				ELECTRICAL SYSTEM	PF23
S5PF2404E 2003-4				COMPONENTS SYSTEM	PF24
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—					
S5PF3104E 2003-4			DISASSEMBLING	WHOLE DISASSEMBLING & ASSEMBLING	PF31
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S5PF3304E 2003-4				UPPER SLEWING STRUCTURE	PF33
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S5PF4204E 2003-4				HYDRAULIC SYSTEM	PF42
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S5PF5104E 2003-4			E/G	ENGINE	PF51
			OPT		

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1.1 GENERAL SAFETY INFORMATION

WARNING

Do Not operate or perform any maintenance on this machine until all instructions found in the OPERATION & MAINTENANCE MANUAL have been thoroughly read and understood.
Improper operation or maintenance of this machine may cause accidents and could result in serious injury or death.
Always keep the manual in the operator's seat pocket.
If it is missing or damaged, place an order with an authorized KOBELCO Distributor for a replacement.
If you have any questions, please consult an authorized KOBELCO Distributor.

1. Most accidents, which occur during operation, are due to neglect of precautionary measures and safety rules. Sufficient care should be taken to avoid these accidents. Erroneous operation, lubrication or maintenance services are very dangerous and may cause injury or death of personnel. Therefore all precautionary measures, NOTES, DANGERS, WARNINGS and CAUTIONS contained in the manual and on the machine should be read and understood by all personnel before starting any work with or on the machine.

2. Operation, inspection, and maintenance should be carefully carried out, and safety must be given the first priority. Messages of safety are indicated with marks. The safety information contained in the manual is intended only to supplement safety codes, insurance requirements, local laws, rules and regulations.

3. Messages of safety appear in the manual and on the machine : All messages of safety are identified by eighter word of "DANGER", "WARNING" and "CAUTION".
   a. **DANGER-** Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury and is represented as follows:

DANGER

   b. **WARNING-** Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury and is represented as follows:

WARNING

   c. **CAUTION–** Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against possible damage to the machine and its components and is represented as follows:

CAUTION

4. It is very difficult to forecast every danger that may occur during operation. However, safety can be ensured by fully understanding proper operating procedures for this machine according to methods recommended by KOBELCO.

5. While operating the machine, be sure to perform work with great care, so as not to damage the machine, or allow accidents to occur.

6. Continue studying the manual until all Safety, Operation and Maintenance procedures are completely understood by all persons working with the machine.

1.2 SAFETY PRECAUTIONS

WARNING

The proper and safe lubrication and maintenance for this machine, recommended by KOBELCO, are outlined in the OPERATOR'S MANUAL for the machine.
Improper performance of lubrication or maintenance procedures are dangerous and could result in injury or death. Read and understand the MANUAL before performing any lubrication or maintenance.

The serviceman or mechanic may be unfamiliar with many of the systems on this machine. This makes it important to use caution when performing service work. A knowledge of the system and or components is important before the removal or disassembly of any component.

Because of the size of some of the machine components, the serviceman or mechanic should check the weights noted in this manual. Use proper lifting procedures when removing any components. Weight of components table is shown in the section ; SPECIFICATIONS.

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1.2 BOOM MAINTENANCE STANDARDS

(1) Clearance of pin and bushing on boom section

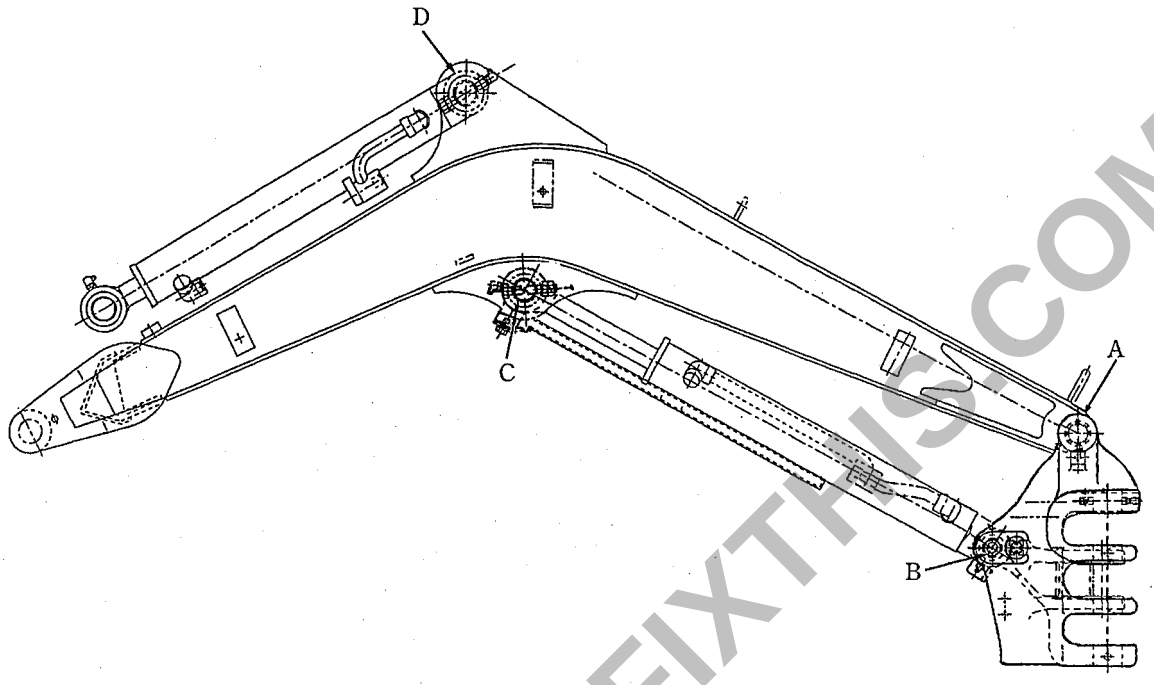


Fig. 1-2 Clearance of pin and bushing on boom section

Table 1-2 Unit : mm (in)

Pos.	Item	Pin parts No.	Standard dimensions			Clearance			Remedy
			Pin dia.	Tolerance on pin dia.	Tolerance on bushing bore dia.	Standard value	Standard value for repair	Serviceability limit	
A	Boom foot	PA12B01032D4	ø 30 (1.1811)	-0.02 -0.05 (-0.0008 -0.0020)	+0.05 0 (+0.0020 0)	0.02 ~0.10 (0.0008 ~ 0.0039)	0.5 (0.020)	0.8 (0.031)	Replace bushing or pin
B	Boom cylinder (Head side)	PF02B01001P1		-0.02 -0.08 (-0.0008 -0.0031)	+0.18 +0.05 (+0.0071 +0.0020)	0.07 ~ 0.26 (0.0028 ~ 0.0102)			
C	Boom cylinder (Rod side)	PA02B01072D2							
D	Arm cylinder (Head side)	PF02B01022P1	ø 35 (1.3780)	-0.03 -0.08 (-0.0012 -0.0031)		0.08 ~ 0.26 (0.0031 ~ 0.0102)			

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

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4. MEASURING HYDRAULIC OIL PRESSURE

4.1 STANDARD FOR HYDRAULIC OIL PRESSURE MEASUREMENT

(1) Hydraulic Instruments

70 kgf/cm² (1000 psi) pressure gauge.....1 set
500 kgf/cm² (7110 psi) pressure gauge...2 sets
Surface Thermometer .....1 set
Pressure Measuring Kit and
Oil Analyzing Equipment .....1 set

(2) Measuring cleanliness of hydraulic oil

⚠ • After releasing air in the hydraulic oil tank, open the cover and sample oil in the hydraulic tank, and measure with the instrument for analysis. If the measured value is over the standard value, replace the return filter and/or change the hydraulic oil.

4.2 PRESSURE MEASUREMENT AND ADJUSTMENT

4.2.1 Main Circuit Pressure

(1) Measuring Conditions

Engine speed : High idling
Hydraulic oil temperature: 50 ~ 60 °C (122 ~ 140 °F)
Coolant temperature (on radiator surface): 60~90 °C (140 ~ 194 °F)

(2) Pressure Measuring Procedures

1) Set the pressure gauge to the pressure detecting port (plugged), and operate the circuit to be measured to measure the relief pressure.
2) When the main relief pressure is being within the standard range, the measurement for the port relief pressure may be omitted.
3) If the main relief pressure is lower than the standard range, tighten up he main relief valve by half turn [pressure increase by 62 kgf/cm² (880 psi)], then measure the pressure at port relief valve.
4) After adjustment for the port relief pressure, return back the main relief pressure within the standard range.

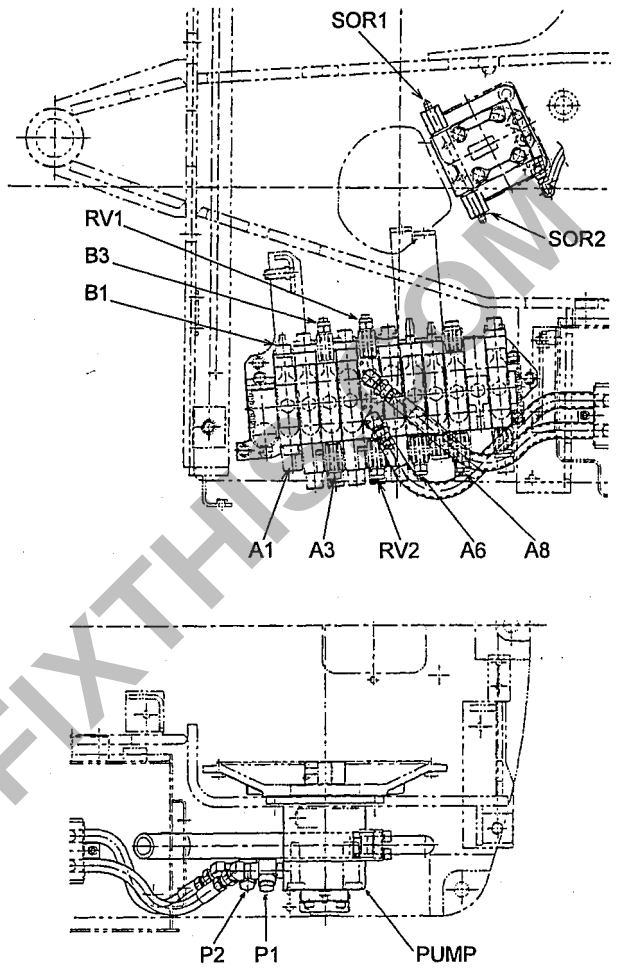


Fig. 4-1 Main hydraulic oil pressure measurement

Operating Circuit	Press. Detecting Port		Relief Valve
	Port Location	Size	
Bucket, Boom, Swing Dozer/Crawler width, & Travel (right)	P1	PF1/4	RV1
Arm & Travel (left)	P2		RV2
Service (N & B)	P1 ,P2		RV1, RV2
Slew	P2		SOR1, SOR2

Location of over load relief valve

A1	Nibbler open	A6	Dozer lowering
B1	Nibbler close	A8	Boom lowering
A3	Arm in	SOR1	Slewing right
B3	Arm out	SOR2	Slewing left

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3.11 NIBBLER / BREAKER OPERATING CIRCUIT

The operation is conducted by the operating pedal, which drives the cable to operate valve.

3.11.1 Nibbler (close) Operating Circuit

(1) Nibbler Operation

Press the left side of the control pedal, and the cable is pulled and consequently the service (nibbler / breaker) valve spool of control valve (2) is Shifted.

Since the pilot oil pressure is not utilized for it, as the same case as the dozer, it is activated regardless to the safety lock lever.

(2) Main Circuit

1) Supply Circuit for Nibbler Cylinder

The discharged oils from P1 and P2 ports on the variable pump flow into P1 and P2 ports on the control valve (2), and join together at the point before the service valve. The pressurized oil discharged from B1 port through the service valve, is supplied to head side of the nibbler cylinder to close the nibbler.

3.11.2 Breaker ON Operating Circuit

(1) Breaker Operation

Press the right side of the control pedal, and the cable is pushed and consequently the service (nibbler / breaker) valve spool of control valve (2) is Shifted.

Since the pilot oil pressure is not utilized for it, as the same case as the dozer, it is activated regardless to the safety lock lever.

(2) Main Circuit

The discharged oils from P1 and P2 join together in the control valve (2). The pressurized oil discharged from A1 port through the service valve enters into the breaker to operate it. The return oil returns to the hydraulic oil tank (23) through the stop valve (18) which is switched to the breaker side.

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3. CONTROL VALVE

3.1 GENERAL VIEW AND HYDRAULIC PORTS NO.

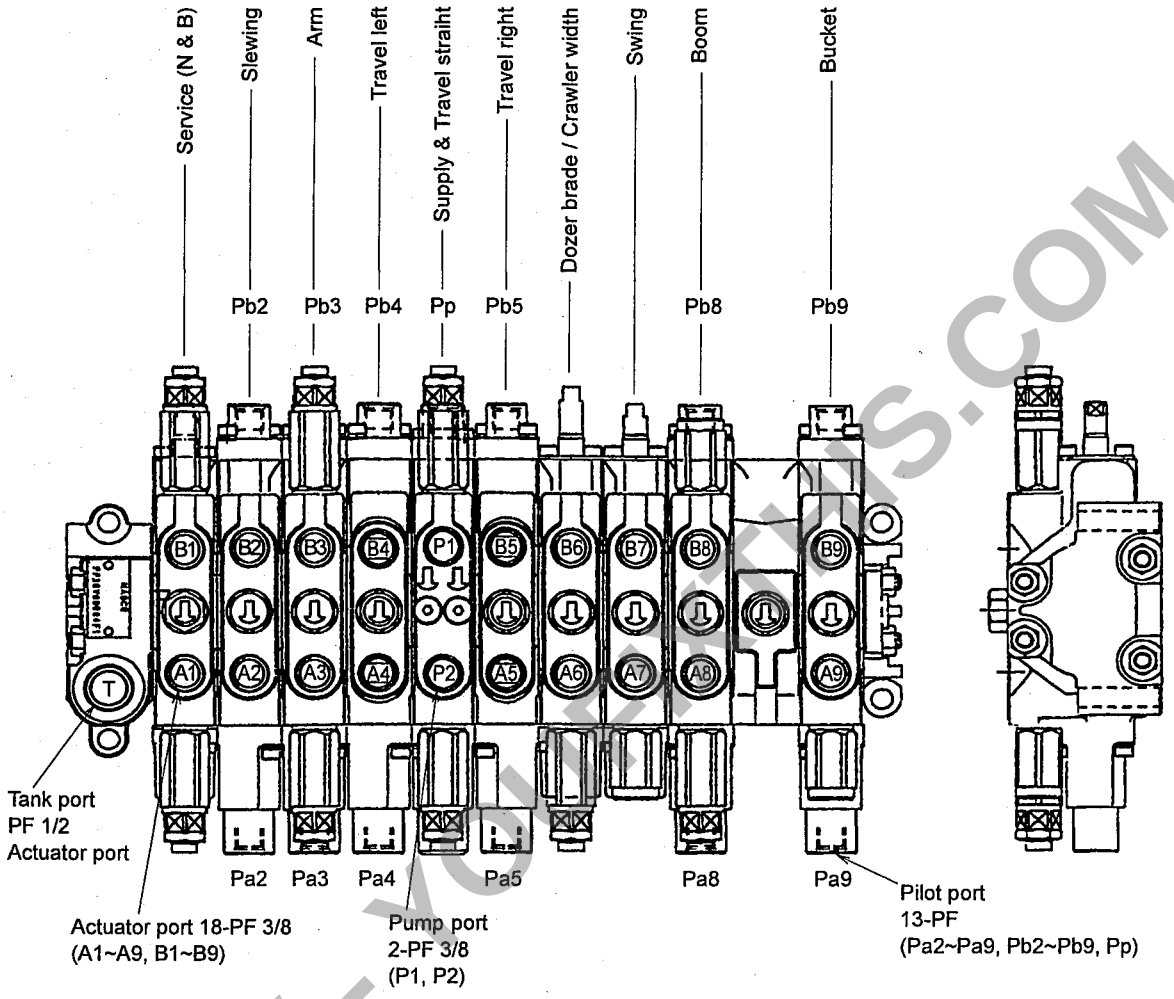


Fig. 3-1

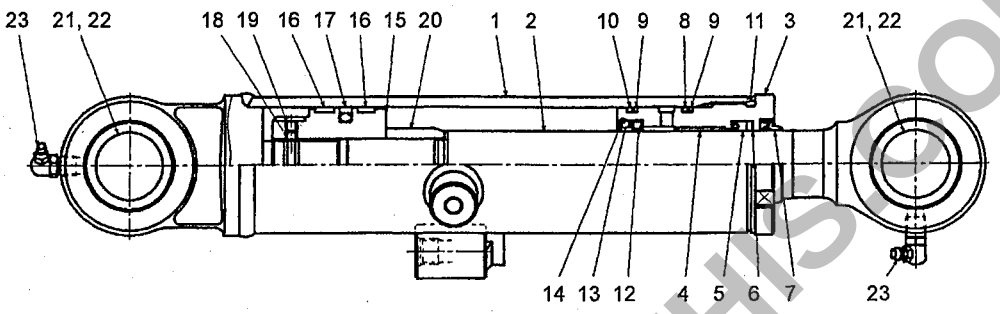
3.2 SPECIFICATIONS

Table. 3-1

ITEM		SPECIFICATIONS
Model(Type)		BCV35-JY10
Valve operation	Manual	Swing, Service, Dozer blade / Crawler width
	Pilot	Travel straight, Travel left, Travel right, Boom, Arm, Slewing
Flow rate		P1, P2-15L/min
Setting pressure at main relief valve P1,P2		P1,P2···210 $^{+5}_{0}$ kgf/cm² (2990 $^{+71}_{0}$ psi) at15L/min (4.0gal/min)
Settingpressure at over load relief valve		A1, B1, A3, B3 port 250 $^{+5}_{0}$ Kgf/cm² (3560 $^{+71}_{0}$ psi) at5L/min (1.3gal/min) A6, A8 port 280 $^{+5}_{0}$ kgf/cm²(3980 $^{+71}_{0}$ pis) at5L/min (1.3gal/min)

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(2) Arm cylinder



No.	NAME	Q'TY	No.	NAME	Q'TY	No.	NAME	Q'TY
1	CYLINDER TUBE ASSY	1	9	BACK-UP RING	2	17	SEAL RING ASSY	1
2	PISTON ROD ASSY	1	10	O-RING	1	18	STEEL BALL	1
3	CYLINDER HEAD	1	11	O-RING	1	19	SETSCREW	1
4	BUSHING	1	12	CUSHION RING	1	20	CUSHION BEARING	1
5	U-RING	1	13	SPACER	1	21	PIN BUSHING	2
6	BACK-UP RING	1	14	STOPPER	1	22	DUST SEAL	4
7	WIPER RING	1	15	PISTON	1	23	GREASE NIPPLE	2
8	O-RING	1	16	SLIDE RING	2			

Fig. 8-3 Construction of arm cylinder

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5.2 INSTALLATION OF SWING BRACKET AND CYLINDER

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

(1) Check the dust seal for damages, and replace the faulty dust seal to new one.

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

(3) Before inserting the pin, apply grease to the shaft area.

(4) Refer to Fig. 2-19 for the shim adjustment at pin installing portion.

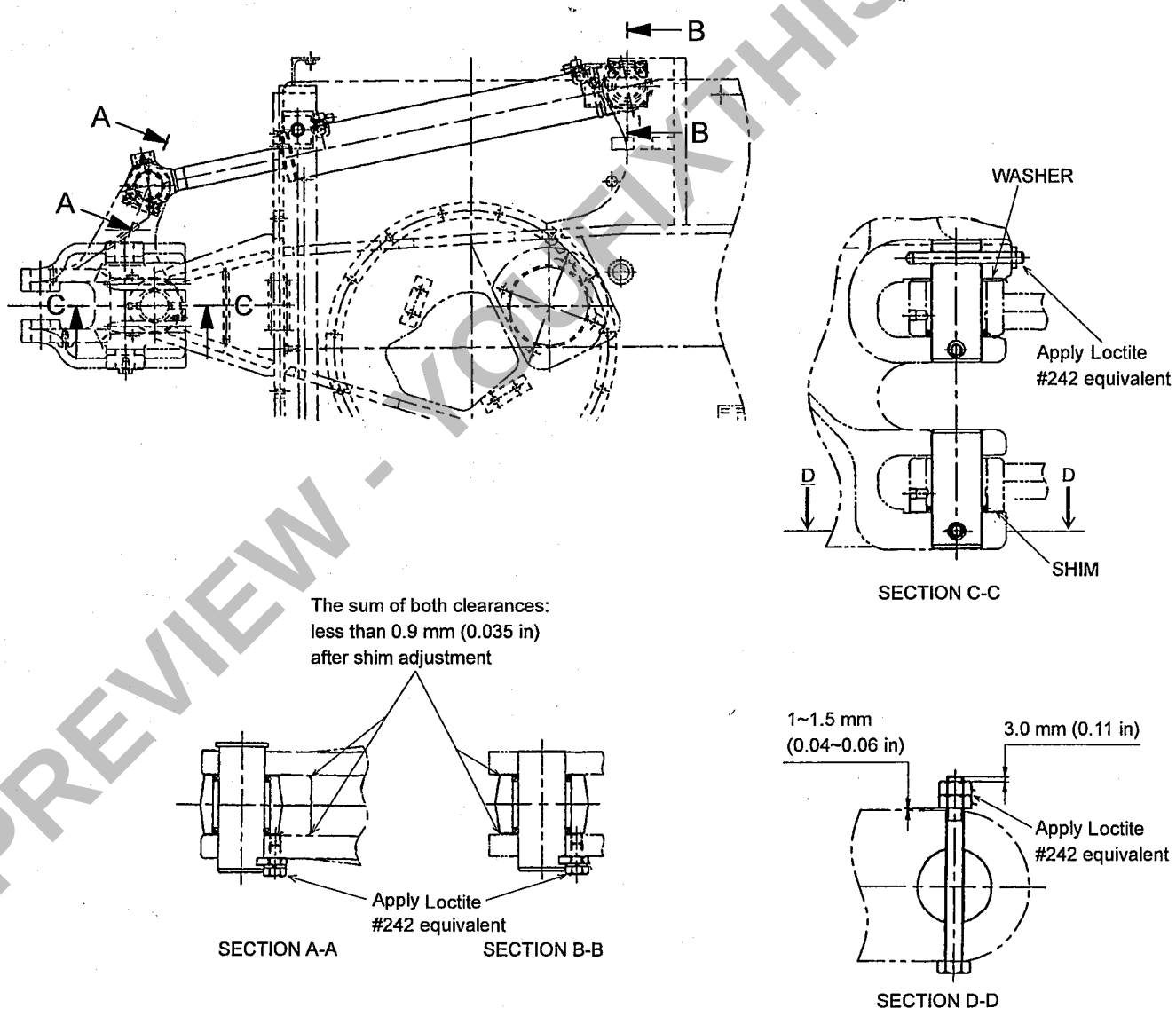


Fig. 2-19 Sectional view of pin installing

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(6) Disconnect each 6 hoses on both right and left pilot valves.
(See Section 18.)

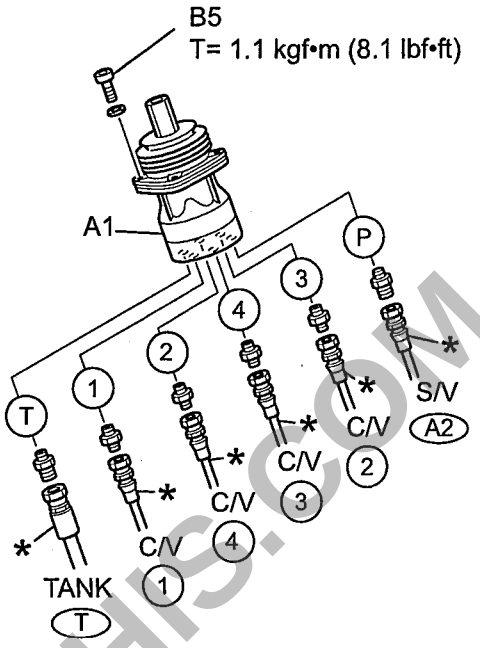


Fig. 9-7 Disconnect pilot hoses

(7) Removing seat stand assy.

1) Loosen and remove 2 capscrews (16) M10 X 35 and 2 capscrews (17) M16 X 50.
: 17 mm, T= 4.7 kgf•m (34 lbf•ft)
: 24 mm, T= 19.5 kgf•m (141 lbf•ft)

2) After confirmation for the fact that all hoses, harnesses and so on have been surely disconnected, lift up the seat stand assy (6) and remove it.

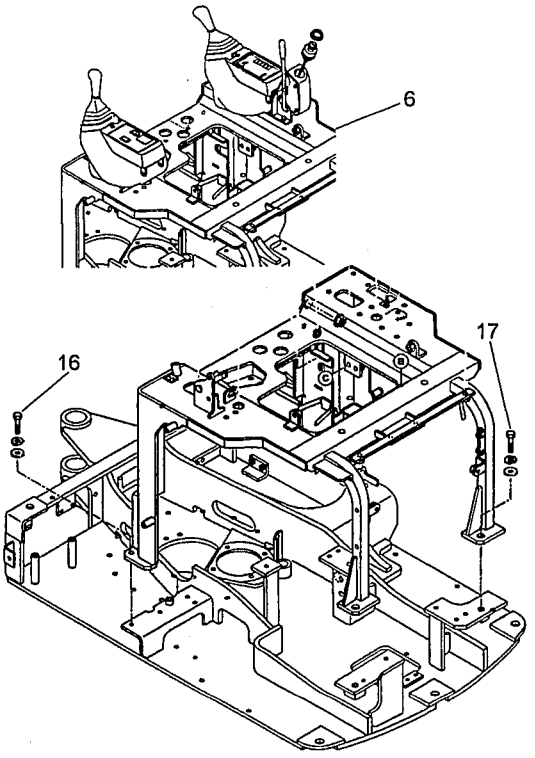


Fig. 9-8 Removing seat stand assy

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⚠ Precaution (These precautions must be observed for safety.)

2.2 PRECAUTIONS FOR DISASSEMBLY

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 assy. 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.

2.3 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.

Table. 2-6

Tools	QT'Y	Remark
Allen wrench	One each	4 , 5 , 6 , 8mm
Spanner	One each	13 , 19 , 21 , 22 , 26mm
Socket wrench	One each	13 , 19 , 21 , 22 , 26mm
Torque wrench	1	0.2kgf·m~2.0kgf·m (1.4~14lbf·ft)
Torque wrench	1	2.0kgf·m~10.0kgf·m (14~72lbf·ft)
Magnet	1	
Pliers	1	
Screw driver (-)	1	
Tweezer	1	

Prepare wash oil,hydaulic oil,grease,loctite #242,tag and warker (felt-tip pen) before hand.

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4.4 TROUBLESHOOTING

Troubles	Possible Causes	Remedy
Motor does not rotate	• Insufficient oil volume in hydraulic oil tank • Failure on hydraulic pump • Failure on relief valve or low setting pressure • Abnormal wear or scuffing on hydraulic motor • Short circuit at inside hydraulic motor	• Replenish tank with hydraulic oil • Replace hydraulic pump • Clean relief valve and set at proper pressure • Disassemble and check hydraulic motor and replace defective parts • Check breakage on face seal, etc., and replace defective parts, if reguired
Unstable rotation	• Low relief setting • Mixing air at suction side of hydraulic pump	• Set relief valve at proper pressure • Check suction side piping, and re-tighten as required
Reverse rotating direction	• Reverse piping • Reverse valve timing on hydraulic motor	• Correct piping • Reassemble to proper valve timing
Oil leakage at connections	• Loosened fixing capscrews • O-ring is caught by part or damage on O-ring	• Tighten with proper torque • Replace O-ring

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4.2 CONSTRUCTION

No.	NAME	Q'TY	No.	NAME	Q'TY
1	Roller	1	6	Snap ring	1
2	Shaft	1	7	Plug	2
3	Bearing	2	8	Pin	3
5	Seal	2			5

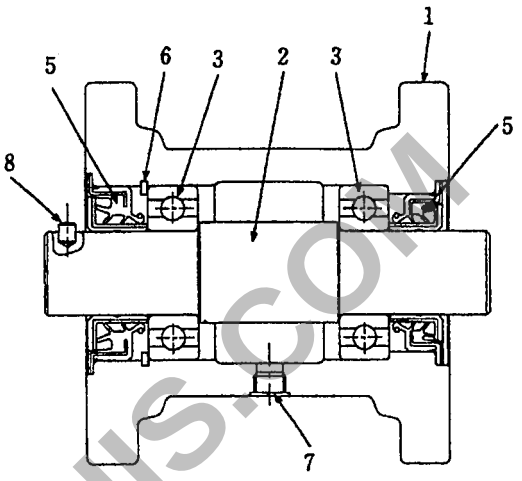


Fig. 4-1 Lower roller assy

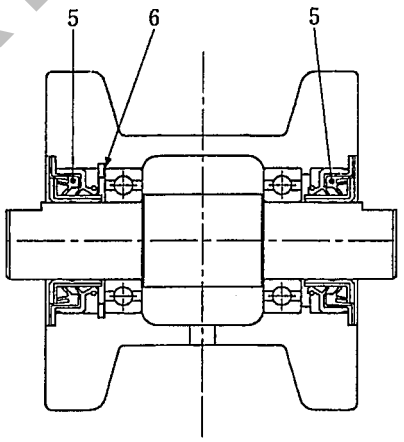


Fig. 4-2 Crawler removing posture

4.3 DISASSEMBLY AND ASSEMBLY

4.3.1 Disassembling

1) Loosen the plug (7) to drain oil.
2) Remove the pin (8)
3) Remove the seals (5).
4) Remove the snap ring (6).

5) Put the lower roller on the supporting stand, and push out the shaft (2) together with the bearings (3).

- Except the case that replacement of the bearing (3) is necessary, do not remove the bearings from the shaft (2).

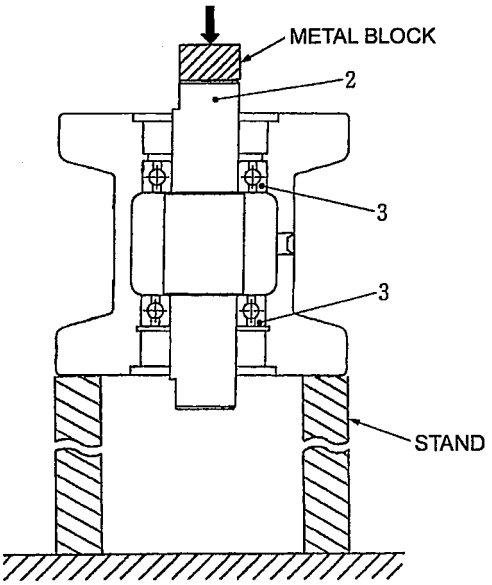


Fig. 4-3 Feeding grease

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b) Install the barrel holder (209).

c) Further install the shoe holder assy (208) to complete the cylinder barrel assy (204).

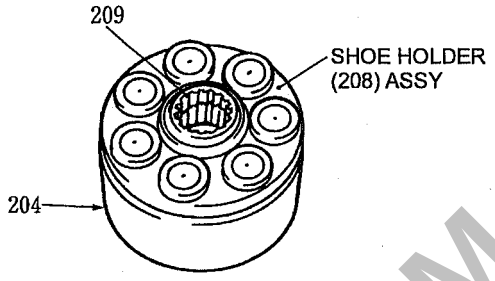


Fig. 1-43 Cylinder barrel (204) assy

1-16) Insert the cylinder barrel (204) assy into the body 2 (202) till the shoe contacts with the swash plate (210).

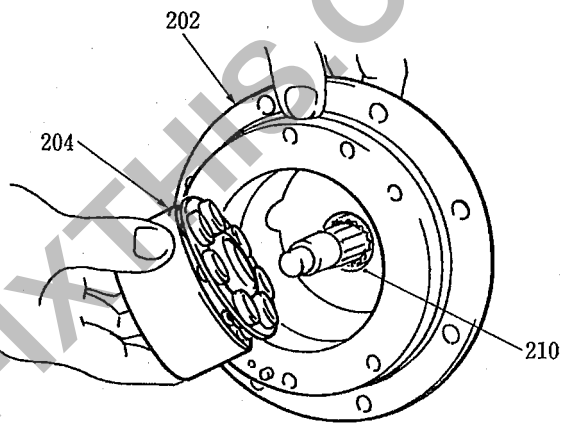


Fig. 1-44 Installing cylinder barrel (204) assy

1-17) Install the valve plate (205) to the body 1 (301).

- Install so that the copper surface of the valve plate (205) is directed upward [cylinder barrel (204) side].
- Apply hydraulic oil on the slide surface (copper surface) of the valve plate (205).
- Apply grease on the reverse side of the valve plate (steel surface) to prevent it from dropping.

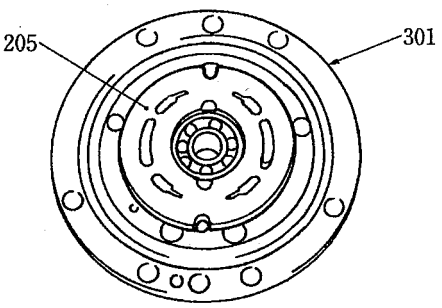


Fig. 1-45 Valve plate (205) installation

1-18) Feed approximately 100 cc (6 cu in) of hydraulic oil to the body 2 (202).

1-19) Combine the bodies 1 (301) and 2 (202).

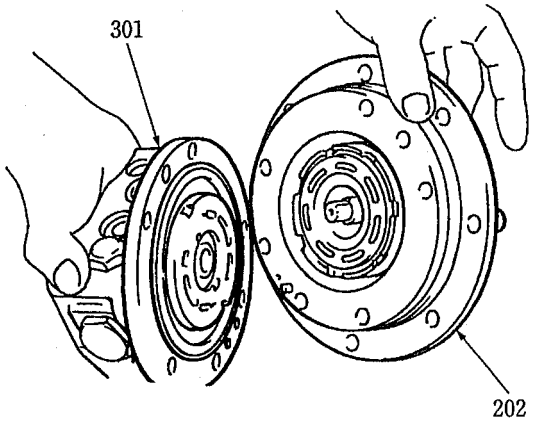
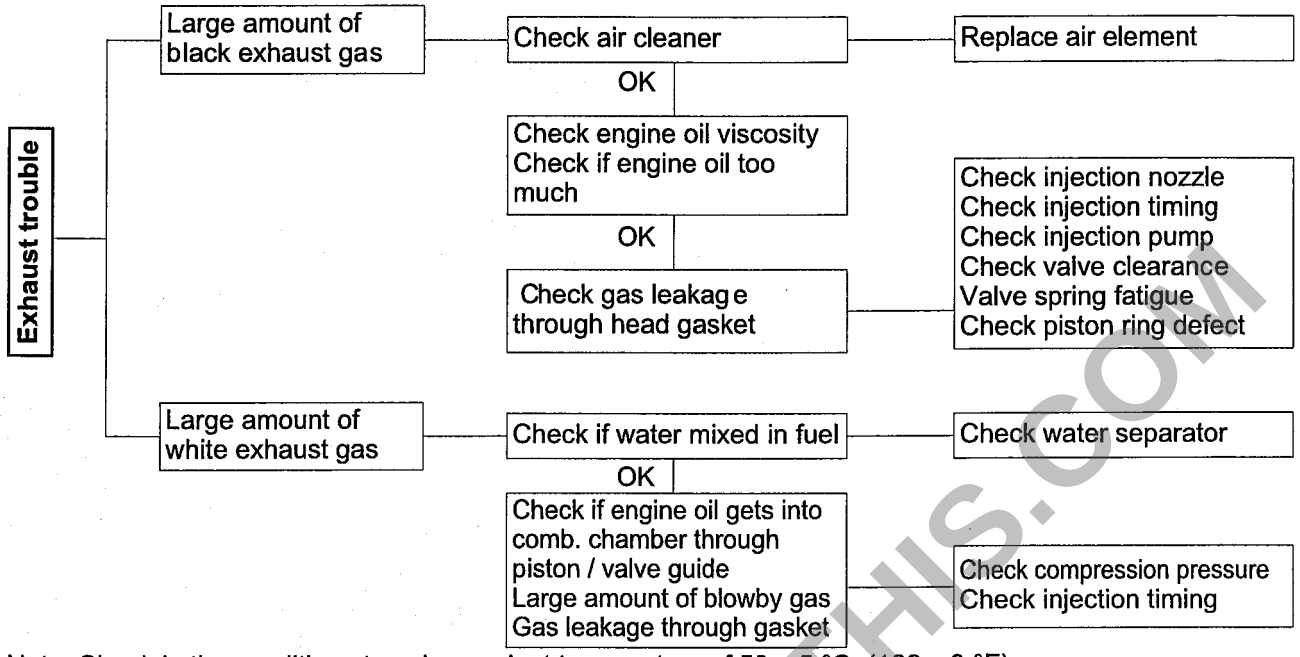


Fig. 1-46 Combining bodies (202) and (301)

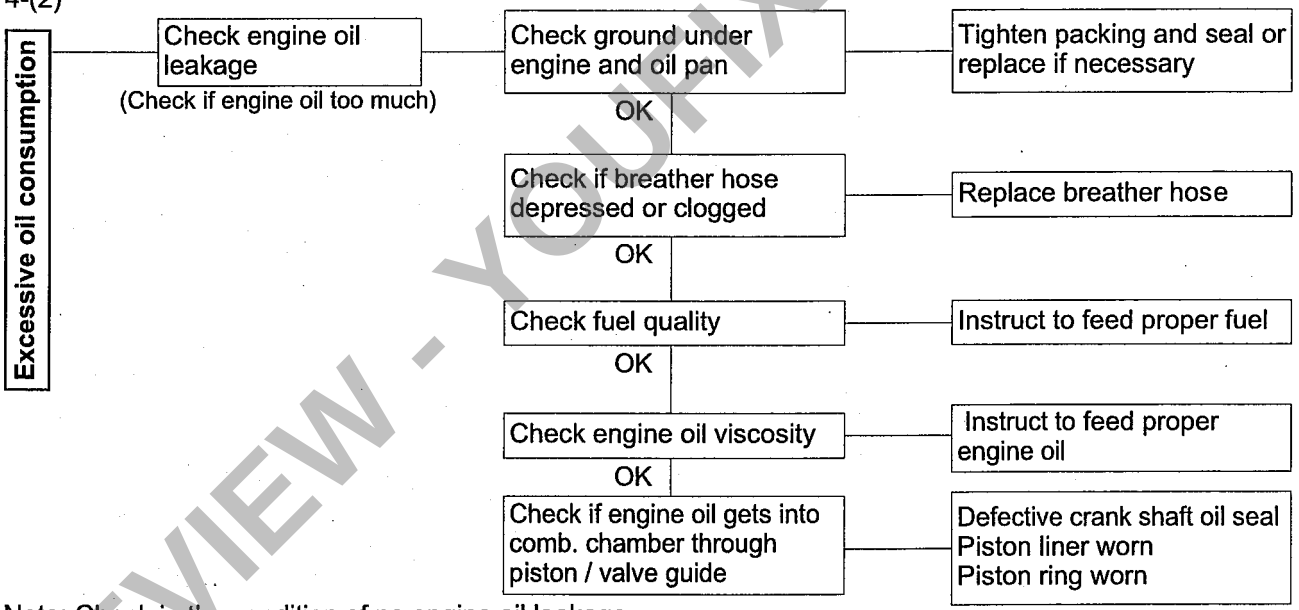
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4-(1)



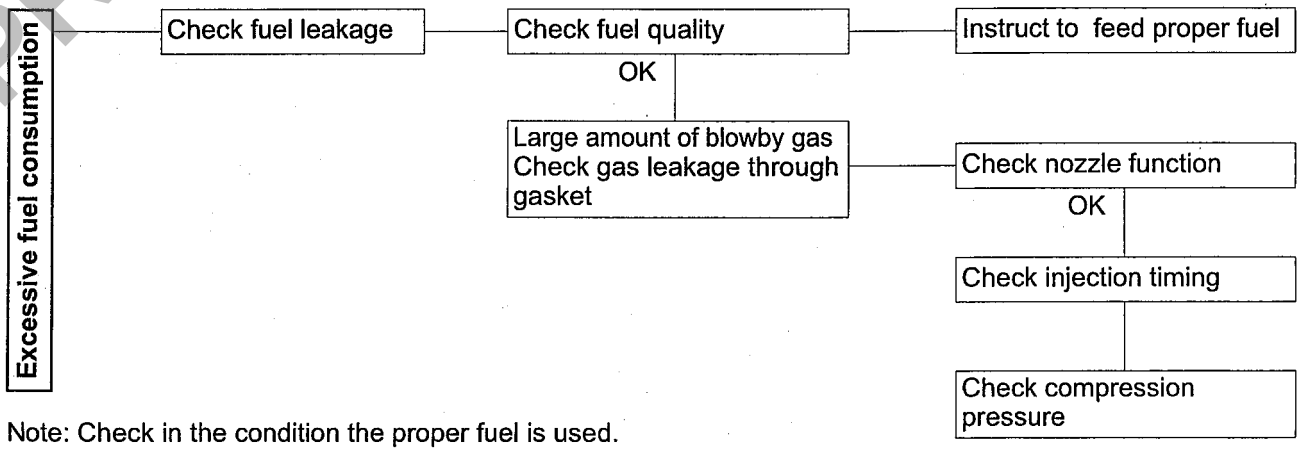
Note: Check in the condition at engine coolant temperature of 50 ± 5 °C. (122 ± 9 °F)

4-(2)



Note: Check in the condition of no engine oil leakage.

4-(3)

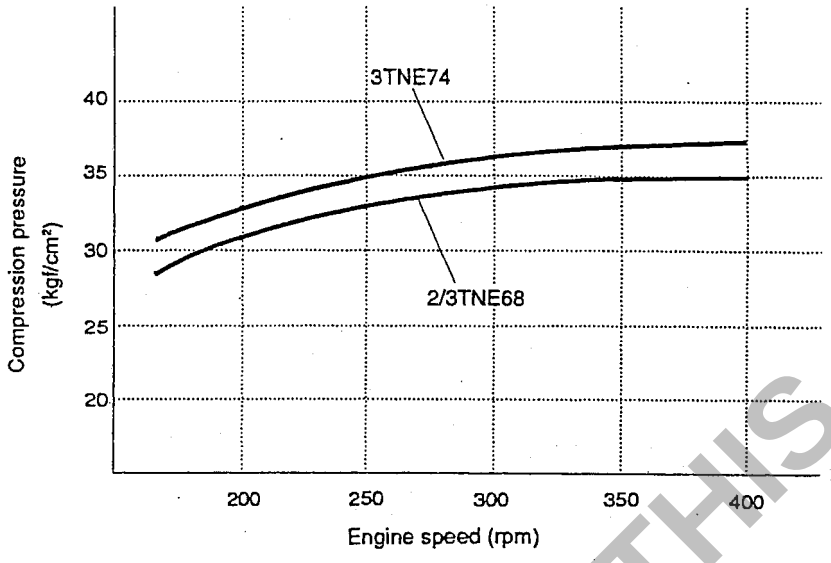


Note: Check in the condition the proper fuel is used.

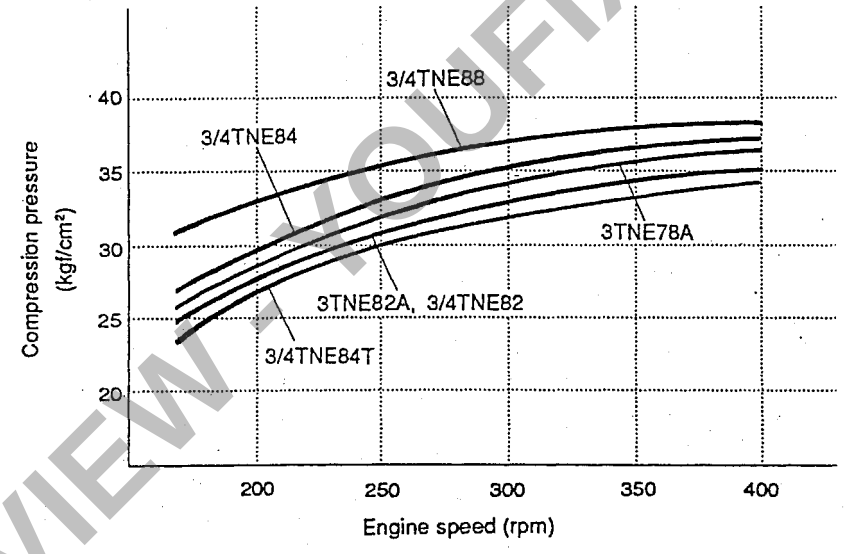
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[Reference: Variation of Compression Pressure with Engine Speed]

(1) Indirect injection system



(2) Direct injection system



2. Action to be taken when the measured compression pressure is below the limit value.

Trouble occurs in a part of the engine. For troubleshooting, refer to Chapter 4, 4-2 trouble diagnosis through measurement of compression pressure.

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7-7. Crankshaft

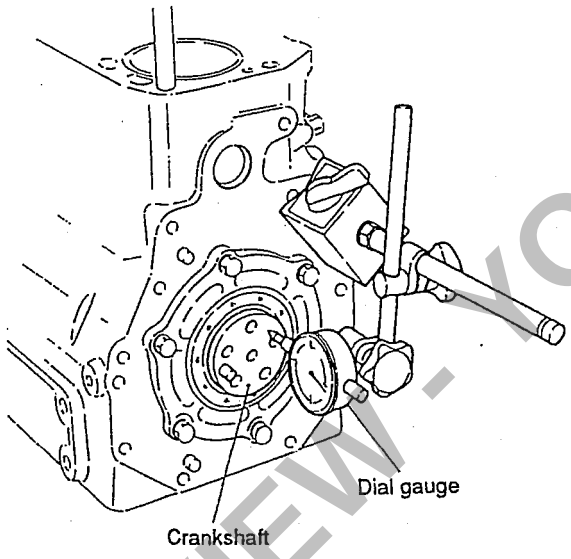
1. Side gap around the crankshaft

Before extracting the crankshaft and when reassembling it, bring a dial gauge into contact to the end of the crankshaft. Force the crankshaft to both sides in the axial direction to measure the thrust gap. Alternatively, insert a thickness gauge directly into a thrust gap between the thrust metal in the standard part and crankshaft to measure the side gap.

If the limit is exceeded, replace the thrust metal with a new one.

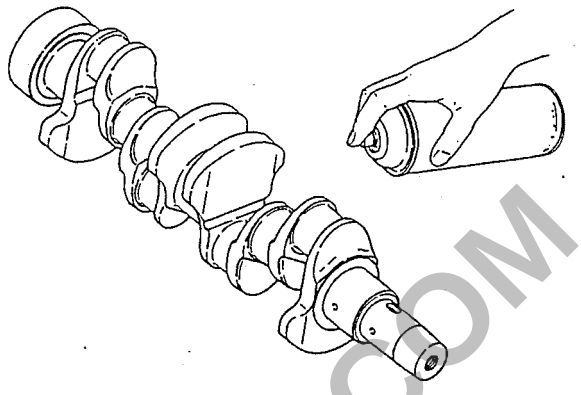
(mm)

	All models
Thrust gap	0.090~0.271



2. Color check of crankshaft

Clean the crankshaft and check it using a color check kit or a magnaflux inspector. Replace the crankshaft if cracked or badly damaged. If the crankshaft is slightly damaged, correct it by re-grinding.



(Color check Inspection)

3. Checking the metal

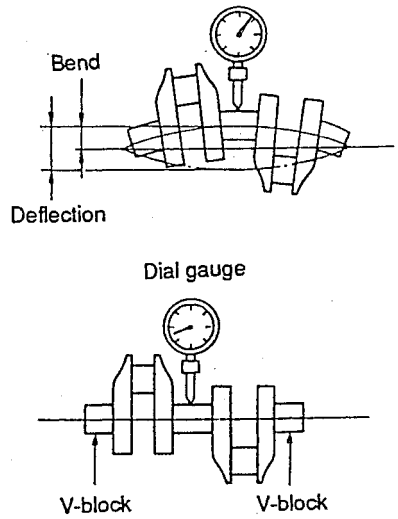
Check the metal for flaking, melting, seizure, and the state of the contact face. Replace the metal if found defective.

4. Bend of the crankshaft

Support the crankshaft with V-blocks at both ends of the journals; measure the runout at the center journal with a dial gauge while rotating the crankshaft to check the extent of crankshaft bend.

(mm)

	All models
	Standard
Bend	0.02 or less



(Measuring the crankshaft bend)

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1-9 4TNE82

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

Item		Model / Unit	4TNE82												
SPECIFICATIONS	Application	—	CL		VM						CH		VH		
	Type	—	Vertical, 4-cycle water-cooled diesel engine												
	Combustion system	—	Direct injection system												
	No. of cylinders – Bore × Stroke	mm	4 – 82 × 90												
	Displacement	ℓ	1.901												
	Firing order	—	1 – 3 – 4 – 2 – 1												
	Revolution speed	rpm	1500	1800	2000	2200	2400	2600	2800	3000	3000	3600	3200	3400	3600
	Output* Continuous rating	kW(HP)	14.3 (19.2)	17.1 (22.9)	—	—	—	—	—	—	27.7 (37.1)	32.7 (43.9)	—	—	—
	Output* Max. rating	kW(HP)	15.7 (21.1)	18.8 (25.2)	20.6 (27.6)	22.6 (30.3)	24.5 (32.9)	26.5 (35.5)	28.5 (38.2)	30.5 (40.9)	30.5 (40.9)	36.0 (48.3)	32.4 (43.4)	34.2 (45.9)	36.0 (48.3)
	Max. revolution speed at no load	rpm	1575^{+50}_{0}	1870^{+50}_{0}	2160^{+50}_{0}	2375^{+50}_{0}	2570^{+50}_{0}	2780^{+50}_{0}	2970^{+50}_{0}	3180^{+50}_{0}	3150^{+50}_{0}	3745^{+50}_{0}	3455^{+50}_{0}	3670^{+50}_{0}	3890^{+50}_{0}
	Min. revolution speed at no load	rpm	≤1200		≤800						≤1500		≤800		
	Direction of rotation	—	Counterclockwise (viewed from flywheel)												
	Power take off	—	Flywheel												
	Compression ratio	—	18.0												
	Fuel injection timing (FID, b.T.D.C.)	deg	10±1		12±1		14±1		16±1		24±1		18±1	20±1	24±1
	Compression pressure	MPa (kgf/cm²)	3.04±0.1 (31±1), at 250 rpm												
	Fuel injection pressure	MPa (kgf/cm²)	$19.6^{+1.0}_{0}$ (200^{+10}_{0})												
	Recommended diesel gas oil	—	ISO 8217 DMA, BS 2869 A1 or A2 (Cetane No. 45 min.)												
	Lubrication system	—	Forced lubrication with trochoid pump												
	Lubricating oil capacity Max/Effective	ℓ	5.8/2.3								7.9/2.5				
	Recommended lubricating oil	—	API grade CC class or higher												
	Cooling system	—	Liquid cooling/Radiator												
	Cooling water capacity	ℓ	2.7 (for engine only)												
	Cooling fan No. of blade × dia.	mm	Pusher type, 6 × ϕ370												
	Crank V-pulley dia./ Fan V-pulley dia.	mm	ϕ120/ϕ90		ϕ110/ϕ110										
	Governor	—	Mechanical centrifugal governor (All speed type)												
	Starting system	—	Electrical												
	*1 Dimensions L × W × H	mm	683 × 498.5 × 618		632 × 448.5 × 618 / 658 × 498.5 × 618						658 × 498.5 × 618		650 × 498.5 × 618 / 658 × 498 × 618		
	*1 Dry weight	kg	184		160/170						170		160/170		
PERFORMANCE	Governing perform-ance (full speed range) Transient speed difference	%	≤10	≤8	≤12						≤10	≤8	≤12		
	Governing perform-ance (full speed range) Steady state speed band	%	≤5	≤4	≤8		≤7		≤6		≤5	≤4	≤8		
	Governing perform-ance (full speed range) Recovery time	sec	≤5		≤6						≤5		≤6		
	Governing perform-ance (full speed range) Fluctuation of revolution	rpm	≤15		≤25						≤30				
	L.O. press. Rated operation	MPa (kgf/cm²)	0.29±0.05 (3.0±0.5)		0.34±0.05 (3.5±0.5)										
	L.O. press. Idling	MPa (kgf/cm²)	≥0.06 (≥0.6)												

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

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5. Checking the valve spring

(1) Visually check to see if the valve spring is free from flaws and corrosion.

(2) Measure the free length (length of the spring) and inclination (squareness of the side of the coil).

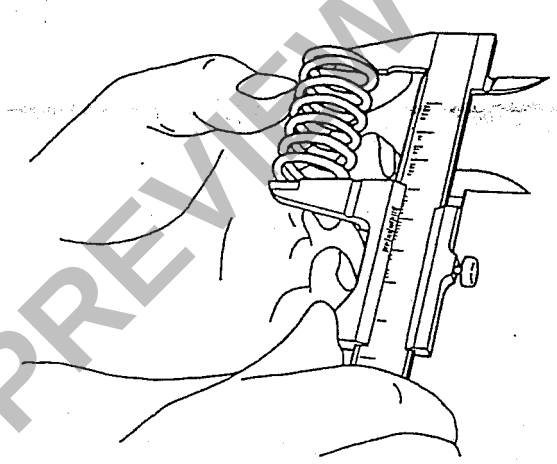
(mm)

		2/3TNE68		3TNE74	
		Standard	Wear limit	Standard	Wear limit
Valve spring	Free length	28	—	37.4	—
	Inclination	—	0.8	—	1.0
	Tension (kg) (when compressed to by 1 mm)	1.14 ~1.40	—	*2.37/ 1.87	—

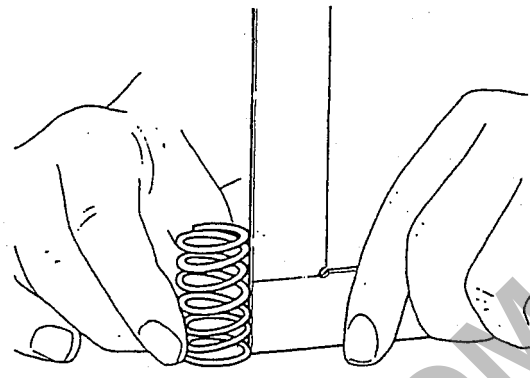
* Tension at variable pitch.

		3TNE78A 3TNE82A		3/4TNE82, 3/4TNE84(T), 3/4TNE88	
		Standard	Wear limit	Standard	Wear limit
Valve spring	Free length	44.4	—	42	—
	Inclination	—	1.1	—	1.1
	Tension (kg) (when compressed to by 1 mm)	*3.61 /2.71	—	*2.36 /3.101	—

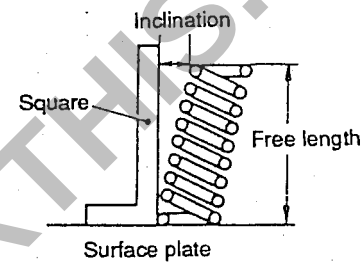
* Tension at variable pitch.



(Measuring the free length)



(Measuring the valve spring inclination)



(Measuring the inclination of valve spring)

6. Checking valve spring holder and cotter

Check contact of the inner surface of the valve spring holder with the circumference of the cotter as well as contact of the inner circumference of the cotter with the notch on the head of the valve stem. If such contact is uneven or if the cotter sinks, replace the cotter with a new one.

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