Service Manual

JS200
from machine no. 705001

JS210
from machine no. 705648

JS220
from machine no. 705001

JS240
from machine no. 708001

JS260
from machine no. 708501

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Introduction

This publication is designed for the benefit of JCB Distributor Service Engineers who are receiving, or have received, training by JCB Technical Training Department.

These personnel should have a sound knowledge of workshop practice, safety procedures, and general techniques associated with the maintenance and repair of hydraulic earthmoving equipment.

Renewal of oil seals, gaskets, etc., and any component showing obvious signs of wear or damage is expected as a matter of course. It is expected that components will be cleaned and lubricated where appropriate, and that any opened hose or pipe connections will be blanked to prevent excessive loss of hydraulic fluid and ingress of dirt. Finally, please remember above all else

SAFETY MUST COME FIRST!

The manual is compiled in sections, the first three are numbered and contain information as follows:

- **1 = General Information** - includes torque settings and service tools.
- **2 = Care & Safety** - includes warnings and cautions pertinent to aspects of workshop procedures etc.
- **3 = Routine Maintenance** - includes service schedules and recommended lubricants for the whole machine.

The remaining sections are alphabetically coded and deal with Dismantling, Overhaul etc. of specific components, for example:

- **A = Optional Equipment**
- **B = Body & Framework** ...etc

The page numbering in each alphabetically coded section is not continuous. This allows for the insertion of new items in later issues of the manual.

Section contents, technical data, circuit descriptions, operation descriptions etc. are inserted at the beginning of each alphabetically coded section.

All sections are listed on the front cover; tabbed divider cards align directly with individual sections on the front cover for rapid reference.

Page cross references are generally made by presenting the subject title printed in bold, followed by the title of the section containing the subject. For example:

> "**24** If the axle is still on the machine, fit the brake calipers (see **Brake Caliper Removal and Replacement**, Section G)."

Note: If only the subject title in bold is given, i.e. no section title, the cross reference is to another part of the same section.

Use the contents list at the beginning of each section to find the exact page number.

Where a torque setting is given as a single figure it may be varied by plus or minus 3%. Torque figures indicated are for dry threads, hence for lubricated threads may be reduced by one third.

'Left Hand' and 'Right Hand' are as viewed from the rear of the machine facing forwards.

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Bolt and Nut Torque Specifications

Tighten the bolts and nuts according to the table. Before and after daily work, check the bolts and nuts for looseness and for those missing. Tighten if loose and replace if missing.

Tighten the bolts and nuts after the first 50 hours of the running-in stage and every 250 hours thereafter.

Tightening Torque Table

*

No	Tightening Point	Bolt Diameter	Wrench	JS200/210/220/240/260 Tighten Torque		
				Nm	kgf m	lbf ft
1†	Travel Motor	M16	24mm	270~310	27.2~31.8	200~230
2†	Drive Sprocket	M16	24mm	270~310	27.2~31.8	200~230
3†	Idler Wheel	M16	24mm	270~310	27.2~31.8	200~230
4†	Upper (Carrier) Roller	M20	30mm	520~608	53.2~62.2	385~450
5†	Lower (Track) Roller	M18	27mm	370~430	37.8~44.1	275~315
6†	Track Guard	M18	27mm	380~440	38.7~45.2	280~325
7	Shoe Bolt	M16	24mm	380~450	38.7~46.0	275~330
8	Counter weight	M27/M30	41/46mm	1058~1235/1335~1545	108~126/136~158	780~910/985~1140
9†	Turntable Bearing (Undercarriage)	M20/M24	30/36mm	475~550/780~910	48.4~55.3/80~93	350~400/575~670
10†	Turntable Bearing (Slew Frame)	M20/M24	30/36mm	475~550/780~910	48.4~55.3/80~93	350~400/575~670
11†	Slew Equipment	M20/M24	30/36mm	525~605/785~910	53.1~62/80~93	390~440/580~670
12†	Engine (Engine Mount)	M16	24mm	265~310	27.0~32	195~230
13†	Engine Bracket	M10	17mm	65~75	6.6~7.6	47~55
14	Radiator	M16	24mm	150~175	15~18	108~130
15†	Hydraulic Pump	M10	17mm	65~75	6.6~7.6	47~55
16†	Hydraulic Oil Tank	M16	24mm	235~285	23.7~29.5	175~210
17†	Fuel Tank	M16	24mm	255~285	25.7~29.5	185~210
18†	Control Valve	M16	24mm	270~310	27.6~31.8	200~230
19†	Rotary Coupling	M12	19mm	110~125	11.1~13	80~94
20	Cab	M16	24mm	127~135	13~14	94~101
21	Battery	M10	17mm	20~30	2.1~2.9	15~21

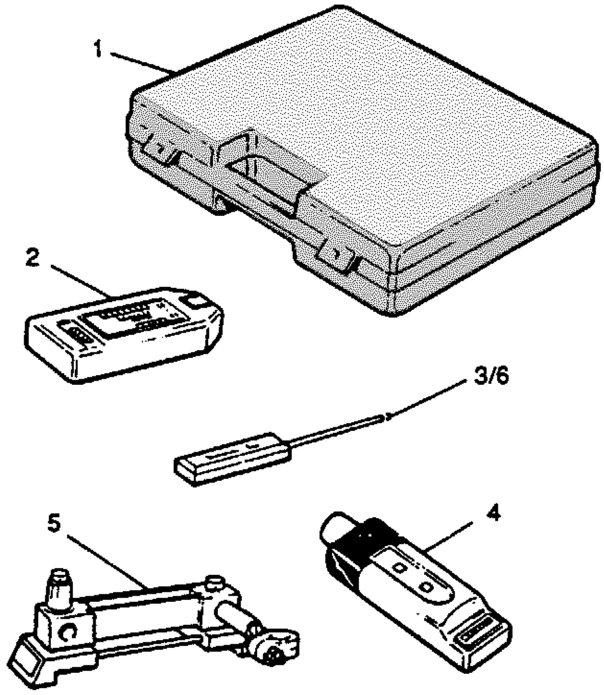
Note: *Use Loctite 262 (adhesive) on those marked † and tighten to the torque listed in the above table.*

The tightening torque for the bolts and nuts not listed above are as follows:

Bolt Diameter (size)			M6	M8	M10	M12	M14	M16	M18	M20
Hex. bolt	Wrench	mm	10	13	17	19	22	24	27	30
	Tightening Torque	Nm	6.9	15.7	32.3	58.8	98.0	137.2	196.0	274.4
		kgf m	0.7	1.6	3.2	5.9	9.8	13.7	19.6	27.4
		lb ft	5	12	24	43	72	101	145	202
Hex. socket head bolt	Wrench	mm	5	6	8	10	12	14	14	17
	Tightening Torque	Nm	8.8	21.6	42.1	78.4	117.6	176.4	245.0	343.0
		kgf m	0.8	2.2	4.2	7.8	11.8	17.6	24.5	34.3
		lb ft	6.5	16	31	58	87	130	181	253

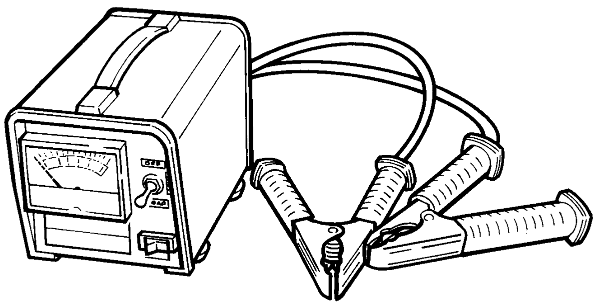
Service Tools

SECTION C - ELECTRICS



Electrical Test Equipment

	1	892/00283	Tool Kit Case
	2	892/00281	AVO Meter
*	**3**	892/00286	Surface Temperature Probe
	4	892/00284	Microtach Digital Tachometer
	5	892/00282	Shunt - open type
	6	892/00285	Hydraulic Oil Temperature Probe
	7	892/00298	Fluke 85 Multimeter



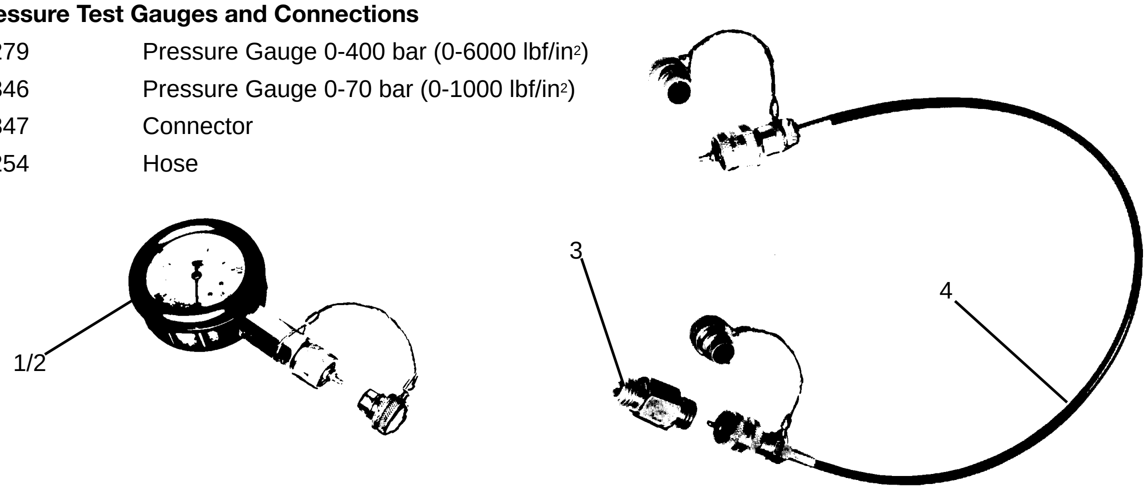
993/85700 Battery Tester

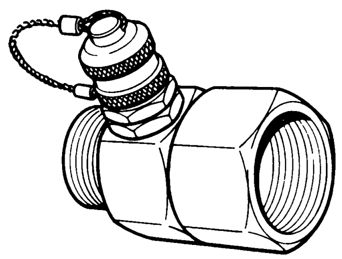
Service Tools *(continued)*

SECTION E - HYDRAULICS

Hydraulic Pressure Test Gauges and Connections

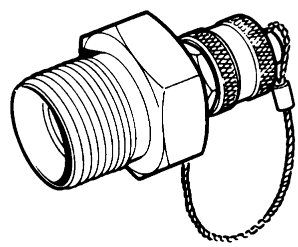
1	892/00279	Pressure Gauge 0-400 bar (0-6000 lbf/in^2)
2	892/00346	Pressure Gauge 0-70 bar (0-1000 lbf/in^2)
3	892/00347	Connector
4	892/00254	Hose





Pressure Test 'T' Adapters

892/00262	1/4 in BSP x 1/4 in F BSP x Test Point
816/55038	3/8 in BSP x 3/8 in F BSP x Test Point
816/55040	1/2 in BSP x 1/2 in F BSP x Test Point
892/00263	5/8 in BSP x 5/8 in F BSP x Test Point
892/00264	3/4 in BSP x 3/4 in F BSP x Test Point
892/00265	1 in M BSP x 1 in F BSP x Test Point
892/00266	1,1/4 in M BSP x 1,1/4 in F BSP x Test Point
892/00267	1,1/2 in M BSP x 1,1/2 in F BSP x Test Point

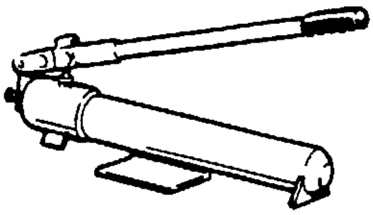


Pressure Test Adapters

892/00255	1/4 in BSP x Test Point
892/00256	3/8 in BSP x Test Point
892/00257	1/2 in BSP x Test Point
892/00258	5/8 in BSP x Test Point
816/15118	3/4 in BSP x Test Point
892/00259	1 in BSP x Test Point
892/00260	1,1/4 in BSP x Test Point
892/00261	5/8 in UNF x Test Point

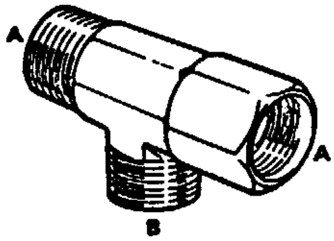
Service Tools *(continued)*

SECTION E - HYDRAULICS

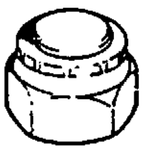


Hand Pump Equipment

892/00223	Hand Pump
892/00137	Micro-bore Hose 1/4 in BSP x 5 metres
892/00274	Adapter 1/4 in M BSP x 3/8 in M BSP Taper
892/00262	1/4 in M BSP x 1/4 in F BSP x Test Point
892/00706	Test Probe
892/00278	Gauge 0 - 40 bar (0 - 600 lb/in^2)
892/00279	Gauge 0 - 400 bar (0 - 6000 lb/in^2)
892/00280	Gauge 0 - 600 bar (0 - 8500 lb/in^2)

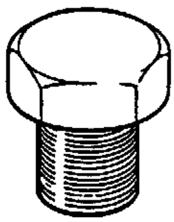


816/50005	1/2 in BSP (A) x 1/2 in BSP (B)
816/60096	3/4 in BSP (A) x 3/4 in BSP (B)
816/00018	1 in BSP (A) x 1 in BSP (B)



Female Cone Blanking Plug

892/00055	1/4 in BSP
892/00056	3/8 in BSP
892/00057	1/2 in BSP
892/00058	5/8 in BSP
892/00059	3/4 in BSP
892/00060	1 in BSP



Male Cone Blanking Plug

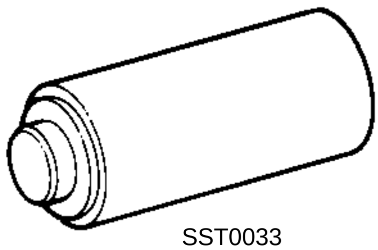
816/00294	1/4 in BSP
816/00189	3/8 in BSP
816/00190	1/2 in BSP
816/00197	5/8 in BSP
816/00196	3/4 in BSP
816/00193	1 in BSP

Service Tools *(continued)*

SECTION E - HYDRAULICS

Slew Motor Jig

SST0033 Oil Seal Jig
SST0034 Taper Bearing Ring Jig
SST0035 Inner Ring Jig
SST0036 Seal Press Fit Jig
(All dimensions are in mm.)



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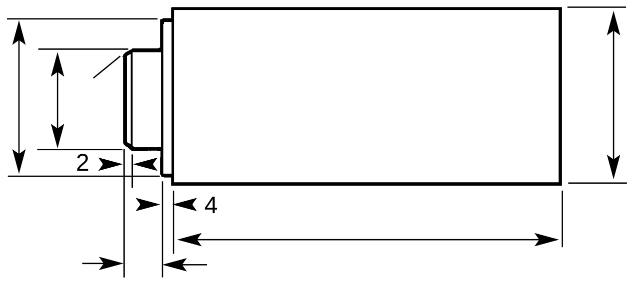
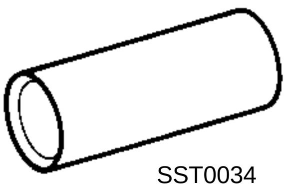
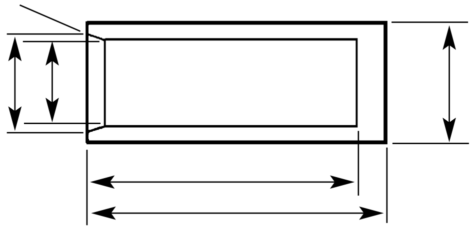
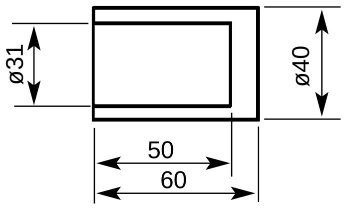


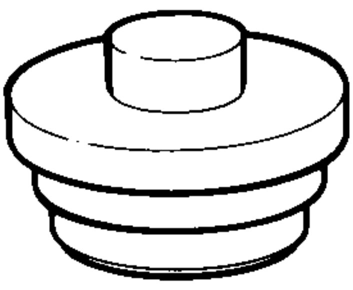


SST0034

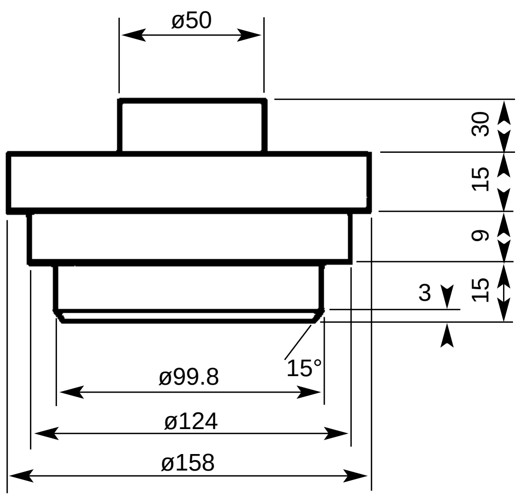


SST0035





SST0036



Service Tools *(continued)*

SECTION E - HYDRAULICS

Ram Dismantling and Assembly

Ram Piston Head Nut (Rig Assembly - Section E, page 75 - 10)

Item	Part Number	Description	Quantity
1	993/99525	Rig assembly (not including spanners and ram)	1
2	993/99522	Anchor side plate (supplied loose unwelded)	1
3	993/99523	Anchor cross member (supplied loose unwelded)	1
4	993/99524	Ram eye end modification	1
5	556/43400	Lift ram	1
6	545/18000	Lynch pin	1
7	811/50232	$1^1/_4$ in Pivot pin	1

Spanner Requirements

JS200/JS200LC/JS220/JS220LC

993/99518	Bucket ram	90 mm A/F Nut
SSP0047	Boom ram	95 mm A/F Nut
993/99519	Dipper ram	100 mm A/F Nut

JS240/JS240LC/JS260/JS260LC

993/99519	Bucket ram	100 mm A/F Nut
993/99519	Boom ram	100 mm A/F Nut
993/99521	Dipper ram	115 mm A/F Nut

Note: *All spanners have operating centres of 500 mm.*

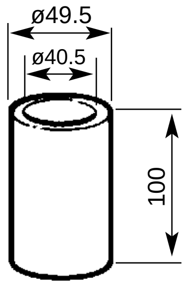
Service Tools *(continued)*

SECTION F - TRANSMISSION

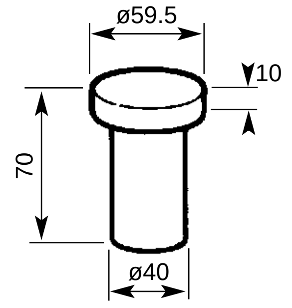
Track Motor Jig

SST0028	Inner Rail Press Jig
SST0029	Snap Ring Jig
SST0030	Oil Seal Jig
SST0031	Case Fixing Jig
SST0032	Bearing Jig

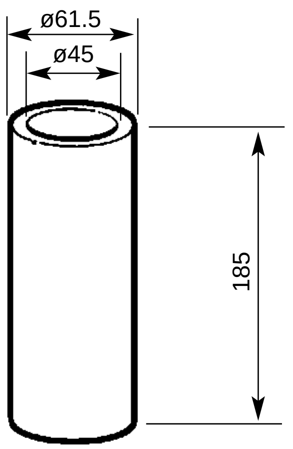
(All dimensions are in mm.)



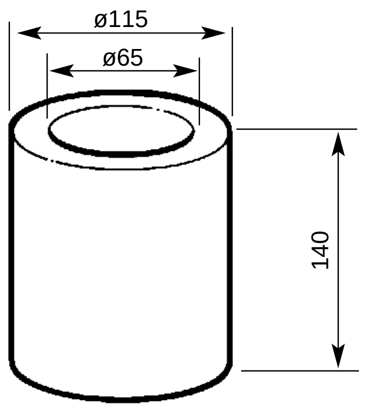
SST0028



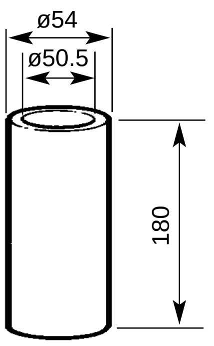
SST0029



SST0030



SST0031



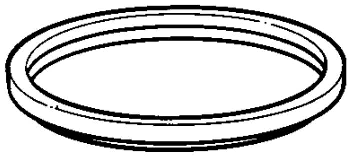
SST0032

Service Tools *(continued)*

SECTION F - TRANSMISSION

Track Gearbox Jig

SST0037 Re-sealing Tool
SST0038 Main Bearing Tool
SST0039 Main Bearing Tool
(All dimensions are in mm.)



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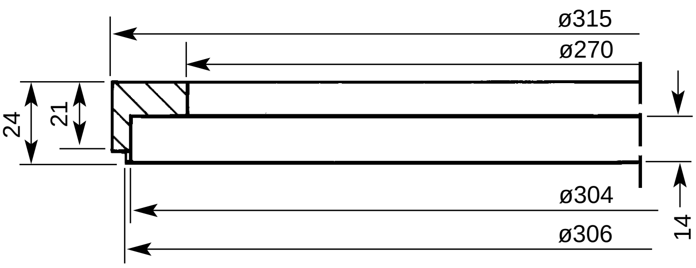
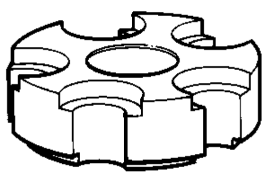
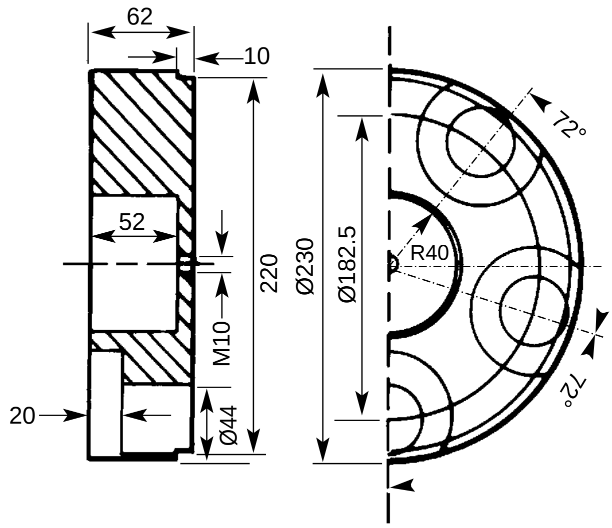
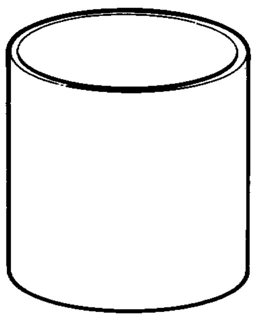




SST0038





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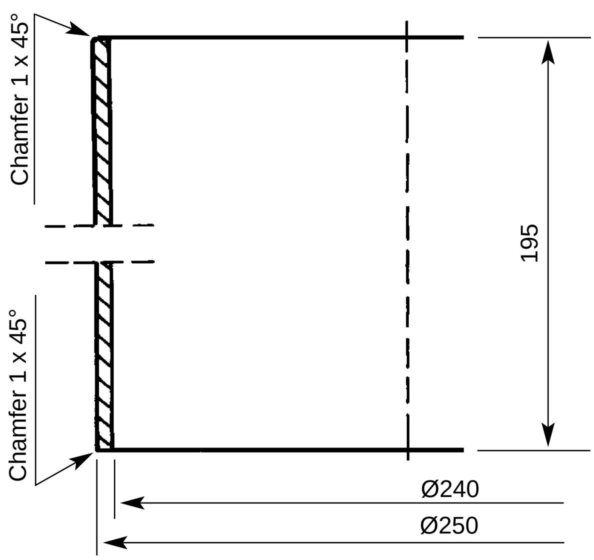
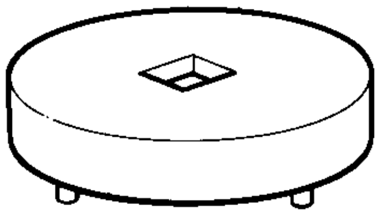


Service Tools *(continued)*

SECTION F - TRANSMISSION

Track Gearbox Jig

SST0040 Ring Nut Tool
SST0041 Planet Gear Tool
(All dimensions are in mm.)



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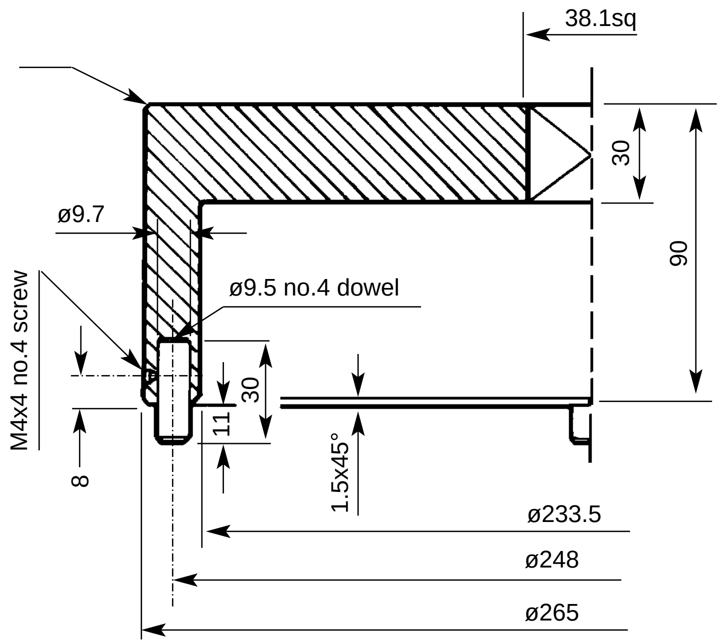
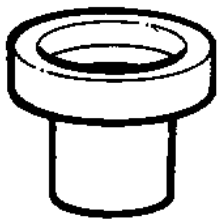
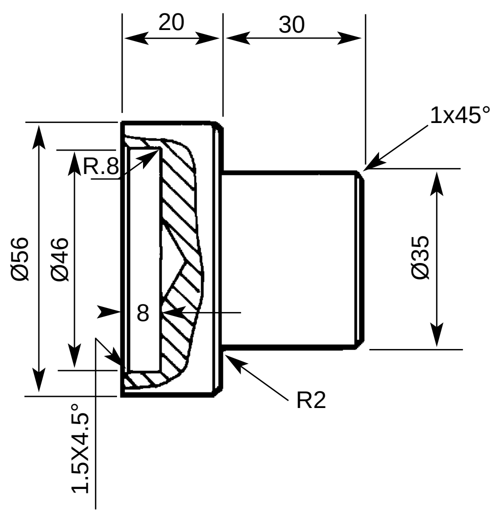




SST0041



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Sealing and Retaining Compounds

JCB Multi-Gasket	A medium strength sealant suitable for all sizes of gasket flanges, and for hydraulic fittings of 25-65 mm diameter.	4102/1212	50 ml
JCB Threadlocker	For threads of 50 mm diameter upwards, e.g. suction strainer.	4101/0451	50 ml
JCB Threadlocker (High Strength)	A high strength locking fluid for use with threaded components. Gasketing for all sizes of flange where the strength of the joint is important.	4102/0551	50 ml
JCB Retainer (High Strength)	For all retaining parts which are unlikely to be dismantled.	4101/0651	50 ml
JCB Threadlocker and Sealer	A medium strength locking fluid for sealing and retaining nuts, bolts, and screws up to 50 mm diameter, and for hydraulic fittings up to 25 mm diameter.	4101/0250 4101/0251	10 ml 50 ml
JCB Threadlocker and Sealer (High Strength)	A high strength locking fluid for sealing and retaining nuts, bolts, and screws up to 50 mm diameter, and for hydraulic fittings up to 25 mm diameter.	4101/0550 4101/0552	10 ml 200 ml
JCB Threadseal	A medium strength thread sealing compound.	4102/1951	50 ml
JCB Activator	A cleaning primer which speeds the curing rate of anaerobic products.	4104/0251 4104/0253	Aerosol (1 ltr) Bottle (200 ml)
JCB Cleaner/Degreaser	For degreasing components prior to use of anaerobic adhesives and sealants.	4104/1557	Aerosol (400 ml)
Anti-Seize Paste	A compound used for assembly and prevention of parts seizure.	4003/0211	
Direct Glazing Kit	For one pane of glass; comprises items marked **†** below plus applicator nozzle etc.		
† Ultra Fast Adhesive	For direct glazing	4103/2109	310 ml
† Active Wipe 205	For direct glazing	4104/1203	250 g
† Black Primer 206J	For direct glazing	4201/4906	30 ml
Clear Silicone Sealant	To seal butt jointed glass.	4102/0901	

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In this publication and on the machine, there are safety notices. Each notice starts with a signal word. The signal word meanings are given below.

⚠ DANGER

Denotes an extreme hazard exists. If proper precautions are not taken, it is highly probable that the operator (or others) could be killed or seriously injured.

INT-1-2-1

⚠ WARNING

Denotes a hazard exists. If proper precautions are not taken, the operator (or others) could be killed or seriously injured.

INT-1-2-2

⚠ CAUTION

Denotes a reminder of safety practices. Failure to follow these safety practices could result in injury to the operator (or others) and possible damage to the machine.

INT-1-2-3

All construction and agricultural equipment can be hazardous. When JCB Excavator is correctly operated and properly maintained, it is a safe machine to work with. But when it is carelessly operated or poorly maintained it can become a danger to you (the operator) and others.

Do not work with the machine until you are sure that you can control it.

Do not start any job until you are sure that you and those around you will be safe.

If you are unsure of anything, about the machine or the job, ask someone who knows. Do not assume anything.

Remember

BE CAREFUL
BE ALERT
BE SAFE

GEN-1-6

As well as the warnings in the following pages, specific warnings are given throughout the book. This section is designed to give a safety code for use of the machine generally and for operation and maintenance practices.

Note: *This section includes a certain amount of operating safety information. But remember that whenever you drive the machine or operate its controls, you are in effect a machine operator. Therefore you should read and understand the information given in the Operator Handbook before driving the machine or operating its controls.*

General Safety

WARNING

Lifting Equipment

You can be injured if you use faulty lifting equipment. Make sure that lifting equipment is in good condition. Make sure that lifting tackle complies with all local regulations and is suitable for the job. Make sure that lifting equipment is strong enough for the job.

INT-1-3-7

WARNING

Clothing

You can be injured if you do not wear the proper clothing. Loose clothing can get caught in the machinery. Wear protective clothing to suit the job. Examples of protective clothing are: a hard hat, safety shoes, safety glasses, a well fitting overall, ear-protectors and industrial gloves. Keep cuffs fastened. Do not wear a necktie or scarf. Keep long hair restrained.

INT-1-3-6

WARNING

Care and Alertness

All the time you are working with or on the machine, take care and stay alert. Always be careful. Always be alert for hazards.

INT-1-3-5

WARNING

Raised Equipment

Raised equipment can fall and injure you. Do not walk or work under raised equipment unless safely supported.

13-1-1-6

DANGER

Before removing the boom from the machine, ensure that the counterweight is adequately supported as in certain ground conditions the machine could tip backwards. Never travel or transport the machine with the boom removed.

BF6-3

Operating Safety

⚠WARNING

Engine

The engine has rotating parts. Do not open the engine cover while the engine is running. Do not use the machine with the cover open.

INT-2-1-6

⚠WARNING

Entering/Leaving

Always face the machine when entering and leaving the cab. Use the step(s) and handrails. Make sure the step(s), handrails and your boot soles are clean and dry. Do not jump from the machine. Do not use the machine controls as handholds, use the handrails.

INT-2-1-7

⚠WARNING

Controls

You or others can be killed or seriously injured if you operate the control levers from outside the cab. Operate the control levers only when you are correctly seated inside the cab.

INT-2-1-3

⚠WARNING

Visibility

Accidents can be caused by working in poor visibility. Keep windows clean and use your lights to improve visibility. Do not operate the machine if you cannot see properly.

INT-2-1-11

⚠WARNING

Machine Limits

Operating the machine beyond its design limits can damage the machine, it can also be dangerous. Do not operate the machine outside its limits. Do not try to upgrade the machine performance with unapproved modifications.

INT-2-1-4

⚠WARNING

Exhaust Gases

Breathing the machine exhaust gases can harm and possibly kill you. Do not operate the machine in closed spaces without making sure there is good ventilation. If possible, fit an exhaust extension. If you begin to feel drowsy, stop the machine at once. Get out of the cab into fresh air.

INT-2-1-10

⚠WARNING

Hazardous Atmospheres

This machine is designed for use in normal outdoor atmospheric conditions. It shoul not be used in an enclosed area without adequate ventilation. Do not use the machine in a potentially explosive atmosphere, i.e. combustible vapours, gas or dust, without first consulting your JCB Distributor.

INT-2-1-14

⚠WARNING

Ramps and Trailers

Water, mud, ice, grease and oil on ramps or trailers can cause serious accidents. Make sure ramps and trailers are clean before driving onto them. Use extreme caution when driving onto ramps and trailers.

INT-2-2-6

⚠WARNING

Communications

Bad communications can cause accidents. Keep people around you informed of what you will be doing. If you will be working with other people, make sure any hand signals that may be used are understood by everybody. Work sites can be noisy, do not rely on spoken commands.

INT-2-2-3

⚠ DANGER

Sparks

Explosions and fire can be caused by sparks from the exhaust or the electrical system. Do not use the machine in closed areas where there is flammable material, vapour or dust.

INT-2-2-10

⚠WARNING

Controls

Keep the machine controls clean and dry. Your hands and feet could slide off slippery controls. If that happens, you will lose control of the machine.

2-2-3-6

Maintenance Safety

⚠WARNING

Soft Ground

A machine can sink into soft ground. Never work under a machine on soft ground.

INT-3-2-4

⚠WARNING

Metal Splinters

You can be injured by flying metal splinters when driving metal pins in or out. Use a soft faced hammer or drift to remove and fit metal pins. Always wear safety glasses.

INT-3-1-3

⚠WARNING

Communications

Bad communications can cause accidents. If two or more people are working on the machine, make sure each is aware of what the others are doing. Before starting the engine, make sure the others are clear of the danger areas; examples of danger areas are: the rotating blades and belt on the engine, the attachments and linkages, and anywhere beneath or behind the machine. People can be killed or injured if these precautions are not taken.

INT-3-1-5

⚠WARNING

Diesel Fuel

Diesel fuel is flammable; keep naked flames away from the machine. Do not smoke while refuelling the machine or working on the engine. Do not refuel with the engine running. There could be a fire and injury if you do not follow these precautions.

INT-3-2-2

⚠WARNING

Petrol

Do not use petrol in this machine. Do not mix petrol with the diesel fuel; in storage tanks the petrol will rise to the top and form flammable vapours.

INT-3-1-6

⚠WARNING

Oil

Oil is toxic. If you swallow any oil, do not induce vomiting, seek medical advice. Used engine oil contains harmful contaminants which can cause skin cancer. Do not handle used engine oil more than necessary. Always use barrier cream or wear gloves to prevent skin contact. Wash skin contaminated with oil thoroughly in warm soapy water. Do not use petrol, diesel fuel or paraffin to clean your skin.

INT-3-2-3

⚠WARNING

Fires

If your machine is equipped with a fire extinguisher, make sure it is checked regularly. Keep it in the operator's cab until you need to use it.

Do not use water to put out a machine fire, you could spread an oil fire or get a shock from an electrical fire. Use carbondioxide, dry chemical or foam extinguishers. Contact your nearest fire department as quickly as possible. Fire fighters should use self-contained breathing apparatus.

INT-3-2-7/1

⚠WARNING

Battery

A battery with frozen electrolyte can explode if it is used or charged. Do not use a machine with a frozen battery. To help prevent the battery from freezing, keep the battery fully charged.

INT-3-1-7

⚠WARNING

Battery Gases

Batteries give off explosive gases. Keep flames and sparks away from the battery. Do not smoke close to the battery. Make sure there is good ventilation in closed areas where batteries are being used or charged. Do not check the battery charge by shorting the terminals with metal; use a hydrometer or voltmeter.

INT-3-1-8

⚠WARNING

Battery Terminals

The machine is negatively earthed. Always connect the negative pole of the battery to earth.

When connecting the battery, connect the earth (-) lead last.

When disconnecting the battery, disconnect the earth (-) lead first.

INT-3-1-9

⚠WARNING

Electrical Circuits

Understand the electrical circuit before connecting or disconnecting an electrical component. A wrong connection can cause injury and/or damage.

INT-3-1-4

⚠ CAUTION

Never use water or steam to clean inside the cab. The use of water or steam could damage the on-board computer and render the machine inoperable. Remove dirt using a brush or damp cloth.

8-3-4-8

Maintenance Safety *(continued)*

CAUTION

Arc Welding

Before carrying out any arc welding on the machine, completely remove the Control Computer to avoid damage to the circuits; also disconnect the alternator plug and battery leads.

When welding items to the mainframe make sure that the earth clamp is positioned on the mainframe and when welding to the undercarriage make sure that the earth clamp is positioned on the undercarriage. If you earth one and weld the other, you may cause severe damage to the slew ring.

Always connect the earth clamp to any other component being welded, i.e. boom or dipper, to avoid damage to pivot pins and bushes.

8-1-2-6/1

WARNING

Hydraulic Hoses

Damaged hoses can cause fatal accidents. Inspect the hoses regularly for:
Damaged end fittings
Chafed outer covers
Ballooned outer covers
Kinked or crushed hoses
Embedded armouring in outer covers
Displaced end fittings.

INT-3-3-2

WARNING

DO NOT remove the hydraulic tank filler cap or cover plate when the engine is running. The hydraulic system is under pressure. You or others could be injured. First stop the engine and then release the pressure.

8-3-4-4/1

WARNING

Hydraulic Pressure

Hydraulic fluid at system pressure can injure you. Before disconnecting or connecting hydraulic hoses, stop the engine and operate the controls to release pressure trapped in the hoses. Make sure the engine cannot be started while the hoses are open.

INT-3-1-11/1

WARNING

Hydraulic Fluid

Fine jets of hydraulic fluid at high pressure can penetrate the skin. Do not use your fingers to check for hydraulic fluid leaks. Do not put your face close to suspected leaks. Hold a piece of cardboard close to suspected leaks and then inspect the cardboard for signs of hydraulic fluid. If hydraulic fluid penetrates your skin, get medical help immediately.

INT-3-1-10/1

CAUTION

Rams

The efficiency of the rams will be affected if they are not kept free of solidified dirt. Clean dirt from around the rams regularly. When leaving or parking the machine, close all rams if possible to reduce the risk of weather corrosion.

INT-3-2-10

CAUTION

Cleaning

Cleaning metal parts with incorrect solvents can cause corrosion. Use only recommended cleaning agents and solvents.

INT-3-2-11

CAUTION

'O'-rings, Seals and Gaskets

Badly fitted, damaged or rotted 'O'-rings, seals and gaskets can cause leakages and possible accidents. Renew whenever disturbed unless otherwise instructed. Do not use Trichloroethane or paint thinners near 'O' rings and seals.

INT-3-2-12

WARNING

Hot Coolant

The cooling system is pressurised when the engine is hot. Hot coolant can spray out when you remove the radiator cap. Let the system cool before removing the radiator cap. To remove the cap; turn it to the first notch and let the system pressure escape, then remove the cap.

INT-3-2-9

CAUTION

If the machine is operated at full load, before its initial run-in procedure is complete, it may cause scuffing and seizing which can adversely effect the service life of the machine.

8-3-1-5

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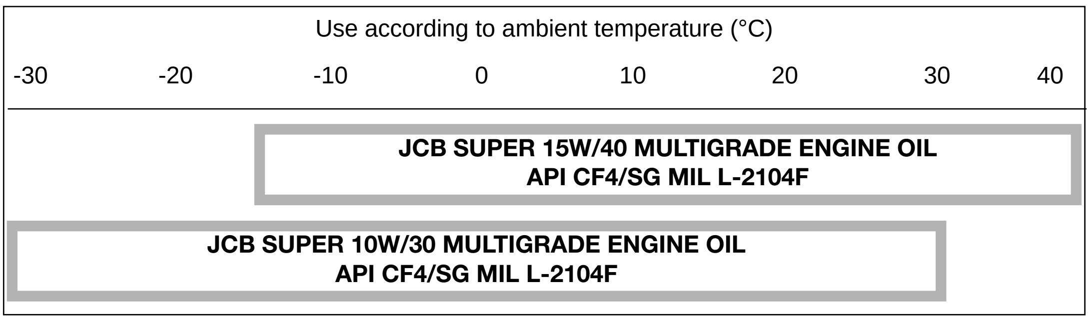
LUBRICANTS AND CAPACITIES

*

JS200/JS210/JS220/JS240/JS260 and Variants

Item	Lubricant	International Specification	Capacity JS200, JS210,JS220, JS240, JS260 and Variants
ENGINE	(see separate chart)		21.5 litres (4.72 UK gal) (5.67 US gal)
TRACK GEARBOX	JCB HD90 Gear Oil	API-GL-5, MIL-L-2105	2 x 3.5 litres (2 x 0.77 UK gal) (2 x 0.92 US gal)
SLEW GEARBOX	JCB HD90 Gear Oil JCB HP Grease	API-GL-5, MIL-L-2105 Lithium complex (NLGI 2)inc. extreme pressure additives	5 litres (1.09 UK gal) (1.31 US gal) 1 litres (0.22 UK gal)
TRACK ROLLERS AND IDLER WHEEL	JCB HD90 Gear Oil	API-GL-5, MIL-L-2105	--
RECOIL SPRING CYLINDER	JCB HP Grease	Lithium complex (NLGI 2)inc. extreme pressure additives	--
HYDRAULIC SYSTEM	JCB Hydraulic Fluid 46	ISO VG46	203 litres (44.64 UK gal) (53.6 US gal)
SLEW RING - BEARING - GEAR TEETH	 JCB HP Grease JCB HP Grease	 Lithium complex (NLGI 2)inc. extreme pressure additives Lithium complex (NLGI 2)inc. extreme pressure additives	 -- JS 200, JS210, JS 220 17 kg (37.48 lb) JS 240, JS 260 20 kg (44.10 lb)
ALL OTHER GREASE POINTS	JCB HP Grease	Lithium complex (NLGI 2)inc. extreme pressure additives	--
COOLING SYSTEM	see ***Coolant Mixtures***		25.5 litres (5.6 UK gal) (6.7 US gal)
FUEL TANK	see ***Type of Fuel***		310 litres (68.19 UK gal) (81.19 US gal)

ENGINE LUBRICATION CHART



It is most important that you read and understand this information and the publications referred to. Make sure that all of your colleagues who are concerned with lubricants read it too.

First Aid - Oil

Swallowing

If oil is swallowed you should not induce vomiting. Get medical advice.

Skin

In the case of excessive skin contact you should wash with soap and water.

Eyes

In the case of eye contact, flush with water for 15 minutes. If irritation persists, get medical attention.

Fires

Extinguish with carbon dioxide, dry chemical or foam. Fire-fighters should use self contained breathing apparatus.

⚠ WARNING

Do not use water to put out an oil fire. This will only spread it because oil floats on water.

Extinguish oil and lubricant fires with carbon dioxide, dry chemical or foam. Fire fighters should use self contained breathing apparatus.

7-3-1-3/1

Hygiene

JCB lubricants are not a health risk when used properly for their intended purposes.

However, excessive or prolonged skin contact can remove the natural fats from your skin, causing dryness and irritation.

Low viscosity oils are more likely to do this, therefore particular care is necessary in handling used oils which can be diluted with fuel contamination.

Whenever you are handling oil products you should maintain good standards of care and personal and plant hygiene. For details of these precautions we advise you to read the relevant publications issued by your local health authority, and note the following:

Storage

Always keep lubricants out of the reach of children.

Never store lubricants in open or unlabelled containers.

Handling

New Oil

There are no special precautions need for the handling or use of new oil, beside normal care and hygiene practices.

Used Oil

Used engine crankcase lubricants contain harmful contaminants. In laboratory tests it was shown that used engine oils can cause skin cancer.

Here are precautions to protect your health when handling used engine oil:

1. Avoid prolonged, excessive or repeated skin contact with used engine oils.
2. Apply a barrier cream to the skin before handling used engine oil.
3. Note the following when removing engine oil from skin:
   - **a.** Wash your skin thoroughly with soap and water.
   - **b.** Using a nail brush will help.
   - **c.** Use special hand cleansers to help clean dirty hands.
   - **d.** Never use petrol, diesel fuel or gas oil.
   - **e.** Avoid skin contact with oil soaked clothing.
   - **f.** Don't keep oily rags in pockets.
   - **g.** Wash dirty clothing before re-use.
   - **h.** Throw away oil-soaked shoes.

Waste Disposal

All waste products should be disposed of in accordance with all the relevant regulations.

The collection and disposal of used engine oil should be in accordance with any local regulations. Never pour used engine oil into sewers or drains.

Spillage

Absorb on sand or a locally approved brand of absorbent granules. Scrape up and remove to a chemical disposal area.

* Service Intervals for Hydraulic Oil and Filters when using a Breaker, Crusher or Pulveriser

When using a breaker, crusher or pulveriser contamination and degradation of the hydraulic oil occurs much more quickly than in normal excavating use. If the machine is used with increasingly degrading oil it can cause problems in the control valve, premature wear of the hydraulic pump and damage to the hydraulic system as a whole.

Servicing of the hydraulic oil and filters must be done more frequently according to the percentage of total operating hours involving use of the breaker, crusher or pulveriser. When a breaker, crusher or pulveriser is fitted, ensure that the oil and filters are changed at the intervals shown in the table below.

The hydraulic oil must be sampled and checked for contamination and degradation at the intervals shown.

		Use Frequency 100%			**Use Frequency 40%**			**Use Frequency 20%**			**Use Frequency 10%**		
Item	**Time (hrs)**	**10**	**100**	**600**	**10**	**300**	**1500**	**10**	**600**	**3000**	**10**	**800**	**4000**
Hydraulic Oil		○		●	○		●	○		●	○		●
Return Filter			●			●			●			●	
Suction Filter			[1]	●		[1]	●		[1]	●		[1]	●
Drain Filter			●			●			●			●	
Servo Filter			●			●			●			●	
Plexus Filter			●			●			●			●	
Breaker In-Line Filter			●			●			●			●	
Hydraulic Oil Sampling		Every 200 hrs			Every 300 hrs			Every 600 hrs			Every 800 hrs		

○ Check oil level and top up as required ● Change [1] Clean

Note: The filters must be changed whenever the period of breaker/crusher use exceeds 100hrs, regardless of the total number of hours the machine has worked.

* Initial Precautions for New Machine Usage

CAUTION

If the machine is operated at full load, before its initial run-in procedure is complete it may cause scuffing and seizing which can adversely effect the life of the machine.

8-3-1-5

A new machine is only dispatched when it has completed all its inspection procedures, but operating it under severe conditions from new will affect its performance and shorten its service life.

1. Carry out the Daily inspection procedure
2. Always warm up the machine sufficiently
3. Hold the engine speed to 80% of the maximum
4. Check to see if the machine is running normally
5. Avoid running or swinging the machine rapidly
6. Avoid sudden shocks e.g. suddenly stopping the boom when lowering
7. Where applicable, grease the front pins daily
8. At 50 hrs carry out servicing

Every 10 Operating Hours or Daily
Whichever occurs first

1. **Clean**
   a. Machine generally.
2. **Grease**
   (If operating in very wet or severe conditions)
   a. Boom/bucket/dipper pivot points.
3. **Check (Engine Stopped)**
   a. Generally for damage.
   b. For oil and coolant leakage.
   c. Security of bolts and nuts ††.
   d. For disconnected or shorted wiring, loose terminals.
   e. Hydraulic fluid level.
   f. Engine oil level.
   g. Track tension.
   h. Windscreen washer fluid level.
   j. Fuel system for leaks.
   k. Fuel level.
   l. The auxiliary circuit hydraulic oil filter visual indicator (if using a rockbreaker)

†† Tapping with a hammer will identify any loose nuts and bolts which should then be tightened to the specified torque.

4. **Check (Engine Running)**
   a. Operation of warning lights and audible alarm.
   b. Operation of other electrical equipment.
   c. Exhaust for excessive smoke.
   d. Excavator operation.
   e. Transmission operation.
   f. Operation of track and slew brakes.
   g. Operation of hour meter.

Every 50 Operating Hours or Weekly
Whichever occurs first

1. **Do the daily jobs plus:**
2. **Clean**
   a. Drain water and sediment from fuel tank.
   b. Drain fuel water separator.
3. **Grease**
   a. All pivot pins.

Every 100 Operating Hours or 2-Weekly
Whichever occurs first

1. **Do a 50 hour service plus:**
2. **Clean**
   a. Battery terminals.
   b. Fuel lift pump strainer†.
3. **Change**
   a. Engine oil main filter element †.
   b. Engine oil †.
   c. Servo oil filter element †.
   d. Engine oil filter by-pass element †.
   e. Return filter element†.
   f. Drain filter element †.
   g. Track and slew gearbox oil level †.
   h. Fuel filter element†.
4. **Check (Engine Stopped)**
   a. Hoses and pipework for chafing or damage.
   b. Condition of ram piston.
   c. Bucket pivot pin grease seals†.
   d. Track plate condition and bolt torque.
   e. Track and running gear.
   f. Top and bottom track rollers for oil leaks †.
   g. Track idler wheels for oil leaks †.
   h. Security of major unit mounting bolts and nuts†. If loose, tighten to specified torque.
   i. Wiring for chafing.
   j. Fan belt adjustment.
   k. Accumulator operation.
   l. Radiator for damage.
   * m. Oil cooler for damage.
   n. Battery electrolyte level†.
   p. Exhaust system security†.
   r. Teeth and sidecutters†.
5. **Check (Engine Running)**
   a. Operation of throttle system†.
   b. Operation of overload warning†.
   c. Operation of stop control†.

† These procedures are only to be carried out after the first 100 hours use of a new machine. Thereafter they are to be carried out as detailed in the following periodic checks.

Every 250 Operating Hours or Monthly
Whichever occurs first

1. **Do a 100 hour service plus:**
2. **Clean**
   a. Drain water and deposits from hydraulic oil tank.
   b. Air cleaner dust valve.
   c. Pre-cleaner
3. **Grease**
   a. Door and canopy hinges.
   b. Slew ring bearing.
4. **Check (Engine Stopped)**
   a. Battery electrolyte level.
   b. Security of major unit mounting bolts and nuts. If loose, tighten to specified torque.
   c. Track and slew gearbox oil level.
   d. Fan belt adjustment.
   e. Air inlet system security

Every 500 Operating Hours or 3-Monthly
Whichever occurs first

1. **Do a 250 hour service plus:**
2. **Clean**
   a. Radiator, grille and oil cooler fins.
3. **Grease**
   a. Slew ring teeth.
4. **Change**
   a. Engine oil.
   b. Engine oil full flow filter element.
   c. Fuel filter element.
   d. Engine oil filter by-pass element.
5. **Check (Engine Stopped)**
   a. Exhaust system security.
   b. Top and bottom track rollers for oil leaks.
   c. Track idler wheels for oil leaks.
   * d. Hydraulic oil (check the degradation and cleanliness by sampling).
   e. Seat belt condition and security.
   f. Teeth and sidecutters.
   * g. Engine oil (check the degredation and cleanliness by sampling).
6. **Check (Engine Running)**
   a Operation of throttle system.
   b. Operation of overload warning.
   c Operation of stop control.

Every 1000 Operating Hours or 6-Monthly
Whichever occurs first

1. **Do a 500 hour service plus:**
2. **Clean**
   a. Fuel lift pump strainer.
   b. Hydraulic fluid suction strainer.
3. **Grease**
   a. Pivot pins.
4. **Change (Engine Stopped)**
   a. Engine air filter element (outer).
   b. Hydraulic tank air breather element.
   c. Track and slew gearbox oil.
   d. Return filter element.†††
   e. Nephron filter.†††
   f. Servo oil filter element.†††
   g. Drain filter.†††
5. **Check (Engine Stopped)**
   a. Track wear.

Every 2000 Operating Hours or Yearly

Whichever occurs first

1. **Do a 1000 hour service plus:**
2. **Check (Engine Stopped)**
   a. Sample hydraulic oil and replace if necessary.
3. **Change**
   a. Hydraulic fluid suction strainer.
   b. Engine air filter element (inner).
   * c. Hydraulic Oil (for machines with biodegradable oil).

Every 4000 Operating Hours or 2 Years
Whichever occurs first

1. **Do a 2000 hour service plus:**
2. **Change**
   a. Long life coolant.
   b. Fuel hose (fuel tank - engine).
   c. Fuel hose (fuel filter - injection pump).
   d. Hydraulic pump exit hose (pump - operation valve).
   e. Boom ram line hose.
   f. Dipper ram line hose.
   g. Bucket ram line hose.

†††If using a breaker, crusher or pulveriser, see page 2-1 for revised servicing schedules.

Every 5000 Operating Hours or 2 Years 6 Months

Whichever occurs first

1. **Do a 1000 hour service plus:**

2. **Change**

   Hydraulic oil.

   Hydraulic tank air breather element.

   Hydraulic suction filter†††.

†††If using a breaker, crusher or pulveriser, see page 2-1 for revised servicing schedules.

General Notes

For the type of grease to use at each point, *see **Lubricants and Capacities***.

Do not mix different types of grease. Keep them separate.

⚠ WARNING

You will be working close into the machine for these jobs. Lower the attachments if possible. Remove the starter key and disconnect the battery. This will prevent the engine being started.

8-3-1-3

Slew Ring Bearing

1. The three grease nipples are grouped together on the front of the machine**.**

Slew Ring Teeth and Slew Pinion

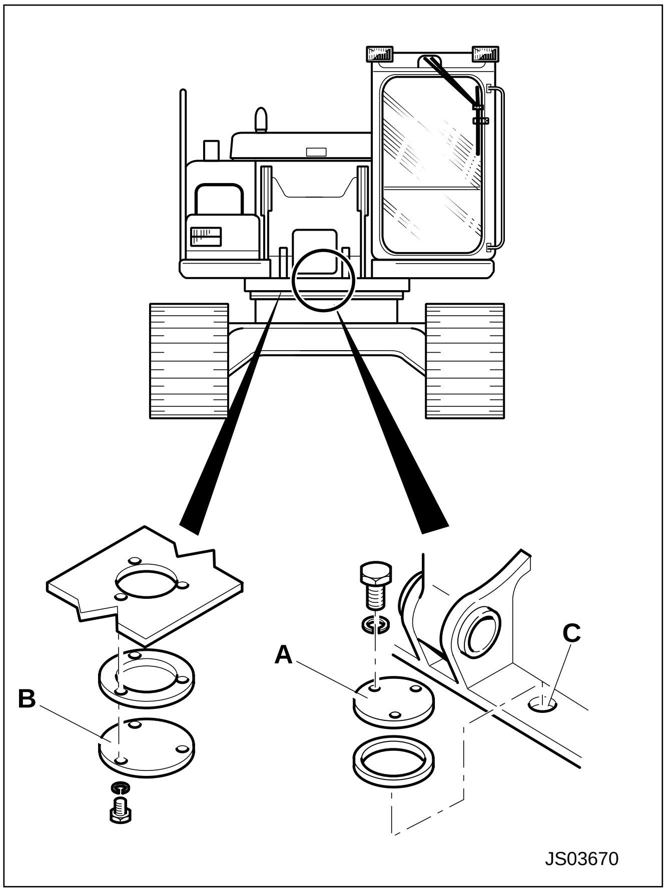
Ensure slew ring is kept full of grease. Always grease whenever the machine has been steam-cleaned.

For location of the slew ring gear refer to ***component Location Diagrams*** .

1. **Make the Machine Safe**
   Stop the engine and remove the starter key.
2. **Grease the Slew Ring**
   * **a.** Remove the inspection port cover **A** (on the lower centre section).
   * **b.** Remove the grease discharge port cover **B** (on the lower inner side).
   c. Remove contaminated grease.
   * **d.** Replace the discharge port cover.
   e. Apply grease to the slew ring via aperture **C**.
3. **Slew the Machine**
   Start the engine and slew the machine a few degrees. Stop the engine, remove the starter key and apply grease again.

   Repeat until the whole ring is greased. Check that grease exudes around the entire circumference.
4. **Refit the Cover**

*



Excavator End

* 16 Grease Points - plus 3 for Triple Articulating Boom (if fitted). See also next page.

⚠ WARNING

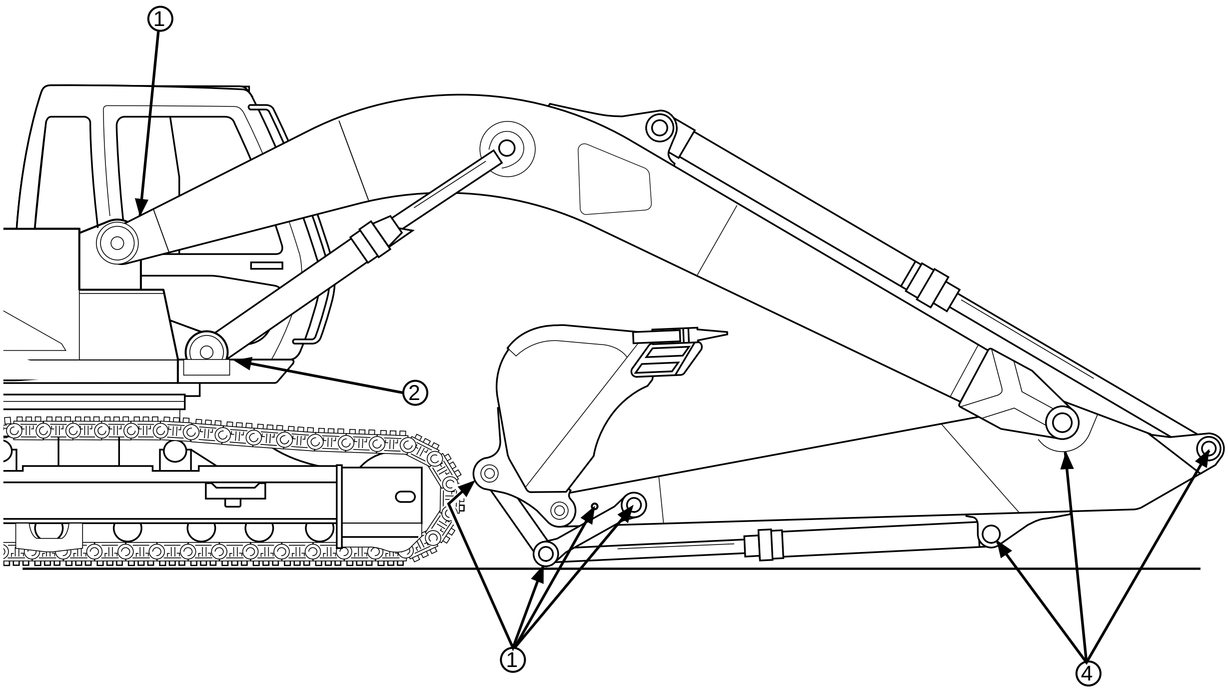
You will be working close into the machine for these jobs. Lower the attachments if possible. Remove the starter key and disconnect the battery. This will prevent the engine being started.

8-3-1-3

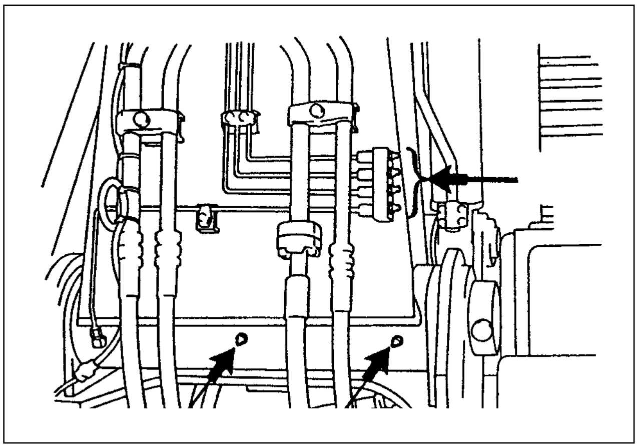
*

Greasing Points	(No.) Drawing reference	Number of greasing points	
Boom		3.	* Centralised greasing (total of 6 points)
Boom ram, eye end pin	1	2.	
Dipper ram, dump end pin		1.	
Boom ram, dump end pin	2	2.	
Bucket ram to Bucket linkage pin		2.	(total of 5 points)
Bucket linkage to Bucket pin	3	1.	
Dipper to Bucket Linkage pin		1.	
Dipper to Bucket pin		1.	
Bucket ram, dump end pin		1.	(total of 3 points)
Dipper ram, eye end pin	4	1.	
Boom to Dipper connecting pin		1.	
Triple articulating boom positioning ram, dump end pin		1.	(total of 3 points)
Triple articulating boom positioning ram, eye end pin	5	1.	
Triple articulating boom - upper/lower boom pivot pin		1.	

*



Excavator End



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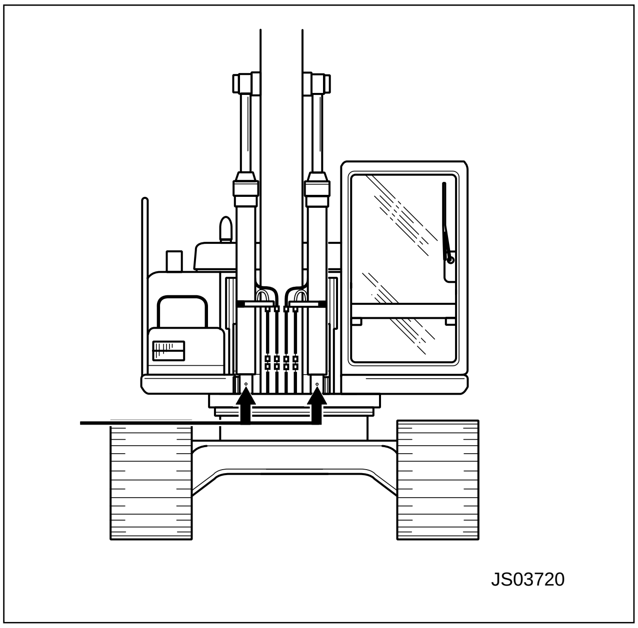

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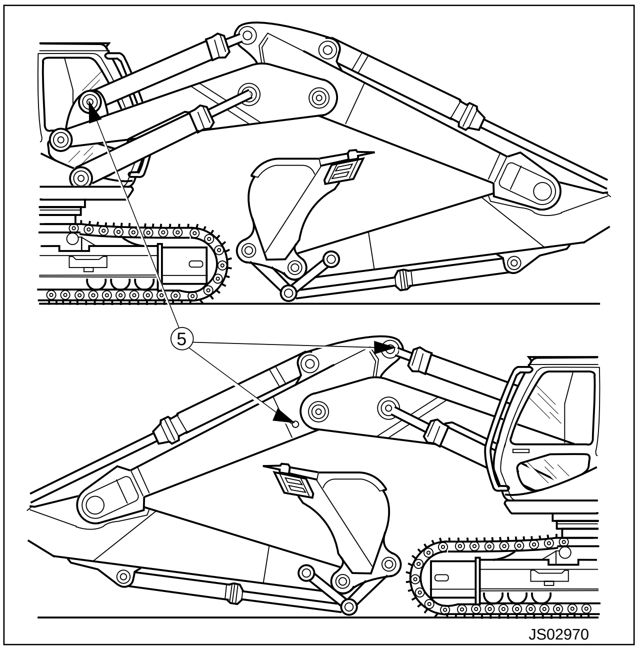

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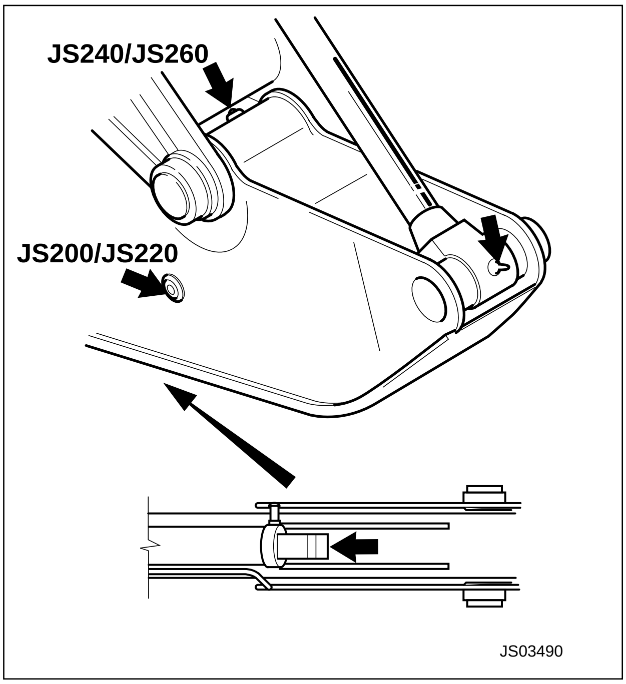

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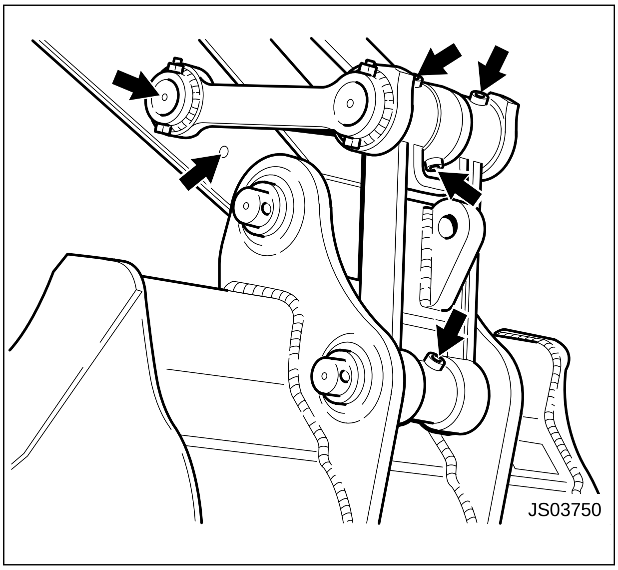


First Aid - Electrolyte

EYES

FLUSH WITH WATER FOR 15 MINUTES. GET MEDICAL HELP FAST.

IF SWALLOWED

DO NOT INDUCE VOMITING. DRINK LARGE QUANTITIES OF WATER OR MILK. Then drink milk of magnesia, beaten egg or vegetable oil.

SKIN

FLUSH WITH WATER. REMOVE AFFECTED CLOTHING.

⚠ WARNING

Batteries give off an explosive gas. Do not smoke when handling or working on the battery. Keep the battery away from sparks and naked flames.

Battery electrolyte contains sulphuric acid. It can burn you if it touches your skin or eyes. Wear goggles. Handle the battery carefully to prevent spillage.

Keep metallic items (watches, rings, zippers etc) away from the battery terminals. Such items could short the terminals and burn you.

Set all switches in the cab to OFF before disconnecting the battery. When disconnecting the battery, take off the earth (-) lead first.

When reconnecting, fit the positive (+) lead first.

Re-charge the battery away from the machine, in a well-ventilated area. Switch the charging circuit off before connecting or disconnecting the battery. When you have installed the battery in the machine, wait five minutes before connecting it up.

5-3-4-3

⚠ CAUTION

Do not disconnect the alternator, the battery, or any part of the charging circuit with the engine running.

8-3-4-1

Charge Rate Depending on the Battery specific Gravity

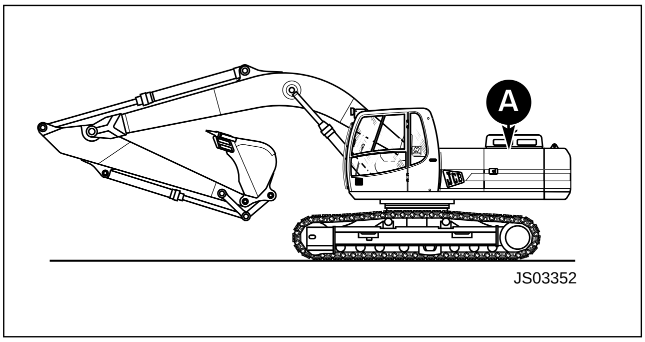
Temperature / Charge Rate	20°C	0°C	-10°C
100% (satisfactory)	1.26	1.27	1.28
90% (satisfactory)	1.24	1.25	1.26
80% (charge)	1.22	1.23	1.24
75% (charge)	1.21	1.22	1.23

If the battery is charged and the charge rate is less than 75%, replace the battery.

Checking the Electrolyte Level

Maintenance free batteries used in normal temperate climate applications should not need topping up. However, in certain conditions (such as prolonged operation at tropical temperatures or if the alternator overcharges) the electrolyte level should be checked as described below.

1. **Open the Battery Compartment A**
   Remove the bolts securing the metal plate above the batteries. Remove the plate.



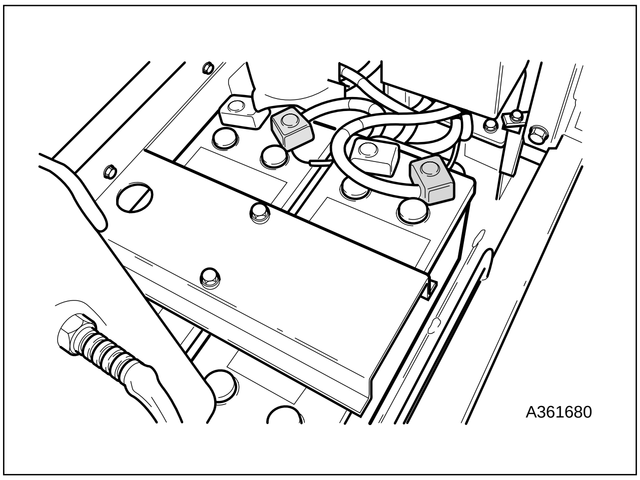
2. **Check the Level**
   Remove the covers and check the electrolyte level in each cell. The electrolyte should be 15 mm (0.6 in) above the plates.
   Top-up if necessary with distilled water or de-ionised water.

⚠ WARNING

Do not top the battery up with acid. The electrolyte could boil out and burn you.

2-3-4-6

3. **Check the Connections**
   Make sure that the terminals are tight and clean. Coat them with petroleum jelly to prevent corrosion.



Air Bleeding Procedures

⚠ WARNING
Hydraulic Pressure

Hydraulic fluid at system pressure can injure you. Before disconnecting or connecting hydraulic hoses, stop the engine and operate the controls to release pressure trapped in the hoses. Make sure the engine cannot be started while the hoses are open.

INT-3-1-11/1

	Air Bleeding Sequence			
	Air Bleeding from pump	Air Bleeding from ram	Air Bleeding from slew motor	Check
Hydraulic oil or pump replacement	O →	O →	O →	O
Ram replacement		O →	→	O
Slew motor replacement			O →	O

Releasing Tank Pressure

⚠ WARNING

DO NOT remove the hydraulic tank filler cap or cover plate when the engine is running. The hydraulic system is under pressure. You or others could be injured. First stop the engine and then release the pressure.

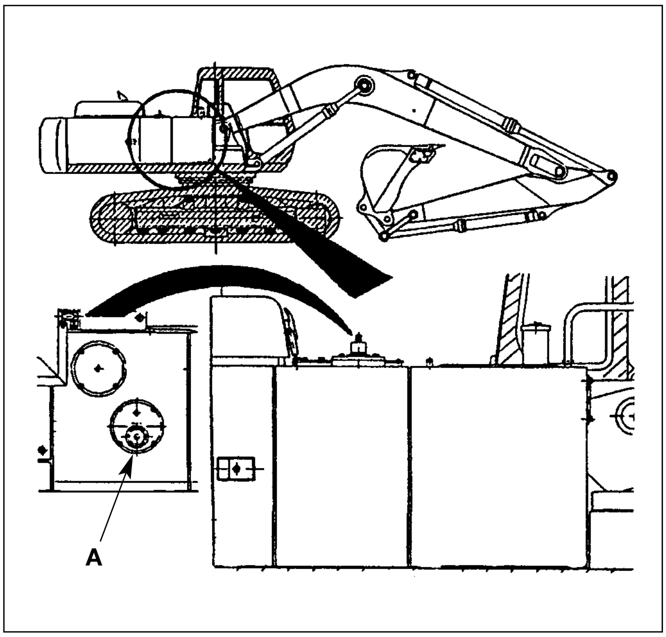
8-3-4-4/1

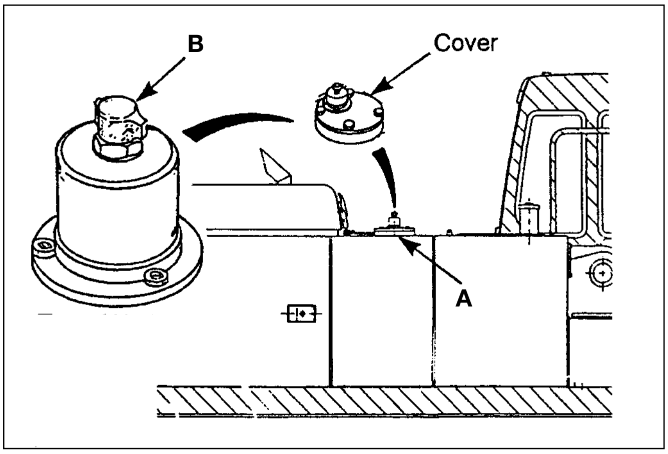
⚠ WARNING

The temperature of the hydraulic oil will be high soon after stopping the engine. Wait until it cools down (less than 40°C) before beginning maintenance.

8-3-4-10

1. **Prepare the Machine**
   - **a.** Position the machine on level ground. Stop the engine. Remove the Starter Key.
   - **b.** Locate the Hydraulic Oil Tank Filler Cap **A** or Filler Plate.
   - **c.** Remove the box Nut of the breather **B** top of the hydraulic oil tank, press the projection and release the pressure from the Tank.





Air Bleeding from Hydraulic Pump

WARNING

Hydraulic Pressure

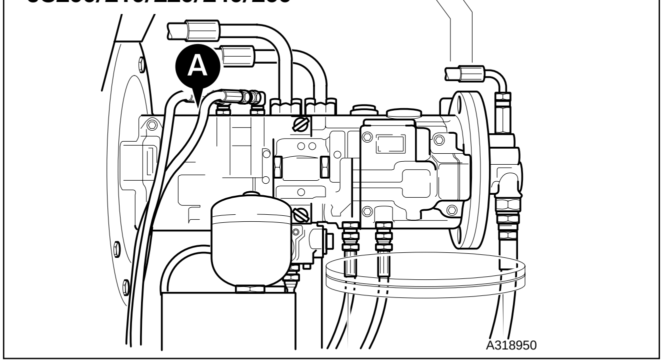
Hydraulic fluid at system pressure can injure you. Before disconnecting or connecting hydraulic hoses, stop the engine and operate the controls to release pressure trapped in the hoses. Make sure the engine cannot be started while the hoses are open.

INT-3-1-11/1

1. Prepare the Machine

- **a.** Position the Machine on level ground. Stop the engine. Remove the starter key.
- **b.** Loosen the air bleeding plug **A** to check that oil comes from the air bleeding port.
- **c.** If oil does not come out, remove the air bleeding plug **A** and fill hydraulic oil into the pump case through the air bleeding port.
- **d.** Temporarily tighten the air bleeding plug **A**.
- **e.** Idle the engine at low speed, slightly loosen the air bleeding plug and continue to run the engine until oil comes out from the air bleeding port.
- **f.** Completely tighten the air bleeding plug **A.**
- **g.** After bleeding is completed, stop the engine for 5 minutes or more and release the bubbles from the oil in the hydraulic oil tank

*__JS200/210/220/240/260__



Air Bleeding from Ram

WARNING

Hydraulic Pressure

Hydraulic fluid at system pressure can injure you. Before disconnecting or connecting hydraulic hoses, stop the engine and operate the controls to release pressure trapped in the hoses. Make sure the engine cannot be started while the hoses are open.

INT-3-1-11/1

WARNING

The temperature of the hydraulic oil will be high soon after stopping the engine. Wait until it cools down (less than 40°C) before beginning maintenance.

8-3-4-10

1. Prepare the Machine

- **a.** Position the Machine on level ground.
- **b.** Idle the engine at low speed and retract each ram 4 or 5 times without reaching the stroke end (about 100mm (4 in.) before the end of the ram.
- **c.** Operate each ram 3 or 4 times to the stroke end to completely bleed the air.
- **d.** After bleeding is completed, stop the engine for 5 minutes or more and release the bubbles from the oil in the hydraulic oil tank.

Air Bleeding from the Slew Motor

WARNING

DO NOT remove the hydraulic tank filler cap or cover plate when the engine is running. The hydraulic system is under pressure. You or others could be injured. First stop the engine and then release the pressure.

8-3-4-4/1

WARNING

The temperature of the hydraulic oil will be high soon after stopping the engine. Wait until it cools down (less than 40°C) before beginning maintenance.

8-3-4-10

1. Prepare the Machine

a. Position the machine on level ground.

b. Idle the engine at low speed, loosen the air bleeding plug **A** and check that oil comes out from the air bleeding port.

DO NOT SLEW THE MACHINE.

c. If no oil comes out, stop the engine, remove the air bleeding plug **A** and fill the motor case with hydraulic oil.

d. Temporarily tighten the air bleeding plug.

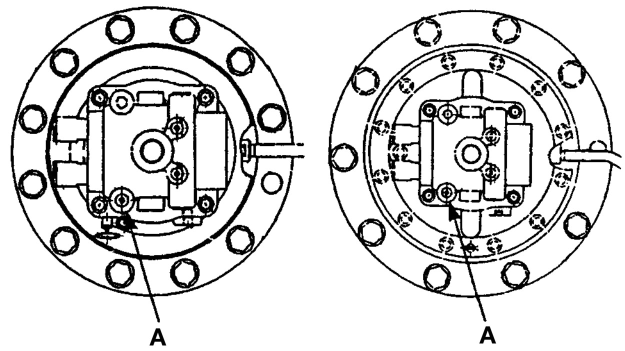
e. Idle the engine at low speed and continue to run until oil comes out from the air bleeding port.

f. Completely tighten the air bleeding plug.

g. Idle the engine at low speed and slowly slew the machine left to right evenly more than 2 turns.

h. After bleeding is completed, stop the engine for 5 minutes or more and release the bubbles from the oil in the hydraulic oil Tank.

* **JS200/JS210/JS220** **JS240/JS260**

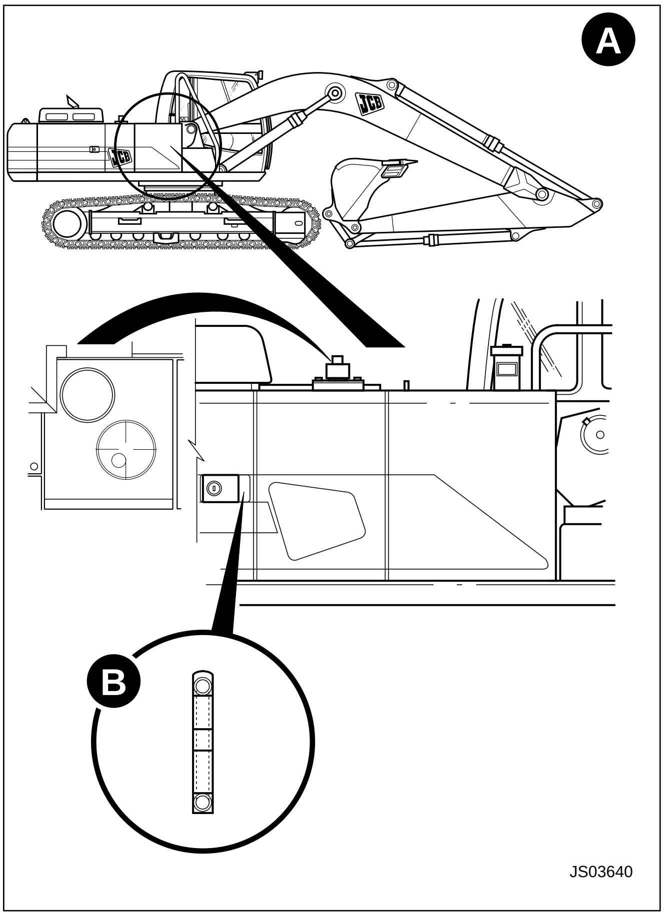


For location of hydraulic oil tank *see* ***Component Location Diagram***.

⚠ WARNING

Fine jets of hydraulic fluid at high pressure can penetrate the skin. Do not use your fingers to check for hydraulic fluid leaks. Do not put your face close to suspected leaks. Hold a piece of cardboard close to suspected leaks and then inspect the cardboard for signs of hydraulic fluid. If hydraulic fluid penetrates your skin get medical help immediately.

INT-3-1-10/1



Checking the Fluid Level

1. **Prepare the Machine**
   Position the machine on level ground with the bucket and dipper rams fully extended and the boom lowered to rest the attachment on the ground, as at **A.**

2. **Check the Level**
   Look at the fluid level in the sight tube **B**. The level should be between the two marks on the tube. If the fluid is cloudy, water or air has entered the system. Water or air in the system could damage the hydraulic pump.

Topping up Fluid Level

⚠ WARNING

DO NOT remove the hydraulic tank filler cap or cover plate when the engine is running. The hydraulic system is under pressure. You or others could be injured. First stop the engine and then release the pressure.

8-3-4-4/1

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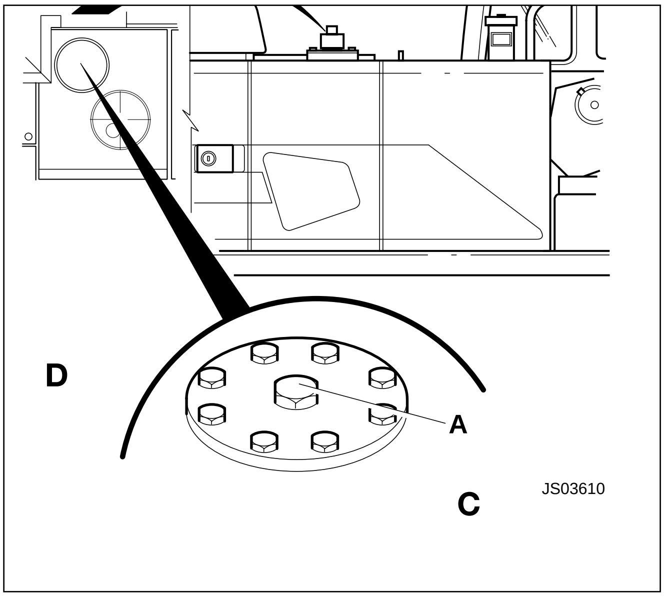


1. **Prepare the Machine**
   Position the Machine on level ground as at **A**. Stop the engine. Remove the starter key.

2. **Locate the Hydraulic Oil Tank Filler Plate**
   See ***Component Location Diagrams***.

3. **Release Tank Pressure**
   See ***Releasing Tank Pressure.***

4. **Add Fluid.**

   a. Remove plug **C** (later machines) or cover **D** (earlier machines).

   b. Refill oil through the filler port using a suitable funnel.

   c. Check the level through the level gauge on the side of the tank.

   d. Refit plug **C** (or cover **D**).

Changing the Hydraulic oil

WARNING

DO NOT remove the hydraulic tank filler cap or cover plate when the engine is running. The hydraulic system is under pressure. You or others could be injured. First stop the engine and then release the pressure.

8-3-4-4/1

WARNING

Hydraulic Pressure

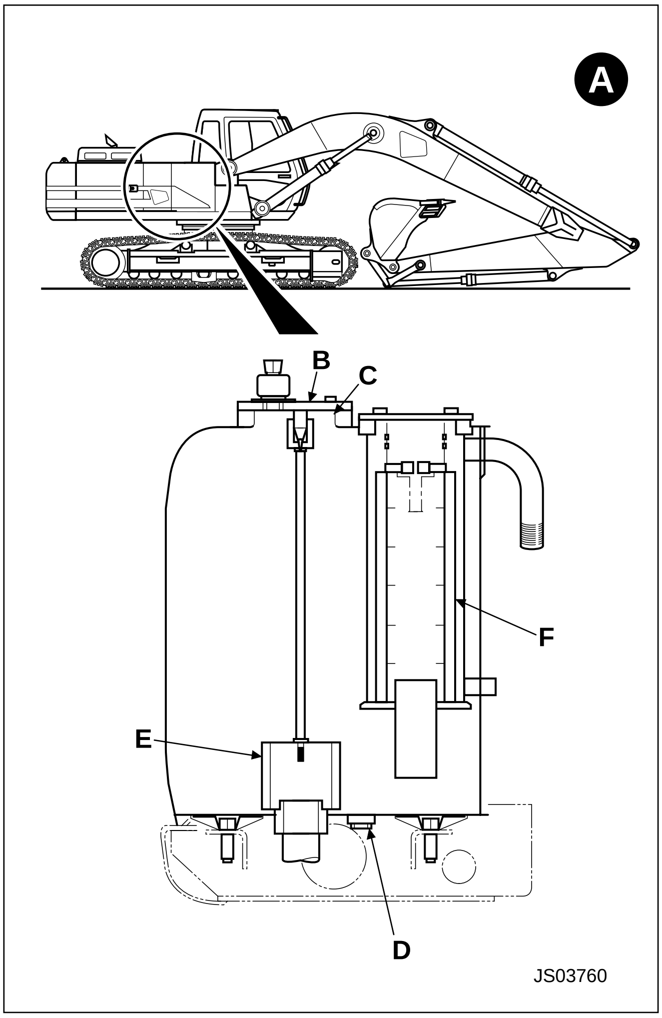
Oil is toxic. If you swallow any oil, do not induce vomiting, seek medical advice. Used engine oil contains harmful contaminants which can cause skin cancer. Do not handle used engine oil more than necessary. Always use barrier cream or wear gloves to prevent skin contact. Wash skin contaminated with oil thoroughly in warm soapy water. Do not use petrol, diesel fuel or paraffin to clean your skin.

INT-3-2-3

1. **Prepare the Machine**
   Position the machine on level ground as at **A**. Stop the engine. Remove the starter key.
2. Locate the Hydraulic oil tank or Filler Plate. *See* ***Component Location Diagrams*** at the end of the section.
3. **Release Tank Pressure**
   See ***Releasing Tank Pressure***.
   - **a .** Remove the filler port cover **B** and 'O'-ring **C.**
   - **b.** Use a pump and discharge the hydraulic oil into an empty waste container.
   - **c.** Remove the drain plug **D** on the bottom of the Tank and drain the remaining oil from the tank (have a drain pan ready).
4. **Replace the Suction Strainer E** *
   See ***Changing the Suction Strainer.***
5. **Replace the Return Filter F**
   See ***Changing the Return Filter.***
6. **Seal the system**
   - **a.** Refit Drain plug **D.**
   - **b.** **Refill the Tank**
     Refill the Tank with Hydraulic oil *(See* ***Lubricants and Capacities*** *for the type of fluid)* to the specified level *see* ***Checking the Fluid Level.***
   - **c.** Install the 'O'-ring **C** and filler port cover **B.**

Note: *If the 'O'-Ring* ***C*** *is damaged, replace it with a new one.*

*



Changing the Hydraulic Oil *(continued)*

7. Bleed the Hydraulic Components
*See **Air Bleeding Procedures***

8. Check for leaks
- **a.** Start the engine and run it for around 5 minutes without load.
- **b.** Slowly operate the Travel, slew and cylinders several times.

9. Check the fluid level
*See **Checking the Fluid Level.***

Changing the Return Filter Element

1. Prepare the Machine
Position the machine on level ground. Stop the engine. Remove the starter Key.

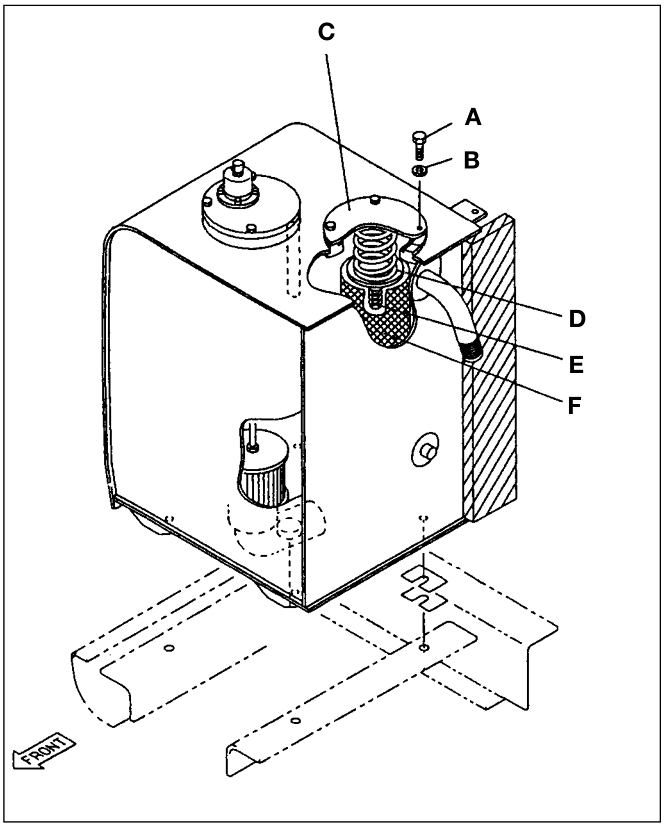
2. Locate the Return filter. *See **Components Location Diagram*** at the end of this section.

3. Release Tank Pressure.
*See **Releasing Tank Pressure**.*

4. Removing the Element
- **a.** Remove the retaining bolts **A** and washers **B** and take off the cover plate **C** complete with its 'O'-ring seal.
- **b.** Remove the spring **D**, bypass valve **E** and element **F.**

5. Fit a New Element
Re-assemble in reverse order, using a new filter element **F** and replace the 'O'-ring with a new one if the one removed is worn or damaged.

6. Seal the system
Refit the cover plate **C** and secure with bolts **A** and washers **B.**

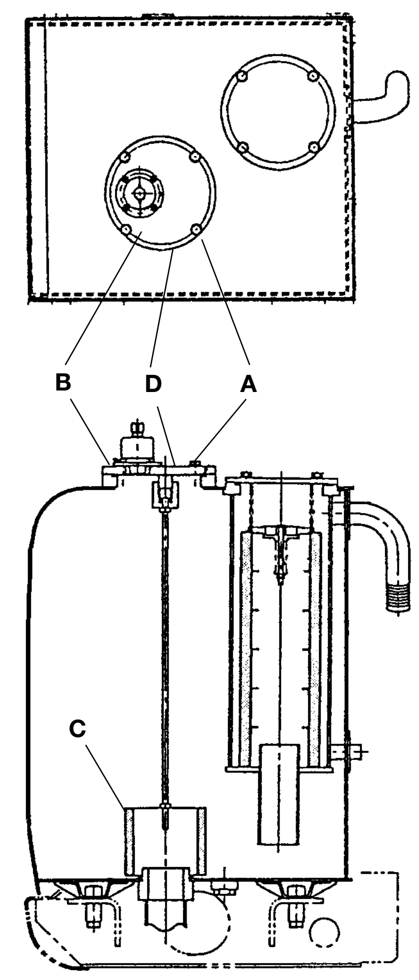


Cleaning/Changing the Suction Strainer

1. **Prepare the Machine**
   Position the machine on level ground
   Stop the engine. Remove the starter key.
2. **Locate the suction Strainer**
   See ***Component Location Diagrams*** at the end of the section.
3. **Release Tank Pressure**
   See ***Releasing Tank Pressure.***
4. **Remove the suction Strainer**
   a. Remove the retaining bolts **A** and washers **D**, lift off cover plate **B.**

   b. Remove the suction strainer **C** and clean with a suitable solvent or, if renewing discard.
5. **Fit the Suction Strainer**
   Fitting is a reversal of removal.
6. **Check the Hydraulic fluid Level**
   See ***Checking the Fluid Level***.
7. **Seal the System**
   Refit the cover plate **B** together with its 'O'-ring.

Note: *Check the 'O'-ring, if it is worn or damaged replace it with a new one and secure with bolts **A** and washers **B.***



Changing the Air Breather Element

1. Prepare the Machine
Position the machine on level ground. Stop the engine. Remove the Starter Key.

2. Release Tank Pressure
See ***Releasing Tank Pressure****.*

* **3. Locate the Air Breather Element**
See ***Identification of Machine Components****.*

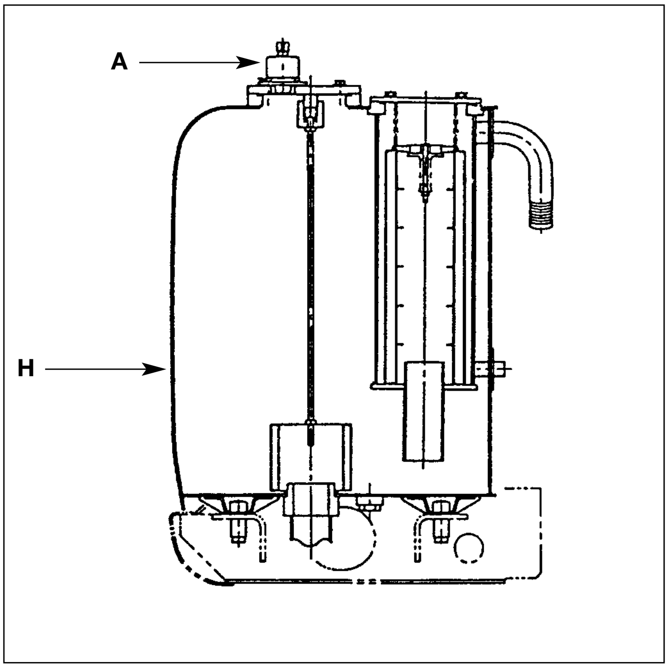
* **4. Replace the Air Breather Element**
* **a.** Remove first the hexagonal nut **A**, seal washer **B** and cover **C**.

* ***Note:*** *The cover* ***C*** *can only fit in one of two positions because of the slot* ***G*** *in the cover which locates over a similar shaped protrusion on the mounting stud.*

* **b.** Remove the old filter element **D** together with the sponge packing **E**.

* **c.** Replace the old filter element **D**, with a new one. When installing the new filter element **D** place the sponge packing **E** on the element.

* **5. Refit the Filter cover C**
* **a.** Adjust the cover so that it fits over the stud, and install in the following order: Seal washer **B**, hexagonal nut **A** and box nut **F**.



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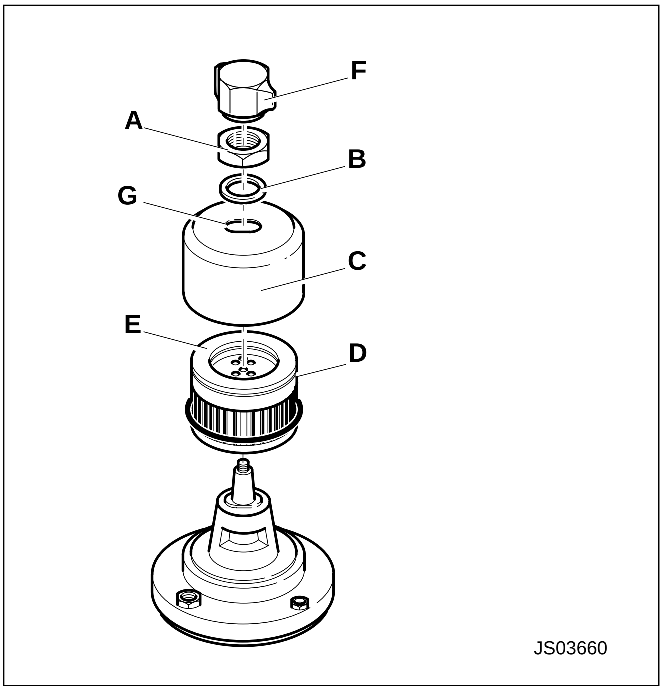


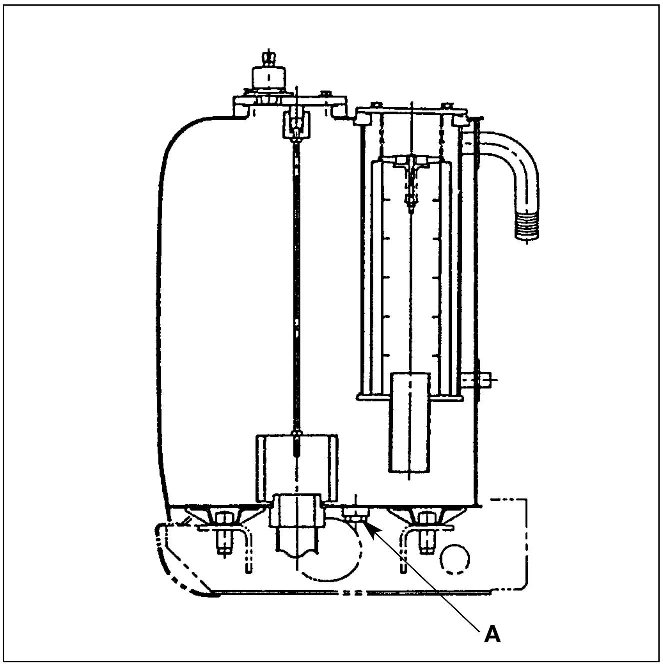
Draining Tank Impurities

* **⚠ WARNING**

Oil is toxic. If you swallow any oil, do not induce vomiting, seek medical advice. Used engine oil contains harmful contaminants which can cause skin cancer. Do not handle used engine oil more than necessary. Always use barrier cream or wear gloves to prevent skin contact. Wash skin contaminated with oil thoroughly in warm soapy water. Do not use petrol, diesel fuel or paraffin to clean your skin.

INT-3-2-3

1. **Prepare the Machine**
   Position the machine on level ground. Stop the engine. Remove the Starter Key.
2. **Release Tank Pressure**
   *See **Releasing Tank Pressure**.*
3. **Drain the Tank Impurities**
   Remove the tank drain plug **A** and drain off accumulated water and other deposits (Have some means of collecting the impurities ready) the task is complete when clean hydraulic fluid flows out.
4. **Seal the System**
   Refit the drain plug **A.**



Changing the Pilot Oil Filter

1. **Prepare the Machine**
   Position the machine on level ground. Stop the engine. Remove the starter key.
2. **Release Tank Pressure**
   *(See **Releasing Tank Pressure**).*
3. **Locate the Pilot Oil Filter**
   *(Refer to **Identification of Machine Components**).*
4. **Dismantle the Filter**
   a. Using a wrench on the case, unscrew the filter case **A** from the filter head **B**.
   Take care not to spill the oil it contains.

   b. Remove and discard the element **C** and O-ring **D**.
5. **Clean the Filter Base and Case**
   Discard any fluid in the filter case. Clean out the case and the underside of the head.
6. **Fit New Filter Components**
   a. Coat the new O-ring **D** with hydraulic fluid and locate in the filter head **B**.

   b. Coat the seal area of the new element **C** and install it in the filter case **A**.

   c. Screw the filter case **A** to the head **B** and tighten with the wrench.

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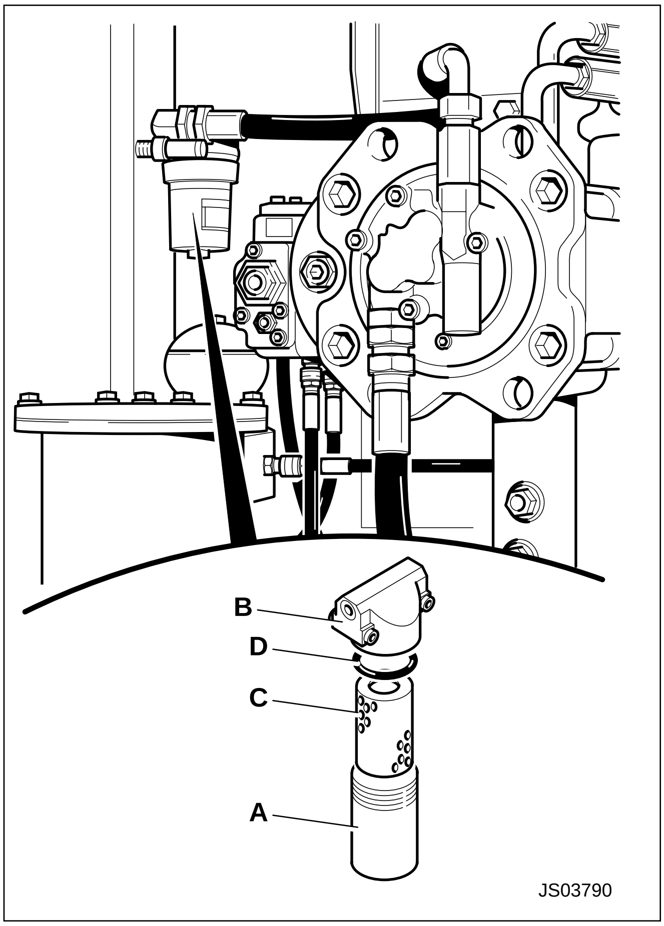
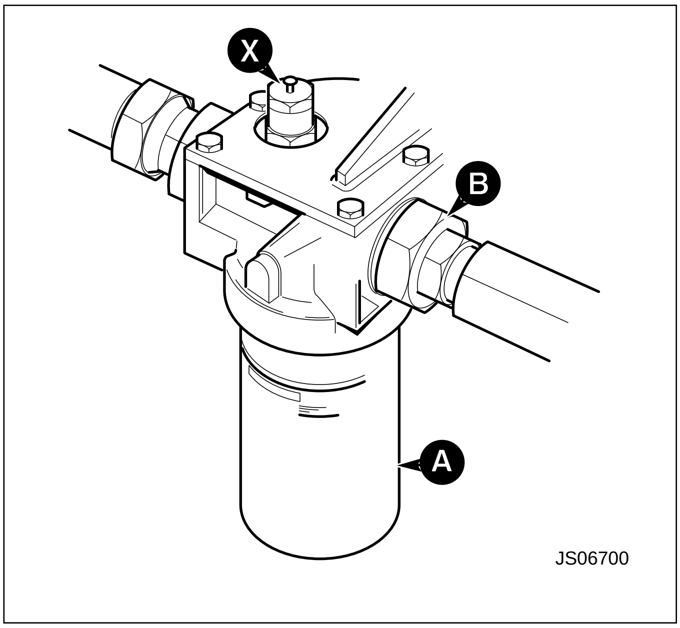


Changing the Breaker In-line Filter

Note: This filter should be changed at the intervals stated in **Service Schedules** or when the visual indicator **X** has popped up. DO NOT USE THE BREAKER WITH A BLOCKED FILTER.

*



1 **Prepare the Machine**
Position the machine on level ground. Stop the engine. Remove the starter key.

2 **Release Tank Pressure**
(See **Releasing Tank Pressure**).

3 **Locate the Filter**

4 **Remove the Oil Filter**
Unscrew and remove filter **A** from head **B**.

5 **Fit the New Filter**
Coat the seal of the new filter with clean hydraulic fluid. Screw the new filter into head **B** and tighten. Check and top up the hydraulic fluid level.

Changing the Drain Line Filter

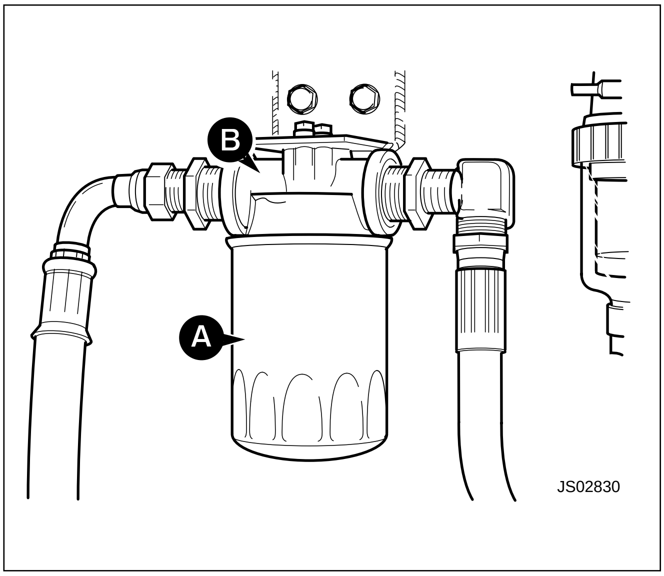
1 **Prepare the Machine**
Position the machine on level ground. Stop the engine. Remove the starter key.

2 **Release Tank Pressure**
(See **Releasing Tank Pressure**).

3 **Locate the Filter**

4 **Remove the Oil Filter**
Unscrew and remove filter **A** from head **B**.

5 **Fit the New Filter**
Coat the seal of the new filter with clean hydraulic fluid. Screw the new filter into head **B** and tighten. Check and top up the hydraulic fluid level.



* Changing the Nephron Filter

⚠ WARNING

The temperature of the hydraulic oil will be high soon after stopping the engine. Wait until it cools down (less than 40°C) before beginning maintenance.

8-3-4-10

1. **Prepare the Machine**
   Position the machine on level ground. Stop the engine. Remove the starter key.
2. **Release Tank Pressure**
   See Releasing Tank Pressure.
3. **Remove the Nephron Filter A**
   a. Close the two stop cocks **B** of the nephron filter case **C**.
   b. Remove the retaining bolts **D**, washers **E** and lift the cover **F**, together with the 'O'-ring **G** and spring **H.**
   c. Slowly lift the Nephron filter **A** and remove.

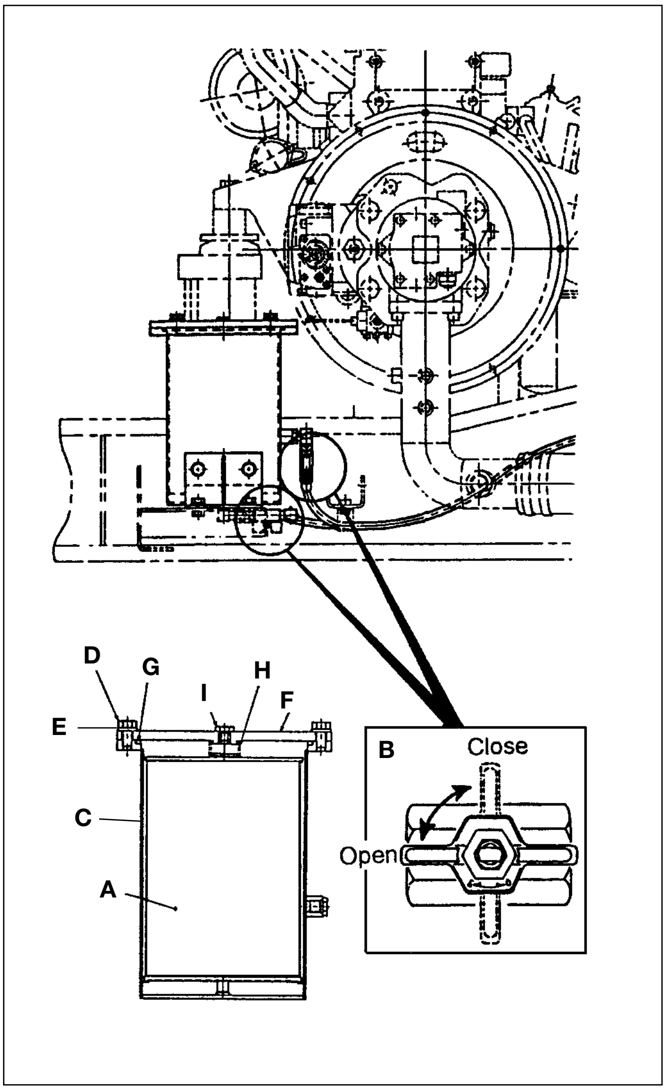
Note: *Be careful not to drop any dirt from the nephron filter A.*

4. **Replace the Nephron filter A**
   a . Peel off the 4 foil seals of the new nephron filter (one on the upper and lower side, and the other two on the sides).

Note: *If the foil is not removed, the filter will not function properly.*

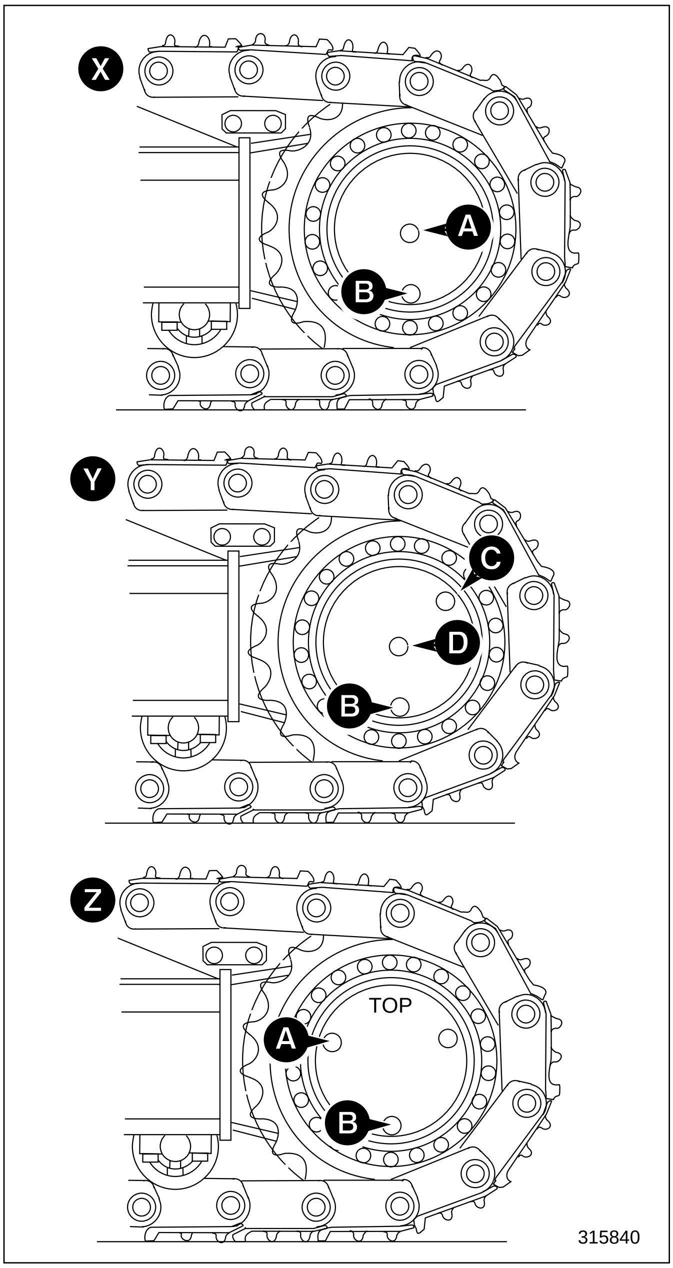
   b. Slowly sink the new nephron filter **A** into its case.
   c. Install the spring **H**, 'O'-ring **G** and cover **F**, secure with bolts **D** and washers **E**.
   d. Open the two stop cocks **B** on the nephron filter case **C**.
5. **Air Bleeding**
   a. Start the engine and set at low idling, loosen the plug **I**, tighten the plug when hydraulic oil flows out.
   b. Stop engine and Check the hydraulic oil level.

   *See **Checking the Fluid Level**.*



* ***Note:*** *There are three alternative configurations of filler, level and drain plugs as shown in figures* ***X, Y*** *and* ***Z****. The following text covers all configurations.*

*



Key

A filler/level plug
B drain plug
C filler plug
D level plug

Checking the Track Gearbox Oil Level

1 Prepare the Machine
Position the machine on level ground with the level and drain plugs as illustrated.

2 Check the Level on One Side
Clean the area around filler/level plug **A** or filler plug **C**/level plug **D** and remove one or both plugs. Oil should run from plug **A** or **D**. Top up through plug **A** or **C** if necessary. (See ***Lubricants and Capacities*** for oil types).

3 Clean and Refit the Plug(s)
Make sure they are tight.

4 Check the Level on the Other Side
Repeat steps 1 to 3.

Changing the Track Gearbox Oil

1 Prepare the Machine
See ***Checking Track Gearbox Oil Level.***

2 Drain the Oil on One Side

a Place a container below the drain plug to catch the oil. The container must be large enough to hold the maximum gearbox capacity (see ***Lubricants and Capacities***).

⚠ CAUTION

Oil will gush from the hole when the drain plug is removed. Keep to one side when you remove the drain plug.
2-3-4-2

b Remove filler/level plug **A** or filler plug **C** and drain plug **B**. Allow the oil to drain out.

c Wipe the plugs clean. Make sure you remove all metal particles.

d Wrap seal tape on the drain plug and refit.

3 Fill with New Oil
See ***Lubricants and Capacities*** for oil type and volume.

a Pour new oil through filler/level plug **A** or filler plug **C** until oil runs out of plug **A** or **D**.

b Clean and wrap seal tape around the plugs. Tightly refit filler/level plug **A** or filler plug **C**/level plug **D**.

4 Change the Oil on the Other Side
Repeat steps **1** to **3**.**Key**

5 Check for Leaks
Run the machine, operate the tracking controls and then make sure there are no leaks.

Checking the Slew Gearbox Oil Level

1. **Prepare the Machine**

   Position the machine on level ground. Stop the engine and remove the starter key.

2. **Locate the Slew Gearbox**

   See Component Location Diagrams at the end of this section.

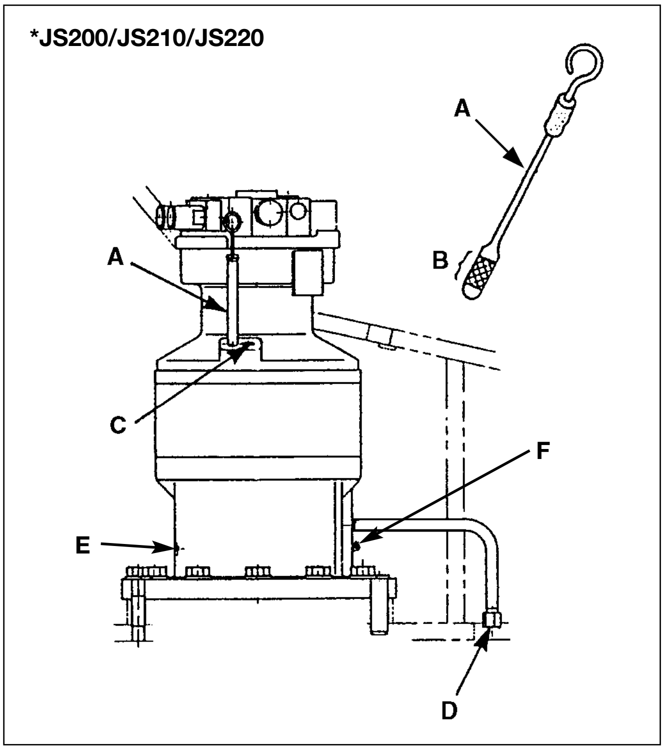
3. **Check the Level**

   a. Remove the dipstick **A**, wipe it clean and re-fit.

   b. Remove the dipstick again and check that the oil level is within the range **B.**

   c. If necessary, top up through filler port **C**. *(See **Lubricants and Capacities** for oil type).*

4. **Refit the Dipstick.**



Changing the Slew Gearbox Oil

1. **Prepare the Machine**

   Position the machine on level ground. Stop the engine and remove the starter key.

2. **Drain the Oil**

   a. Remove the drain plug **D**. Allow the oil to drain out.

   b. Wipe the drain plug clean. Remove any metallic particles, if foreign matter is found, contact local dealer.

   c. Refit the drain plug. Make sure it is tight.

3. **Fill with New Oil**

   *See **Lubricants and Capacities*** for oil type and volume.

   Fill with new oil through filler port **C** until it reaches the full mark on the dipstick when settled. refit the dipstick.

4. **Check for Leaks**

   Run the machine, operate the slew controls and make sure there are no leaks.

Replenishing Slew Gearbox Grease

1. **Prepare the Machine**

   Position the machine on level ground. Stop the engine and remove the starter key.

2. **Remove Air Bleed Plug E.**

CAUTION

Failure to remove the bleed plug before adding grease could damage the inner seal.

8-3-4-7

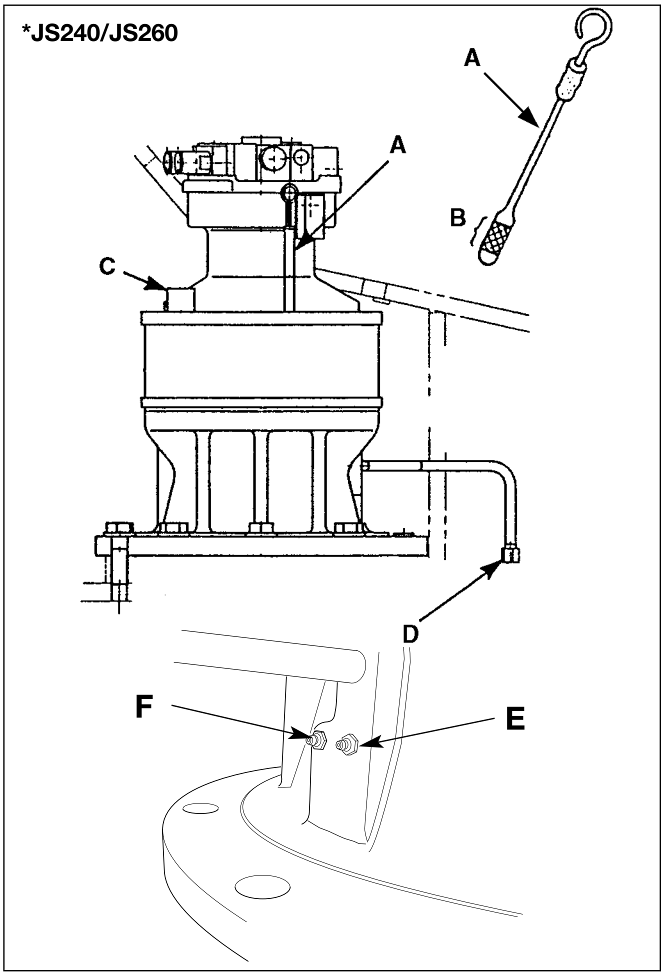
3. **Fill Up with Grease**

   *See **Lubricants and Capacities*** for grease type.

   Pump in grease through nipple **F** until the grease starts to ooze from bleed plug **E**. Refit and tighten the bleed plug.

* On later machines, the slew gearbox bearing (normally lubricated at point **F** has changed to a sealed for life type bearing and no longer requires lubrication.

Note: All machines that have a grease nipple at **F** still require lubricating every 1000 hours.



Cleaning the Tracks

⚠ WARNING

If two people are doing this job make sure that the person working the controls is a competent operator. If the wrong control lever is moved, or if the controls are moved violently, the other person could be killed or injured.

If you will be working with another person, make sure you both understand what the other will be doing. Learn and use the recognised signalling procedures. Do not rely on shouting - he will not hear you.

To clean the tracks you must turn them. When the tracks are turning, keep clear of rotating parts.

Before starting this job, make sure that you have no loose clothing *(cuffs, ties, etc)* which could get caught in rotating parts.

Keep people not involved with the job well away!

8-3-3-1

1. **Prepare the Machine**
   Park the machine on level ground. Open the bucket and slew the boom until it is at 90° to the track. Lower the bucket to the ground.

2. **Raise the Track**
   Operate the boom and dipper controls so that the track on the side nearest the bucket is lifted up clear of the ground.

3. **Rotate the Track**

⚠ WARNING

Rotating the tracks off the ground may cause stones and other debris to be thrown with considerable force. If you are on the outside, keep well clear. Keep other people well clear.

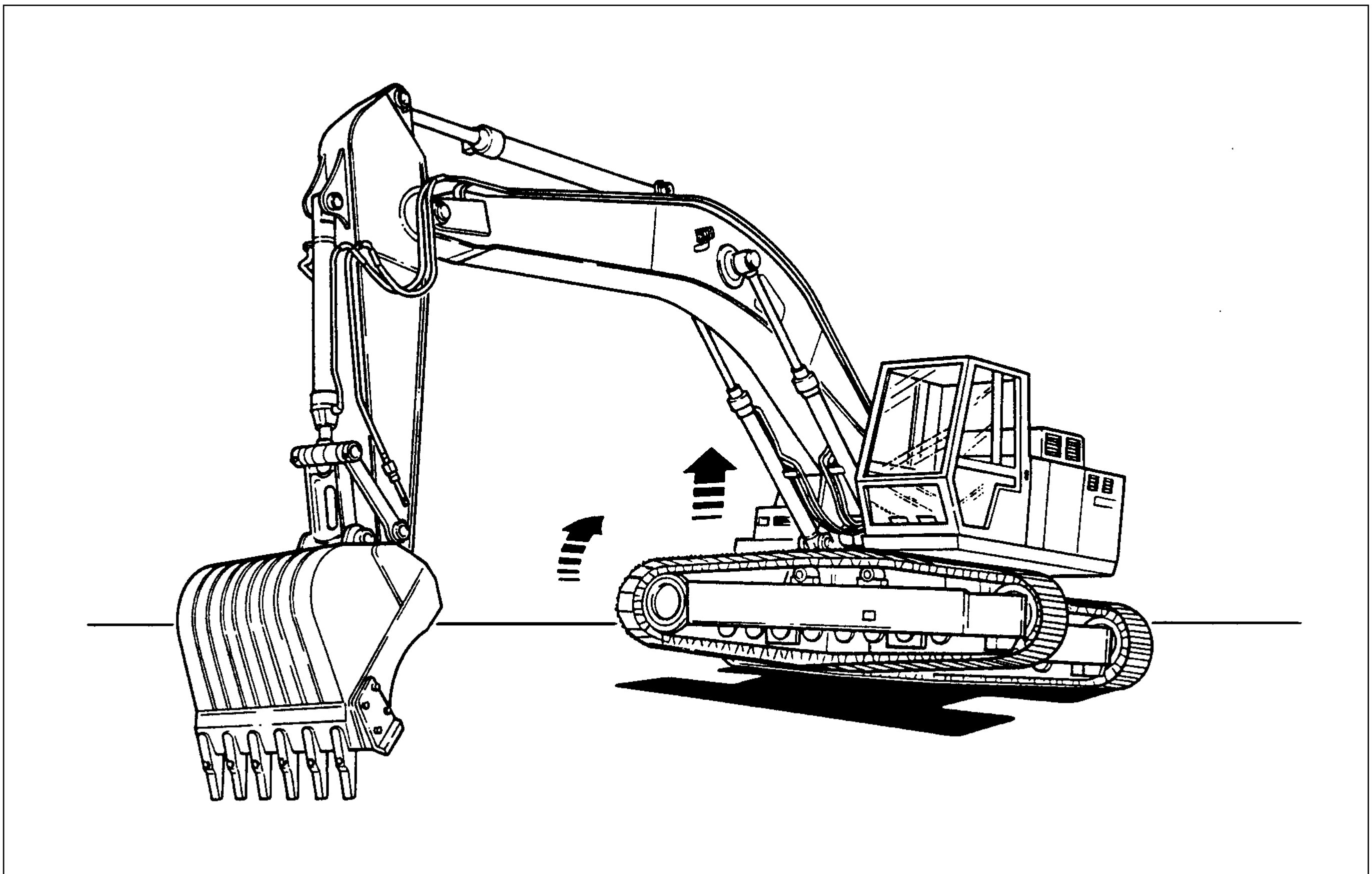
8-3-3-2

* When it is safe to do so and you are sure that everyone is clear of the machine, operate the controls to rotate the track which is off the ground. Rotate it first one way and then the other to shake off the mud. If necessary, the person outside may use water to get the mud off.

4. **Inspect the Track**
   When you have finished, inspect the track rollers, sprockets and idler wheels for damage and oil leaks.

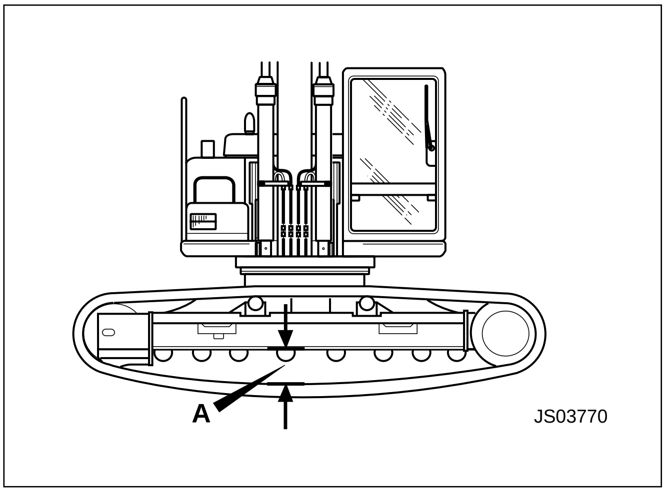
5. **Lower the Track**
   Operate the boom and dipper controls to lower the track to the ground.

6. **Repeat for the Opposite Track**
   Slew the boom round to the other side and repeat steps 2 to 5 inclusive for the other track.



Checking/Adjusting the Track Tension

*



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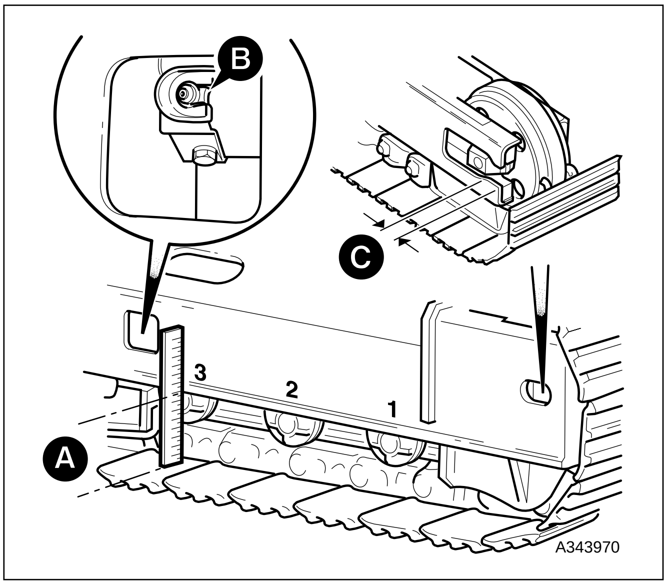


1. **Prepare the Machine**
   Position the machine on level ground. Run it backwards and forwards several times. Stop after running it forwards.

   Carry out steps 1 to 3 of **Cleaning the Tracks**. Block up the undercarriage frame. Finish track rotation by running the track forwards. Stop the engine and remove the starter key.

⚠ WARNING

NEVER position yourself or any part of your body under a raised machine which is not properly supported. If the machine moves unexpectedly you could become trapped and suffer serious injury or be killed.
INT-3-3-7

2. **Check the Tension**
   Measure gap **A** in line with the fourth roller from the front and between the lower surface of the track frame and the upper surface of the shoe. The dimension should be 275-295 mm for hard ground conditions. For operation on soft sand or sticky mud it should be 320-340 mm.

3. **Adjust the Track Tension**
   Adjustment is made by either injecting or releasing grease from the check valve **B**. Inject grease to reduce the gap (increase the tension) or open to release grease and increase the gap.

⚠ WARNING

When opening the check valve always stand to one side and loosen a little at a time until grease starts to come out. If you over-loosen too much grease could spurt out or the valve cover fly out and cause serious injury.
8-3-4-5

⚠ WARNING

Under no circumstances must the check valve be dismantled or any attempt made to remove the grease nipple from the check valve.
8-3-4-9

   If gap **C** exists between the idler wheel shaft and the track frame, you may use pressure to apply the grease. If there is no gap **C** after the application of grease, then the necessary repairs must be carried out.

Note: *Excessive tension can cause the track rail to wear the drive rollers and sprocket, insufficient tension can cause wear to the drive sprocket and track rail.*

4. **Lower the Track**
   Remove the blocks from beneath the undercarriage and lower the track to the ground using the boom and dipper controls.

5. **Repeat for the Opposite Track**
   Slew the boom round to the other side and repeat steps 1 to 4 above.

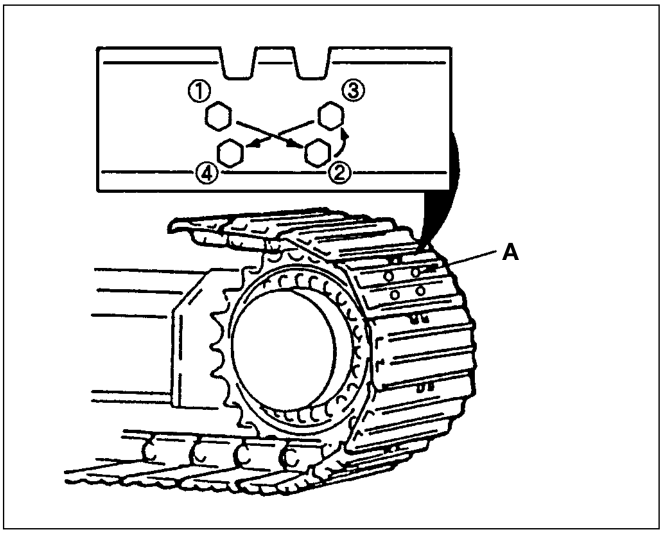
Checking the Shoe Plate

1. **Prepare the Machine**
   a. Position the machine on level ground. Run it backwards and forwards several times. Stop after running it forwards.

   b. Stop the engine and remove the starter key.

2. **Checking the Shoe Bolts A**
   Check to see if any are loose or damaged.

* 3. **Tightening the Shoe Bolts A**
   Tighten the Shoe bolts **A** in the sequence shown to the correct torque. *See **Bolt Torque Specifications***.



Checking the Rollers and Idler Wheels for Oil Leaks

1. **Prepare the Machine**
   *See **Checking/Adjusting the Track Tension,*** step 1.

2. **Look for Oil Leaks**
   Check the top and bottom rollers and the idler wheels for oil leaks.

⚠ CAUTION

Do not run the machine if you discover oil leaks in the top or bottom rollers or idler wheels. Failure to rectify such leaks could cause damage to the machine.
8-3-4-6/1

3. **Lower the Track**
   *See **Checking/Adjusting the Track Tension,*** step 4.

4. **Repeat for the Opposite Track**
   Slew the boom to the other side and repeat steps 1 to 3 above.

* Changing the Air Filter Elements

1. Prepare the Machine
Put the machine on level ground. Lower the bucket to the ground.

2. Stop the Engine
Remove the starter key.

Note: *Renew the inner element every second time you renew the outer element. As a reminder, mark the inner element with a felt tip pen when you renew only the outer element.*

Outer element must be changed sooner if the filter warning light on the instrument panel lights up.

DO NOT run engine with end cover or dust valve removed.

DO NOT attempt to wash or clean elements they must be renewed.

3. Locate the Air Filter
*(See **Identification of Machine Components**).*

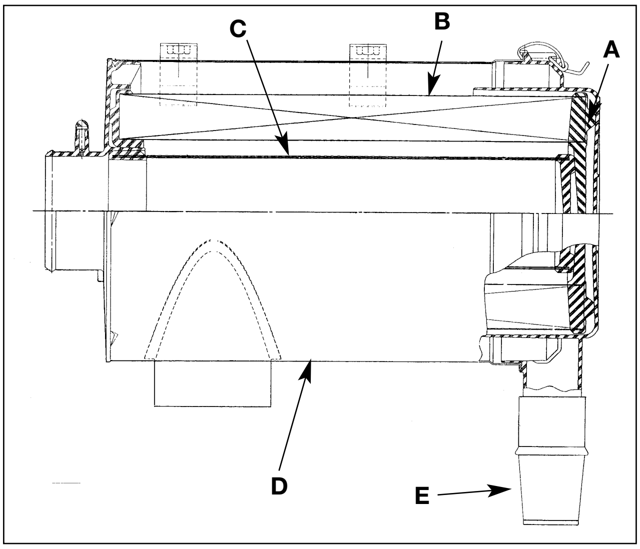
* **4. Open the Hydraulic Compartment**

* **5. Remove the Elements**
Remove end cover **A**. Remove the outer element **B**. Remove the inner element **C**.

* **6. Clean the Filter**
Clean the pre-cleaner, the inside of the canister **D**, the end cover **A**, and dust valve **E**.

* **7. Fit the New Elements**
Carefully insert the new inner element into the canister. Make sure it seats correctly. Carefully insert the new outer element **B**. Make sure it seats correctly.

* **8. Assemble the Filter**
Fit the end cover **A** onto the canister. Make sure the dust valve **E** is fitted, then fasten the retaining clips. Fit the pre-cleaner. Make sure the air filter blocked switch connector is fitted.



Checking the Oil Level

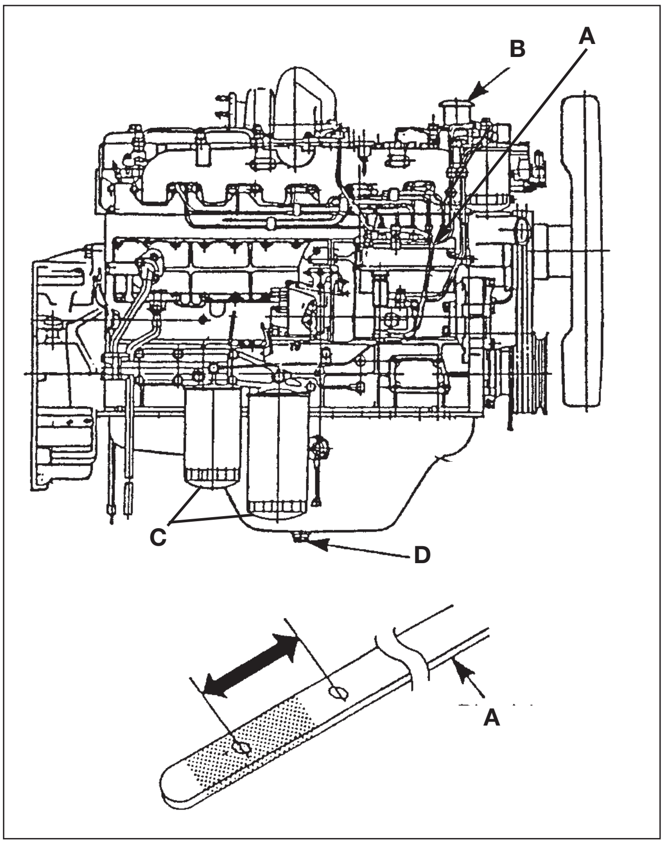
1. **Prepare the Machine**
   Park the machine on level ground. Lower the bucket to the ground.

2. **Stop the Engine**

3. **Open the Engine Compartment**

4. **Check the Oil Level**
   Remove the dipstick **A**. The correct oil level should be between the two indicator marks add oil if necessary through filler **B**.
   Use the recommended oil (*see **Lubricants and Capacities***).
   Make sure that the dipstick and filler cap are secure.

Changing the Oil and Filters



1. **Do steps 1-3 of checking the Oil Level**

2. **Drain the Oil**
   Place an oil collecting container of suitable size beneath the engine sump drain point. Remove drain plug **D**.

⚠ WARNING

Hot oil and engine components can burn you. Make sure the engine is cool before doing this job.
2-3-3-2

3. **Change the Filters**
   a. Unscrew the filters **C**.
   b. Clean the filter heads.
   c. Smear the seal on each new filter with oil. Tighten the filter until the seal bites onto the filter housing. Tighten the filter a minimum of one more turn.

4. **Fill the System**
   Securely tighten the drain plug **D** and refill the engine with new oil through filler cap **B** *(See **Lubricants and**
   * ***Capacities***).
   Wipe off any spilt oil. Make sure the filler cap **B** is secure.

5. **Check for leaks**
   a. Before starting the engine, turn the engine over with the Engine Shutdown control pressed down until the oil pressure warning light goes out.
   b. Start the engine and let it idle for a few minutes
   c. Stop the engine, and let it stand for a few minutes, remove the key.
   d. Check the engine for any leaks, and check the oil level. *See **Checking the Oil Level***.

Note: *Check the oil level only after about 20 minutes. If you check it straight after the engine has stopped, the oil level indicated will be false as the oil is still distributed around the engine and needs to fall.*

Checking the Coolant Level

1. **Park the Machine on Level Ground**
   Stop the engine and let it cool down. Open the engine compartment.

! WARNING

The cooling system is pressurised when the coolant is hot. Hot coolant will burn you. Make sure that the engine is cool before checking the coolant level or draining the system.

2-3-3-3

2. **Release System Pressure**
   For location of engine cooling radiator, *see **Component Location Diagrams*** at the end of this section.

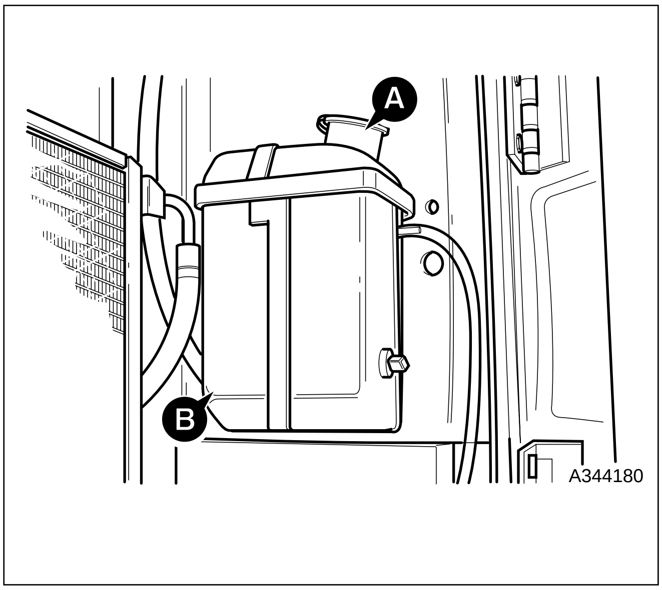
   Carefully slacken cap **A**. Let any pressure escape. Remove the cap.

3. **Check the Level**
   The level should be between the FULL and LOW marks on the expansion bottle **B**. Top up the bottle with pre-mixed water/anti-freeze if necessary. See ***Coolant Mixtures.***

4. **Refit the Pressure Cap A**
   Make sure it is tight.

Note: *Check the quality of the antifreeze mixture every year - before the cold weather starts. Change it every two years.*

*



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Coolant Mixtures

To prevent the coolant freezing in cold conditions, antifreeze must be added. **JCB Four Seasons Antifreeze and Summer Coolant** will give protection down to the temperatures shown in the table.

Antifreeze Solution	**Starts to freeze at**
55%	-36°C (-33°F)

Never use less than a 50% solution, otherwise there will not be enough corrosion protection.

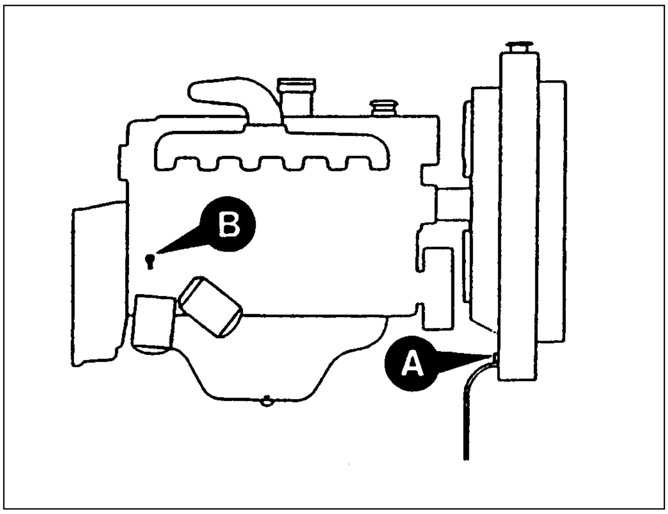
Never use more than 60% solution, otherwise the cooling system may be damaged.

Leave the antifreeze in all the year round as it gives protection against corrosion.

Check the strength of antifreeze solution at least once a year, preferably at the start of the cold period. Always renew the antifreeze every two years.

A 50% antifreeze mixture should be used even if frost protection is not needed. This gives protection against corrosion and raises the coolant's boiling point.

Changing the Coolant



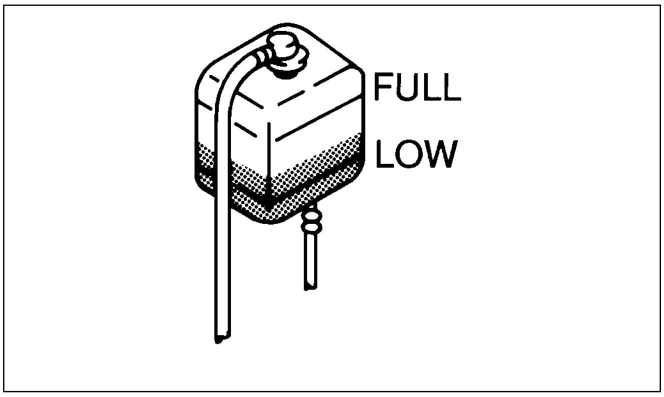
1. **Do Steps 1 and 2 of '*Checking the Coolant Level*'**
2. **Drain the System**
   Open the radiator drain tap **A**. Remove the cylinder block drain plug **B**. Remove the expansion bottle cap (see ***Checking the coolant Level***). Let the coolant drain out.

⚠ CAUTION

Keep your face away from the drain hole when removing the drain plug.

2-3-3-4

3. **Flush the System**
   If necessary. Use clean water.
4. **Refit the Drain Plug**
   Clean and refit the drain plug **B**, making sure it is tight.
   Close the radiator drain tap **A**.
5. **Fill the System**
   Using the necessary mix of clean, soft water and antifreeze, (see ***Coolant Mixtures***) fill via the expansion bottle cap until the level in the bottle is between the FULL and LOW marks.



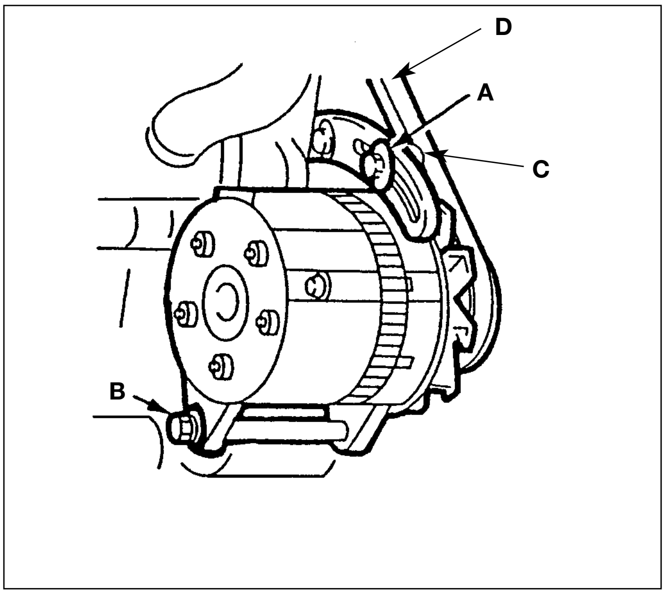
6. **Refit the Radiator Pressure Cap**
   Make sure it is tight.
7. **Refit the Expansion Bottle Cap**
   Make sure it is tight.
8. **Check for Leaks**
   Run the engine for a while to raise the coolant to working temperature and pressure. Stop the engine.
   Check for leaks. Re-check the level in the expansion bottle and top up if necessary.

Adjusting the Fan Belt

⚠ WARNING

Make sure the engine cannot be started. Disconnect the battery before doing this job.

2-3-3-5



1. **Check the Fan Belt Tension**
   There must be 10 mm (0,4 in) slack at **D** on the belt.
2. **Loosen the Alternator**
   Slacken bolts **A** and **B**.
3. **Adjust the Fan Belt**
   Use tension bolt **C** to adjust the alternator so that there is 10 mm (0.4 in) slack at point **D** on the belt.

   Note: *If the fan belt is stretched so much that it cannot be adjusted correctly, fit a new belt (see below).*
4. **Secure the Alternator**
   Re-tighten bolts **B**. Then re-tighten bolt **A**.

Fitting a New Fan Belt

1. **Loosen the Alternator**
   Slacken bolts **A** and **B** and adjust tensioner **C** so that the fan belt can be removed.
2. **Fit a New Fan Belt**
   With the alternator located as in **1**, fit a new belt, making sure its 'V' profile locates in the pulleys correctly.

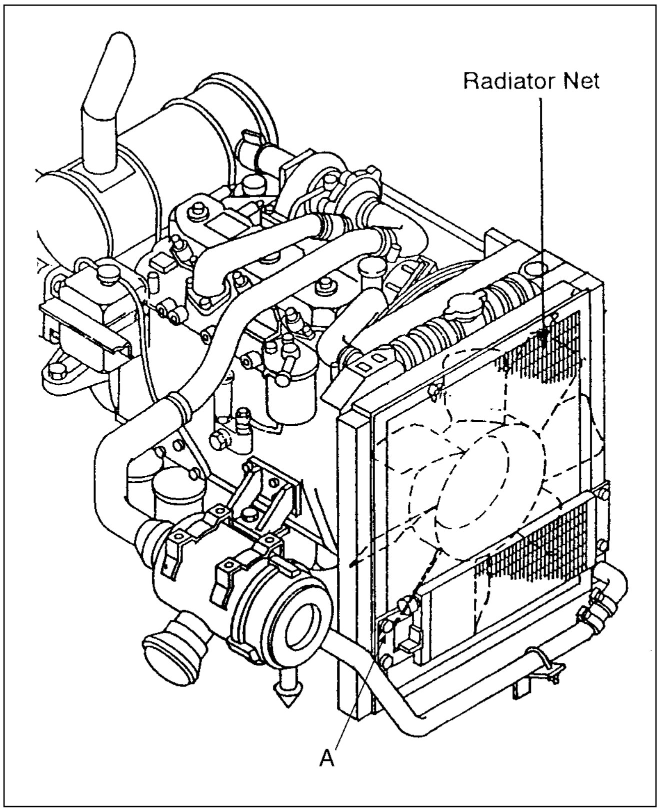
   Note: *It may be necessary to apply slight leverage to the new belt to get it over the pulleys.*
3. **Adjust the Fan Belt**
   Carry out steps **3** and **4** of ***Adjusting the Fan Belt.***
4. **Re-check the Fan belt Tension**
   After about 1 hour's running re-check the belt tension.

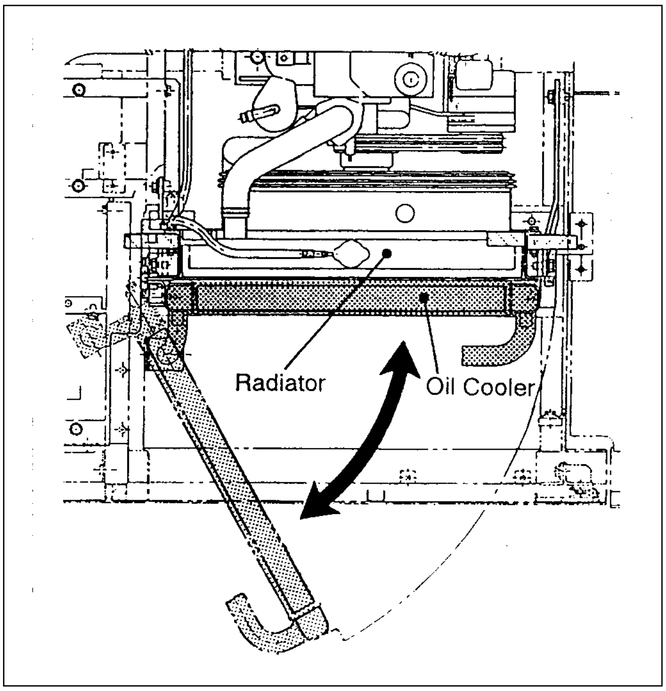
Cleaning the Radiator and Oil Cooler

A clogged radiator and/or oil cooler can lead to engine overheating. Regularly check for a build-up of dirt and debris and, if necessary, use compressed air to clean out the grille. At the same time check all hoses for damage or perishing, and replace if necessary.

Note: *Do not use high-pressure steam as it can deform the radiator.*

1. **Cleaning the Radiator Net**
   Remove the net for cleaning. When using the machine in dusty conditions, inspect the net for clogging every day, then replace.
2. **Swing Out type Oil Cooler *(if fitted)***
   - **a.** Remove the Oil Cooler mounting bolts **A**, washers **B**, Housing Cover **C** and stays **D**, then swing the cooler out.
   - **b.** Clean the oil cooler and then return it to its normal position.
   - **c.** Fasten securely.
   - **d.** Start the engine and check for leaks.
3. **Non-Swing Oil Cooler**
   - **a.** Remove the oil cooler mounting bolts **A** with washers **B.**
   - **b.** Remove the oil cooler.
   - **c.** Clean the oil cooler and then return it to its normal position.
   - **d.** Fasten securely.
   - **e.** Start the engine and check for leaks.





Draining Fuel Tank Impurities

Stop the engine and remove the key.

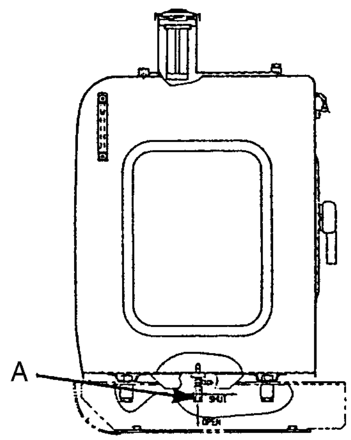
Loosen the drain tap **A** on the underside of the fuel tank. Drain the water and deposits until clean diesel oil flows out.

Close the drain tap firmly.

⚠ WARNING

Fuel oil is highly inflammable. Completely wipe off any spilt fuel which could cause a fire.

8-3-4-3



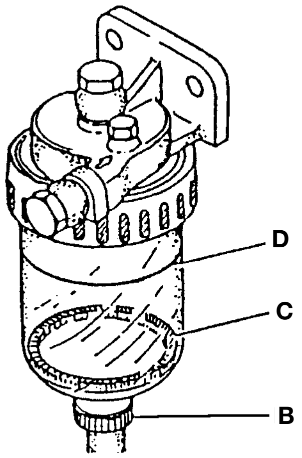
Draining the Water Separator

The water separator should be drained at least every 50 hours, but more often if necessary.

Stop the engine and remove the key.

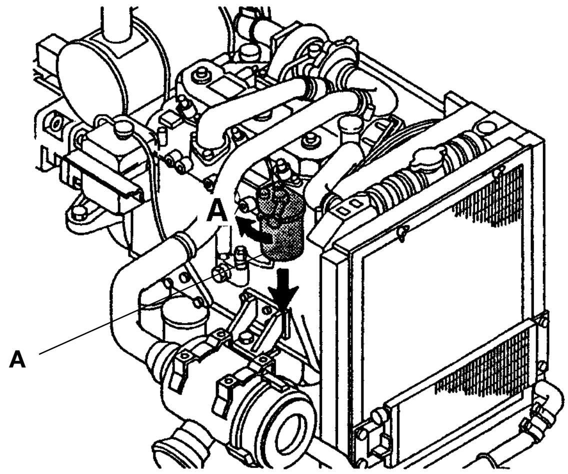
Open the drain plug **B** to release the accumulated water in the bowl.

Under no circumstances should the float **C** be allowed to rise above the red line **D** or water could get taken further into the system with serious consequences.



Changing the Fuel Filter Element

1. **Stop the Engine**
   Stop the engine and remove the key.
2. **Disconnect the Battery**
3. **Open the Engine Compartment**
   Locate the fuel filter (see ***Component Location Diagrams*** at the end of this section).
4. **Remove the Element A**
   Using a chain wrench, unscrew the filter element from the filter head. Avoid spilling the fuel retained in the element.
5. **Fit the New Element**
   - **a.** Smear the new filter element sealing ring with fuel oil and hand tighten onto the filter head. Use a chain wrench to tighten by a further $^{2}/_{3}$ turn.
   - **b.** After installation, bleed the air.
   - **c.** Wipe up any spilled fuel.



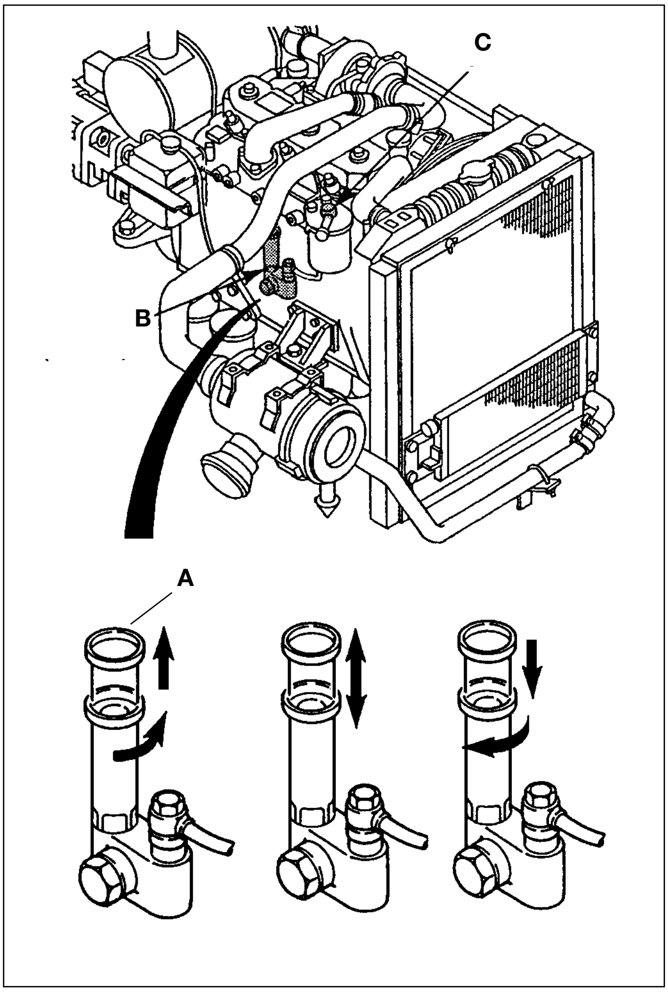
Bleeding the Fuel System

Air in the fuel system could cause misfiring or failure to start.

Air will enter the system if any part of it is disconnected or emptied.

Note: *Running the engine with air in the system could damage the fuel injection pump. After maintenance, remove air from the fuel system as detailed below.*

1. **Stop the Engine**
   Switch off the engine and remove the key.
2. **Disconnect the Battery**
   Remove the - ve lead to chassis.
3. **Open the Engine Compartment**
   Locate the priming pump and bleed point *(see Illustrations)*.
4. **Prepare for Bleeding**
   Loosen the knob **A** on the priming pump **B** by turning it anti-clockwise. The knob will be lifted by spring pressure.
5. **Bleed the System**
   Loosen bleed plug **C**. Depress knob **A** to bleed air from filter.
6. **Restore the System to Normal**
   Tighten bleed plug **C**. Depress knob **A** and turn clockwise to lock into priming pump **B**.
7. **Check for Leaks**



⚠ WARNING

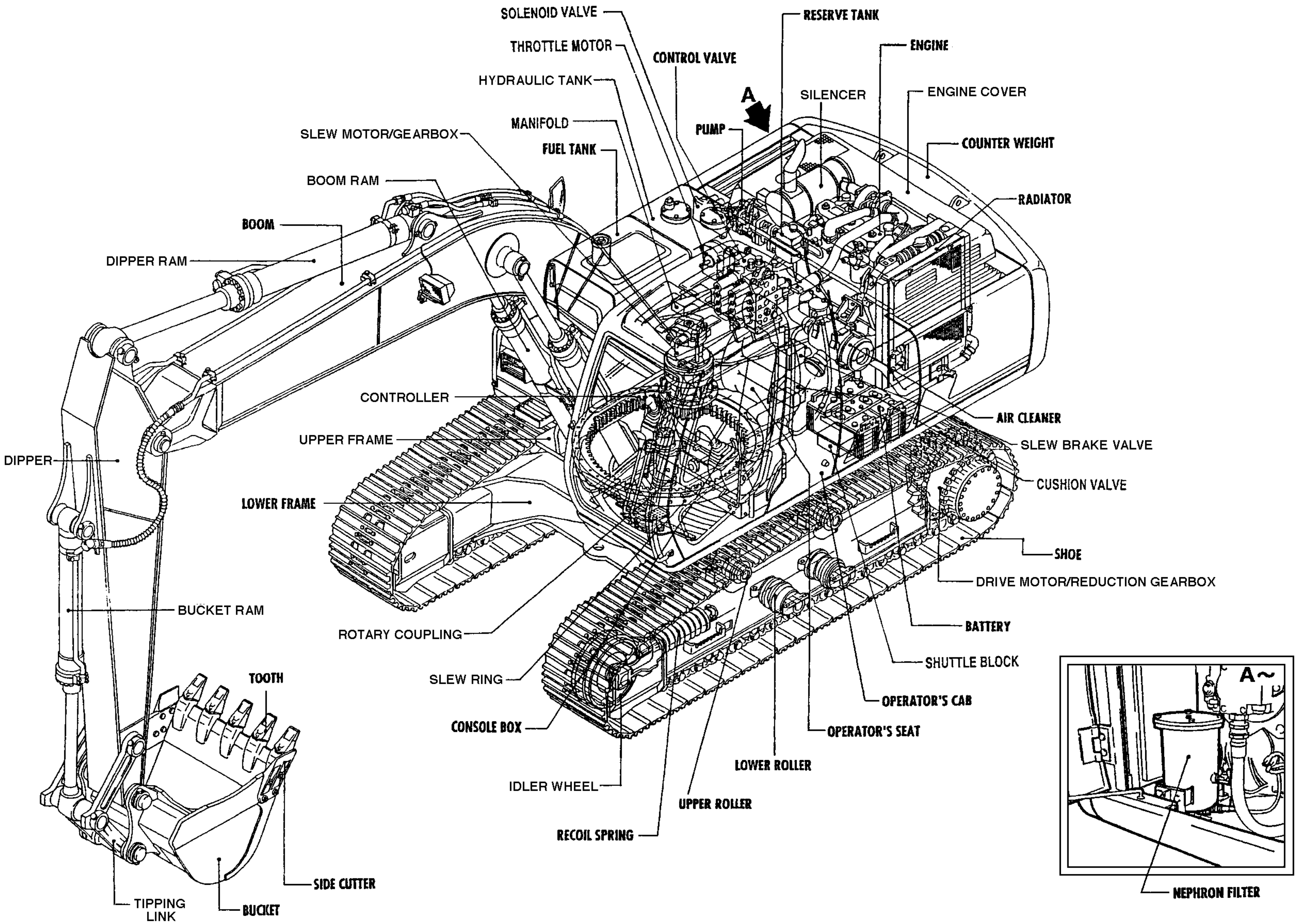
Fuel oil is highly inflammable. Completely wipe off any spilt fuel which could cause a fire.

8-3-4-3

Wipe up any spilled fuel. Then start the engine and check for leaks.

Routine Maintenance

Component Location Diagram



JS02490

Introduction

It is important before taking measurements that control conditions are maintained.

a. Position the machine on a level safe site.

b. Adhere strictly to the safety operation.

c. Confirm the setting when an adjustment is made.

The items to prepare are:-

a. The check sheet

b. Tape measure

c. Dial gauge with magnetic stand

d. Angle gauge

e. Chalk

f. Stop watch

Basic Measurement Conditions

When checking the performance value, certain conditions should be fulfiled:-

a. The machine should be in the **S**. Mode.

b. The hydraulic oil temperature should be 45°C-55°C.

c. The engine speed should be within ±50 rpm of the Reference Value.

d. The hydraulic equipment should be operated several times before testing.

e. The operation to be measured should be operated three times and an average taken.

f. Measure on level hard ground.

These consist of two basic types of measurement:-

1. Speed Measurements

a. Bucket Ram Speed.

* **b.** Dipper Ram speed.

c. Boom Ram Speed.

d. Slew Speed.

e. Travel Speed.

2. Other Measurements

a. Travel Linearity.

b. Slew Backlash.

c. Lateral Movement in turntable bearing.

d. Slew Brake.

e. Slew Lock Characteristics.

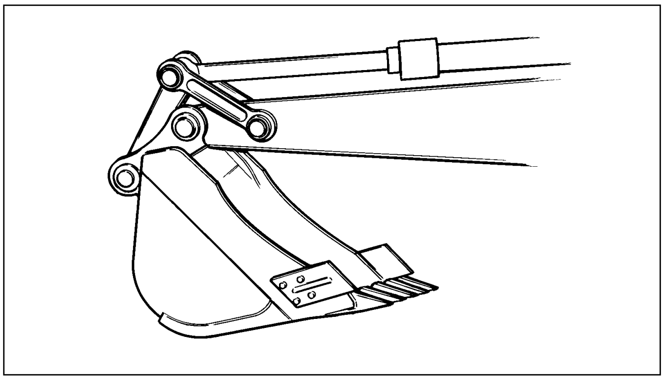
f. Natural Internal Leakage, Natural Ram Drop.

g. Amount of Hydraulic Oil squeezed out by each ram.

Speed Measurements

a. Bucket Ram speed.

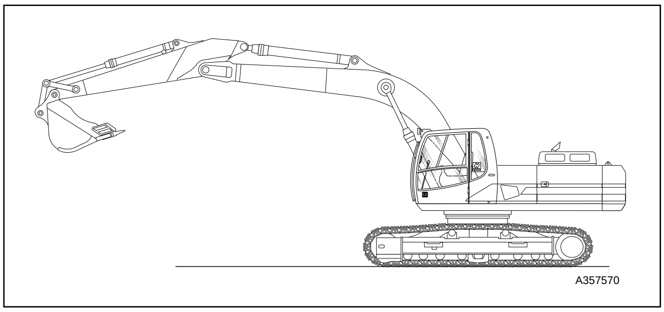
The conditions for checking are that the Dipper should be level.
Measurement is of the time it takes the bucket to fully open and close from each end of the stroke



b. Dipper Ram speed

The conditions for checking are that the Dipper should be level with the bucket open.

Measurement of the time it takes the Dipper to open and close from each end of the stroke.

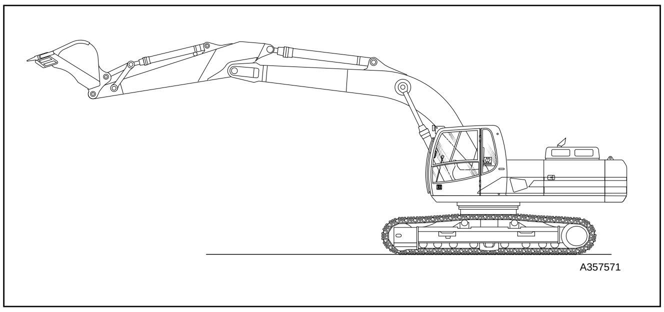


c. Boom Ram speed

The conditions for checking are that the Dipper and the bucket are open.

Measurement of the time it takes for the boom to go from a fully raised to fully lowered position.

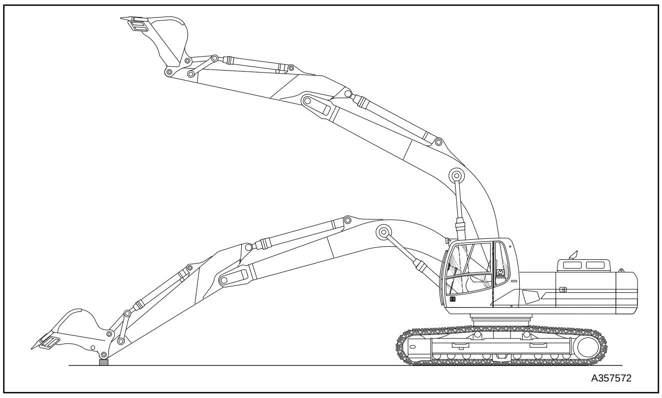
Note: *Place a wooden block where the Dipper would make contact with the ground, so as to prevent a shock loading of the arm, when it is lowered.*



d. Slew Speed

The conditions for checking are that the attachment is facing forwards and that a vertical line is chalked on the turntable bearing and lowering, then place the attachment in the minimum slew position.

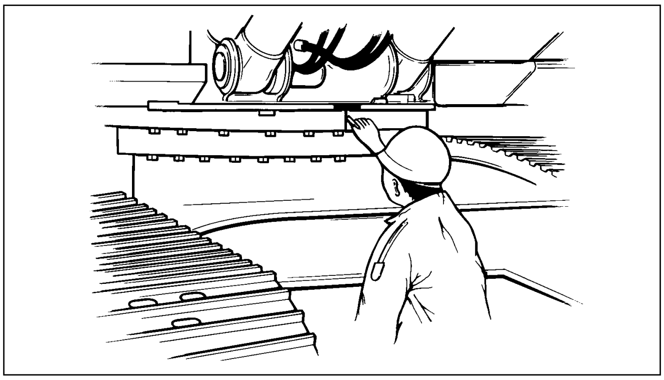
Rotate the upper framework and after one complete rotation, then measure the time it takes for the next rotation.



e. Travel Speed

The conditions for checking are that the main unit is jacked up, then marks are made on the Traction Motor and side frame. Rotate the sprocket two times or more to warm the motor then, record the time it takes for the motor to complete ten revolutions.

Measurement should be done with the machine in each mode, low, medium and high speed and three measurements in each direction in each mode should be done to obtain an average.

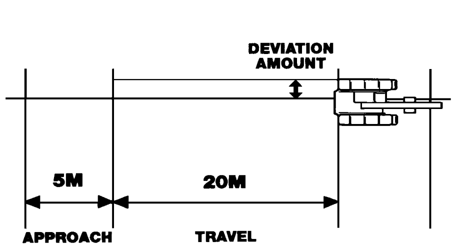


Other Measurements

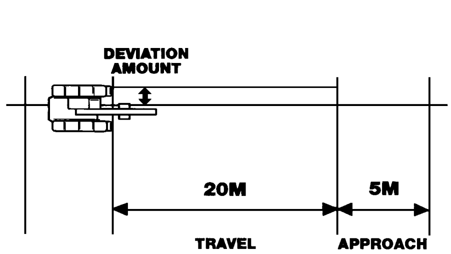
a. Travel Linearity.

The conditions for checking are that the machine should have an approach of 5 metres and a travel distance of 20 metres; measurement is of the amount of deviation after 20 metres between the reference line and track shoe.
Approach the reference line and adjust the position of the track shoe/travel direction against the reference line in the first 5 metres, then without adjusting, allow the machine to travel 20 metres, then measure the deviation, then complete the same procedure in reverse.

MEASUREMENT METHOD



MEASUREMENT METHOD

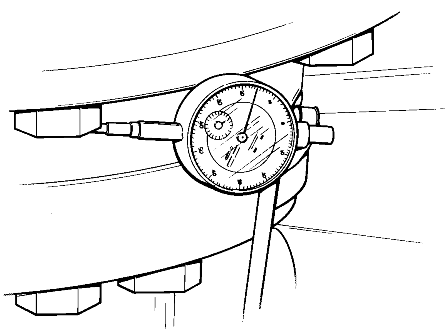


b. Slew Backlash.

1. The conditions for checking is to position the bucket in the open position slightly above ground and the engine stopped.
2. Gently push the bucket from the side and put a mark on the ground, this becomes the 'Zero Point'.
3. Then do the same for the opposite side of the bucket and make a mark, the distance the bucket has moved is the amount of backlash.

Note: *If the front attachment is pushed from side to side repeatedly or if there is leakage or the attachments are loose, correct measurement will not be possible.*
If the attachments are loose, position a dial gauge on the turntable bearing and measure the movement here.

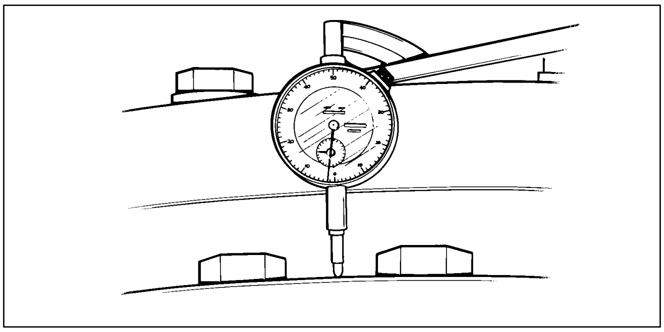
*



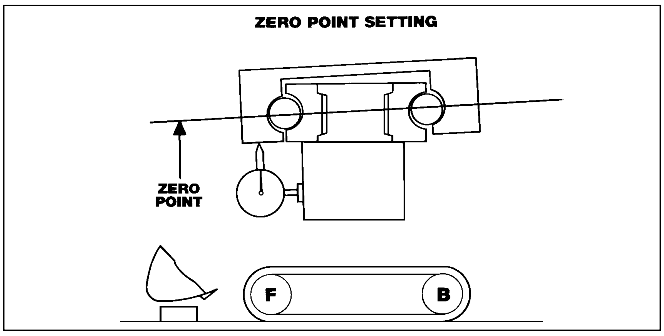
Other Measurements *(continued)*

c. Lateral Movement in turntable bearing.

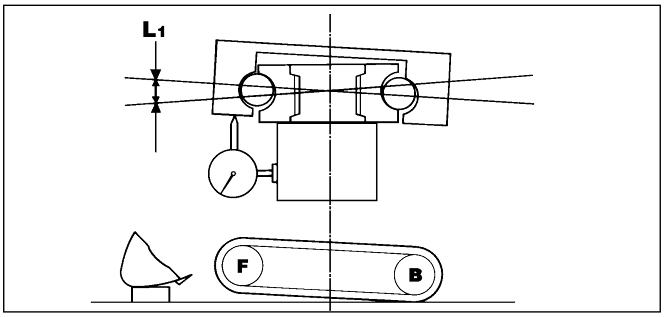
1. First set the Dipper in a perpendicular position and position the bucket 200 mm above the ground, stop the engine.



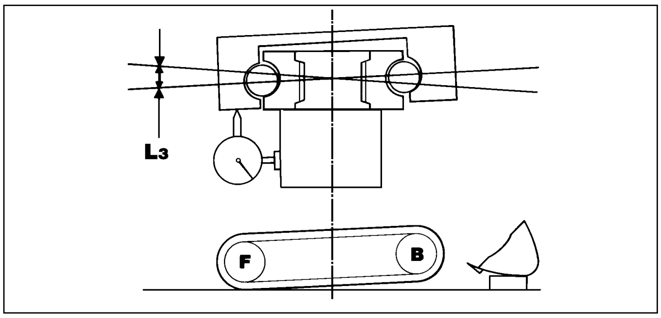
2. Install a dial gauge and set the needle to the Zero Point.



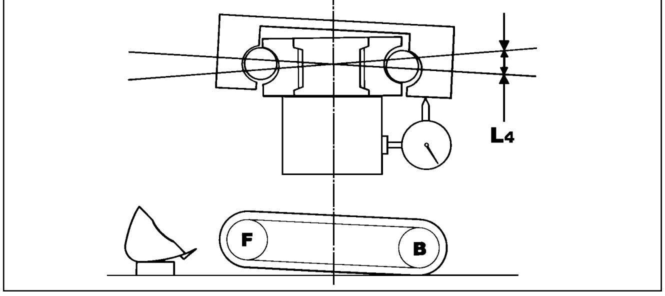
3. Start the engine and lift the main body with the bucket, when the bottom of the shoe is 100 mm above ground, note the reading on the dial gauge. The needle will turn in the counter clock wise direction. This value becomes L1, lower the body to the ground and confirm the needle reads zero.



4. Then rotate the main body 180° and repeat the procedure, this time the needle will rotate clock wise. This value becomes L3.

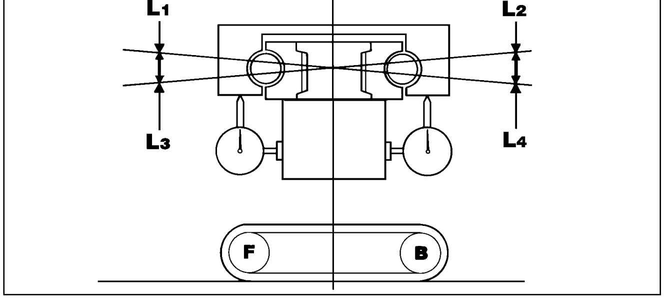


5. Next, place the dial gauge on the rear of the vehicle and repeat the two above procedures to obtain L2 and L4.



6. The lateral movement is shown as the result of the equation.

Note. *Always stop the engine when installing or removing the dial gauge or reading the dial gauge.*



Other Measurements *(continued)*

d. Slew Brake

1. The slew brake performance is measured at the minimum slew position.
Mark the turntable bearing and lower ring.

Note: *The person must stand well out of the machines slew radius on the front side, and also to confirm that no other personnel are in the vicinity.*

2. Rotate the upper body and when the machine has completed its full initial start rotation, indicate to the operator when the two marks will coincide on the next rotation. The operator then moves the lever to neutral.

3. After the swinging has stopped, measure the distance between the two indicating marks.

e. Slew Lock Characteristics.

1. The conditions for checking this is to load the bucket with soil at the maximum working radius. Then drive up a slope of 20° , then set the attachment to a 90° position relative to the direction of travel.

* 2. Confirm with an angle gauge that the machine is at 20° and mark the turntable bearing and lower ring.

3. Stop the engine and remove the key. Measure the distance the Upper Slew Body has moved relative to the lower frame after 30 minutes.

f. Natural Internal Leakage, natural ram drop.

1. The conditions for checking are that the dipper is fully open with the bucket open.

2. Using a marker pen, mark the wiper seal on the bucket ram piston rod, then mark the wiper seal on the dipper ram rod.

3. Gently raise the dipper till the bucket is 2 m above ground.

4. Make a mark 100 mm from the wiper seal on the boom ram rod.

5. Switch the engine off and remove the key. Wait 10 minutes then measure the distance from the ground to the bucket.

Measure the movement of each:-
Ram Rod
Boom
Dipper
Bucket

Other Measurements *(continued)*

g. Amount of Hydraulic Oil squeezed out by each ram.

1. To check the amount of hydraulic fluid squeezed out by each ram rod, check the oil ring state after moving the rod 100 metres, wipe all the rods and confirm there are no scratches. Refer to the service text for the No. of reciprocations to accomplish the distance.
2. Measure the width of the oil ring on each ram rod to see if it is within specifications.

This completes the measurement procedure for the Performance Evaluation.

Checking the FOPS Structure

All excavators are designed so that an operator's protective structure can be fitted. In certain applications such as demolition, machines must be fitted with the optional Falling Objects Protection Structure (FOPS). It is the operator's responsibility to identify the risk of an application.

⚠ WARNING

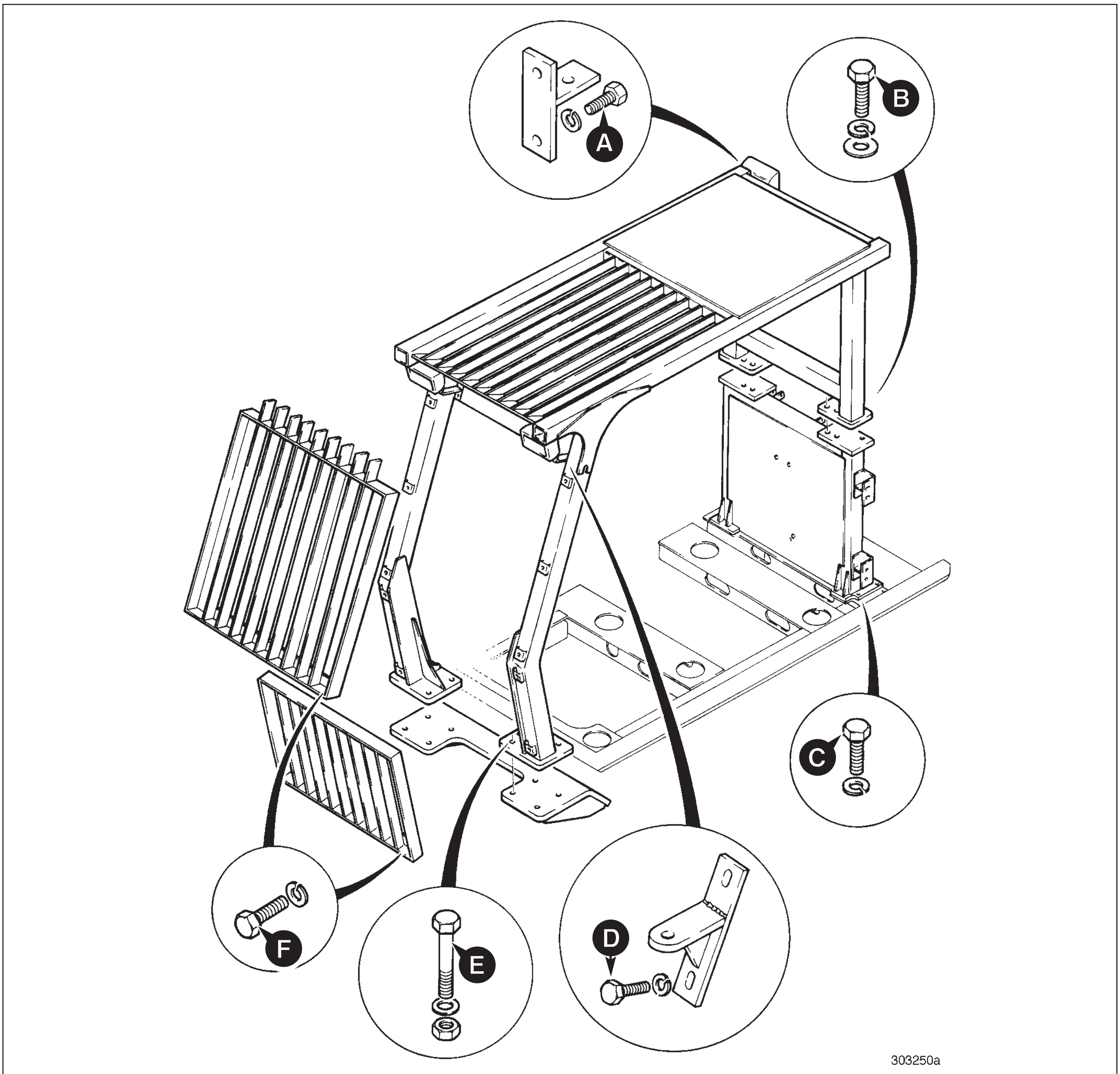
If a machine requires a Falling Objects Protection Structure (FOPS), you could be killed or seriously injured if you operate the machine in a dangerous application with a damaged or missing FOPS Structure. If the FOPS has been in an accident, do not use the machine until the structure has been renewed. Modifications that are not approved by the manufacturer may be dangerous and will invalidate the FOPS certification.

8-3-5-4

Check that all the FOPS mounting bolts are in place and undamaged. Check the FOPS mounting bolts for correct torque tightness.

Torque Setting

A Torque tightness is 78 Nm (57.5 lbf ft)
B Torque tightness is 343 Nm (253 lbf ft)
C Torque tightness is 343 Nm (253 lbf ft)
D Torque tightness is 78 Nm (57.5 lbf ft)
E Torque tightness is 343 Nm (253 lbf ft)
F Torque tightness is 137 Nm (101 lbf ft)



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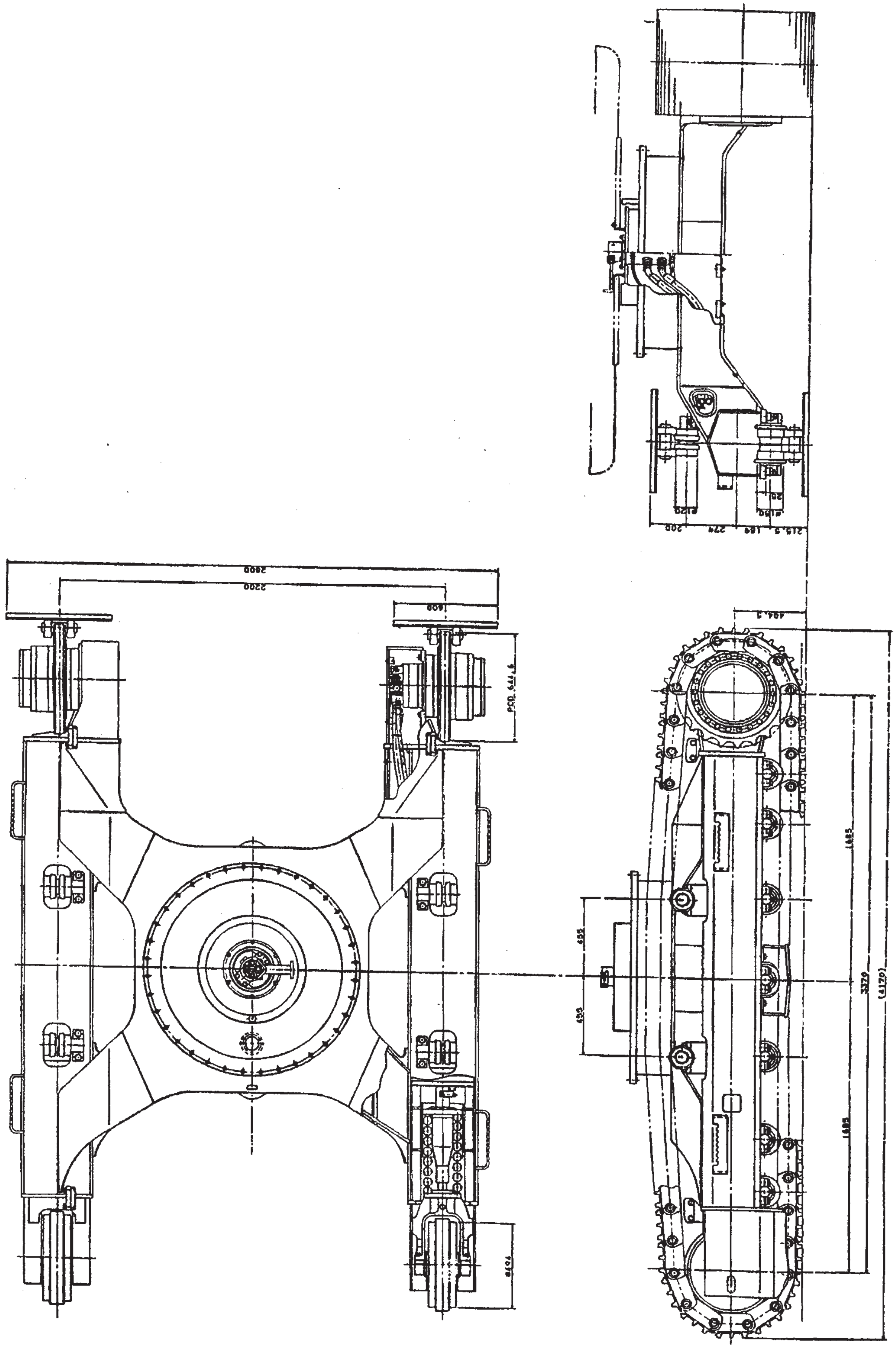
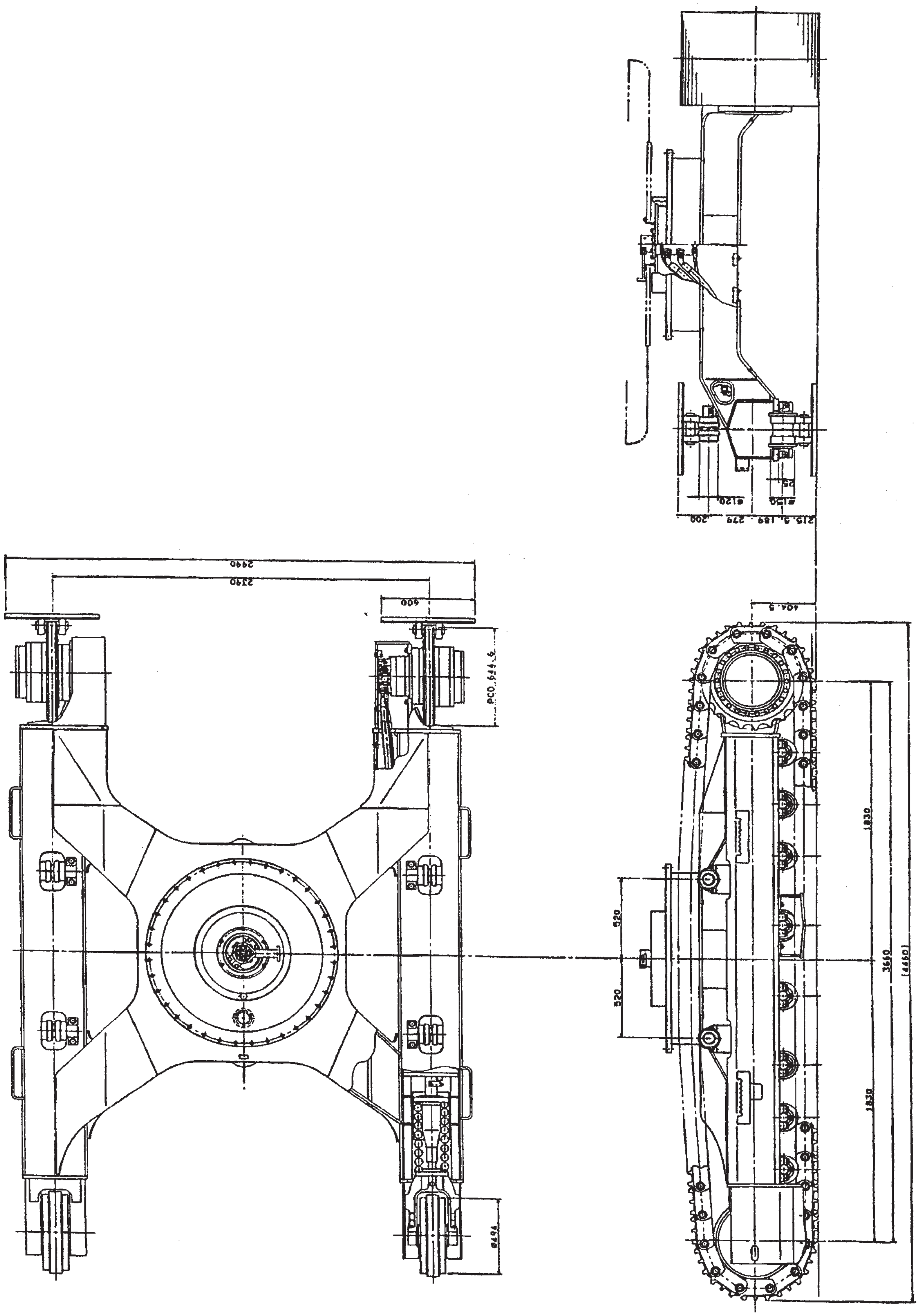
Torque Specifications JS200/JS240

Component	Nm	kgfm	lb/ft	Remarks
Counterweight	1059.1-1235.6/1333.7-1549.5	108-126/136-158	780-910.98/983.28-1142.3	Apply 262
Turntable Bearing (Lower Frame)	521.0-608/784-914	53.1-62/79.9-93.2	383.91-448.26/577.67-673.83	Apply 262
Turntable Bearing (Slew Frame)	521.0-608/784-914	53.1-62/79.9-93.2	383.91-448.26/577.67-673.83	Apply 262
Slew Equipment	521.0-608/784-914	53.1-62/79.9-93.2	383.91-448.26/577.67-673.83	Apply 262
Hydraulic Oil Tank	232.3	23.7-29.5	171.35-231.28	Apply 262
Fuel Tank	251.9-	25.7-29.5	185.81-213.28	Apply 262
Cab	127.4	13-14.5	93.99-104.83	Apply 262

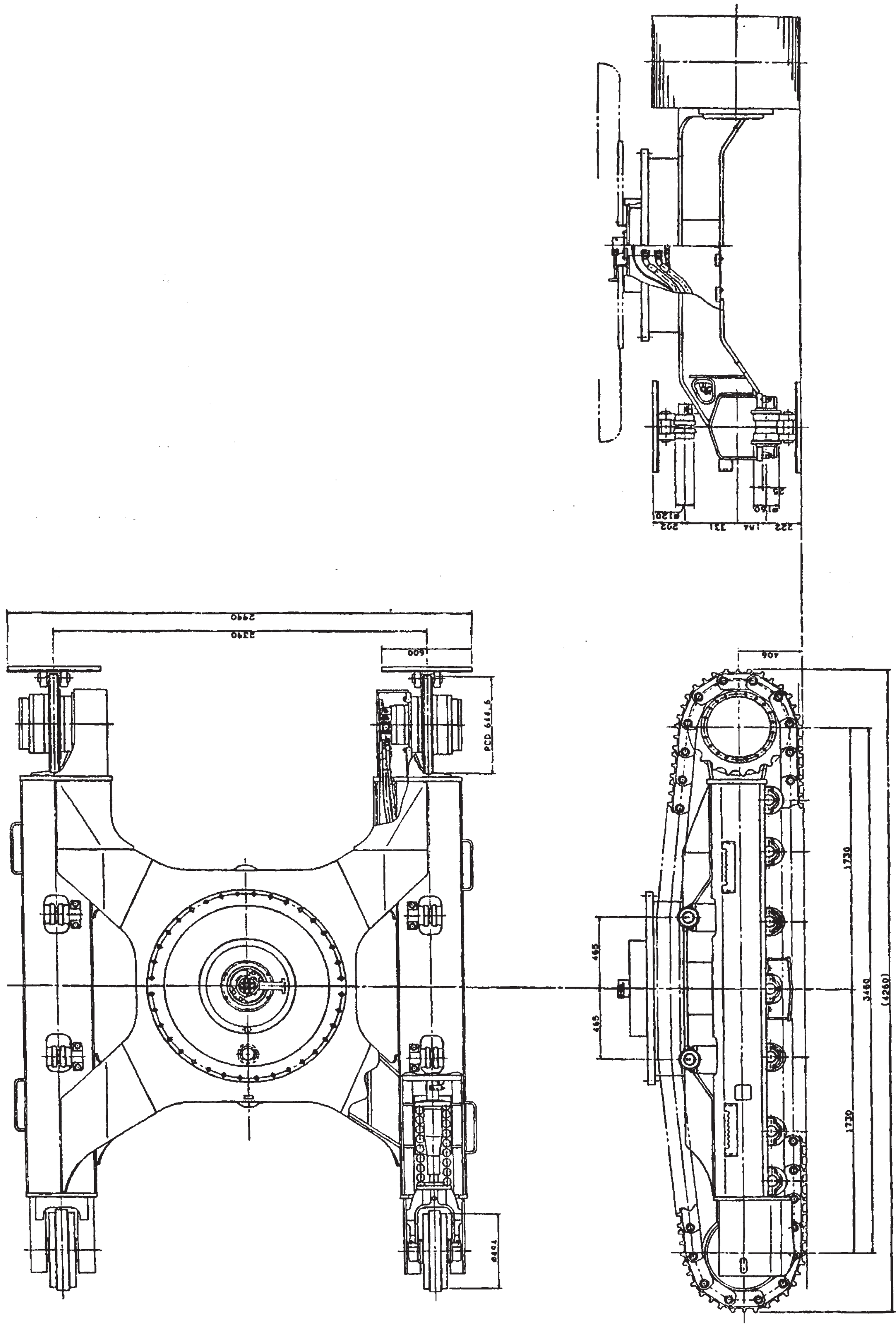
* Dimensions JS200/JS220



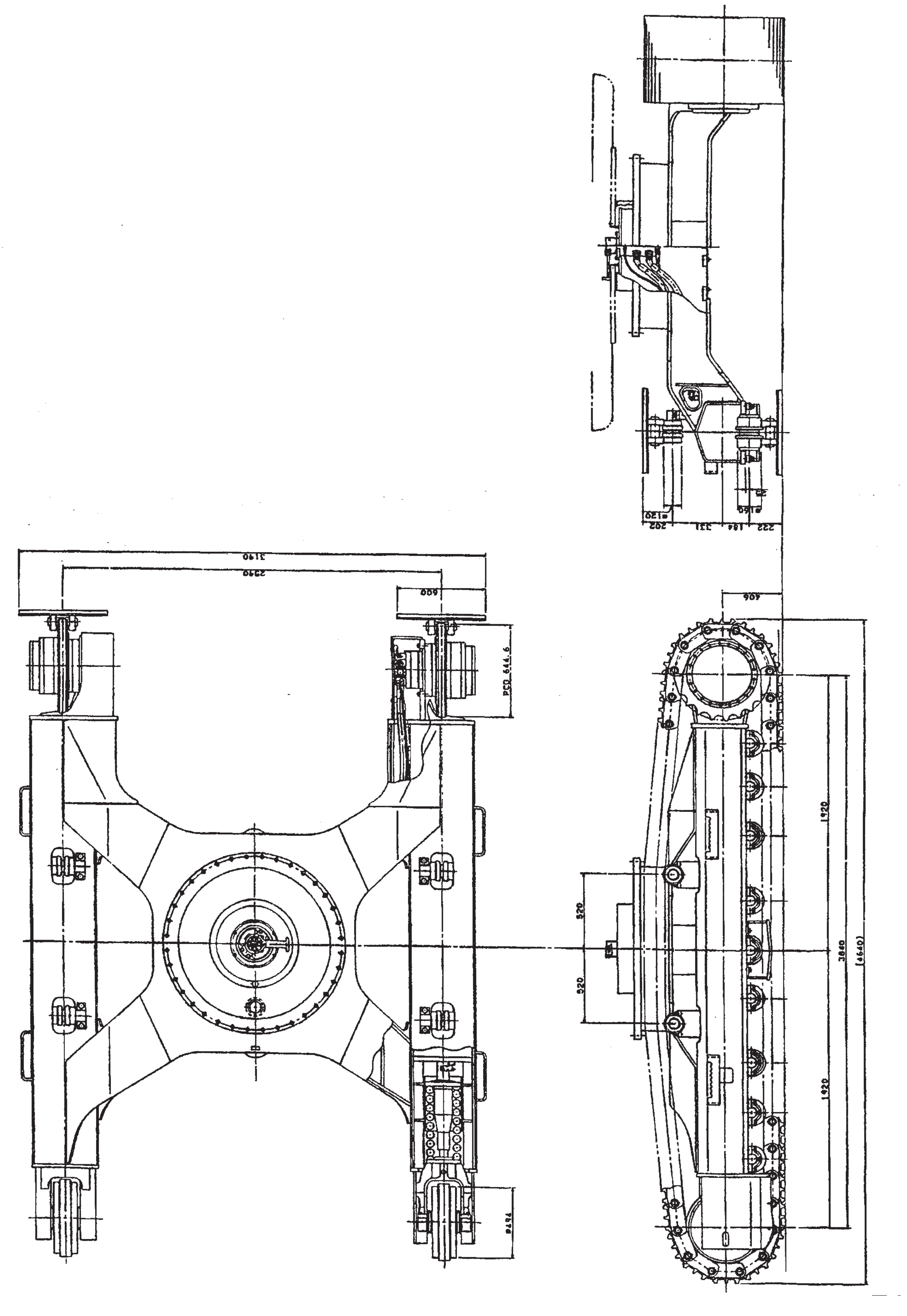
* **Dimensions JS200LC/JS220LC**



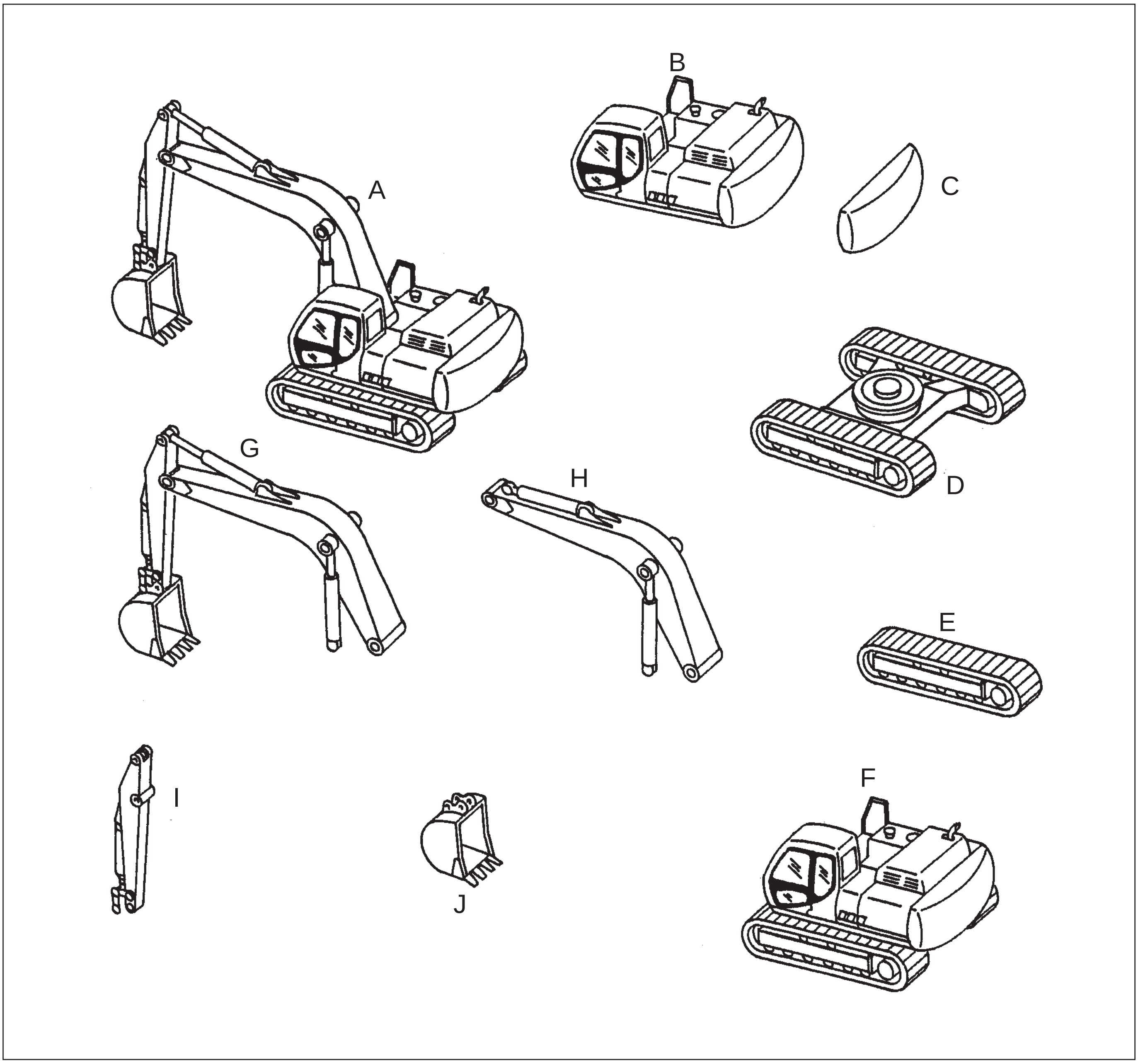
* Dimensions JS240/JS260



Dimensions JS240LC/JS260LC



* Weights JS200, JS200LC, JS220, JS220LC, JS240, JS240LC, JS260, JS260LC



* Weights JS200, JS200LC, JS220, JS220LC

Machine fitted with 3 m boom, 600 mm grouser shoes, 0.7 m^3 bucket (JS200/220), 0.8 m^3 bucket (JS200LC/220LC).

Symbol	Position Name	Weight (kg)			
		JS200	JS200LC	JS220	JS220LC
A	Overall Mass	18700	19100	21475	22155
B	Upper Mechanism Includes counterweight and slew ring bearing	8340	←	9850	←
C	Counterweight	3710	←	5010	←
D	Undercarriage (with grouser shoe)	6650	7080	7823	8503
E	Shoe (600 mm grouser) (one side)	1270	1350	1388	←
F	Machine Main Body	14990	15420	17673	18353
G	Attachment	3659	3706	3802	←
H	Boom (including ram)	2050	←	←	←
I	Dipper (including ram and link)	974	←	←	←
J	Bucket	682	←	←	←

* Weights JS240, JS240LC, JS260, JS260LC

Machine fitted with 3.1 m boom, 600 mm grouser shoes, 0.9 m^3 bucket (JS240/260), 1.0 m^3 bucket (JS240LC/260LC).

Symbol	Position Name	Weight (kg)			
		JS240	JS240LC	JS260	JS260LC
A	Overall Mass	22500	23100	24920	25790
B	Upper Mechanism Includes counterweight and slew ring bearing	9850	←	10785	←
C	Counterweight	4510	←	5500	←
D	Undercarriage (with grouser shoe)	7950	8550	9399	10269
E	Shoe (600 mm grouser) (one side)	1370	1480	1445	←
F	Machine Main Body	17800	18400	20184	21054
G	Attachment	4684	4736	←	←
H	Boom (including ram)	2638	←	←	←
I	Dipper (including ram and link)	1268	←	←	←
J	Bucket	830	←	←	←

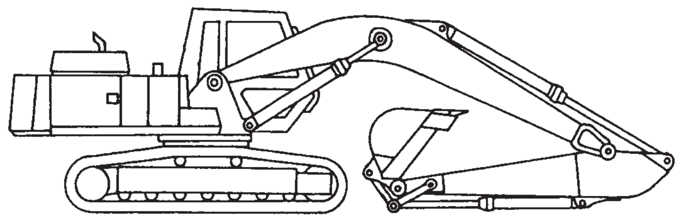
* Weights JS200, JS200LC, JS220, JS220LC, JS240, JS240LC, JS260, JS260LC

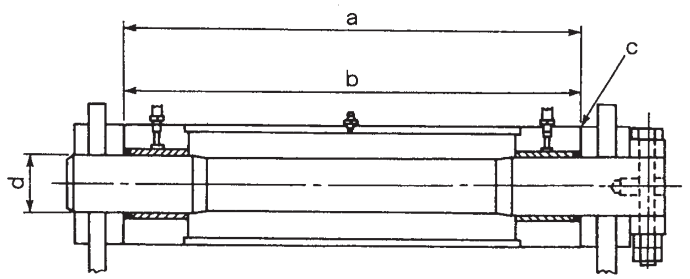
	Part Name	Dry Weight (kg)			
		JS200/220	JS200LC/220LC	JS240/260	JS240LC/260LC
1	Travel motor	270	←	←	←
2	Drive Sprocket	51	←	←	←
3	Take-up roller	88	←	←	←
4	Upper roller assembly	17	←	←	←
5	Lower roller assembly	37	←	←	←
6	500 mm grouser shoe assembly	1266	1348	1386	1485
7	600 mm grouser shoe assembly	1473	1569	1505	1633
8	700 mm grouser shoe assembly	1601	1706	1636	1775
9	-	-	-	-	-
10	Slew mechanism	194	←	335	←
11	Slew ring	216	←	389	←
12	Counterweight	3710/5010	←	4510/5500	←
13	Engine	490	←	495	←
14	Radiator	106	←	145	←
15	Hydraulic pump	150	←	←	←
16	Fuel Tank	81	←	←	←
17	Sump Tank	127	←	←	←
18	Control valve	166	←	←	←
19	Rotary joint	31	←	←	←
20	Boom	1305	←	1747	←
21	Dipper	613	←	786	←
22	Bucket	682	←	830	←
23	Boom ram	179	←	211	←
24	Dipper ram	277	←	341	←
25	Bucket ram	148	←	215	←

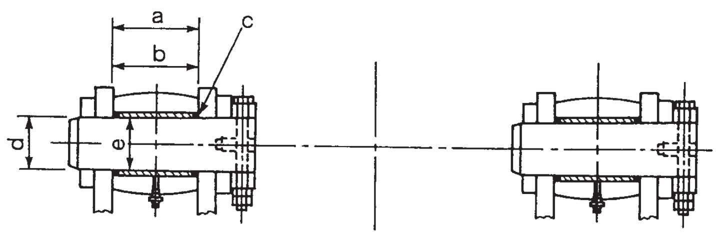
Attachments

Boom and Slew Frame Installation JS200, JS200LC

Equipment Name	Part Name	Code	Standard Value (mm)	Service Limit (mm)
1. Boom and slew frame installation	Slew frame	a	682	692
	Boom	b	681	679
	Clearance	c	1.0-3.5	Shim for adjustment KRV1180
	Pin	d	ø90	ø89
	Bushing (boom)	e	ø90	ø91.5
* **2.** Boom ram and slew frame installation	Slew frame	a	106	112
	Boom ram (dump end)	b	105	103
	Clearance	c	1.0-2.5	Shim for adjustment KRV1197
	Pin	d	ø80	ø79
	Bushing (boom ram)	e	ø80	ø81.5

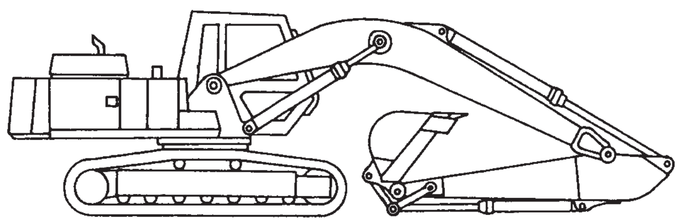


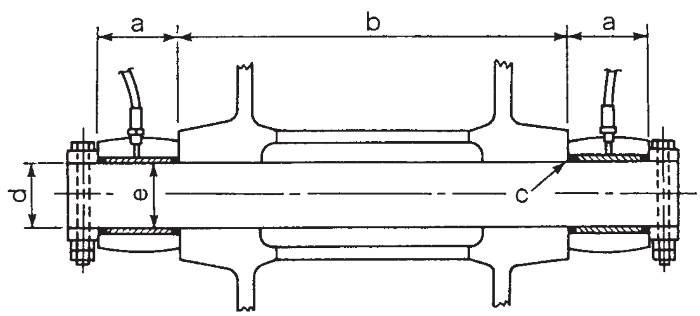




Boom Ram Installation JS200, JS200LC

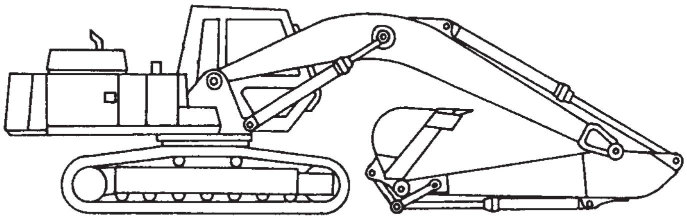
Equipment Name	Part Name	Code	Standard Value (mm)	Service Limit (mm)
3. Boom and boom ram installation	Boom ram (dump end)	a	100	98
	Boom	b	525	519
	Clearance	c	1.0-2.5	Shim for adjustment KRV1178
	Pin	d	ø85	ø84
	Bushing (boom ram)	e	ø85	ø86.5



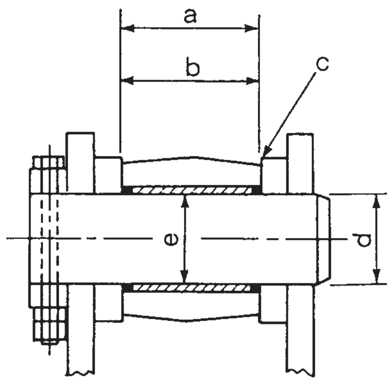


Attachments (continued)

Dipper Ram Installation JS200, JS200LC



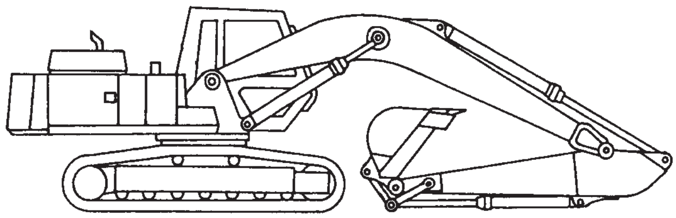
Equipment Name	Part Name	Code	Standard Value (mm)	Service Limit (mm)
4. Dipper ram installation	Boom	a	121	127
	Dipper ram (dump end)	b	120	118
	Clearance	c	0.5-3.0	Shim for adjustment KRV1197
	Pin	d	ø80	ø79
	Bushing (Dipper ram)	e	ø80	ø81.5

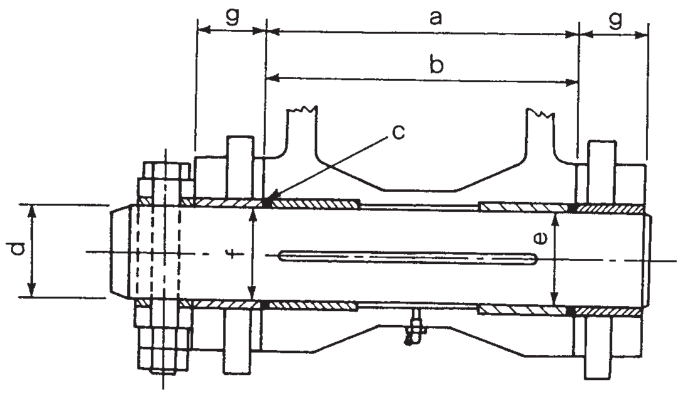


Attachments *(continued)*

Dipper Pivot Installation JS200, JS200LC

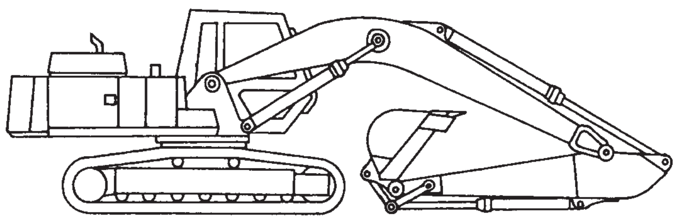
Equipment Name	Part Name	Code	Standard Value (mm)	Service Limit (mm)
5. Dipper Pivot installation	Boom	a	286	289.5
	Dipper	b	285.5	283.5
	Clearance	c	0.5-1.1	Shim for adjustment KRV1180
	Pin	d	ø90	ø89
	Bushing (Dipper)	e	ø90	ø91.5
	Bushing (boom)	f	ø90	ø91.5
	Boom	g	ø80	78

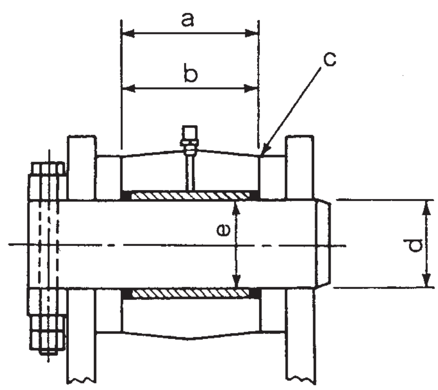




Dipper and Dipper Ram Installation JS200, JS200LC

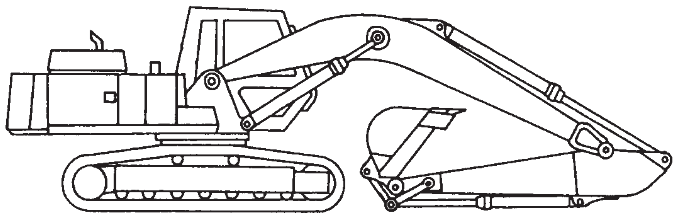
Equipment Name	Part Name	Code	Standard Value (mm)	Service Limit (mm)
6. Dipper and Dipper ram installation	Boom	a	121	127
	Dipper ram (eye end)	b	120	118
	Clearance	c	0.5-3.0	Shim for adjustment KRP1349
	Pin	d	ø80	ø79
	Bushing (Dipper ram)	e	ø80	ø81.5



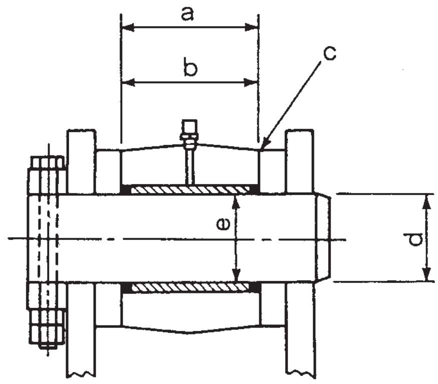


Attachments *(continued)*

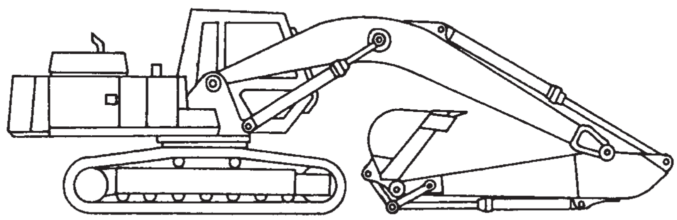
Bucket Ram Installations JS200, JS200LC



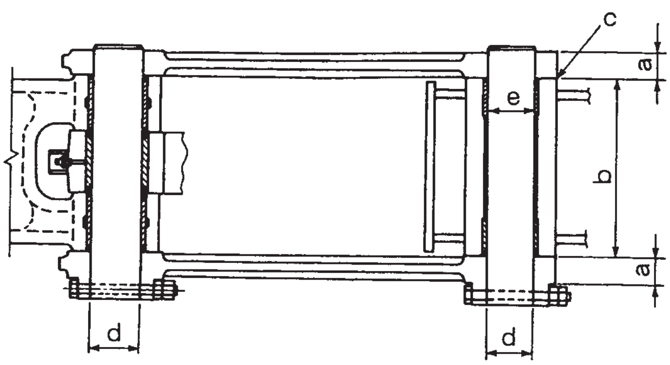
Equipment Name	Part Name	Code	Standard Value (mm)	Service Limit (mm)
7. Bucket Ram installation	Dipper	a	101	107
	Bucket ram (eye end)	b	100	98
	Clearance	c	0.5-3.0	Shim for adjustment KRV1176
	Pin	d	ø75	ø74
	Bushing (bucket ram)	e	ø75	ø76.5



Dipper and Dipper Link Installation JS200, JS200LC

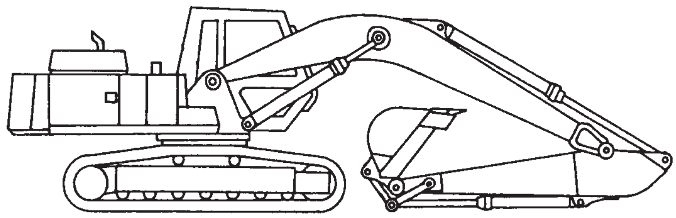


Equipment Name	Part Name	Code	Standard Value (mm)	Service Limit (mm)
8. Dipper and Dipper link installation	Dipper Link	a	46	43
	Dipper	b	280	278
	Clearance	c	1.0-1.5	Shim for adjustment KHV0169
	Pin	d	ø75	ø74
	Bushing (Dipper)	e	ø75	ø76.5

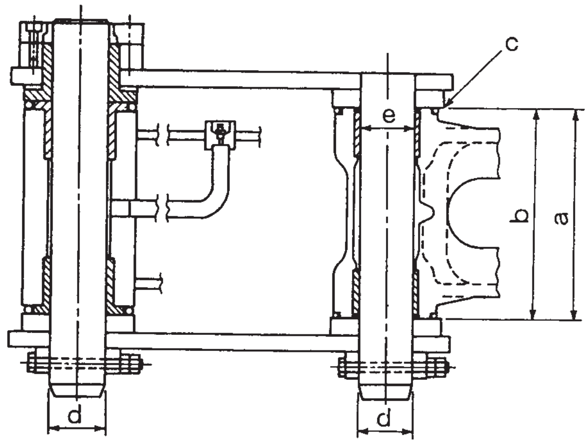


Attachments *(continued)*

Bucket and Bucket Link Installation JS200, JS200LC

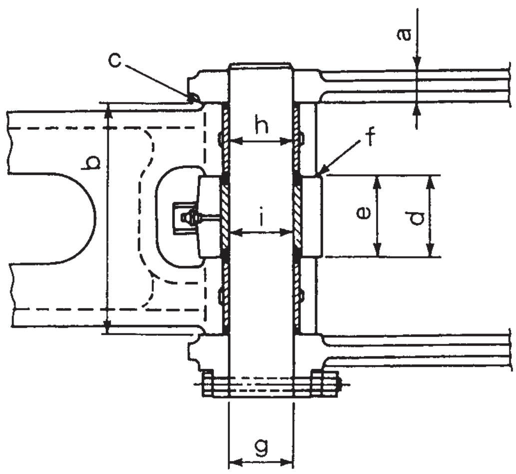


Equipment Name	Part Name	Code	Standard Value (mm)	Service Limit (mm)
9. Bucket and bucket link installation	Bucket	a	307	313
	Bucket link	b	306	304
	Clearance	c	1.0-3.5	Shim for adjustment KRV1197
	Pin	d	ø80	ø79
	Bushing (bucket link)	e	ø80	ø81.5



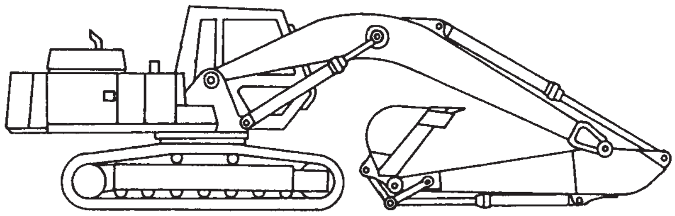
Bucket Link and Bucket Ram Installation JS200, JS200LC

Equipment Name	Part Name	Code	Standard Value (mm)	Service Limit (mm)
10. Bucket link and bucket ram installation	Dipper Link	a	46	43
	Bucket link	b	280	278
	Clearance	c	1.0-1.5	Shim for adjustment KHV0170
	Bucket link	d	96	98
	Bucket ram (eye end)	e	95	93
	Clearance	f	1.0-2.0	Shim for adjustment KHV0170
	Pin	g	ø85	ø84
	Bushing (Bucket link)	h	ø85	ø86.5
	Bushing (Bucket ram)	i	ø85	ø86.5

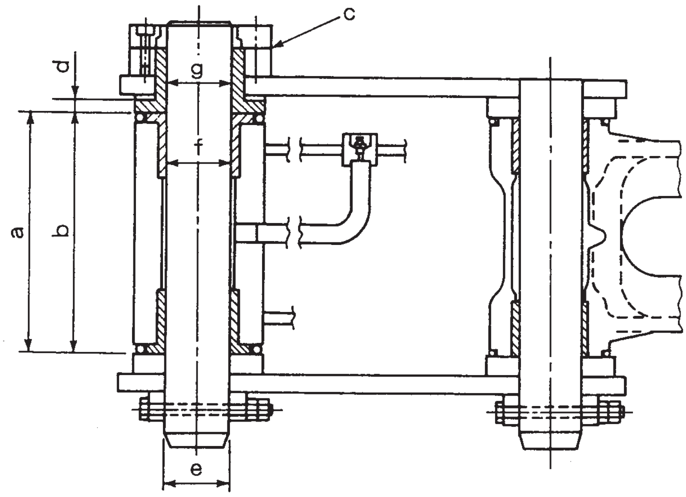


Attachments *(continued)*

Bucket and Dipper Installation JS200, JS200LC



Equipment Name	Part Name	Code	Standard Value (mm)	Service Limit (mm)
11. Bucket and dipper installation	Bucket	a	307	313
	Dipper	b	306	304
	Clearance	c	1.0-3.5	Shim for adjustment KRV1159
	Bushing (bucket)	d	16	8
	Pin	e	ø80	ø79
	Bushing (bucket)	f	ø80	ø81.5
	Bushing (bucket)	g	ø80	ø81.5



Attachments *(continued)*

Shim Adjustment Table

(Unit: mm)

Pin Diameter	Shim Thickness	Shim Outer Diameter									
		90	100	110	120	130	135	140	145	150	160
60	1.2										
65	1.2		KNV0538		BHV1034						
70	1.2			KNV0696		KNV0539					
75	1.2					KRV1176		KHV0169			KNV0534
80	1.2							KRV1197		KRP1349	
85	1.2					KRV1178				KHV0170	
90	1.2						KBV0837				KSP0268
95	1.2									KNV0468	
100	1.2										
105	1.2										
110	1.2										
115	1.2										
120	1.2										
125	1.2										
130	1.2										

Attachments *(continued)*

Shim Adjustment Table *(continued)*

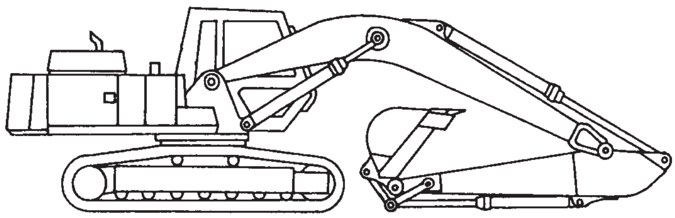
(Unit: mm)

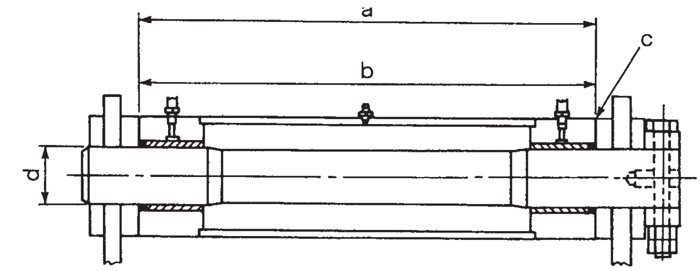
Pin Diameter	Shim Outer Diameter										
	165	170	180	185	190	200	210	220	230	240	250
60											
65											
70											
75											
80											
85											
90	KBV0764				KRV1180						
95											
100								KBV0474			
105											
110											
115											
120			KRV1159								
125											
130					KBV0713						

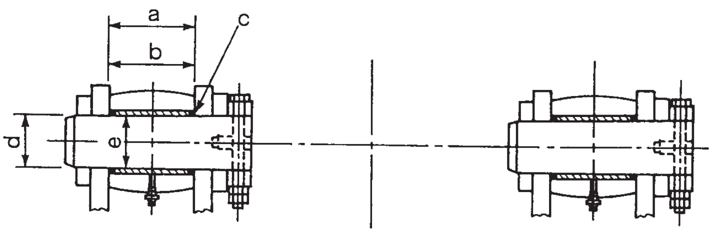
Attachments *(continued)*

Boom and Slew Frame Installation JS240, JS240LC

Equipment Name	Part Name	Code	Standard Value (mm)	Service Limit (mm)
1. Boom and slew frame installation	Slew frame	a	676	686
	Boom	b	-	-
	Clearance	c	1.0-3.5	Shim for adjustment KBV0474
	Pin	d	ø100	ø99
	Bushing (boom)	e	ø100	ø101.5
2. Boom and slew frame installation	Slew frame	a	109	115
	Boom ram (dump end)	b	108	106
	Clearance	c	1.0-2.5	Shim for adjustment KBV0764
	Pin	d	ø90	ø89
	Bushing (boom ram)	e	ø80	ø91.5

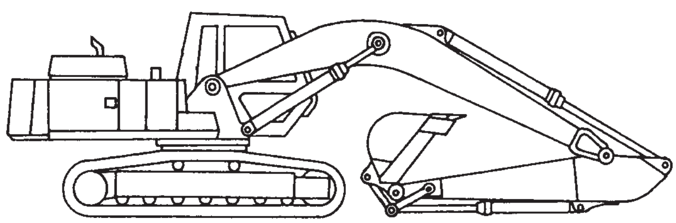


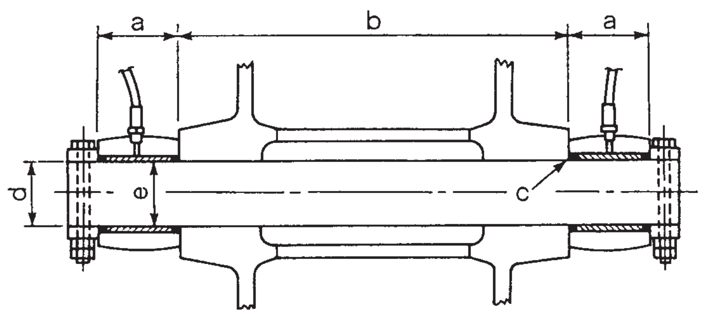




Boom Ram Installation JS240, JS240LC

Equipment Name	Part Name	Code	Standard Value (mm)	Service Limit (mm)
3. Boom and boom ram installation	Boom ram (dump end)	a	108	106
	Boom	b	508	502
	Clearance	c	1.0-2.5	Shim for adjustment KBV0837
	Pin	d	ø90	ø89
	Bushing (boom ram)	e	ø90	ø91.5

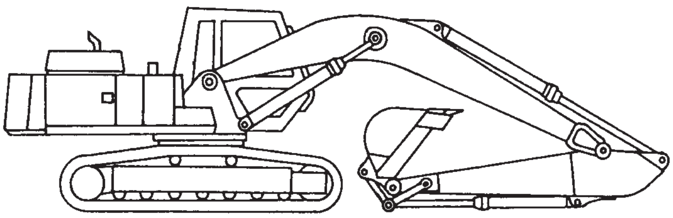


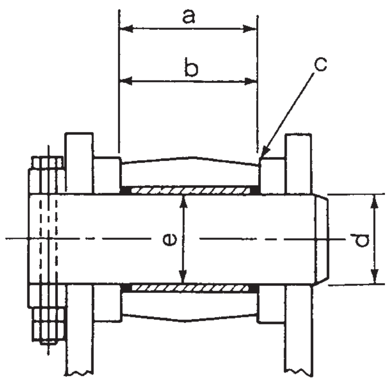


Attachments *(continued)*

Dipper Ram Installation JS240, JS240LC

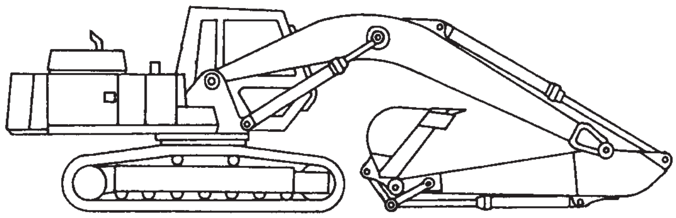
Equipment Name	Part Name	Code	Standard Value (mm)	Service Limit (mm)
4. Dipper Ram installation	Boom	a	121	127
	Dipper ram (dump end)	b	120	118
	Clearance	c	0.5-3.0	Shim for adjustment KBV0764
	Pin	d	ø90	ø89
	Bushing (Dipper ram)	e	ø90	ø91.5

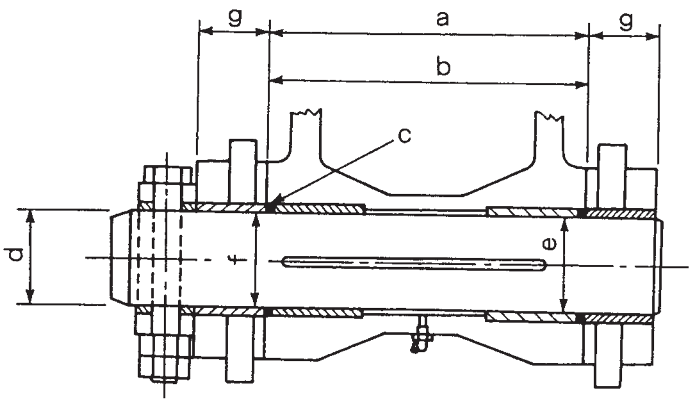




Attachments *(continued)*

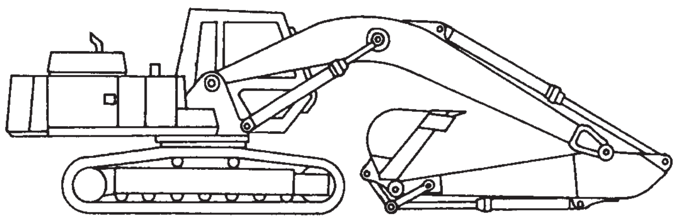
Dipper Pivot Installation JS240, JS240LC

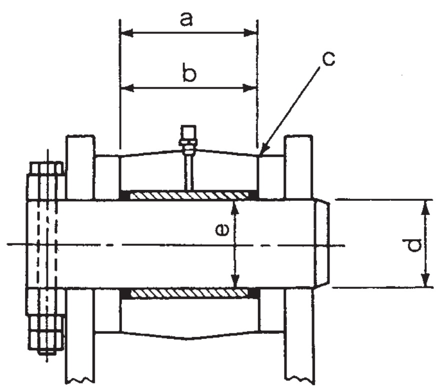




Equipment Name	Part Name	Code	Standard Value (mm)	Service Limit (mm)
5. Dipper Pivot installation	Boom	a	286	289.5
	Dipper	b	285.5	283.5
	Clearance	c	0.5-1.1	Shim for adjustment KBV0000
	Pin	d	ø100	ø99
	Bushing (Dipper)	e	ø100	ø101.5
	Bushing (boom)	f	ø100	ø101.5
	Boom	g	82	80

Dipper and Dipper Ram Installation JS240, JS220LC

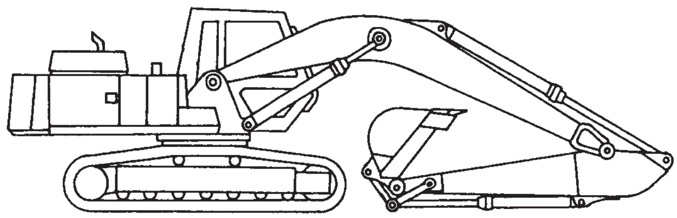




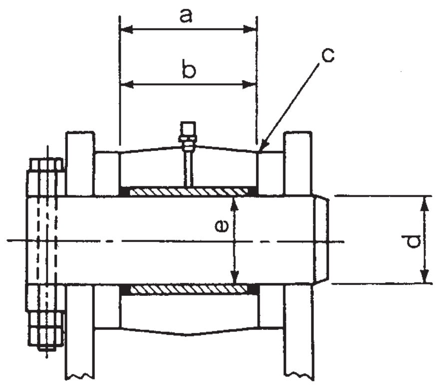
Equipment Name	Part Name	Code	Standard Value (mm)	Service Limit (mm)
6. Dipper and Dipper ram installation	Boom	a	121	127
	Dipper ram (eye end)	b	120	118
	Clearance	c	0.5-3.0	Shim for adjustment KRV1180
	Pin	d	ø90	ø99
	Bushing (Dipper ram)	e	ø90	ø91.5

Attachments *(continued)*

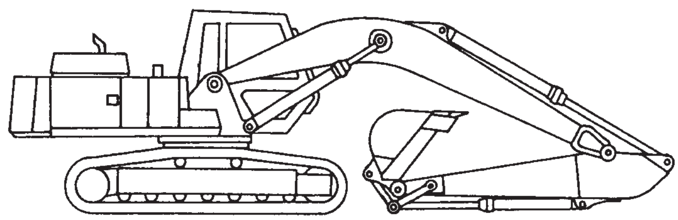
Bucket Ram Installations JS240, JS240LC



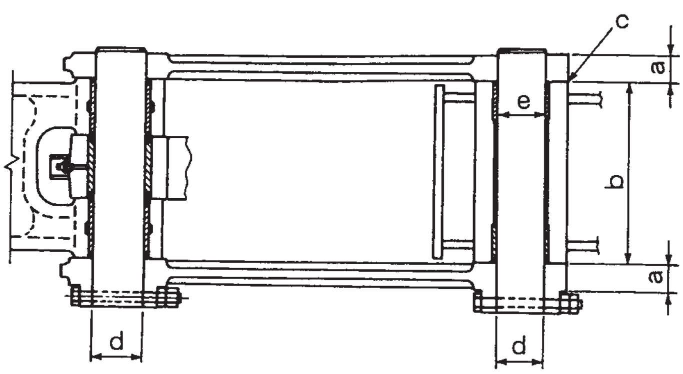
Equipment Name	Part Name	Code	Standard Value (mm)	Service Limit (mm)
7. Bucket ram installation	Dipper	a	116	122
	Bucket ram (eye end)	b	115	113
	Clearance	c	0.5-3.0	Shim for adjustment KRV1197
	Pin	d	ø80	ø79
	Bushing (bucket ram)	e	ø80	ø81.5



Dipper and Dipper Link Installation JS240, JS240LC

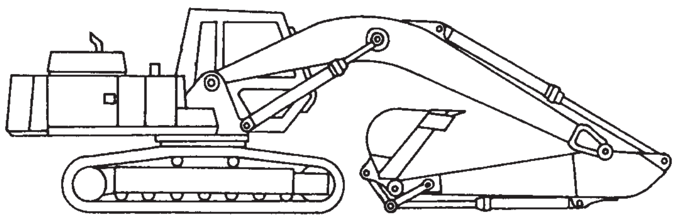


Equipment Name	Part Name	Code	Standard Value (mm)	Service Limit (mm)
8. Dipper and Dipper link installation	Dipper Link	a	50	47
	Dipper	b	296	294
	Clearance	c	1.0-1.5	Shim for adjustment KRP1349
	Pin	d	ø80	ø79
	Bushing (Dipper)	e	ø80	ø81.5

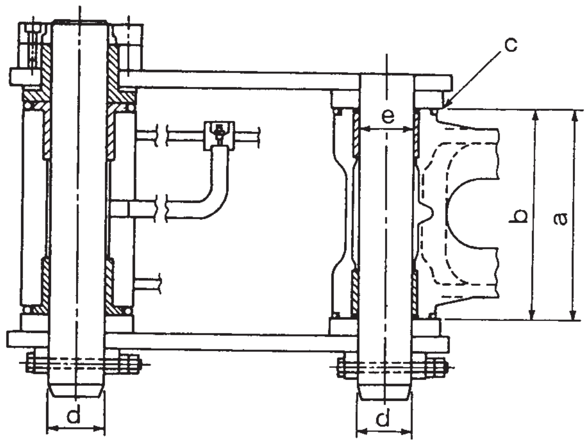


Attachments *(continued)*

Bucket and Bucket Link Installation JS240, JS240LC

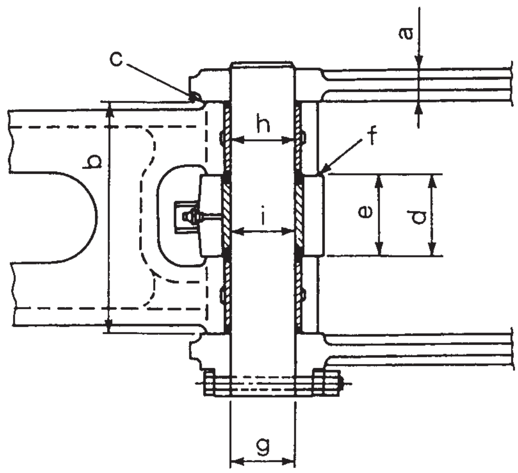


Equipment Name	Part Name	Code	Standard Value (mm)	Service Limit (mm)
9. Bucket and bucket link installation	Bucket	a	326	323
	Bucket link	b	325	323
	Clearance	c	1.0-3.5	Shim for adjustment KRV1180
	Pin	d	ø90	ø89
	Bushing (bucket link)	e	ø90	ø91.5



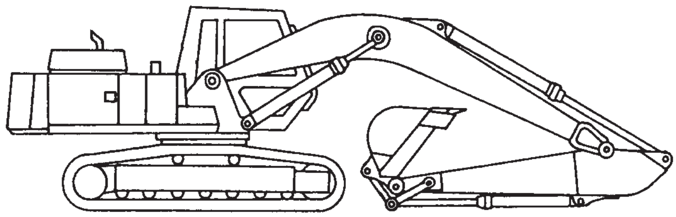
Bucket Link and Bucket Ram Installation JS240, JS240LC

Equipment Name	Part Name	Code	Standard Value (mm)	Service Limit (mm)
10. Bucket link and bucket ram installation	Dipper Link	a	50	47
	Bucket link	b	296	294
	Clearance	c	1.0-1.5	Shim for adjustment KSP0268
	Bucket link	d	106	108
	Bucket ram (eye end)	e	105	103
	Clearance	f	1.0-2.0	Shim for adjustment KSP0268
	Pin	g	ø90	ø89
	Bushing (Bucket link)	h	ø90	ø91.5
	Bushing (Bucket ram)	i	ø90	ø91.5

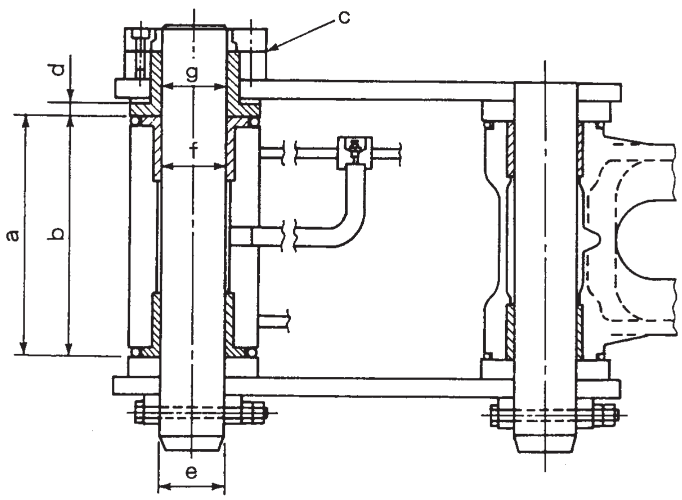


Attachments *(continued)*

Bucket and Dipper Installation JS240, JS240LC



Equipment Name	Part Name	Code	Standard Value (mm)	Service Limit (mm)
11. Bucket and Dipper installation	Bucket	a	326	323
	Dipper	b	325	323
	Clearance	c	1.0-3.5	Shim for adjustment KBV0713
	Bushing (bucket)	d	16	8
	Pin	e	ø90	ø89
	Bushing (bucket)	f	ø90	ø91.5
	Bushing (bucket)	g	ø90	ø91.5



Attachments *(continued)*

Shim Adjustment Table

(Unit: mm)

Pin Diameter	Shim Thickness	Shim Outer Diameter									
		90	**100**	**110**	**120**	**130**	**135**	**140**	**145**	**150**	**160**
60	1.2										
65	1.2		KNV0538		BHV1034						
70	1.2			KNV0696		KNV0539					
75	1.2					KRV1176		KHV0169			KNV0534
80	1.2							KRV1197		KRP1349	
85	1.2					KRV1178				KHV0170	
90	1.2						KBV0837				KSP0268
95	1.2									KNV0468	
100	1.2										
105	1.2										
110	1.2										
115	1.2										
120	1.2										
125	1.2										
130	1.2										

Attachments *(continued)*

Shim Adjustment Table *(continued)*

(Unit: mm)

Pin Diameter	Shim Outer Diameter										
	165	170	180	185	190	200	210	220	230	240	250
60											
65											
70											
75											
80											
85											
90	KBV0764				KRV1180						
95											
100								KBV0474			
105											
110											
115											
120			KRV1159								
125											
130					KBV0713						

Direct Glazing

The following procedures explain how to correctly remove and install panes of glass that are directly bonded to the cab frame apertures. When carrying out the procedures, relevant safety precautions must be taken.

1 Always wear safety glasses during both removal and replacement.

2 Use protective gloves - heavy duty leather gauntlet type gloves when cutting out the broken glass; 'non-slip' type gloves when handling/moving panes of glass; surgical type gloves when using the polyurethane adhesives.

3 Wear protective overalls.

4 DO NOT smoke - the activators and primers used in the procedures are highly flammable.

5 Do not attempt to handle or move panes of glass unless you are using glass lifters (see **Service Tools**, Section 1).

Several special tools are required to successfully complete the removal and replacement procedures. Reference is made to the tools in the text. The majority of these tools can be obtained locally and the remainder from JCB Service (see **Service Tools**, Section 1).

The work must only be carried out in a dry, frost free environment. A protective canopy may be required or the machine/frame must be moved to a sheltered area. In damp or wet conditions, hinged doors and window frames can be removed from the machine and taken to a more suitable (dry) environment.

Glass should not be replaced at temperatures below 5°C (41°F).

Removing the Broken Glass and Old Sealant

⚠ WARNING

Always wear safety glasses when removing or installing screen glass. Never use a power operated knife when removing the sealant around a toughened glass screen. The action of the knife could cause particles of glass to be thrown with sufficient force to cause serious injury, even when safety glasses are being worn. Use only hand operated tools when working with toughened glass.

BF 2-3/1

Direct Glazing (cont'd)

Removing the Broken Glass and Old Sealant (cont'd)

1 Position the machine on level ground and apply the parking brake. Stop the engine. Put protective covers over the cab seat and control pedestals.

2 Toughened glass - remove as much of the shattered glass as possible prior to cutting out the old sealant.

3 Cut out the old sealant, leaving approximately 1 to 2 mm on the cab frame. There are several tools and techniques for doing this:

a Braided Cutting Wire and Handles **B**. This method uses a 3-core wire, a wire starter tube and two handles (see **Service Tools**, Section 1).

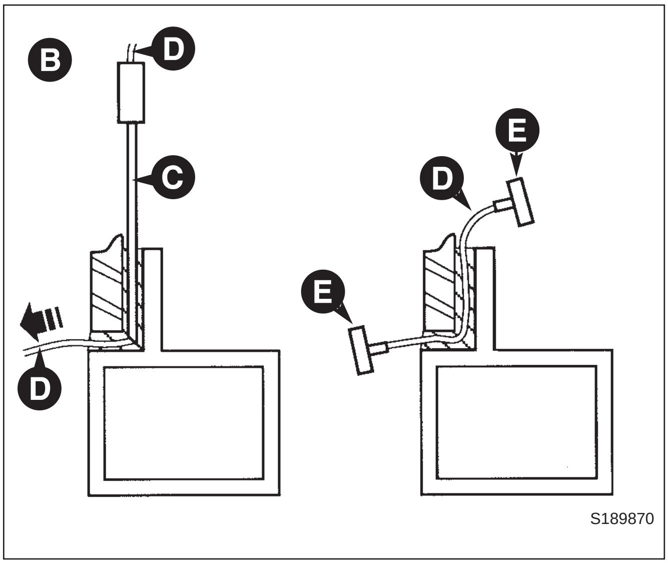
(i) Insert the steel tube **C** into the old sealant on the inside of the glass.

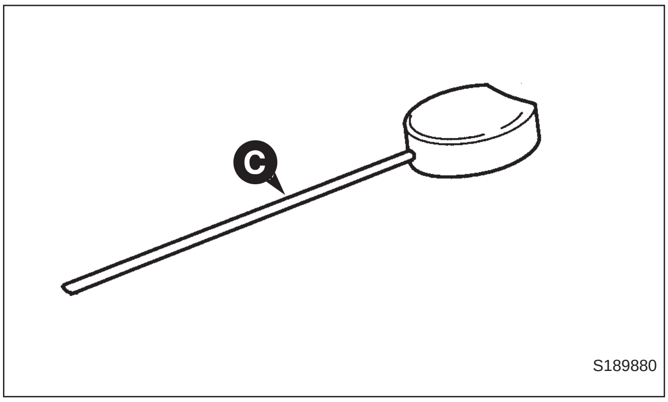
(ii) Insert the braided cutting wire **D** down the centre of the steel tube. If necessary, from the outside, cut out local sealant at the point of the tube to gain access to the wire.

(iii) Using suitable pliers, pull the cutting wire through the sealant to the outer side of the glass.

(iv) Secure each end of the braided cutting wire in the special handles **E**.

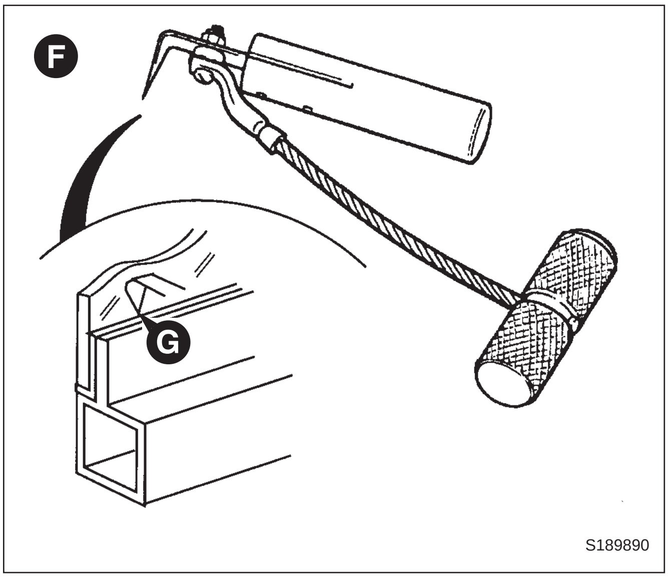
(v) Move the cutting wire backwards and forwards in a sawing motion and at the same time gently push or pull the wire to cut through the old sealant.





Direct Glazing (cont'd)

Removing the Broken Glass and Old Sealant (cont'd)



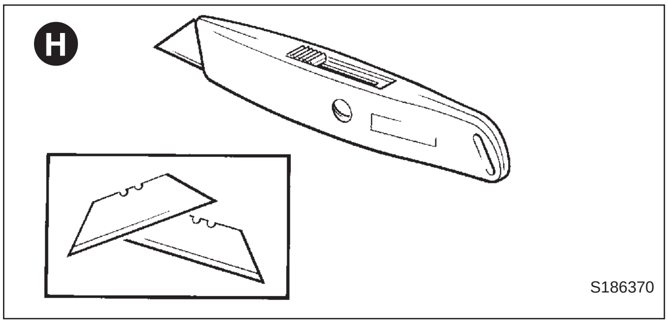
b Cut-out Knife **F**. The cut-out knife can be used as a left handed or right handed tool. For the knife and its replaceable blades, refer to **Service Tools**, Section 1.

(i) Insert the knife blade into the sealant.

(ii) Make sure that the blade of the knife is against the glass as shown at **G**.

(iii) Use the 'pull-handle' to pull the knife along and cut out the old s ealant.

c Craft Knife **H**. The blades are replaceable.



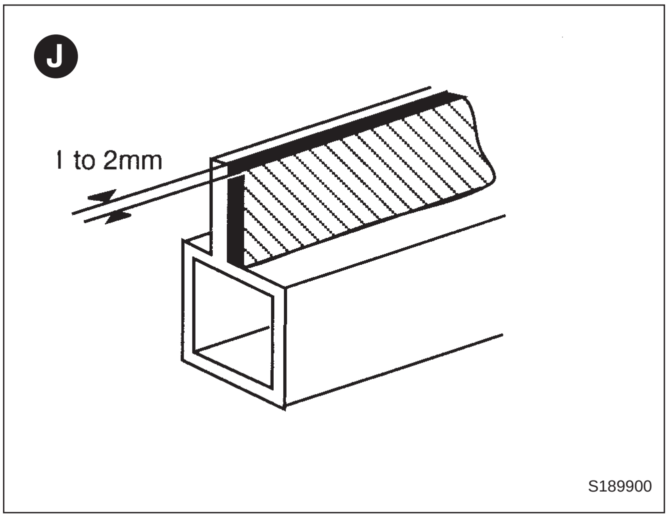
(i) Insert the knife blade into the sealant.

(ii) Pull the knife along and cut out the old sealant.

Note: There are other tools available to cut out the old sealant. For example, there is a long handle type craft knife to give extended reach. Refer to **Service Tools,** Section 1, for details of this and any other tools.

4 Toughened glass - remove the cut off sealant and all remaining particles of shattered glass.

5 If necessary, trim off the remaining old sealant to leave approximately 1 to 2 mm on the upright face of the cab frame aperture, as shown at **J**.



6 Apply a coat of 'Black Primer 206J' to the paintwork if:

a Paintwork was damaged or scratched during the glass/sealant removal procedures.

b The old sealant was inadvertently cut back to the cab frame during the glass/sealant removal procedures.

Preparing the Cab Frame Aperture

1 If damp or wet, dry the aperture area using a hot air gun (sourced locally).

2 Use 'Active Wipe 205' to thoroughly clean and 'prime' the trimmed sealant. Use a lint free cloth to apply the 'Active Wipe 205', allow 5 minutes flash off (drying) time.

Note: Do not use any other type of cleaning fluids, otherwise they may be absorbed into the old sealant and ultimately prevent the new glass from bonding.

Direct Glazing (cont'd)

Preparing the New Glass

1 Make sure that the new glass correctly fits the frame aperture **K**.

a Put two spacer blocks **L** onto the bottom part of the frame aperture.

b Install the new glass on the spacer blocks - ALWAYS USE GLASS LIFTERS **M** (see **Service Tools**, Section 1). Check that there is an equal sized gap all round the edge of the glass.

Note: The spacer blocks are rectangular in section to give two common gap widths. If necessary they can be trimmed to a smaller size to give an equal sized gap around the glass.

IMPORTANT: The glass edges MUST NOT touch the frame, otherwise movement of the frame will chip and eventually break the newly installed glass.

2 After checking for size, remove the new glass and place it on a purpose made glass stand **N** (see **Service Tools**, Section 1).

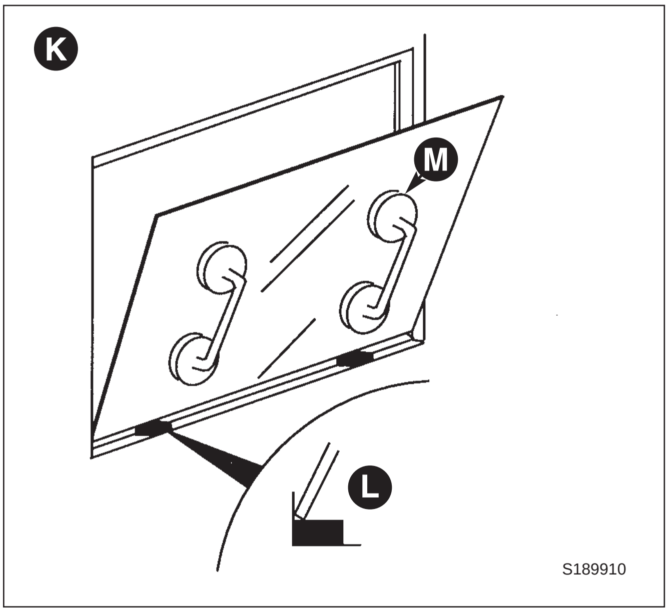
Small panes of glass will need locating on a 600 x 700 mm x 15 to 19 mm thick plywood board **P** (sourced locally to fit the glass stand **N**). It is recommended that an access hole is cut in the board to accommodate the glass lifter, making it easier and safer to handle small panes of glass. The board should be covered with felt or carpet to give an anti-scratch surface. Resting the glass on four spacer blocks will ensure clearance of the cartridge nozzle tip during application of the polyurethane sealant.

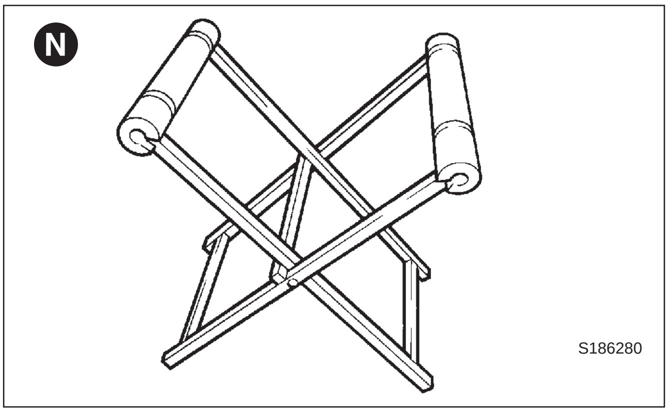
3 Make sure the glass is positioned on the stand the correct way up (i.e. with the black ceramic ink band upwards) ready for application of primer etc.

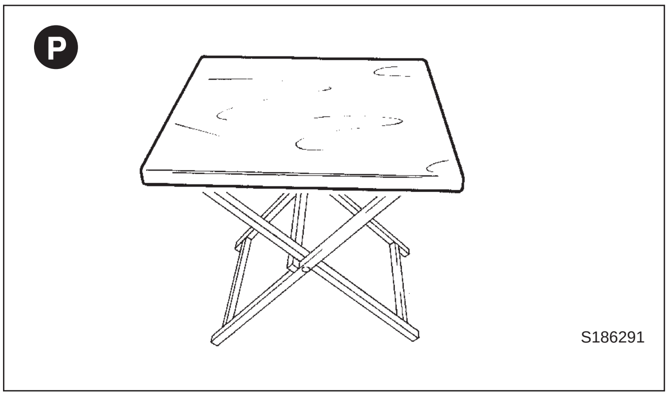
4 **a** Use 'Active Wipe 205' to thoroughly clean and 'prime' the black ceramic ink band printed on the glass (see **Note 1**). Use a lint free cloth to apply the 'Active Wipe 205', allow 5 minutes flash off (drying) time.

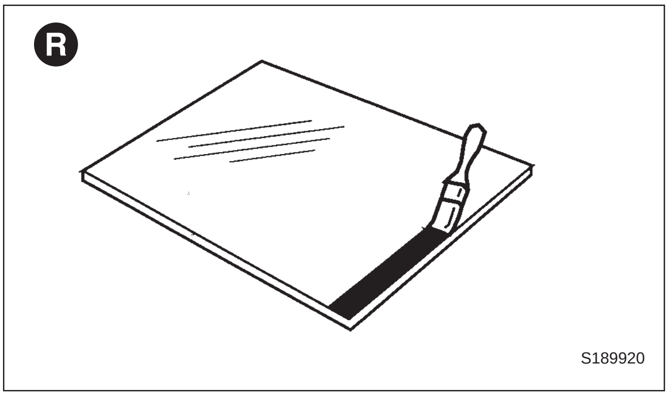
Note 1: Do not touch the glass after cleaning with the 'Active Wipe 205'.

b If the glass does not have a black ceramic ink band, paint a band on the glass using 'Black Primer 206J'. The band should be approximately 25mm (1in) wide, and the edge should be a neat straight line as shown at **R**.









Direct Glazing (cont'd)

Preparing the New Glass (cont'd)

5 Install the Ultra Fast Adhesive cartridge (see **Sealing and Retaining Compounds**, Section 1 and **Note 2** below) into a suitable applicator gun:

- **a** Remove the aluminium disc cover from the base of the cartridge and discard the 'dessicant capsule'.
- **b** Make sure that the rolled edge of the cartridge is not damaged - if necessary, the edges should be pressed flat, otherwise it will be difficult to remove the cartridge from the applicator gun.
- **c** Pierce the front 'nozzle' end of the cartridge to its maximum diameter.
- **d** Fit the pre-cut nozzle shown at **S**.
- **e** Install the cartridge in the applicator gun.

Note 2: Cold material will be very difficult to extrude. The cartridges must be pre-heated in a special oven (see **Service Tools**) for 1 hour to a temperature of 80°C (176°F). Pre-heating the cartridges makes the adhesive more workable and also brings the 'curing' time down to 30 minutes.

6 Apply the pre-heated adhesive to the glass (do not start in a corner). Keep the nozzle guide **T** against the edge of the glass and make sure that the adhesive forms a continuous 'pyramid' shape.

Note 3: Once the pre-heated adhesive has been applied to the glass, install the glass in the aperture as soon as possible. After approximately 10 minutes the sealant will form a 'skin', this will prevent the glass from bonding.

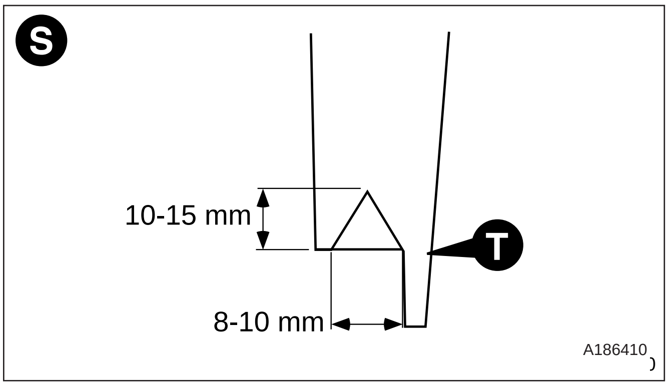
7 After applying the adhesive, leave a small amount of sealant protruding from the nozzle. This will prevent any adhesive left in the cartridge from 'curing'.

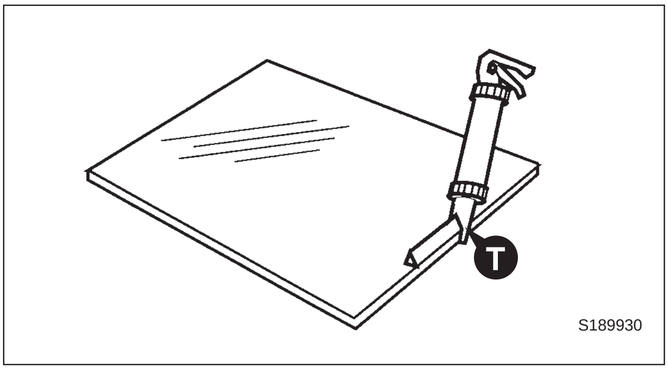
Installing the New Glass

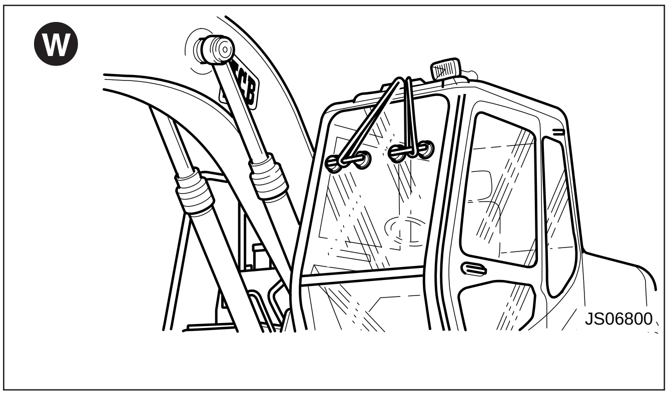
1 If the internal trim strip is damaged, renew it (cut to length as required) before fitting the new glass. Make sure the two spacer blocks are in position (see step 1 of **Preparing the New Glass**).

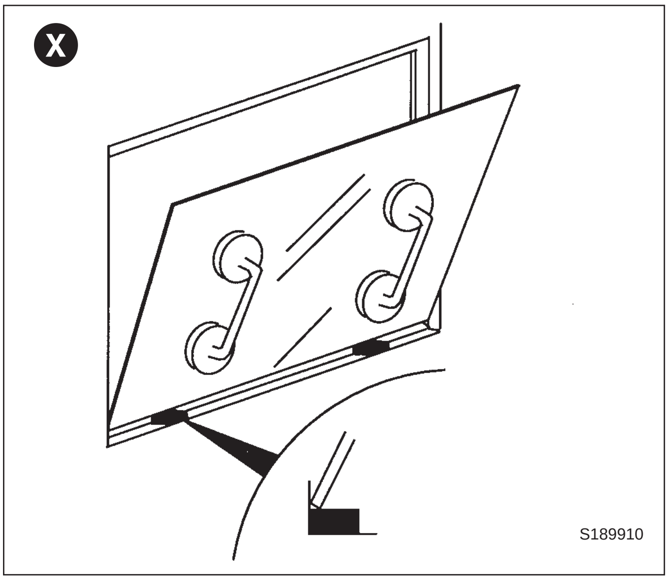
2 Install the glass in the frame aperture:

- **a** ALWAYS use the special lifting tools when moving the glass. Use a lifting strap to hold large panes of glass in position as shown **W**.
- **b** Sit the bottom edge of the glass on the spacer blocks as shown **X**.
- **c** Make sure that the glass is correctly positioned, then gently press around the edges of the glass and ensure full adhesive contact is achieved. Do not press too hard or too much adhesive will squeeze









Direct Glazing (cont'd)

Installing the New Glass (cont'd)

3 Make the inside seal smooth:

a Wearing surgical gloves, dip your finger in a soapy water solution.

b Use your finger to make the inside seal smooth.

4 All exposed edges must be sealed using Black Polyurethane Sealant (see **Sealing and Retaining Compounds**, Section 1).

5 Fit the external trim strip by cutting to length and pressing into position.

6 Clean the glass after installation:

IMPORTANT: Use extreme caution when wiping the inside of the new glass - pushing too hard on the inside of the glass will affect the integrity of the bonded seal.

a Small amounts of sealant can be cleaned from the glass using the 'Active Wipe 205'.

b Large amounts of excess sealant should be left to 'cure' (see **Note 4**) and then cut off with a sharp knife.

Note 4: On completion of the glass replacement procedures, the sealant 'curing' time is 30 minutes. This means that the machine can be driven and used after 30 minutes, but it MUST NOT be used during the curing period of 30 minutes.

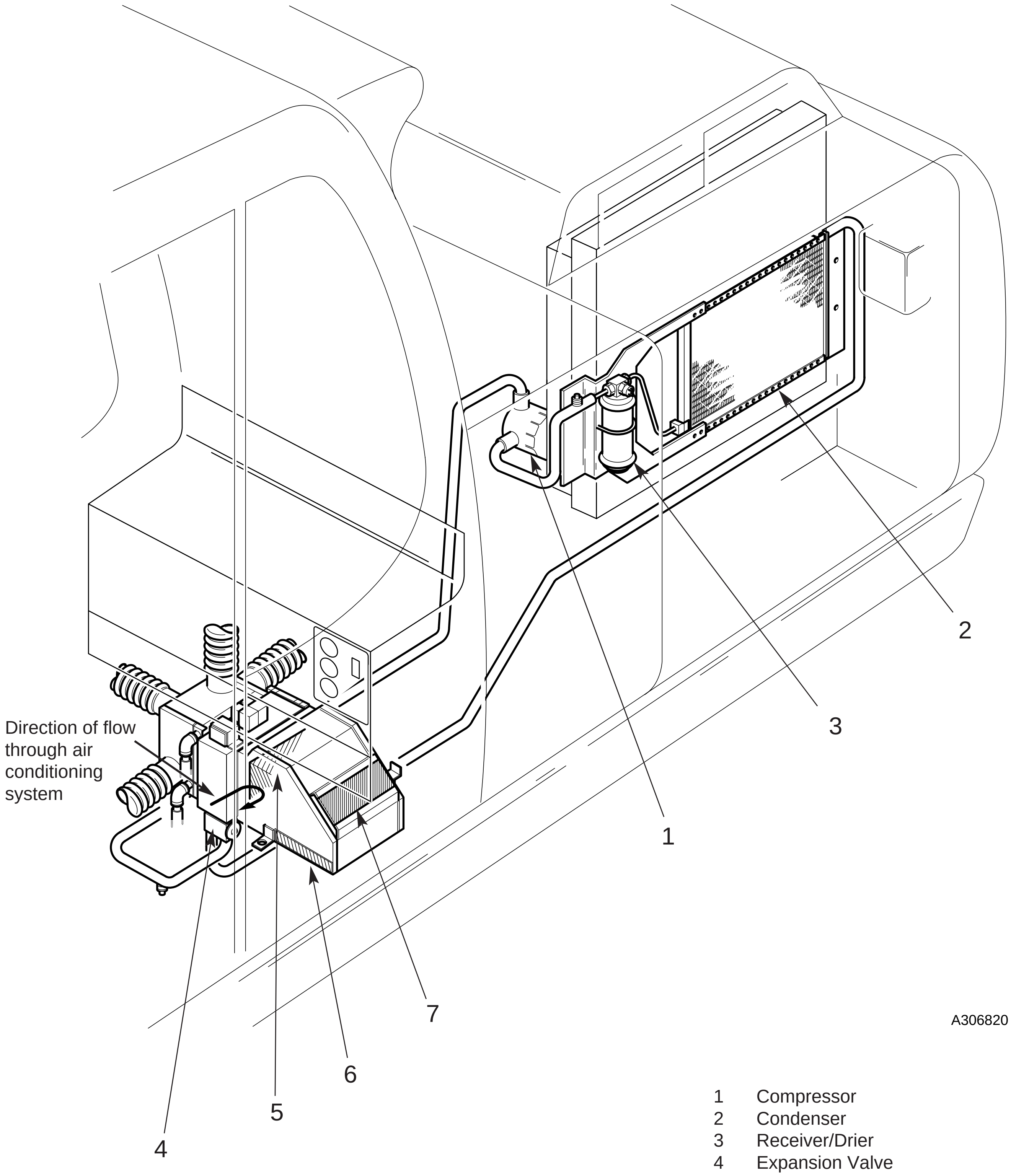
c Clean the glass using a purpose made glass cleaner.

7 On completion of the glass installation procedures tidy the work area:

a Remove ALL broken glass from the cab area.

b Remove the protective covers from the cab seat and control pedestals.

c Renew all 'warning' and 'information' decals so that the new installation conforms with the original cab installation.



1 Compressor
2 Condenser
3 Receiver/Drier
4 Expansion Valve
5 Evaporator Coil
6 Air Filter
7 Air Filter

Operation

To maintain optimum operator comfort in warm climates or during seasons of high ambient temperature, the air conditioning system recirculates, clean, dehumidified air into the cab. Cooling is provided by passing the recirculated air, over an evaporator coil in the air conditioning unit.

The air conditioning system is a closed circuit through which the refrigerant is circulated, its state changing from gas to liquid and back to gas again, as it is forced through the system.

The major components of the system are the compressor **1**, condenser **2**, receiver drier **3**, expansion valve **4** and evaporator coil **5.**

Heater/Air Conditioning Controls

Located on the **Left side of the Rear Panel**, the heater/air conditioning controls are used in conjunction with the heater fan controls.

Heater Controls

A Ventilation control - with the control turned fully clockwise, air to the heater is taken directly from outside the cab. With the control turned fully anti-clockwise, air to the heater is drawn from inside the cab and re-circulated. Settings between the two extremes result in varying mixtures of fresh and re-circulated air.

B Air flow control - with the control turned fully anti-clockwise, air flow from the heater is directed into the body of the cab. With the control turned fully clockwise air flow from the heater is directed at the windscreen. Settings between the two extremes result in degrees of partial flow to the cab and to the windscreen.

C Heat control - with the control turned fully clockwise, air flow from the heater is hot. With the control turned fully anti-clockwise air flow from the heater is cool. Settings between the two extremes result in varying temperatures.

Air Conditioning Controls (if fitted)

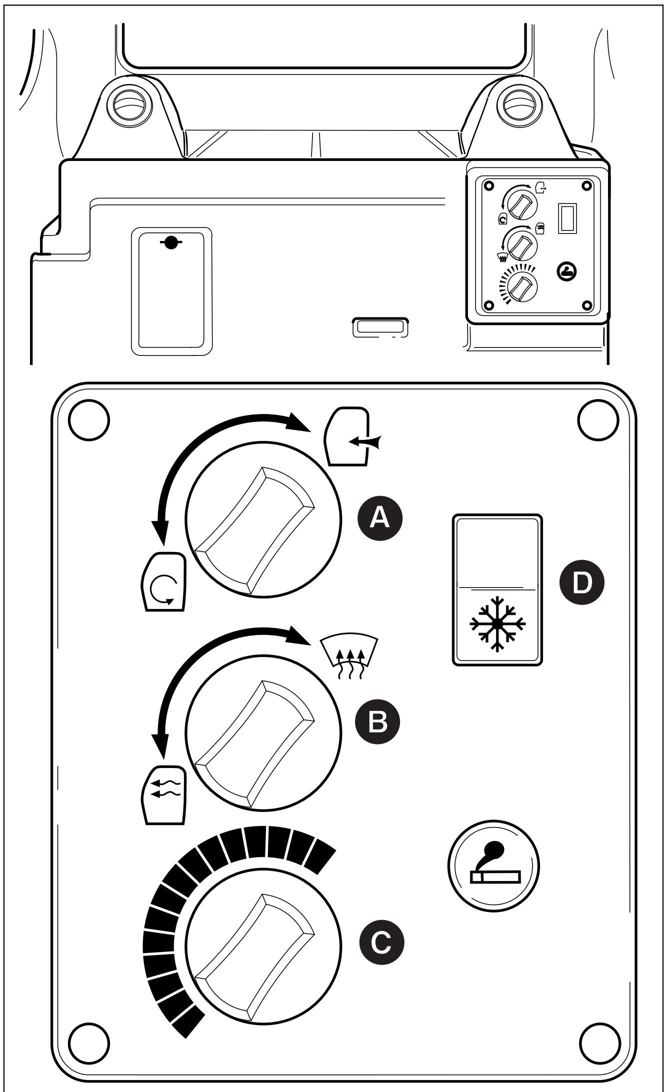
D Air conditioning ON/OFF control - this two position rocker switch is used to select or deselect the facility. When the ‘snow flake’ icon is pressed to switch air conditioning ON, the switch illuminates.

Air conditioning system power is generated from the engine, via an electromagnetic clutch to the compressor. Three switches, connected in series, are included in the clutch supply line, all must be closed for the clutch and therefore the air conditioning system to operate.

The compressor **1** draws in low pressure refrigerant gas from the suction line (evaporator to compressor) and increases refrigerant pressure through compression. This process also increases the refrigerant temperature.

High pressure refrigerant is forced from the compressor to the condenser **2**, which is mounted on the radiator on the side of the engine. Ambient air is drawn across the condenser by the engine-driven cooling fan. In the condenser, the refrigerant changes state to a high pressure, high temperature liquid but with a lower heat content.

The refrigerant passes through the receiver drier **3,** which contains a desiccant to remove moisture from the system. The receiver drier serves as a reservoir for refrigerant and also includes a filter to remove foreign particles from the system.



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Operation (cont'd)

The high temperature, high pressure refrigerant is forced by compressor action into the expansion valve **4**, which meters the amount of refrigerant entering the evaporator. In the expansion valve the refrigerant instantaneously expands to become a low pressure, low temperature liquid.

The refrigerant is drawn through the evaporator coil **5** by the suction of the compressor. The temperature of refrigerant is now considerably below that of the air being drawn across the evaporator coil by the blowers. Heat is transferred from the ambient and recirculated air to the refrigerant, causing the low pressure liquid to vaporise and become a low pressure gas. Moisture in the air condenses on the evaporator coil and is drained away via condensate.

Cool de-humidified air is emitted through air vents into the cab.

The low temperature, low pressure, high heat content refrigerant gas, is now drawn by suction back to the compressor, where the cycle is completed.

Control

Control of the system is achieved by the cyclic action of the compressor's electromagnetic clutch. When current is fed to the field coil of the compressor's clutch, a magnetic field develops between the field coil and the armature which pulls the field coil, complete with clutch assembly, onto the compressor's rotor. Since the clutch assembly is turned constantly by the crankshaft pulley drive belt, the compressor armature turns, starting the refrigeration cycle.

Current is fed to the field coil through three series switches whose contacts are controlled by the following:

1 The manual switch **D** in the cab

2 The thermostat switch monitoring the evaporator temperature

3 The high and low level pressure switch

Switch **D** will start the refrigeration cycle provided that the ambient temperature in the cab is greater than 0°C and the refrigerant pressure remains within the specified limits.

The thermostat has its sensor inserted in the evaporator coil. It controls the refrigeration cycle by switching the compressor clutch on and off to prevent freezing of the condensate on the evaporator coil.

The pressure level switch is housed in a common assembly located on the Receiver Drier. If the refrigerant pressure exceeds the upper pressure limit specified or falls below the lower limit, the contacts will open and the clutch will disengage, closing down the refrigeration cycle.

Pressures Switch Settings

High Pressure Switch 28 bar (406 lbf/ in^2)
Low Pressure Switch 2.1 bar (30.4 lbf/ in^2)

Safety Procedures

The air conditioning system includes a pressurised closed circuit containing a non-CFC, environmentally friendly refrigerant, Type R-134a. Any service procedure which breaks into the closed circuit and therefore requires discharging of the system, must only be carried out by service personnel with specialist knowledge of air conditioning systems. The following guidelines should be adhered to by all personnel servicing the air conditioning system.

⚠ WARNING

The air conditioning system is a closed loop system and contains pressurised refrigerant. No part of the system should be disconnected until the system has been discharged by a refrigeration engineer. or a suitable trained person You can be severely frostbitten or injured by escaping refrigerant

4-3-4-1/2

⚠ CAUTION

Do not operate the air conditioning system when there is no refrigerant in the system, otherwise the compressor will be damaged.

4-3-4-4

1 It is critical that the correct refrigerant (R-134a) is used and that charging is done only by qualified personnel. As a precaution, in case of accidental leakage, discharging and charging of the vehicle refrigerant system must be conducted in a well ventilated area.

2 Containers of refrigerant should be stored in a cool environment away from direct sunlight.

⚠ WARNING

Do not carry out welding operations close to the air conditioning refrigerant circuit. A poisonous gas is produced when refrigerant comes into contact with naked flames. Do not smoke or allow naked flames close to the refrigerant circuit.

BF 1- 9

3 **Do Not** perform welding operations close to refrigerant hoses (maintain a distance of at least 0.5m from hoses).

4 **Do Not** steam clean refrigerant system components.

5 When charging or discharging the refrigerant system refrain from smoking. Naked flames must not be allowed in the immediate vicinity. The refrigerant does not give off a poisonous odour, however, when it comes into contact with a naked flame, a poisonous gas is produced.

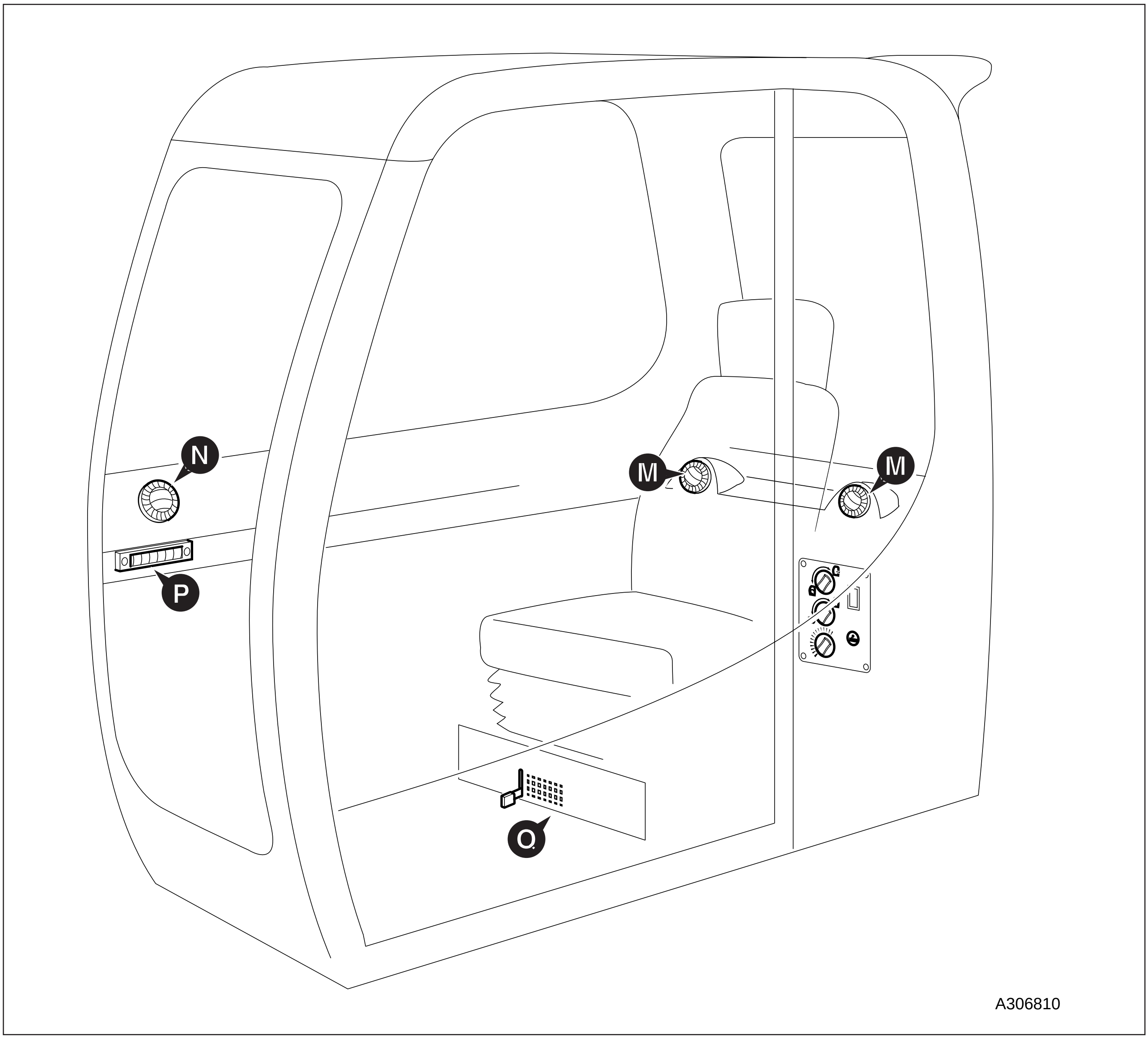
6 When handling refrigerant, rubber gloves and goggles should be worn. Operators should ensure that no refrigerant comes into contact with the skin. Particular care should be taken when connecting or disconnecting charging hoses or pressure switches. When these components are connected to the system, a short release of refrigerant occurs. This results in a high velocity, very cold gas being emitted from the connection point.

Operation (cont'd)

Note: In dusty conditions, it is recommended that air be recirculated within the cab, otherwise the filter may become clogged.

Two air vents **M** are located in the cab rear panel, and two air vents **N** and **P** are located on the right hand console. One air vent **Q** is located under the drivers seat. The vents can be turned to direct the air flow where required. When the vents are open, hot or cold air will flow directly into the cab.

For the most effective front window demisting, the air vents should be closed and air circulation control turned fully to the left.



Fault Finding

Procedures that require charging or discharging the system are not given in this manual as they require special equipment that is usually held only by trained refrigeration engineers. Fault indications are given in the table below.

The system will not function in very low ambient temperatures, therefore tests should be carried out in a warm environment.

It is recommended that, to locate faults on the system accurately and quickly, an electronic leak detector and a refrigerant pressure gauge should be used. However, leaks can be detected on the system by using soapy water applied to the suspected leak area and system pressure can be assessed by the state of refrigerant passing through the receiver drier sight glass. Following sections of the manual deal with the major components of the air conditioning system and give further fault finding and maintenance information.

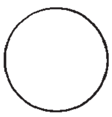
General Fault Indications

There are several indications that may help to determine the fault area on a system not working efficiently:

a)	Poor performance	Low system pressure - Condenser coil air flow restricted -	Evacuate and recharge system. Remove debris from around coil using compressed air or low pressure water.
		Air filters blocked Compressor drive belt too slack	Clean with detergent and water. Adjust to correct tension.
b)	Warm or slightly cool air emitted from unit	Expansion valve stuck open or closed -	Renew expansion valve.
c)	Blower does not operate	Fuse blown Circuit fault	Replace fuse (20A) and retest. Fault find and repair.
d)	Compressor clutch continually cuts out	Condenser coil blockage - Overcharging of refrigerant system- Blocked expansion valve/condenser -	Remove debris from around coil/renew condenser. Evacuate and recharge system. Clear blocked component .

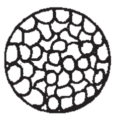
Sight Glass Indications

An approximate indication of the condition of the refrigerant can be seen through the receiver/drier sight glass when the compressor is running. Refer also to **Checking Refrigerant Charge Level**, on page 12-8.



S201520A

Clear - No fault indicated unless the system is unable to provide cool air. The indication then is that the system is completely discharged of refrigerant.



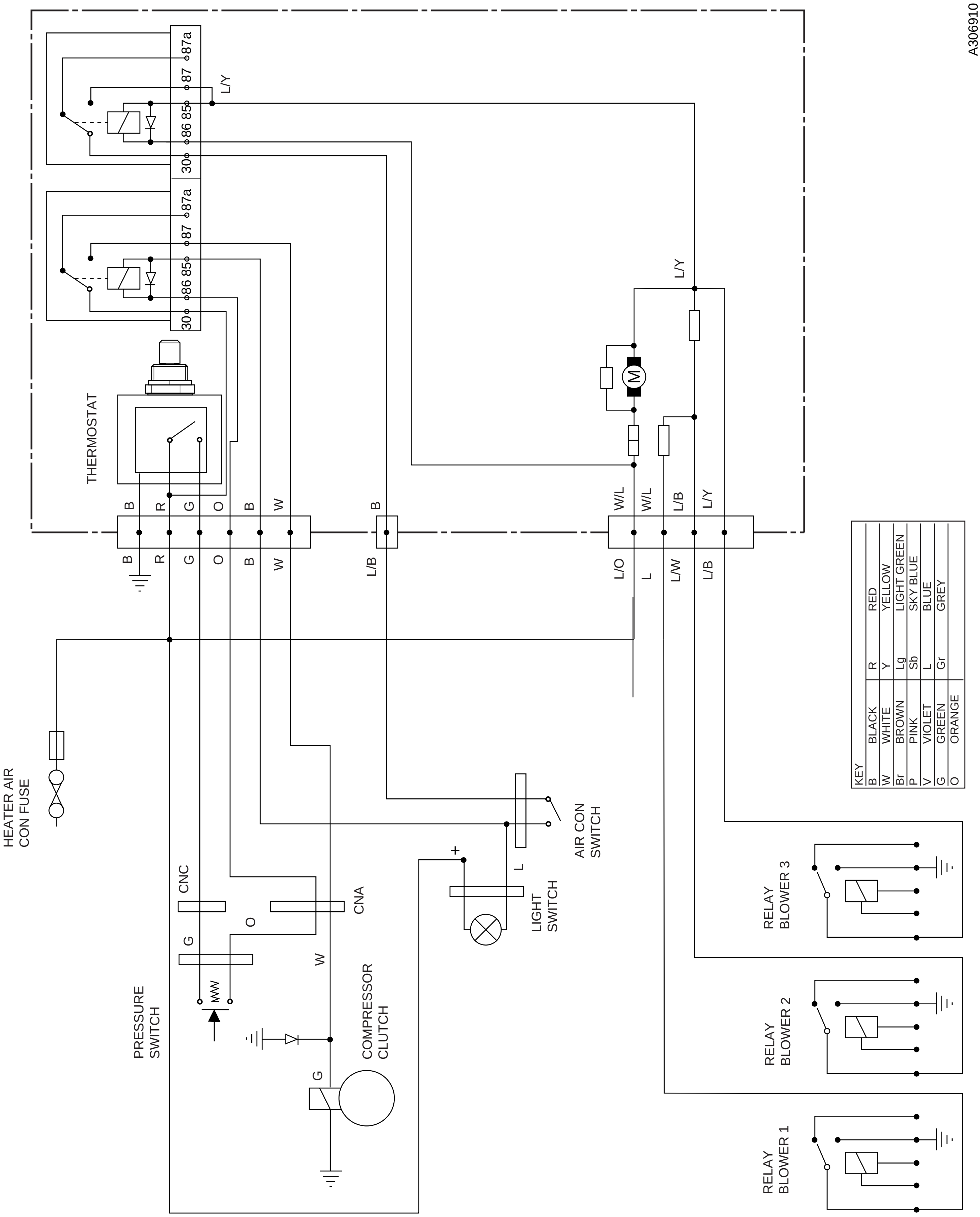
S201520B

Foam or bubbles - Refrigerant low and in need of charging.

S201520C

Clouded - Desiccant breakdown in the receiver-drier.

Note: Sight glass indications cannot always give a positive identification of a problem. Further diagnosis, preferably by a refrigeration engineer using pressure gauges, is advisable before reaching a definite conclusion.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87
86 85
30
L/Y
THERMOSTAT
M
B R G O B W
B
W/L W/L L/B L/Y
L/B
L/O L L/W L/B
HEATER AIR CON FUSE
AIR CON SWITCH
LIGHT SWITCH
L
+
CNC
CNA
O
G
W
PRESSURE SWITCH
COMPRESSOR CLUTCH
RELAY BLOWER 3
RELAY BLOWER 2
RELAY BLOWER 1
KEY
B BLACK
W WHITE
Br BROWN
P PINK
V VIOLET
G GREEN
O ORANGE
R RED
Y YELLOW
Lg LIGHT GREEN
Sb SKY BLUE
L BLUE
Gr GREY

Fault Finding (cont'd)

No Air Conditioning

CHECK			ACTION
1	Are the controls set correctly, i.e. air conditioning selected, thermostat switch set to coldest position and blower switched on?	YES: NO:	Check 2 Reset controls and retest.
2	Is the air conditioning (evaporator) blower working?	YES: NO:	Check 3. Check 4.
3	Is the compressor running (visual check of pulley/clutch)?	YES: NO:	Check 9 Check 5.
4	Is the air conditioning fuse(s) blown?	YES: NO:	Renew fuse(s) and retest. Check 8.
5	Is there a 24V supply to the pressure switch harness?	YES: NO:	Check 6. Check 7.
6	Does the compressor clutch engage with pressure switch assembly bypassed?	YES: NO:	Replace pressure switch assembly. Renew the compressor clutch and retest.
7	Does the clutch engage with thermostat switch bypassed?	YES: NO:	Renew thermostat switch and retest. Check all electrical connections.
8	Are blower switch and wiring OK?	YES: NO:	Renew blower unit complete. Renew switch or wiring.
9	Is sight glass indication OK?	YES: NO:	Check 10. Charge check required by refrigeration engineer.
10	Is condenser air flow blocked?	YES: NO:	Clean condenser and radiator. Check 11.
11	Is evaporator air flow blocked?	YES: NO:	Clean filter and, if necessary the evaporator. Call in refrigeration engineer.

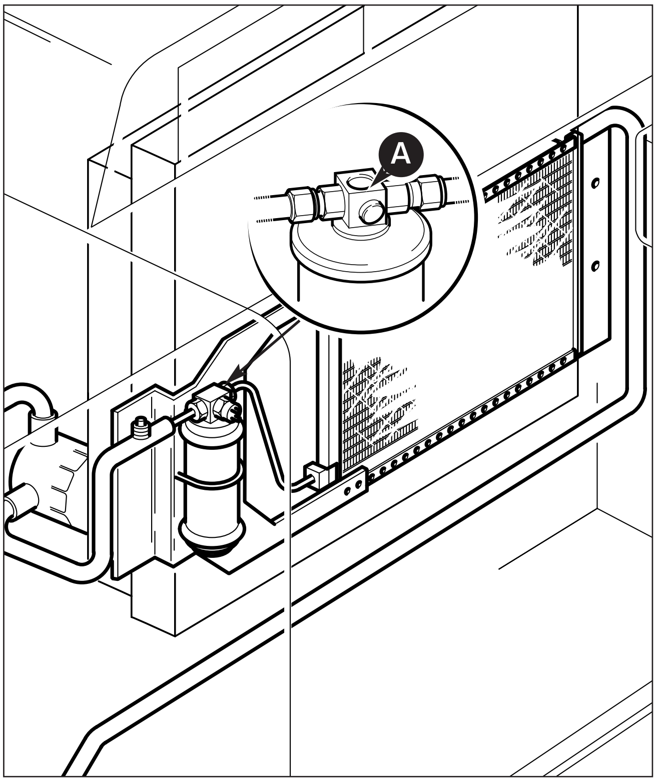
Checking Refrigerant Charge Level

The pressure in the system, i.e. the refrigerant charge level can be determined by checking the state of refrigerant at the receiver drier sight glass. The receiver drier is mounted on the radiator on the side of the engine.

If the level of charge is correct the sight glass will be clear. If the charge is low bubbles will be seen. Bubbles may also be an indication of inadequate cooling, due to a restriction of air flow around the condenser coil. Recharging of the system should be carried out by an air conditioning engineer. Check refrigerant charge level as follows:

1 Park the machine on firm, level ground. Lower the excavator arms to the ground. Engage the parking brake.

2 Open the left hand side, rear door.



3 Start the engine and run at idle. Switch air conditioning ON to circulate refrigerant.

4 Check refrigerant charge level at sight glass **A**.

Leak Testing

⚠ WARNING

Leak testing in Air Conditioning systems should be carried out only in a well ventilated area.
BF 1-2

Note: The refrigerant is heavier than air and will leak downwards from the defective component. Check in still conditions but in a well ventilated area.

Hose or pipe connections are likely leakage points of any refrigerant circuit.

To test for leaks in the high pressure side of the system i.e. from the compressor output to the expansion valve, run the air conditioning for a few minutes then switch off the engine and test for leakage using an electronic leak detector or soapy water.

To test for leakage in the low pressure side of the system, switch off the air conditioning and leave for a few minutes before testing.

Tightening Leaking Hoses

⚠ WARNING

The air conditioning system is a closed loop system and contains pressurised refrigerant. No part of the system must be disconnected except by a qualified refrigeration engineer. You can be severely frostbitten or injured by escaping refrigerant
4-3-4-1/1

The refrigerant hoses have crimped ferrule end fittings. The hose connectors have an 'O' ring seal which compresses when the connection is tight, creating an air tight seal.

Hoses are used to connect the inlets and outlets of the compressor, condenser, receiver drier and expansion valve (the evaporator coil is connected to the expansion valve within the air conditioning unit using rigid pipes).

If leakage is detected from a hose connector, either by means of an electronic leak detector or soapy water, tighten the connector up and repeat the leakage test. If leakage is still evident, it will be necessary to de-gas the system and renew the connector 'O' ring seal.

System Diagnosis

Normally Functioning A/C System

Gauge Readings:
- **Low Side Gauge -** Normal.
- **High Side Gauge -** Normal.

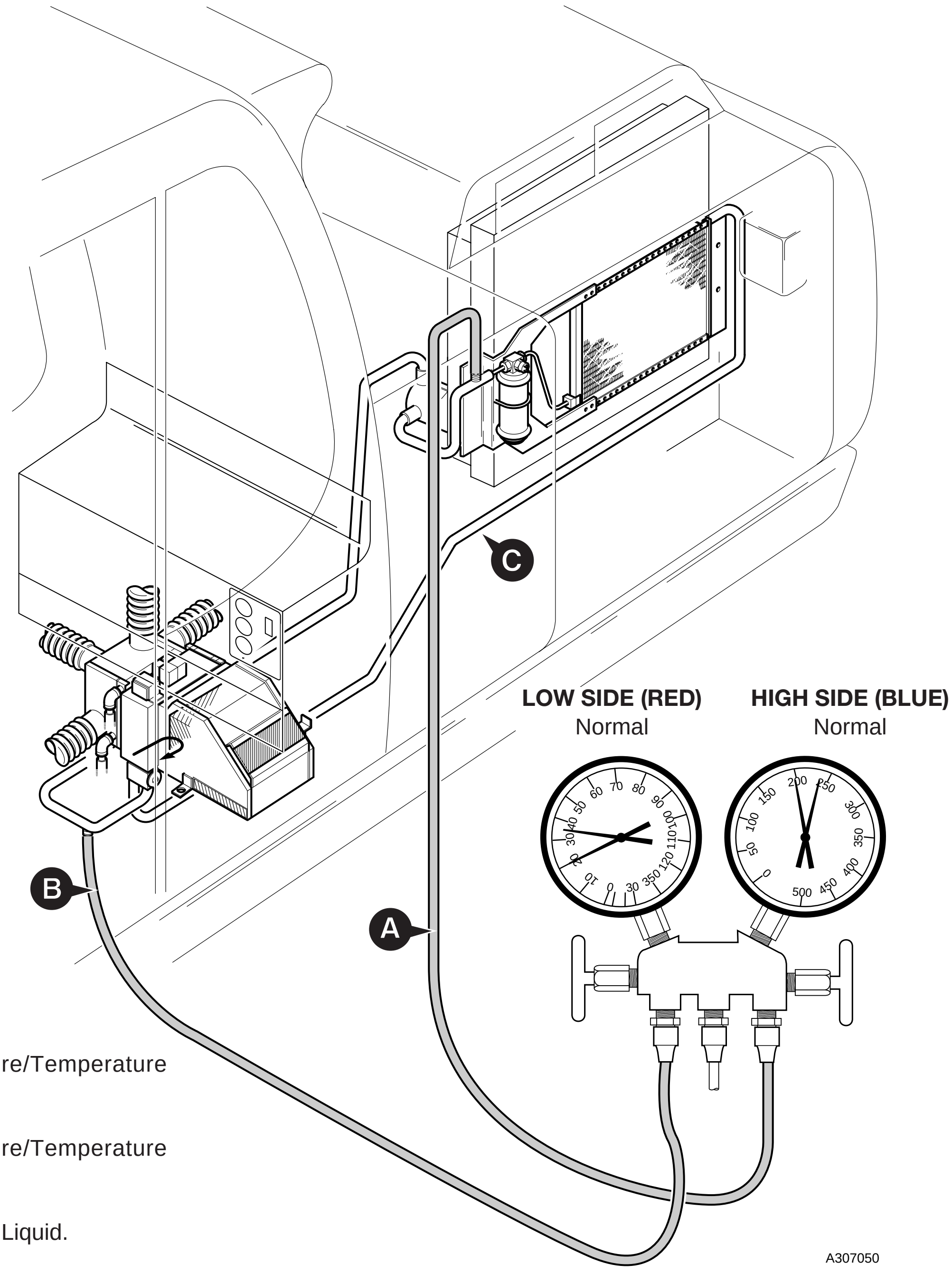
Other symptoms:
- **Sight Glass -** Clear.
- **Discharge Air -** Cold.

Normal gauge readings will depend on system components and ambient conditions, make sure that the valves are closed and the readings are stable and that the system has a full charge.

The pressures on the manifold at 25 °C with the engine at 1500 RPM, the blower on maximum and the thermostat set to maximum, should be approximately:

Typically, the high pressure is 6 - 8 times the low pressure.

LOW SIDE - 2.0 bar (2.0 kgf/cm^2)(29 lbf/in^2)
HIGH SIDE - 14.8 bar (15.1 kgf/cm^2)(215 lbf/in^2)



A High Pressure/Temperature Gas.

B Low Pressure/Temperature Gas.

C High Pressure Liquid.

System Diagnosis (cont'd)

Low R-134a Charge

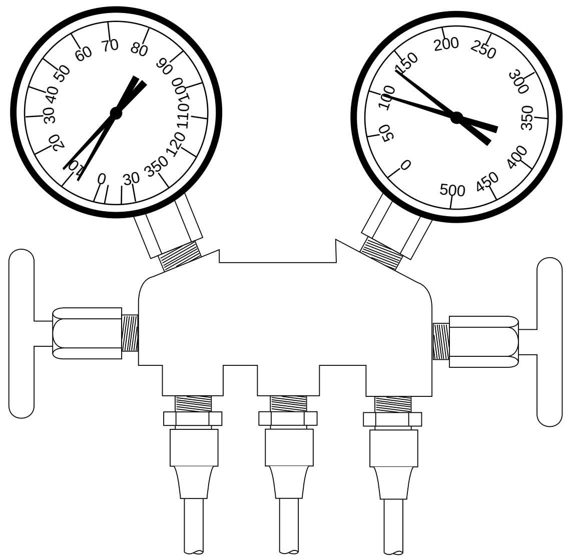
Gauge Readings:
- **Low Side Gauge -** Low.
- **High Side Gauge -** Low.

Other symptoms:
- **Sight Glass -** Bubbles continuously visible.

Diagnosis:
System slightly low on R-134a, due to leak or incorrect charge.

Correction:
1. Leak test system.
2. Evacuate A/C system.
3. Repair system leaks.
4. Charge system with R-134a.
5. Operate system and check performance.

LOW SIDE (RED) Low **HIGH SIDE (BLUE)** Low



LOW SIDE - 0.76 bar (0.77 kgf/cm²)(11 lbf/in²)
HIGH SIDE - 8.3 bar (8.5 kgf/cm²)(121 lbf/in²)

Poor Refrigerant Circulation

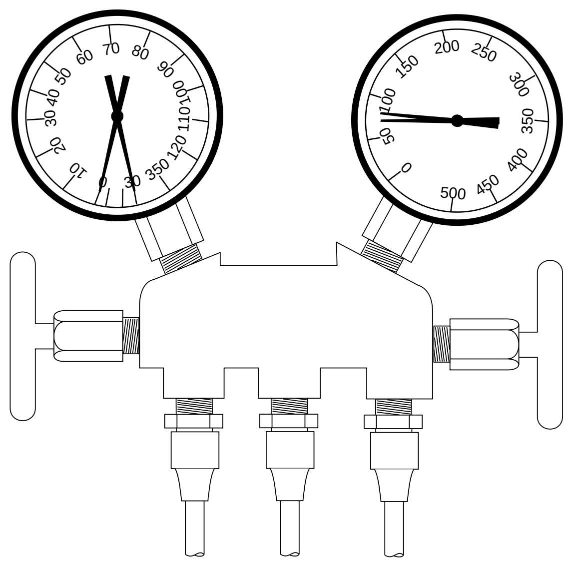
Gauge Readings:
- **Low Side Gauge -** Zero to negative.
- **High Side Gauge -** Low.

Other symptoms:
- **Receiver-Drier -** Frost on tubes from receiver-drier to evaporator unit.

Diagnosis:
Refrigerant flow obstructed by dirt, receiver-drier clogged.

Correction:
1. Evacuate A/C system.
2. Replace receiver-drier.
3. Charge system with R-134a.
4. Operate system and check performance.

LOW SIDE (RED) Zero to negative **HIGH SIDE (BLUE)** Low



LOW SIDE - -1.0 bar (-1.1 kgf/cm²)(-15 lbf/in²)
HIGH SIDE - 5.4 bar (5.5 kgf/cm²)(78 lbf/in²)

System Diagnosis (cont'd)

No Refrigerant Circulation

Gauge Readings:

Low Side Gauge - Zero to negative.
High Side Gauge - Low.

Other symptoms:

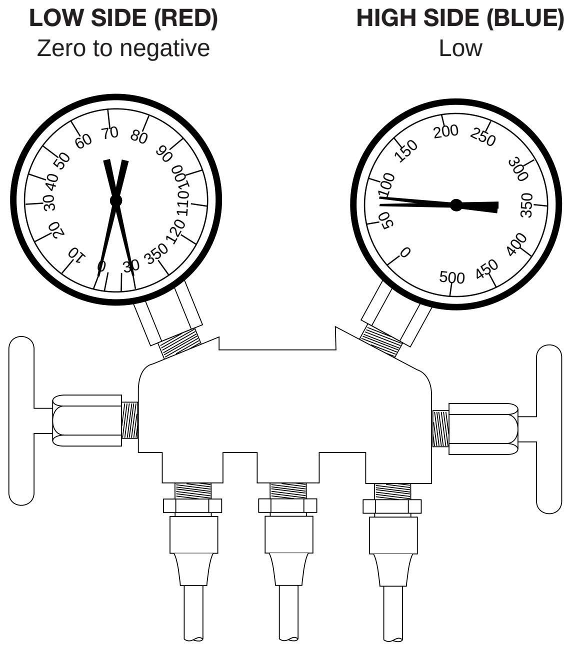
Receiver-Drier - Frost or moisture on tubes before and after receiver-drier.

Diagnosis:

Refrigerant flow obstructed by dirt, moisture or gas leakage from expansion valve heat sensing tube.

Correction:

1. Evacuate A/C system.
2. Check heat sensing tube at expansion valve. Replace expansion valve if necessary.
3. Remove expansion valve and attempt removal of dirt. If dirt cannot be removed, replace expansion valve.
4. Replace receiver-drier.
5. Charge system with R-134a.
6. Operate system and check performance.



LOW SIDE - -1.0 bar (-1.1 kgf/cm²)(-15 lbf/in²)
HIGH SIDE - 5.4 bar (5.5 kgf/cm²)(78 lbf/in²)

Insufficient Cooling of Condenser or Refrigerant Overcharge

Gauge Readings:

Low Side Gauge - High.
High Side Gauge - High.

Other symptoms:

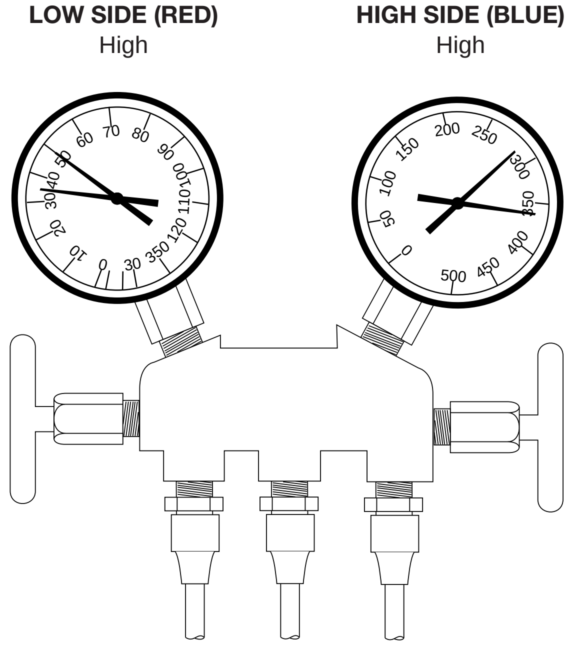
Sight Glass - No bubbles visible even at lower engine RPM.

Diagnosis:

Refrigerant overcharge, condenser cooling fins clogged with dirt or cooling fans malfunctioning.

Correction:

1. Clean condenser cooling fins.
2. Check cooling fan operation.
3. Evacuate A/C system.
4. Charge system with R-134a.
5. Operate system and check performance.



LOW SIDE - 3.0 bar (3.0 kgf/cm²)(43 lbf/in²)
HIGH SIDE - 22.1 bar (22.5 kgf/cm²)(320 lbf/in²)

System Diagnosis (cont'd)

Air in System

Gauge Readings:
Low Side Gauge - High.
High Side Gauge - High.

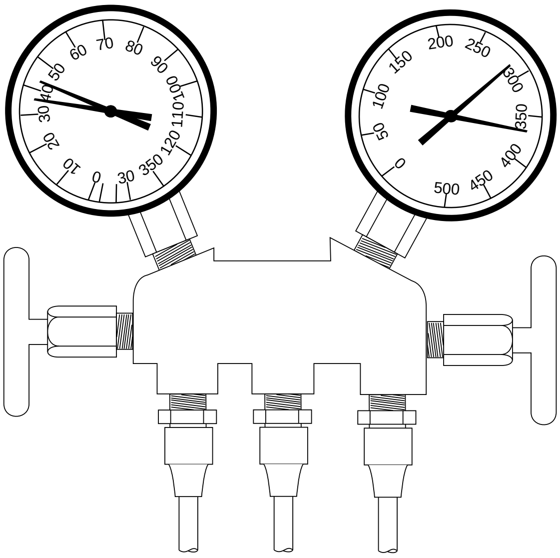
Other symptoms:
Sight Glass - Bubbles visible during system operation.
Pipes - Low pressure pipes are hot to the touch.

Diagnosis:
Air is present in the system, possibly from inadequate evacuation procedure.

Correction:
1. Evacuate A/C system.
2. Check compressor oil for contamination. Check compressor for proper oil amount. Correct if necessary.
3. Charge system with R-134a.
4. Operate system and check performance.

LOW SIDE (RED)
High

HIGH SIDE (BLUE)
High



LOW SIDE - 2.8 bar (2.8 kgf/cm²)(40 lbf/in²)
HIGH SIDE - 22.1 bar (22.5 kgf/cm²)(320 lbf/in²)

Expansion Valve Improperly Mounted or Heat Sensing Tube Defective (Opening Too Wide)

Gauge Readings:
Low Side Gauge - High.
High Side Gauge - High.

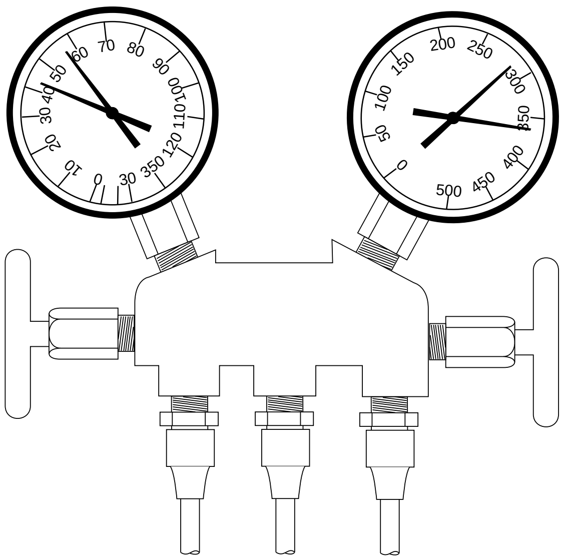
Other symptoms:
Pipes - Large amount of frost or moisture on low side pipes.

Diagnosis:
Excessive refrigerant in low side pipes possibly from expansion valve being opened too wide.

Correction:
1. Leak test system.
2. Evacuate A/C system.
3. Repair system leaks.
4. Charge system with R-134a.
5. Operate system and check performance.

LOW SIDE (RED)
High

HIGH SIDE (BLUE)
High



LOW SIDE - 3.5 bar (3.5 kgf/cm²)(50 lbf/in²)
HIGH SIDE - 22.1 bar (22.5 kgf/cm²)(320 lbf/in²)

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CAPs II Diagnostic system	10-1

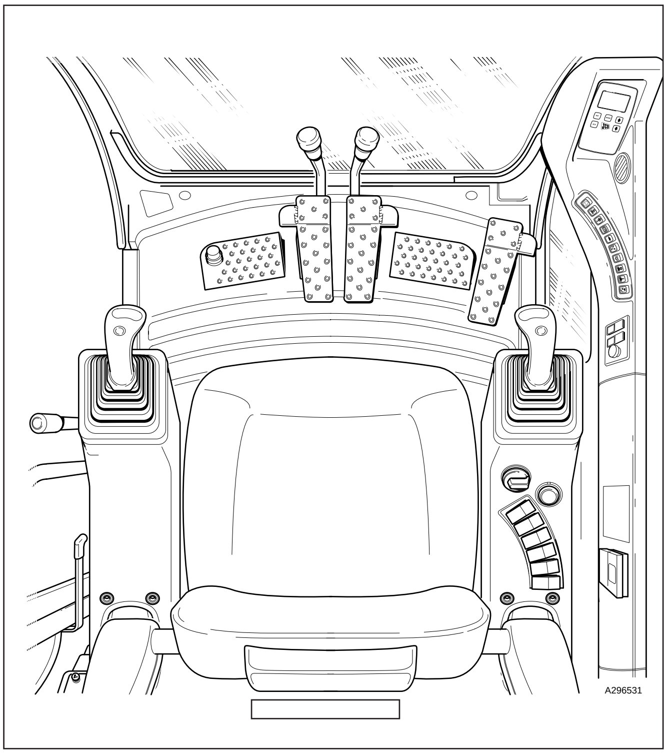
The A.M.S. system

The JCB A.M.S. system (Advanced Management System) is a whole machine electronic control system which replaces the CAPS II system. The system controls engine speed, pump power, transmission, excavator functions, lights, wiper, auxiliary circuits, warning lamps, etc.

The **AMS manual supplement 9803/6450** is an addition to the following JS XO Machine Service Manuals:

Manual No.	Machine No.	Serial No.
9803/6410	JS 130	759561
	JS 160/180	703075
9803/6310	JS 130W	717027
	JS 145W	810001
	JS 160W	718966
	JS 175W	875001
9803/6400	JS 200/210	706966
	JS 220	706966
	JS 240/JS 260	709004
9803/6320	JS 200W	809056
9803/6420	JS 330	712847
	JS 460	714550

Note: Only those areas of the machines which detail the AMS system are covered in the supplement. For all other aspects refer to the above manuals.

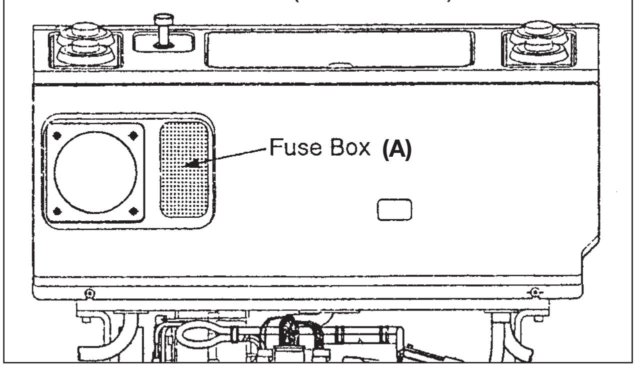


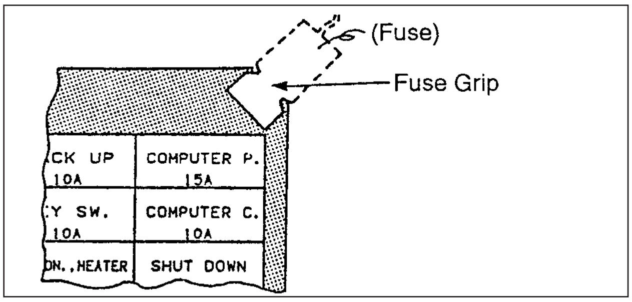
AMS JS200/210/220/240/260 Tracked Machine

Circuit Protection; Fuse rating and circuit names

BACK UP 10A	COMPUTER P. 15A
KEY SW. 10A	COMPUTER C. 10A
AIRCON., HEATER 20A	SHUT DOWN 15A
LAMP 15A	LEVER LOCK 10A
LAMP (SPARE) 15A	LUBRICATOR 10A
LAMP (SPARE) 15A	WARNING BEACON 10A
LAMP (SPARE) 15A	OIL PUMP 20A
WIPER, WASHER 15A	CONDENSER MOTOR 15A
HORN, ROOM LAMP 10A	SPARE 10A
RADIO, LIGHTER 10A	SPARE 10A

Fuse Box Location (Rear Console)





Fuse Replacement

*See illustration on the right for location of Fuse Box (**A**).*

1. Prepare the machine, stop the engine remove the starter key.
2. Prepare an appropriate fuse of the correct amperage, remove cover.

Note: The fuse cover's right corner is the grip.

3. Replace the blown fuse with a new one.
4. Install the fuse cover.

Note: If the reason for the blown fuse is unknown or the fuse fails repeatedly, check the electrical circuit(s) concerned.

Lighting and Horn

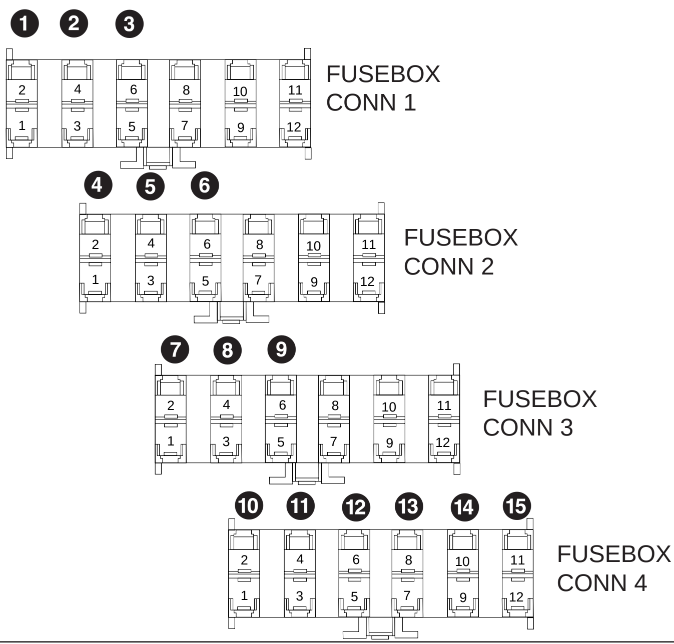
	Voltage	Wattage	No. off
Working light Tank	24 V	70 W	1
Boom	24 V	70 W	1
Roof light Cab	24 V	10 W	1
Horn	24 V		2

Fuses for later Machines

The electrical circuits are protected by fuses. The fuses are located in a fuse box on the rear console. If a fuse blows, find out why and rectify the fault. Ensure the power is turned off.

1	Radio/Lighter	10A
2	Warning Beacon	10A
3	Fuel Pump	20A
4	Lamp Option	15A
5	Lamp Standard	15A
6	Horn/ Room Light	10A
7	Back-Up	10A
8	Key Switch	10A
9	Shut Down	15A
10	Computer Power	15A
11	Computer Control	10A
12	Lever Lock	10A
13	Heater	20A
14	Wiper/washer	10A
15	Auxiliary	10A

Fuse layout for later machines



Batteries

Testing - Specific Gravity

The specific gravity of the electrolyte gives an idea of the state of charge of the battery. Readings should be taken using a hydrometer, when the electrolyte temperature is 15°C (60°F). If the battery has recently been on charge, wait approximately one hour (or slightly discharge the battery) to dissipate the 'surface charge' before testing.

Readings should be as tabulated and should not vary between cells by more than 0.04. A greater variation indicates an internal fault on that particular cell.

If the electrolyte temperature is other than 15°C (60°F) a 'correction factor' must be applied to the reading obtained. Add 0.007 per 10°C (18°F) if the temperature is higher than 15°C (60°F) and subtract the same if the temperature is lower.

Specific Gravity at 15°C (60°F)

	Fully Charged	**Half Discharged**	**Fully Discharged**
Ambient temperature up to 27°C (80°F)	1.270-1.290	1.190-1.210	1.110-1.130
Ambient temperature above 27°C (80°F)	1.240-1.260	1.170-1.190	1.090-1.110

* ## Battery Testing

This test is to determine the electrical condition of the battery and to give an indication of the remaining useful ‘life’.

Before testing ensure that the battery is at least 75% charged (SG of 1.23 to 1.25 for ambient temperature up to 27°C).

Ensure that the battery is completely disconnected from the vehicle.

Connect up the battery tester (part no. 993/85700) as follows:

1 Set the CHECK/LOAD switch **A** to OFF.

2 Set rocker switch **B** to the battery voltage (12V).

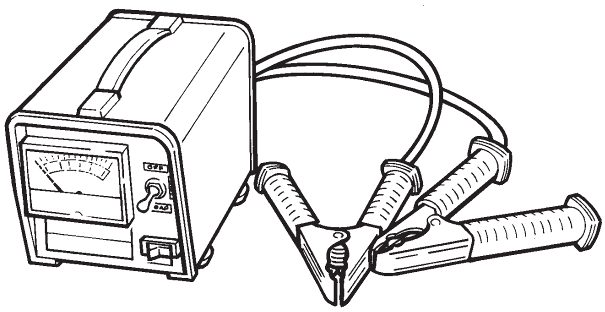
3 Connect the red flying lead to the battery positive (+) terminal and the black flying lead to the battery negative (-) terminal.

4 Set the CHECK/LOAD switch **A** to CHECK to read the battery no-load voltage which should be at least 12.4 volts.

5 Set the CHECK/LOAD switch **A** to LOAD and hold down for 5 - 10 seconds until the meter reading stabilises. The reading should be at least 9 volts.

Note: Do not hold the switch in the load position for more than 10 seconds.

6 If the foregoing tests are unsatisfactory, consult Fault Diagnosis below.



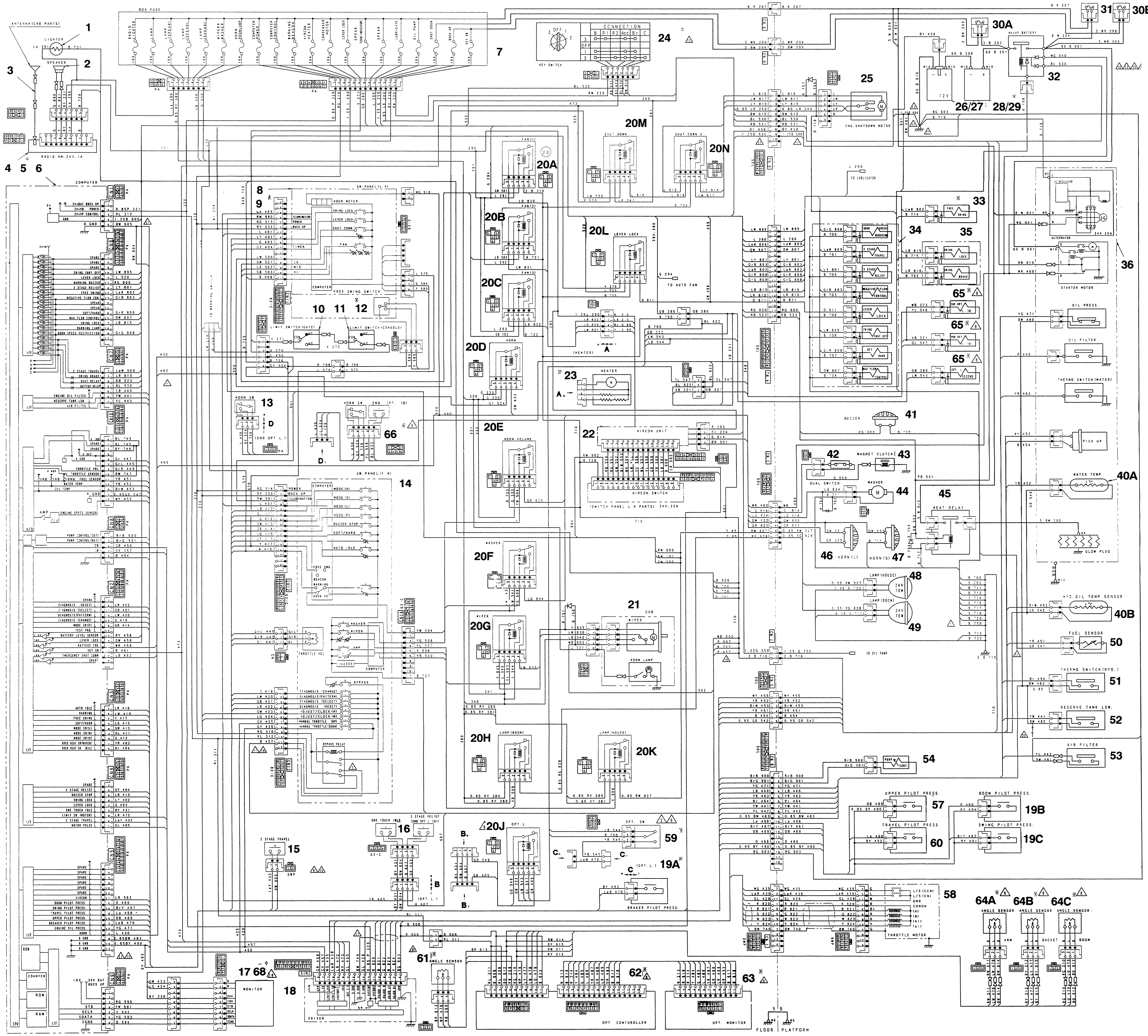
239510

Fault Diagnosis

	Battery Tester Readings		**Remedy**
1	CHECK: LOAD:	0 - 12.6 Volts less than 6 Volts	Renew Battery
2	CHECK: LOAD:	6 - 12.4 Volts less than 9 Volts and falls steadily but remains in yellow zone.	Recharge and re-test. If tests still unsatisfactory renew battery.
3	CHECK: LOAD:	less than 10 Volts less than 3 Volts	Indicates battery has been over-discharged and unlikely to recover. Renew battery.
4	CHECK:	more than 11 Volts	Charge battery which will probably recover.

Main Components

1	Cigar Lighter
2	Loudspeaker
3	Radio Aerial Lead
4	Radio (Standard)
5	Radio (AM/FM) (Optional)
6	System Controller (Computer)
7	Fuse Box
8	Switch Panel - Left Hand (Standard)
9	Switch Panel - Left Hand (Optional)
10	Limit Switch - Lever Lock (Gate)
11	Limit Switch - Lever Lock (Console)
12	Switch - Free Swing (Optional)
13	Horn Push
14	Switch Panel - Right Hand
15	Switch - Speed Change
16	Switch - One Touch Idle
17	Monitor, Controller
18	Driver
19A	Push-button - Breaker Pilot Pressure
19B	Push-button - Boom Pilot Pressure
19C	Push-button - Swing Pilot Pressure
20A	Relay - Fan 1
20B	Relay - Fan 2
20C	Relay - Fan 3
20D	Relay - Horn
20E	Relay - Horn Volume
20F	Relay - Screenwasher
20G	Relay - Screenwiper
20H	Relay - Lamp (Boom)
20J	Relay - Auxiliary Lamps (Optional)
20K	Relay - Cab Light
20L	Relay - Lever Lock
20M	Relay - Engine Shutdown 1
20N	Relay - Engine Shutdown 2
21	Indicator Lamp-wiper Motor
22	Air Conditioning Unit
23	Cab Heater
24	Starter Switch
25	Motor - Engine Shut-down
26/28	Batteries - Standard
27/29	Batteries - Heavy Duty (Optional)
30A	Fusible Link - Starter Switch/Back-up Fuses
30B	Fusible Link - Engine Shut-down Fuse
31	Fusible Link - Fuse Box
32	Relay - Battery
33	Solenoid Valve Free Swing (Optional)
34	Solenoid Valve Block
35	Solenoid Valve - Swing Brake/Swing Lock
36	Engine Block
40A	Sensor - Water Temperature
40B	Sensor - Hydraulic Oil Temperature
41	Warning Buzzer
42	Air Conditioning - Drier Switch
43	Air Conditioning - Compressor Magnetic Clutch
44	Motor - Screen Washer
45	Relay - Engine Glow Plugs
46	Horn - Loud
47	Horn - Standard
48	Working Lights - Cab Mounted
49	Working Lights - Boom Mounted
50	Sensor - Fuel Level
51	Switch - Hydraulic Oil Overheat
52	Switch - Hydraulic Oil Reserve Tank Level
53	Switch - Air Filter Blocked
54	Control - Hydraulic Pump
57	Pressure Switch - Upper Pilot Pressure
58	Motor - Engine Throttle
59	Solenoid - Breaker Pilot Pressure (Optional)
60	Pressure Switch - Travel Pilot Pressure
61	Pressure Switch - Angle Sensor (Optional)
62	Controller - Optional
63	Monitor - Optional
64A	Angle Sensor - Dipper (Optional)
64B	Angle Sensor - Bucket (Optional)
64C	Angle Sensor - Boom (Optional)
65	Solenoid (3) - Optional
66	Switch - Double (Optional)
68	Monitor - Optional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64C
65
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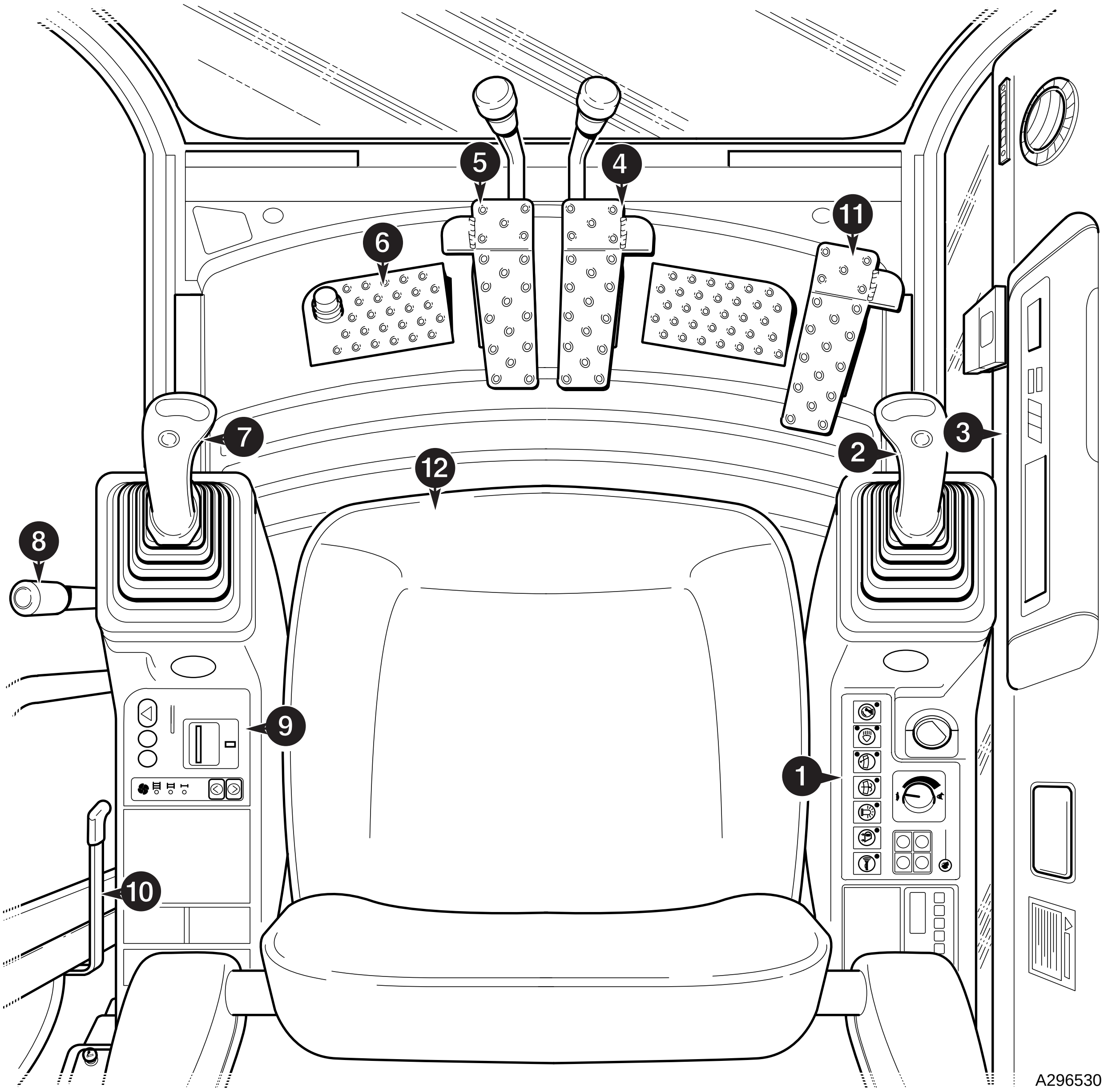
BOX FUSE
KEY SWITCH
COMPUTER
MONITOR
DRIVER
AIRCON UNIT
AIRCON SWITCH
HEATER
STARTER MOTOR
ALTERNATOR
GLOW PLUG
BUZZER
OPT. CONTROLLER
OPT. MONITOR
FLOOR PLATFORM
THROTTLE MOTOR
ANGLE SENSOR

Operator’s Cab



1 **Right Console**

2 **Right Excavator Joystick Control**

3 **Display Monitor**

4 **Right Hand Track Control**

5 **Left Hand Track Control**

6 **Travel Speed Range Change Switch**

7 **Left Excavator Joystick Control**

8 **Control Lock Lever**

9 **Left Console**

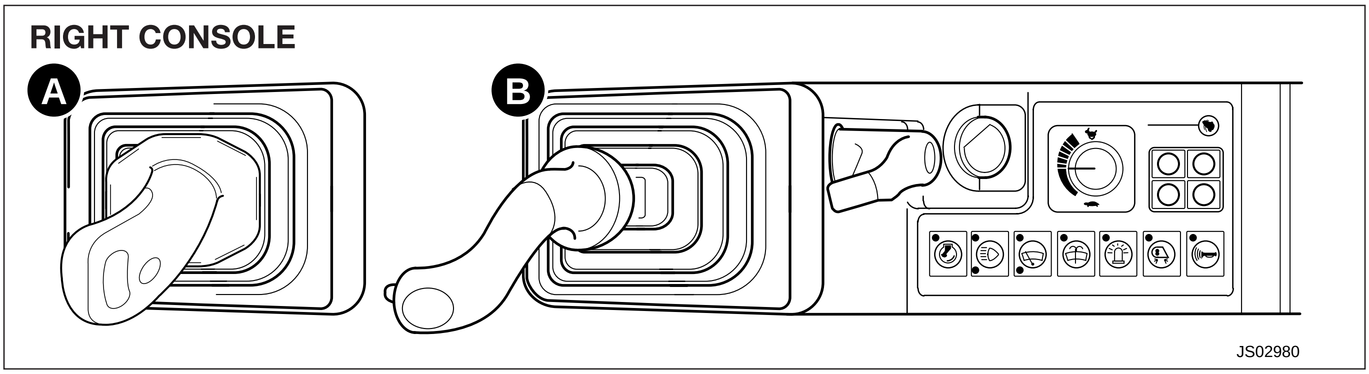
10 **Door Lock Release Lever**

11 **Optional Circuit Pedal (if fitted)**

12 **Operators seat**

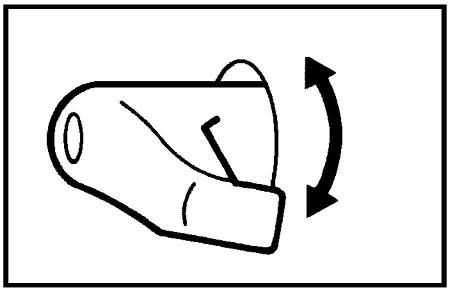
Right Console

* *For correct operation and description see* '**Operator's Handbook**'

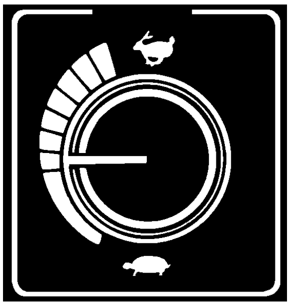


Note: *Your machine will be equipped with hand controller type **A** or **B**.*

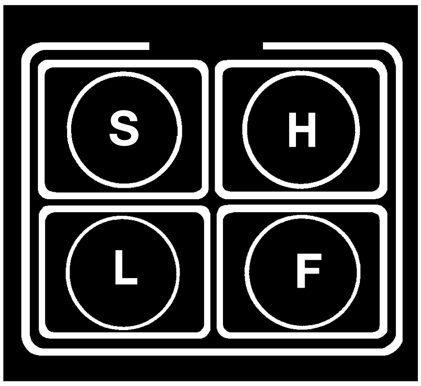
* **Right Console Tilt Handle (If fitted)**



Throttle Volume Control

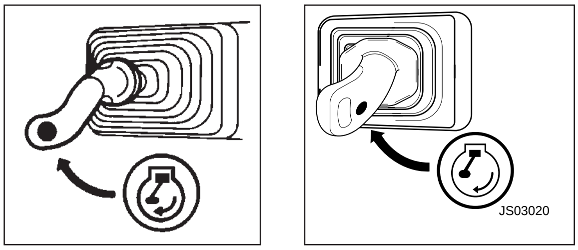


Mode Selection

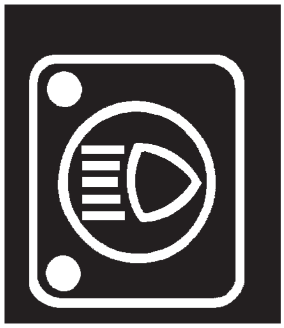


One Touch/Auto change switch

Idle Switch



Work lamp Switch



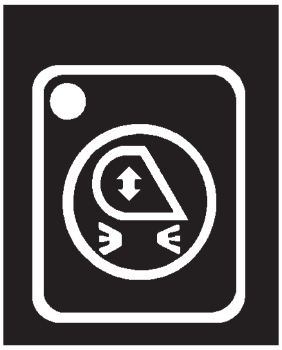
Wiper Switch

Washer Switch

Right Console (continued)

Soft/Hard

*

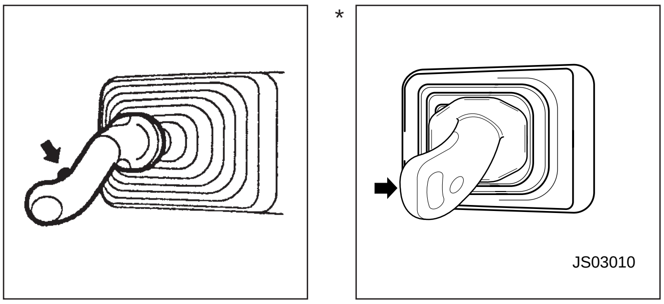


Buzzer Stop Switch

*

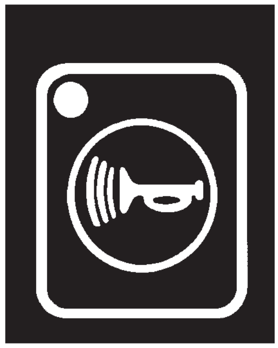
Power-up button

*

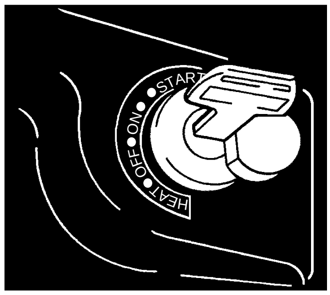


Horn Volume

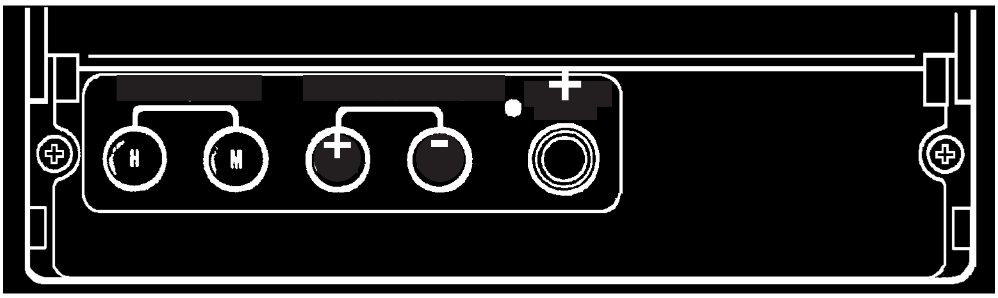
*



Starter Switch

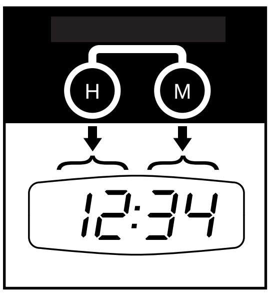


Right Console (side panel)



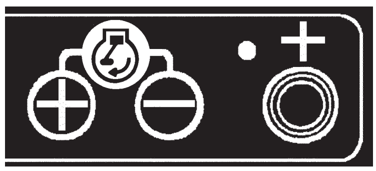
Time Adjust

*



Back-up

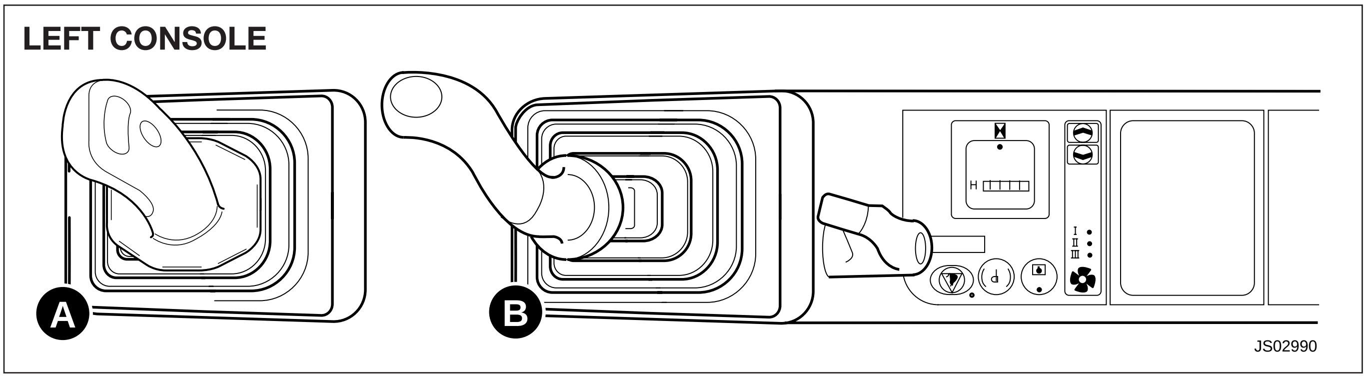
*



Left Console

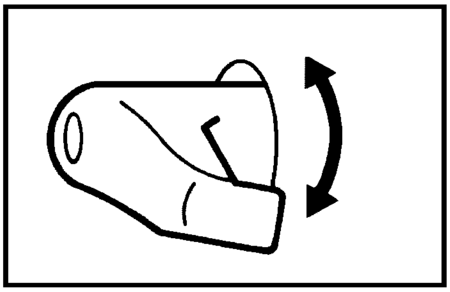
*For correct operation and description see '**Operator's Manual**'*

*



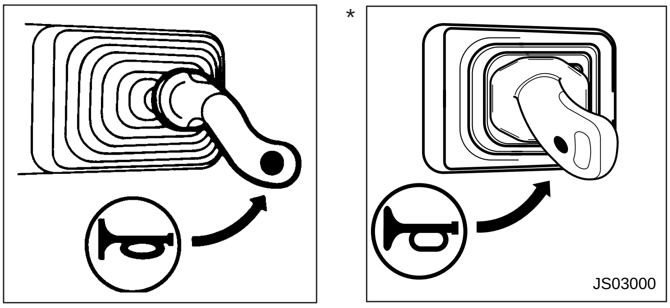
Note: *Your machine will be equipped with hand controller type **A** or **B**.*

Left Console Tilt Handle

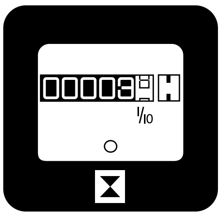


Horn Switch

*

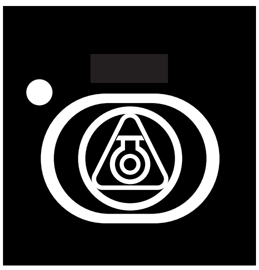


Hour Meter



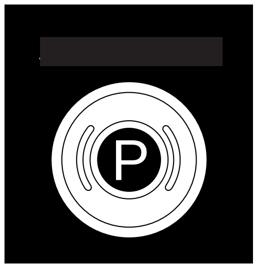
Emergency Stop Switch

*



Swing Brake Switch

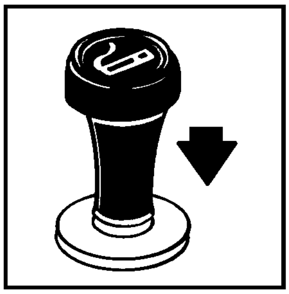
*



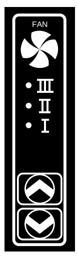
Lever-lock Switch

*

Cigarette Lighter

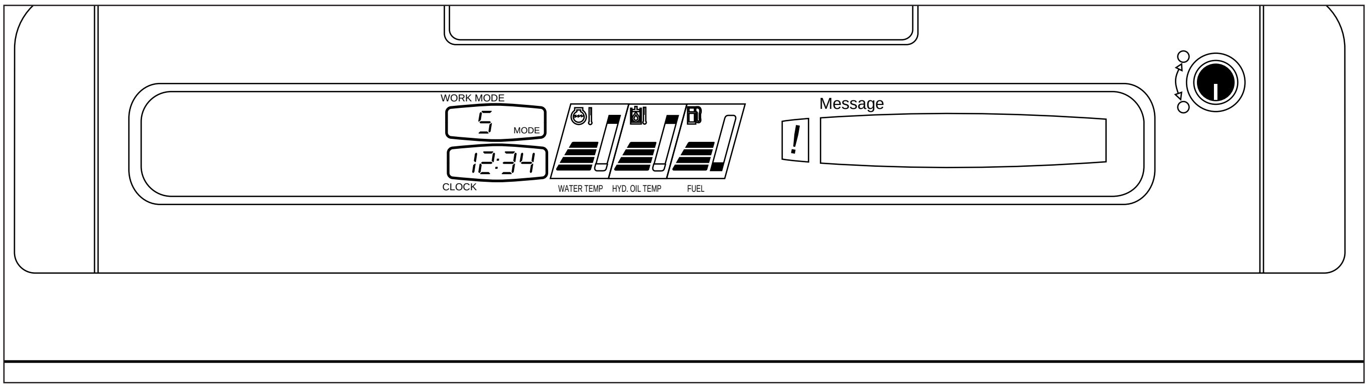


Heater and Air Conditioning

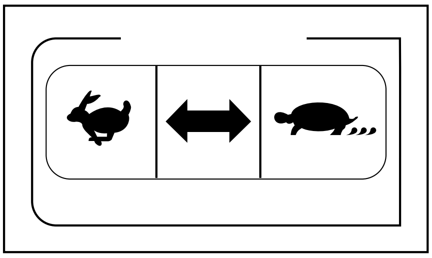


Monitor

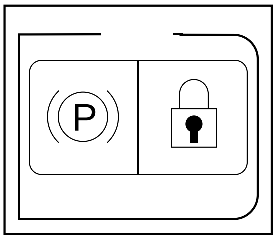
*For correct operation see '**Operator's Manual**'*



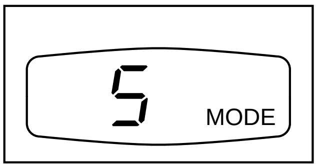
Machine Condition Indicators *



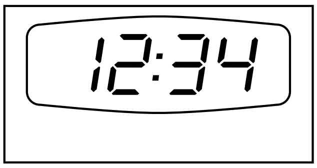
Lock Indicator *



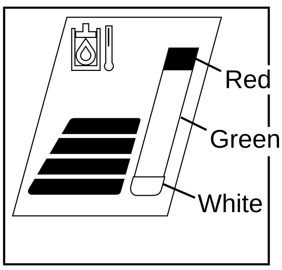
Work Mode Indicator *



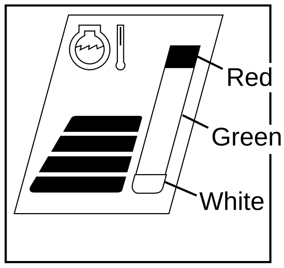
Time Indicator *



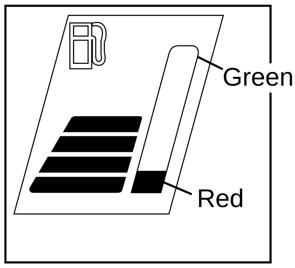
Bar Graph Hydraulic Oil Temp *



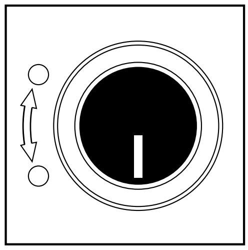
Water Temp *



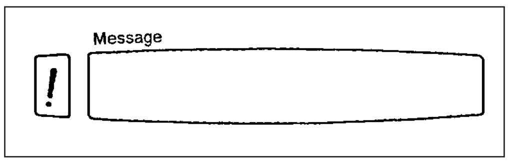
Fuel Indicator *



Brightness Control



Message Indicator



Control, Function, Operation

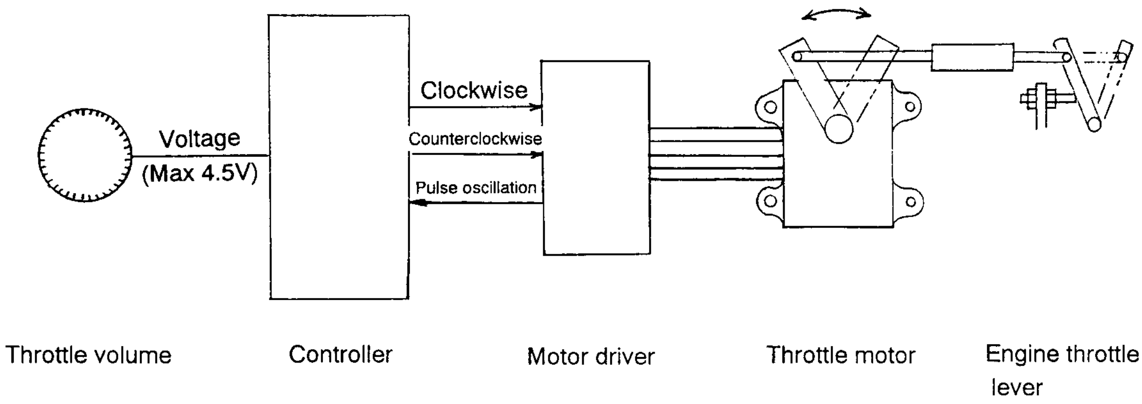
	CONTROL	FUNCTION	OPERATION
a	Engine revolutions automatic adjustment.	Slight difference of RPM between each mode	Engine speed varies according to mode: S Mode is100rpm less than H mode L Mode is 200rpm less than H mode
		Idling RPM is regulated according to the mode selected.	Idle Mode Revolutions 900rpm
		One-touch/auto idle RPM is reduced to the machine's original idling RPM.	Idle Mode Revolutions 900rpm
b	Idling Control.	An operator can adjust engine RPM by one-touch.	Engine RPM and idle RPM selected according to throttle volume in the F-mode.
		The one touch/automatic idle switch can be set to 'AUTO' so that engine automatically idles when not under load.	When auto idle is selected, automatically decreased to idle RPM 15 seconds after lever is put into neutral.
	Breaker revolution control.	When breaker pedal is operated, the engine speed changes automatically to suit the breaker.	Pressure in Breaker pilot line activates a switch which signals the control of engine speed
	Engine automatic warm-up.	When starting a cool engine, a special warming up process is begun automatically.	Increases RPM gradually from starting, and warms up & circulates lubricating oil around the engine.
	Detection of throttle motor asseembly defect	Detects assembly in which throttle motor damage is highly possible and alarm is given.	Monitors for an abnormality in the motor position at which the limit switch is closed. If an abnormality exists, motor stops.
	Engine reverse rotation prevention	Reverse rotation of an engine is detected, and is stopped	After the engine has been operating for 12 seconds, the engine oil pressure switch is monitored. If an ON status is detected for more than 3 seconds, engine stops.

Control, Function, Operation

	CONTROL	FUNCTION	OPERATION
3	Pump control	Pump control depends on work such as, H mode, large working load, S mode, good fuel economy, and L mode, for fine operation.	The supply current to electromagnetic proportional pressure reducing valve which is built into the pump, is regulated.
3	Boom lowering speed regulation	It also decreases boom lowering speed in L/F mode.	When L/F mode is selected the boom lowering stroke of control valve spool is restricted.
4	Cushioned Boom Starting	Prevents shock loads when starting to lower the boom.	When starting, a momentary negative control signal is generated.
5	Pressure raising system	Power increased when more force is desired, or during travel.	Pressure raised by 2-stage MRV being operated by solenoid valve.
6	3-speed travel and max. flow cut	High, middle or low speed travel operation obtained by switch. Performance improved during F mode.	Selects travel motor 2-speed positions, to give function of restricting max. flow of pump.
7	Cushion control	When cushion control is selected shock is relieved when boom and arm are de-selected. When hard operation is selected, the cushion is turned off.	Modulates movement of control valve boom/arm spools when they are deselected.
8	Power cut delay	A power supply is maintained to allow electrical devices to be operated after key switch is tuned to OFF .	After the key switch is turned OFF there is a 5 seconds delay before the battery relay is cut OFF.
9	Swing brake/swing lock	Key OFF or lock SW ON: 100% swing brake. Key ON and operation other than swing: 50% swing brake. Swing operation: 0% (release).	Pressure is maintained by a pressure reducing valve, dependent upon brake selection.
10	Lever lock (Left console)	Unless the controls are immobilised, by raising the left console, entering and leaving the cab is impossible. In an emergency, it is possible to shut off the services immediately by raising the console.	With left console raised the controls are isolated.
12	Overload protection	If power transistor output of controller is shorted, the controller is protected.	An overcurrent sensing circuit is fitted within the controller. When the output is shorted, the power transistor output is stopped, thus preventing an internal overload in the computer.
13	Monitor display	Radiator water temperature Hydraulic oil temperature Fuel remaining Warning display	

Basic Operation

The engine throttle control is done with the electric throttle motor.

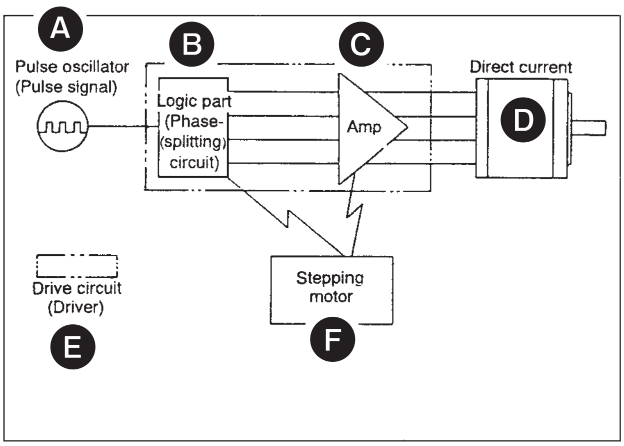


A stepping motor is now used as part of the throttle motor.

Stepping Motor

This rotates in direct synchronization with the amount of pulses received from the pulse oscillator.

Pulse oscillator
This circuit is used to make the pulse signal that determines the degree of rotation and rotational speed of the stepping motor. The stepping motor rotates when it is synchronised with the pulse signal from the pulse oscillator. The degree of rotation is dependant on the frequency of the pulse.



Stepping Motor Basic Drive Structure

Component Key

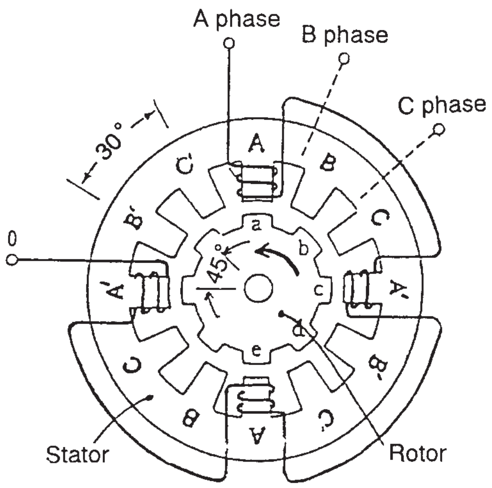
A Pulse oscillator (pulse signal)
B Logic part (phase splitting circuit)
C Amp
D Direct current
E Drive circuit (driver)
F Stepping motor

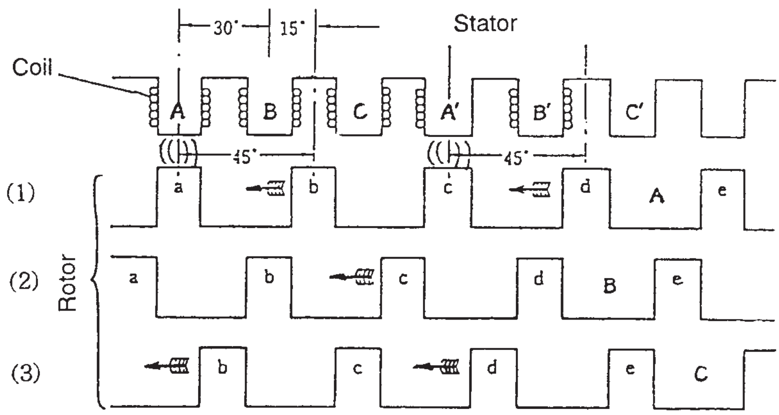
Stepping Motor *(continued)*

Driver Circuit (driver)

The driver circuit of a stepping motor consists of a logical section which forms and distributes a pulsed signal from an oscillator and an amplifying section which amplifies and supplies the signal to the motor.

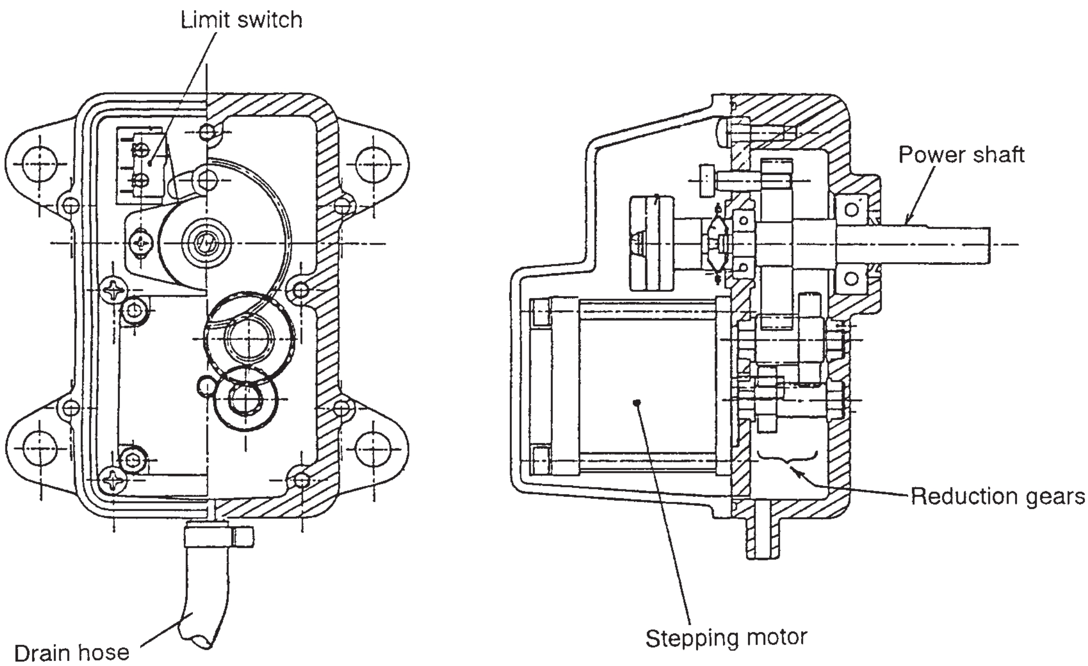
Stepping motor principle (if 1st - phase is on drive)





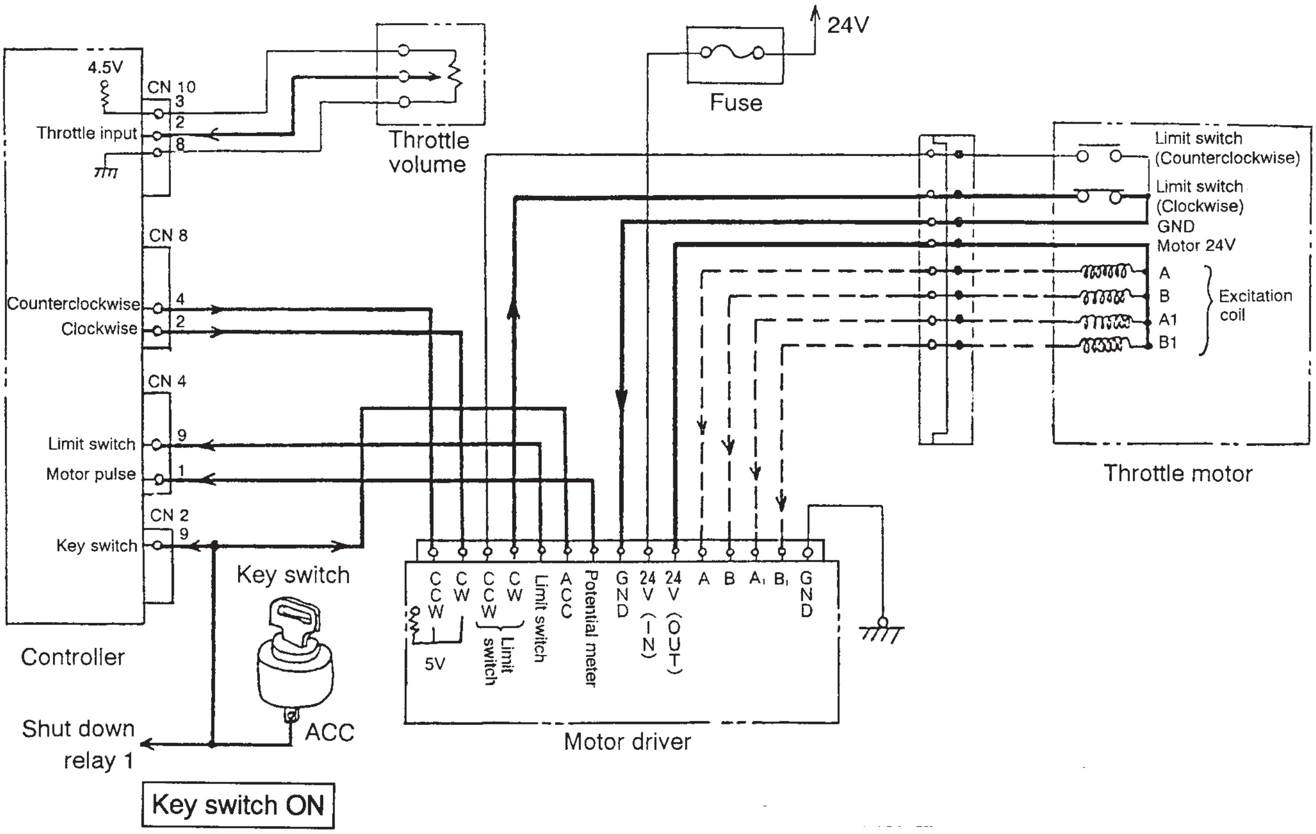
The wound phases of **A**, **B** and **C** are rolled on the stator.

When a pulse enters **A** phase, rotor is in (1) condition and A-a, A-c are energised. The excitation of **A** phase breaks down and then the pulse of **B** phase enters, B-b, B-d are energised and results in (2) condition. When the rotor rotates in a counter clockwise direction it sets up the condition (**A-B-C**). When a pulse is registered in the order (C-B-A) the rotor is rotating clockwise.



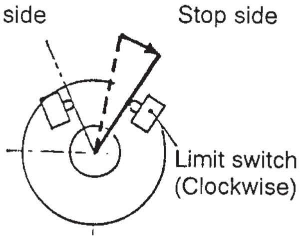
Throttle Motor Structure

Throttle related function



A signal enters CN2-9 of the controller and ACC of the motor driver from ACC key switch. (24V) The controller and the driver sense that the key switch is **ON**, when this signal enters. The controller sends a clockwise rotation instruction (CN8-2) to the driver, and the driver sends a pulse clockwise rotation (ABA1B1) to the throttle motor. When the throttle motor rotates clockwise, the limit switch is depressed, and a signal is then sent to the controller (CN4-9) through the driver, to inform the controller that the 'O point detection' of the throttle motor has been achieved. (O pulse)

After 'O point detection' has been achieved, in order for the controller to confirm the throttle volume position, the voltage (CN10-2) from the throttle volume control is converted to a pulse number.

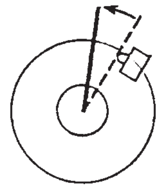


Throttle motor (0 detected)

Throttle related function *(continued)*

For the Throttle motor to rotate to the position required by the throttle volume, an instruction from (CN8-4) to rotate counter clockwise is sent from the controller to the motor driver, and when received, sends a counter clockwise pulse from the motor driver the throttle motor. Confirmation of the received pulse by the motor driver is achieved by a feedback signal pulse sent back to the controller, at (CN4-1).

When the throttle motor pulse (that is the pulse which is converted by controller voltage from the throttle volume) eventually becomes equal to the pulse which is sent to the controller as a feedback signal from the driver, the throttle motor will stop rotating.



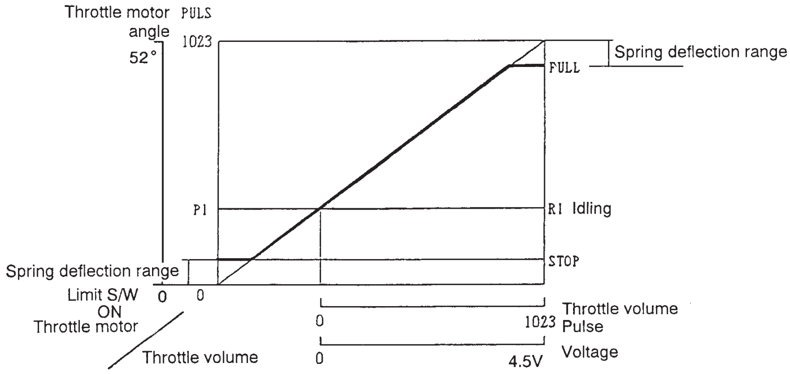
Throttle motor

(Stops at pulse position of throttle volume)

Revolution increase

When the throttle volume control is rotated clockwise, the voltage of the throttle input increases, because of this the controller sends a counter clockwise revolution signal to the driver, and the driver sends a counter-clockwise pulse to the throttle motor, again the controller gets confirmation by a feedback signal pulse sent from the driver.

When the throttle motor pulse (that is the pulse which is converted by the controller voltage from throttle volume) eventually becomes equal to the pulse which is sent to the controller as a feedback signal from the driver, the throttle motor will stop rotating.

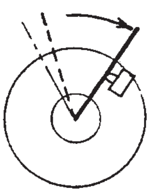


Engine Stop

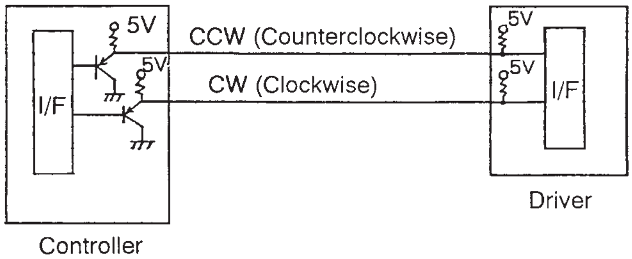
When turning the key switch to **OFF**, the signal of the **ACC** line of the motor driver switches to **OFF**. When this signal is turned **OFF**, the driver sends a pulse to the throttle motor until the limit switch of clockwise rotation is turned **ON**.

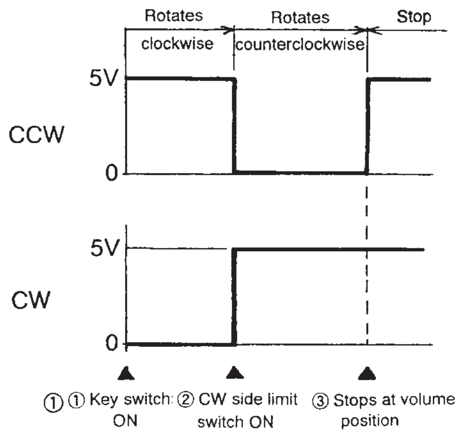
The governor lever moves to the stop side, causing the engine to stop, at the same time another circuit operates and moves the fuel cut lever to the stop position.

Engine stop



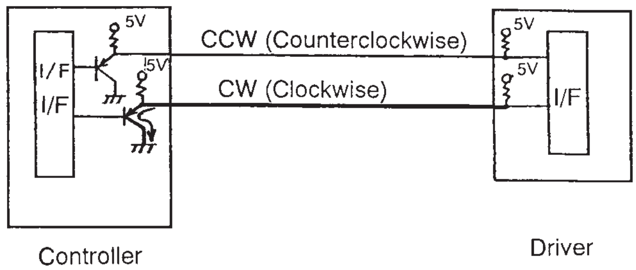
Controller rotational instructions





1. **After key switch ON**

   When the transistor on the **CW** side of the controller is turned **ON**, **5V** from a driver circuit drops to ground. At this point the **CW** line is **0V** and **CCW** line is **5V** at the driver side.

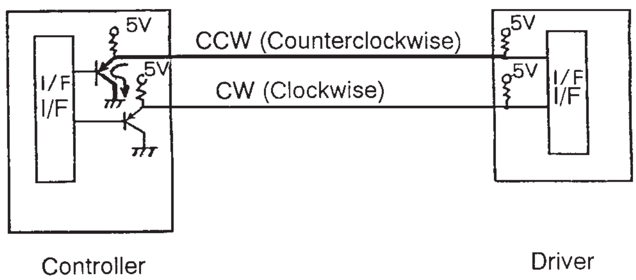


CCW5V CW0V

Rotation instruction of clockwise direction is set.

2. **After CW side limit switch ON**

   The controller turns **OFF** the transistor on the **CW** side, and turns **ON** the **CCW** side on the driver. **CW** line is **5V** and **CCW** side is **0V**.



CCW0V CW5V

Rotation instruction of counterclockwise direction is set.

3 . **The stop status in volume position**

   CCW and **CW** of a transistor are turned **OFF**, and both lines at the driver side are **5V**.

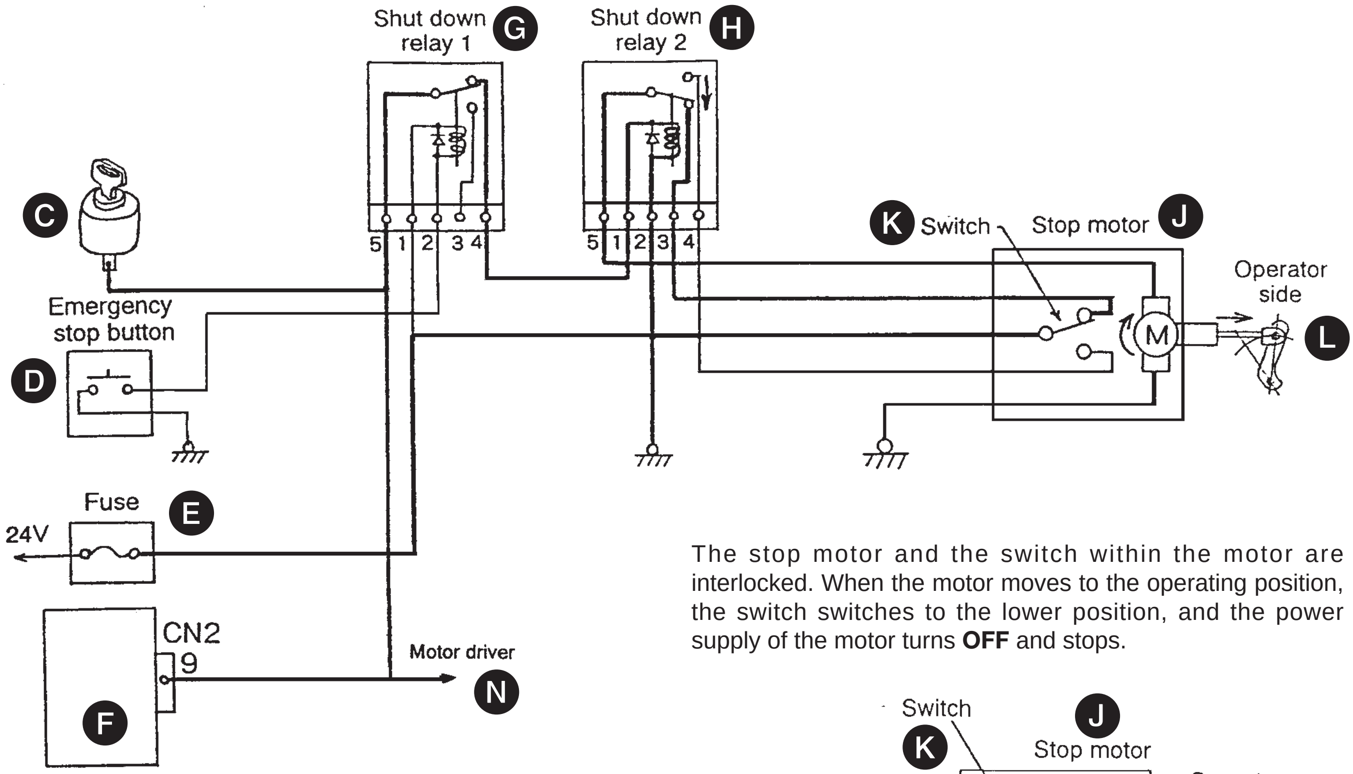
CCW5V CW5V

Motor rotation stops.

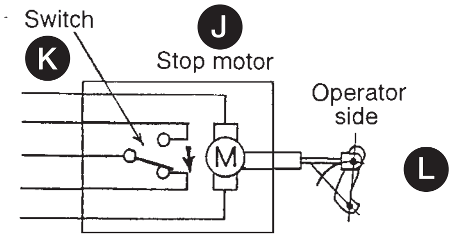
Stop Motor Function

A Key Switch ON

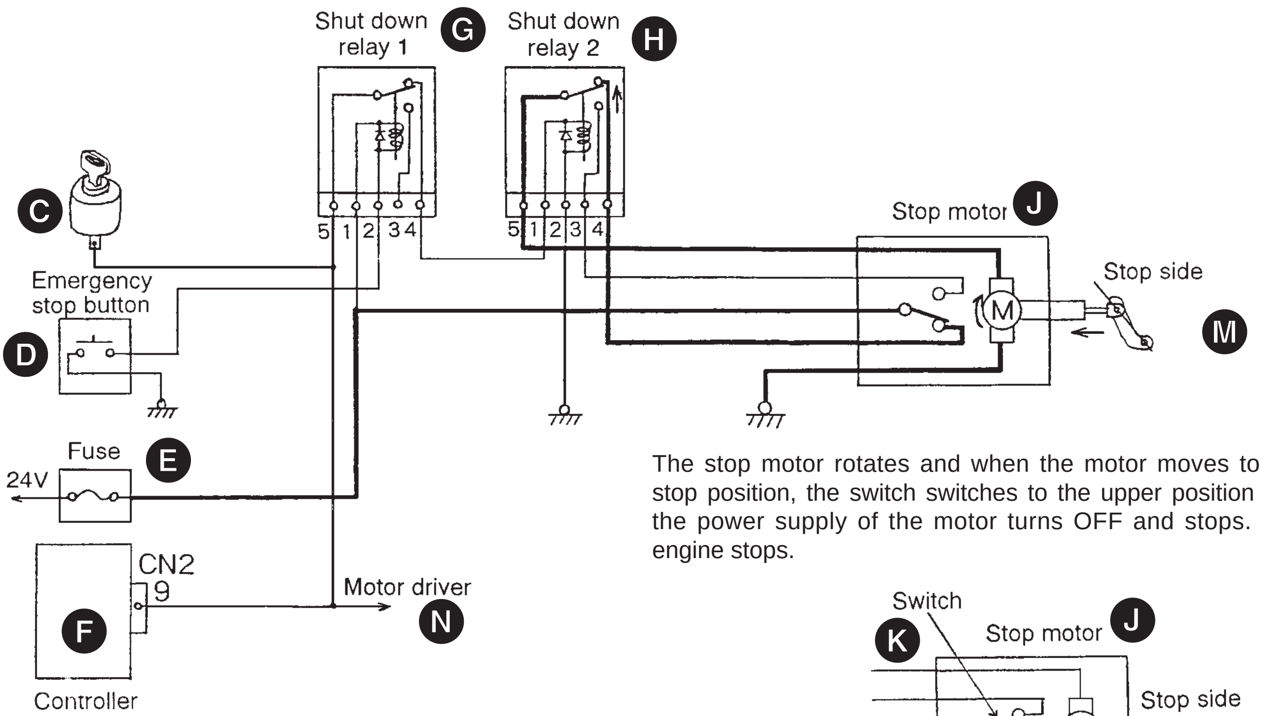
With the key switch in the **ON** position, the power flows through relay and energises the actuating coil of relay 2 which supplies current to rotate the stop motor.



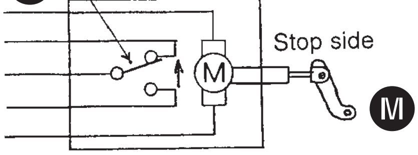
The stop motor and the switch within the motor are interlocked. When the motor moves to the operating position, the switch switches to the lower position, and the power supply of the motor turns **OFF** and stops.



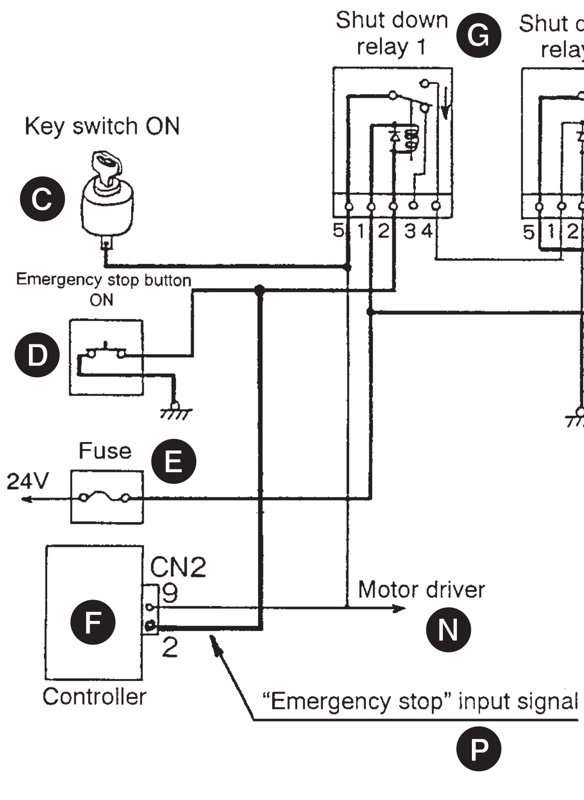
B Key Switch OFF



The stop motor rotates and when the motor moves to the stop position, the switch switches to the upper position and the power supply of the motor turns OFF and stops. The engine stops.



Emergency stop button ON



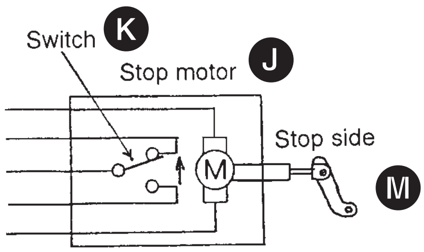
The coil of relay 1 is excited when the emergency stop button is pressed when the key switch is **ON** (previous section **A**), and the relay switch turns to the lower position.

Since the excitation voltage to relay 2 collapses, the relay switch is returned to the upper position. The power supply circuit of the motor is formed, rotates, turns to the stop position, and the engine stops.

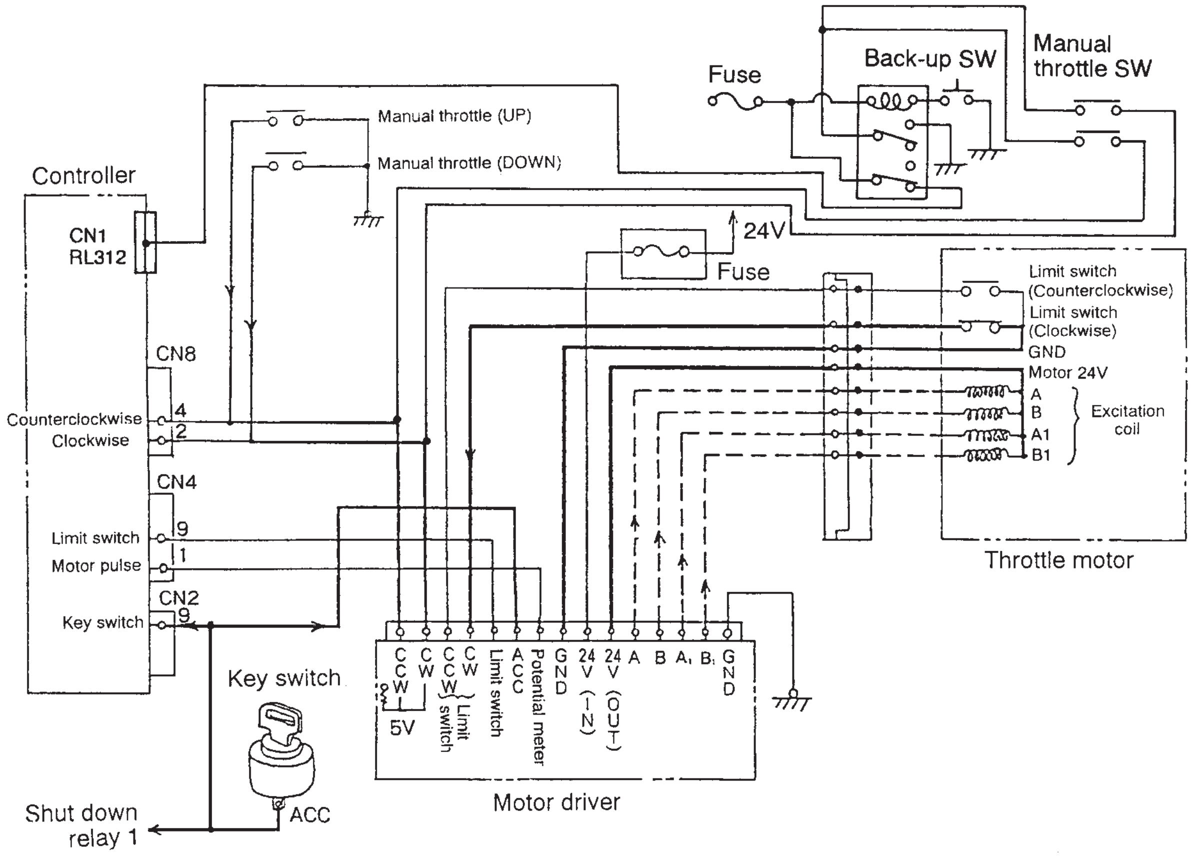
The motor switch is switched to upper position, and it stops.

Component Key (Pages 4-6 and 4-7)

C Key switch
D Emergency stop button
E Fuse
F Controller
G Shut-down relay 1
H Shut-down relay 2
J Stop motor
K Switch
L Motor control - operating position
M Motor control - stop position
N To motor driver
P Emergency stop signal



Redundancy (Back-up) throttle control



If the throttle control does not operate due to a controller defect, press the redundancy switch. Throttle control is then taken over by the manual throttle buttons.

When pressing a redundancy switch, control power supply to the controller is turned **OFF**, and the manual throttle circuit is activated. There is a signal of **5V** on the motor driver side. When pressing manual throttle, instruction of a rotational direction is sent to a motor driver, same method as in previous section Controller rotational instructions.

To stop engine, manual throttle is pressed **DOWN**, or the key switch is turned **OFF**.

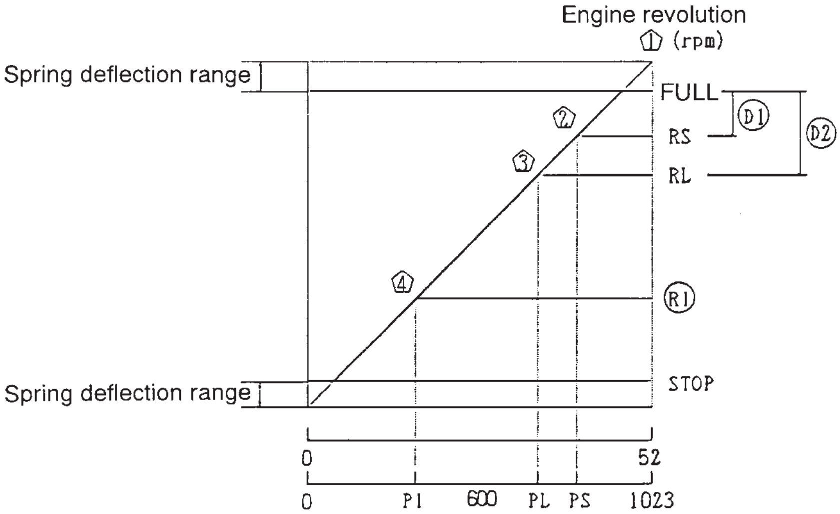
While running the engine, if the redundancy switch is turned **OFF** (normal status), the engine stops so that the **0** position of throttle motor is detected.

Automatic Engine Adjustment

* There is a variation in engine RPM depending on each machine. To finely control, in each mode or to eliminate wide variation in idling RPM, store the setting RPM to the controller at an early stage. This is called automatic adjustment.

* When replacing a new controller or a throttle motor or adjusting and replacing control link between the engine and throttle motor, automatic adjustment must be done.

* **Note:** If a new throttle motor is fitted or the cable/linkage adjusted, the controller must have its memory wiped before programming can commence.



FULL : H MODE MAX Revolutions
RS : S MODE MAX Revolutions
RL : L MODE MAX Revolutions
RI : IDLE Revolutions

	* **RPM**
D1	100
D2	200
R1	900

Automatic adjustment explanation

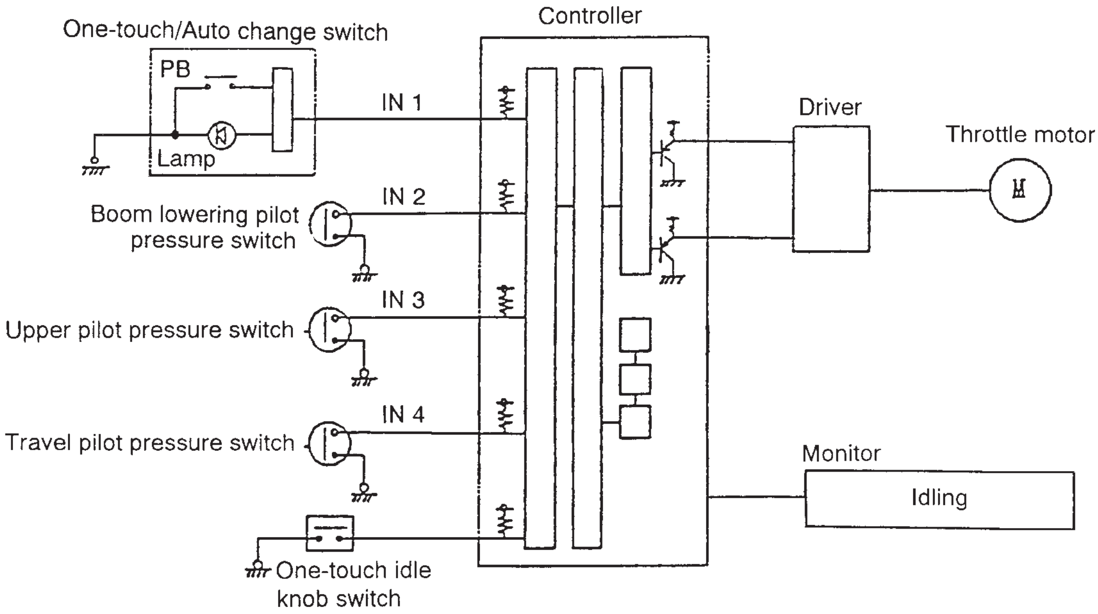
1. Engine **RPM** at the time of full throttle: **FULL** is read.
(H mode **MAX**)

2. While monitoring engine **RPM**, **RPM** is decreased automatically.
RS = FULL-D1
RL = FULL-D2
RI = Idling revolutions = 900 rpm
When each **RPM** is reached, position of a throttle motor, PS, PL and PI are read.

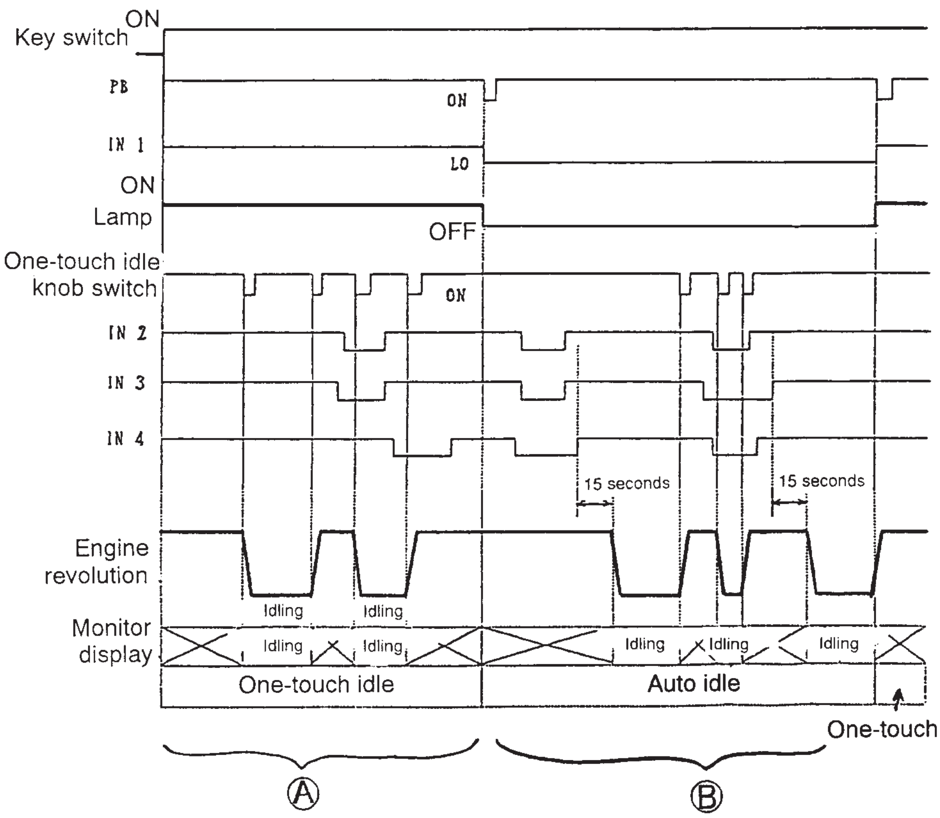
* **3.** **PS**, **PL** and **PI** are stored by the controller.

Refer to adjustment instructions for automatic adjustment method.

Idling Control



Time Chart



With the key switch **ON** pressing the one-touch switch causes the switch lamp to come on.

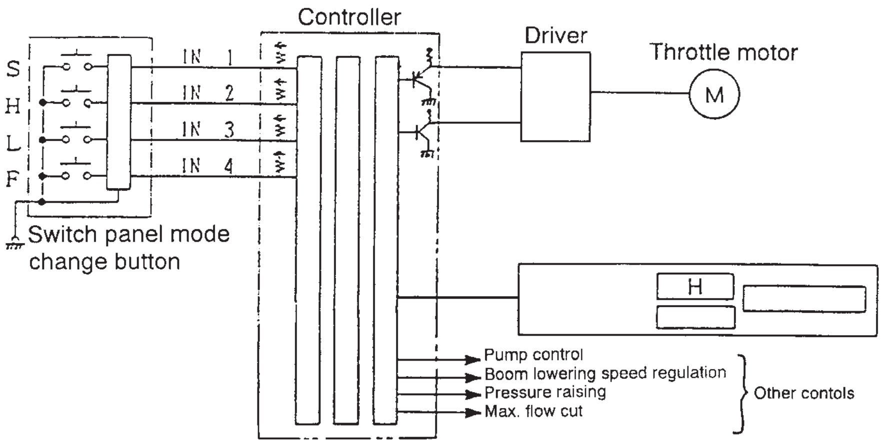
A. One-touch idle operation is possible when in one-touch idling mode regardless of whether the pilot pressure switches of IN2, IN3, IN4 are **ON** or **OFF**.

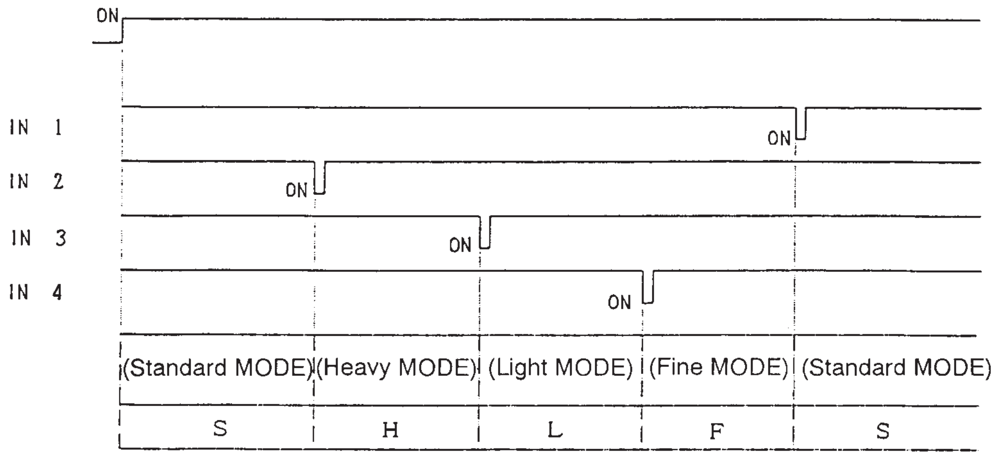
B. When pressing the change switch, (lamp goes off) the Auto idle mode is activated.
When changing to Auto idle, and with all IN2, IN3, IN4 switches turned **OFF** the engine automatically goes into the idle mode after 15 seconds have elapsed.

To exit from the idle mode, this is only possible by pressing the idle switch, regardless of the position of the switches IN2, IN3, IN4.

When the engine key is turned **OFF** during auto idle, if it is turned on again, auto idle is disengaged, and results in a one-touch idle status.

Revolution Control for Each Mode

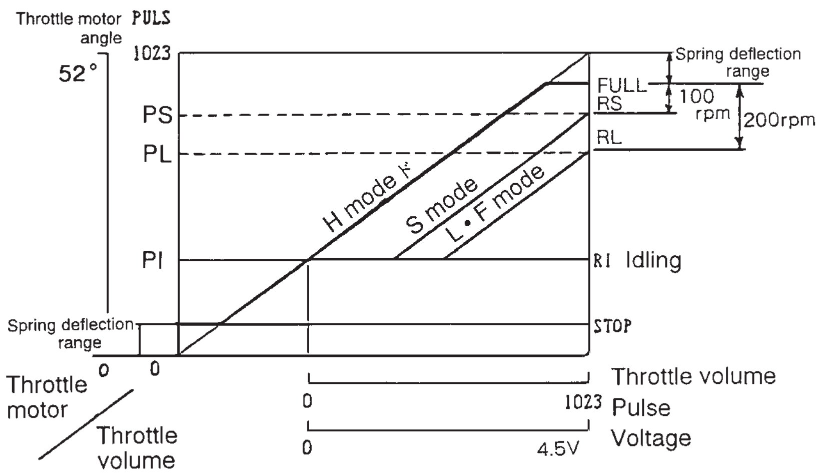




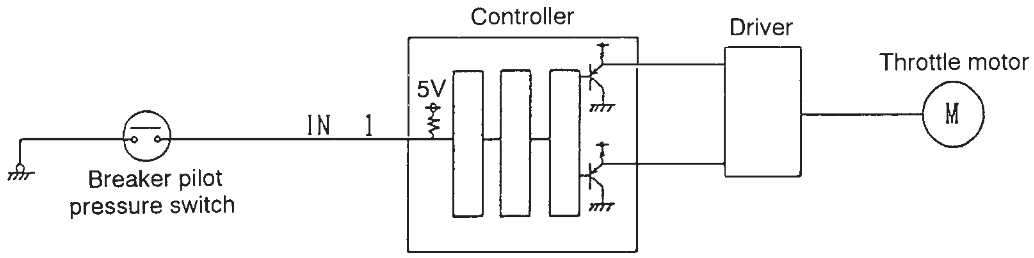
The machine is in the standard mode when the key switch is **ON**. This position is 100 rpm less than the **FULL** rotational position (H mode). Also note the position where it has decreased by 200 rpm from **FULL** rotation in **L** and **F** modes.

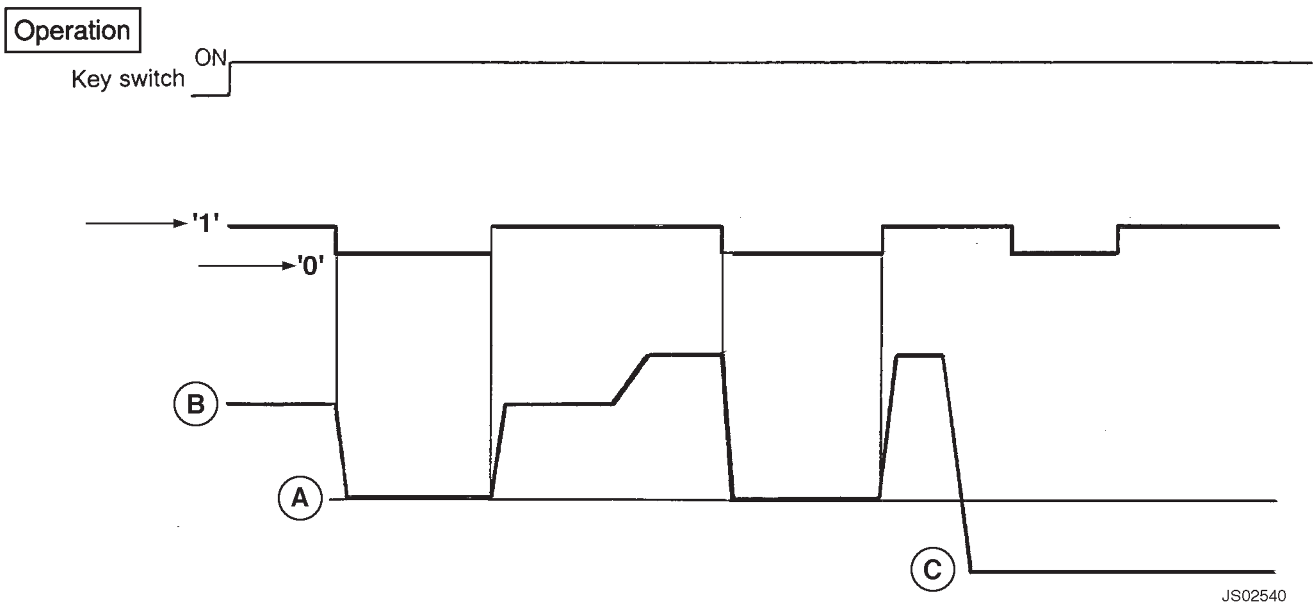
Relation of throttle volume and pulse are shown in diagram below. Even though the position of throttle volume is the same, engine RPM varies with each mode.

However, when pressing a mode switch button, the above four modes can be selected together with their corresponding engine RPM.



* Control of Engine Speed for Breaker Operation



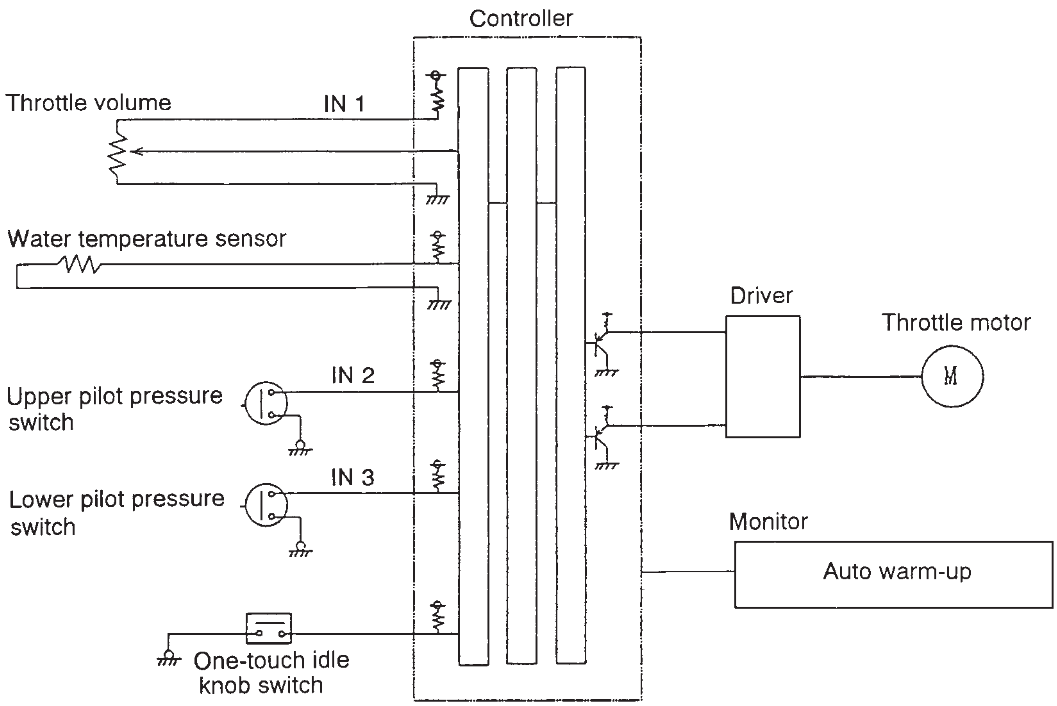


* **Note:** It is necessary to preset the engine r.p.m. to a speed which delivers the flow rate required for breaker operation (see **Setting Function** under **Self Test Function**).

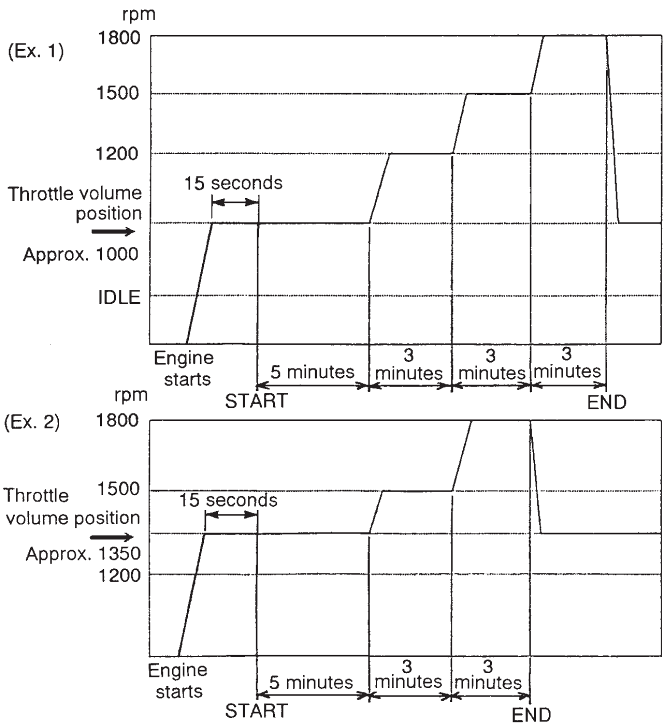
* The breaker can only be operated when the throttle control lever is set to give a higher engine speed (condition **B**) than that required for breaker operation (condition **A**). The following brief explanation assumes that this criteria has been met. If the throttle control lever setting gives an engine speed lower (condition **C**) than condition **A** the breaker circuit is inhibited.

* When the breaker foot pedal is pressed, the breaker pilot switch closes to apply a logic ‘1’ signal to the controller. The controller output causes the throttle motor to reduce the engine speed to the breaker pre-set speed. When the foot pedal is released the logic ‘1’ signal is disconnected and the controller, via the throttle motor, causes the engine speed to revert (increase) to that set by the throttle control lever.

Engine Auto Warm-up



Time Chart



Conditions for automatic warming up

1. Water temperature is less than 50°C.
2. Upper Pilot pressure switch is **OFF.** (attachment is not operating.)
3. Lower Pilot pressure switch is **OFF**. (travel is not operating.)
4. One-touch idle is turned **OFF**.
5. 12 seconds after engine start.
6. * Throttle dial not moved.

* **Note:** The automatic warming up sequence will function only when the above conditions are adhered to.

Detection of Throttle Motor Assembly Defect (Out-of-step)

Fault

When the pulse signal cannot be interrupted by the driver, and deviates from regular rotation.

Possible Factors

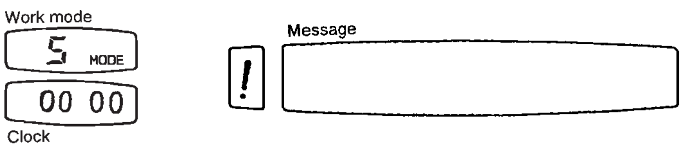
1. If the adjusting screw of the throttle link is loosened, and the length of the link is changed more than the deflection of the spring.
2. If the key switch is **ON** (also during running), and the throttle motor rotates by abnormal external force and shifts to the stop position.

Out of step detection

(Safety device works to protect throttle motor from breakage when above problem occurs.)

1. After the key switch is **ON**, the limit switch of clockwise direction (stop position) is not turned on after 2 seconds.
2. After the key switch is **ON**, the clockwise limit switch is turned on and afterwards even though the key switch is not turned **OFF** or the emergency stop switch is not pressed, the clockwise limit switch is turned **ON** again.

   Any of the above conditions will stop the drive of the throttle motor, and 'electric system abnormality' is displayed on the message and '0000' is displayed on the clock.

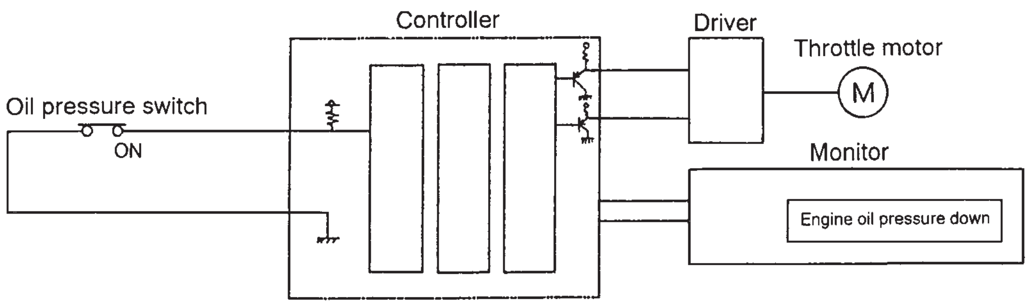


Check the throttle link position first if the above is displayed. Refer to throttle link installation procedures.

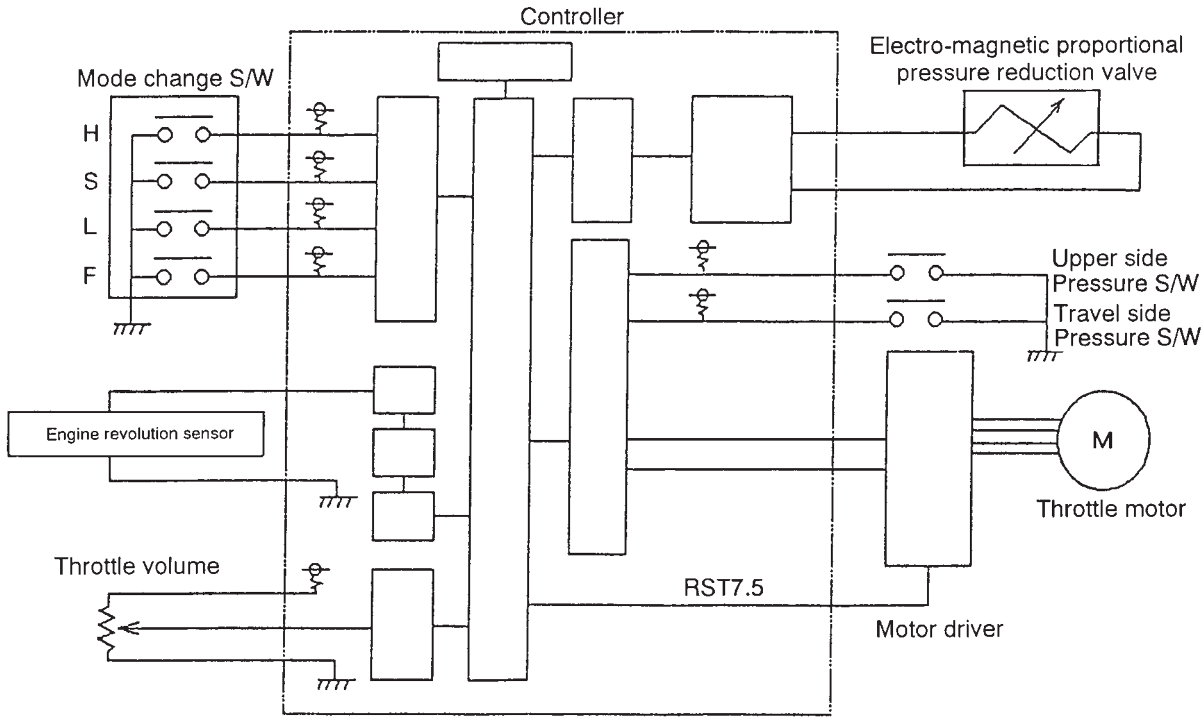
Engine Reverse Rotation Prevention

If the engine goes into a reverse rotation, this feature will stop the engine in order to protect it and the hydraulic circuit.

When the engine changes to reverse rotation from forward rotation, the engine oil pressure decreases. Twelve seconds after the engine has been started, the pressure switch turns on for 3 seconds and the throttle motor is moved to the engine stop position.



Schematic



* Current is sent to electromagnetic proportional pressure reducing valve of the pump in each mode to control pump flow rate.

* In the H mode, engine RPM is raised and current value is variable between Imax and Imin. This utilises maximum output of the engine.

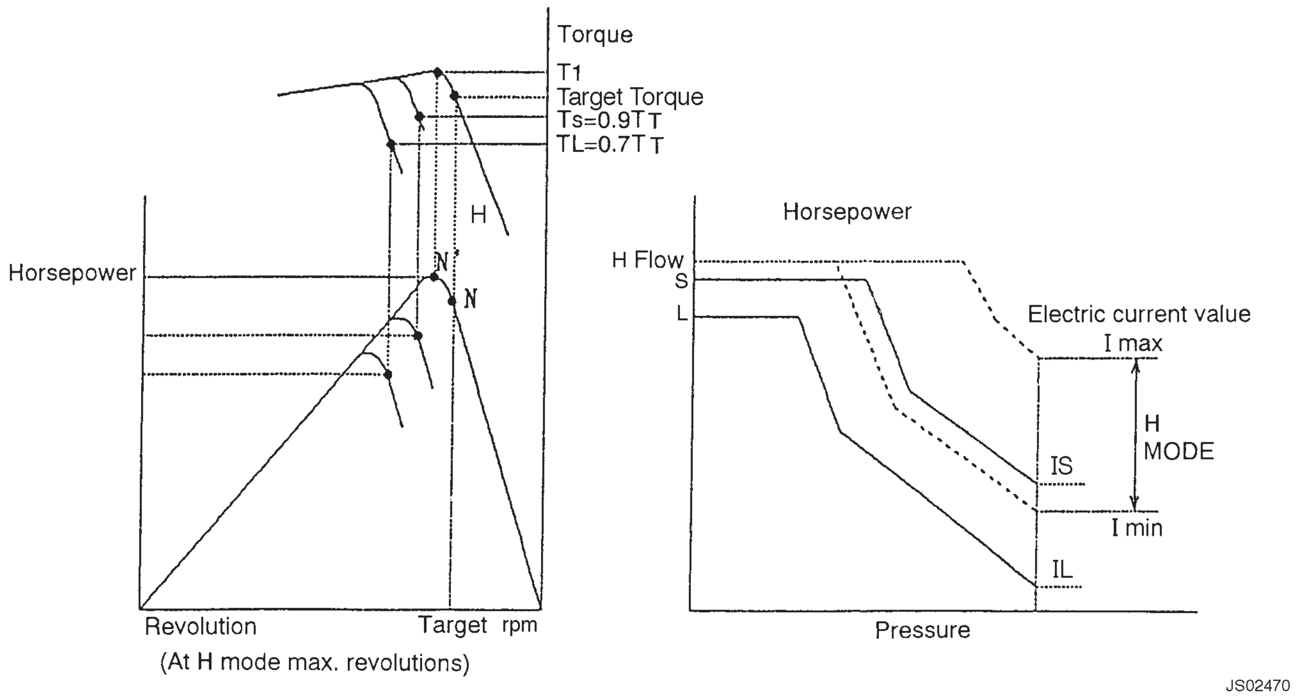
* The S,L, and F modes have fixed current values.

* Current value of each mode

*

Mode / Machine Type	H		S	L	F
	Imax	Imin	IS	IL	IF
JS200	495 mA	300 mA	305 ± 20 mA	0 + 10 mA	0 + 10 mA
JS240	520 mA	325 mA	330 ± 20 mA	0 + 10 mA	0 + 10 mA

Schematic *(continued)*



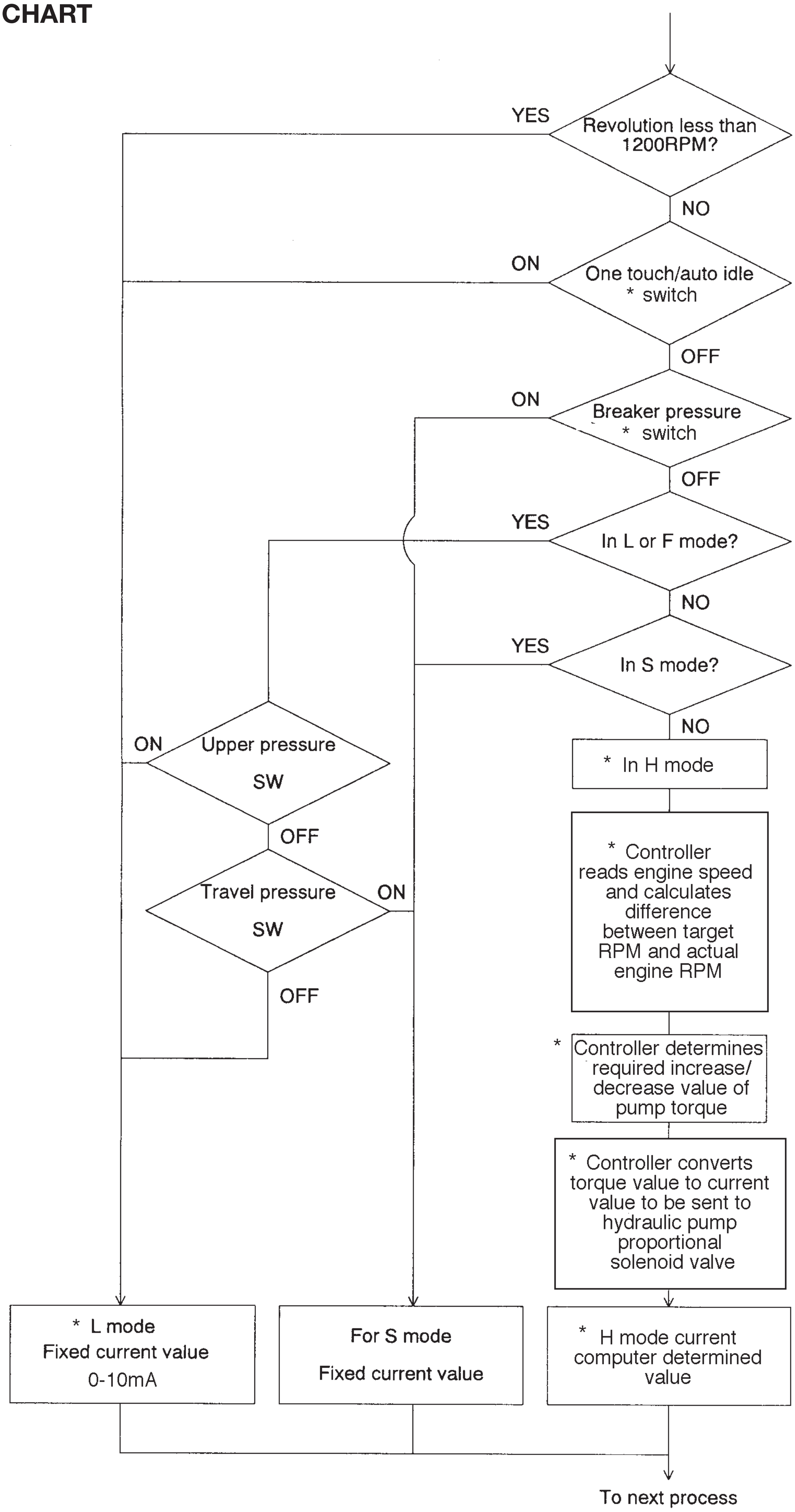
* **S MODE**: Pump torque equals 90% of engine target torque **T**, IS is the constant current value.

* **L MODE**: Pump torque equals 70% of engine target torque **T**, IL is the constant current value. (Same as **F** mode).

* If engine **RPM** is less than 1200 rpm: the current is the same as **L MODE** irrespective of mode selection.

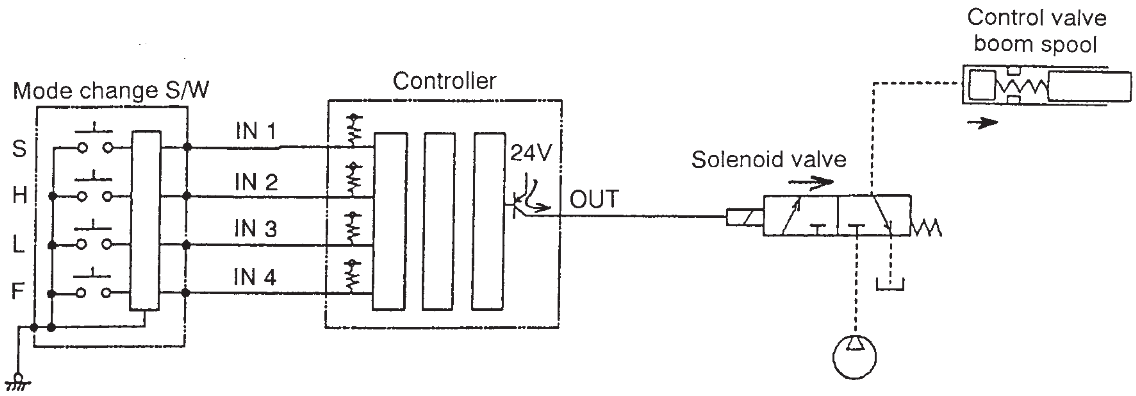
* When **L** or **F MODE** are selected at the same time as travel (upper side pressure **SW OFF**, travel pressure **SW ON**) the current is the same as **S MODE** providing engine speed is greater than 1200 rpm. (Purpose; travel smoothness.)

FLOW CHART

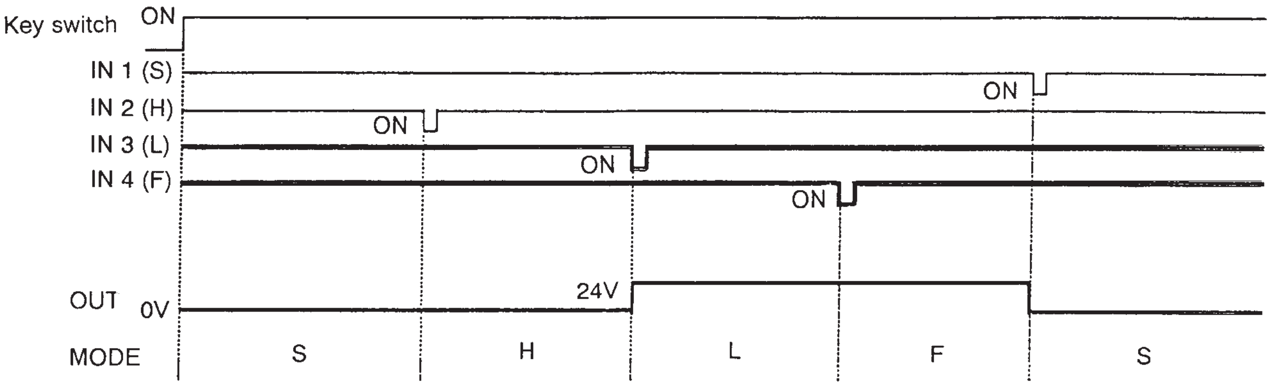

Revolution less than 1200RPM?
YES
NO
One touch/auto idle * switch
ON
OFF
Breaker pressure * switch
ON
OFF
In L or F mode?
YES
NO
In S mode?
YES
NO
* In H mode
* Controller reads engine speed and calculates difference between target RPM and actual engine RPM
* Controller determines required increase/ decrease value of pump torque
* Controller converts torque value to current value to be sent to hydraulic pump proportional solenoid valve
Upper pressure SW
ON
OFF
Travel pressure SW
ON
OFF
* L mode Fixed current value 0-10mA
For S mode Fixed current value
* H mode current computer determined value
To next process
JS02530

Boom Lowering Speed Regulation

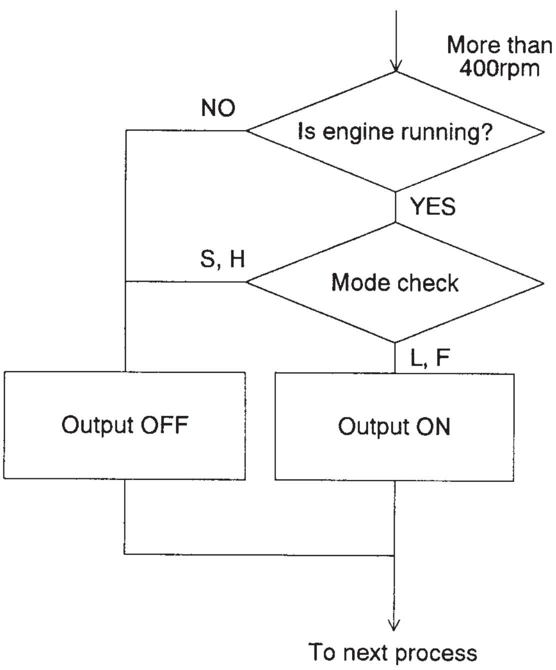
Circuit Diagram



Time Chart



Flow Chart - Boom Lowering Speed Regulation

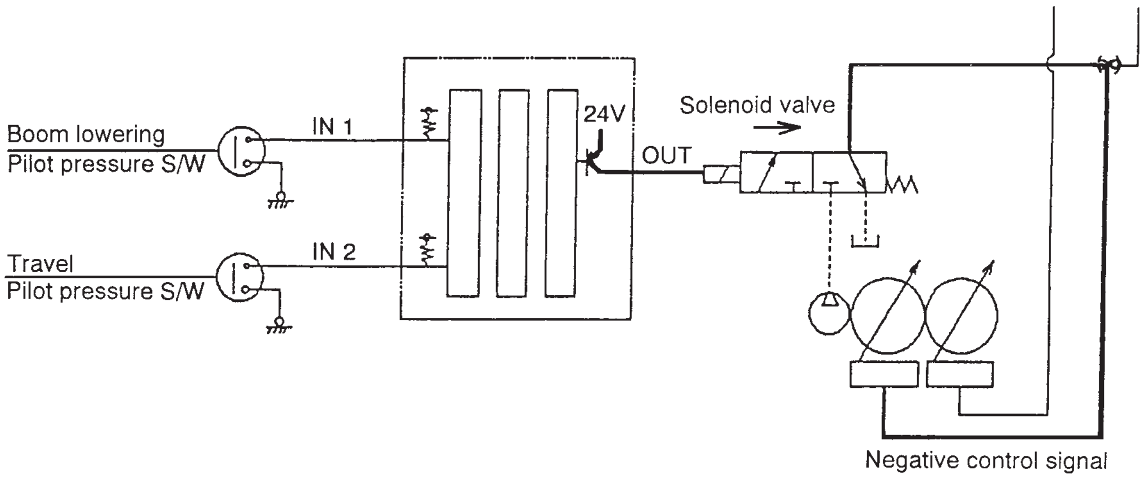


Regulating the speed of the boom lowering procedure is activated only in L, F mode.

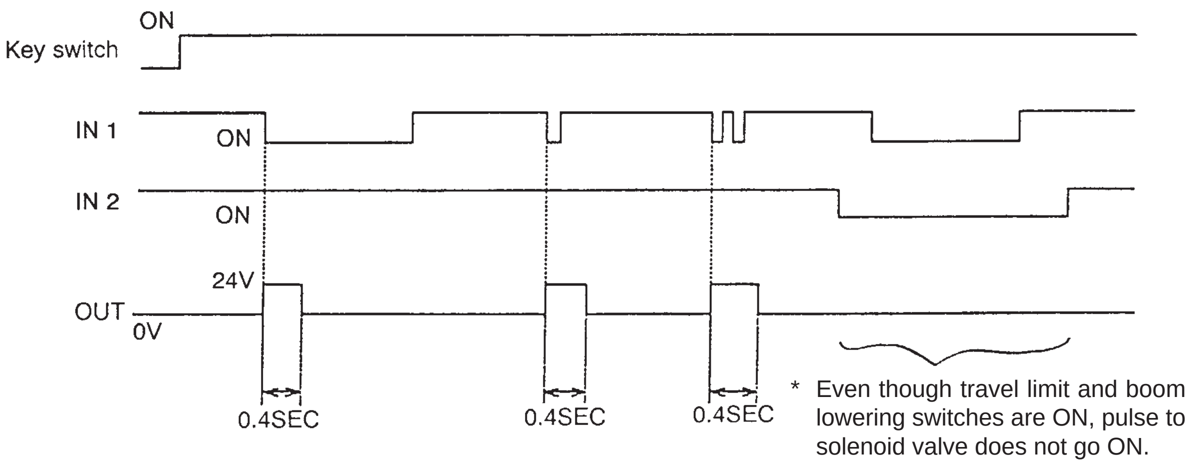
When changing to L, F mode, a transistor in the controller turns **ON**, and switches a solenoid valve.
Pilot pressure is sent on the raising side of the boom spool on the control valve, and the movement of the spool is regulated.

Cushioned Boom Starting

Circuit Diagram



Time Chart

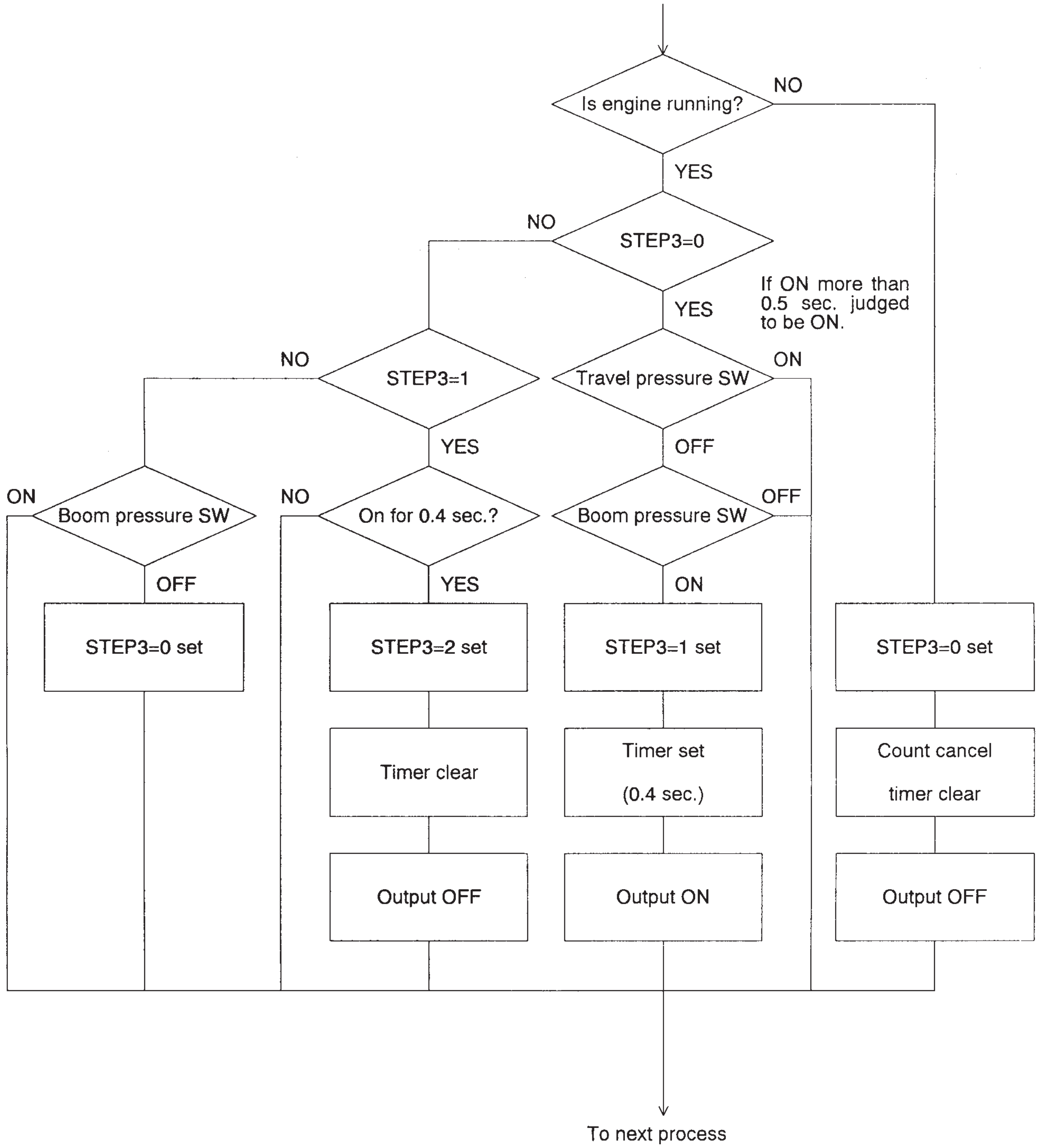


* When the boom lowering pressure switch turns **ON**, the solenoid valve switches on for 0.4 sec, and pilot pressure is sent to the negative control signal port of the pump. This pilot pressure adjusts the pump swashplate angle to temporarily reduce the output flow and thereby initially slow down (cushion start) the boom lowering facility.

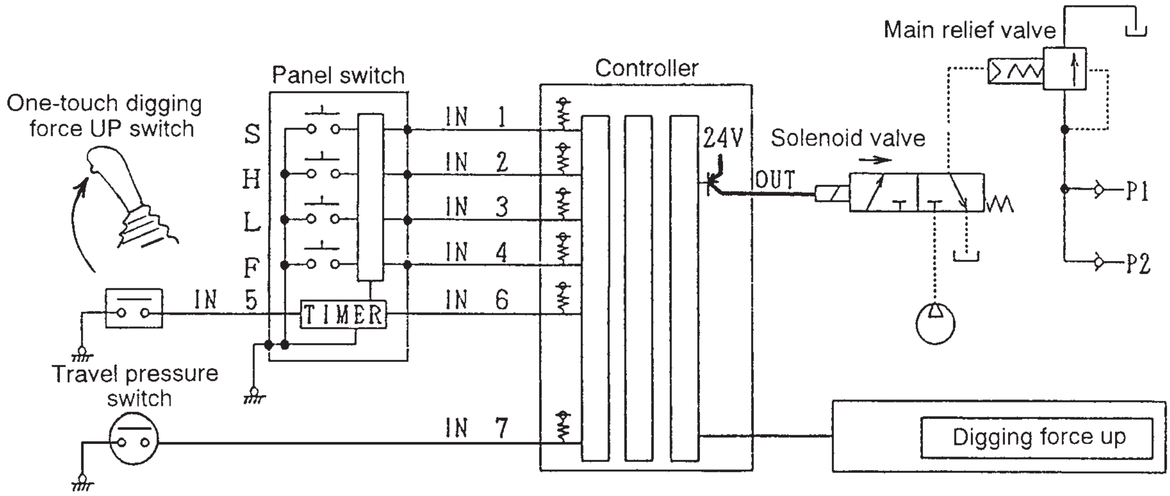
* If travel and boom lowering procedure are initiated together, the boom cushioned start facility is not available, because the travel pilot pressure is monitored to ensure smooth travel.

Cushioned Boom Starting *(continued)*

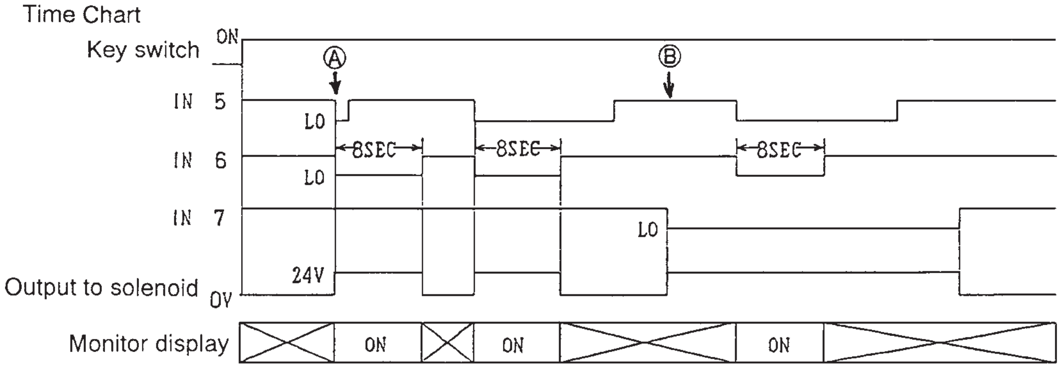
Flow Chart



Pressure Increasing System
(One-touch digging force UP, Travel power UP)



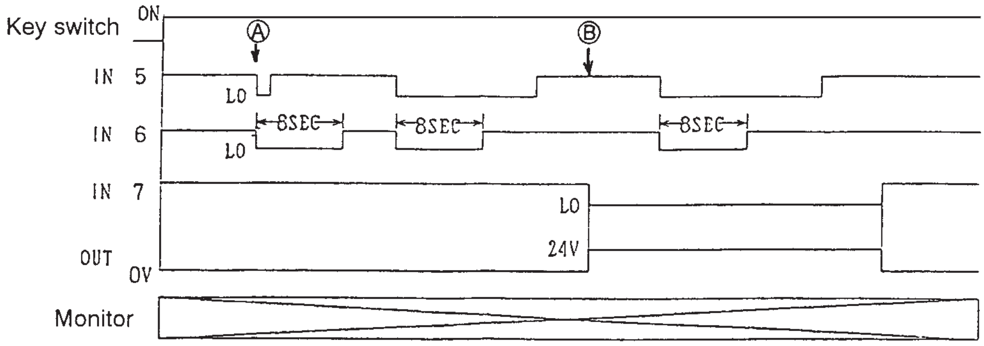
H • S mode



* **A** In only **H** or **S** modes, when the one-touch digging force **UP** switch is turned **ON** (IN5), the signal enters the controller through the timer in the panel switch and remains for 8 sec, 24V is output from the controller to the now activated solenoid valve. Pilot pressure enters the main relief valve, and pressure setting increases. IN6 switches for 8 seconds after one-touch digging force **UP** switch is turned **ON**. 'One-touch digging force **UP** is displayed on the monitor at the same time. If the one-touch digging force **UP** switch is pressed for a long period the pressure setting increases only for 8 seconds.

* **B** Always in the **F** mode or when the travel pressure switch is turned on, 24V is output to the solenoid valve and pressure setting increases. It increases while travel pressure switch is **ON** (no timer setting). It is not displayed on the monitor. In turning **ON** the one-touch digging force **UP** switch in this condition, digging force **UP** appears on the monitor for 8 seconds.
Though it is in the travel plus an attachment condition (one-touch digging force **UP** switch **OFF**) the pressure setting increases, and the pressure setting of the attachment also increases its pressure.

Pressure Increasing System *(continued)*
L Mode



A Even though the one-touch digging force **UP** switch is pressed, the voltage is not output to the solenoid valve, and a pressure increase is not obtained.

B Pressure raising is performed in **H**, **S** mode when travel pressure switch is **ON**. A pressure increase is obtained in travel plus an attachment function.

F Mode

When **F** mode is set, voltage is output to the solenoid valve regardless of one-touch digging force **UP**, and results in pressure raising condition.

Result

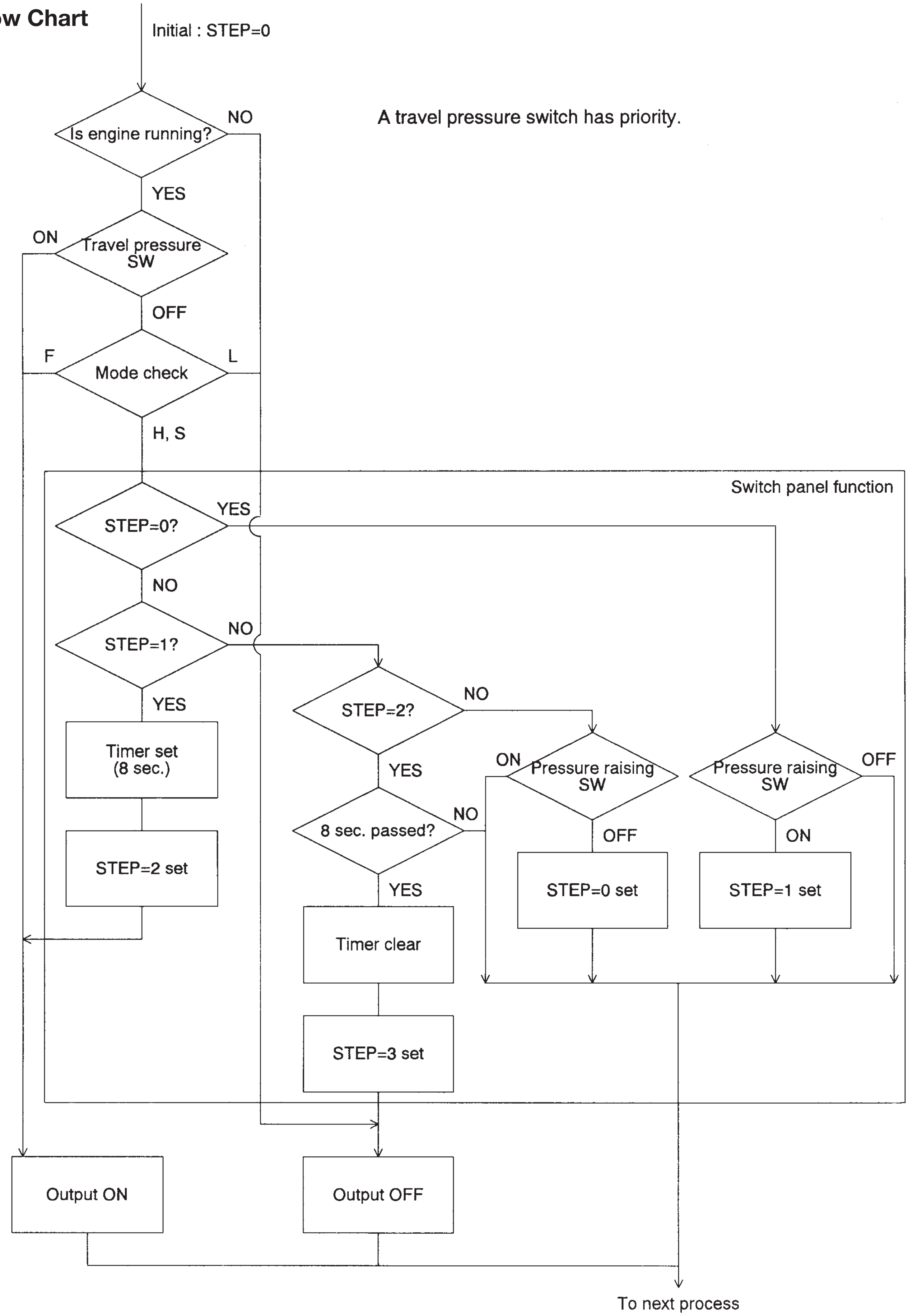
1. A pressure increase is obtained when the travel lever is moved (not displayed on the monitor).

2. There is a pressure increase when travel and an attachment function is called for, even though the digging force **UP** switch is not pressed.

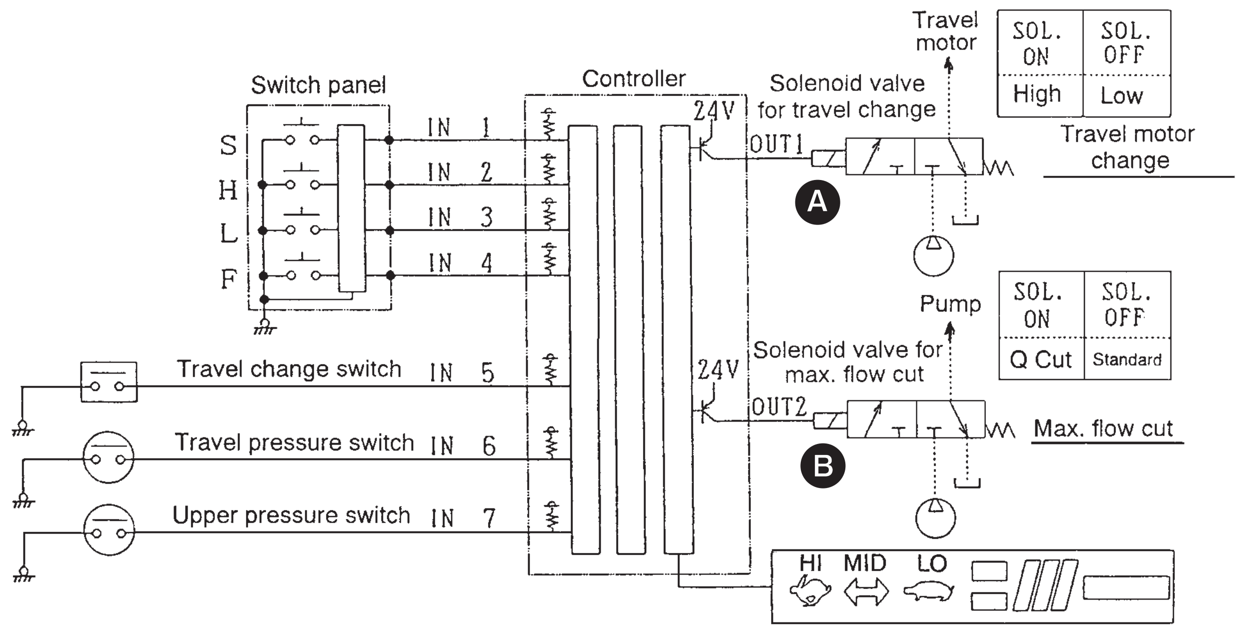
3. **H**,**S**,**F** mode: pressure increases during an attachment function. However, in **H**, **S** mode digging force **UP** switch must be pressed. It is displayed on the monitor. In **F** mode, the pressure will always increase for improvement of lifting work ability. It is not displayed on the monitor.

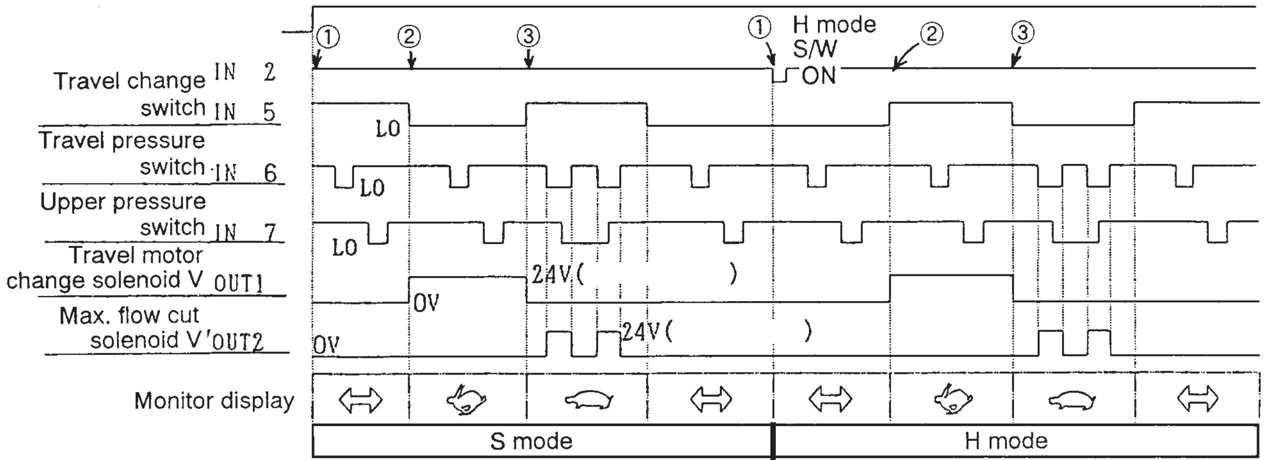
Pressure Increasing System *(continued)*

Flow Chart



3-Speed Travel and Max. Flow (Q) Cut



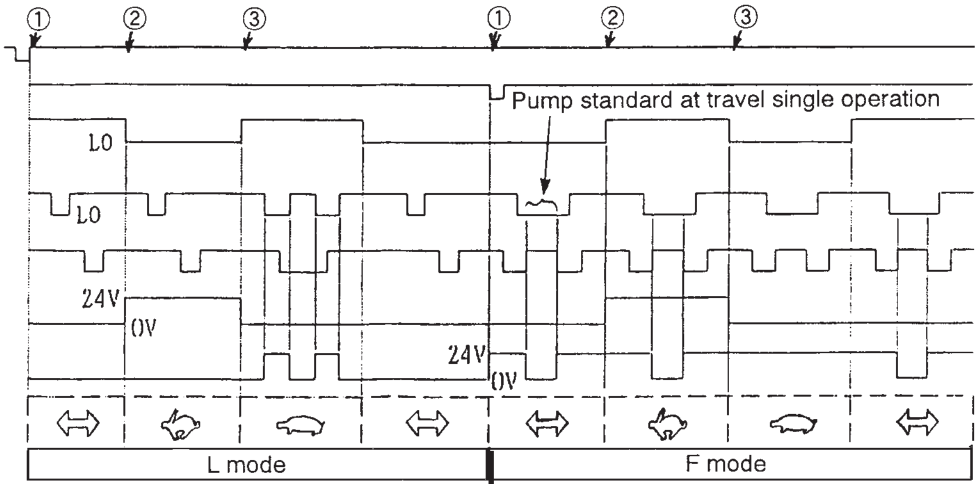


1. **Travelling at middle speed** (always middle speed as the key is switched **ON**).
   Even though travel and upper pressure switches are ON, there is no output to solenoid valves **A** and **B**.
   Travel motor swash plate is in low speed position.
   Pump: Standard flow.
2. **Travelling at high speed** (pressing IN5 switch once when travelling at middle speed, shifts to high speed.)
   The travel motor switching solenoid valve turns ON and swash plate of the motor shifts to high speed position.
3. **Travelling at low speed** (pressing IN5 switch once when travelling at high speed, shifts to low speed.)
   When a travel pressure switch is switched, the max. flow cut solenoid valve turns ON and flow (Q) is cut. Swash plate of the motor shifts to low speed position.
   Pump flow is cut.
   When upper pressure switch is turned on, max. flow rate cut solenoid valve is de-energised to prevent excavator circuits being slowed

1. **At middle speed travel**
   Travel motor swash plate: low side
   Pump: Standard
2. **At high speed travel**
   Travel motor swash plate: Upper side
3. **At low speed travel**
   Pump: Q cut

Same as in S mode.

3-Speed Travel and Max. Flow Cut *(continued)*



1. **At middle speed travel**
   Travel motor swash plate: low side
   Pump: Standard
2. **At high speed travel**
   Travel motor swash plate: Upper side
3. **At low speed travel**
   Pump: Q cut

Q cut is done by **F** mode using the **ON** signal of upper pressure S/W for the first time.

1. **At middle speed travel**
   - Travel only operation — Travel motor swash plate: Low side; Pump: Standard
   - Upper only operation — Pump: Q cut
   - Travel + upper combined — Travel motor swash plate: Low side; Pump: Q cut
2. **At high speed travel**
   - Travel only operation — Travel motor swash plate: Upper side; Pump: Standard
   - Upper only operation — Pump: Q cut
   - Travel + upper combined — Pump: Q cut
3. **At high speed travel**
   - Travel only operation — Travel motor swash plate: Low side; Pump: Standard
   - Upper only operation — Pump: Q cut
   - Travel + upper combined — Travel motor swash plate: Low side; Pump: Q cut

3-Speed Travel and Max. Flow (Q) Cut *(continued)*

Relation of Travel Mode and Motor Swash Plate, Pump Quantity Cut

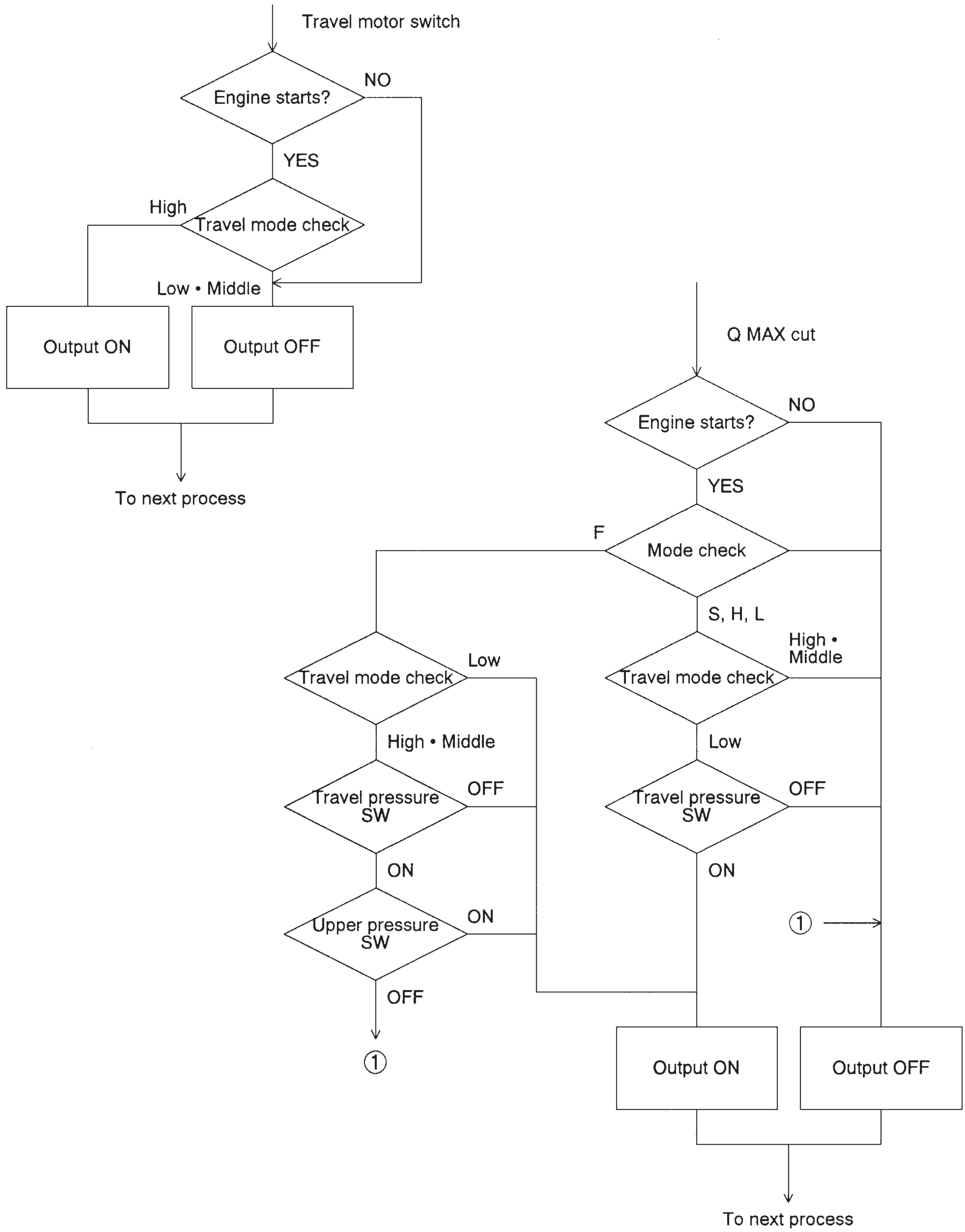
	High Speed	Middle Speed	Low Speed
Travel motor	Upper side	Low side	Low side
Pump output quantity	Standard	Standard	Q cut

Relation of Travel Mode and Motor Swash Plate, Pump flow (Q) Cut

Work mode is independent.
However, since **MAX**. rotation changes by the working mode, the travel speed changes by travel mode, and working mode.

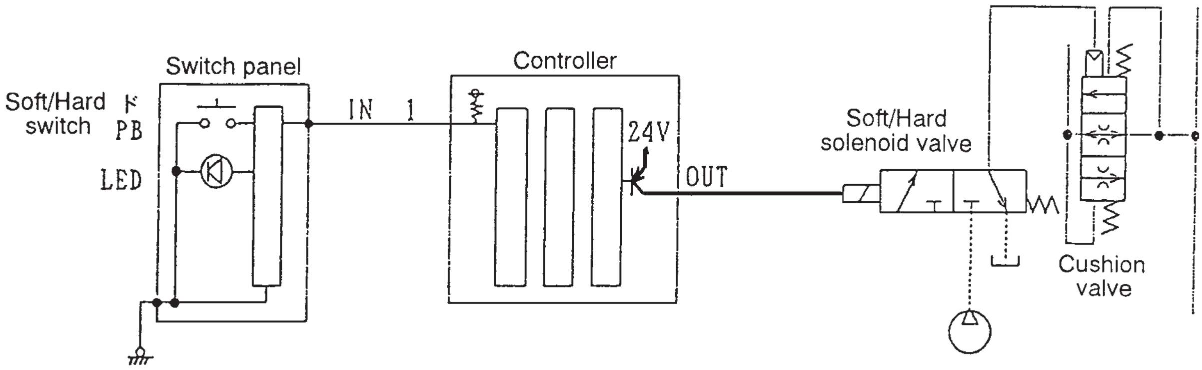
3-Speed Travel and Max. Flow Cut *(continued)*

Flow Chart

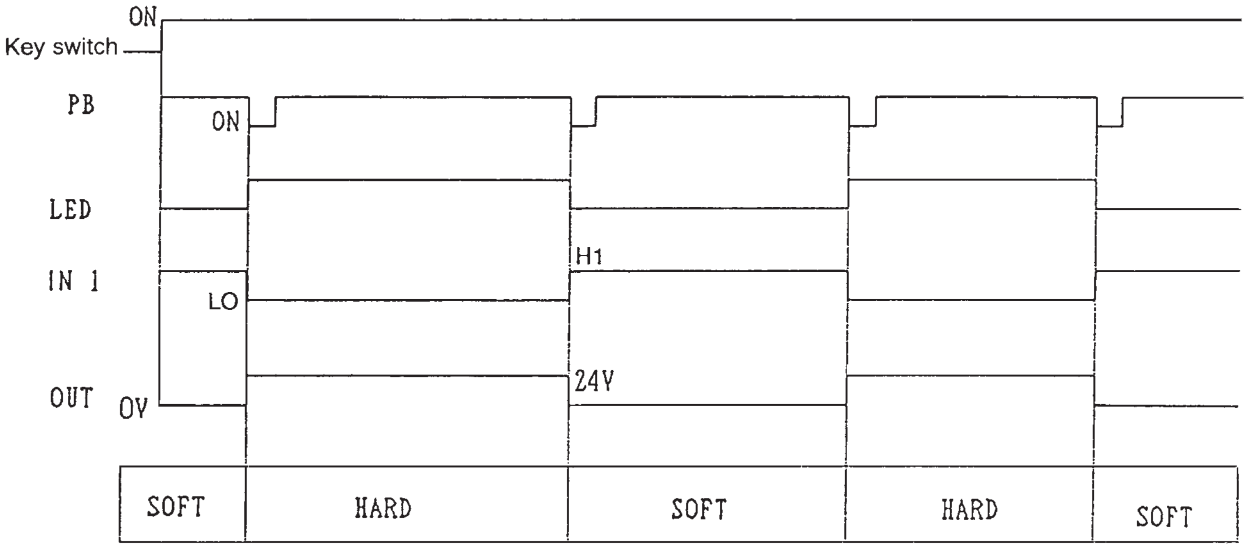


Cushion (Soft/Hard) Switch

Circuit Diagram



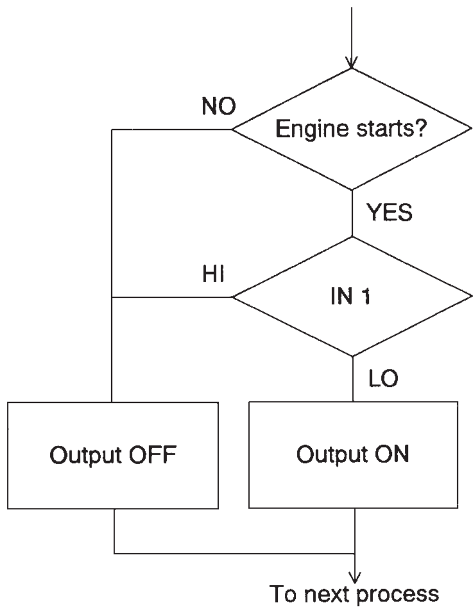
Time Chart



Flow Chart - Cushion (Soft/Hard) Switch

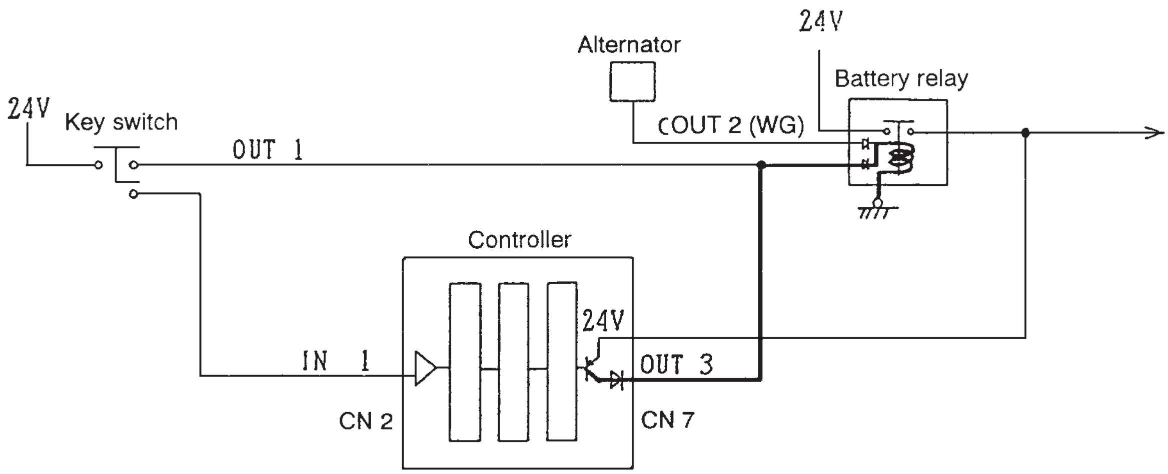
Output to the soft/hard solenoid valve is **OFF** when key switch is **ON**. This is its SOFT status

After the engine is started, the signal received from the panel switch is altered. The signal of IN1 turns to LO, and 24V is output to the solenoid valve from the controller. When the solenoid valve switches, the hard condition exists.

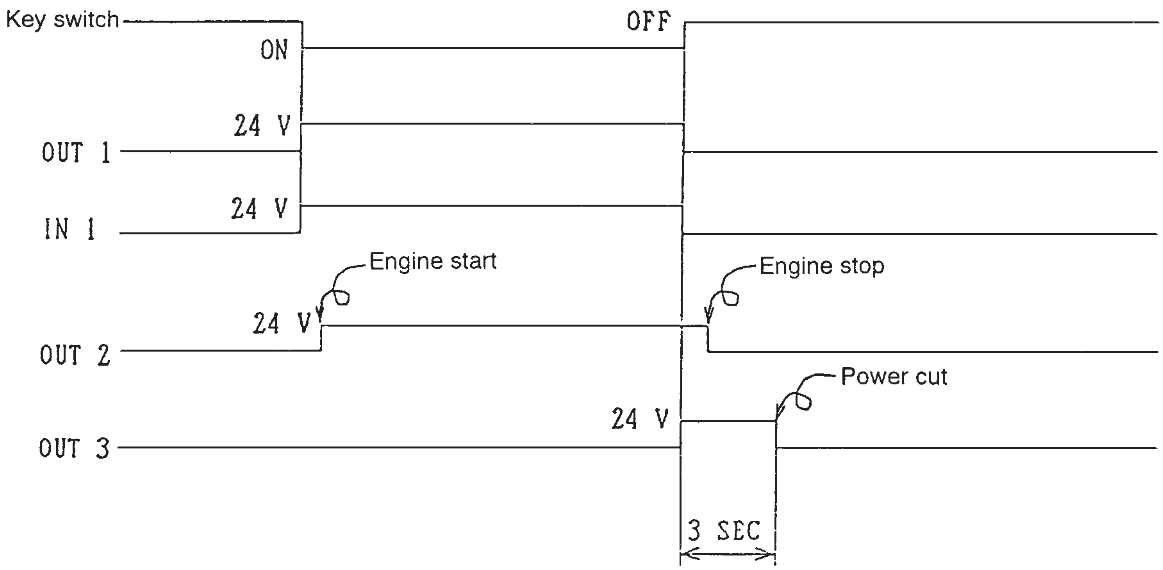


Power Supply Cut Delay

Circuit Diagram



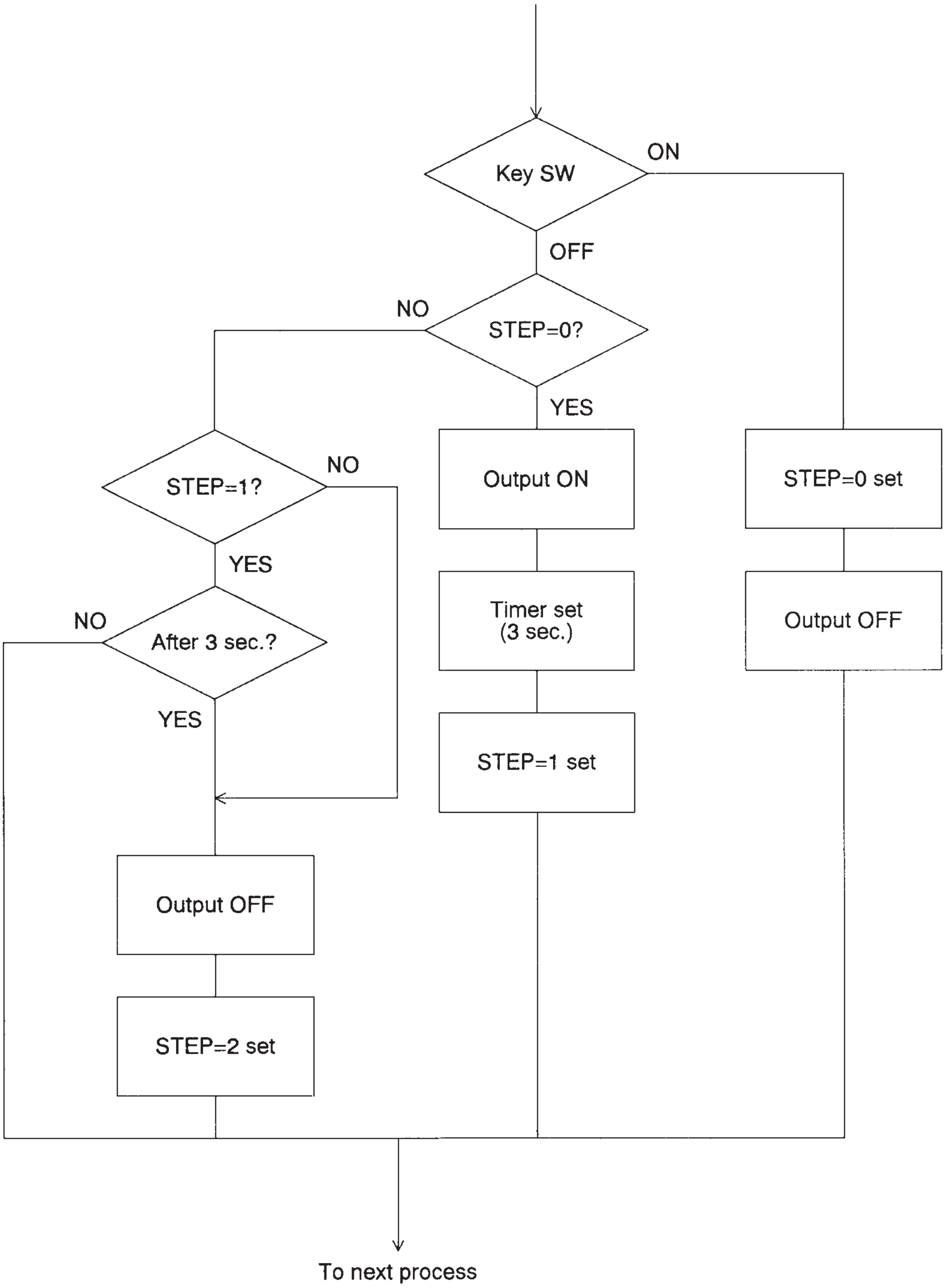
Time Chart



When the signal (IN1) from the key switch is turned **OFF**, 24V from OUT 3 is output from the controller for 3 seconds. After 3 seconds the output of OUT 3 stops, and power to the coil from the electric battery relay is cut, contacts on the electric battery relay break, and the power supply is cut.

Power Supply Cut Delay

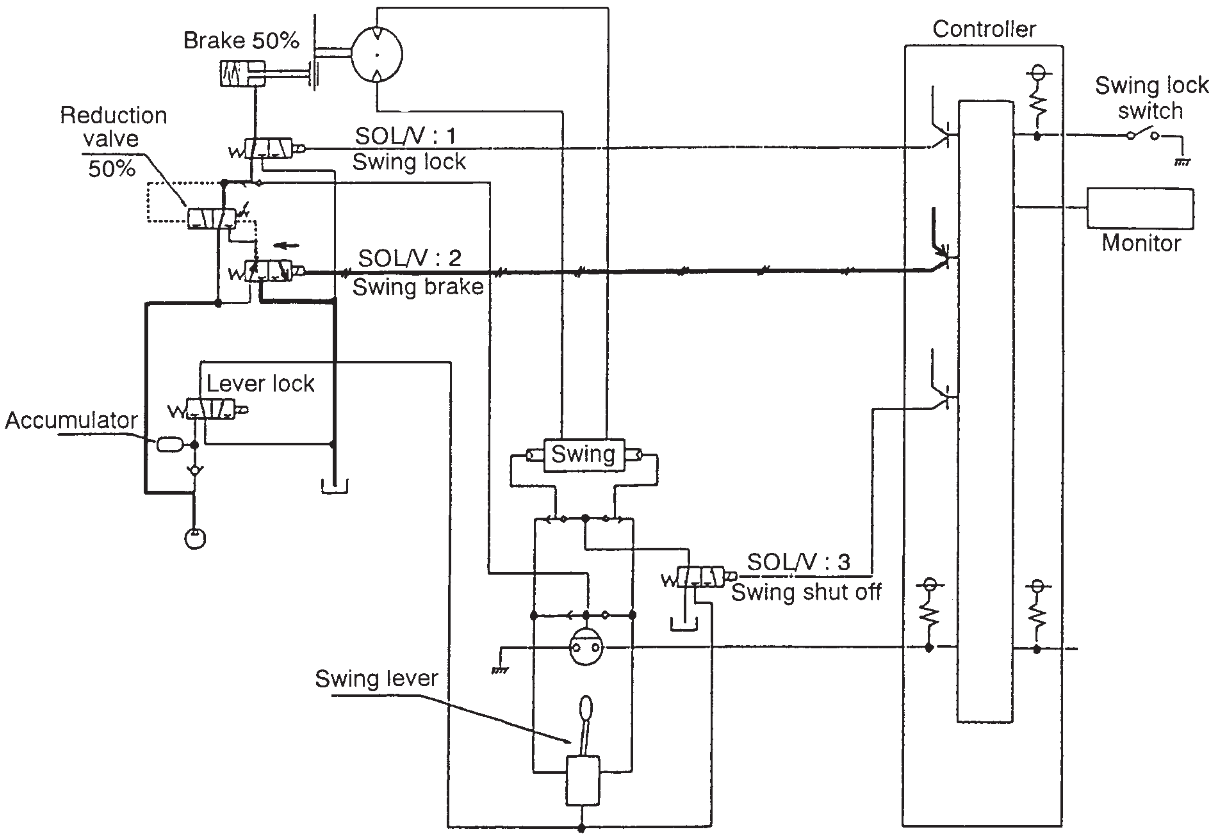
Flow Chart



Swing Brake/Swing Lock

(1) Swing Brake

1) Engine is running and swing lever is in neutral (50% brake).

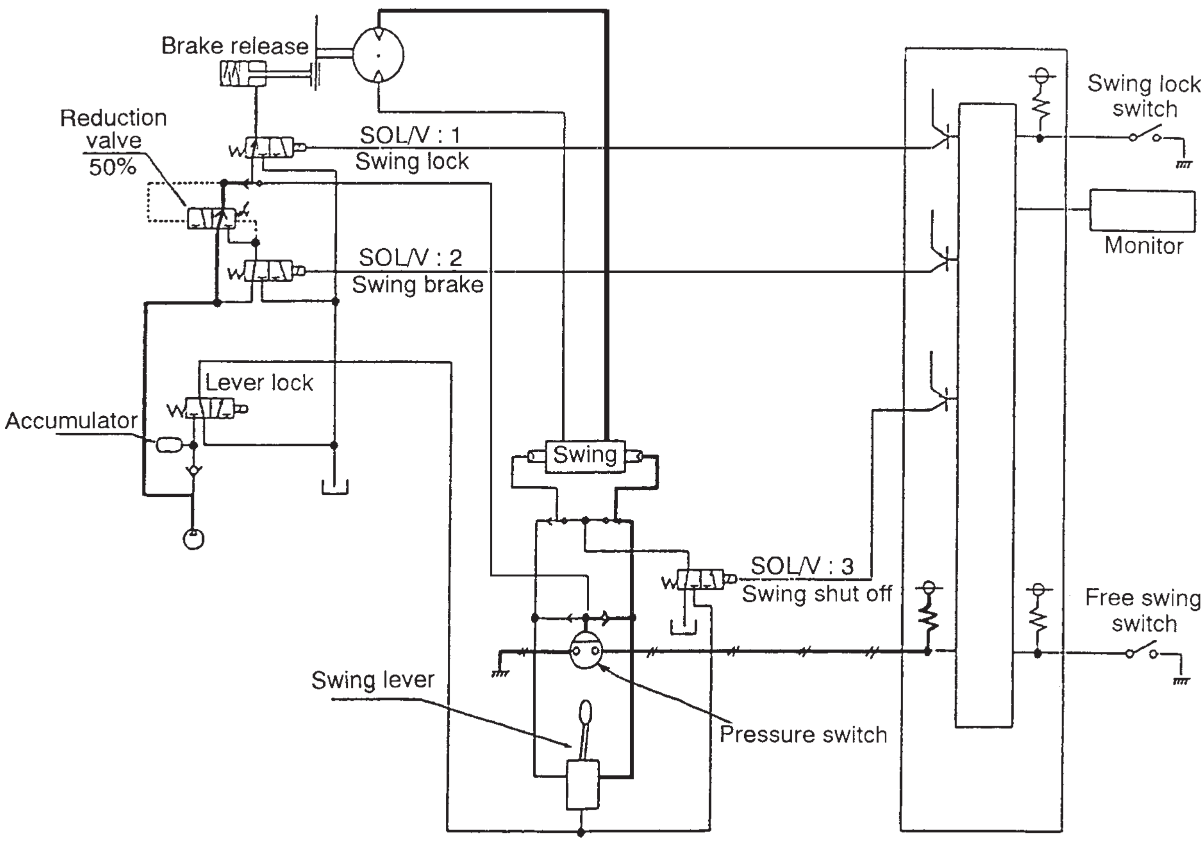


Swing lever	Swing lock SW	SOL:1 100% lock	SOL: 2 50% brake	SOL: 3 Shut off	Monitor (Ⓟ)
OFF	OFF	OFF	**ON**	OFF	

24V is output to the swing brake solenoid valve (SOL:2), the pilot pressure which ran through the pressure reducing valve enters the swing motor, and operates with a braking force of 50%.

Swing Brake/Swing Lock *(continued)*

2) Engine is running and swing lever operation (brake release)



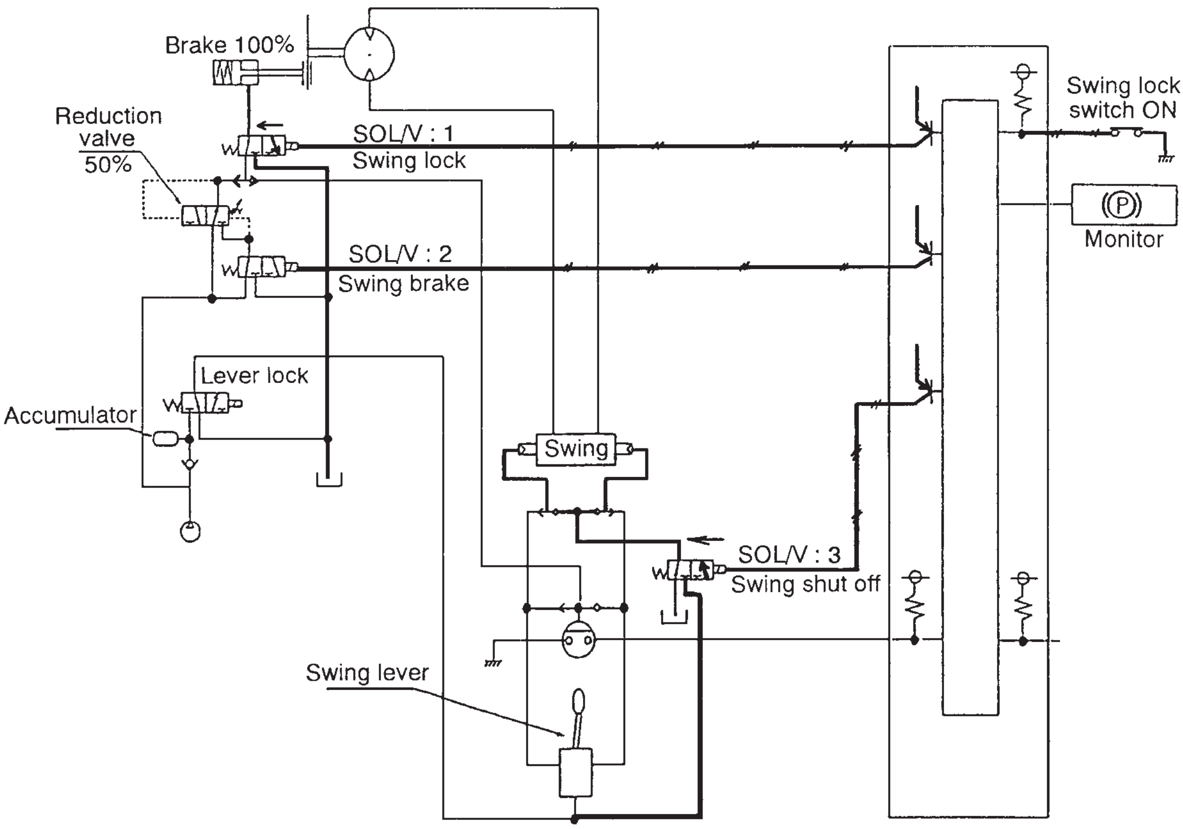
	Swing lever	Swing lock SW	SOL:1 100% lock	SOL: 2 50% brake	SOL: 3 Shut off	Monitor (P)
	OFF	OFF	OFF	**ON**	OFF	
a.	**ON**	OFF	OFF	OFF	OFF	
b.	OFF	OFF	OFF	5 sec. after lever in neutral **ON**	OFF	

a. In operating the swing lever, the signal of the pressure switch enters the controller, and the output to the swing brake solenoid valve (SOL: 2) is turned **OFF**. Pilot pressure enters directly, and the brake is fully released.

b. In returning the swing lever to neutral, the signal of the pressure switch goes **OFF**. The computer then outputs 24V on the swing brake solenoid valve (SOL: 2) and after the 5 seconds delay the brake operates at 50%.

Swing Brake Swing Lock *(continued)*

(2) Swing Lock (Swing Lock Switch ON, 100% Brake)



Swing lever	Swing lock SW	SOL:1 100% lock	SOL: 2 50% brake	SOL: 3 Shut off	Monitor (Ⓟ)
OFF	**ON**	5 sec. after lever in neutral **ON**	**ON**	**ON**	**(Ⓟ)**

When the swing lock switch is turned on

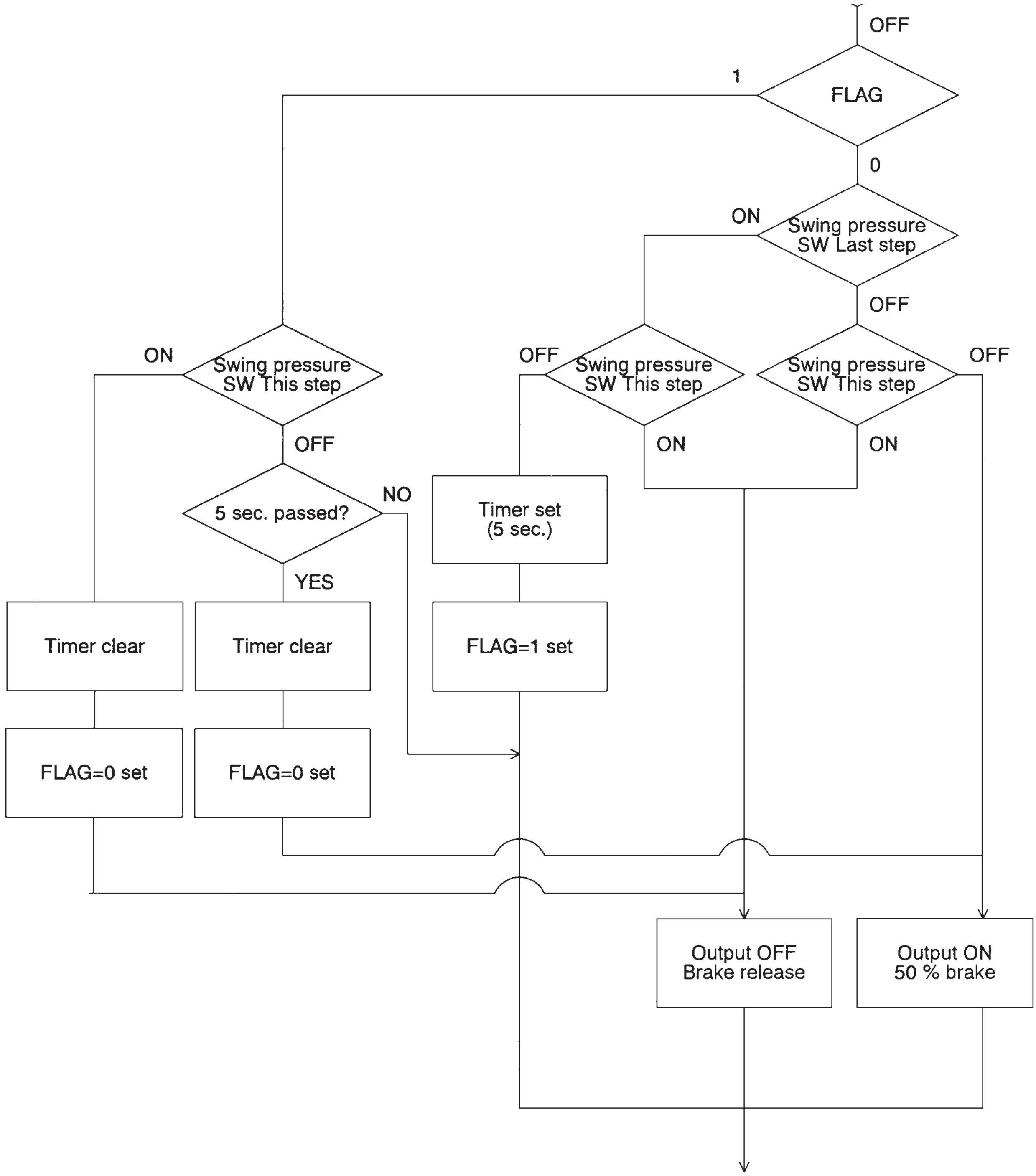
a. 24 V is output to the swing shut off solenoid (SOL:3) and the solenoid valve shifts. Pilot pressure enters both ends of the swing section of the control valve, and the pilot pressure is then shut off instantly (spool of control V does not move).

b. After 5 seconds, 24V is output to the swing lock solenoid valve (SOL: 1) and the solenoid valve shifts. Oil within the brake piston of the motor flows to the tank. The brake locks by torque at 100%.

c. Also 24V is output on the swing brake solenoid valve (SOL; 2) and the solenoid valve shifts.

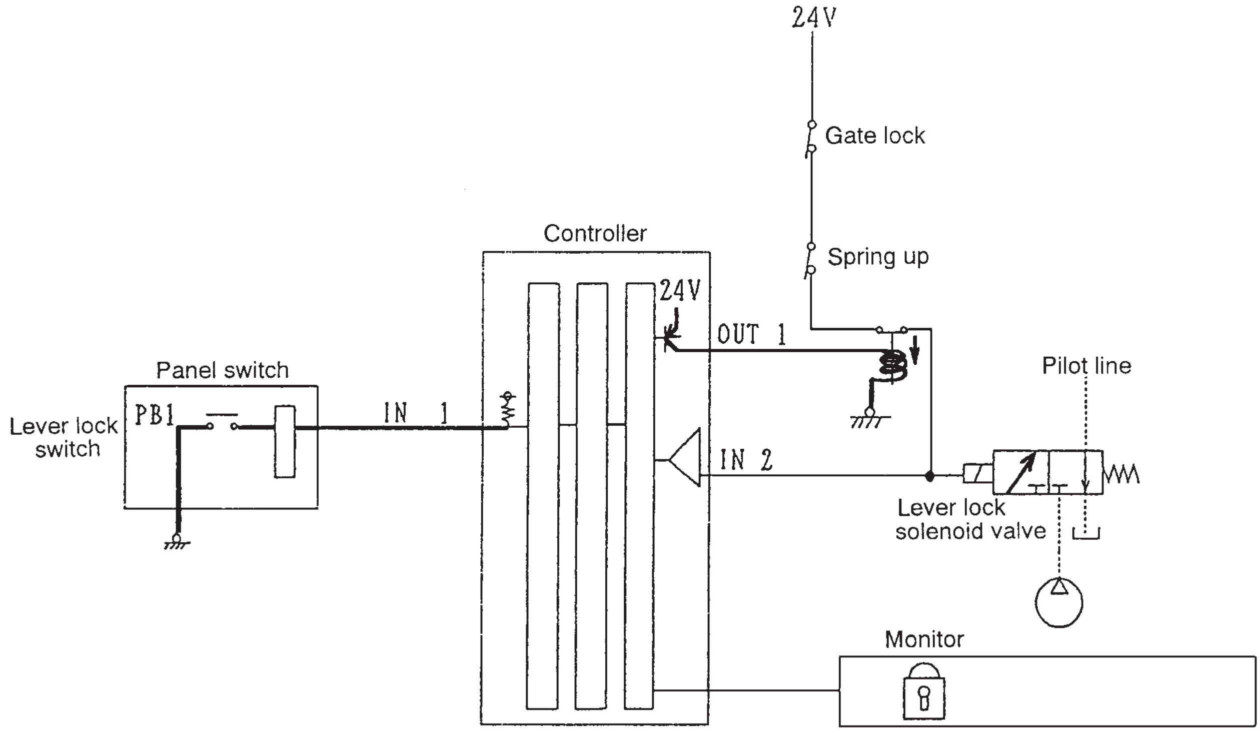
Swing brake/Swing lock *(continued)*

Flow Chart

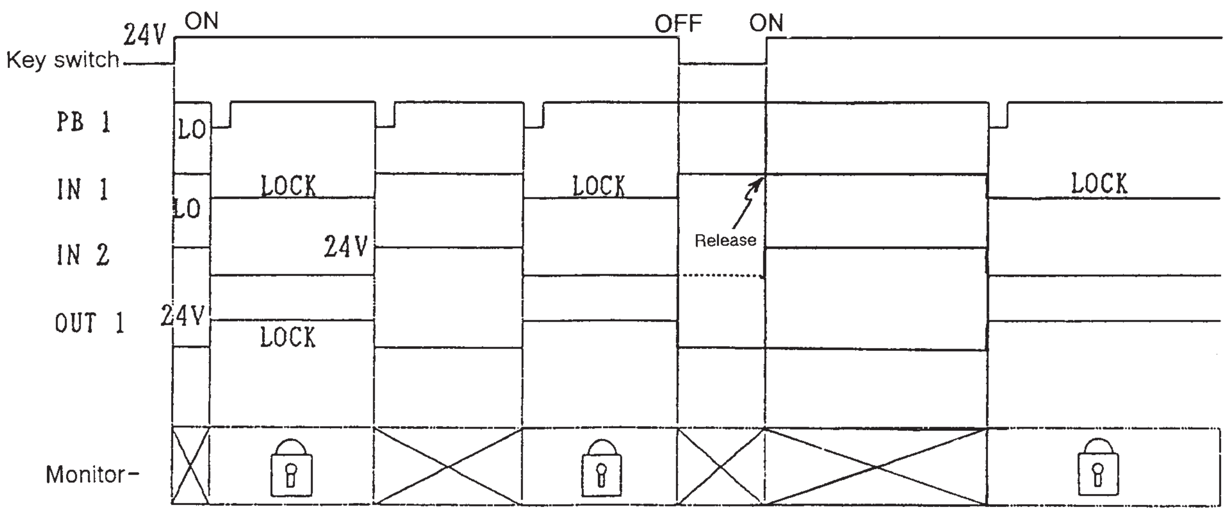


Lever Lock

Circuit Diagram

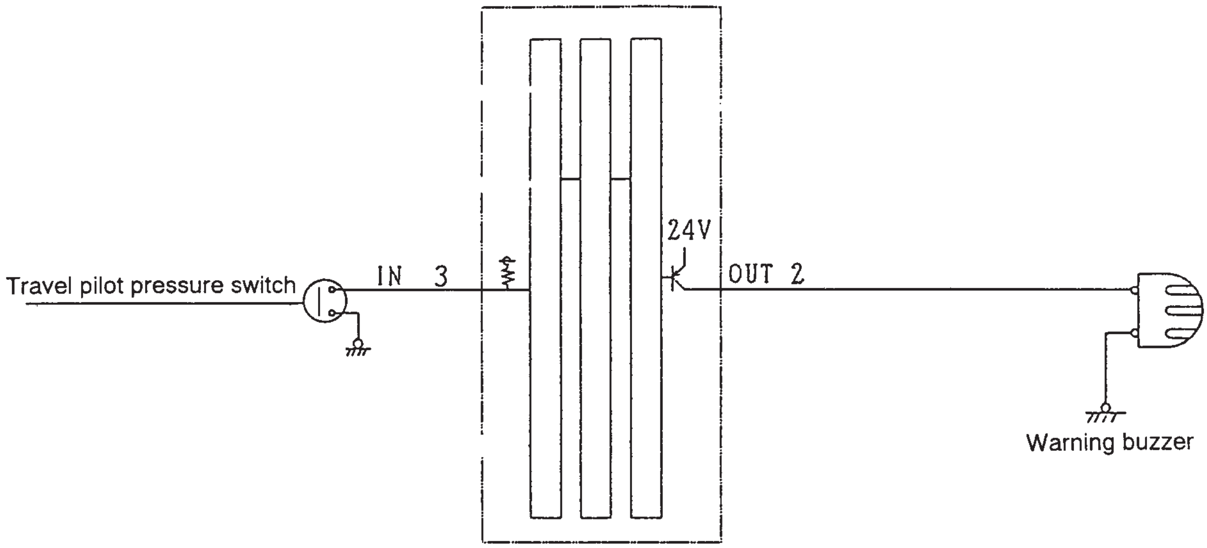


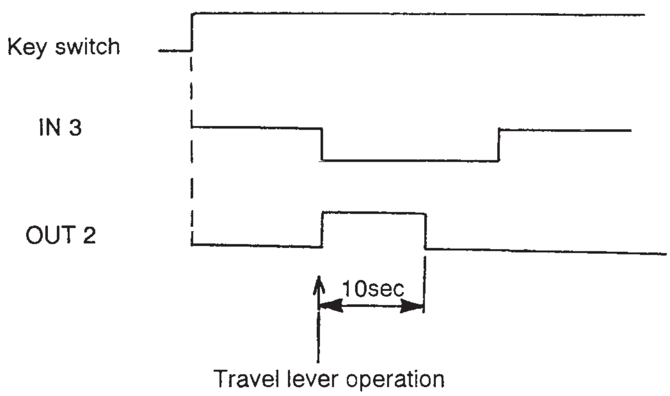
Time Chart



Travel Warning

Circuit Diagram

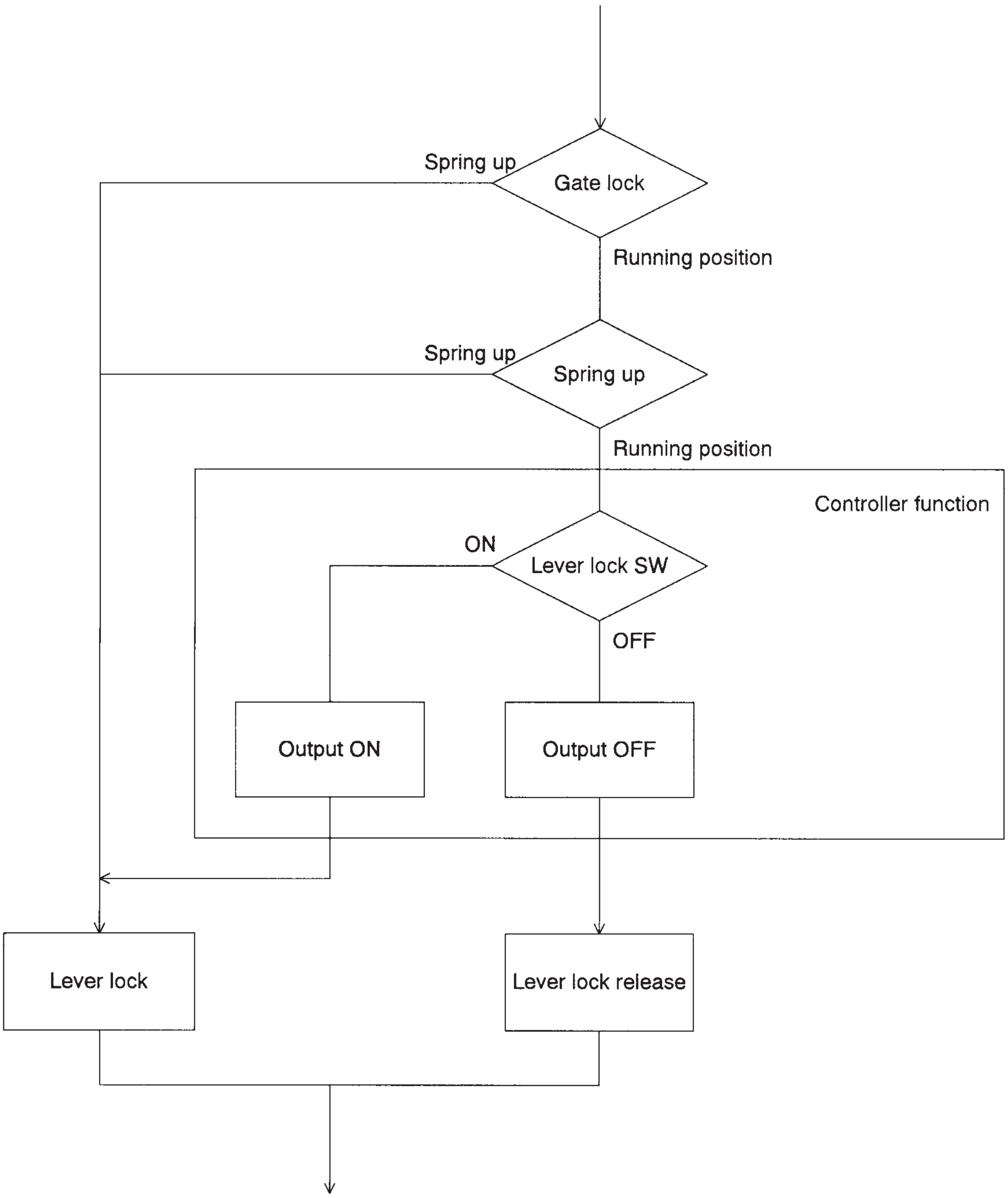




A travel pilot pressure switch is turned **ON** by travel lever operation and 24V is output for 10 seconds to the buzzer.

Lever Lock *(continued)*

Flow Chart



Power Transistor Protection

Controller

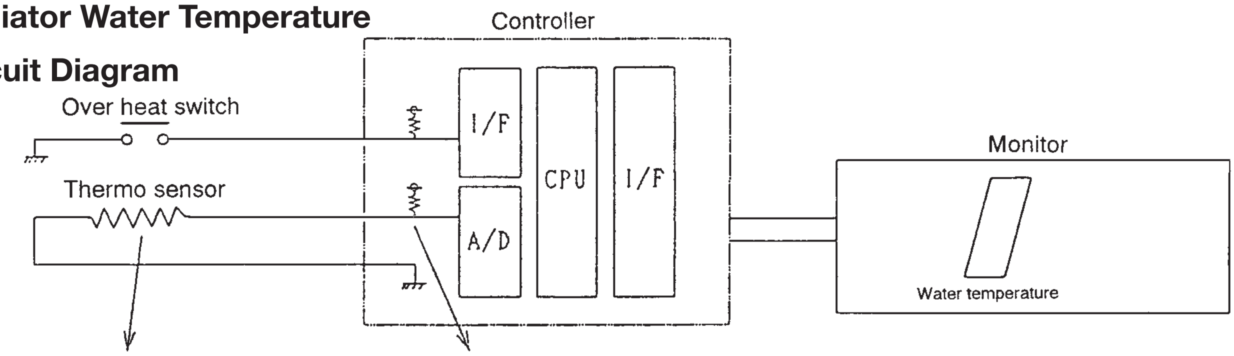
Position	
8	Spare
7	Spare
6	Spare
5	Swing shut off solenoid V
4	Lever lock solenoid V
3	Travel alarm
2	Pressure raising solenoid V
1	Free swing solenoid V
16	Negative control solenoid V
15	Spare
14	Spare
13	Soft/Hard change solenoid V
12	Max. flow cut solenoid V
11	Swing lock solenoid V
10	Warning lamp
9	Boom lowering speed regulation solenoid V
20	Travel 2-speed change solenoid V
19	Swing brake solenoid V
18	Heating relay
17	Battery relay

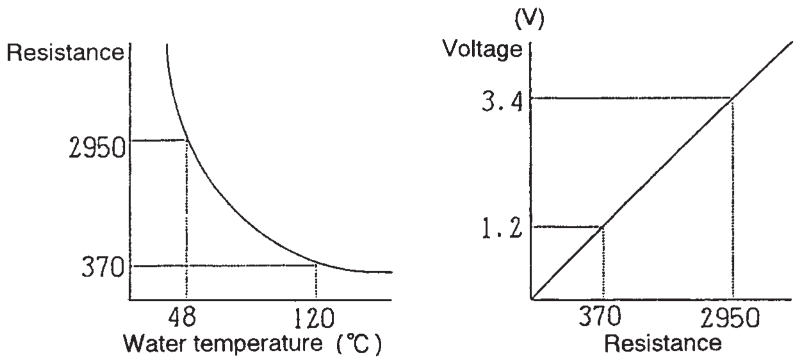
If a solenoid valve or relay is shorted, it stops the output of a power transistor, in order to protect the controller. 'Electric system abnormality' is indicated at this time in message display. By performing a self check, the position of the abnormality is indicated. Check wiring and components of the relevant circuit.

Display Monitor

Radiator Water Temperature

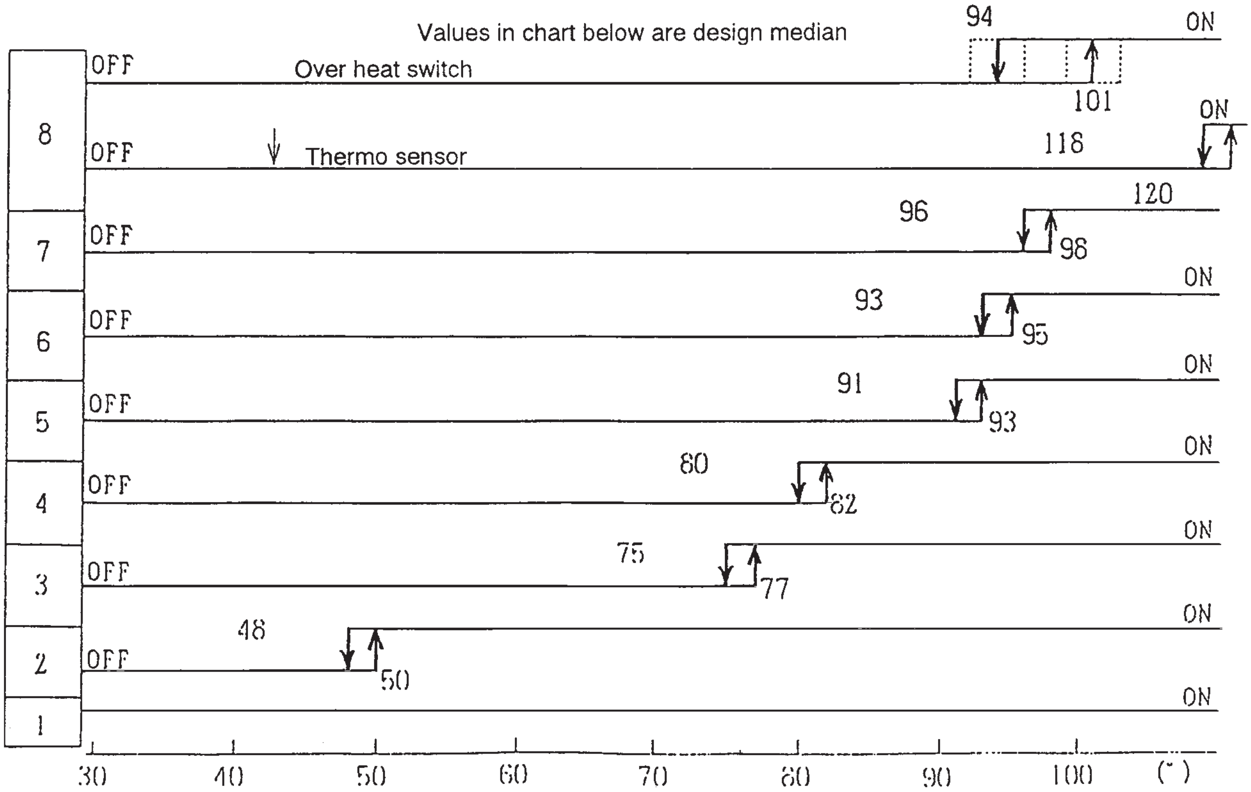
Circuit Diagram





1. Overheat switch position and the **ON** signal of the thermostat sensor are OR processed and number 8 is lit.
2. Overheat switch position and the **OFF** signal of the thermostat sensor are AND processed and number 8 turns off.
3. Number 8 is lit on the condition that numbers 1-7 are lit.
4. When numbers 1-7 are off and the signal for number 8 is transmitted, they light-up in numerical sequence after a 30 second delay.
5. Number 7 is put out on the condition that number 8 is turned out.
6. If the signal to switch off number 7 is transmitted when number 8 is lit, the lights-out signal of the Thermostat sensor must also occur.
7. When number 8 is lit, 'OVER HEAT' is indicated.

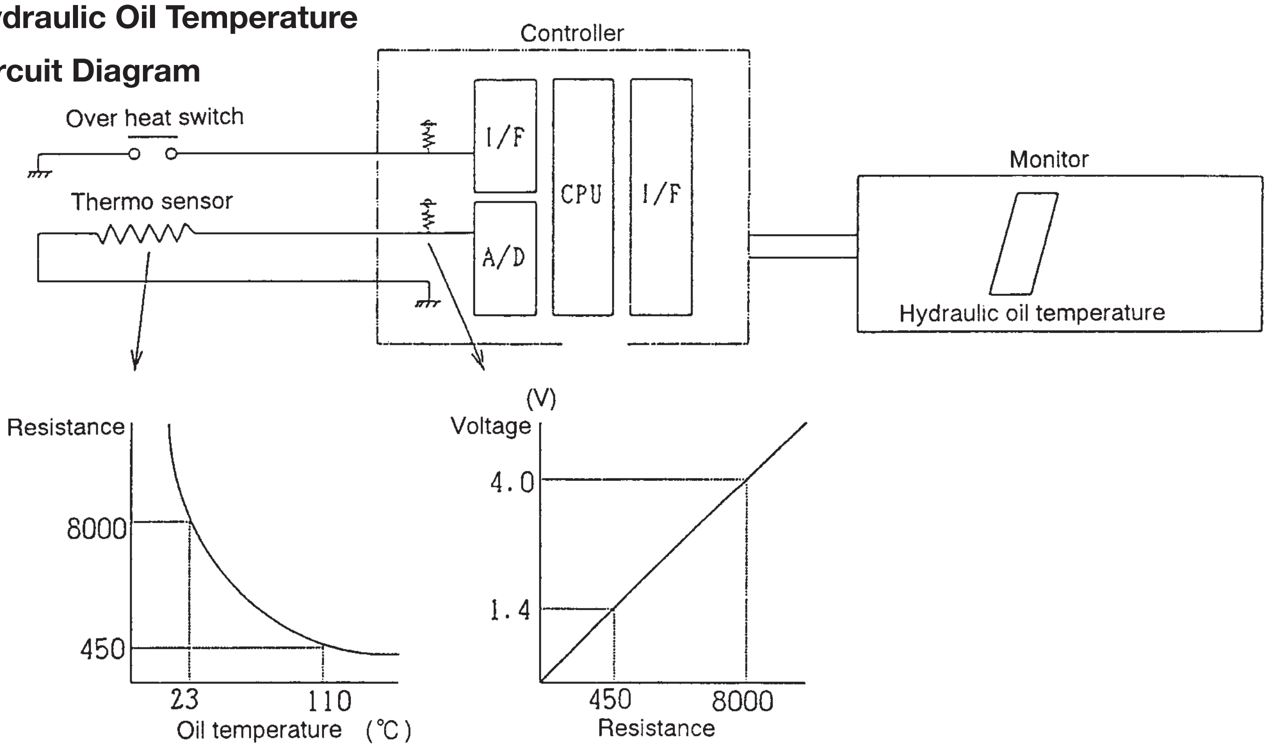
Values in chart below are design median



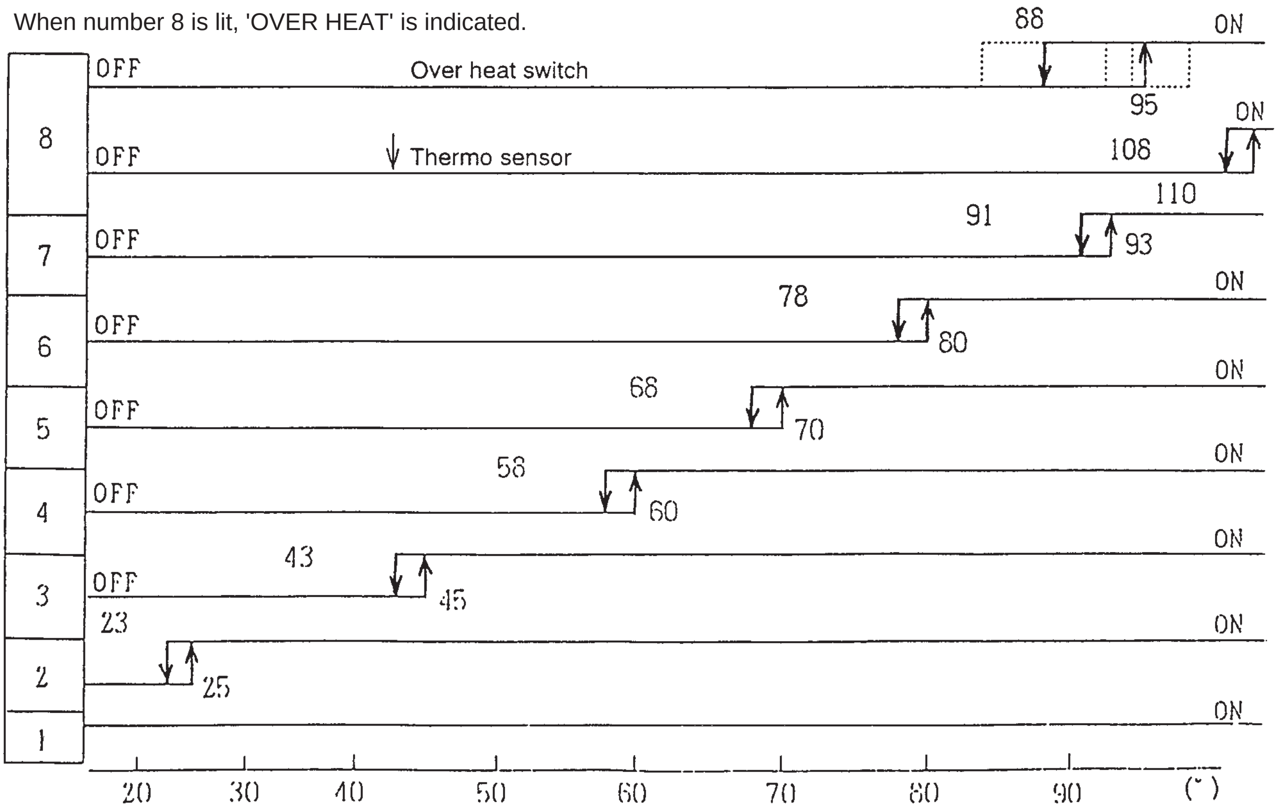
Display Monitor *(continued)*

Hydraulic Oil Temperature

Circuit Diagram



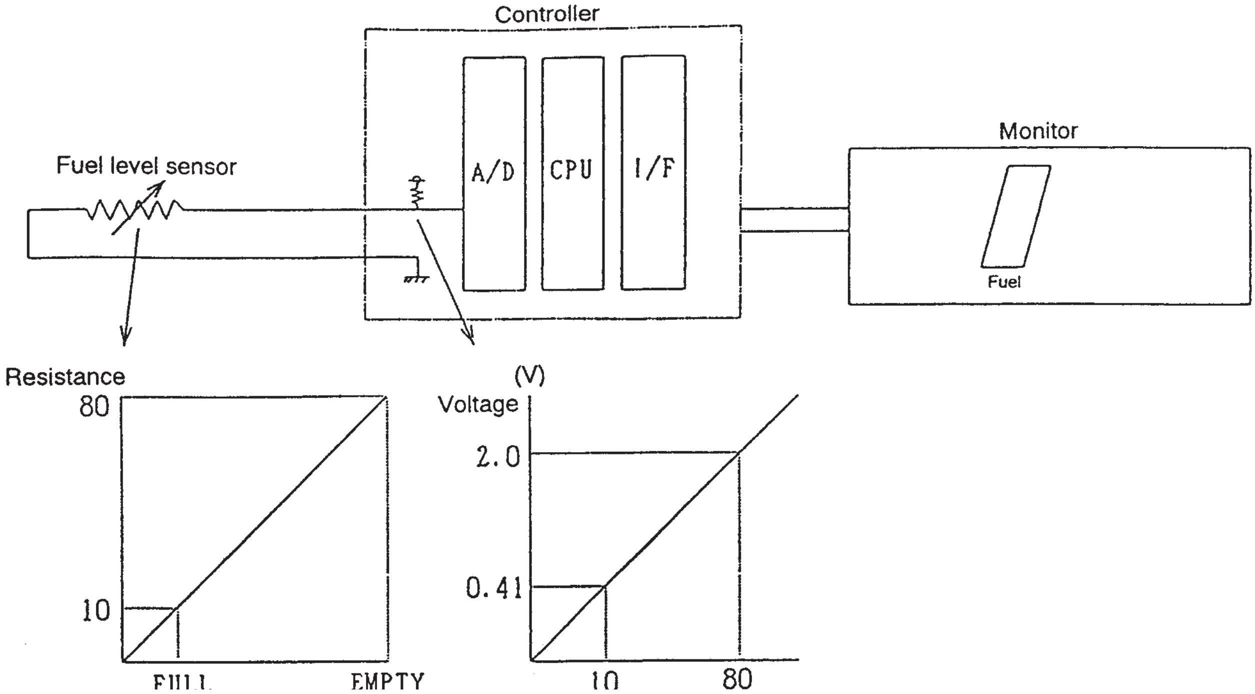
1. Overheat switch position and the **ON** signal of the thermostat sensor are OR processed and number 8 is lit.
2. Overheat switch position and the **OFF** signal of the thermostat sensor are AND processed and number 8 turns off.
3. Number 8 is lit on the condition that numbers 1-7 are lit.
4. When numbers 1-7 are off and the signal for number 8 is transmitted, they light-up in numerical sequence after a 30 second delay.
5. Number 7 is put out on the condition that number 8 is turned out.
6. If the signal to switch off number 7 is transmitted when number 8 is lit, the lights-out signal of the Thermostat sensor must also occur.
7. When number 8 is lit, 'OVER HEAT' is indicated.



Display Monitor *(continued)*

Fuel Remaining

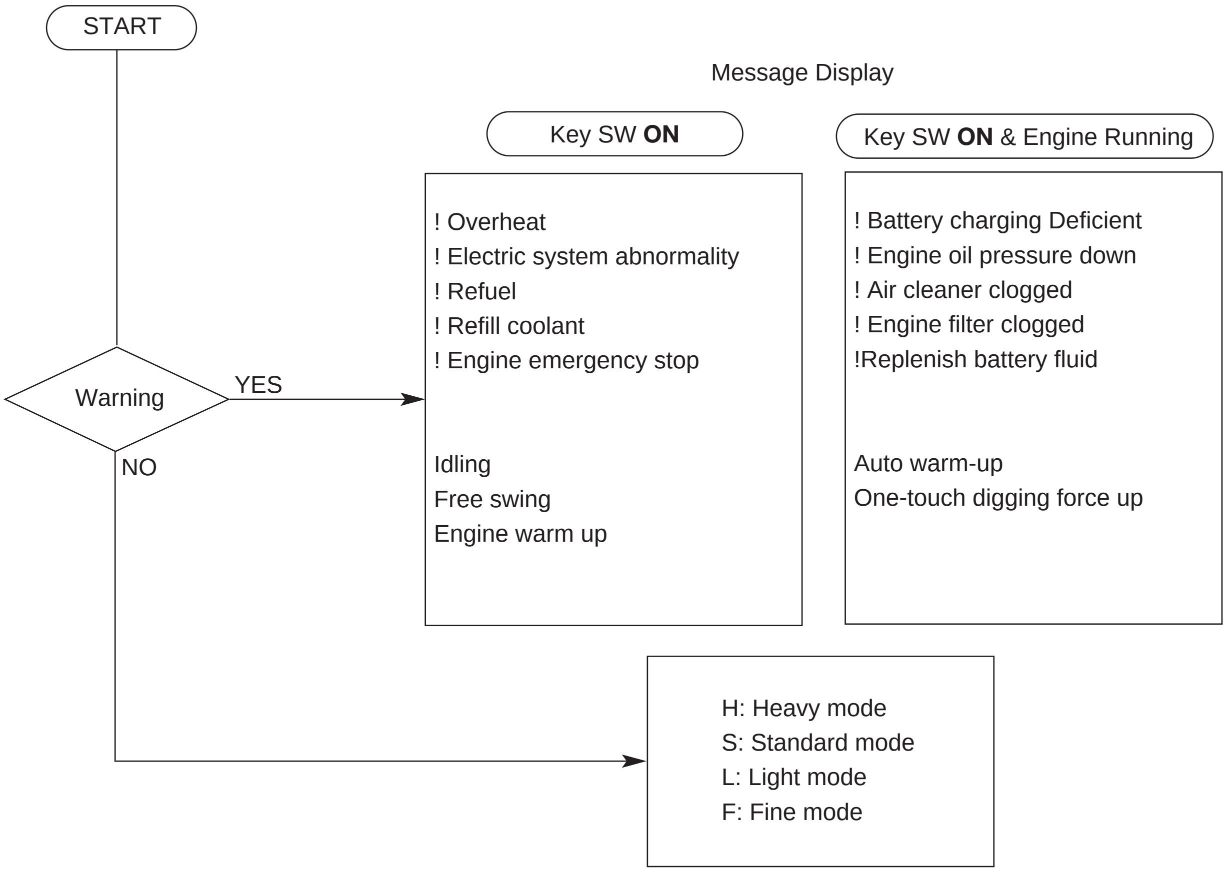
Circuit Diagram



FUEL REMAINING (litres)	RESISTANCE (OHM)	MONITOR
284~	13~10	8
243~284	21~13	7
200~243	27~21	6
158~200	34~27	5
115~158	44~34	4
72~115	59~44	3
39~72	78~59	2
39	80~78	1 (1 hour left - Refuel)

Display Monitor *(continued)*

Warning Display (Message Display)



Note 1: If several instructions are displayed they appear alternately every 5 seconds.

Note 2: When AUTO GLOW warm-up is finished, buzzer is sounded for 3 seconds.

!	Engine emergency stop	Engine emergency stop (emergency stop switch **"ON"**) is displayed.
!	Refuel	Fuel amount indicated if low. Check, and supply fuel.
!	Refill coolant	Coolant level is low. Check and supply cooling water.
!	Replenish battery fluid	Battery liquid level sensor is not fitted. Fault should not be displayed.
!	Air cleaner clogged	Air cleaner element is clogged. Wash or replace element.
!	Engine oil pressure down	Pressure of engine oil low. Check engine oil quantity, and replenish if low.
!	Engine filter clogged	Engine oil filter is clogged. Replace engine oil filter. (When replacing engine oil filter, also replace engine oil).
!	Over heat	Engine coolant or hydraulic oil temperature is high. Turn engine to low idling, to lower the water or oil temperature. (Check radiator, and clean it.)
!	Battery Charging Deficient	Abnormal charging system is displayed. Check the electric circuit.
!	Electric system abnormality	Abnormal electric system (short and disconnection) is displayed. Check the electric circuit.

Throttle Motor and Throttle Link Replacement

1. **Prepare the machine**
   Position the machine on level ground.
   Stop the engine and remove the starter key.

2. **Locate the throttle motor and link**

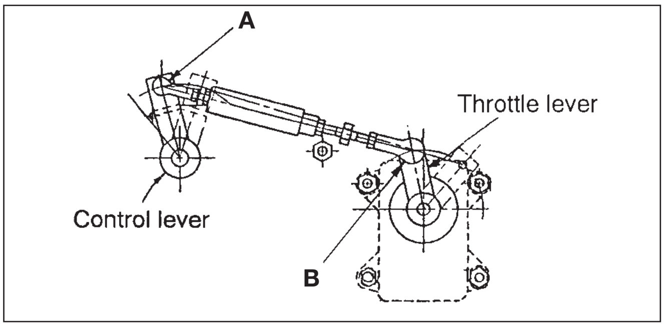
   *See **Component Location Diagram in Routine Maintenance**.*

Note: *Upon delivery of the Throttle motor the position of the output axis shaft is in a random position, so it needs adjusting.*

3. **Throttle motor replacement**
   Connect the wiring of the Throttle motor and switch it to the redundancy position.

   Position the motor so that the output shaft is rotated counter clockwise.

4. **Removal of Throttle Link**
   Remove the nuts of the throttle link at the control lever **A**, then remove the nuts on the opposite end of the throttle link at the throttle lever end **B**. Then remove the link without disassembly.



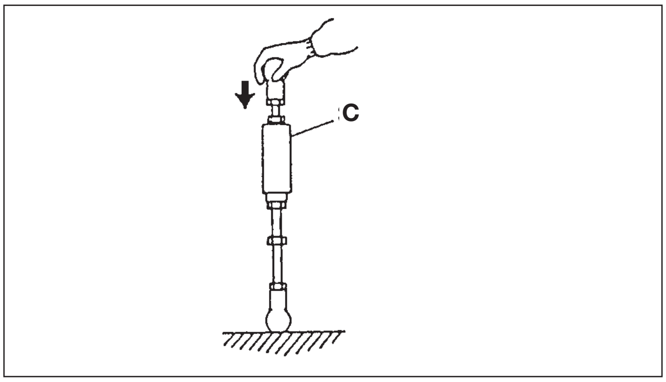
5. **Checking operation of Throttle Link**

   a. Confirm whether the Spring chamber **C** of the link operates normally before installing the throttle motor.

   b. Stand the link and press on it from the top, and confirm that the spring has compressed (approx 20 mm).

   c. If using the throttle link when the spring does not compress because of its internal corrosion, the motor will be damaged.

   d. If the spring does not compress, replace it.

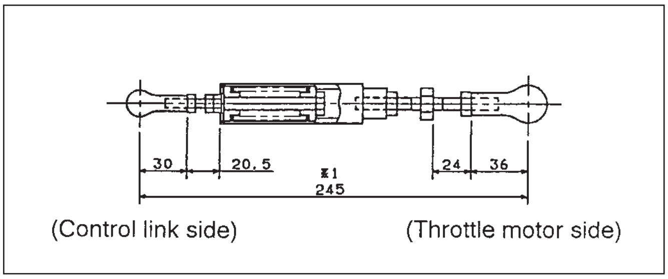


6. **Disassembly of throttle link**

   a. While it is possible to disassemble the link it is advisable to replace the unit with a new one.

   b. If it is disassembled, reassemble the unit to the dimensions shown opposite.

Note: *The overall dimensions shown are not fixed as each installation may vary.*

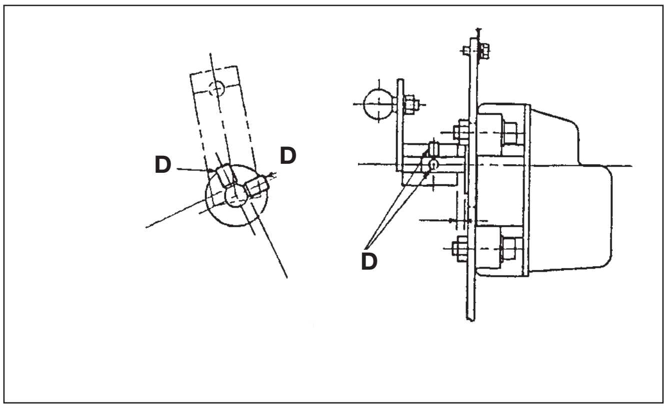


Throttle Motor and Throttle Link Replacement *(continued)*

7. Installation of the throttle link lever

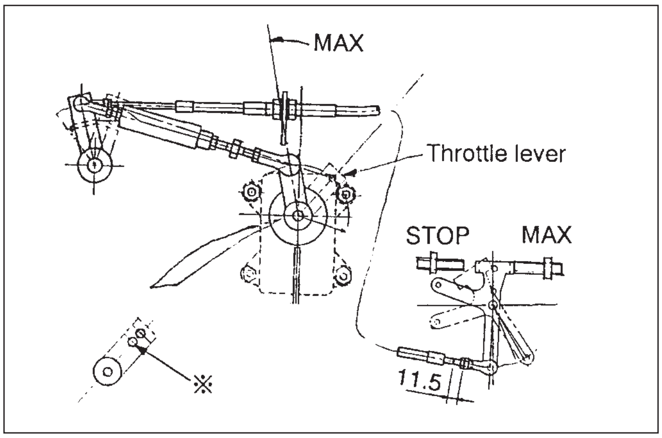
a. Install the lever on the new throttle motor without forcing it.

b. Coat the screws **D** with loctite before fastening.



8. Installation of the throttle link

a. After installation of the throttle motor, install the throttle links to the throttle lever and the control link.



9. Adjustment of Throttle Link

a. Switch it to redundancy.

b. Adjust the link of the engine side of the governor so that it hits the stopper bolt on the Max side of the throttle **UP** switch.

c. After checking that it does hit the screw, rotate the spring chamber out 3 Complete rotations (counter clockwise) from that position.

d. Adjust the length of the link so that the stroke of the spring chamber is 1.5-5mm.

10. Confirmation of Throttle Motor Operations

a. Confirm that the 'electric system abnormality' is not displayed in the monitor when the key switch is **ON**.

b. With the throttle volume at engine **MAX** position, confirm that the spring chamber contracts, after the link of the engine side governor hits the stop.

c. At the **STOP** side, with the throttle volume knob at the engine **MIN** position, confirm that the spring chamber contracts after the key switch is **OFF**.

Note: *Perform the automatic adjustment after confirmation of the above adjustment.*

Automatic Adjustment

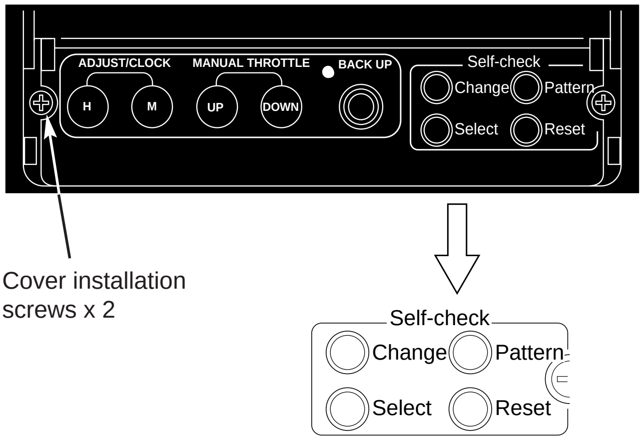
Always perform the automatic adjustment when the controller and or the throttle motor or linkage is replaced. The controller must be programmed to suit the machine model. There are differences in the controller's programming for various models and territories.

Initial Set-up of the Controller for Machine Identification

To set the machine, the controller's original programming must be cleared.

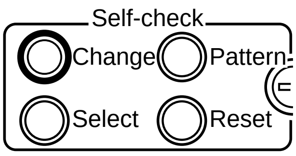
1 Remove plastic cover from around redundant mode switches.

*

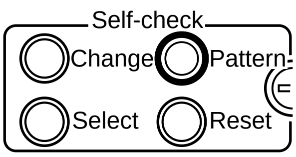


2 Switch ignition on.

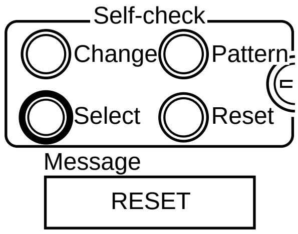
3 Press **CHANGE** button once.



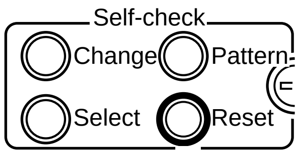
4 Press **PATTERN** button once.



5 Press **SELECT** button until **RESET** is displayed in the message display.



6 Press **RESET** button for 20 sec until buzzer sounds.

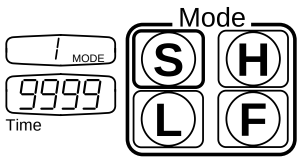


7 Switch ignition off.
Controller's original programme is now cleared.

8 Switch ignition on (9999 displayed).

* Initial Set-up of the Controller for Machine Identification (continued)

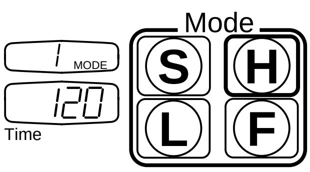
9 Repeatedly press **S** Mode switch until the monitor's desired language is displayed on the mode screen.



JS03260

LANGUAGE	MODE SCREEN
JAPANESE	0
ENGLISH	1
THAI	2
CHINESE	3
GERMAN	4
FRENCH	5
ITALIAN	6
SPANISH	7
PORTUGUESE	8
DUTCH	H
DANISH	L
NORWEGIAN	F
SWEDISH	EC
FINNISH	C

10 Repeatedly press **H** Mode switch until the machine model is displayed on the clock (last 3 digits).



JS03270

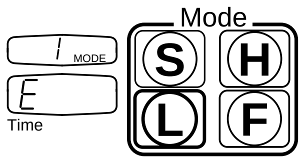
*

MODEL	CLOCK	MODE SCREEN
†JS 200/220	200	1
†JS 240/260	220	1

* † Including all variants.

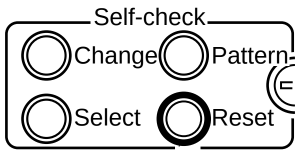
If the 4th digit in the clock window reads '9' (e.g. 129), press the 'F' mode switch until the 4th digit reads '0'.

11 Repeatedly press **L** Mode switch until 'E' is displayed on the clock (1st digit). All other displays are for non-JCB applications and are therefore not applicable.



JS03280

12 Press **RESET** button once.



13 Start engine.

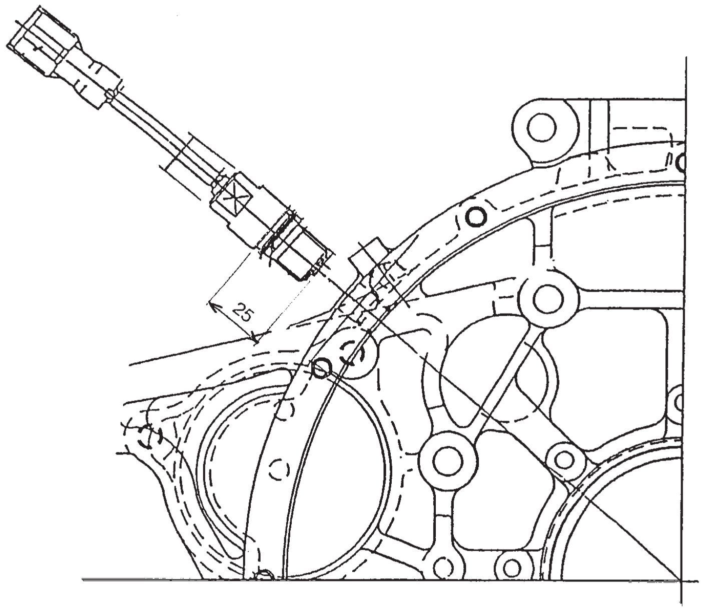
14 Press **CUSHION** switch once. The following sequence will occur:

1. Engine goes to maximum rpm - CAPS fine tunes for **H** mode.
2. Engine speed decreases by 100 rpm - CAPS fine tunes for **S** mode.
3. Engine speed decreases by a further 100 rpm - CAPS fine tunes for **L** mode.
4. Engine speed returns to idle - CAPS fine tunes idling speed.

Programming is complete when a digging mode is displayed in the message screen.

15 Switch the ignition off.

Revolution Sensor Removal and Installation



1. **Prepare the Machine**
   Position the machine on level ground.
   Stop the engine and remove the starter key.
2. **Locate the Flywheel housing**
   a. The flywheel housing is machined to accommodate the sensor.
   b. Remove the sensor by unscrewing it.

Note: *Check the 'O'-ring for damage or wear, replace if necessary.*

3. Installation is by screwing the sensor in the machined section at a torque of 44.13-53.0 Nm(33-40 lb ft).

Note: *The clearance between the sensor and the flywheel is 3.1 +0.4 mm.*

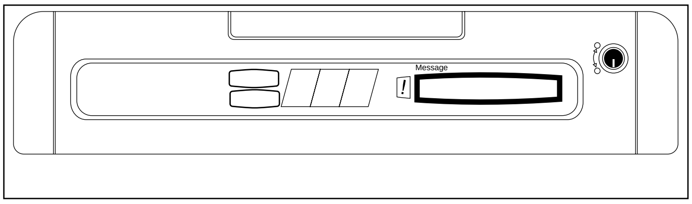
Self Test Function

This series of vehicles contain numerous sensors to enable the machine to perform its own self test diagnosis.

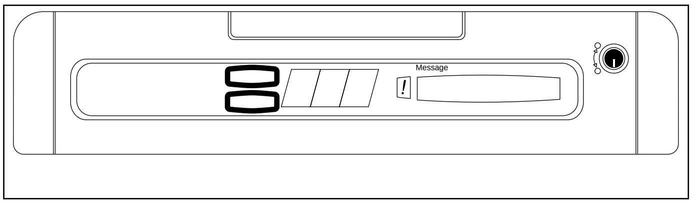
Below is a list of functions which are monitored by the system.

* **1.** Destination, Model Name, Language
2. Engine R.P.M
3. Pump Input Amperage
4. No. of Throttle Pulses
5. Hydraulic Oil Temperature
6. Water Temperature
* **7.** Fuel Sensor Resistance Value
* **8.** Throttle Volume Voltage Input
* **9.** Transistor Output
10. Pressure Switch Input

The items to be checked, appear in the **MESSAGE** display Section



The data is displayed on the **CLOCK** display

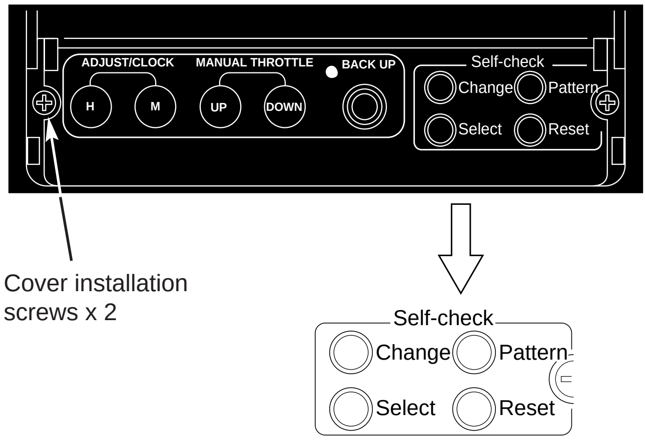


Each item is changed with the Self Check Switches located on the right hand side of the back-up switch. *

There are four Self Check Switches

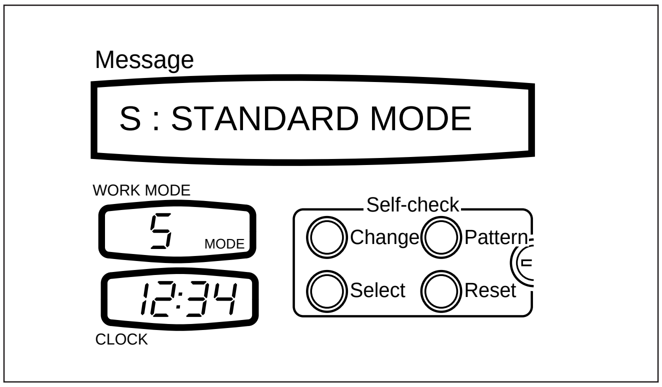
1. The **CHANGE** switch which is used to change to the self-check mode.
2. **PATTERN** switch which changes from the service check function to the setting function.
3. **SELECT** switch which moves from item to item.
4. **RESET** which locks the set values into the controller.

This set of four switches are usually covered so that the operator cannot accidentally operate them.



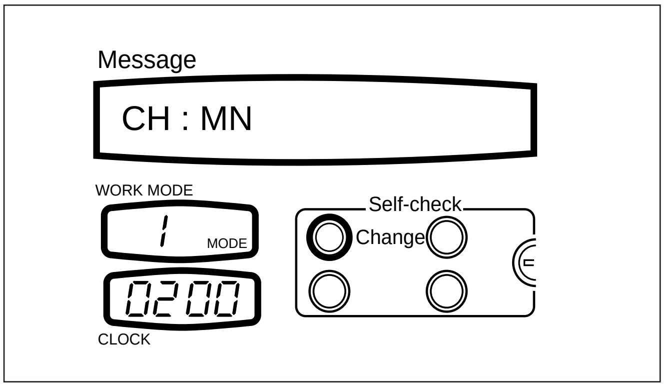
Checking Methods

When the engine key is inserted and turned to the **ON** position, the **"STANDARD MODE"** is displayed in the Message display section, and **S** is displayed in the **WORK** mode section and the**TIME** is displayed in the **CLOCK** display.



When the **CHANGE** switch is pressed the Country and Model designation is displayed:

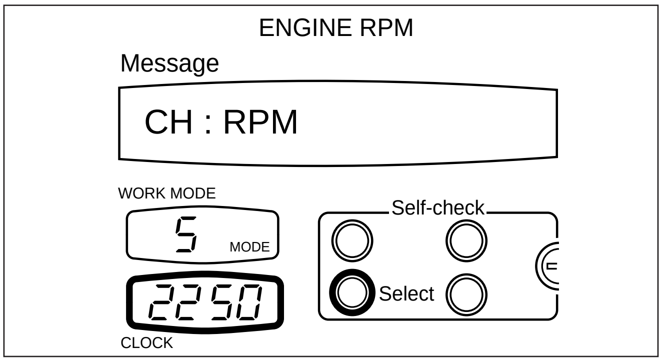
0200 = JS200
0220 = JS240



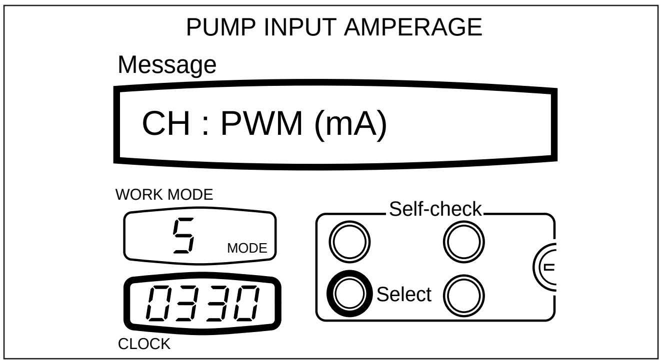
Self Test Function *(continued)*

The Self Check items can be displayed by pressing the **SELECT SWITCH** after every singular display in the following order.

When the **SELECT** switch is pressed the Engine RPM is displayed

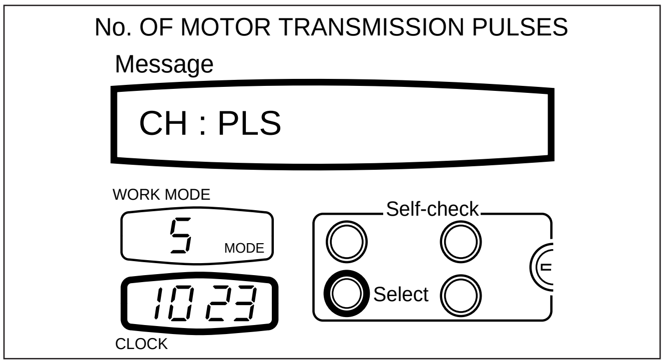


Pressing **SELECT** changes the display as shown.
With the **S** mode displayed it will show 330 mA, the **H** mode will show 520mA, if the engine is at maximum speed

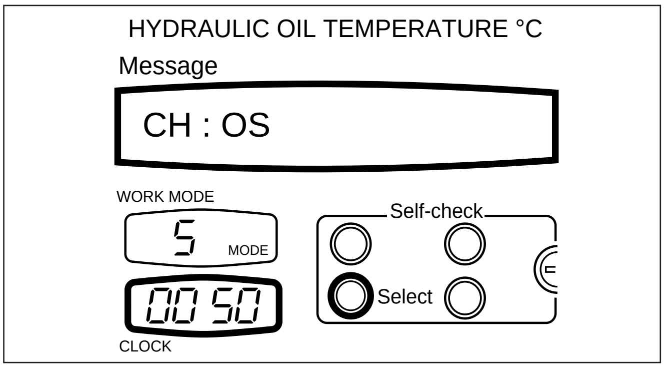


Pressing **SELECT** changes the display as shown.

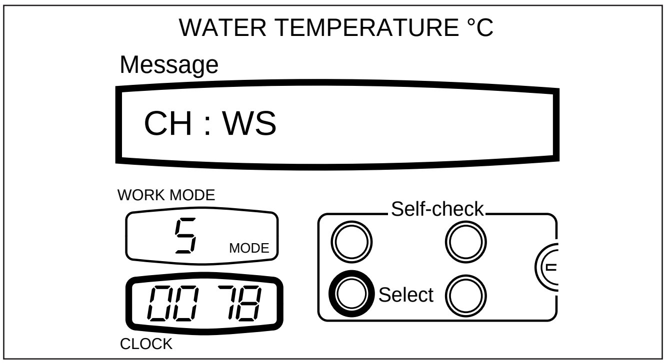
With the throttle motor set at its minimum position it will output approximately 620 pulses to a maximum of 1023 as displayed in the clock display.



Pressing **SELECT** changes the display as shown.



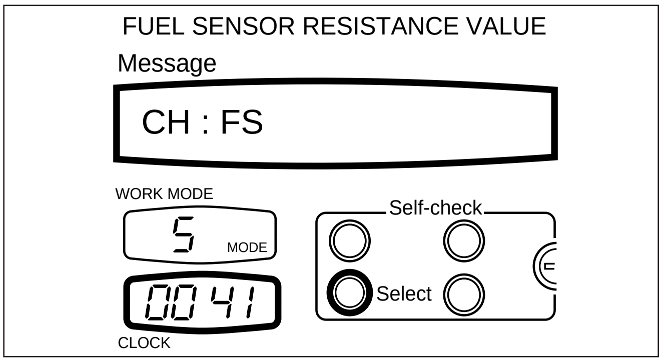
Pressing **SELECT** changes the display as shown.



Self Test Function *(continued)*

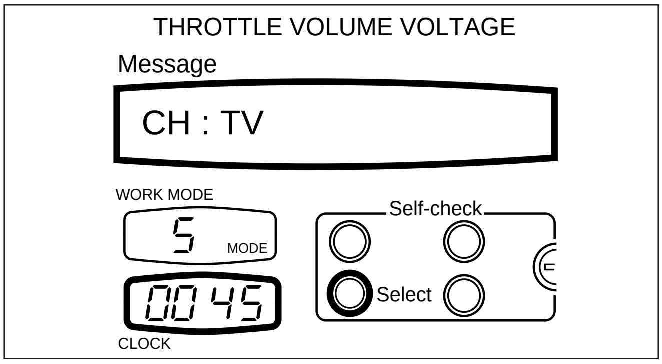
Pressing **SELECT** changes the display as shown.

The fuel sensor resistance is shown in Ohms in the clock display.

*


Pressing **SELECT** changes the display as shown.

A value of 0 to a maximum of 4.5 Volts will be displayed in the clock display depending on the position of the throttle.

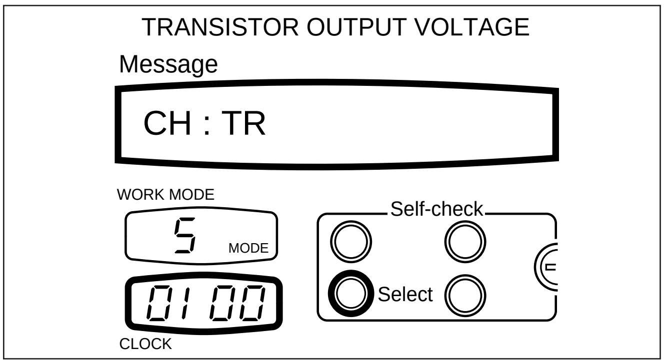


* Pressing **SELECT** changes the display as shown.This monitors transistor block output.

When TR is displayed, pressing the reset button once will initiate the controller to test all the transistor block outputs 1 through 20. If a faulty output is detected it will stop at that output number. Monitor will display “ELEC. PROBLEM” (short circuits only).

To detect open circuits, select different services in turn and check screen display:

e.g. ‘1’ = closed circuit
‘0’ = open circuit



CONTROLLER TRANSISTOR OUTPUT NUMBERS

1	Free swing solenoid valve	Block 1
2	2 stage MRV control solenoid valve	Block 1
3	Low flow hydraulic circuit	Block 1
4	Servo isolator solenoid valve	Block 1
5	Slew shut off solenoid valve	Block 1
6	Not used	Block 1
7	Not used	Block 1
8	Not used	Block 1
9	Boom lower speed restriction solenoid valve	Block 2
10	Not used	Block 2
11	Slew lock solenoid valve	Block 2
12	Max flow cut solenoid valve	Block 2
13	Cushion solenoid valve	Block 2
14	Not used	Block 2
15	Not used	Block 2
16	Negative control solenoid valve	Block 2
17	Battery relay	Block 3
18	Glow plug relay	Block 3
19	Slew brake solenoid	Block 3
20	2 speed travel solenoid valve	Block 3

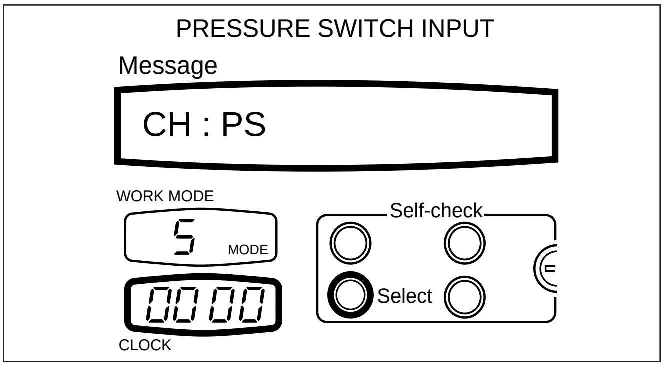
| | 1 | 0 | 1 | 0 = Output off, 1 = Output on

Block 3 Block 2 Block 1

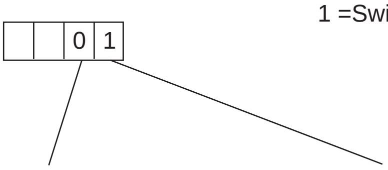
* Self Test Function *(continued)*

Start engine. Pressing **SELECT** changes the display as shown.

* This monitors pressure switch information in the clock display.



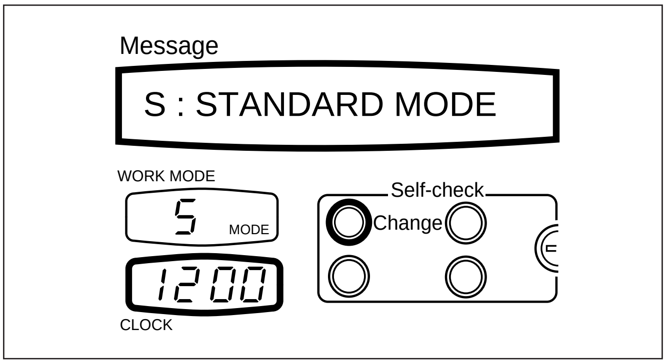
0 =Switch open
1 =Switch closed



Excavating Pressure switch

* Travel/boom/slew/hammer Pressure switch

When the **CHANGE** switch is pressed when the checks are completed and the system will return to the **STANDARD MODE** for normal operation.



Note: Engine has to be started to perform the above procedure.

Select boom down, display should be:	1 1
* Select slew left or right, display should be:	1 1
Select any other excavator service, display should be:	1 0
Select travel, display should be:	0 1
* Select hammer, display should be:	0 1

Self Test Function *(continued)*

Setting Function

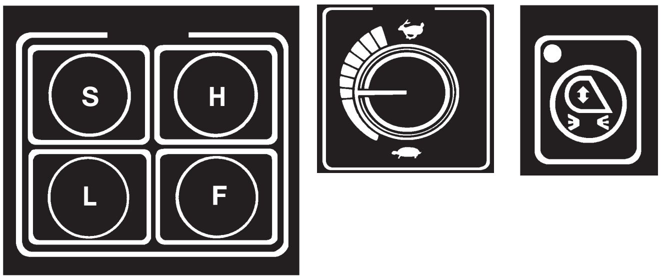
* This section deals with setting separate parameters:

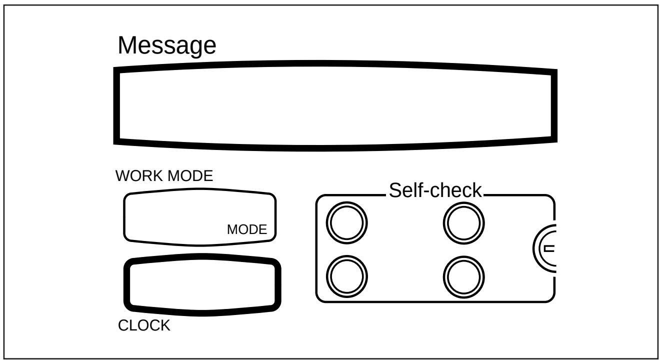
* **1.** Breaker engine speed.

2. Automatic idle time.

* In addition to the previous sections displays, the following switches are used.

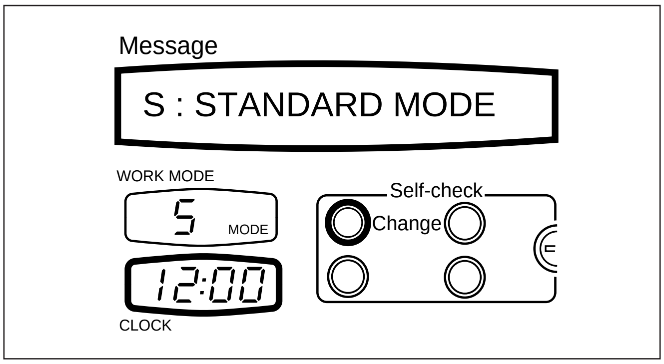
*



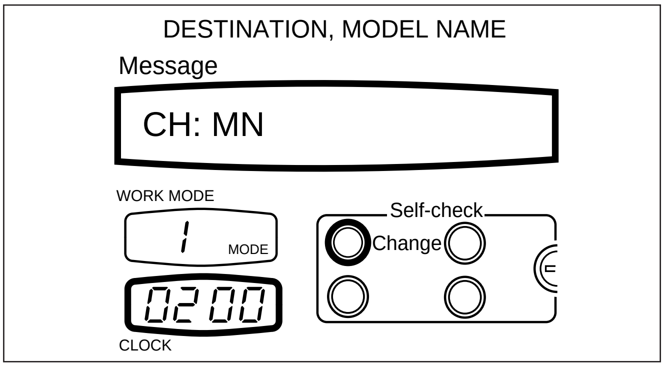


* **Setting Breaker Engine Speed**

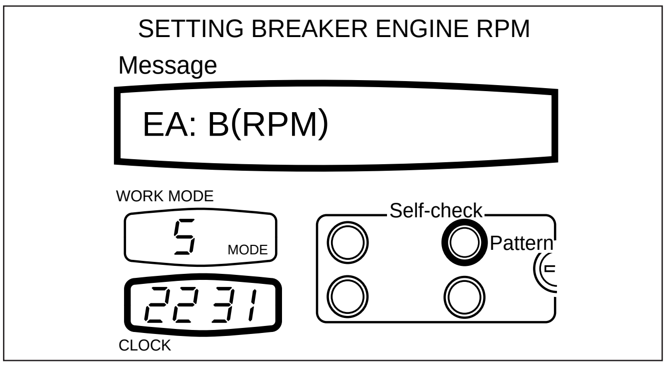
* With the starter key in the **ON** position the display is as shown. Start the engine.



* Press the **CHANGE** switch to produce the display shown right.

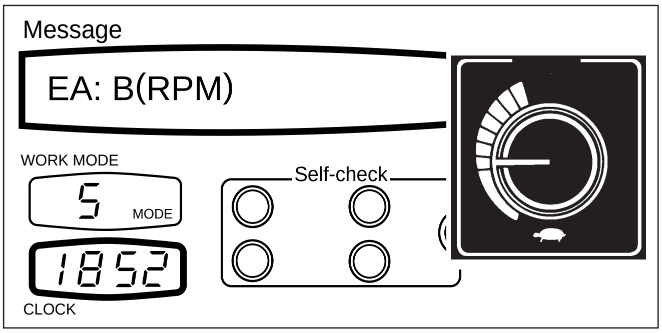


* Press the **PATTERN** switch to produce the display shown right. Engine RPM is displayed in the **CLOCK** window.

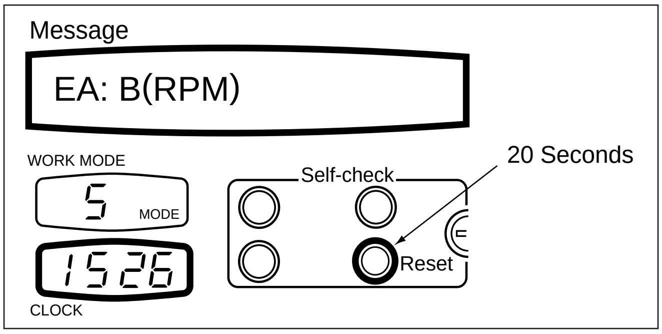


Self Test Function *(continued)*

* Using the **THROTTLE CONTROL** knob, set the engine speed to that required for breaker operation (as displayed in the **CLOCK** window).



* ***Note:*** *Different breakers may require different engine speeds. Check that the breaker engine RPM setting is correct for the breaker being used as given in the following table:*



Machine	Hammermaster	Engine RPM	Normal flow l/min
JS200/200LC/ 220/220LC	660	1765	150
JS240/240LC/ 260/260LC	760	1700	150
JS200/200LC/ 220/220LC	670	1765	150
JS240/240LC 260/260LC	770	1985	180

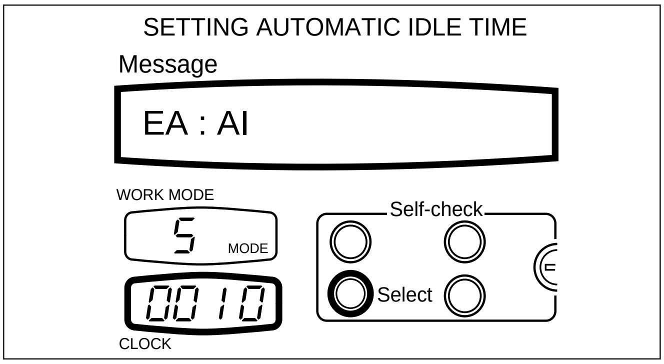
* When the desired RPM is shown, press and hold the **RESET** switch for 20 seconds to enter the setting into the controller. A buzzer will sound when the setting is complete. The controller will now automatically adjust the engine RPM to the selected speed when the breaker is operated.

* Turn the starter key to **OFF** to silence the buzzer.

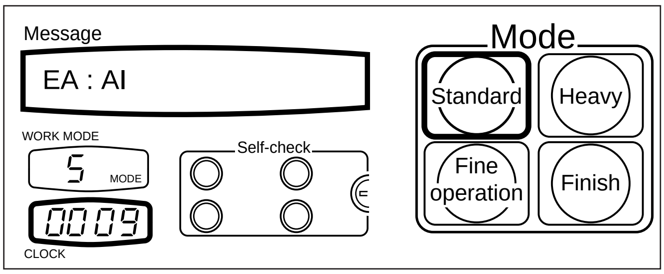
* **Setting Automatic Idle Time**

* Switch the ignition on, and press the **CHANGE** button. Press the **PATTERN** button once, then press the **SELECT** button repeatedly until the monitor displays EA:A1.

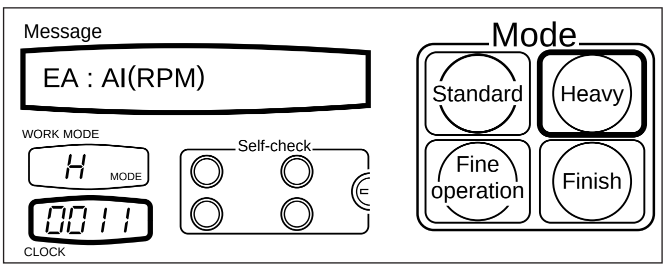
* The 'S' and 'H' **MODE** select switches are used to reset the **AUTOMATIC IDLE TIME**.



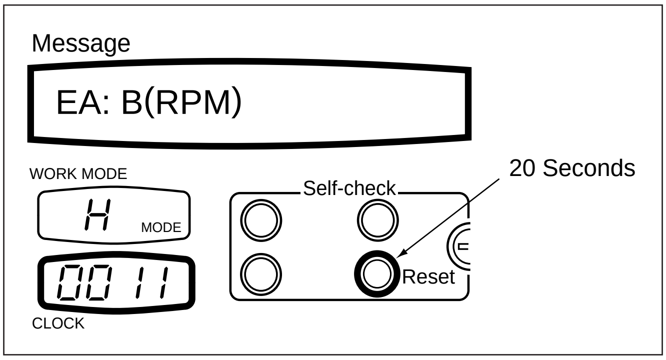
* To reduce the **AUTOMATIC IDLE TIME** press the **STANDARD MODE** switch. Each press **reduces** the delay displayed in the **CLOCK** window by 1 second. 'S' is displayed in the **WORK MODE** window during this operation.



* To increase the **AUTOMATIC IDLE TIME** displayed in the **CLOCK** window, press the **HEAVY MODE** switch. Each press **increases** the delay displayed in the **CLOCK** window by 1 second. 'H' is displayed in the **WORK MODE** window during this operation.



* Self Test Function *(continued)*



* When the desired **AUTOMATIC IDLE TIME** is reached, press and hold the **RESET** switch for 20 seconds to enter the setting into the controller. A buzzer will sound when the setting is complete.

* Turn the starter switch to **OFF** to silence the buzzer.

---

* **Other functions**

* Other functions, not applicable in normal use, can be displayed using the **SELECT** button:

CH:1 = Min engine RPM for scrap magnet use.

* **CH:7** = Changing Proportional Solenoid mA Value.

* If kerosene fuel is to be used it is necessary to reduce the current at the proportional solenoid on the hydraulic pump as follows:

1. Switch ignition on.
2. Press **CHANGE** button once.
3. Press **PATTERN** button once.
4. Press **SELECT** button repeatedly until monitor reads **CH:7**
5. Press **H MODE** switch to change mA value. (0=normal,1= reduced current).
6. Press **RESET** button for 20 sec until buzzer sounds.
7. Switch ignition off. The proportional solenoid mA value is now reduced.

CH:8 = Battery level sensor.

Fault Diagnosis

This section is designed to simplify the Task of Fault Finding.
When a message is displayed, the description of the fault is shown and the Problem No. is shown; this in turn then relates to the relevant page showing the Problem No.

Procedure
Depending on the result of the inspection or measurement inside the box, continue on to either the **YES** or **NO** branch and onto the next box. Inside each box, the inspection or measurement method or values are written. The necessary preparatory work, operations and values are listed. Make sure the preparatory work is carried out, that is checking the procedures and equipment, as mistakes in judgements and procedures can seriously damage the equipment.

Note: *When removing or checking a piece of electrical equipment turn the key switch* ***OFF****.*

Fault Diagnosis *(continued)*

This explains how to trouble shoot in the event that the message does not go out even though suitable measures are taken to check and clear the problem.

!Mark	Message Display	Trouble Description	Problem No.
!	Engine emergency stop	Even though the emergency stop button is pressed, the message does not go out.	1
!	Refuel	Even though fuel is supplied, the message does not go out.	2
!	Refill coolant	Even though cooling water is supplied, the message does not go out.	3
!	Replenish battery fluid	Battery fluid sensor not fitted, fault should not be displayed.	4
!	Air cleaner clogged	Even though filter is cleaned, the message does not go out.	5
!	Engine oil pressure Drop	Even though engine oil is correct, the message does not go out.	6
!	Engine filter clogged	Even though the engine oil filter is replaced and the engine oil is correct, the message does not go out.,	7
!	Over heat	Even though hydraulic oil temperature is less than 84°C and the engine cooling water temperature is less than 92°C, the message does not go out.	8
!	Battery Charging Deficient	The message does not go out.	9
!	Electric system abnormality	The message does not go out.	10

This explains how to trouble shoot when an operation is not indicated on a message, but it does not operate normally.

1. Engine control area

Trouble Description	Trouble No.
Engine does not start. → "Electric system abnormality" is indicated on monitor. → YES	Refer to trouble No. 10.
NO	11
* Controlling engine rotation is not possible. → Engine rotation does not change with throttle volume	12

Fault Diagnosis *(continued)*

		Item	Judgement Value	Measure
Start-up Inspection items	Lubricants • Coolants	1. Fuel amount check	-	Refuel
		2. Inspection for fuel contaminant	-	Clean, drain
		3. Hydraulic oil amount check	-	Refill oil
		4. Inspection of hydraulic oil strainer	-	Clean, drain
		5. Inspection of oil amount for each reduction gear	-	Refill oil
		6. Inspection of engine oil amount (amount in oil pan)	-	Refill oil
		7. Coolant amount check	-	Refill water
		8. Dust indicator clogging check	-	Clean or replace
	Electric Equipment	9. Inspection for looseness, corrosion of battery terminal and wiring	-	Tighten or replace
		10. Inspection for looseness, corrosion of alternator terminal and wiring	-	Tighten or replace
		11. Inspection for looseness, corrosion of starter terminal and wiring	-	Tighten or replace
Other Inspection Items	Hydraulic • Mechanical Equipment	12. Abnormal sound, smell check	-	Repair
		13. Oil leakage check	-	Repair
		14. Air-bleeding	-	Air bleeding
	Electricity • Electric Equipment	15. Battery voltage (engine stopped) check	* 25-26V	Replacement
		16. Battery fluid sensor not fitted, fault should not be displayed.	-	Replenish or replace
		17. Inspection for discolouration, burning, peeling of wiring	-	Replacement
		18. Inspection for wiring clamp removal, sagging	-	Repair
		19. Inspection for wet wiring (special attention to wet connector and terminal)	-	Disconnect and dry
		20. Inspection for fuse breakage, corrosion	-	Replacement
		21. Alternator voltage check (engine revolution more than 1/2 throttle) (When battery insufficiently charged, may be about 25V right after starting.)	27.5~29.5V	Replacement
		22. Battery relay making noise (when starter switch is **ON** or **OFF**)	-	Replacement

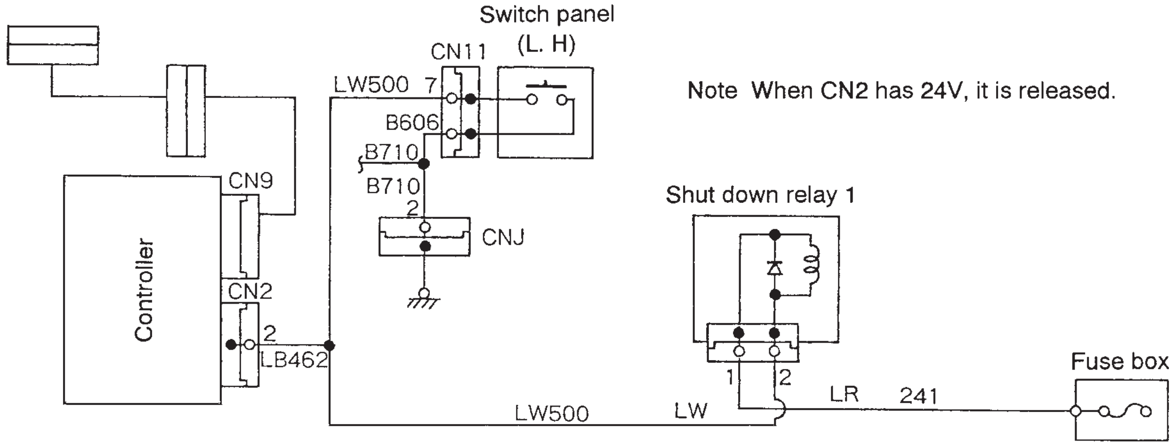
Fault Diagnosis *(continued)*

Emergency Engine Stop, Problem No.1

Note: *Even if the emergency stop button is pressed the message does not go out.*

Prior Confirmation
Items

1. The **"MODE"** of the mode display is not flashing.
2. Confirm that the fuses in the fuse box are normal.
3. The engine does not run.



Troubleshoot	Cause	Remedy
Key switch **ON**. When CN11 connector is removed, does message go out? YES →	* Defective LW wiring from switch panel or switch panel defective.	Repair wiring or replace switch panel.
NO → Remove CN2 connector and measure voltage of female side of LB. Is it within the range of 20~30V? YES →	Bad connection of CN2 connector or controller defect.	Clean CN2 connector terminal or replace controller.
NO → Measure voltage of LW with shut down relay 1 connector connected. Is it within the range of 20~30V. YES →	Breakage of LW wiring between shut off relay 1 and controller.	Repair LW wiring.
NO → Remove shut off relay 1 connector and measure resistance of 1 and 2 of relay side. Connect 1 to +, 2 to -. Is it 250 . NO (∞) →	Defective shut off relay 1.	Replace shut off relay 1.
YES →	Breakage of LR wiring between shut off relay 1 and fuse.	Repair LR wiring.

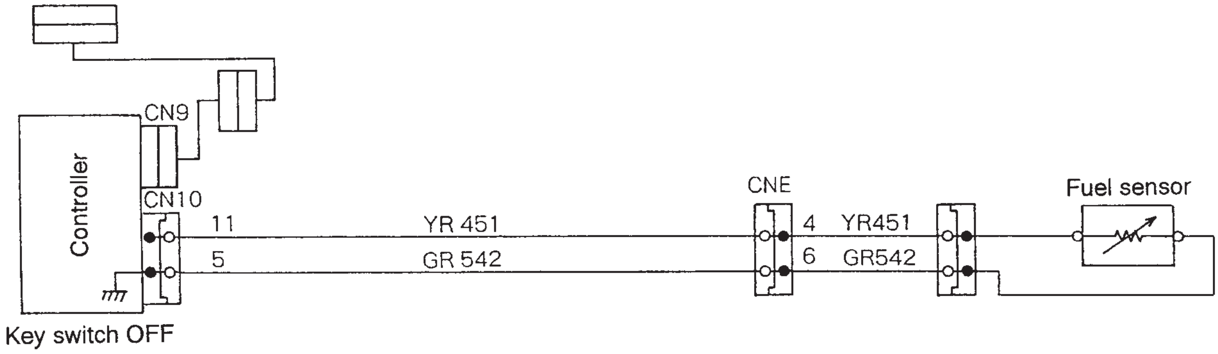
Fault Diagnosis *(continued)*

Refuel, Problem No.2

Note: *Message does not go out even if refuelled*

Prior Confirmation
Items

1. The **"MODE"** of the mode display is not flashing.
2. Fuel bar graph displays one.



Troubleshoot	Cause	Remedy
Key switch **ON** Measure resistance value of sensor at self-check. Is it within the range of values in chart below? (Refer to resistance values in chart below.) → YES	Controller defect	Replace controller.
NO → Key switch OFF Remove sensor coupler and measure resistance on sensor side. Is it within the range of values in chart below? (Refer to resistance values in chart below.) → NO	Fuel sensor defect	Replace sensor or inspect it.
YES → Remove CNE connector and measure resistance between male side terminal YR and GR. Is it within the range of values in chart below? (Refer to resistance values in chart below.) → NO	Bad connection of fuel sensor connector	Clean connector terminal.
YES → Remove CN10 connector and measure resistance between female side terminal YR and GR. Is it within the range of values in chart below? (Refer to resistance values in chart below.) → NO	Bad connection of CNE	Clean CNE connector terminal.
→ YES	Controller defect or bad connection of CN10	Replace controller or clean CN10 connector terminal.

Note: *When there is breakage in the wiring, the bar graph goes out completely.*

Resistance Value between YR and GR

Monitor	1 Refuel.	2	3	4	5	6	7	8
Resistance Value (OHM)	80~78	78~59	59~44	44~34	34~27	27~21	21~13	13~10

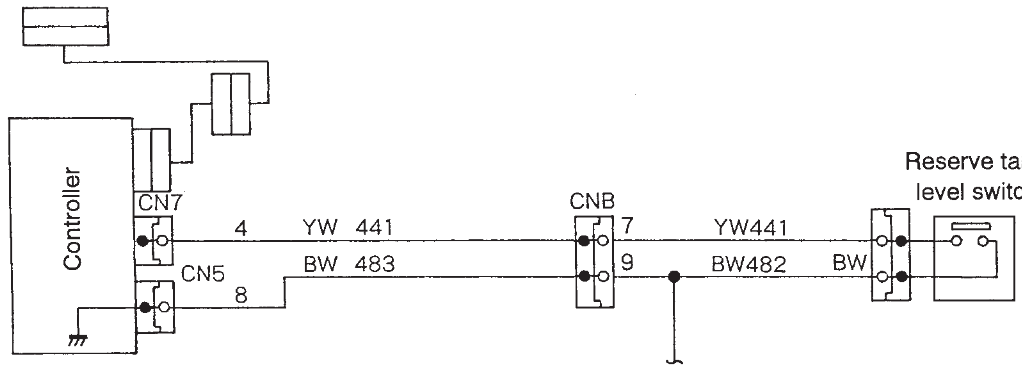
Fault Diagnosis *(continued)*

Coolant Refill, Problem No 3

Note: *Message does not go out even if coolant is refilled*

Prior Confirmation
Items

1. The **"MODE"** of the mode display is not flashing.



Troubleshoot	Cause	Remedy
Key switch **ON**		
When reserve tank level switch connector is removed, does message go out? YES →	Reserve tank level switch defect	Replace reserve tank.
NO → When reserve tank level switch connector is removed, does message go out? YES →	* Defective YW wiring between reserve tank level switch and CNB	Repair YW wiring.
YES →	* Defective YW wiring between CNB and CN7	Repair YW wiring.
NO →	Controller	Replace controller.

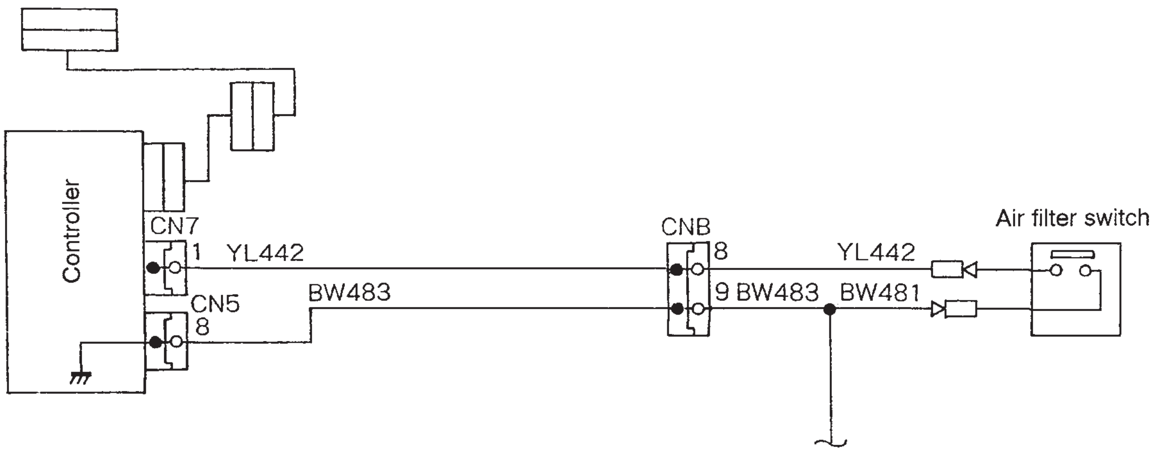
Fault Diagnosis *(continued)*

Air Cleaner clogged, Problem No. 5

Note: *Message does not go out even if the filter is washed.*

Prior Confirmation
Items

1. The **"MODE"** of the mode display is not flashing.



Troubleshoot	Cause	Remedy
Key switch **ON**		
When spade terminal of air filter switch on YL side is removed, does message go out? YES →	* Air filter switch defect	* Replace air filter switch.
NO → When CNB connector is removed, does message go out? YES →	* Breakage or bad connection of BW wiring between CNB and air filter switch	* Repair BW wiring.
NO → When CN7 connector is removed, does message go out? YES →	* Breakage or bad connection of BW wiring between CNB and CN5	* Repair BW wiring.
NO →	Controller defect	Replace controller

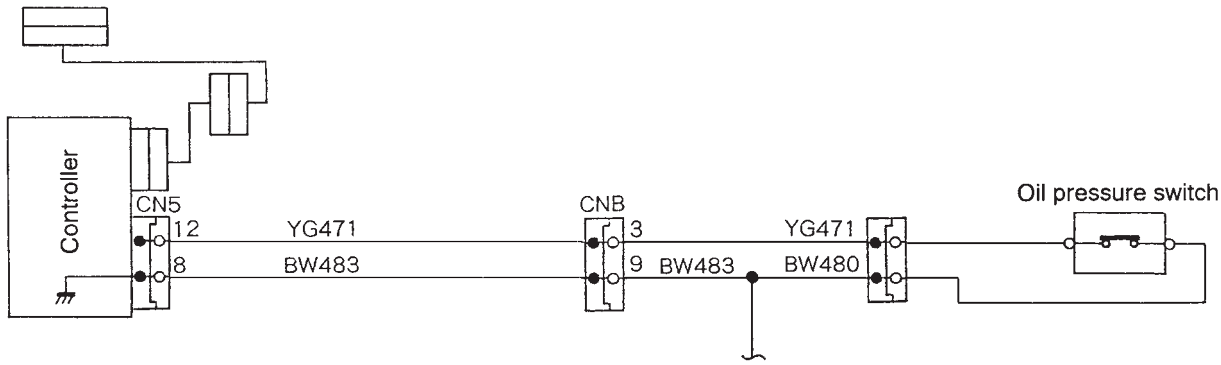
Fault Diagnosis *(continued)*

Low Engine Oil Pressure. Problem No. 6

Note: *Message does not go out even if engine oil is satisfactory.*

Prior Confirmation
Items

1. The "MODE" of the mode display is not flashing.



Troubleshoot	Cause	Remedy
Confirm after 12 seconds have passed after starting the engine.		
When oil pressure switch connector is removed, does message go out? YES →	Oil pressure switch defect	Replace-ment
NO → When CNB connector is removed, does message go out? YES →	* Defective YG wiring between CNB and oil pressure switch	Repair YG wiring.
NO → When CN5 connector is removed, does message go out? YES →	* Defective YG wiring between CNB and oil pressure switch	Repair YG
NO →	Controller defect	Replace controller

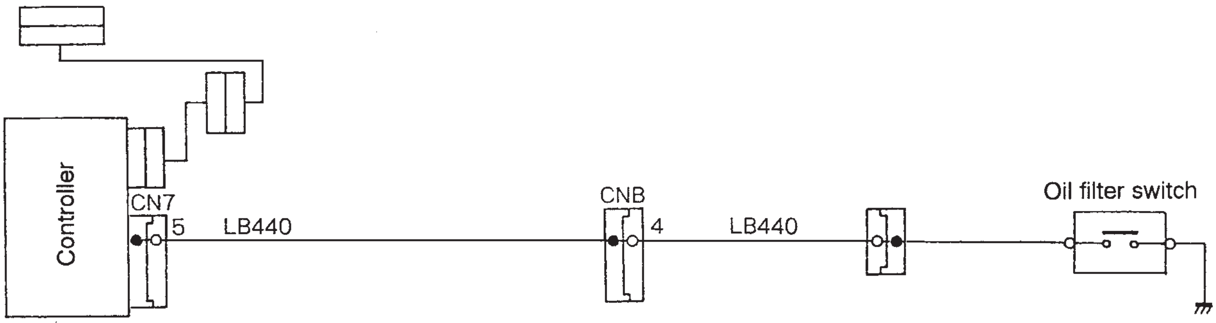
Fault Diagnosis *(continued)*

Engine Oil Filter Blocked, Problem No 7

Note: *Message does not go out even if the engine oil filter is replaced and the oil is satisfactory.*

Prior Confirmation
Items

1. The **"MODE"** of the mode display is not flashing.



Troubleshoot	Cause	Remedy
Engine starts		
When oil filter connector is removed, does message go out? YES	Oil filter switch defect	Replace switch.
NO → When CNB connector is removed, does message go out? YES	* Defective LB wiring between CNB and oil filter switch	Repair LB wiring.
NO → When CN7 connector is removed, does message go out? YES	* Defective LB wiring between CN7 and CNB	Repair wiring.
NO	Controller defect	Replace controller.

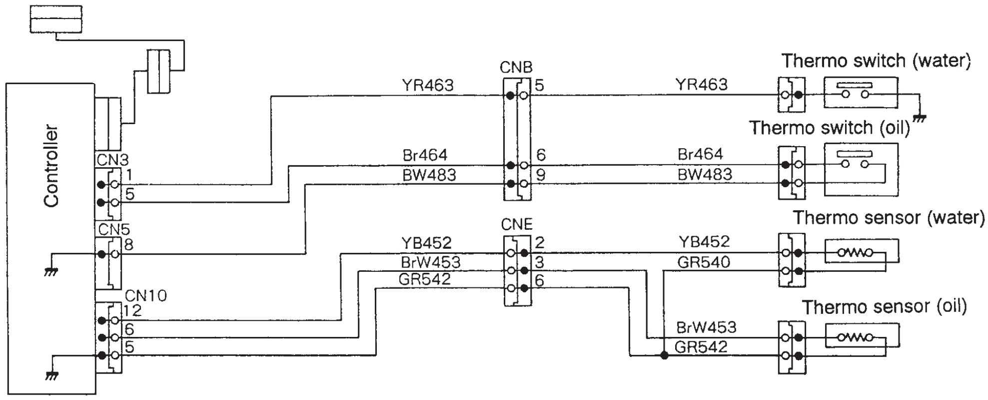
Fault Diagnosis *(continued)*

Fluid Overheating, water, oil, Problem No 8

Note: *Message does not go out even if the actual temperature is below the following; Hydraulic Oil Temperature 84°C. Engine Coolant Temperature 92°C.*

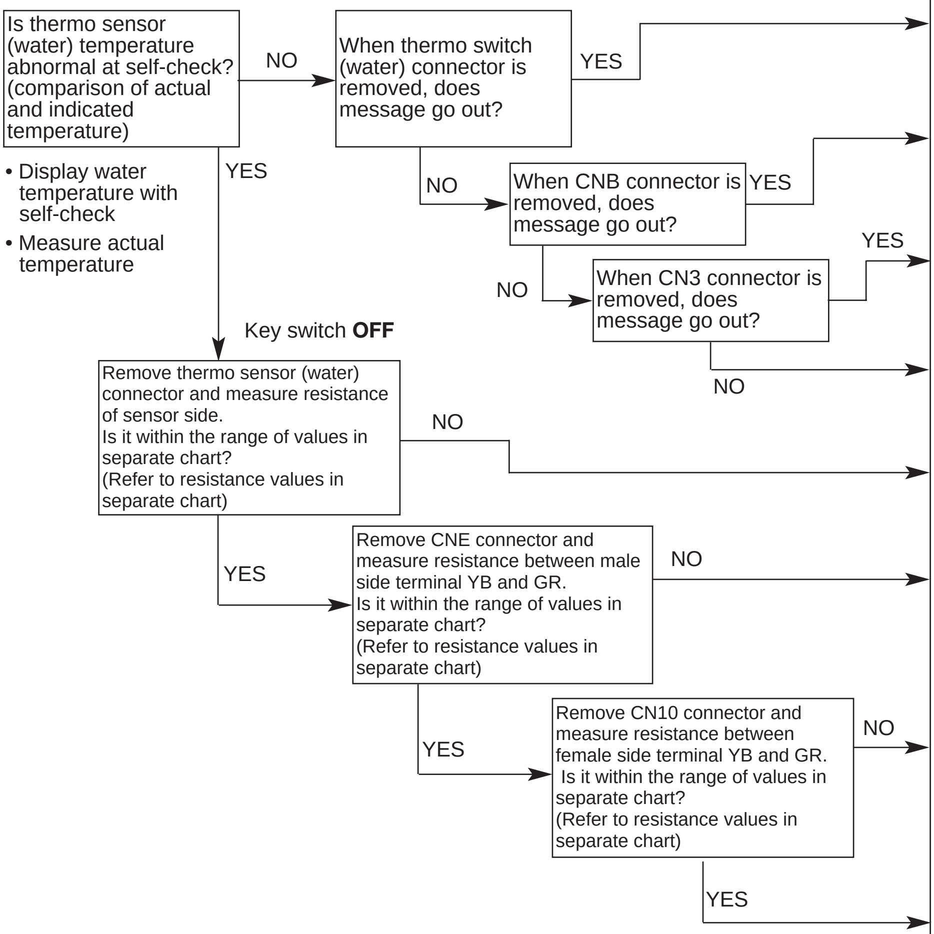
Prior confirmation
Items

1. The **"MODE"** of the mode display is not flashing. **2.** Each bar graph displays more than one graduation.
3. Confirm that the water and oil temperature bar graph is lit at 8 graduations.



Troubleshoot | Cause | Remedy

1. Water temperature bar graph lit at 8 graduations.
Key switch **ON**



Cause	Remedy
Thermo switch (water) defect	Replace switch
* Defective YR wiring between CNB and thermo switch	Repair YR wiring
* Defective YR wiring between CN3 and CNB	Repair YR wiring.
Controller defect	Replace controller
Thermo switch (water) defect	Replace sensor.
Bad connection of thermo (water) connector	Clean sensor connector terminal
Bad connection of CNE	Clean CNE connector terminal
Controller defect or bad connection CN10	Replace controller or clean CN10 connector terminal

Note: *When there is breakage in the wiring, the bar graph goes out completely.*

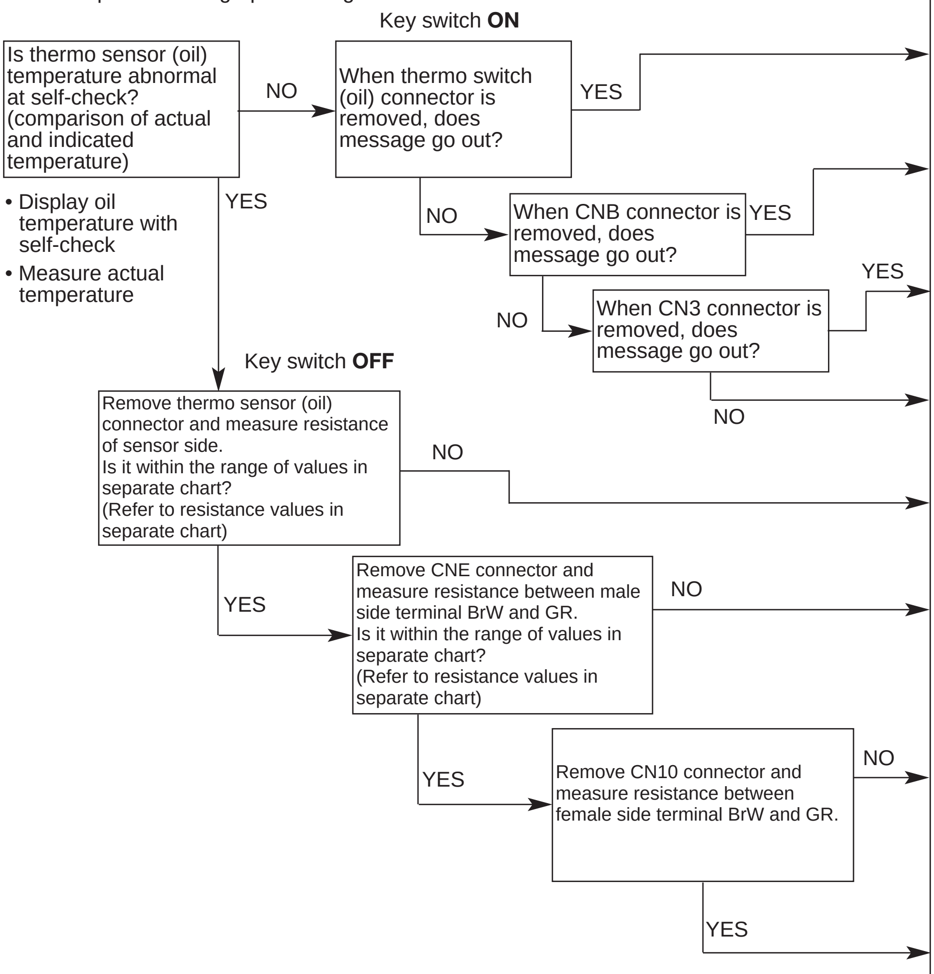
Fault Diagnosis *(continued)*

Fluid Overheating, water, oil, Problem No 8 *(continued)*

Note: *Message does not go out even if the actual Temperature is below the following:-*
Hydraulic Oil Temperature 84°C
Engine Coolant Temperature 92°C

Troubleshoot

1. Oil temperature bar graph lit at 8 graduations.



Cause	Remedy
Thermo switch (oil) defect	Replace switch
* Defective Br wiring between CNB and thermo switch (oil)	Repair Br wiring
* Defective Br wiring between CN3 and CNB	Repair Br wiring.
Controller defect	Replace controller
Thermo switch (oil) defect	Replace sensor.
Bad connection of thermo sensor (oil) connector	Clean sensor connector terminal
Bad connection of CNE	Clean CNE connector terminal
Controller defect or bad connection CN10	Replace controller or clean CN10 connector terminal

Note: *When there is breakage in the wiring, the bar graph goes out completely.*

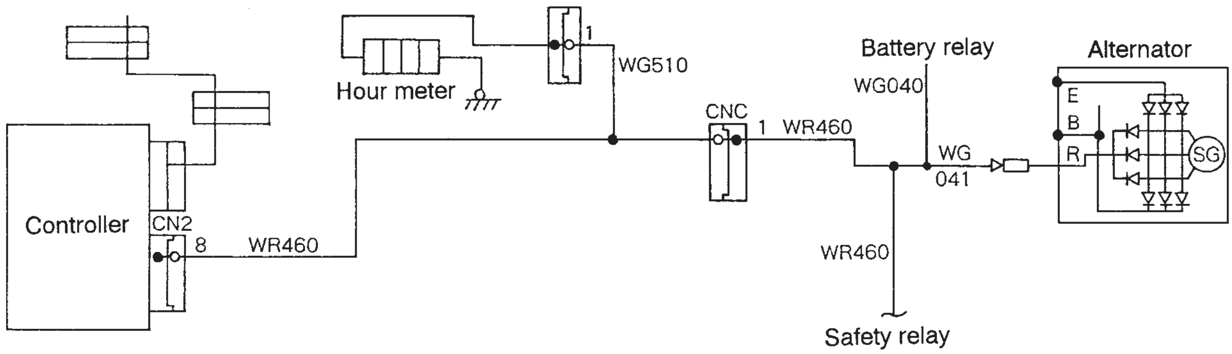
Fault Diagnosis *(continued)*

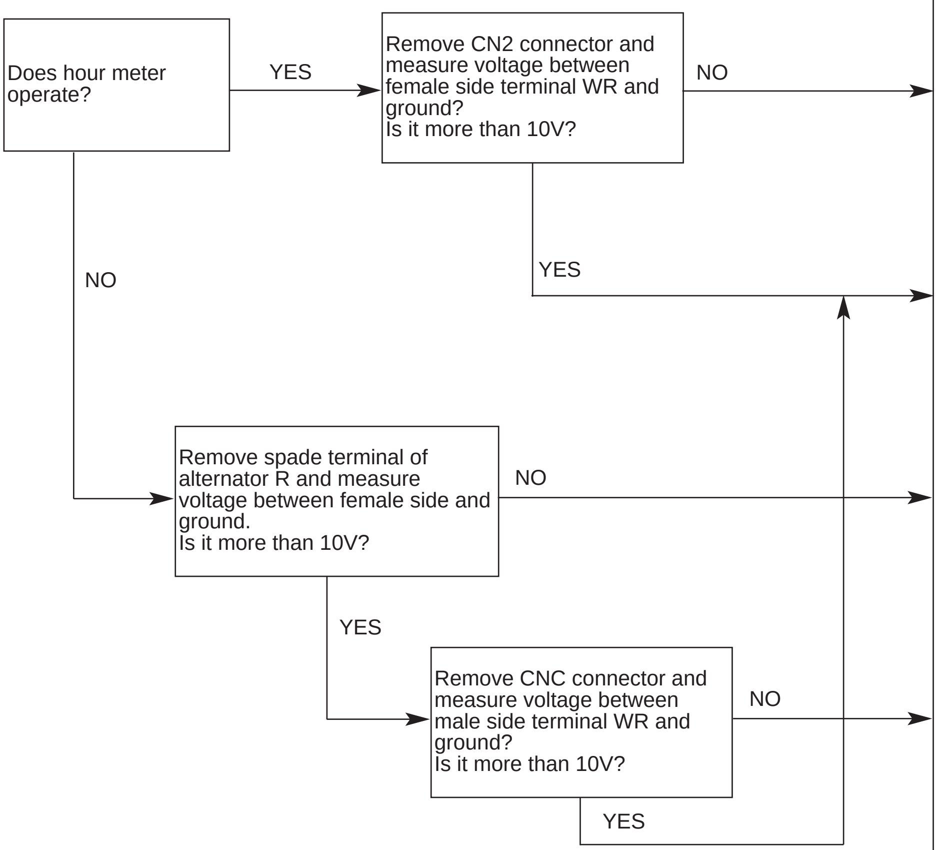
Battery Charging, Problem No 9

Note: *Message does not go out.*

Prior Confirmation
Items

1. The **"MODE"** of the mode display is not flashing.



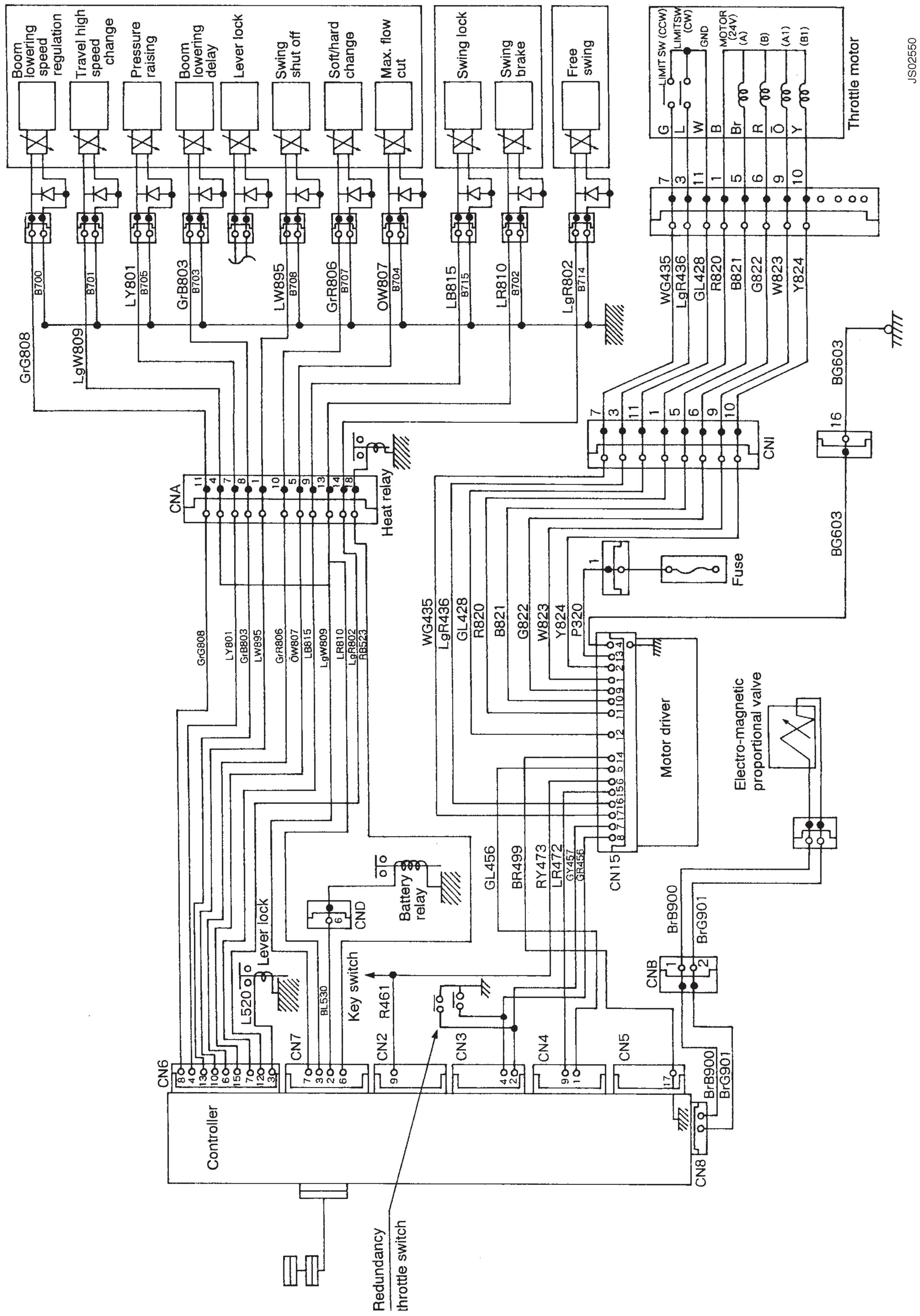


Troubleshoot	Cause	Remedy
Remove CN2 connector – NO	* Defective WR wiring between CNC and CN2	Repair WR
Remove CN2 connector – YES; Remove CNC connector – YES	Bad connection of CN2 or controller defect	Clean CN2 connector terminal or replace controller.
Remove spade terminal – NO	Alternator defect	Replace alternator
Remove CNC connector – NO	Breakage of WR wiring between CNC and alternator or bad connection of alternator spade terminal	Repair WR wiring between CNC and alternator or clean spade terminal.

Fault Diagnosis *(continued)*

* **Electrical Systems, Message Fault, Problem No 10**

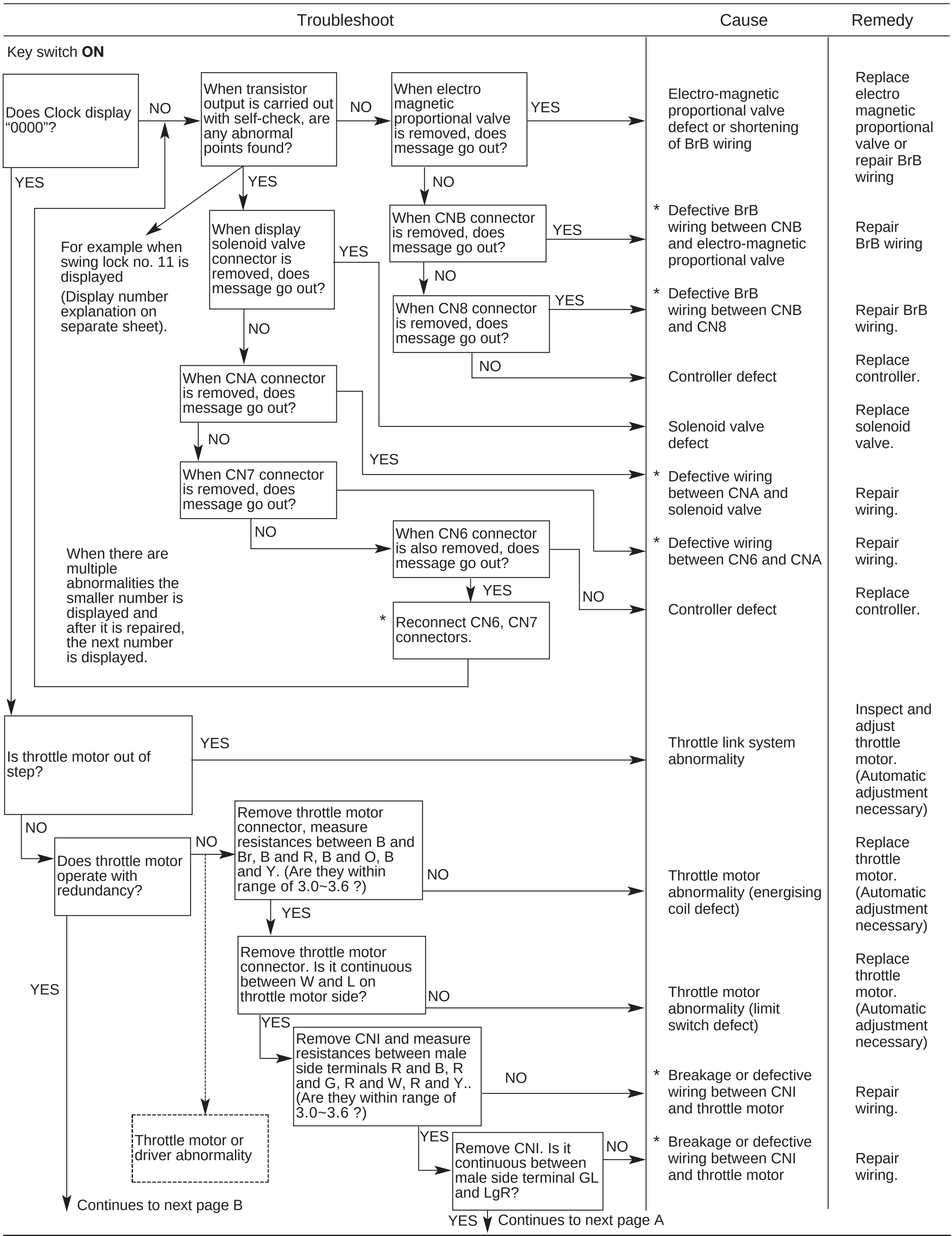
Note: *Message does not go out.*



Fault Diagnosis *(continued)*

Electrical System, Message Fault, Problem No. 10 *(continued)*

Note: *Message does not go out.*



Fault Diagnosis *(continued)*

Electrical System, Message Fault, Problem No.10 *(continued)*

Note: *Message does not go out.*

Troubleshoot	Cause	Remedy
B Continued from previous page **A** YES → Remove driver connector CN15 and measure resistances between female side terminals R and B, R AND G R and W, R and Y. Are they within the range of 3.0~3.6 . → NO	* Breakage or defective wiring between CNI and CN15	Repair wiring
Same work as *1 YES → Remove driver connector CN15. Is it continuous between female side terminals GL and LgR? → NO	* Breakage or defective wiring between CNI and CN15	Repair wiring
* Ignition switch YES → Remove driver connector CN15 and measure voltage between female side terminals P and BG, connecting P to + and BG to -. Is it within the range of 20~30V?. → NO	Breakage of wiring P between CN15 and fuse box	Repair P wiring
* Ignition switch YES → Remove driver connector CN15 and measure voltage between female side terminals RY and BG, connecting RY to + and BG to -. Is it within the range of 20~30V? → NO	Breakage of wiring RY between CN15 and key switch	Repair RY wiring
YES →	Driver defect	Replace driver
* Redundancy switch OFF, ignition switch ON Control System Abnormalities YES → * Remove controller side connector CN8 and measure voltage between GY and ground. Is it 0V? Measure voltage between GR and ground. Is it 5V? → NO	Controller defect	Replace controller
YES →	Breakage of wiring GY or GR between controller CN8 and driver CN15	* Repair GR or GY wiring

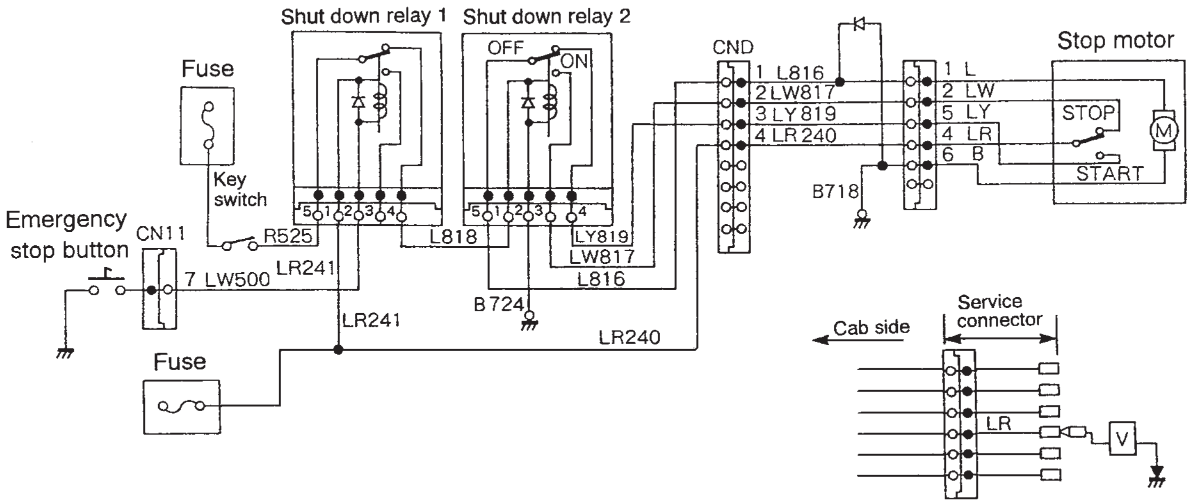
Fault Diagnosis *(continued)*

Engine Trouble, Problem No 11

Note: *Engine does not start even though the message "electrical system abnormal" is not displayed.*

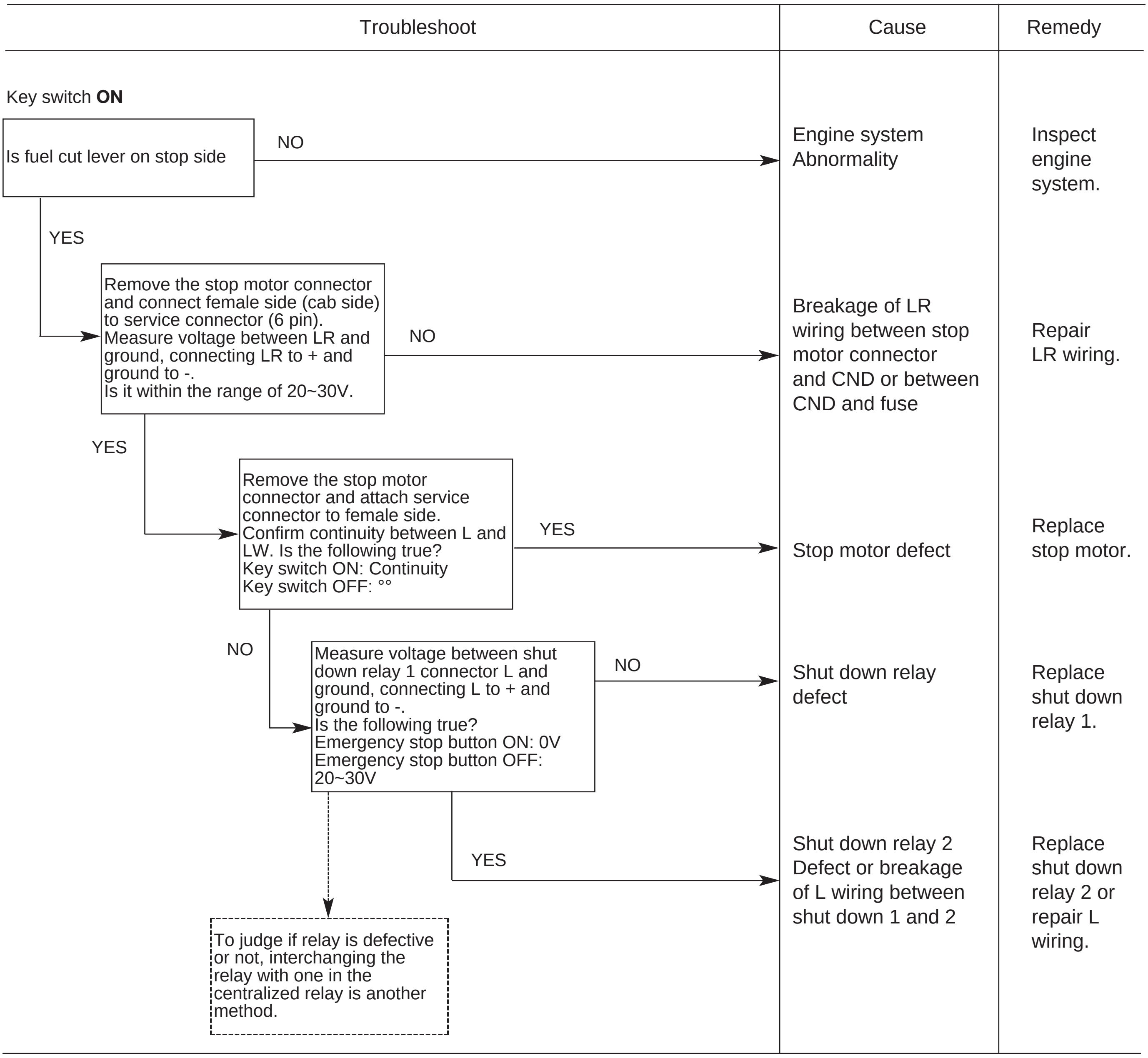
Prior Confirmation
Items

* ● No abnormalities in engine or fuel system.
* ● Fuse is not blown.
* ● The message "Engine emergency stop" is not displayed.
* ● Redundancy switch is **OFF**.
* ● Starter motor rotates and engine is cranking.



Fault Diagnosis *(continued)*

Engine Trouble, Problem No 11 ***(continued)***



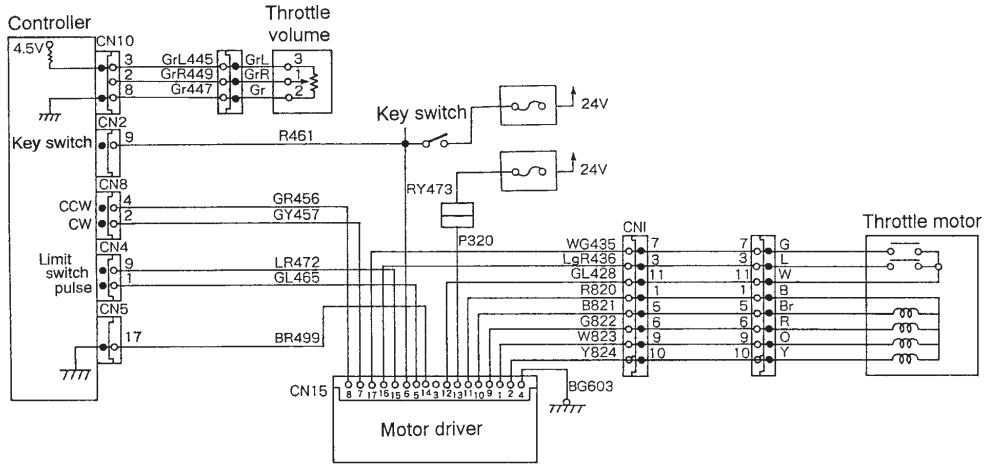
Fault Diagnosis *(continued)*

Engine Problem, Problem No 12

Note: *Engine revolutions do not change with throttle volume control.*

Prior Confirmation
Items

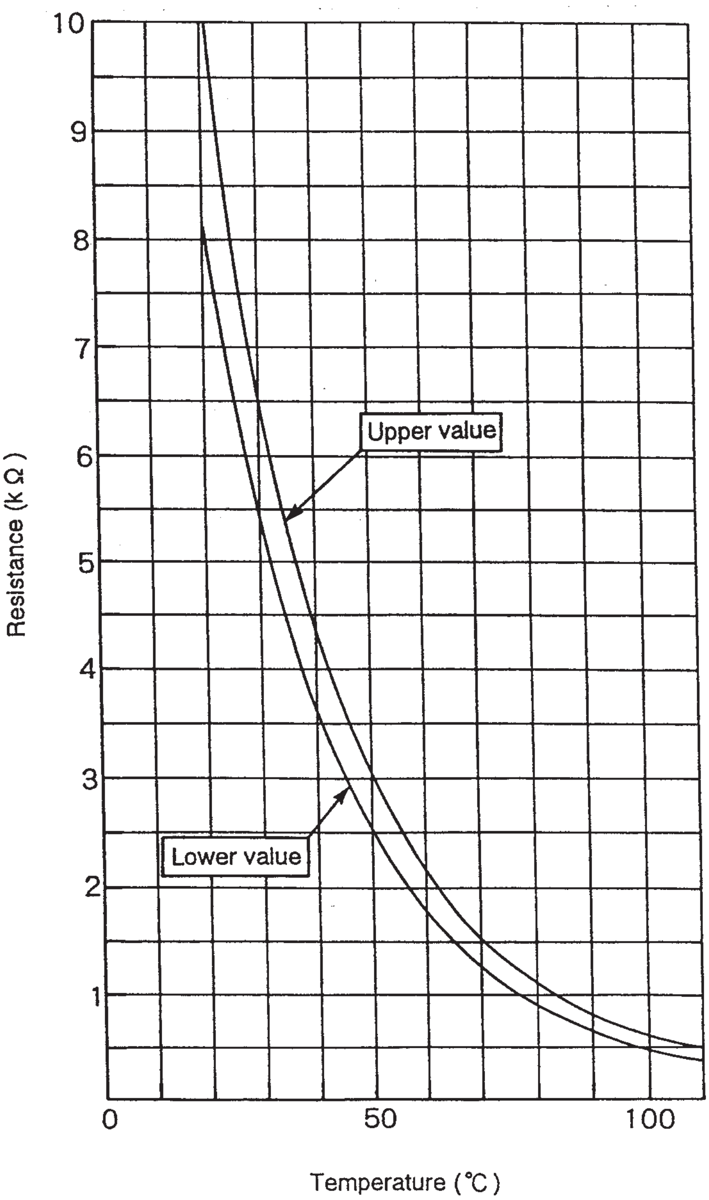
1. The message "Engine emergency stop" is not displayed.



Troubleshoot	Cause	Remedy
Key switch **ON**		
Change voltage moving throttle volume with self-check. Is it within the range of 0~4.5V? NO → Without removing CN10 connector, change the voltage between GrR + and Gr - moving the throttle volume. Is it within the range of 0~4.5V? YES →	Controller defect or bad connection of CN10 connector	Replace controller or clean CN10 connector terminal.
NO → Remove throttle volume connector, measure resistance between throttle volume side connector GrR and GrL. Is it within the range of 0~1 ? NO →	Throttle volume defect.	Replace throttle volume.
YES → Remove throttle volume connector, measure resistance between throttle volume side connector GrR and Gr. Is it within the range of 0~1 ? NO → Throttle volume defect. YES →	Breakage or shortening of one of the wirings, GrL, GrR, Gr between CN10 and throttle volume	Repair of the GrL, GrR, Gr.
YES (from first check) → Check motor transmitted pulse by self-check. Is it within the range of 500~1023? YES →	Controller defect	Replace controller.
NO (Even though the throttle motor is moving.) → Remove controller CN4 and driver CN15. Is GL wiring continuous? NO →	Breakage of GL wiring	Repair GL wiring
YES →	Driver defect	Replace driver.

Sensor Resistance Valve

Water temperature (Oil temperature)	Minimum	Maximum
20°C	8.00k	10.20k
30°C	5.35k	6.50k
40°C	3.60k	4.55k
50°C	2.50k	3.10k
60°C	1.70k	2.20k
70°C	1.20k	1.55k
80°C	0.85k	1.15k



Diagnostics for CAPS II Controllers

The diagnostic capabilities of the present CAPS II system have been improved to include facilities for storing information on intermittent faults occurring in the electrical system and machine performance data .

The original diagnostic capabilities included facilities to check the following:

CH : MN	Machine Model Code
CH : RPM	Engine R.P.M
CH : PWM	Milliamps Supplied To Hydraulic Pump
CH : PLS	Throttle System Pulse Count
CH : OS	Hydraulic Oil Temperature
CH : WS	Water Temperature
CH : FS	Resistance Of Fuel Level Sensor
CH : TV	Throttle System Voltage
CH : TR	Transistor Output Check †
CH : PS	Pressure Switch Output Check

† The controller can check the outputs to the main relays / solenoids and test for short circuit.

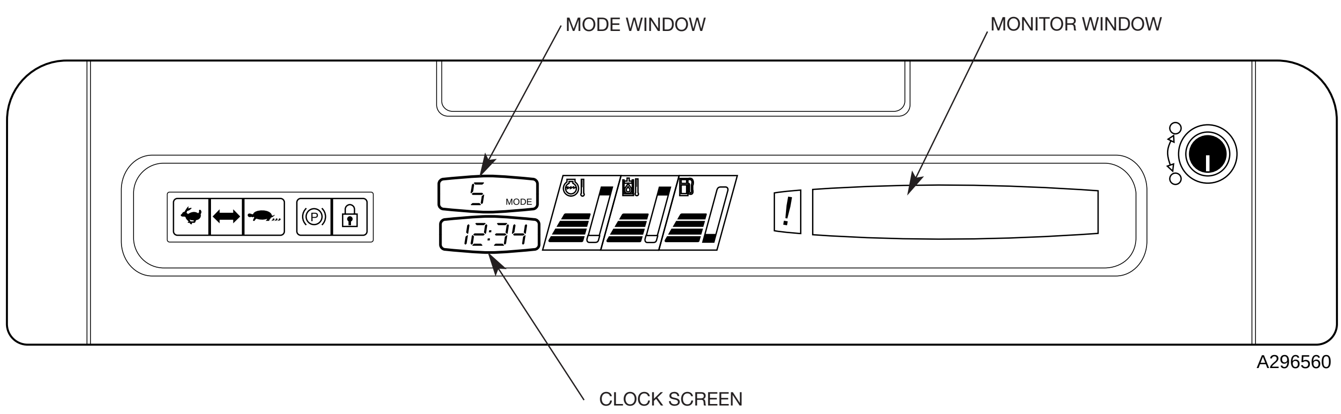
This system was limited by the fact that all checks are instantaneous and no facility existed for storing information on intermittent faults. If the ignition was switched off the controller would reset itself and the fault if intermittent would no longer be present, this can make fault diagnosis very difficult.

Improvements to Diagnostic System

The stage II system retains all of the previous functions of the original system with the addition of two DATA LOGGING channels with the denominations channel 3 and channel 4.

Channel 3: Monitors and stores information on the electrical system.
Channel 4: Monitors and stores information on machine performance.

This system is accessed using the same setup buttons used on the previous system to reprogram the controller and as before, the items to be checked appear in the monitors displays.



Channel 3 electrical system abnormalities

Channel 3 will monitor and store information on the following functions:

Computer reset (engine stop due to electrical interference)
If the computer signal is subject to electrical interference it will shut down the engine as it tries to reset the controller and throttle motor, this function will record any instances of this happening confirming that this was the cause of the problem.

Throttle motor limit switches
The throttle motor relies on information gained from the limit switches. This function will record any instances of the lower limit switch either not operating or operating twice, either of these would cause a throttle system failure. The previous system would only display `ELECTRICAL PROBLEM´. This system will record the number of times that an abnormality occurs with the throttle motor limit switches again confirming that this was the cause of the problem.

Electrical system abnormalities
This function will record any electrical faults occurring on the main solenoids and relays, showing that a fault had occurred with a particular solenoid or relay, even if no fault was evident when fault finding.

Intermittent electrical contact
This function will indicate any electrical services which experience intermittent electrical contact.

Air filter clogged
This will record the engine hours at which any air filter clogged messages were received by the controller.

Channel 4 machine performance data

Channel 4 will monitor and store information on the following machine performance:

Hour meter
The controller will store a back up reading of engine hours in case of failure or unauthorised tampering with the hour meter in the cab.

Machine actual working hours
The controller will store the actual hours a machine has been working as opposed to hours the engine has been running, this can give a clearer indication of actual component life.

Machine working modes
The controller will store the amount of hours the machine has been working in each of the four working modes.

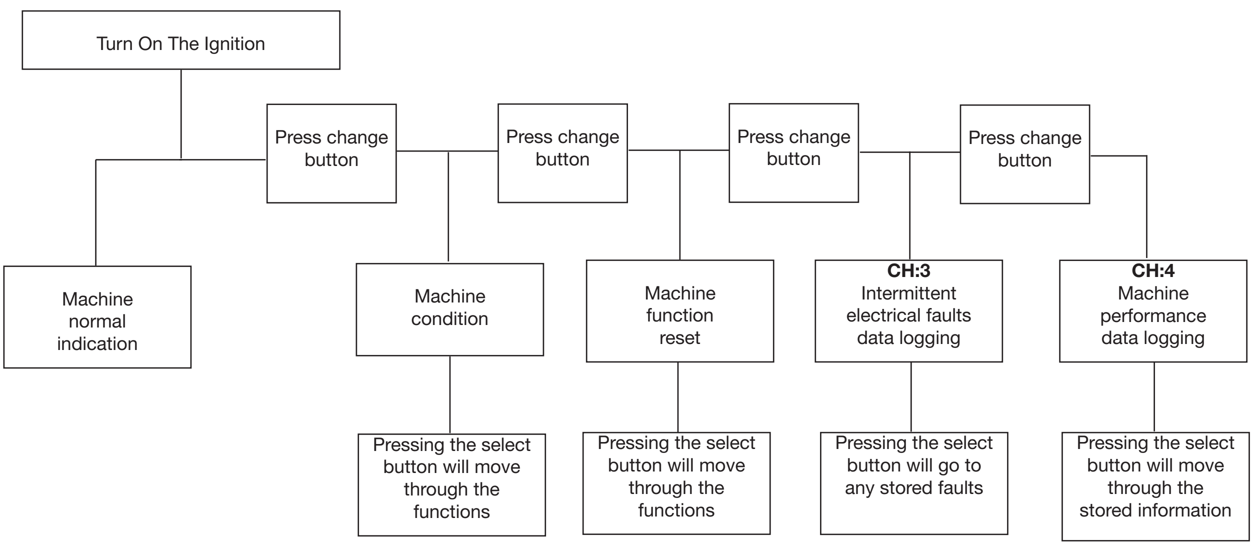
Travel/Swing / excavating / hammering operations
The controller will store the amount of hours that a machine has been performing each of these functions.

Engine coolant / hydraulic oil temperature
The controller will record how many hours a machine has been operating at a specific coolant or hydraulic oil temperature, it will also record the maximum temperature reached by the engine coolant and hydraulic oil.

Engine RPM
The controller will record how many hours the engine has been operating at specific engine rpm’s.

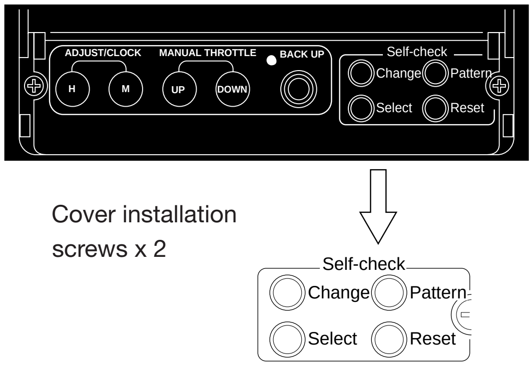
Key Switch ON / OFF;
The controller records how many times the key switch has been turned on.

One touch idle/ auto idle
The controller records the frequency of use of these functions.



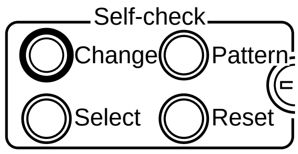
To read stored information on channel 3

1 Remove redundancy buttons cover.

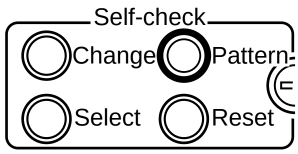


2 Switch on the ignition.

3 Press the change button once.

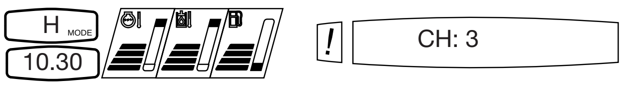


4 Press the pattern button twice.



5 Set the working mode to H mode.
If the monitor now gives 3 beeps this is to indicate that no faults have occurred and therefore no information has been stored.

If the monitor does not give 3 beeps then one or more faults have occurred and been stored.



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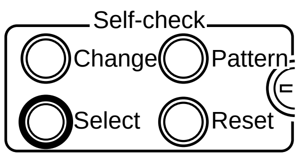
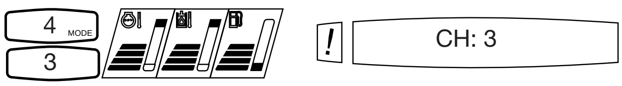
6 Press the select button once.



7 The monitor will now display the first numerical fault code.

Make a note of the numerical codes in the mode screen clock screen and message window (refer this to data sheet for channel 3).
Press the select button again, if a second fault has been stored, the monitor will display the fault codes for this fault.
If no second fault has been stored then the display will return to the clock time and mode indication.



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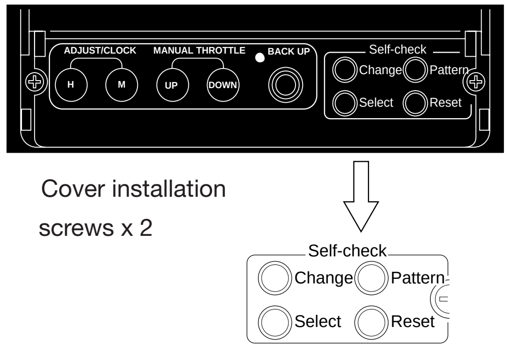
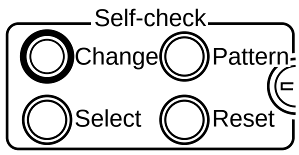
To Read stored information on channel 4

1 Remove redundancy buttons cover.

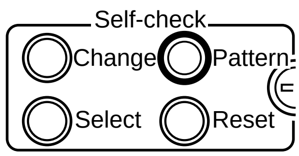


2 Switch on the ignition.

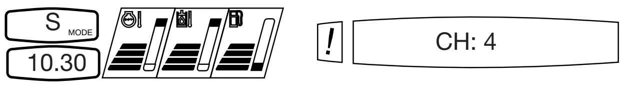
3 Press the change button once.



4 Press the pattern button three times.

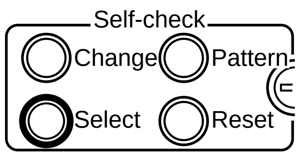


5 Set the working mode to S mode.



A296560

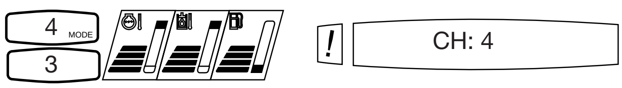
6 Press the select button once.



7 The monitor will now display the first numerical performance measurement.

Make a note of the numerical codes in the mode screen, clock screen and message window refer to the attached performance logging pages (10 - 8 and 10 - 9).

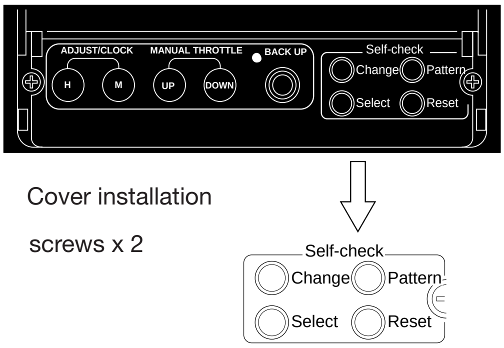
Press the select button again to read the second code and record this, continue until all of the codes have been recorded.



A296560

To Reset Stored Information

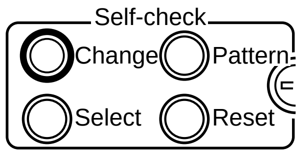
1 Remove redundancy buttons cover.



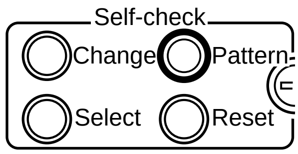
Cover installation screws x 2

2 Switch on the ignition.

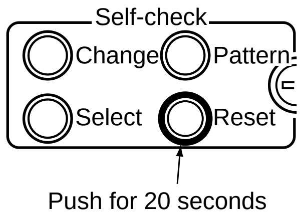
3 Press the change button once.



4 To reset channel 3 press the pattern button twice, to reset channel 4 press the pattern button three times.



5 Press and hold the reset button for 20 seconds. The buzzer will sound after 20 seconds to indicate that the channel has been reset.



6 Switch off the ignition.

IMPORTANT: REPROGRAMMING THE CONTROLLER WILL NOT RESET THE INFORMATION STORED ON CHANNEL 3 AND CHANNEL 4.

Calculating max. engine water temperature reached and max. hydraulic oil temperature reached

The values given in channel 4 monitor window 8, mode window 9, clock screen value X are digital values and need to be converted to a temperature value using the formula.

Resistance = $$\frac{1000 \text{ x value X}}{255 \text{ - value X}}$$

This resistance value will then relate to a temperature on the temperature graph on the following page.

FOR EXAMPLE:

The value given for the max engine water temperature reached is 95
Using the formula

Resistance = $$\frac{1000 \text{ x value X (which is 95)}}{255 \text{ - value X (which is 95)}}$$

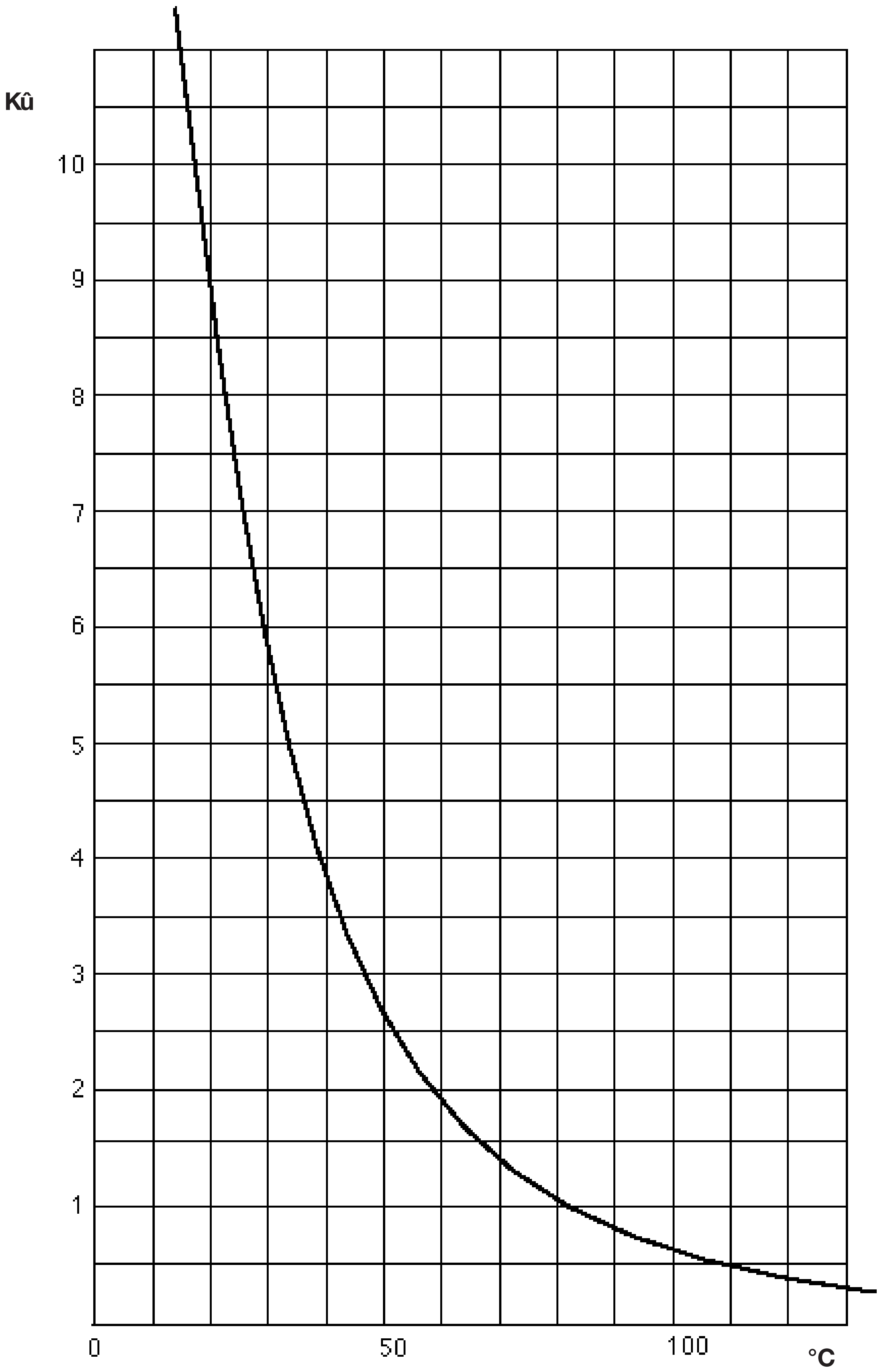
therefore:

Resistance = $$\frac{1000 \text{ x } 95}{255 \text{ - } 95}$$

Resistance = $$\frac{95000}{160}$$ = 593.75 ohms (Remember 1kû = 1000 û.)

Relating this value to the temperature graph on the following page gives a temperature of 97°c
Therefore max temperature reached by engine water is 97°c

This procedure is the same for calculating max. temperature reached by hydraulic oil.


Kû
10
9
8
7
6
5
4
3
2
1
0
50
100
°C

Channel 3: Service Text

SELECT SWITCH (*1)	MONITOR WINDOW	MODE WINDOW	CLOCK WINDOW / INDICATION ITEM		Unit/ Indication
	CH; 3	H, S, L or F	Hour meter	Initial indication	hour
		1	Computer reset (Engine stop)	Wrong earth	Numbers (occurrence)
		2	Electric system abnormality (1)	Limit SW ON = 0 time	Numbers (")
		3	Electric system abnormality (2)	Limit SW ON = 2 time	Numbers (")
		4	Electric system abnormality (3)	CN6-12 Free swing sol. V	1
				CN6-4 2- stage relief sol. V	2
				CN6-11 Travel alarm	3
				CN6-3 Lever lock sol V	4
				CN6-10 Swing shut off sol.V	5
				CN6-2 Spare	6
				CN6-9 Spare	7
				CN6-1 Spare	8
				CN6-8 Boom lowering speed regulation sol. V	9
				CN6-16 Warning lamp	10
				CN6-7 Swing lock sol. V	11
				CN6-15 Max. flow cut sol. V	12
				CN6-6 Soft/hard change sol. V	13
				CN6-14 Spare	14
				CN6-5 Spare	15
				CN6-13 Negative control sol. V	16
				CN7- 2 Battery relay	17
				CN7-6 Heating relay	18
				CN7-3 Swing brake sol. V	19
				CN7-7 Travel 2 speed change sol. V	20
		7	Wrong electrical contact (digital signal) see 10-9		
		6(*)	Short, Break and Wrong electrical contact (analog system) **A B C D** **A:** Sub-No. **B:** Short or Not **C:** Break or not **D:** Wrong electrical contact or not	1 CN10-13 Eng. rotation sensor	1 0 1 1
				2 CN10-8 Throttle volume	2 0 0 1
				3 CN10-11 Fuel sensor	3 1 1 1
				4 CN10-12 Water temp. sensor	4 1 1 1
				5 CN10-6 Oil temp. sensor	5 1 1 1
		8	Air cleaner clogged	The time the fault was logged	

(*1) If there is no trouble, the computer buzzes for 3 seconds and retains the initial indication.
(*2) Computer can not detect the following items:
Short of Engine rotation sensor.
Short or break of throttle volume.

Channel 3: Service Text (continued)

SELECT SWITCH (*1)	MONITOR WINDOW	MODE WINDOW	CLOCK WINDOW / INDICATION ITEM			Unit/ Indication
	CH; 3	7	Wrong electrical contact (digital Signal)	CN2-10	Battery Level sensor	1
				CN2-3	Lever lock	2
				CN2-8	Battery charge	3
				CN2-2	Emergency shut down	4
				CN2-7	Spare	5
				CN2-1	Spare	6
				CN2-13	Spare	7
				CN3-9	S-mode switch	8
				CN3-4	H-mode switch	9
				CN3-8	L-mode switch	10
				CN2-6	F-mode switch	11
				CN2-12	Change switch	12
				CN2-5	Pattern switch	13
				CN2-11	Select switch	14
				CN2-4	Reset switch	15
				CN3-3	Hard/soft change switch	16
				CN3-7	Spare	17
				CN3-6	Warning switch	18
				CN3-2	Auto-idle switch	19
				CN3-5	Over heat switch (oil)	20
				CN3-1	Over heat switch (Water)	21
				CN4-9	Limit switch (throttle motor)	22
				CN4-4	Travel 2 speed change switch	23
				CN4-8	Buzzer stop switch	24
				CN4-3	One touch idle switch	25
				CN4-7	Lever lock switch	26
				CN4-6	Swing lock switch	27
				CN4-2	Spare	28
				CN4-5	2 stage relief switch	29
				CN5-13	Spare	30
				CN5-12	Engine oil pressure switch	31
				CN5-4	Horn switch	32
				CN5-11	Spare	33
				CN5-3	Spare	34
				CN5-10	Spare	35
				CN5-9	Spare	36
				CN7-1	Air filter	37
				CN7-4	Reserve tank switch	38
				CN7-5	Engine oil filter	39

Channel 4: Performance logging sheet

SELECT SWITCH	MONITOR WINDOW	MODE WINDOW	CLOCK WINDOW INDICATION ITEM	VALUE
0	CH; 4	H, S, L or F	Time	
1	1	H, S, L or F	Hour Meter	
2	2	H, S, L or F	Machine actual working hours	
3	3	1	Hours spent in S Mode	
4	3	2	Hours spent in H Mode	
5	3	3	Hours spent in L Mode	
6	3	4	Hours spent in F Mode	
7	4	H, S, L or F	Travel hours	
8	5	H, S, L or F	Swing hours	
9	6	H, S, L or F	Excavating hours	
10	7	H, S, L or F	Hammer hours	
11	8	1	Water temperature 1st bar hours	
12	8	2	Water temperature 2nd bar hours	
13	8	3	Water temperature 3rd bar hours	
14	8	4	Water temperature 4th bar hours	
15	8	5	Water temperature 5th bar hours	
16	8	6	Water temperature 6th bar hours	
17	8	7	Water temperature 7th bar hours	
18	8	8	Water temperature 8th bar hours	
19	8	9	Water max. temperature reached †	
20	9	1	Oil temperature 1st bar hours	
21	9	2	Oil temperature 2nd bar hours	
22	9	3	Oil temperature 3rd bar hours	
23	9	4	Oil temperature 4th bar hours	
24	9	5	Oil temperature 5th bar hours	
25	9	6	Oil temperature 6th bar hours	
26	9	7	Oil temperature 7th bar hours	
27	9	8	Oil temperature 8th bar hours	
28	9	9	Oil max. temperature reached †	
29	10	1	Engine rpm below 1000 rpm hours	
30	10	2	Engine rpm 1000 - 1200 rpm hours	
31	10	3	Engine rpm 1200 - 1400 rpm hours	
32	10	4	Engine rpm 1400 - 1600 rpm hours	
33	10	5	Engine rpm 1600 - 1800 rpm hours	
34	10	6	Engine rpm 1800 - 2000 rpm hours	
35	10	7	Engine rpm 2000 - 2200 rpm hours	
36	10	8	Engine rpm above 2200 rpm hours	
37	11	H, S, L or F	Ignition switch ON/OFF No. of times operated	
38	12	H, S, L or F	One touch idle No. of times operated	
39	13	H, S, L or F	Auto idle No. of times operated	

† Remember this is a digital value and must be converted to a temperature using the equation on page 10-6.

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* **Note:** Except where indicated otherwise, information for the JS200 applies to all variants of this machine, including the JS220. Similarly, information for the JS240 applies also to all variants of that machine, including the JS260.

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* **Note:** Except where indicated otherwise, information for the JS200 applies to all variants of this machine, including the JS220. Similarly, information for the JS240 applies also to all variants of that machine, including the JS260.

Pump

Type	Twin variable displacement piston pump
Displacement Volume	96.6 (cc/rev) x2
* Working Pressure	350 kgf/cm^2 (343 bar, 4977 lb/in^2)
Maximum Output	198.7 litre/min (43.7 UK gal)
Fixed Displacement Gear Pump Displacement Volume	 10 cc/rev
* Working Pressure	40 kgf/cm^2 (39.2 bar, 569 lb/in^2)
Maximum Output	20.5 litre/min (4.5 UK gal)
Dry weight	* 132 kg (291 lb)

Control Valve

Type	Hydraulic Pilot System
Operating System	Set pressure relief
Main Relief Pressure Standard * Pressure Raising	 320 kgf/cm^2 (314 bar, 4550 lb/in^2) at 138 litre/min (30.3 UK gal) 350 kgf/cm^2 (343 bar,4977 lb/in^2) at 155 litre/min (34 UK gal)
* Overload Relief Pressure * Dipper, Bucket (except JS220LC Long Reach) * Dipper out (JS220LC Long Reach only) * Dipper in (JS220LC Long Reach only) * Bucket (JS220LC Long Reach only) * Boom Raising * Boom Lowering Pressure	 370 kgf/cm^2 (363 bar, 5263 lb/in^2) at 20 litre/min (4.4 UK gal) 370 kgf/cm^2 (363 bar, 5263 lb/in^2) at 20 litre/min (4.4 UK gal) 220 kgf/cm^2 (216 bar, 3132 lb/in^2) at 20 litre/min (4.4 UK gal) 240 kgf/cm^2 (235 bar, 3407 lb/in^2) at 20 litre/min (4.4 UK gal) 370 kgf/cm^2 (363 bar, 5263 lb/in^2) at 20 litre/min (4.4 UK gal) 250 kgf/cm^2 (245 bar, 3555 lb/in^2) at 20 litre/min (4.4 UK gal)
* Function	Travel priority, Slew priority, Boom and Dipper Load Holding Valve, Boom and Dipper 2 Speed Confluence
* Dry Weight	* 165 kg (364 lb)

Slew Equipment

Type	Fixed displacement piston motor
Suction Capacity	151 cc/rev
* Working Pressure	285 kgf/cm^2 (279 bar, 4052 lb/in^2)
* Work Flow	198.7 litre/min (43.6 gal/min)
* Set Pressure Relief * All models except JS220LC Long Reach * Model JS220LC Long Reach only	 285 kgf/cm^2 (279 bar, 4053 lb/in^2) at 155 litre/min (34 UK gal) 245 kgf/cm^2 (240 bar, 3480 lb/in^2) at 155 litre/min (34 UK gal)
* Reduction Gear Ratio	16.757 : 1
Slew Brake Brake Torque * Brake Pressure Release	 More than 75.4 kgf m (739.4 Nm, 545 ft lbs) (not including reduction gear) Min 30 kgf/cm^2 (29.4 bar, 426 lb/in^2)
Dry Weight	* 197 kg (434 lb)

Travel Equipment

Type	Fixed Displacement Piston Motor (automatic 2-speed change)
Suction Capacity	157.8/92.9 cc/rev
Working Pressure	350 kgf/cm^2 (343 bar, 4977 lb/in^2)
Working Flow	199 litre/min (43.7 UK gal)
Reduction Gears Deceleration Ratio	 44.384
Parking Brake Brake Torque Brake Pressure Release * Brake Valve Pressure Relief	 2135 kgf/m (20.9 kN/m) including reduction gear > 14 kgf/cm^2 (6.8 bar, 101 lb/in^2) 360 kgf/cm^2 (353 bar, 5119 lb/in^2) at 40 litre/min (8.8 UK gal)
Dry Weight	* 270 kg (595 lb)

Boom Ram

Cylinder Inside Diameter	125 mm
Rod Diameter	85 mm
Max Contracted Length	1790 mm
Stroke	1295 mm
Dry Weight	* 176 kg (388 lb)

Dipper Ram

Cylinder Inside Diameter	135 mm
Rod Diameter	100 mm
Max Contracted Length	2150 mm
Stroke	1580 mm
Dry Weight	* 275 kg (606 lb)

Bucket Ram

Cylinder Inside Diameter	120 mm
Rod Diameter	80 mm
Max Contracted Length	1582 mm
Stroke	1012 mm
Dry Weight	* 146 kg (322 lb)

Pump

Type	Twin variable displacement piston pump
Displacement Volume	96.4 cc/rev x2
Working Pressure	320 kgf/cm^2 (309 bar, 4550lb/in^2)
Maximum Output	212.2 litre/min (46.6 UK gal)
Fixed Displacement Gear Pump Displacement Volume	10 cc/rev
* Working Pressure	40 kgf/cm^2 (39.2 bar, 568lb/in^2)
Maximum Output	22.0 litre/min (4.8 UK gal)
Dry Weight	* 132 kg (291 lb)

Control Valve

Type	Hydraulic Pilot System
Operating System	Set relief pressure
Main Relief Standard * Pressure Raising	 320 kgf/cm^2 (314 bar, 4550 lb/in^2) at 168 litre/min (37 UK gal) 350 kgf/cm^2 (343 bar, 4977 lb/in^2) at 155 litre/min (34 UK gal)
Overload Relief Pressure Boom Raising, Arm, Bucket * Boom Lowering Pressure	 370 kgf/cm^2 (363 bar, 5263 lb/in^2) at 20 litre/min (4.4 UK gal) 250 kgf/cm^2 (245 bar, 3555 lb/in^2) at 20 litre/min (4.4 UK gal)
* Function	Travel priority, Slew priority, Boom and Dipper Load Holding Valve, Boom and Dipper 2 Speed Confluence
Dry Weight	* 165 kg (364 lb)

Slew Equipment

Type	Fixed displacement piston motor
Suction Capacity	151 cc/rev
Working Pressure	285 kgf/cm^2 (279 bar, 4053 lb/in^2)
Work Flow	212.2 litre/min (46.6 gal/min)
* Set Pressure Relief	285 kgf/cm^2 (279 bar, 4052 lb/in^2) at 188 litre/min (41.3 UK gal)
* Reduction Gear Ratio	22.097 : 1
Slew Brake	
Brake Torque	More than 75.4 kgf m (739.4 Nm, 545 ft lbs) (Not including reduction gear)
* Brake Pressure Release	Min 30 kgf/cm^2 (min 29.4 bar, 426 lb/in^2)
Dry Weight	* 325 kg (716 lb)

Travel Equipment

Motor	Fixed displacement piston motor (automatic 2-speed change)
Suction Capacity	164.4/98.1 cc/rev
* Working Pressure	350 kgf/cm^2 (343 bar, 4977 lb/in^2)
Working Flow	211 litre/min (46.4 UK UK gal)
Reduction Gears Deceleration Ratio	 44.384
Parking Brake Brake Torque Brake Pressure Release * Brake valve pressure relief	 2135 kgf/m (20.9 kNm, 15436 ft/lb) including reduction gear > 14 kgf/cm^2 (13.5 bar, 199 lb/in^2) 360 kgf/cm^2 (353 bar, 5119 lb/in^2) at 40 litre/min (8.8 UK gal)
Dry Weight	* 270 kg (595 lb)

Boom Rams

Cylinder Inside Diameter	130 mm
Rod Diameter	90 mm
Max Contracted Length	1843 mm
Stroke	1278 mm
Dry Weight	* 214 kg (472 lb)

Dipper Ram

Cylinder Inside Diameter	150 mm
Rod Diameter	105 mm
Max Contracted Length	2234 mm
Stroke	1632 mm
Dry Weight	* 341 kg (752 lb)

Bucket Ram

Cylinder Inside Diameter	135 mm
Rod Diameter	90 mm
Max Contracted Length	1687 mm
Stroke	1073 mm
Dry Weight	* 211 kg (465 lb)

All Machines (see Note on Contents Page)

Pump

Part Name	Size	Torque			Tool	Name
		Nm	kgf m	lbf ft		
Hexagonal Socket Head (Material quality SCM 435)	M5	7	0.70	5	B = 4	
	M6	12	1.20	9	5	
	M8	29	3.00	22	6	
	M10	57	5.8	42	8	
	M12	98	10.00	72	10	
	M14	157	16.00	116	12	Allen wrench
	M16	235	24.00	174	14	
	M18	333	34.00	246	14	
	M20	432	44.00	318	17	
PT UMESEN (Material quality S45C) Wrap seal tape 1.5~2 times	PT 1/16	7	0.70	5	4	
	PT 1/8	10	1.05	8	5	
	PT 1/4	17	1.75	13	6	Allen wrench
	PT 3/8	34	3.50	25	8	
	PT 1/2	49	5.00	36	10	
PO PLUG (Material quality S35C) PF PLUG (Material quality S45C)	PF 1/4	29	3.00	22	6	
	PF 1/2	98	10.00	72	10	
	PF 3/4	147	15.00	109	14	Allen wrench
	PF 1	186	19.00	137	17	
	PF 11/4	265	27.00	195	17	
	PF 11/2	275	28.00	203	17	

This table refers to the Hydraulic pump sectional drawing

Component	Nm	kgf m	lbf ft	Part No.	Remarks	Qty
Hexagonal socket head bolts	432	44	318	401	M20	8
Hexagonal socket head bolts	29	3	22	406, 413	M8	4
Hexagonal socket head bolts	12	1.2	9	407	M6	3
Vp plug	36	3.7	27	466	PF$^{1}/_{4}$	3
Vp plug	168 9	17 0.9	123 6	468 490	PF$^{3}/_{4}$ NPTF$^{1}/_{16}$	4
* Tilting pin, Servo Piston	333	34	246	531, 532	M24 x 2	2, 2
Hexagon nut	235	24	174	808	M20	2

* ## All Machines (see Note on Contents Page)

This table refers to the regulator sectional drawing

*

Regulator	Nm	kgf m	lbf ft	Part No.	Remarks	Qty
Hexagonal socket head bolts	29	3	22	412, 413	M8	2, 2
Hexagonal socket head bolts	12	1.20	9	436, 438	M6	2, 10
Plug	36 9	3.7 0.9	27 6	466 496	PF $^1/_4$ NPTF $^1/_{16}$	 5
Lock nut	157	16	116	630	M30 x 1.5	1
Hexagon nut	16	1.6	12	801	M8	3

*

Component	Nm	kgf m	lbf ft	Remarks
Rotary coupling, lock bar bolts	109-125	11.1-12.7	80-92	Apply Loctite 262
Hydraulic pump to engine bolts	65-76	6.6-7.7	48-56	Apply Loctite 262
Control valve mounting bolts	267-312	27.2-31.8	192-230	
Rotary coupling bottom cover	31-37	3.2-3.8	23-27	
Rotary coupling mounting bolts	103	10.5	76	Apply Loctite 242
Rotary coupling filter bolts	39	4	29	
Rotary coupling motor cover	157	16	116	
Rotary coupling motor make-up and by-pass valve; Relief valve	78	8	58	
Make-up and by-pass cap	137	14	101	
Relief valve cap	157	16	116	

* ## Boom Ram JS200 (see Note on Contents Page)

This table refers to the JS200 Boom Ram sectional drawing

	Nm	kgf m	lbf ft	Part No.	Remarks	Qty
Hexagonal socket head bolts	265	27	195	12	M16 x 2	12
Set Screw	57 ±11	5.8 ±1.09	42 ±8	22	M12 x 1.75	1
Nut	5000	510	3690	21	M65 x 2	1

* ## Dipper Ram JS200 (see Note on Contents Page)

This table refers to the JS200 Dipper Ram sectional drawing

	Nm	kgf m	lbf ft	Part No.	Remarks	Qty
Hexagonal socket head bolts	367	38	270	12	M18 x 2.5	12
Set Screw	57 ±11	5.8 ±1.09	42 ±8	22	M12 x 1.75	1
Nut	9340	952	6885	21	M70 x 2	1

* Bucket Ram JS200 (see Note on Contents Page)

This table refers to the JS200 Bucket Ram sectional drawing

	Nm	kgf m	lbf ft	Part No.	Remarks	Qty
Hexagonal socket head bolts	265	27	195	12	M16 x 2	12
Set Screw	57 ±11	5.8 ±1.09	42±8	21	M12 x 1.75	1
Nut	7140	728	5265	20	M62x2	1

* Boom Ram JS240 (see Note on Contents Page)

This table refers to the JS240 Boom Ram sectional drawing

	Nm	kgf m	lbf ft	Part No.	Remarks	Qty
Hexagonal socket head bolts	367	38	270	12	M18 x 2.5	12
Set Screw	57 ±11	5.8 ±1.09	42 ±8	22	M12 x 1.75	1
Nut	5790	590	4265	21	M70 x 2	1

* Dipper Ram JS240 (see Note on Contents Page)

This table refers to the JS240 Arm Cylinder sectional drawing

	Nm	kgf m	lbf ft	Part No.	Remarks	Qty
Hexagonal socket head bolts	520	53	380	12	M12 x 2.5	12
Set Screw	57 ±11	5.8 ±1.09	42 ±8	22	M14 x 2.0	1
Nut	13200	1348	9746	21	M80 x 2	1

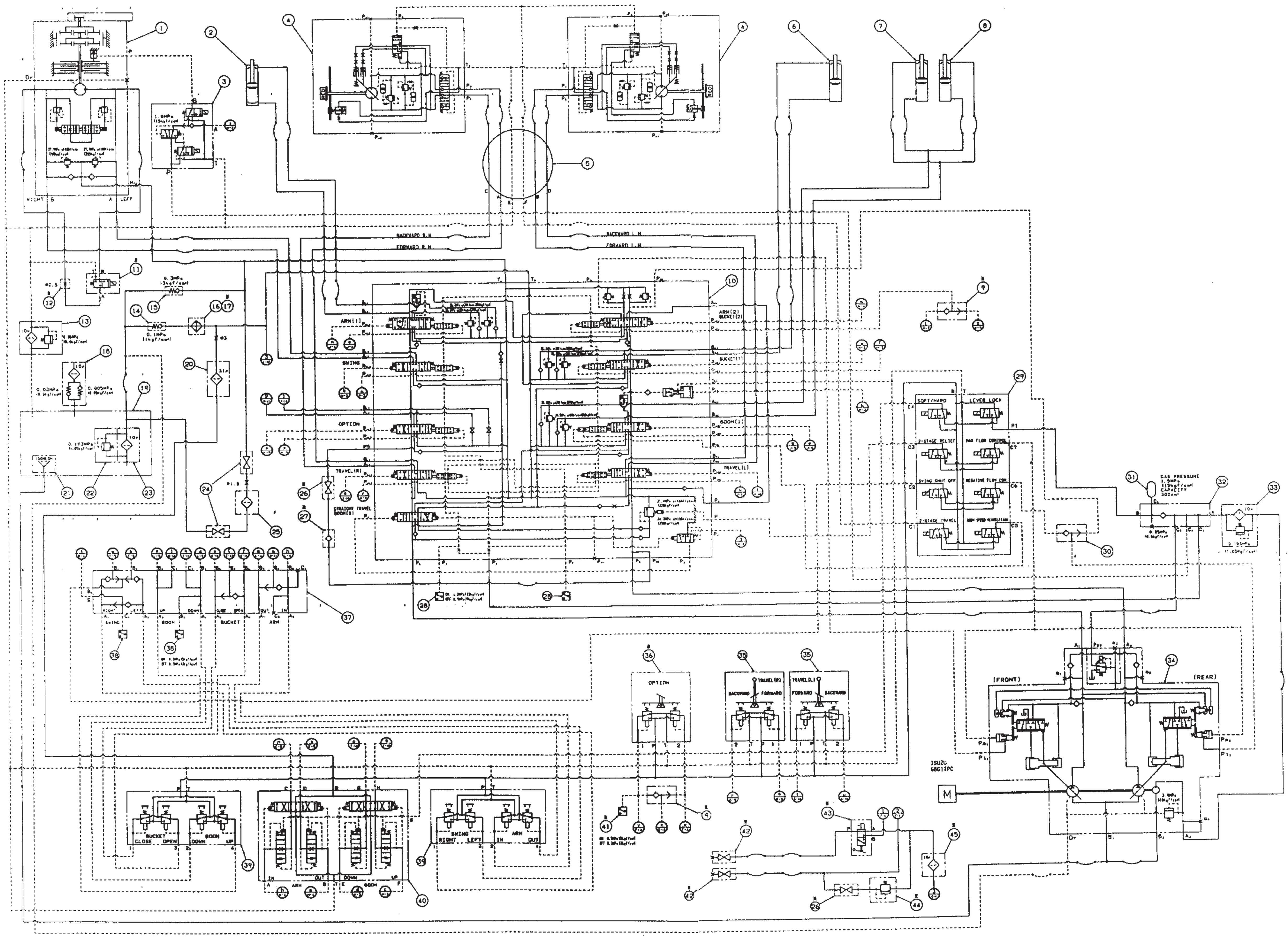
* Bucket Ram JS240 (see Note on Contents Page)

This table refers to the JS240 Bucket Ram sectional drawing

	Nm	kgf m	lbf ft	Part No.	Remarks	Qty
Hexagonal socket head bolts	367	38	270	12	M18 x 2.5	12
Set Screw	57 ±11	5.8 ±1.09	42 ±8	21	M12 x 1.75	1
Nut	9340	952	6885	20	M70 x 2	1

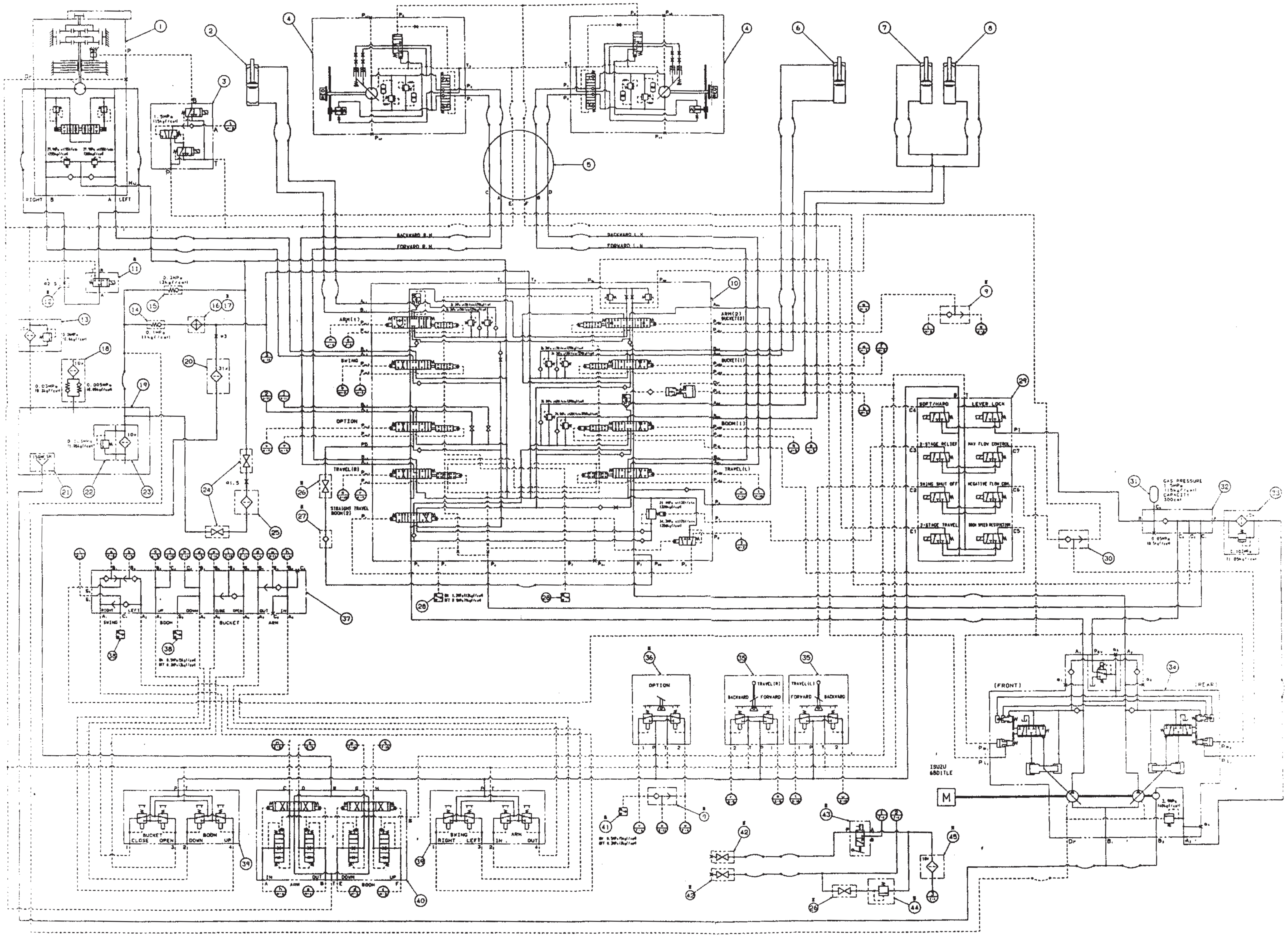
* **Schematic, Hydraulic Circuit JS200 (and Variants)**

1	MOTOR; SLEW		30	VALVE; SHUTTLE
2	RAM; DIPPER		31	ACCUMULATOR
3	VALVE; ASSEMBLY		32	VALVE; CHECK
4	MOTOR; TRACTION		33	FILTER; LINE
* 5	COUPLING; ROTARY		34	PUMP; HYD
6	RAM; BUCKET		35	VALVE; REMOTE CONT
7	RAM; BOOM (L)		36	VALVE; REMOTE CONT
8	RAM; BOOM (R)		37	VALVE; SHUTTLE
9	VALVE; SHUTTLE		38	SWITCH; PRESS
10	VALVE; CONTROL		39	VALVE; STOP
11	VALVE; SOLENOID		40	VALVE; SPL
12	ORIFICE		41	SWITCH PRESS.
13	FILTER; LINE		42	VALVE; STOP
14	VALVE; CHECK		43	VALVE; SPL
15	VALVE; CHECK		44	VALVE; RELIEF
16	RADIATOR		45	FILTER; LINE
17	RADIATOR			
18	BREATHER; AIR			
19	TANK; SUMP			
20	FILTER; LINE			
21	STRAINER			
22	VALVE; RELIEF			
23	FILTER; RETURN			
24	VALVE; STOP			
* 25	FILTER; NEPHRON			
26	VALVE; STOP			
27	VALVE; CHECK			
28	SWITCH; PRESS.			
29	VALVE; SOLENOID			

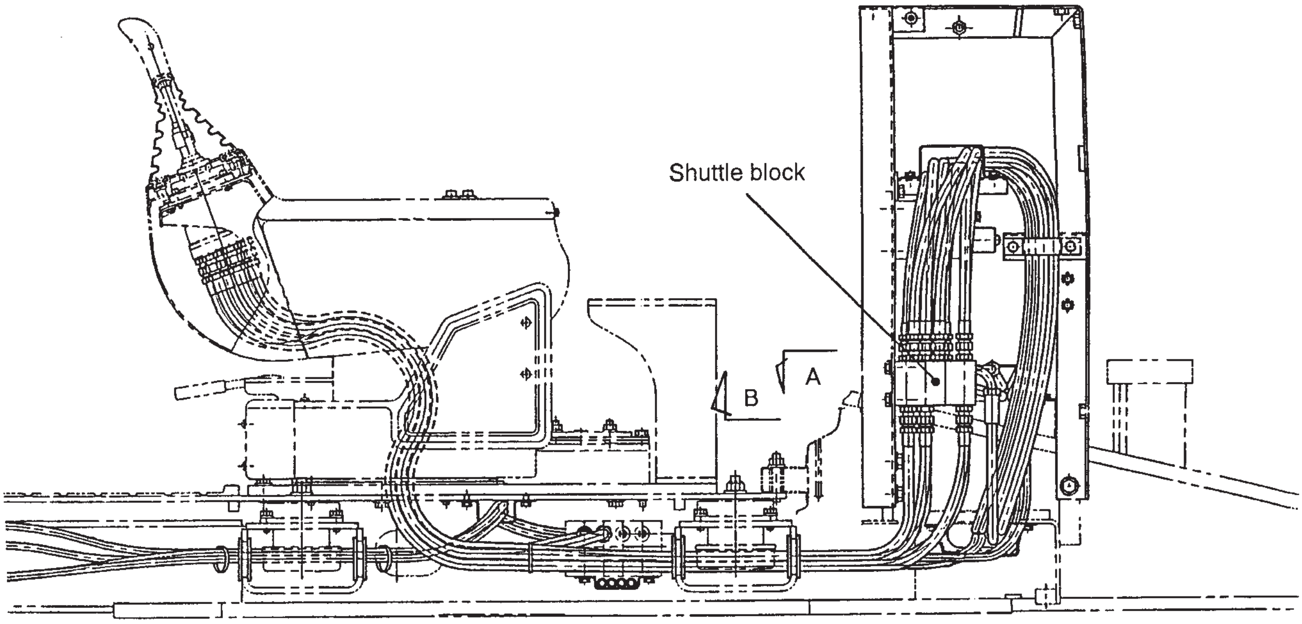


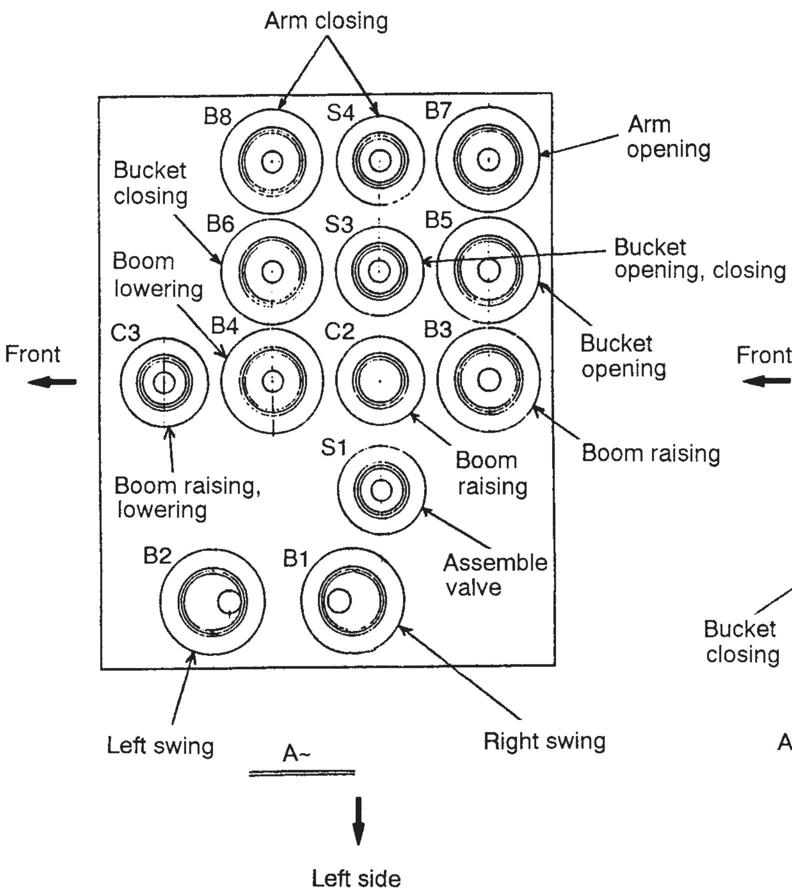
Schematic, Hydraulic Circuit JS240 (and Variants)

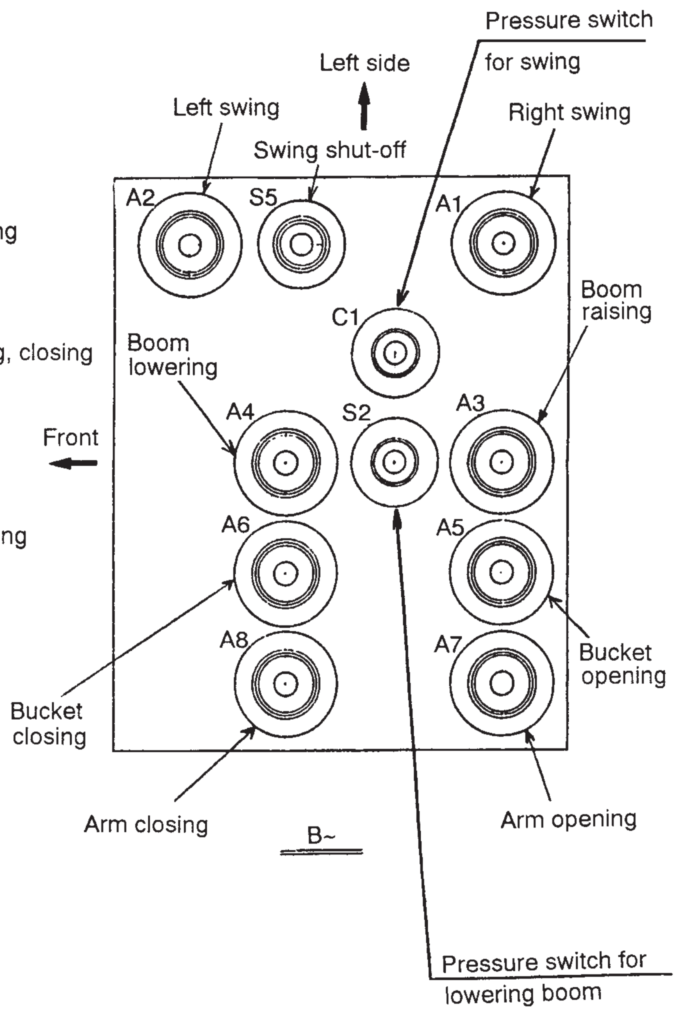
1	MOTOR; SLEW	30	VALVE; SHUTTLE
2	RAM; DIPPER	31	ACCUMULATOR
3	VALVE; ASSEMBLY	32	VALVE; CHECK
4	MOTOR; TRACTION	33	FILTER; LINE
5	COUPLING; ROTARY	34	PUMP; HYD
6	RAM; BUCKET	35	VALVE; REMOTE CONT
7	RAM; BOOM (L)	36	VALVE; REMOTE CONT
8	RAM; BOOM (R)	37	VALVE; SHUTTLE
9	VALVE; SHUTTLE	38	SWITCH; PRESS
10	VALVE; CONTROL	39	VALVE; STOP
11	VALVE; SOLENOID	40	VALVE; SPL
12	ORIFICE	41	SWITCH PRESS.
13	FILTER; LINE	42	VALVE; STOP
14	VALVE; CHECK	43	VALVE; SPL
15	VALVE; CHECK	44	VALVE; RELIEF
16	RADIATOR	45	FILTER; LINE
17	RADIATOR		
18	BREATHER; AIR		
19	TANK; SUMP		
20	FILTER; LINE		
21	STRAINER		
22	VALVE; RELIEF		
23	FILTER; RETURN		
24	VALVE; STOP		
25	FILTER; NEPHRON		
26	VALVE; STOP		
27	VALVE; CHECK		
28	SWITCH; PRESS.		


BACKWARD R.H.
FORWARD R.H.
BACKWARD L.H.
FORWARD L.H.
ARM(1)
SWING
OPTION
TRAVEL(R)
STRAIGHT TRAVEL
BOOM(2)
ARM(2)
BUCKET(2)
BUCKET(1)
BOOM(1)
TRAVEL(L)
SOFT/HARD
LEVER LOCK
2-STAGE RELIEF
MAX FLOW CONTROL
SWING SHUT OFF
NEGATIVE FLOW CON.
2-STAGE TRAVEL
GAS PRESSURE
RIGHT
LEFT
UP
DOWN
CLOSE
OPEN
OUT
IN
BOOM
BUCKET
ARM
OPTION
TRAVEL(R)
TRAVEL(L)
BACKWARD
FORWARD
(FRONT)
(REAR)
ISUZU
6BD1TLE
M
SWING
RIGHT
LEFT

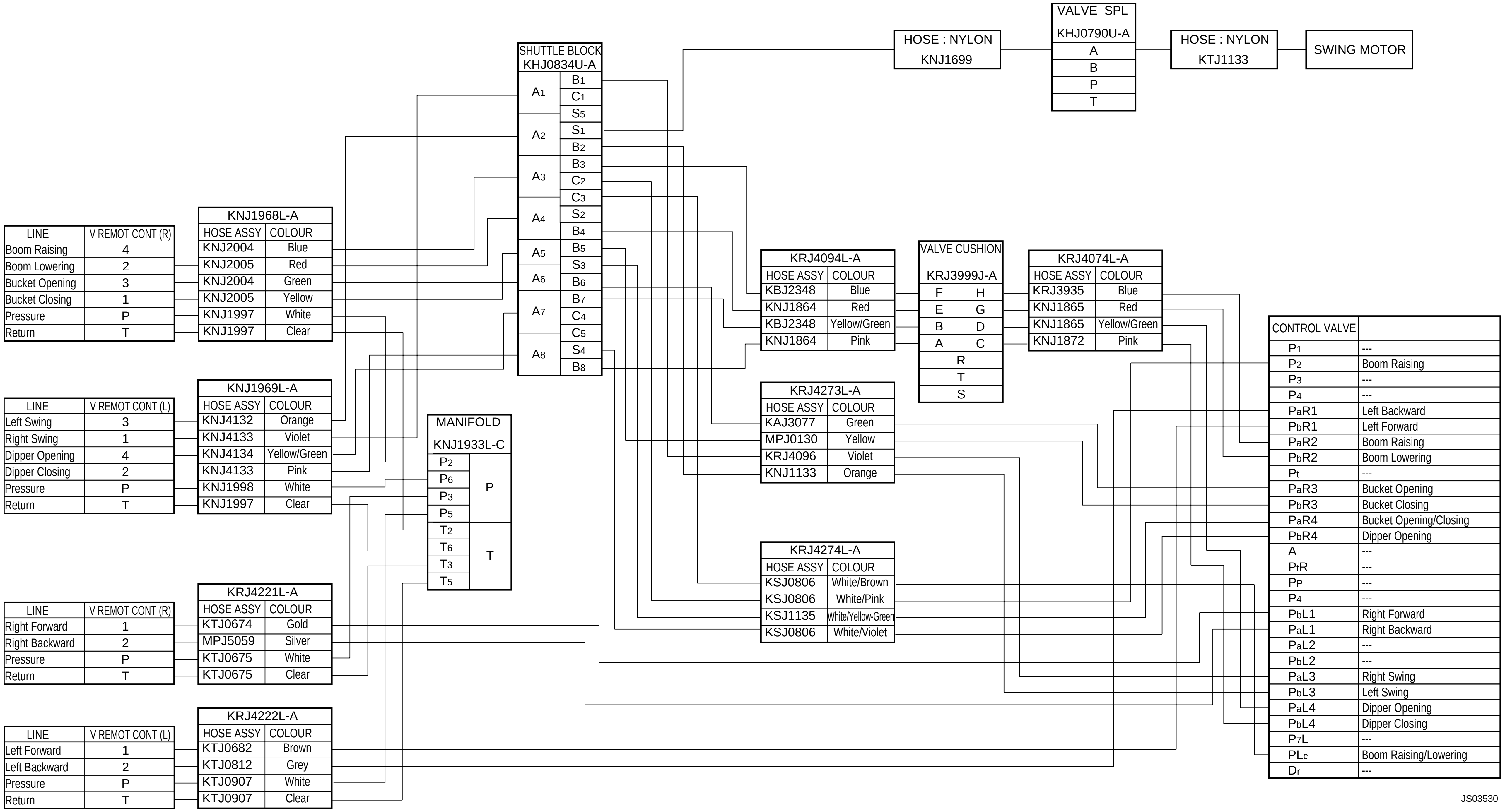
Shuttle Block JS200, JS240







Pilot Control Line Hose Connection Diagram, JS200, JS240



Main Relief Valve Pressure

Note:- *P1 refers to test point on pump.*

1. Prepare the machine
Put the operator levers into neutral, lower the gate lock lever.
Start the engine and place the machine on level ground, lower and open the dipper and set the bucket on the ground. Stop the engine. Release the hydraulic oil tank pressure. *(See **Releasing Tank Pressure**).*

* **1.1** Connect a 0-400 bar (0-6000 lb/in^2) pressure gauge and adaptor to the P1 pressure test point, see **A**.

1.2 Start the engine, and confirm that the engine is at its maximum no-load speed and it is in the **S** mode.

* **1.3** Operate the dipper and read the pressure gauge with the ram at end of stroke.

2. High Pressure Setting *(Pressure raising)*

a. Release lock nut **B** and tighten the adjusting screw **C** until the piston **E** touches the inner face marked *, make sure, when locking screw **C** with lock nut **B**, that nut **F** does not turn.

b. Tighten plug **D** and adjust the pressure *(while watching the pressure gauge and gradually tightening plug **D**)*. After setting the pressure, 338 bar ± 19 bar(4977 lb/in^2 ± 284.4 lb/in^2), lock with nut **G**.

3. Low pressure setting *(Standard)*

a. Adjust the pressure as in the high pressure setting above by loosening plug **D**. If the plug **C** is also loosened, the piston **E** moves to the plug **C** the spring loading is reduced.

b. Pressure is therefore reduced. The setting pressure is 314 bar ± 19 bar (4621 lb/in^2 ± 284.4 lb/in^2).

Note: *The pressure is adjusted 209 bar (3086 lb/in^2) per revolution.*

c. Lock with the plug **B.**

4. Stop the engine

5. Confirmation of the rated pressure

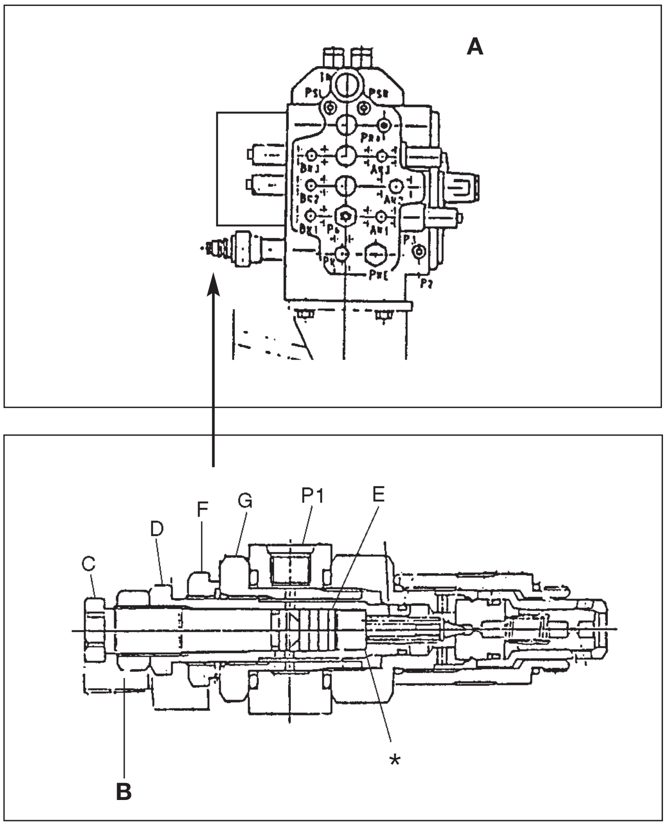
* **a.** Start the engine, raise the r.p.m to maximum in the **S** mode, operate the pressure raising switch in the RH Joystick and check for leakage at the adjusted points.

* **b.** Operate the dipper, hold the service in the stalled position and then stop the control at the standard pressure.

* **c.** Press the pressure raising switch on the RH Joystick and check the pressure.

* **d.** If it needs adjusting, repeat the procedure from step 1.3.

6. Stop the engine and relieve the pressure in the hydraulic oil tank *(see **Releasing Tank Pressure**)* . Remove the pressure gauge and adaptor and reconnect the hose.

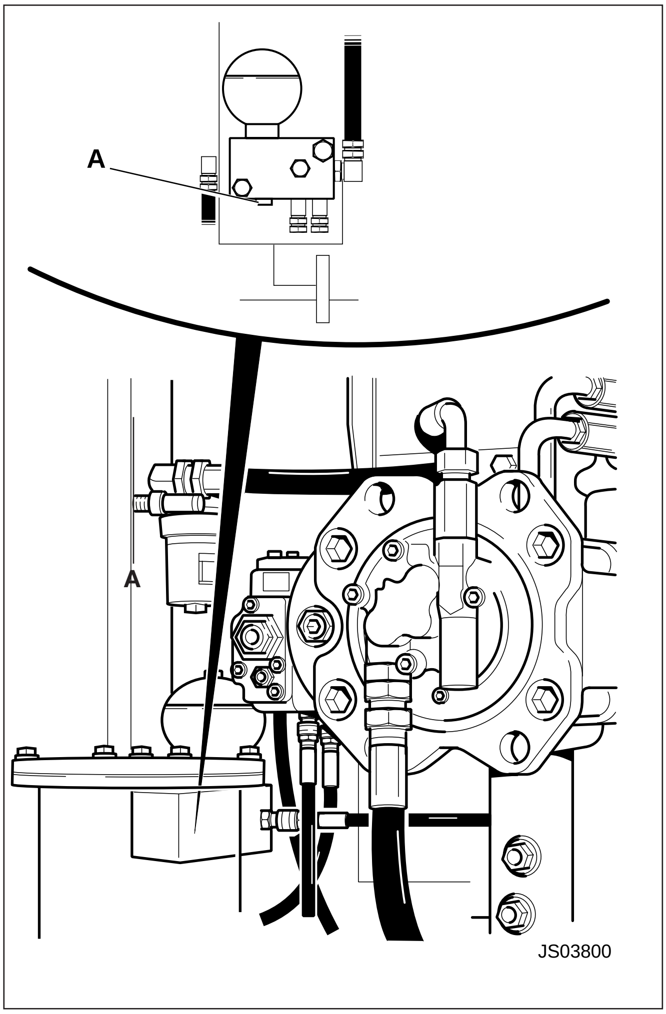


Accumulator Pressure

Prepare the engine
Put the operators lever into neutral, lower the gate lock lever, Start the engine and place the machine on level ground, lower and open the dipper and set the bucket on the ground.

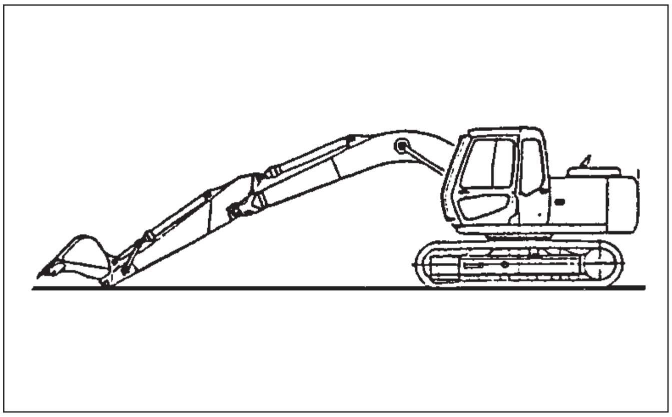
1. Release the hydraulic oil tank pressure *(See **Releasing Tank Pressure**)*.
2. * Connect a 0-100 bar (0-1500 lb/in^2) pressure gauge to the port **A** on the accumulator housing.
3. Start the engine, and let it idle for a few minutes before switching the engine **OFF** and then setting the Key Switch to **ON** with engine **OFF**.
4. Move the slew lever slowly either to the left or the right. Check the pressure just before it suddenly drops. Set pressure is 14.4 ± .47 bar (213 ± 7 lb/in^2)
5. If the pressure is unsatisfactory, renew the accumulator unit.
6. Set the Key Switch to **OFF** and release hydraulic tank pressure before disconnecting the gauge and adaptor.
7. Replace plug.

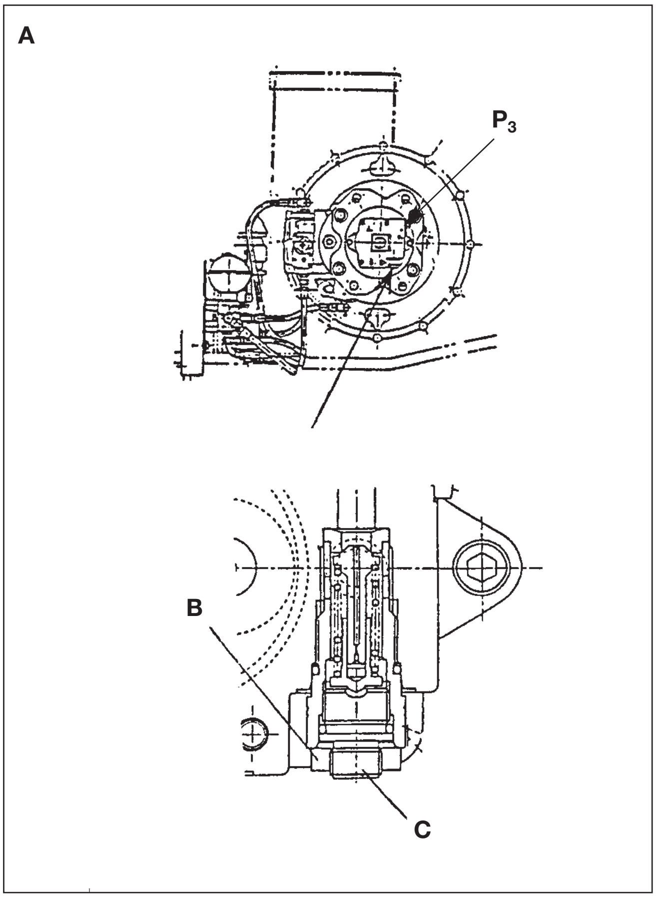
*



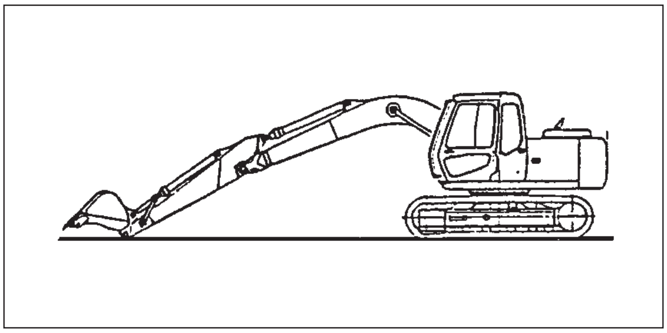
Pilot Relief Pressure

1. **Prepare the machine**
   Put the operator levers into neutral, lower the gate lock lever. Start the engine and place the machine on level ground, lower and open the dipper and set the bucket on the ground. Stop engine.
2. Release the hydraulic oil tank pressure. *(See **Releasing Tank Pressure**)*.
3. Connect a 0-100 bar (0-1500 lb/in^2) pressure gauge and adaptor (see **A**) to the port marked P3 on the pump.
4. Start the engine and confirm that the engine is at its maximum no-load speed and it is in the **S** mode.
5. Loosen the lock nut **B** of the Pilot Relief Valve.
6. Adjust the adjusting screw **C**, to the correct pressure 39.6 ± 2.9 bar (583 ± 48 lb/in^2)
7. Hold the adjusting screw **C** in position and tighten the lock nut **B**.
8. **After locking, check the relief pressure again.** If it is not within the limits above, perform steps 4 onwards again.
9. Stop the engine, release the tank pressure, then remove the gauge and adaptor from the pump.

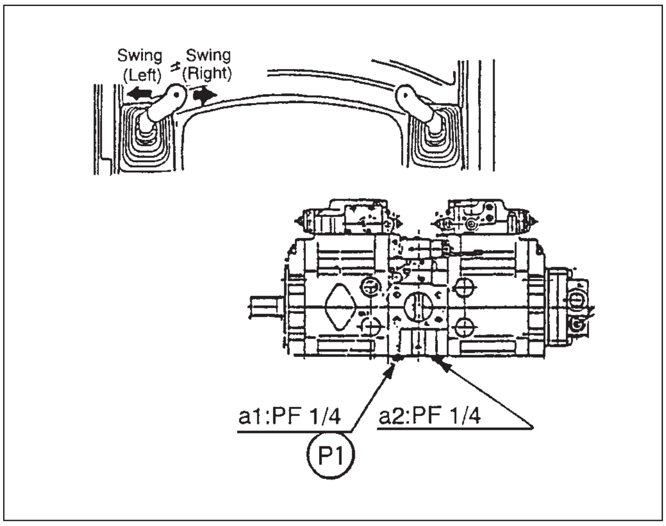




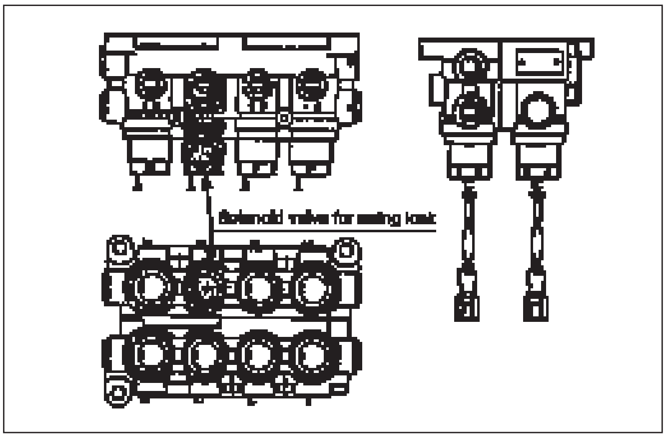
Slew Motor Pressure Relief



1. **Prepare the machine**
   Put the operators lever into neutral, lower the gate lock lever. Start the engine and place the machine on level ground, lower and open the dipper and set the bucket on the ground. Stop the engine.
2. Release the hydraulic oil tank pressure. *(See **Releasing Tank Pressure**).*
3. Connect a 0-500 bar (0-7000 lb/in^2) pressure gauge and adaptor to the port marked P1 on the pump.
4. **Initiate slew lock procedures.**
   a. Remove the water-proof connector on the slew lock solenoid valve, which is on the hydraulic pump side.
   b. Press the slew lock switch which is on the left hand console inside the cab, and confirm that the slew (swing) lock symbol appears on the monitor.
   * **c.** Start the engine, and operate the engine at around 1000 r.p.m, then operate the slew lever slowly. Listen to confirm that the relief sound is heard and that the machine does not slew.
   d. Run the engine at maximum no-load speed and in the **S** mode.
   e. Operate the slew lever.
5. Confirm the pressure of 299.8 ± 14.4 bar (4408 ± 213 lb/in^2) at the gauge.



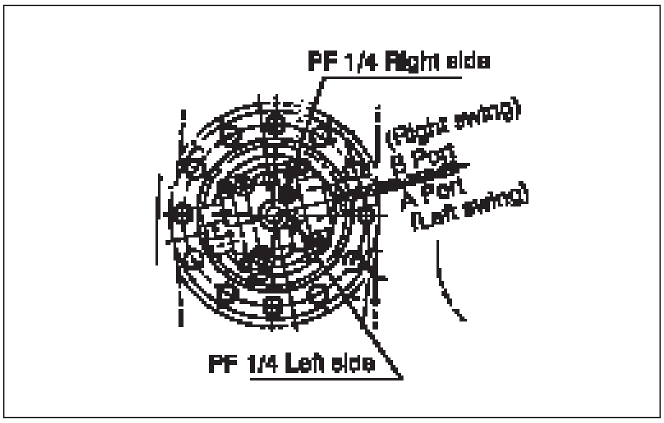
Notes:
1. *If the water-proof slew lock solenoid valve is not removed, slew lock status can be obtained with the slew lock switch **ON**, but slew relief is not carried out.*
2. *Wire colour code to the solenoid is Dark Green.*
3. *Pressure measurement is also possible on the slew motor, upper section.*



6. If the pressure is within the limits, stop engine release tank pressure and remove the gauge and adaptor; If the readings are outside the limits, continue as below.
7. **Pressure Adjustment**
   a. Confirm the present pressure reading.
   b. The difference between the set pressure and the present pressure determines the number of shims **F** required for adjustment.

   $$\text{The No of shims} = \frac{\text{Set pressure-Present Pressure}}{4.83 \text{ bar } (71.1 \text{ lb/in}^2)}$$
8. Remove the relief valve assembly from the slew motor.

Note: *If both relief valves are removed at the same time, mark them left and right to facilitate reassembly in the correct position.*



Slew Motor Pressure Relief *(continued)*

9. Disassemble

a. Place the relief valve in a vice and remove the cap **A** with a 14 mm **A/F** hexagonal socket, take out the piston **B**, liner **C**, poppet **E**, shim **F** and spring **D**.

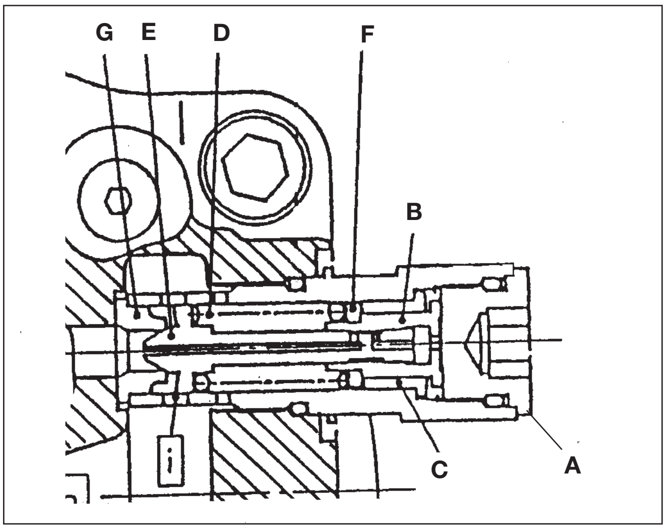
b. Remove the poppet **E** away from the seat **G**, and spring **D** and add or remove a shim (as required by the above calculation) between the spring **D** and spacer.

c. After shim adjustment, install the poppet **E**, spring **D**, shim(s) **F**, piston **B** and liner **C** onto the sleeve.

d. Fix the sleeve into a vice and install the cap **A** with a torque of 156.9 Nm (115.17 ft).

10 a. Install the relief assembly in the slew motor unit, and confirm the pressure.

b. If it is not within the setting pressure, repeat the procedure from step 7.



Port Relief Pressure

Note: *Because port relief pressure is set higher than main relief pressure, it is necessary to temporarily set the main relief pressure higher than port pressure.*

Temporary setting of main relief pressure

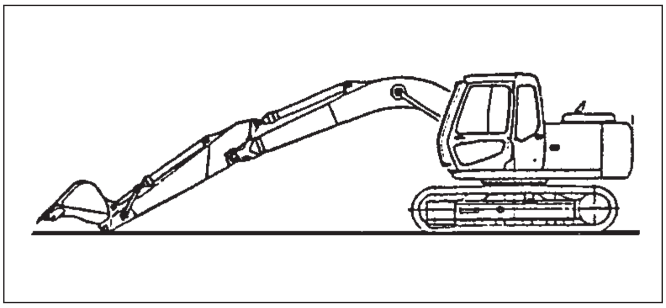
1. Prepare the machine
   a. Put the operators lever into neutral, lower the gate lock lever. Start the engine and place the machine on level ground, lower and open the dipper and set the bucket on the ground.

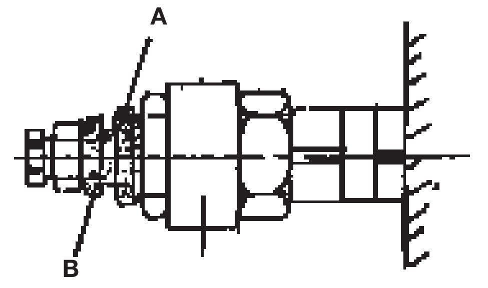
   b. Run the engine at maximum no-load speed and in the **S** mode.

2. Loosen the lock nut **A** and tighten the pressure raising adjusting screw **B** 180° clockwise, then tighten the lock nut **A** of the Main Relief Valve.

3. After completing an adjustment on a particular port relief valve, loosen the lock nut **A** and unscrew the pressure raising adjusting screw **B**, over 180° to return to the standard setting pressure.

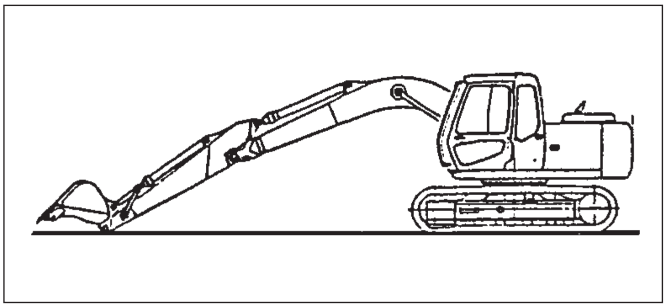
4. Stop the engine





Main relief

Port Relief for Boom Ram

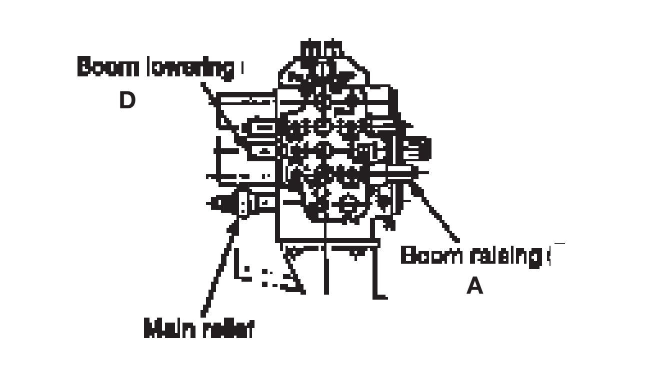


1. **Prepare the machine**
   a. Put the operator lever into neutral, lower the gate lock lever. Start the engine and place the machine on level ground, lower and open the arm and set the bucket on the ground.

   b. Stop the engine, and release hydraulic pressure. *(See **Releasing Tank Pressure**).*

   c. Connect a 0-500 bar (0-7000 lb/in^2) pressure gauge and adaptor to port P2 on the hydraulic pump.

2. Refer to the previous section "Temporary setting of main relief pressure" and complete step 2.

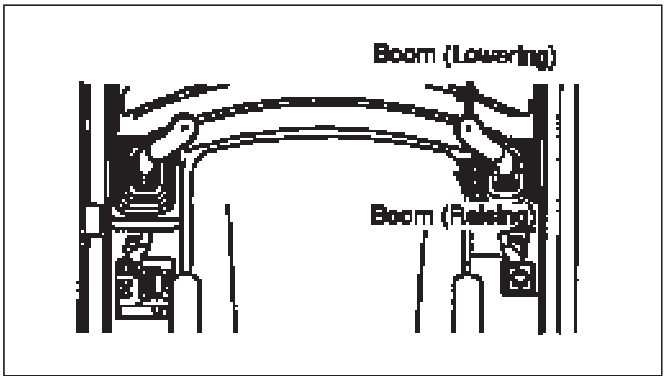


3. **Pressure Adjustment**
   a. Start the engine and lower the gate lock lever, run the engine at maximum no-load speed and in the **S** mode.

   b. Position the boom lever in the raised position and maintain.

   c. Check the gauge for the set pressure of 377 bar ± 14.4 bar (5546 ± 213 lb/in^2). If it is outside the limits, adjust the port relief valve **A** by loosening the lock nut **B** and always coming up to the correct set pressure by first unscrewing, and then screwing in adjusting screw **C**.

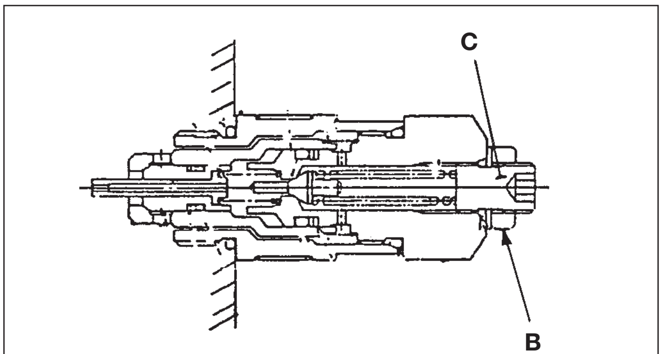
4. Adjust the boom lowering port relief valve **D**, as above, to the set pressure of 241 ± 14.4 bar (3555 ± 213 lb/in^2) by first positioning the boom lever in the lowered position and maintaining it.



5. If the boom cannot be lowered fully, the two ARV's can be exchanged so that the ARV of the boom lowering can be adjusted in the boom raising position (boom lever in raised position) and then replaced.

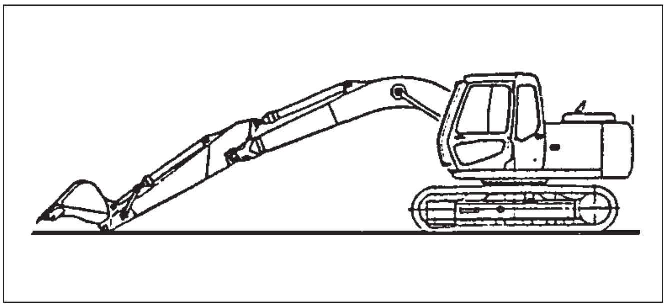
6. **Adjust the main relief Pressure**
   See previous section "Temporary setting of main relief pressure", item 3.

7. Stop the engine and release the hydraulic pressure, *(see **Releasing Tank Pressure**)*, remove the pressure gauge and adaptor.



Port relief

Port Relief for Dipper Ram



1. **Prepare the Machine.**
   a. Put the operator lever into neutral, lower the gate lock lever. Start the engine and place the machine on level ground, lower and open the dipper and set the bucket on the ground.

   b. Stop the engine and release hydraulic pressure. *(See **Releasing Tank Pressure**)*.

   c. Connect a 0-500 bar (0-7000 lb/in^2) pressure gauge and adaptor to port P1 on the hydraulic pump.

2. Refer to the section "Temporary setting of main relief pressure" and complete step 2.

3. **Pressure Adjustment**
   a. Start the engine and lower the gate lock lever, run the engine at maximum no-load speed in the **S** mode.

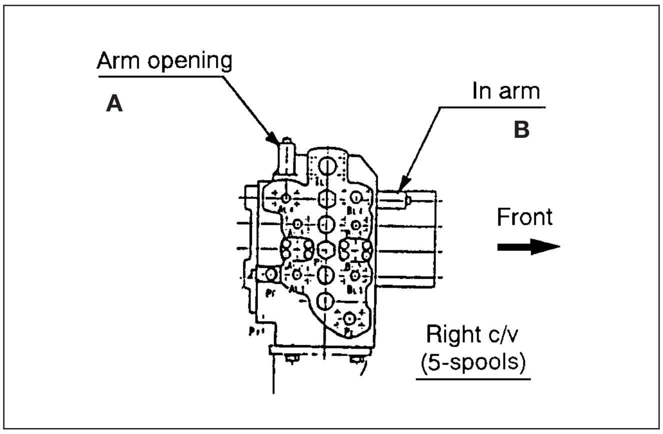
   b. Position the arm operating lever in the opening position and maintain.

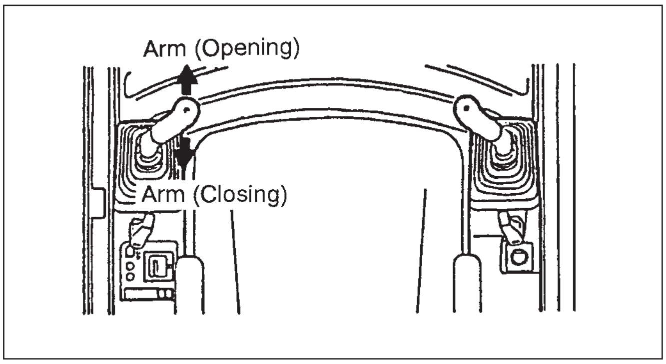
   c. Check the gauge for the set pressure of 377 bar ± 14.4 bar (5546 ± 213 lb/in^2). If it is outside the limits, adjust the port relief valve **A** by loosening the lock nut **B** and always coming up to the correct set pressure by first unscrewing, and then screwing in adjusting screw **C**.

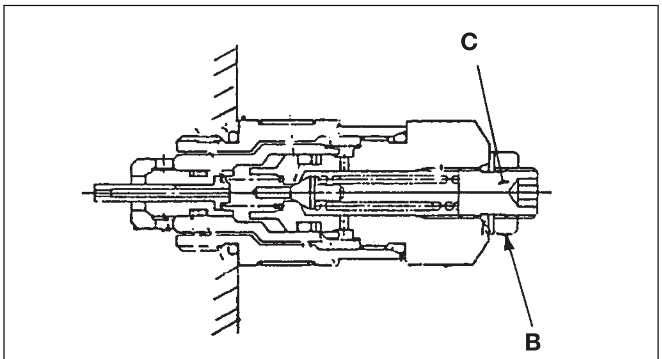
   d. Operate the dipper operating lever in the closing position and maintain, perform the above procedure (**c**), adjusting port relief valve **B**.

4. **Adjust the main relief pressure**
   See previous section "Temporary setting of main relief pressure", item 3.

5. **Stop the engine and release the hydraulic pressure** *(See **Releasing Tank Pressure**)*, remove the pressure gauge and adaptor.

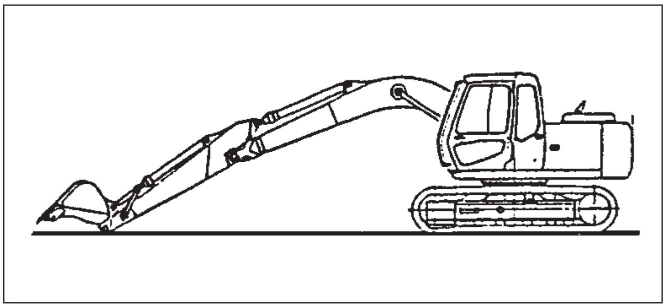






Port relief

Port Relief for Bucket Ram



1. **Prepare the Machine**
   a. Put the operator lever into neutral, lower the gate lock lever, start the engine and place the machine on level ground, lower and open the dipper and set the bucket on the ground.

   b. Stop the engine, and release hydraulic pressure. *(See **Releasing Tank Pressure**)*.

   c. Connect a 0-500 bar (0-7000 lb/in^2) pressure gauge and adaptor to port P2 on the hydraulic pump.

2. Refer to the section "Temporary setting of main relief pressure" and complete step 2.

3. **Pressure Adjustment**
   a. Start the engine and lower the gate lock lever, run the engine at maximum no-load speed in the **S** mode.

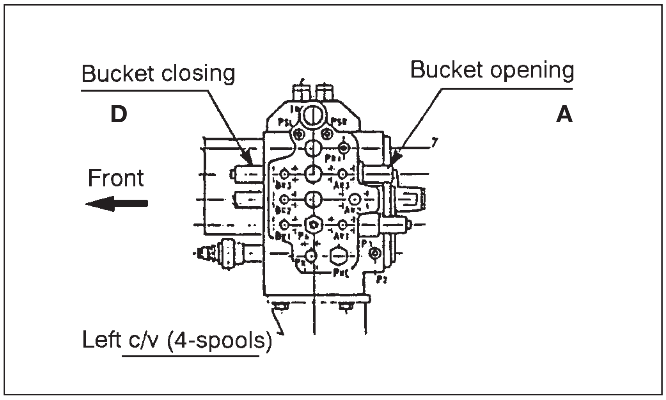
   b. Position the bucket lever in the opening position and maintain.

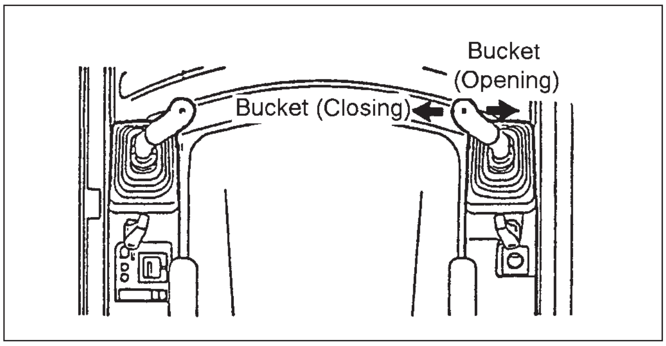
   c. Check the gauge for the set pressure of 377 bar ± 14.4 bar (5546 ± 213 lb/in^2). If it is outside the limits, adjust the port relief valve **A** by loosening the lock nut **B** and always coming up to the correct set pressure by first unscrewing, and then screwing in adjusting screw **C**.

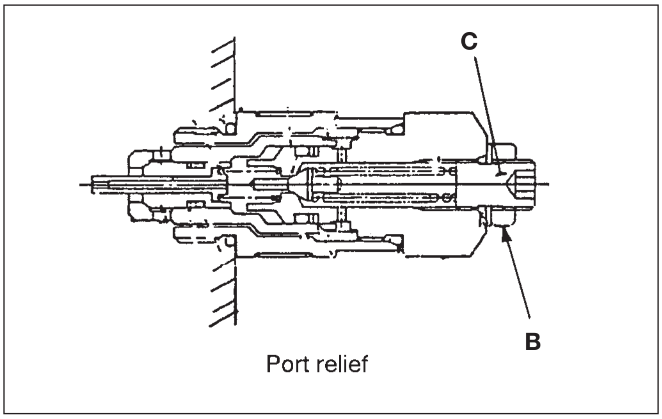
   d. Operate the bucket lever in the closing position and carry out the above procedure (**c**) for adjusting port relief valve **B**.

4. **Adjust the main relief pressure**
   See previous section "Temporary setting of main relief pressure", item 3.

5. **Stop the engine and release the hydraulic pressure**
   *(See **Releasing Tank Pressure**)*, remove the pressure gauge and adaptor.







Travel Motor Relief Pressure

1. **Prepare the Machine**
   a. Put the operator lever into neutral, lower the gate lock lever, start the engine and place the machine on level ground, lower and open the dipper and set the bucket on the ground.

   b. Stop the engine and release hydraulic pressure. *(See **Releasing Tank Pressure**)*.

   c. Connect a 0-500 bar (0-7000 lb/in^2) pressure gauge and adaptor to port P1 (left travel), P2 (Right travel).

Note: *Because the travel motor relief pressure is higher than the relief pressure, raise the main relief pressure to more than 350 bar (5120 lb/in^2).*

2. Refer to the section "Temporary Setting of main relief pressure" and complete step 2.

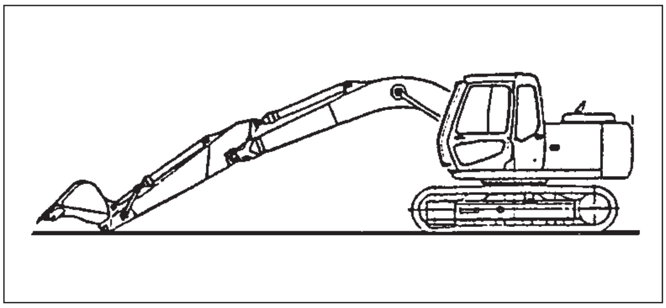
3. Insert lock pin **A** into the drive sprocket, on the appropriate side being measured.

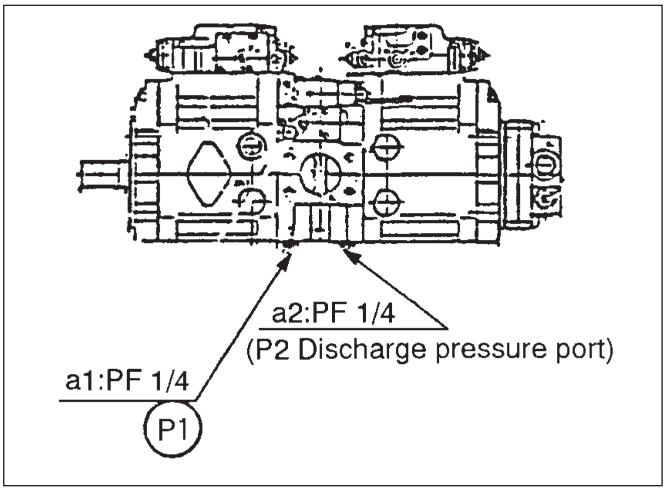
4. **Pressure Adjustment**
   a. Start the engine and lower the gate lock lever, run the engine at maximum no-load speed in the **S** mode.

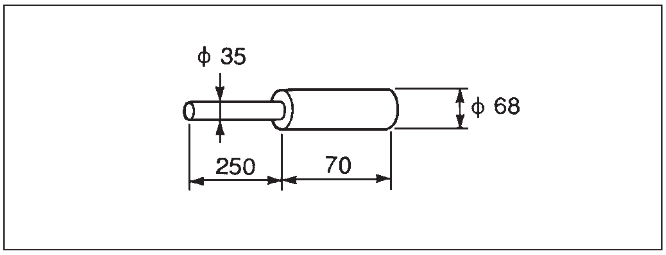
   b. Slowly engage the travel motor left or right whichever is locked up.

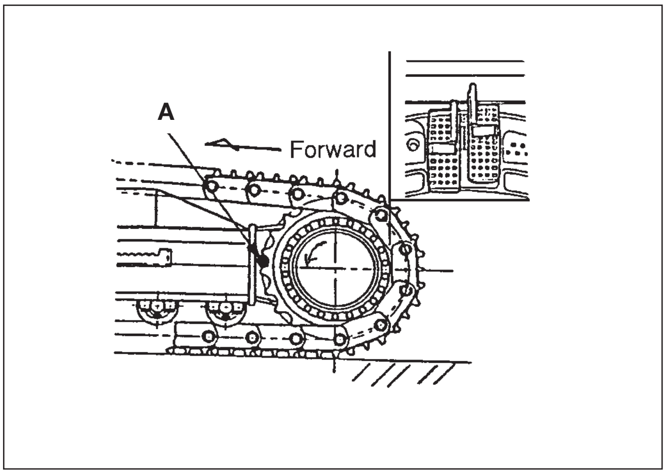
   c. Check the gauge for the set pressure of 402 bar ± 20 bar (5830 ± 284 lb/in^2). If it is outside the limits, adjust the port relief valve **A** by loosening the lock nut **B** and always coming up to the correct set pressure by first unscrewing, and then screwing in adjusting screw **C**.

   d. Repeat the procedure from step 3 for the other side.





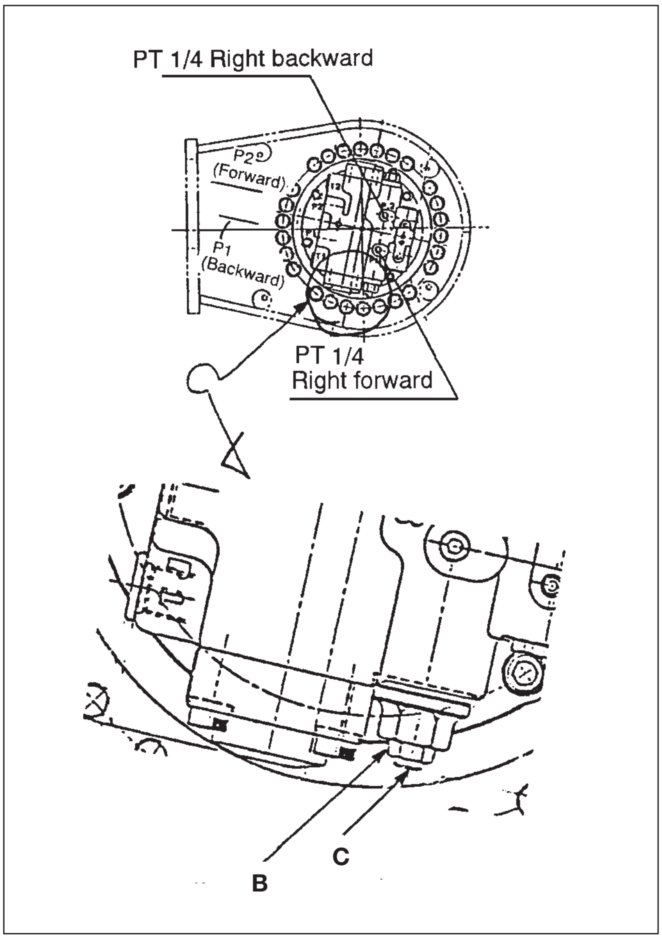




Travel Motor Relief Pressure *(continued)*

5. Adjust the main relief pressure
See previous section "Temporary setting of main relief pressure", item 3.

6. Stop the engine and release the hydraulic pressure.
*(See **Releasing Tank Pressure**)*, remove the pressure gauge and adaptor.



Hydraulic Pump

Proportional Pressure Reduction Valve.

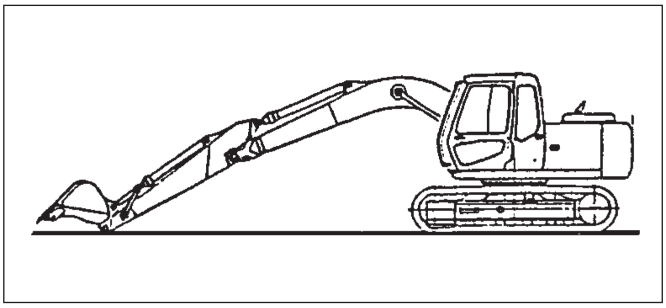
1. **Prepare the Machine**
   a. Put the operator lever into neutral, lower the gate lock lever, start the engine and place the machine on level ground. Lower and open the dipper and set the bucket on the ground.

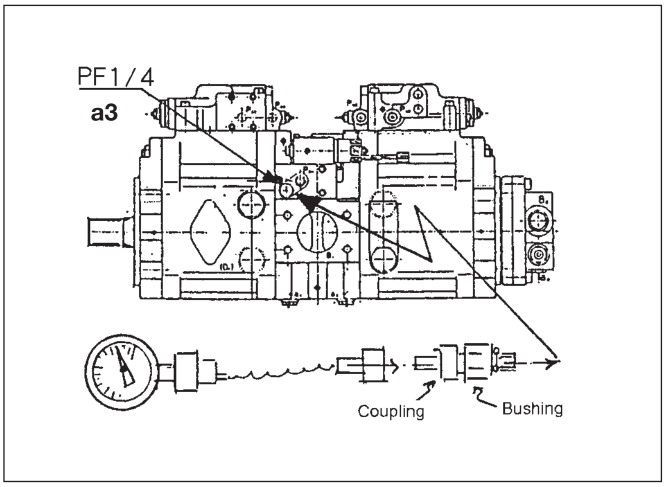
   b. Stop the engine and release hydraulic pressure. *(See **Releasing Tank Pressure**)*.

   c. Connect a 0-500 bar (0-7000 lb/in²) pressure gauge and adaptor to port a3.

2. **Pressure**
   a. Start the engine and lower the gate lock lever, run the engine at maximum no-load speed, with the operator lever in neutral.

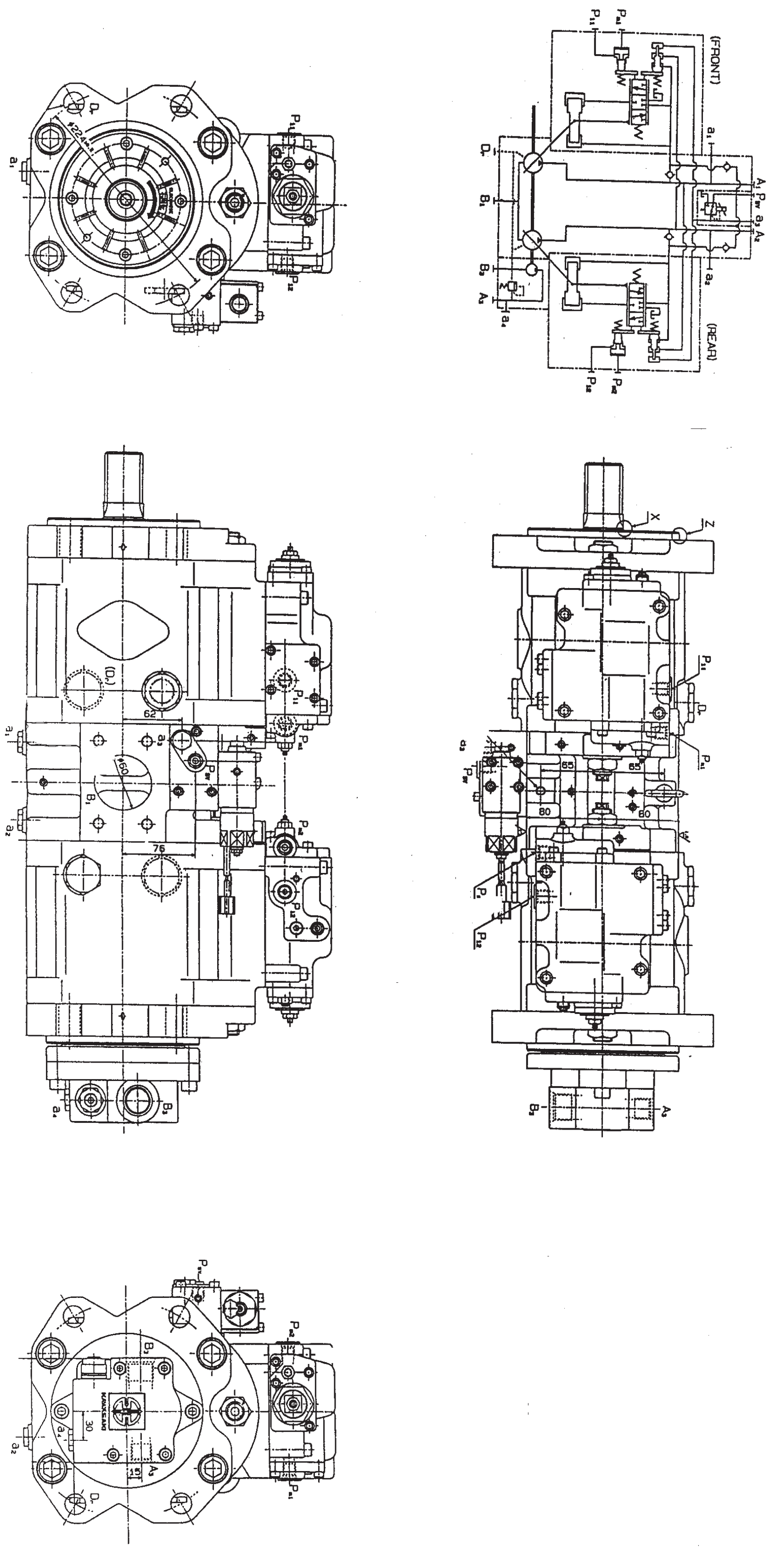
   b. Refer to the chart below for the pressure reading in the relevant modes.

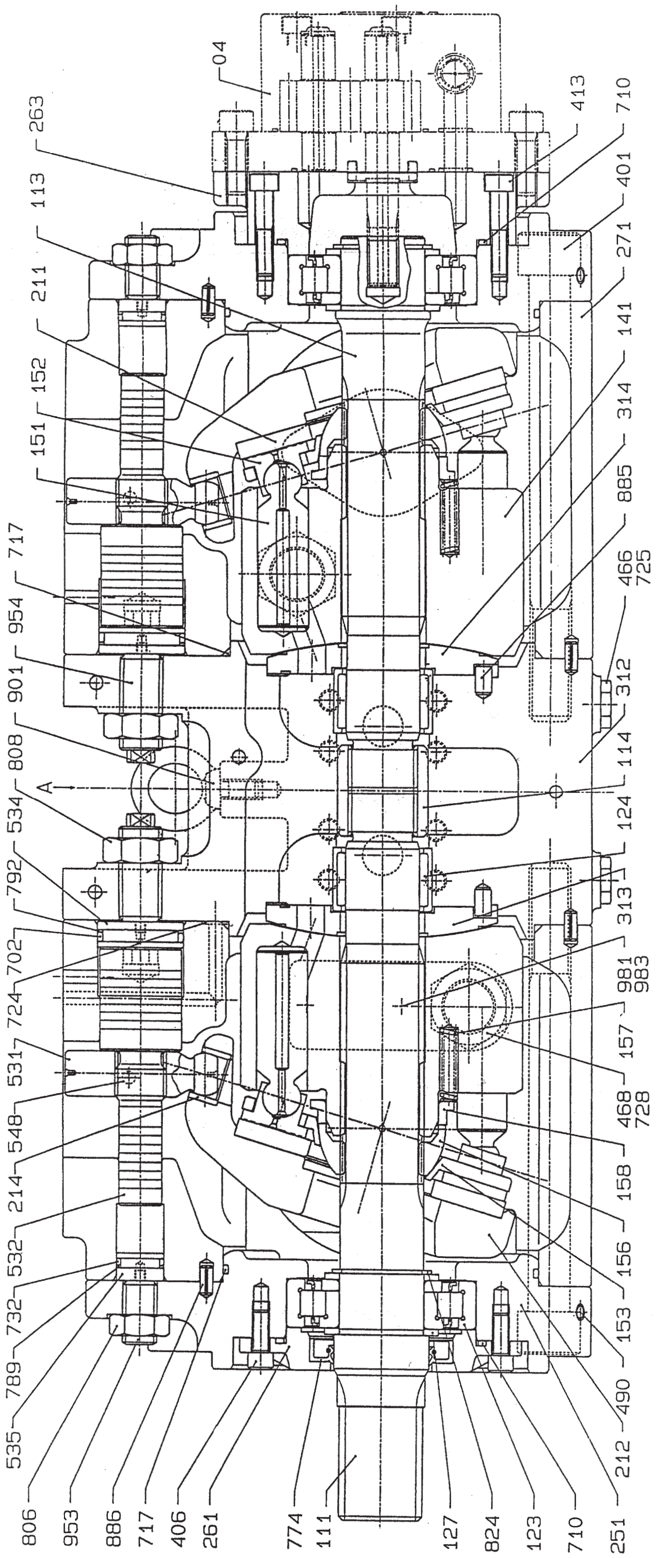




Engine revolutions		Max.
Lever operation		Neutral
Mode Operation	H	99.5 lb/in²-355 lb/in³, 6.7 bar - 24.1 bar (7 - 25 kgf/cm²)
	S	367 lb/in²-455 lb/in², 24.9 bar - 30.9 bar (26 - 32 kgf/cm²)
	L.F.	_
Pressure gauge		0-500 bar, 0-7000 lb/in² (50kgf/cm²)
Measurement port		a3

No adjustment is possible

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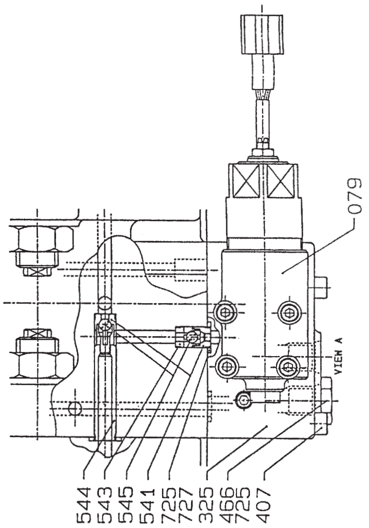
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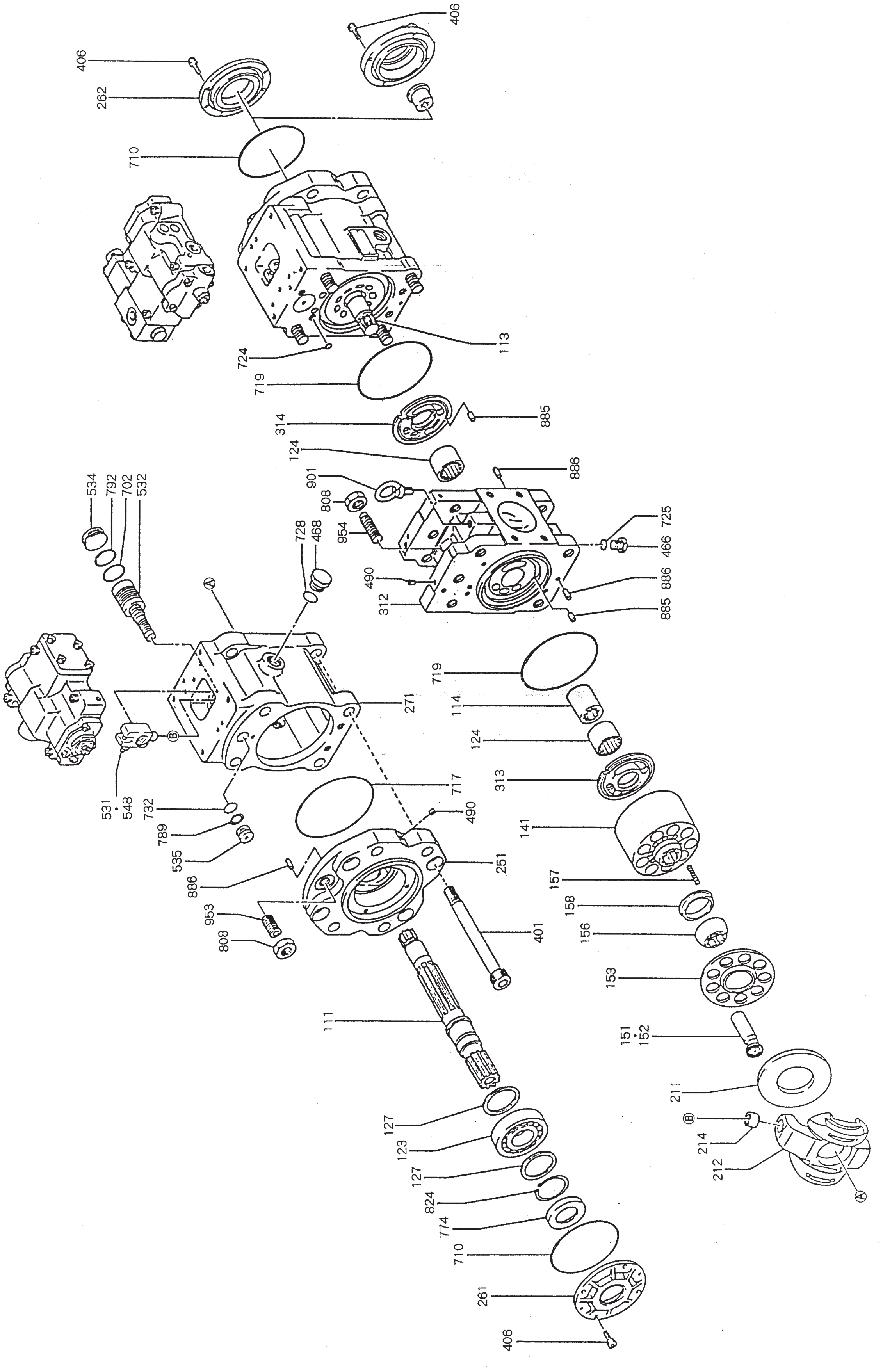
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Schematics, Technical Data

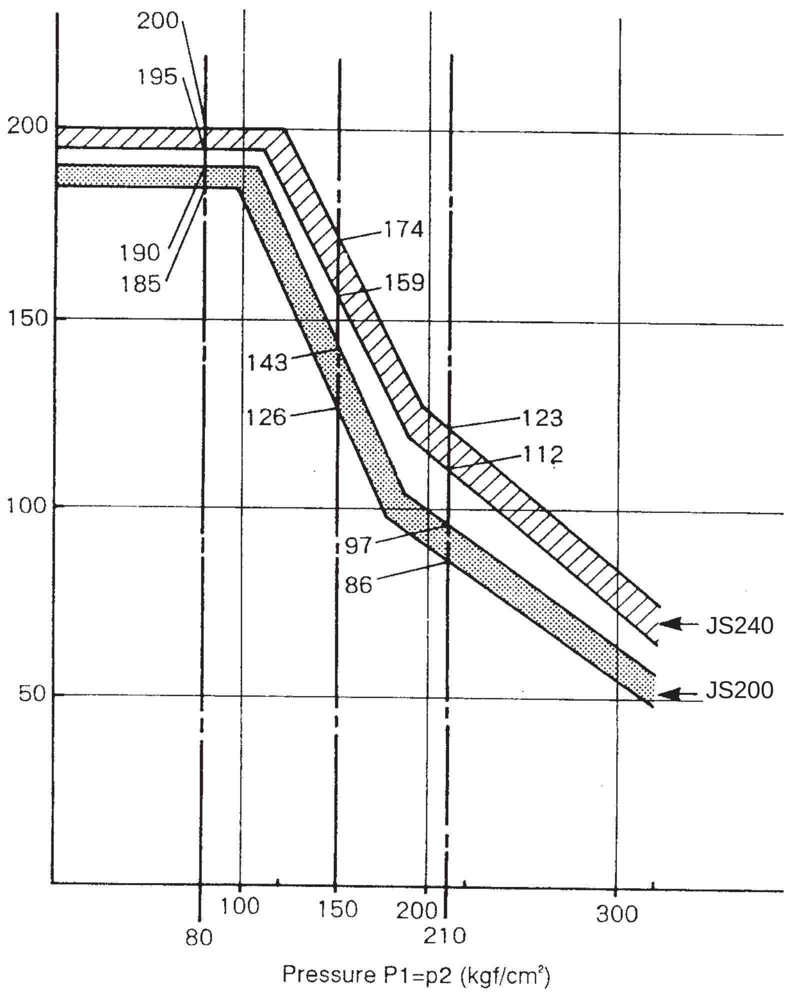
JS200, JS240 Hydraulic Pump P-Q Line Diagram

This diagram shows the values for the new machine. Changes occur depending on the conditions of use.

Magnetic proportional value electric current
JS200 - 305mA
JS240 - 330mA
Engine revolutions
JS200 - 1,920r.p.m
JS240 - 2,050r.p.m

JS240			
Measured Pressure			Flow (l/min)
bar	lb/in2	kgf/cm2	
77.3	1137	80	195 - 200
145.1	2133	150	159 - 174
203.1	2986	210	112 - 123

JS200			
Measured Pressure			Flow (l/min)
bar	lb/in2	kgf/cm2	
77.3	1137	80	185 - 190
145.1	2133	150	126 - 143
203.1	2986	210	86 - 97



Precautions During Use

Installation

Item	Precautions	Model
1. Removal of anti-rust coating	The shaft end spline party is coated with anti-rust coating so remove it with cleaning agent and apply a lubricant such as molybdenum disulphide and install to the coupling. When using cleaning agent, do not get it on the oil seal.	Both models
2. Tightening installation bolts	* Refer to tightening torque for each screw size on page E 2-1 for installation bolts for the pump.	Both models

Laying Up

Item	Precautions	Model
1. Long term non-use	It is not desirable to leave the pump motor unused for a long period of time (more than one year.) At intervals, start the engine even if for short periods of time. When left unused by itself, rotating the shaft end by hand can be effective. If left unused for an extended period of time, inspection for overhaul will become necessary.	Both models
2. Revolution direction	The direction of revolution for the pump is as described by the arrow on the name plate.	Both models

Oil Filling and Air Bleeding

Item	Precautions	Model
1. Oil filling	Fill the pump casing inside fully with oil. Inside the pump are the bearing, piston/shoe, spherical bush and other high speed moving parts. There is the danger that these parts may seize or be damaged.	Both models
2. Air Bleeding	If there is any air left in the circuit or pump, this may cause faulty operation or damage so be sure to bleed the air completely.	Both models

Pump Trouble Shooting

Often the regulator and attendant valves or pump are combined which makes it very difficult to discover the reason for the trouble. Inspect the following categories which will assist in discovering the abnormal point.

1. Filter and Drain Oil Inspection.

Inspect the filter element. Check to see whether there is an abnormally large amount of foreign matter. There will be a small amount of metallic powder due to wear of the shoe or cylinder, but if there is a large amount of metallic powder in the filter, it may be due to trouble with the shoe.
Also check the drain oil in the pump casing.

2. Abnormal Vibration and Sound.

Check to see if there is any abnormal vibration or sound in the pump main body. Check to see if it is like the regular frequency sound of the regulator's working or attendant valve relief working. If it is an abnormal vibration or sound, it is possible that there is damage or cavitation inside the pump.

3. Measure Pressure of Each Part.

When it is a control problem, do not unnecessarily open ports for inspection purposes, measure the pressure for each section and find the abnormal item.

Prime Mover Overload

Cause	Treatment	Note
1. Are the revolutions - pressure higher than pre-determined values?	**1.** Set to pre-determined value.	
2. Is the regulator torque setting too high?	**2.** Re-inspect regulator.	**2**. Refer to regulator instructions.
3. Seizure or damage of pumps internal parts	**3.** Replace damaged parts.	**3**. Check the filter or drain oil for signs of abnormal wear.
4. Wrong regulator hose connection.	**4.** Correct hose lines.	

When pump flow is extremely low, delivery pressures does not increase

Cause	Treatment	Note
1. Regulator breakdown	**1.** Repair the regulator	**1.** Refer to regulator instructions
2. Seizure or damage of pump internal parts.	**2.** Replace damaged parts.	**2.** Check filter, drain oil.
3. Pump breakdown.	**3.** Replace damaged parts.	**3.** Remove pump and inspect shaft coupling.
4. Attendant valve breakdown.	**4.** Inspect attendant valve.	
5. Incorrect regulator hose connection.	**5**. Correct hose lines.	

Pump Trouble Shooting *(continued)*

Abnormal Sound and Vibration

Cause	Treatment	Note
1. Cavitation.	**1.** Prevent cavitation. Check to see if hydraulic oil is white and cloudy.	**1.1.** Boost pressure is low **1.2.** Pump is broken. **1.3.** Air is sucked by suction pipe. **1.4.** Suction resistance is high.
2. Damage of shoe caulking part.	**2**. Replace piston, shoe, shoe plate.	
3. Crack in cylinder.	**3**. Replace cylinder.	
4. Bad installation of pump.	**4**. Correct installation.	
* **5**. Relief valve bouncing.	* **5**. Repair relief valve.	* **5**. Refer to relief valve instructions.

Operation

The rotary group consists of the drive shaft F (111), cylinder rod (141), piston shoe (151, 152), press plate (153), spherical bush (156), spacer (158) and cylinder spring (157). The drive shaft is supported on both sides by the bearings (123, 124). The shoe is caulked on the piston and forms the spherical coupler, and because it slides slightly on the shoe plate (211), it has a pocket to balance the oil pressure. The subgroup, which is made up of the piston and shoe is held down on the shoe plate by the cylinder spring through the press plate and spherical bush. In the same way, the cylinder block is held down on the valve plate (313) by the cylinder spring.

* The swash plate group consists of the swash plate (212), shoe plate (211), swash plate support (251) bush (214) pin (531) and servo piston (532). The swash plate is supported by the swash plate support at the cylindrical part formed by the side opposite to the shoe sliding surface. The oil pressure controlled by the regulator is guided to the hydraulic cavities on both sides of the servo piston which moves the servo piston to the left and right, causing the swash plate, through the spherical portion of the pin, to press on the swash plate support and changes the angle (a).

The valve cover group is comprises the valve block (312), valve plate (313) and valve plate pin (885). The valve plate, which has two oval shaped ports, is on the valve block and delivers oil to and recovers oil from the cylinder block. The oil directed by the valve plate flows through the valve block and is connected to the outer piping.

When the drive shaft is driven by the engine, the cylinder block rotates simultaneously with the spline coupling. When the swash plate is leaning, the piston in the cylinder block rotates simultaneously with the cylinder block and causes reciprocal motion relative to the cylinder.

Therefore, during one rotation, the piston moves away from the valve plate for 180° (enough for oil suction) and approaches the valve plate for the remaining 180°. When the swash plate leaning angle is at the minimum 5° the piston does not stroke and does not deliver oil.

Dismantling

Refer to the drawing on the previous pages of the pump and associated components.

Before attempting to dismantle the hydraulic pump, drain all oil, blank all inlet and outlet ports and wash the outer surfaces with a suitable solvent to remove all dirt and dust. Dry using compressed air.

Make different alignment marks across each sub-assembly joint face as an aid to assembly.

The rotary groups, servo pump, relief valve and proportional pressure reduction valve must be replaced as entire assemblies.

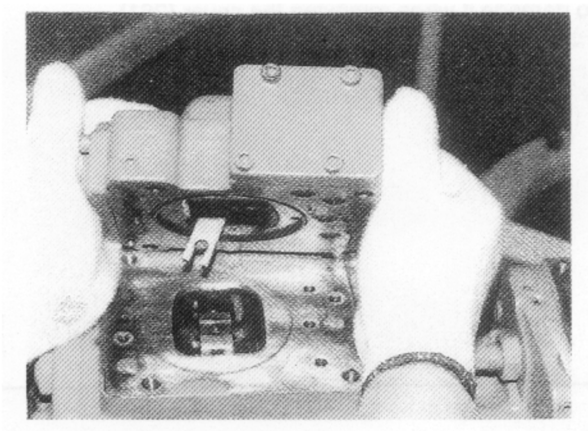
Adjusting screws should only be moved when absolutely necessary. Moving the adjusting screws will alter the power output settings. If the adjusting screws must be moved, measure and record the dimensions and positions.

The pump contains two rotary groups and control systems; the No.1 (subsidiary) pump and the No.2 (drive) pump. Take care not to confuse parts between the two.

During disassembly, record the number and dimensions of shims. Take care to reassemble in the same manner.

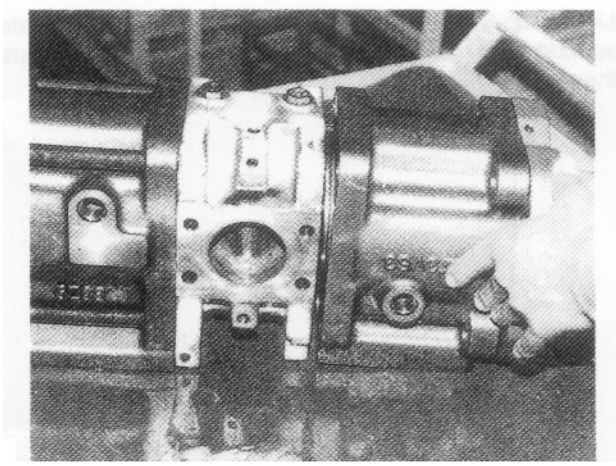
1. Remove the drain port plugs and drain the oil from both the front and rear pump.

2. Remove the hexagonal socket head bolts (412, 413) and remove the regulator (refer to the regulator maintenance section for the disassembly procedures).



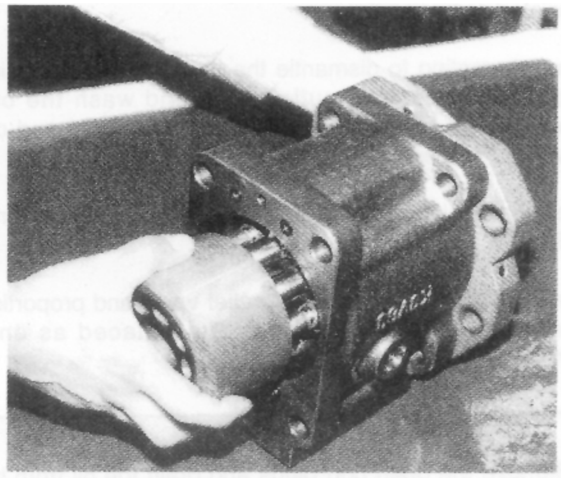
3. Loosen the hexagonal socket head bolt (401) which connects the swash plate support (251), pump casing (217) and valve block (312). If the gear pump etc. are attached to the back of the pump, remove them first.

4. Place the pump so that the regulator installation side is down and place level on the work bench. Separate the pump casing (271) and valve block (312).

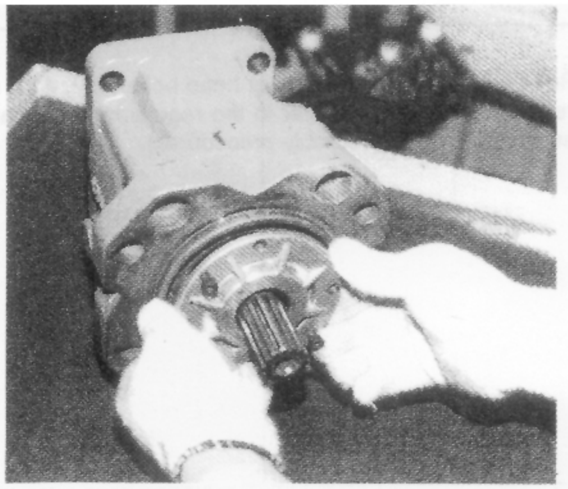


Dismantling *(continued)*

* **5.** Pull out the cylinder (141) (keeping it straight in relation to the drive shaft (111)) from the pump casing (271) and also pull out the piston (151), press plate (153), spherical bush (156) and cylinder spring (157) at the same time.

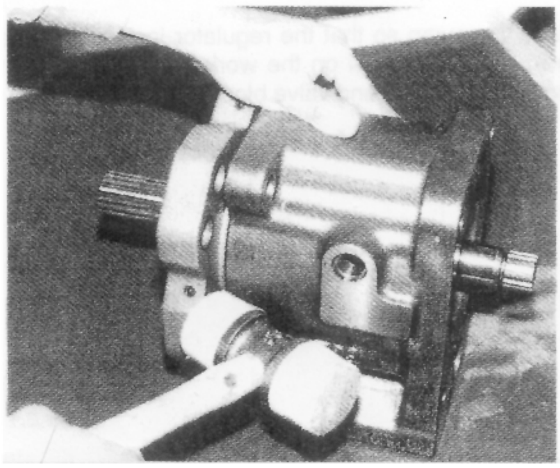


6. Remove the hexagonal socket head bolt (406) and remove the seal cover (261).
This is an oil seal on the seal cover (261) be careful not to damage it when removing the cover (261).



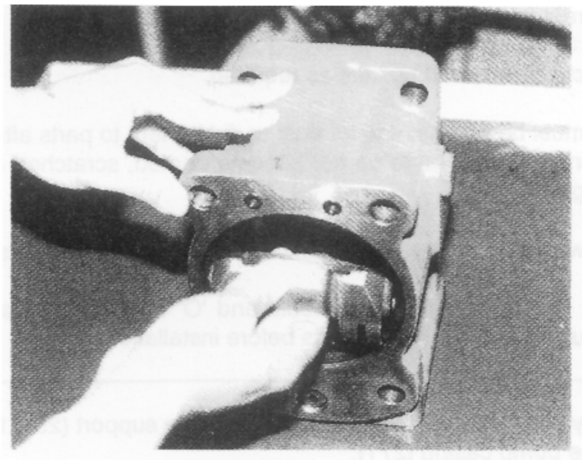
7. Remove the hexagonal socket head bolt (408) and remove the rear cover (263).

8. Lightly tap the installation flange part of the swash plate support (251) from the pump casing side and separate them.

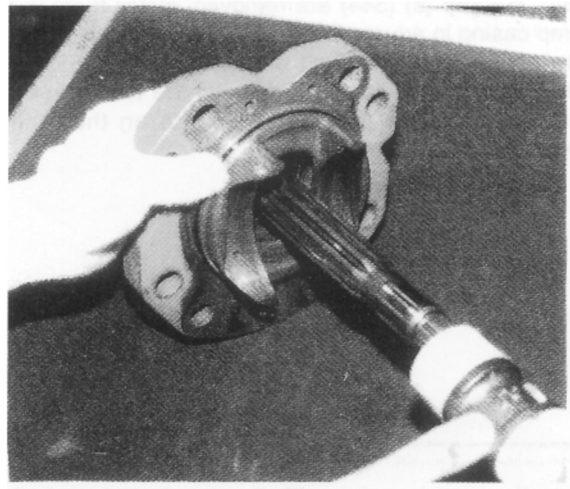


Dismantling *(continued)*

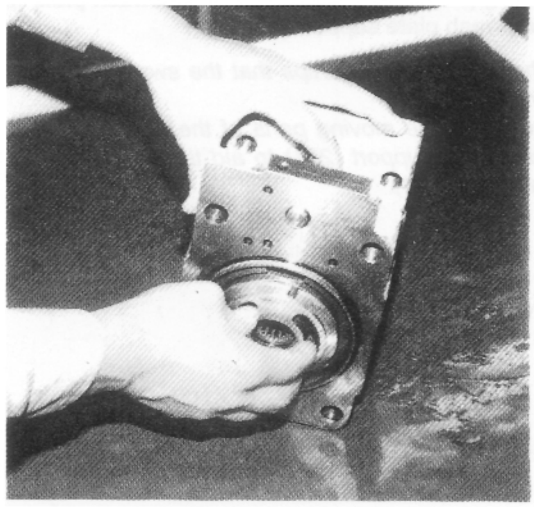
9. Remove the shoe plate (211) and swash plate (212) from the pump casing (271).



10. Lightly tap the drive shaft (111, 113) end with a plastic hammer and remove the drive shaft from the swash plate supporter.



11. Remove the valve plate (313, 314) from the valve block (312). It may be removed in step **4**.



12. If necessary, remove the stopper (L) (534), stopper (S) (535), servo piston (532), tilting pin (531) from the pump casing (271) and also the needle bearing (124) and spline coupling (114) from the valve block (312).
Use a jig to remove tilting pin (531) take care not to damage the fitting part of the tilting pin (531) and servo piston (532) because it is coated with Loctite. Do not remove the needle bearing (124) unless the life of the bearing is in question.

Note: *Do not loosen the hexagonal nuts of the valve block and swash plate support because the flow setting will change.*

Assembly

Clean each part in a suitable solvent and dry using compressed air.

Inspect all parts and replace as required.

Care must be taken not to let dust or dirt adhere to parts after cleaning and that parts do not become dented, scratched or damaged.

Fit new 'O' rings, plugs, packing, oil seals and fastener seals.

Apply grease to all new oil seals and 'O' rings, and clean hydraulic fluid to all sliding parts before installation.

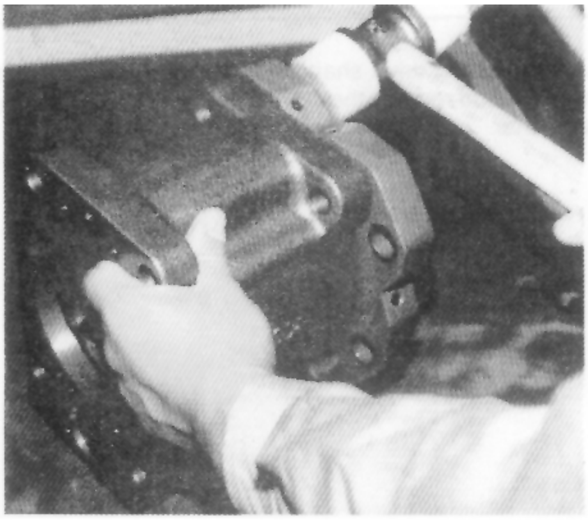
All tapped holes and gasket faces should be thoroughly degreased by washing as liquid packing and adhesive is used on all gasket surfaces and threads.

Apply adhesive to the final few threads of a bolt or screw. Do not apply excessive amounts of adhesive. Wipe off any surplus.

Leave the pump for at least twelve hours after assembly to allow the adhesive to fully dry.

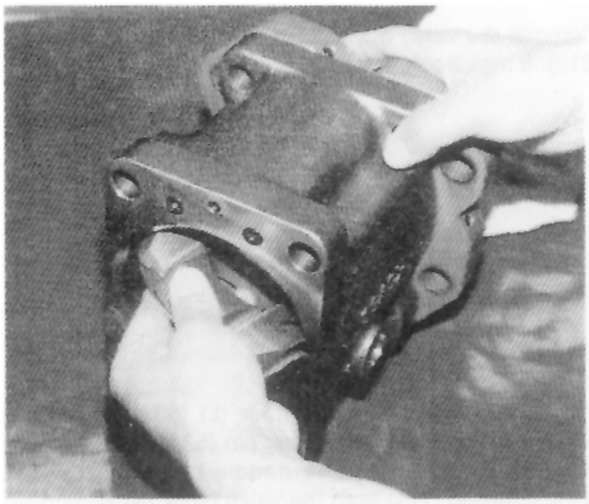
Ensure that the pump controllers are fitted to the positions from which they were removed.

1. By lightly tapping, install the swash plate support (251) to the pump casing (271).
When the servo piston (532), tilting pin (531) stopper (534), stopper (s) (544) are removed, install them in the pump casing in advance.
Use a jig when tightening the servo piston (532) and tilting pin (531) so as not to damage the tilting pin head and feedback pin. Also, coat Loctite on the screw threads when assembling.



2. Place the pump casing with the regulator installation surface facing down. Fit the swash plate tilting bush to the tilting pin (531) and then mate the swash plate (212) to the swash plate support (251).

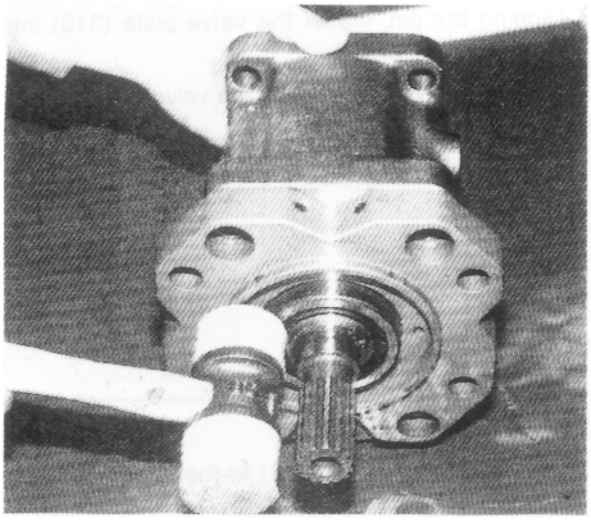
* ***Note:*** *Check with the fingertips that the swash plate moves smoothly.*
Apply grease to the moving parts of the swash plate (212) and swash plate support (251) to aid the installation of the drive shaft (113) (111).



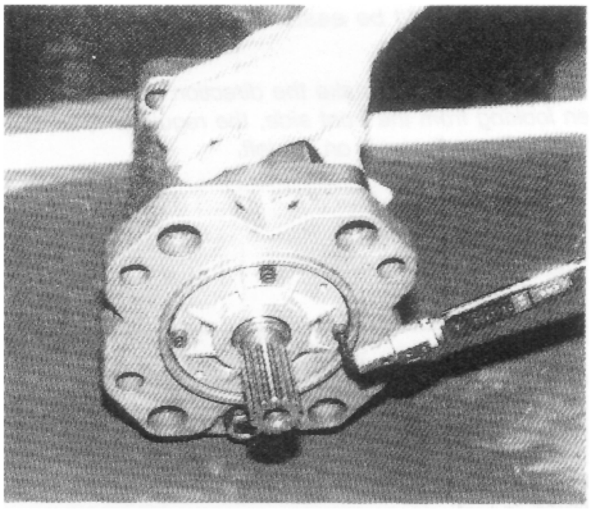
Assembly *(continued)*

3. Install the drive shaft (111) which has the bearing (123), bearing spacer (127) and stop ring (824) set on it to the swash plate support (251).

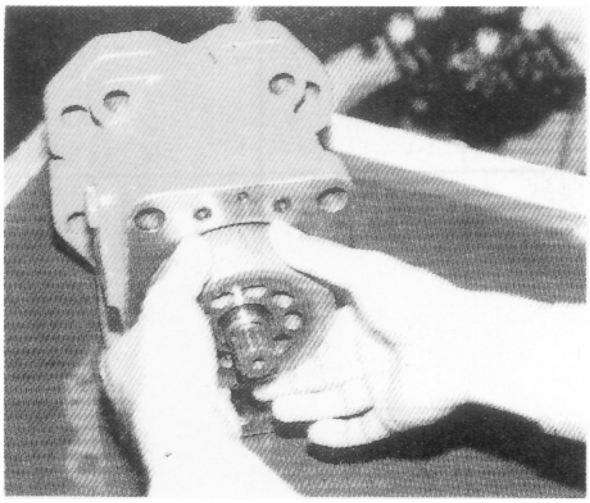
Note: *Do not hit the drive shaft with the hammer. Tap the outer ring of the bearing with a plastic hammer to install it and use a steel bar to fit it securely.*



4. Install the seal cover (F) (261) to the pump casing (271) and fix with hexagonal socket head bolt (406).
Coat the oil seal inside the seal cover (F) with a thin coat of grease.
Install the oil seal taking care not to damage it.
Attach the rear cover (263) and the seal cover (262) in the same way if it is a tandem pump.



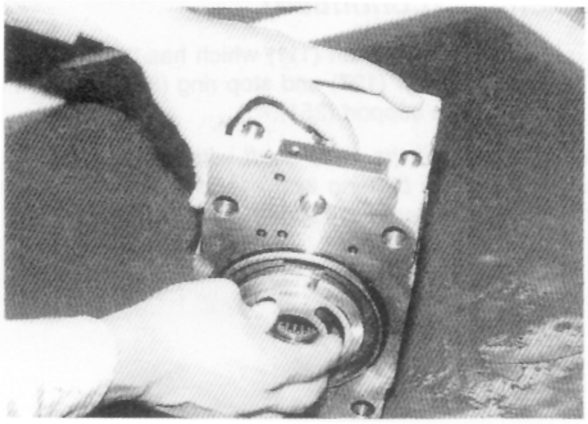
* **5.** Assemble the piston cylinder sub-assembly (cylinder (141), piston shoe (151, 152), press plate (153), spherical bush (156), spacer (158), cylinder spring (157)), align the spherical bush and cylinder spline and insert into the pump casing.



Assembly *(continued)*

6. Aligning the pin, install the valve plate (313) into the valve block (312).

Note: *Be careful not to mistake the valve plate suction and delivery directions.*

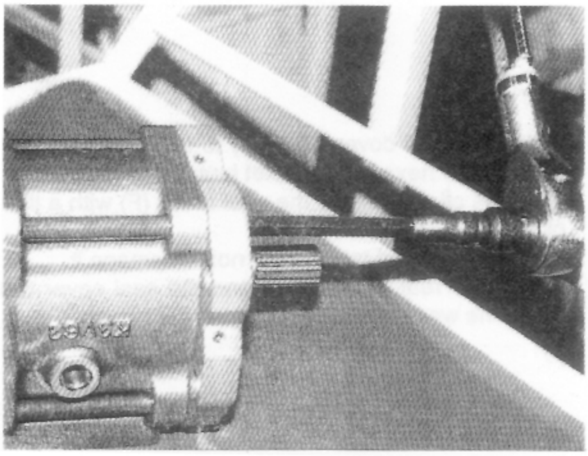


7. Install the valve block (312) to the pump casing (271) and tighten the hexagonal socket head bolt (401).

Note:

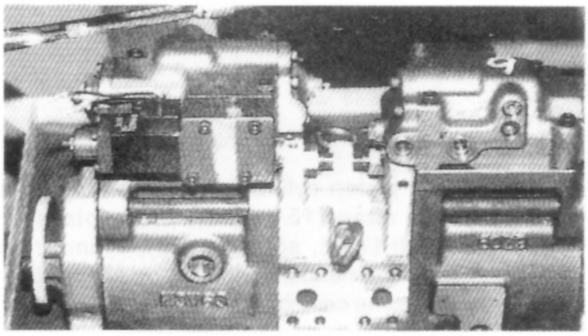
a. *The work would be easier if the rear of the pump is assembled first.*

b. *Take care not to mistake the direction of the valve block. When looking from the front side, the regulator is on the top and the delivery flange is on the left.*



8. Insert the feedback pin of the tilting pin into the feedback lever of the regulator and install the regulator, tightening the hexagonal socket head bolts (412, 413).

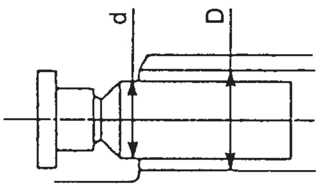
Note: *Take care not to mistake the front and rear of the regulator.*



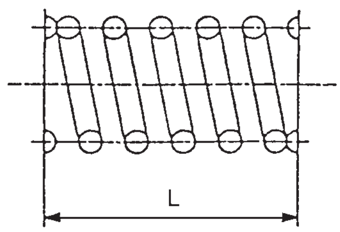
Main body wear limit

If the wear of the parts exceeds the standards below, replace or readjust. However, if they are extremely damaged judging from the external appearance, replace with the appropriate part.

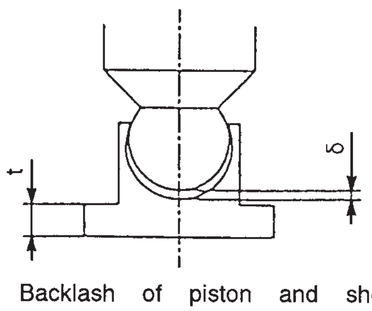
Part Name and Inspection Item	Standard Dimensions/Recommended Replacement Value				Treatment
	Pump Model				
		KRJ3785, KBJ2316			
Clearance between piston and cylinder bore (D-d)	0.028 / 0	0.039 / 0	0.043 / 0	0.0375 / 0.078	Replace piston or cylinder
* Backlash of piston and shoe caulking part(δ)	0~0.1 / 0.3	0~0.1 / 0.3	0~0.1 / 0.3	0~0.1 / 0.35	Replace piston shoe assembly
Shoe thickness(t)	3.9 / 3.7	4.9 / 4.7	5.4 / 5.0	5.4 / 5.0	Replace piston shoe assembly
Cylinder spring free height (L)	31.3 / 30.2	41.1 / 40.3	47.9 / 47.1	40.9 / 40.1	Replace cylinder spring
Assembled height of press plate and spherical bush	10.5 / 9.8	9.8 / 8.8	13.5 / 12.5	13.5 / 12.5	Replace press plate or spherical bush



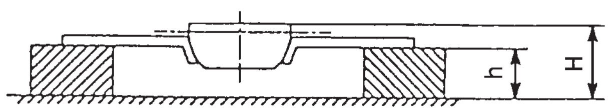
Clearance between piston and cylinder bore: D-d



Cylinder spring free height: L



Backlash of piston and shoe caulking part: δ
Shoe thickness: t



Assembled height of press plate and spherical bush: H-h

Main body wear limit *(continued)*

Cylinder, Valve Plate, Swash Plate (Shoe Plate) Modification Standards

Valve Plate (sliding part) Swash Plate (shoe plate part) Cylinder (sliding part) Roughness of each surface	Surface roughness requiring modification	3-Z
	Standard surface roughness (modification value)	* Less than 0.4 (lapping)

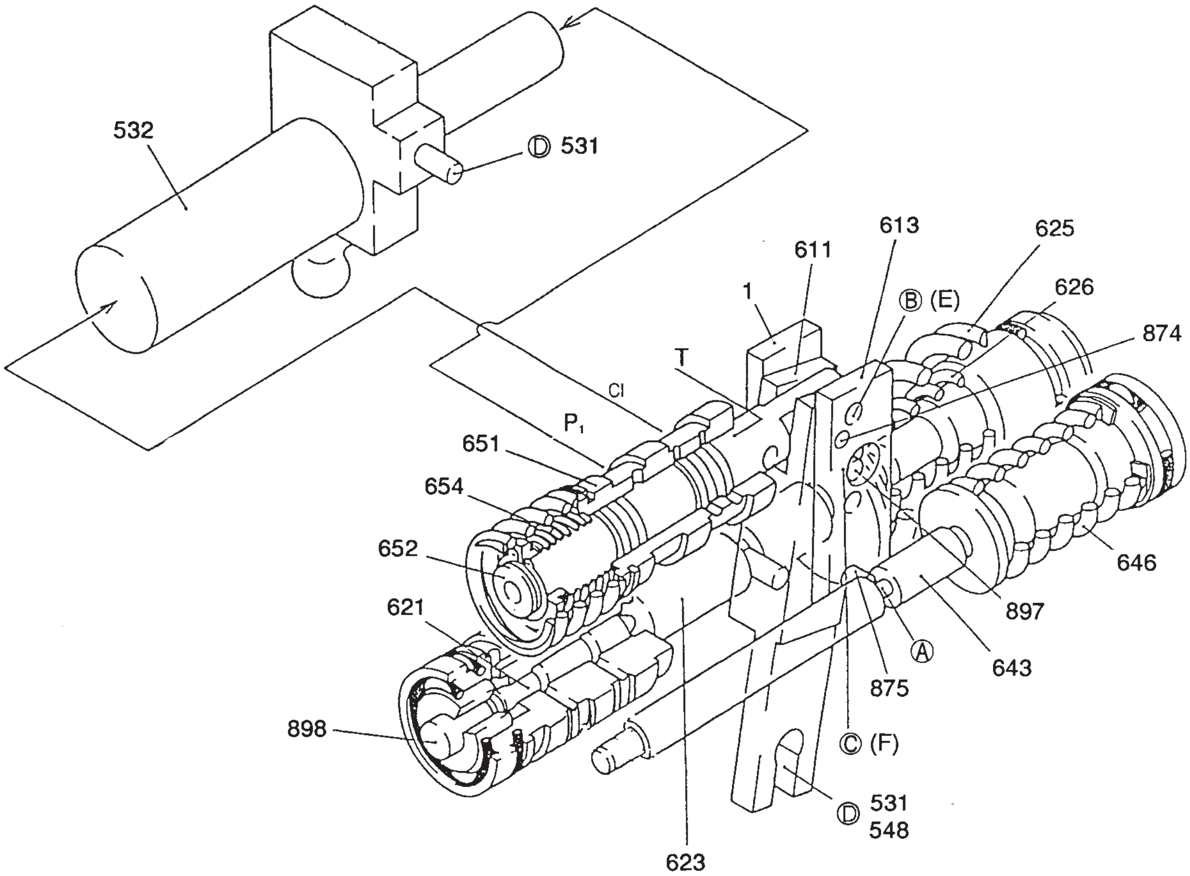
* Specifications

Displacement ....*	97.2 (96.5) cc/rev
Revolving Speed Range....	Rated 2070 (2200) rev/min
Pressure	Rated 320 (320) kgf/cm^2. Max 350 (350) kgf/cm^2
Maximum Flow Rate....	201 (211) l/min (Rated revolution load pressure 80 Kgf/cm^2)
Minimum Flow Rate	50 (50) l/min (Rated revolution load pressure 80 Kgf/cm^2)
Input Horsepower	125 (154) PS
Maximum Input Torque....	43.4 (49.1) kgf-m
Control Function	Full horsepower control
	Power shift control
	Negative flow control
	Q_{max} cut control
Other	KHI 10 cc/rev with gear pump
	Proportional pressure reducing valve (KDRDE5PR-10/40C04)

Volume change is by Regulator Adjustment

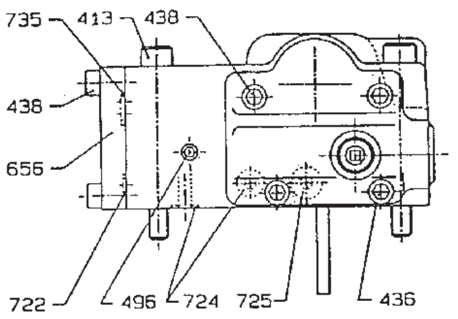
Pump Speed		2070 min-1	2400 min-1
Maximum Flow Rate		Adjust screw (954) at 1/4 revolution Flow rate ^{3} Q=6.0 L/min (1.31 imp gal)	Adjust screw (954) at 1/4 revolution Flow rate ^{3} Q=6.3 L/min (1.31 imp gal)
Minimum Flow Rate		Adjust screw (953) at 1/4 revolution Flow rate ^{3} Q=4.8 L/min (1.05 imp gal)	Adjust screw (953) at 1/4 revolution Flow rate ^{3} Q=5.1 L/min (1.12 imp gal)
Input Horsepower	Outer Spring Adjustment	Adjust screw (923) at 1/4 revolution Flow rate ^{3} Q=18 L/min (3.9 imp gal) Pressure ^{3} P=16kg/cm^2 (227 lb/in^2, 15.4 bar) Torque ^{3} T=4.2 kgf m Factor A=1.6 of return revolution for set change of inner spring	Adjust screw (928) at 1/4 revolution Flow rate ^{3} Q=20 L/min (4.3 imp gal) Pressure ^{3} P=18kg/cm^2 (225 lb/in^2, 17.3 bar) Torque ^{3} T=4.7 kgf m Factor A=1.9 of return revolution for set change of inner spring
Input Horsepower	Inner Spring Adjustment	Adjust screw C1(925) at 1/4 revolution Flow rate ^{3} Q=11 L/min (2.4 imp gal) Pressure ^{3} P=36kg/cm^2 (511.9 lb/in^2, 34.8 bar) Torque ^{3} T=4.9 kgf m	Adjust screw C1(925) at 1/4 revolution Flow rate ^{3} Q=11 L/min (2.4 imp gal) Pressure ^{3} P=27kg/cm^2 (383.9 lb/in^2, 26.1bar) Torque ^{3} T=4.2 kgf m
Flow Rate Control Characteristic		Adjust screw (924) at 1/4 revolution * Pilot Pressure ^{3} Pi=1.7 kg/cm^2 (24.1lb/in^2,1.63bar) ^{3}Q=13 L/min (2.8 imp gal)	Adjust screw (924) at 1/4 revolution * Pilot Pressure ^{3} Pi=1.7 kg/cm^2 (24.1lb/in^2,1.63bar) ^{3}Q=14 L/min (3.07 imp gal)
Qmax Cut Characteristic		Adjust screw (642) at 1/4 revolution Qmax cut flow rate *	Adjust screw (642) at 1/4 revolution Qmax cut flow rate *

Specifications, *(continued)*

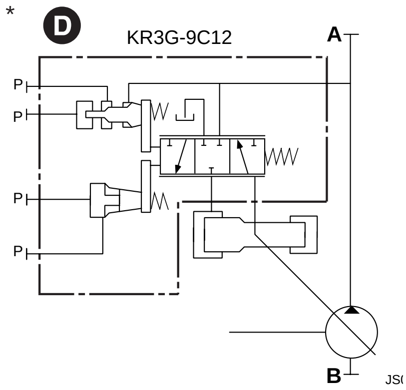


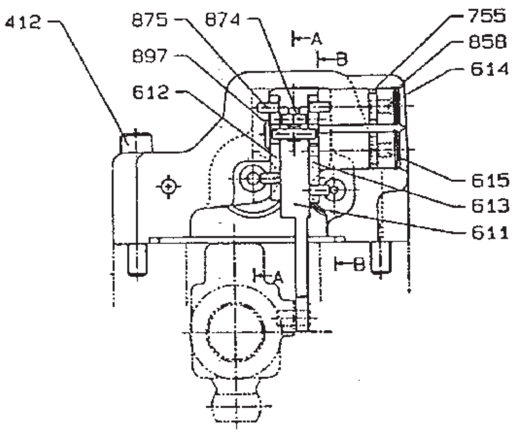
Key

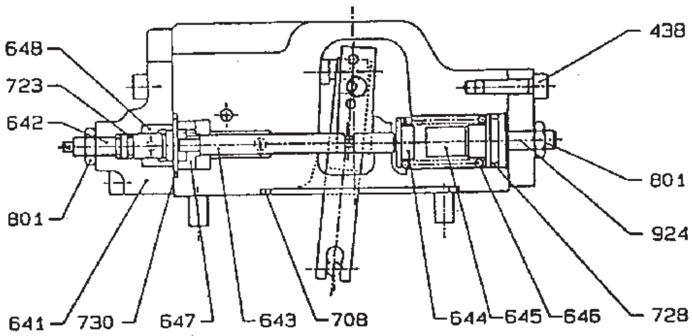
531	Tilting pin
532	Servo piston
548	Feedback pin
611	Feedback lever
621	Compensator piston
623	Compensator rod
625	Outer spring
626	Inner spring
643	Pilot piston
646	Pilot spring
651	Sleeve
652	Spool
654	Return spring
874	Pin
875	Pin
897	Pin
898	Pin



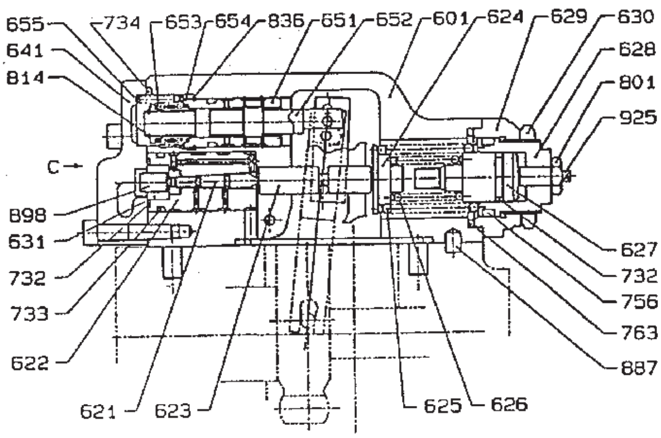
View C







SECTION B-B



SECTION A-A

JS02670

Section	Part Name	Q'ty
925	Adjust screw	1
924	Hexagonal socket lock screw	1
898	Pin	1
897	Pin	1
887	Pin	1
875	Pin	4
874	Pin	1
858	Locking ring	2
836	Lock pin	1
814	Stop ring	1
801	Hexagon nut	3
763	O-ring	1
756	O-ring	1
755	O-ring	2
735	O-ring	1
734	O-ring	1
733	O-ring	1
732	O-ring	2
730	O-ring	1
728	O-ring	1
725	O-ring	1
724	O-ring	9
723	O-ring	1
722	O-ring	3
703	O-ring	1
856	Blind cover	1
655	Set spring	1
854	Return spring	1
853	Spring base	1
852	Spool	1
851	Sleeve	1
848	Piston (QMC)	1
647	Stopper	1
646	Pilot spring	1
645	Adjust ring (Q)	1
644	Spring base (Q)	1
643	Pilot piston	1
642	Adjust screw (QMC)	1
641	Pilot cover	1
631	Pf Sleeve	1
630	Lock nut	1
629	Cover (C)	1
628	Adjust screw (C)	1
627	Adjust ring (C)	1
626	Inner spring	1
625	Outer spring	1
624	Spring base (C)	1
623	Compen rod	1
622	Piston case	1
621	Compen piston	1
615	Adjust plug	1
614	Fulcrum plug	1
613	Lever (2)	1
612	Lever (1)	11
611	Feedback lever	
601	Casing	1
496	-	5
438	Hexagonal socket head bolt	10
436	Hexagon socket head bolt	2
413	Hexagon socket head bolt	2
412	Hexagon socket head bolt	2
-	Regulator sub	1

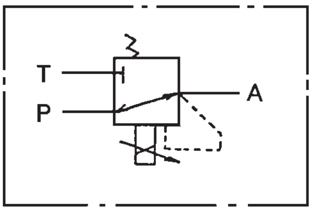
Specifications, *(continued)*

Proportional Pressure Reducing Valve Specifications (Reference)

1. Specifications

(1) Max. primary pressure	40 kgf/cm^2
(2) Max, back pressure (allowable pressure)	10 kgf/cm^2
(3) Secondary pressure setting range	0-40 kgf/cm (at primary press.=40 kgf/cm^2)
(4) Max. flow rate	6 l/min
(5) Electrical specifications	
1 Rated current	800 mA
2 Coil resistance (at 20°C)	* 13.5 ± 0.7
* 3 Recommended fluctuation of proportional solenoid current	70 ~ 75 Hz, 400 ~ 600 mApp

2. Hydraulic symbol



* **Checking the Proportional Solenoid Current**

* **Service Procedure**

* **Method 1**

* Refer to **Self Test, Self Test Function, Pump Input Amperage**.

* **Method 2**

* **1** Switch engine off.

* **2** Pull apart bullet connector on any of the two wires leading from the Proportional Solenoid on the Hydraulic Pump.

* ***Note:*** *Depending on which wire is disconnected will determine the polarity of the current reading.*

* **3** Insert an appropriate Multimeter in series between the bullet connector and the wire that has been disconnected.

* **4** Ensure that the Multimeter is scaled to mAmps **not** Amps.

* **5** Switch engine on to maximum revs.

* **6** Measure the current at the Proportional Solenoid.

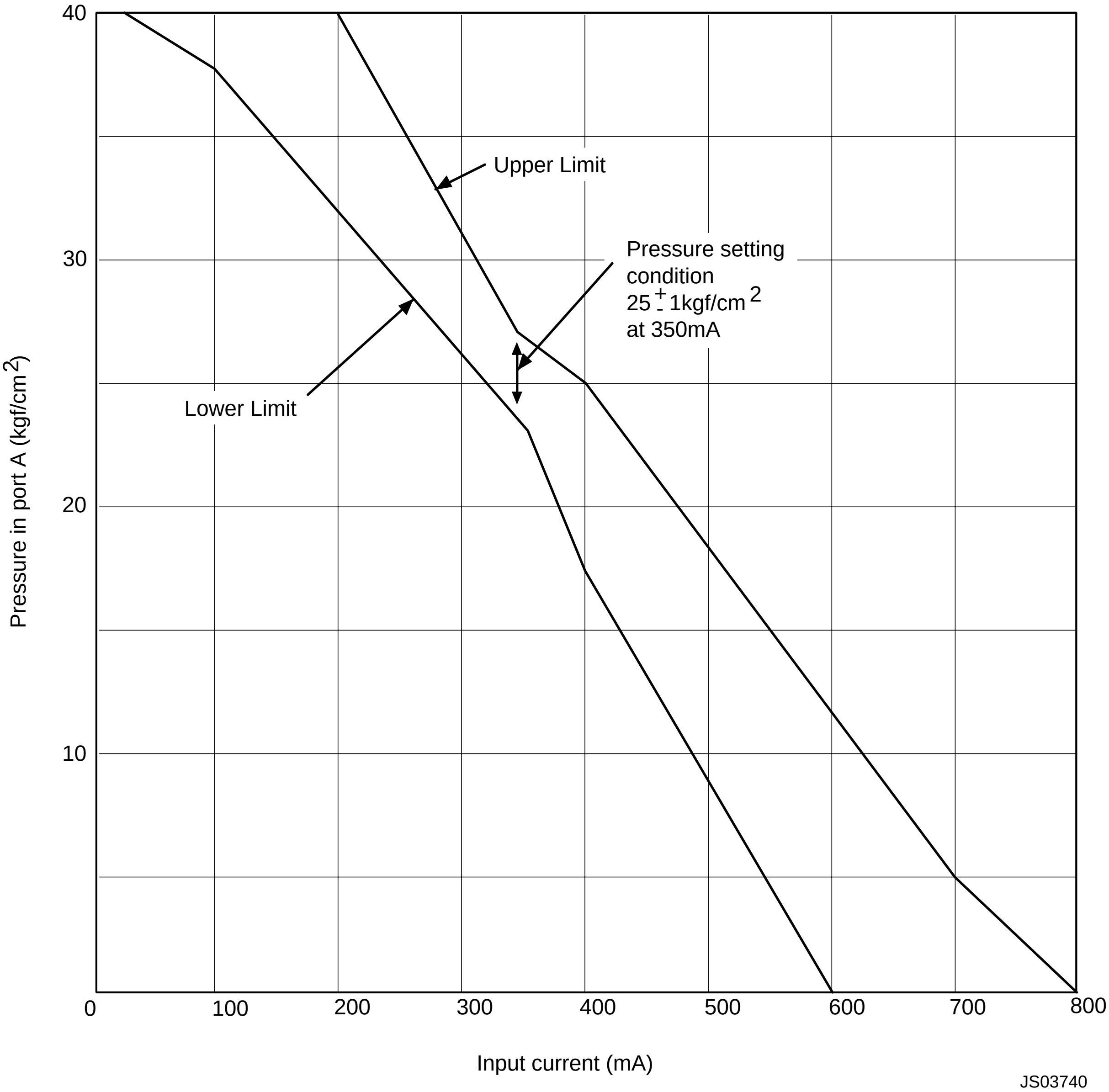
Specifications, *(continued)*

PROPORTIONAL PRESSURE REDUCING VALVE

ALLOWABLE RANGE OF CURRENT-PRESSURE PROFILE

- Primary press. 40 kgf/cm^2 (38.6 bar, 568.8 lb/in^2)
- Flow in port A 0 l/min
- * Fluctuation of proportional solenoid current * 70 - 75 Hz, 400 ~ 600 mApp

*



JS03740

Operation

Refer to the sectional drawings at the beginning of this section.

The regulator consists of the following control mechanisms:

1. Horsepower control.

* Automatically reduces the pump swash angle (delivery flow) according to the increase in P_1 pump delivery pressure and P_2 pump delivery pressure and limits the input torque to below a preset value.
* The system operates by the summation of load pressure of the two pumps so that engine overload is prevented.

* **2. Power shift control (Power modes H, S, L).**

* The pump output horsepower set value is shifted by changing the electric current supplied to the proportional pressure reducing valve attached to the regulator.
* There is one proportional pressure reducing valve but the secondary pressure Pf (power shift pressure) goes through the pump's inner passages to the horsepower control part of the regulator for each pump, shifting each pump to the same horsepower set value. With this mechanism, it is possible to change the output power of the pump to the most suitable power for the machine application.

* **3. Flow rate control (Negative control).**

* The pump swash angle and therefore the delivery flow rate is controlled by changing the pilot pressure Pi. (see illustration **D** on page 20 - 3). The regulator has the flow rate control (negative control) system in which the delivery flow rate Q reduces in relation to valve block negative pressure. The pump delivers only the required flow so that power is not wasted.

4. Q max cut control.

* Maximum delivery flow is controlled by pilot pressure Pm. This control is a two-position control so by switching **ON-OFF** pilot pressure P_m, the maximum delivery flow rate can be reduced by 35%. Either of the two steps only can be selected, not intermediate sections.

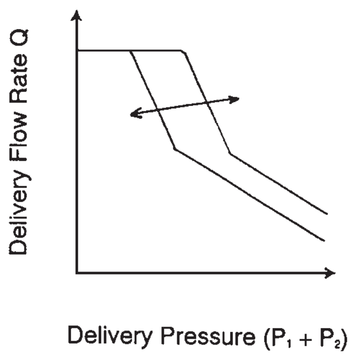
* The regulator possesses the above four control mechanisms but when each control works in combination with another, the low swash (low flow rate) instructions have priority as explained below.

* Priority Mechanism of Low Tilt (Low Flow Rate) Command

As explained above, the flow rate control and horsepower control tilt commands are relayed to the feedback lever and spool through the large hole (C, F parts) of lever 1 and lever 2. Because the C, F parts are structured so that the pin (o4) protrudes in the large hole (o8), the lever which decreases the tilt and pin (897) touch while the o8 hole of the lever which is in the larger tilt command state and the pin (897) do not touch and is free. By this mechanical selection method, the commands for low tilt side for flow rate control and horsepower control have priority.

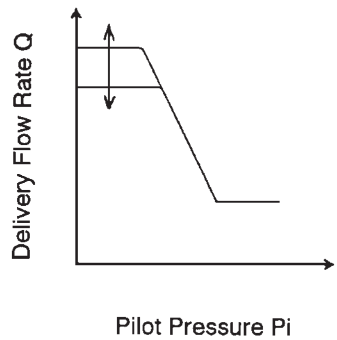
* Power Shift Control

As shown in the graph, the pump horsepower is controlled at will by power shift pressure Pf.
When power shift pressure Pf increases, the compensatory rod (623) moves to the right through the pin (898) and compensatory rod (621) so the pump tilting angle decreases and horsepower set is lowered, which is the same as in the explanation for overload prevention operation of the horsepower control. On the other hand, when power shift pressure Pf decreases, horsepower increases.



* Qmax Cut Control

As shown in the graph, the maximum flow can be switched in two steps by the pilot pressure Pm.
When pilot pressure Pm is applied, Pm pressure is led to the left of piston QMC (648) and piston QMC overcomes the spring force of spring (646) moving the stopper (647) and pilot piston (643) to the right and decreasing the pump delivery flow rate.
The adjust screw QMC (642) has a collar, so piston QMC comes into contact with that collar and stops. Thus the position of the pilot piston sets the pump maximum flow rate.



Regulator Trouble Shooting

Engine Overloads

Put a load on each pump to determine if the front or rear pump is malfunctioning. If both pumps are abnormal, check **1** and **2**. If only one pump is abnormal, begin with **3**.

1. Check to see if the power shift command current value I is normal or not.

2. Power shift pressure is low
- * Check fluctuation of solenoid current.
- * Renew the proportional pressure reducing valve.

3. Disassemble and clean the compensatory piston, compensatory rod.

4. Disassemble and clean the pin (898).

Maximum Flow Rate Is Not Achieved

1. Confirm that the pilot pressure Pi is normal or not.

2. Disassemble and clean the pilot piston.

* **3.** Disassemble and clean the piston (648).

4. Disassemble and clean the spool.

Note: *If any of the parts shows wear or scratches, replace it.*

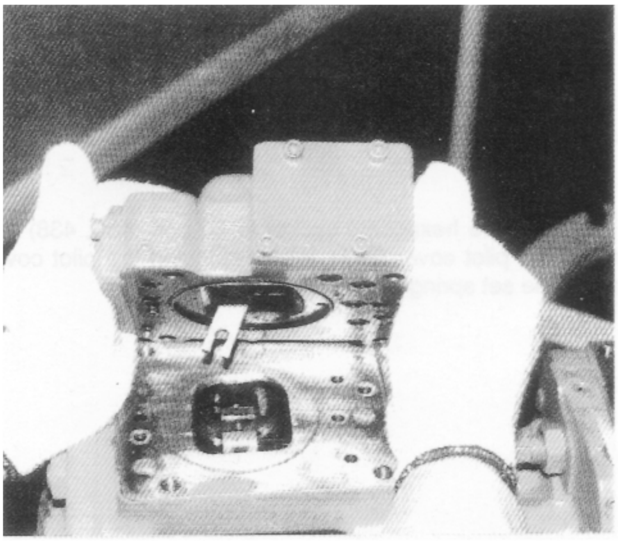
Regulator Disassembly

Refer to the sectional drawings at the beginning of this section.

Before dismantling, blank all inlet and outlet ports and wash the outer surfaces with a suitable solvent to remove all dirt and dust. Dry using compressed air.

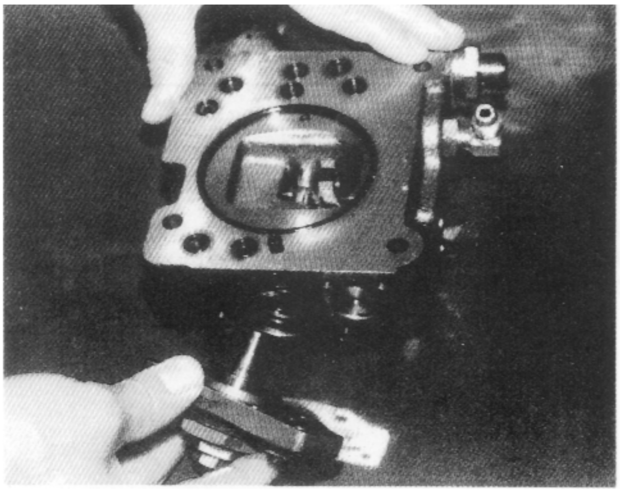
Adjusting screws should only be moved when absolutely necessary. Moving the adjusting screw will alter the power output settings. If the adjusting screws must be moved, measure and record the dimensions and positions.

1. Remove the hexagonal socket head bolts (412, 413) and remove the pump main body from the regulator.



2. Remove the hexagonal socket head bolt (438) and remove the cover (C) (629).

Note: *Adjusting screws (C), (CI) (628, 925), adjusting ring (C) (672), lock nut (630), hexagonal nut (801), adjusting screw (921) is assembled on the cover (C). Do not loosen these nuts and screws, for the adjusted pressure and flow rate setting will be changed.*

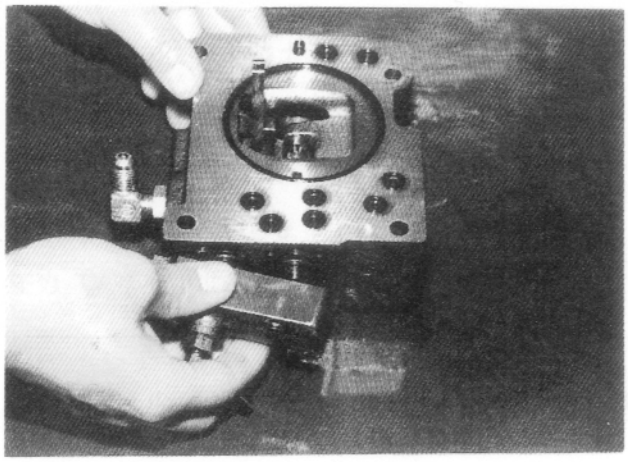


Regulator Disassembly *(continued)*

3. After removing the cover (C) (629) SUB, remove the outer spring (625), inner spring (626), spring base (C) (624) from the compensatory part and pull out the adjusting ring (Q) (645), pilot spring (646), spring base (644) from the pilot part.

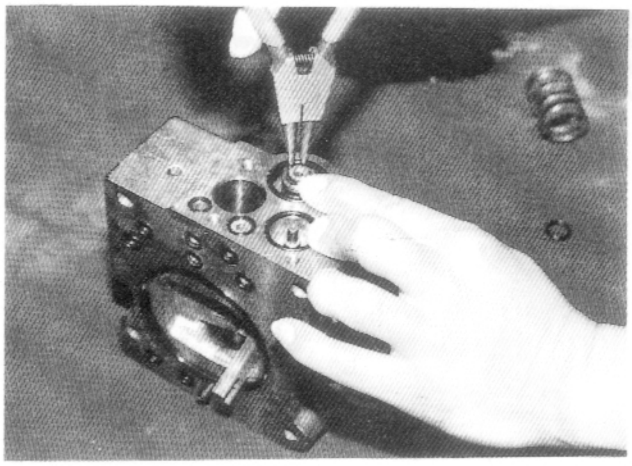
Note: *For easy removal, use M4 bolt to pull out adjusting ring (Q) (645).*

4. Remove the hexagonal socket head bolt (436, 438) and remove the pilot cover (641). After removing the pilot cover, remove the set spring (655) from the pilot part.



5. Remove the stop ring (814) and remove the spring base (653), return spring (654) and sleeve (651).

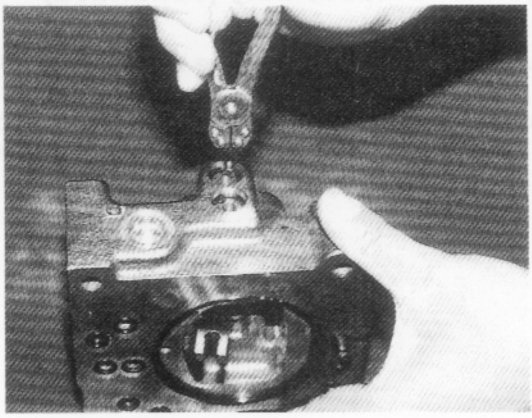
Note: *(1) The SAAKURIPPU (836) is assembled to the sleeve (651). (2) When removing the stop ring (814), the return spring (654) will jump out so do not lose it.*

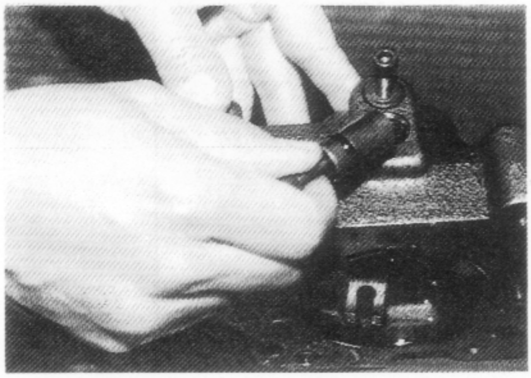


Regulator Disassembly *(continued)*

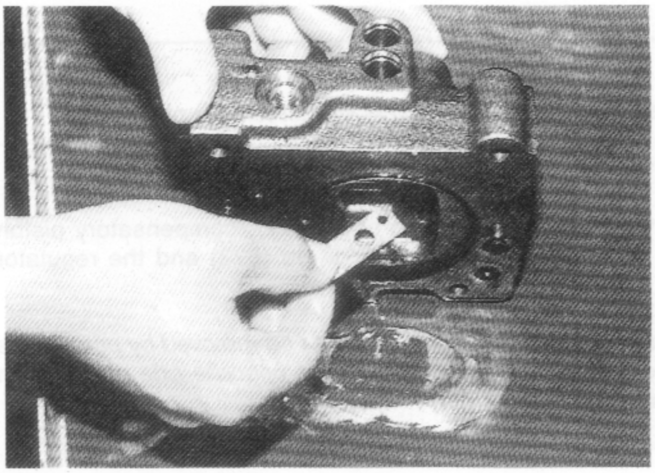
6. Remove the locking ring (858) and remove the fulcrum plug (614) and adjusting plug (615).

Note: *For easy removal, use M6 bolt to pull out the fulcrum plug (614) and adjusting plug (615).*





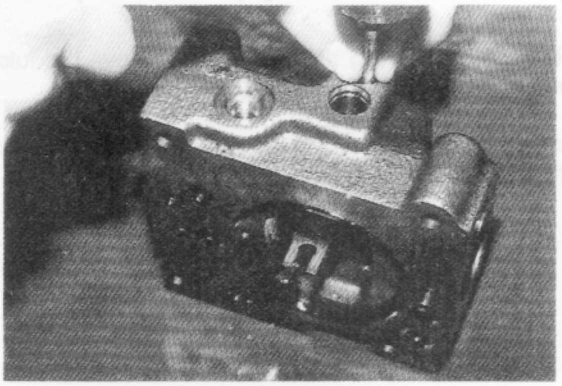
7. Remove the lever (2) (613). Do not pull out the pin (875).

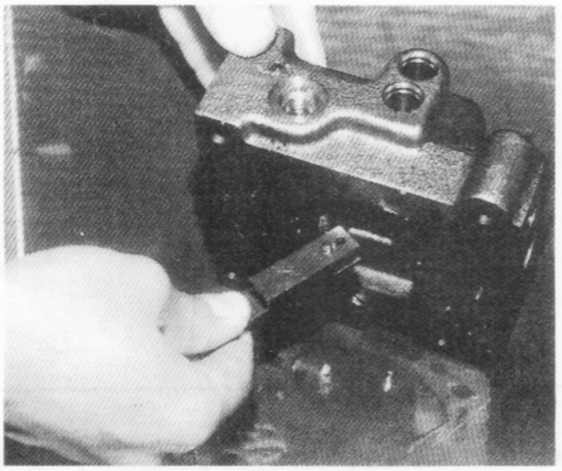


Regulator Disassembly *(continued)*

8. Pull out pin (874) and remove the feedback lever (611).

Note: *To remove the pin (874) (o4), use a slim steel bar and push out from above taking care not to touch the lever (1) (612).*





9. Remove lever (1) (612). Do not remove pin (875).

10. Take out the pilot piston (643) and the spool (652).

11. Take out the piston case (622), compensatory piston (621) and compensatory rod (623) and the regulator disassembly is complete.

Note: *The piston case (622) can be removed by pushing the compensatory rod (623) from the opposite side of the piston case.*

Regulator Assembly

Clean each part in a suitable solvent and dry using compressed air.

Inspect all parts and replace as required.

Care must be taken not to let dust or dirt adhere to parts after cleaning and that parts do not become dented, scratched or damaged.

* Fit new 'O' rings, plugs, packing and oil seals, and apply clean hydraulic fluid to all sliding parts before installation.

All tapped holes and gasket faces should be thoroughly degreased by washing as liquid packing and adhesive is used on all gasket surfaces and threads.

Apply adhesive to the final few threads of a bolt or screw. Do not apply excessive amounts of adhesive. Wipe off any surplus liquid packing.

Ensure that the pump controllers are fitted to the positions from which they were removed.

---

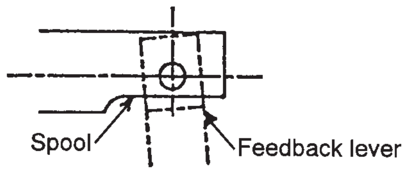
1. Assemble the compensatory rod (623) into the compensatory hole of the casing (601).

2. Insert the pin which is press-fitted into the lever (1) (612) into the compensatory rod groove and assemble the pin which is press-fitted into the casing to the lever (1).

---

3. Assemble the spool (652) and sleeve (651) into the spool hole of the casing.

Note: *(1) Confirm that the spool and sleeve slide smoothly inside the casing. (2) Be careful of the spool direction.*



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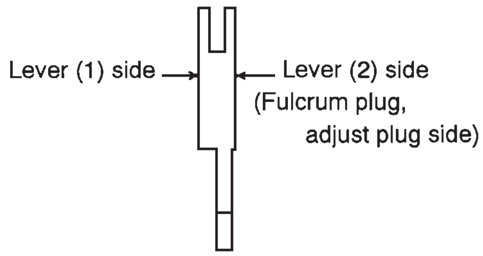
4. Assemble the feedback lever (611) and insert the pin (874), aligning with the feedback pin hole.

Note: *(1) To facilitate work, insert the pin a little into the feedback lever beforehand. (2) Be careful not to mistake the direction of the feedback lever.*



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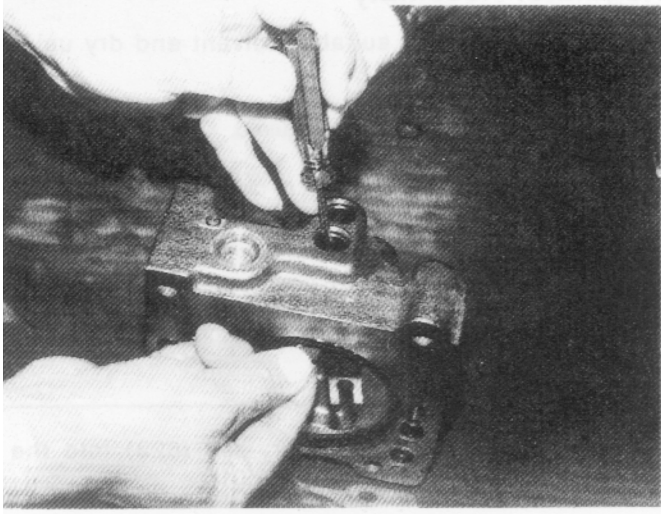
5. Assemble the pilot piston (643) to the casing hole for flow rate control.

Note: *(1) Confirm that the pilot piston slides smoothly.*

Regulator Assembly *(continued)*

6. Insert the pin, which is press-fitted into the lever (2) (613), into the pilot piston groove and assemble lever (2).



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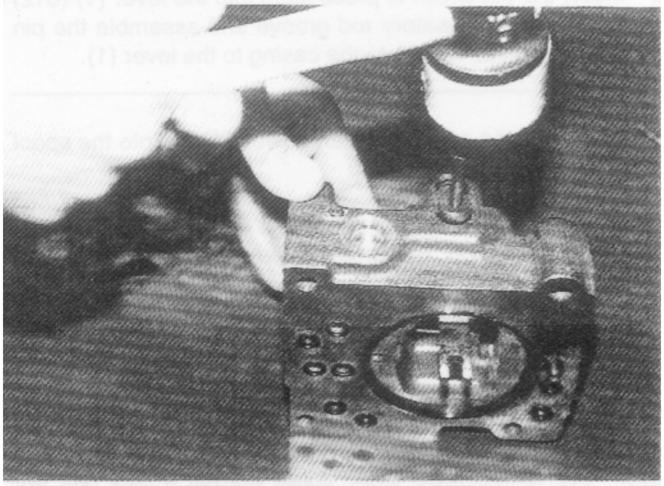
7. Assemble the fulcrum plug so that the pin, which is press-fitted in the fulcrum plug, is inserted in the lever (2) pin hole. Install the locking ring (858).



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8. Insert the adjusting plug (615) and assemble the locking ring.

Note: *(1) Ensure that the fulcrum plug and adjusting plug are inserted into the correct hole. (2) Check the feedback lever moves smoothly and is not too loose.*

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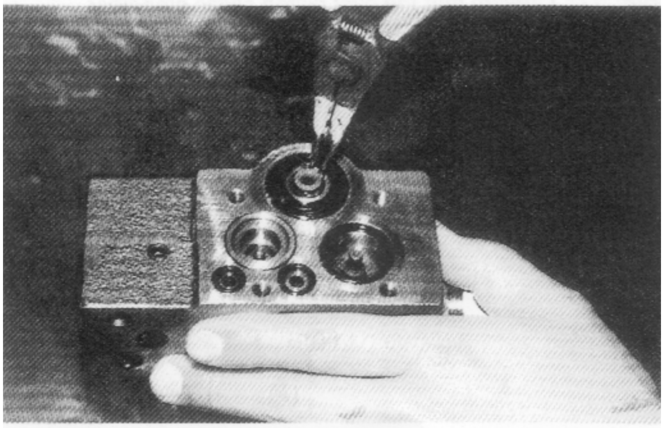
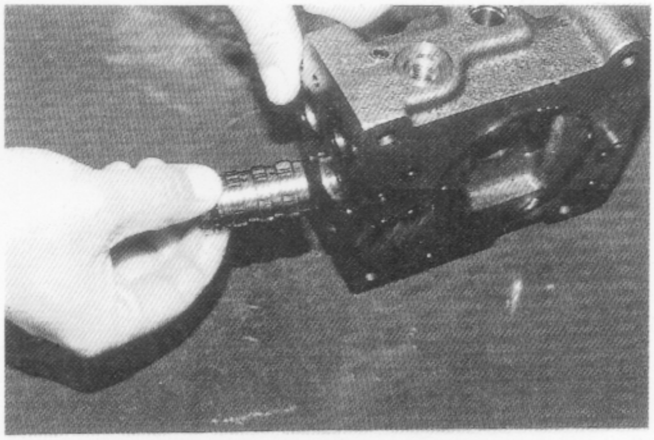
9. Assemble the return spring (654) and spring base (653) into the spool hole and install the stop ring (814).



Regulator Assembly *(continued)*

10. Assemble the set spring (655) into the spool hole and the compensatory piston (621) and piston case (622) into the compensatory hole. Install the pilot cover (641) and tighten with hexagonal socket head bolts (436) (438).



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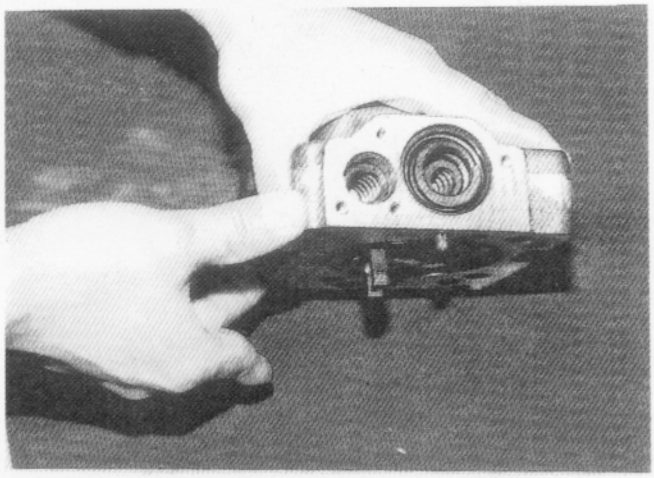
11. Assemble the spring base (644), pilot spring (646) and adjusting ring (Q) (645) into the pilot hole and assemble the spring base (624), inner spring (626) and outer spring (625) into the compensatory hole.

***Note:** Make sure the spring base is fitted in the correct direction.*



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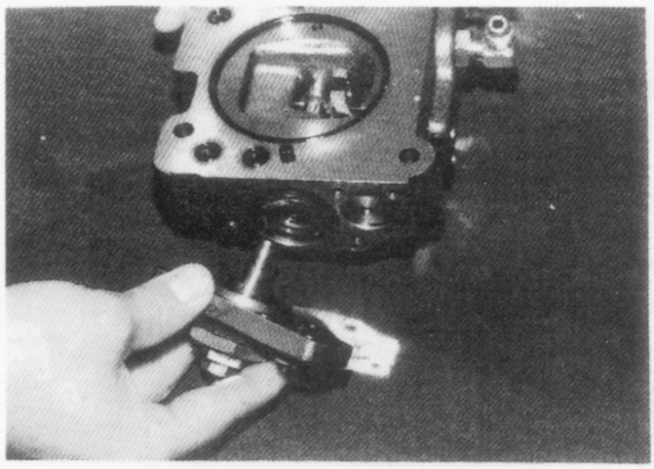
*

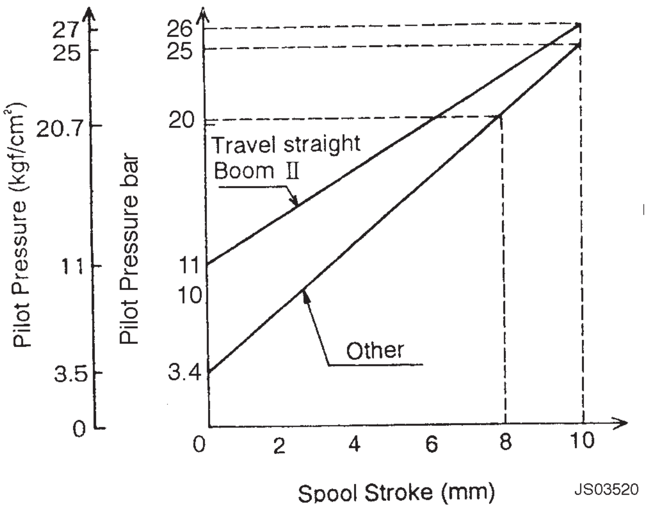
12. Install the cover (C) (629) complete with the adjusting screw (628),(925), adjusting ring (C) (627), lock nut (630), hexagonal nut (801) adjusting screw (924d) and tighten the hexagonal socket head bolt (438). This completes the reassembly.



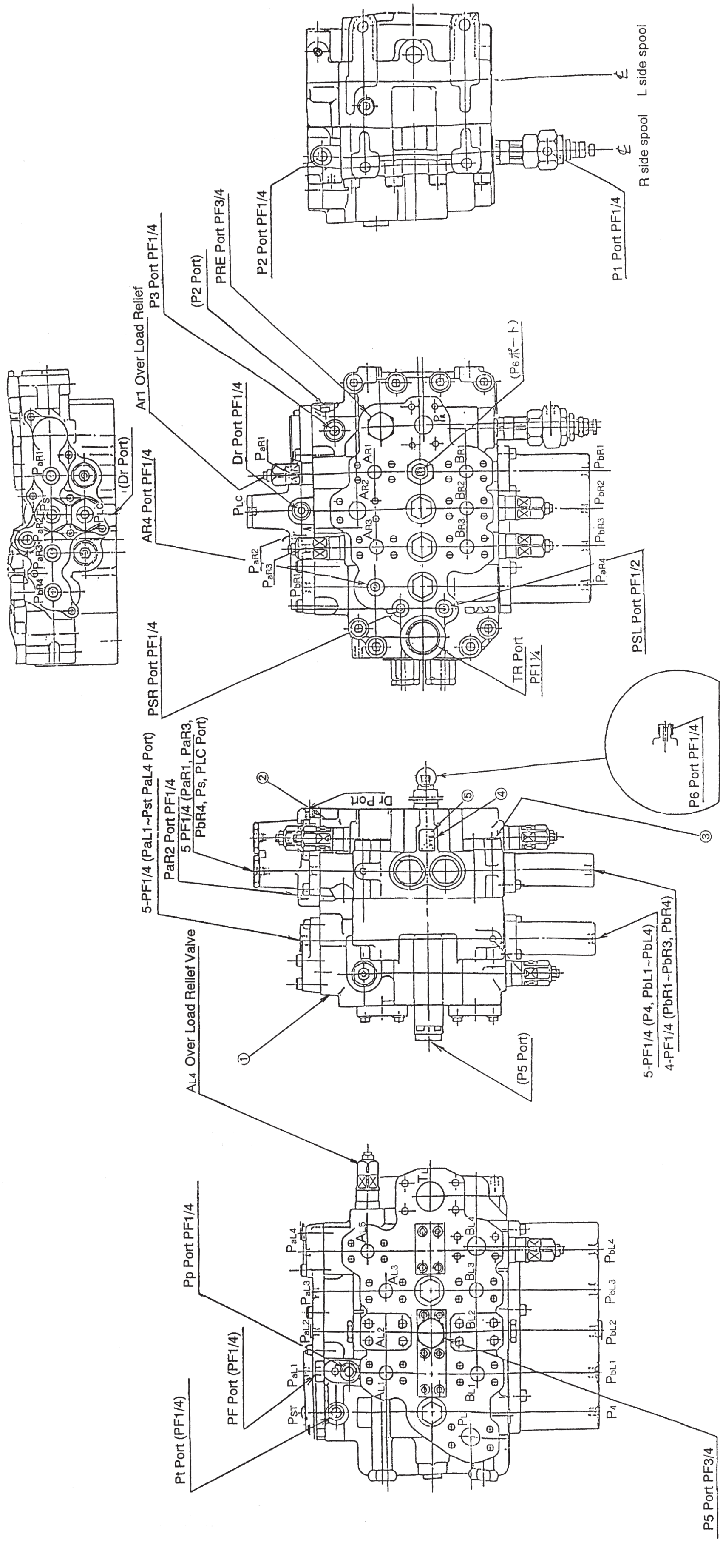
Specification, Technical Data

Weight: 165kg (74.8lb)

* **Spool Stroke versus Pilot Pressure**



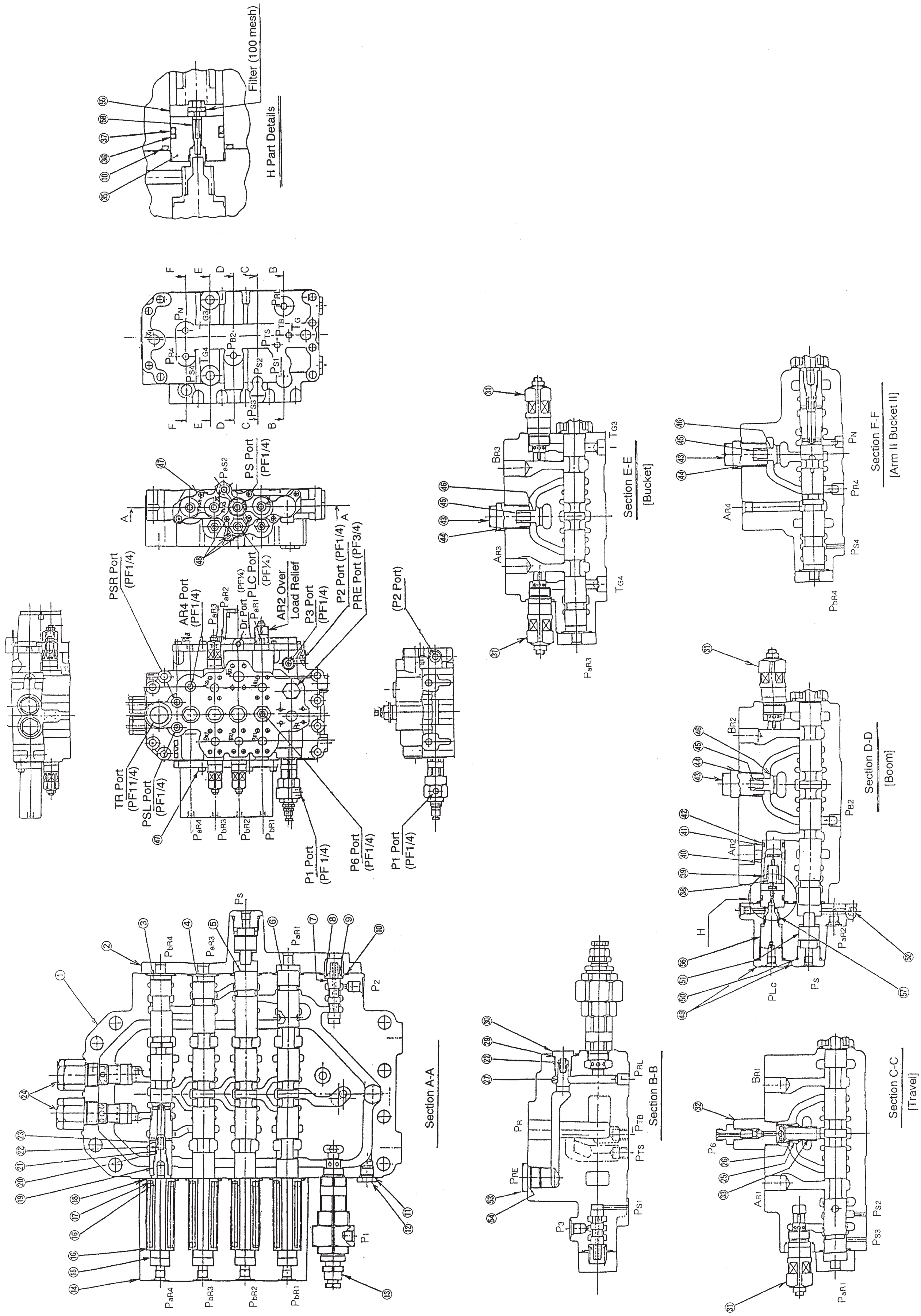
	*** Control Valve Set Pressures**		
*	Maximum Flow:	†(JS200/220) P_L, P_K 198.7 l/min (43.7 imp gal), P_P 20.5 l/min (4.5 imp gal), P_S 20.5 l/min (4.5 imp gal) †(JS240/260) P_L, P_K 212.2 l/min (46.67 imp gal), P_P 22 l/min (4.8 imp gal), P_S 22 l/min (4.8 imp gal)	
*	Main Relief Set Pressure †(JS200/220)	(Lo) 320 kgf/cm² (309 bar, 4550.4 lb/in²) at 138 l/min (30.3 imp gal) (Hi) 350 kgf/cm² (338 bar, 4977 lb/in²) at 126 l/min (27.7 imp gal)	
*	Main Relief Set Pressure †(JS240/260)	(Lo) 320 kgf/cm² (309 bar, 4550.4 lb/in²) at 168 l/min (36.9 imp gal) (Hi) 350 kgf/cm² (338 bar, 4977 lb/in²) at 155 l/min (34.09 imp gal)	
*	AL_4 (Dipper Out)	Port Overload Relief Set Pressure:	370 kgf/cm² (363 bar, 5263 lb/in²) at 20 l/min (4.3 imp gal)
*	BL_4 (Dipper In) (except JS220LC Long Reach)	Port Overload Relief Set Pressure:	370 kgf/cm² (363 bar, 5263 lb/in²) at 20 l/min (4.3 imp gal)
*	BL_4 (Dipper In) (JS220LC Long Reach only)	Port Overload Relief Set Pressure:	220 kgf/cm² (216 bar, 3132 lb/in²) at 20 l/min (4.3 imp gal)
*	AR_2 (Boom Raise)	Port Overload Relief Set Pressure:	370 kgf/cm² (363 bar, 5263 lb/in²) at 20 l/min (4.3 imp gal)
*	BR_2 (Boom Lower)	Port Overload Relief Set Pressure:	250 kgf/cm² (245 bar, 3555 lb/in²) at 20 l/min (4.3 imp gal)
*	AR_3 (Bucket Open) (except JS220LC Long Reach)	Port Overload Relief Set Pressure:	370 kgf/cm² (363 bar, 5263 lb/in²) at 20 l/min (4.3 imp gal)
*	AR_3 (Bucket Open) (JS220LC Long Reach only)	Port Overload Relief Set Pressure:	240 kgf/cm² (235 bar, 3407 lb/in²) at 20 l/min (4.3 imp gal)
*	BR_3 (Bucket Close) (except JS220LC Long Reach)	Port Overload Relief Set Pressure:	370 kgf/cm² (363 bar, 5263 lb/in²) at 20 l/min (4.3 imp gal)
*	BR_3 (Bucket Close) (JS220LC Long Reach only)	Port Overload Relief Set Pressure:	240 kgf/cm² (235 bar, 3407 lb/in²) at 20 l/min (4.3 imp gal)
	Pilot Port Maximum Pressure: (JS200/JS240) P_P, P_S 40 kgf/cm² (38.6 bar, 568.8 lb/in²)		
*	†Including all variants.		


L side spool
R side spool
P1 Port PF1/4
P2 Port PF1/4
PRE Port PF3/4
(P2 Port)
P3 Port PF1/4
Ar1 Over Load Relief
Dr Port PF1/4
(Dr Port)
AR4 Port PF1/4
PSR Port PF1/4
PSL Port PF1/2
TR Port
PF1¼
P6 Port PF1/4
5-PF1/4 (PaL1~Pst PaL4 Port)
PaR2 Port PF1/4
5 PF1/4 (PaR1, PaR3,
PbR4, Ps, PLC Port)
Dr Port
AL4 Over Load Relief Valve
(P5 Port)
5-PF1/4 (P4, PbL1~PbL4)
4-PF1/4 (PbR1~PbR3, PbR4)
Pp Port PF1/4
PF Port (PF1/4)
Pt Port (PF1/4)
P5 Port PF3/4

Code	Part Name	Q'ty
1	Valve housing	1
2	Spool (Arm 1)	1
3	Spool (Swing)	1
4	Spool (Spare)	1
5	Spool (Travel)	1
6	Spool (Linear, Boom 2)	1
7	O-ring	5
8	Spring seat	10
9	Spring	4
10	Spool end	5
11	Cap	1
12	Plug	2
13	O-ring	2
14	Cap	1
15	O-ring	5
16	Plug	1
17	Back up ring	1
18	O-ring	3
19	Spring	1
20	Poppet	1
21	Plug	1
22	O-ring	1
23	Spring	1
24	Poppet	1
25	O-ring	2
26	Plug	2
27	Spring	2
28	Poppet	2
29	Sleeve	1
30		
31	Spring	1
32	Poppet	1
33	O-ring	3
34	Plug	2
35	Plug	2

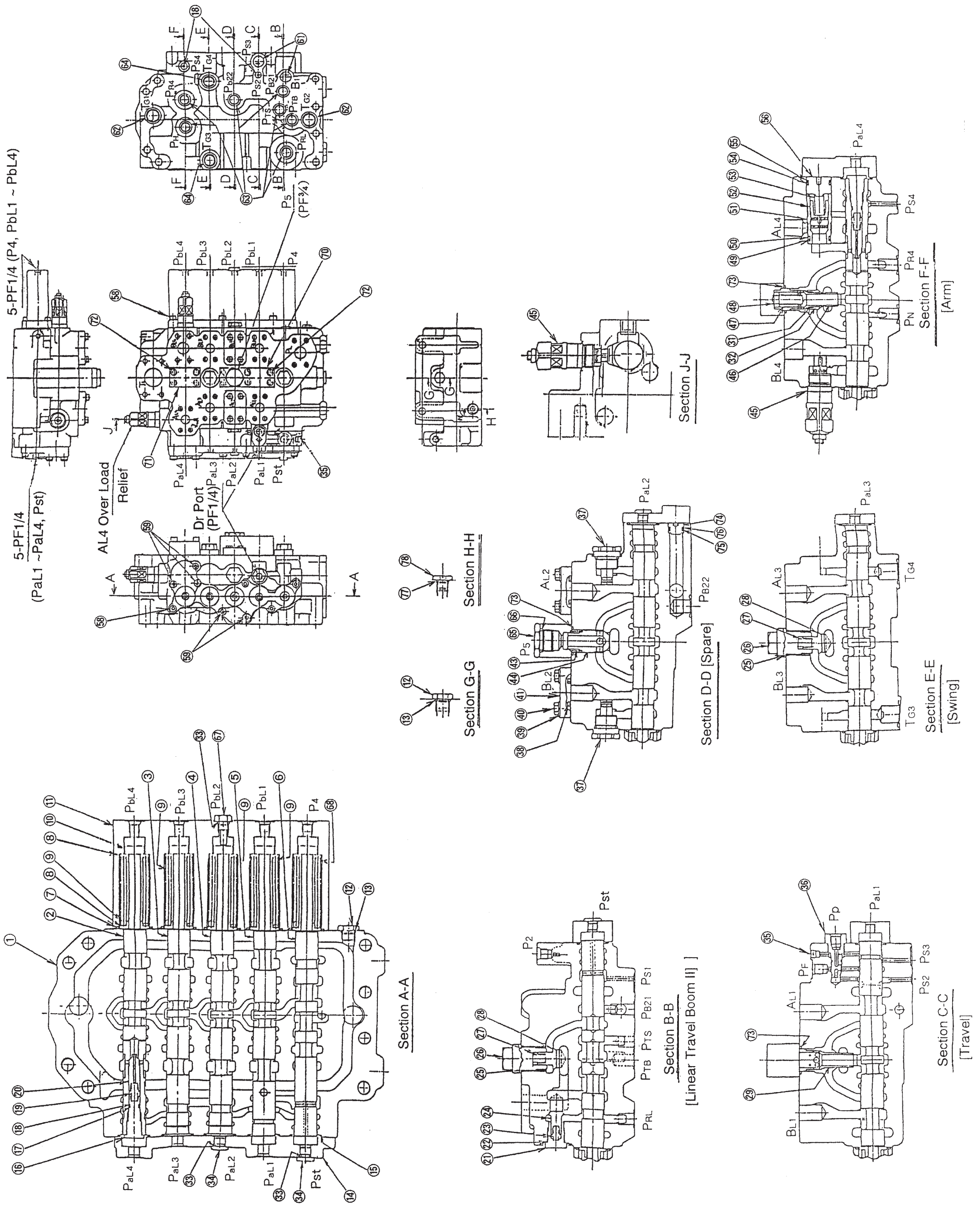
Code	Part Name	Q'ty
36	Plug Assembly	1
37	Plug Assembly	2
38	O-ring	2
39	Washer	8
40	Bolt	8
41	Plate	2
42		
43	Spring	1
44	Poppet	1
45	Relief Valve Assembly	2
46	Sleeve	1
47	Poppet	1
48	Spring	1
49	Back up ring	1
50	O-ring	1
51	Sleeve	1
52	Poppet	1
53	Spring	1
54	O-ring	1
55	Back up ring	1
56	Plug	1
57		
58	Socket head bolt	10
59	Socket head bolt	5
60		
61	O-ring	2
62	O-ring	2
63	O-ring	7
64	O-ring	2
65	Plug	1
66	O-ring	1
67	Plug	1
68	Spring	1
69		

Code	Part Name	Q'ty
70	Flange	1
71	Flange	1
72	Socket head bolt	10
73	O-ring	3
74	Plug	1
75	O-ring	1
76	Back up ring	1
77	O-ring	1
78	Plug	1


Filter (100 mesh)
H Part Details
PSR Port (PF1/4)
AR4 Port (PF1/4)
Dr Port (PF1/4)
PLC Port (PF1/4)
AR2 Over Load Relief
P3 Port (PF1/4)
P2 Port (PF1/4)
PRE Port (PF3/4)
PS Port (PF1/4)
(P2 Port)
TR Port (PF11/4)
PSL Port (PF1/4)
P1 Port (PF 1/4)
P6 Port (PF1/4)
P1 Port (PF1/4)
Section E-E [Bucket]
Section F-F [Arm II Bucket II]
Section D-D [Boom]
Section A-A
Section B-B
Section C-C [Travel]

Code	Part Name	Q'ty
1	Valve housing	1
2	Cap	1
3	Spool (Arm 2 Bucket 2)	1
4	Spool (Bucket 1)	1
5	Spool (Boom 1)	1
6	Spool (Travel)	1
7	Spool	1
8	Spring	1
9	Spring seat	1
10	O-ring	6
11	O-ring	1
12	Plug	1
13	Relief Valve Assembly	1
14	Cap	1
15	Spool end	4
16	Spring seat	8
17	Spring	4
18	O-ring	4
19	Plug	1
20	Back up ring	1
21	O-ring	1
22	Spring	2
23	Poppet	1
24	Relief Valve Assembly	2
25	Poppet	1
26	Spring	1
27	Poppet	1
28		
29	O-ring	1
30	Plug	1

Code	Part Name	Q'ty
31	Relief Valve Assembly	4
32	Check Valve Assembly	1
33	sleeve	1
34		
35	Plug	1
36	Back up ring	1
37	O-ring	1
38	Spring	1
39	Poppet	1
40	sleeve	1
41	O-ring	1
42	Back up ring	1
43	Plug	3
44	O-ring	3
45	Spring	3
46	Poppet	3
47	Socket head bolt	11
48	Socket head bolt	3
49	Plug	2
50	O-ring	2
51	Piston	1
52	Plug	1
53	Plug	1
54	O-ring	1
55	Spacer Assembly	1
56	Piston	1
57	Spring	1
58	Poppet	1


5-PF1/4 (P4, PbL1 ~ PbL4)
5-PF1/4
(PaL1 ~PaL4, Pst)
AL4 Over Load
Relief
Dr Port
(PF1/4)
Section A-A
Section G-G
Section H-H
Section B-B
[Linear Travel Boom II]
Section D-D [Spare]
Section J-J
Section C-C
[Travel]
Section E-E
[Swing]
Section F-F
[Arm]

Code	Part Name	Q'ty
1	Valve housing	1
2	Cap	1
3	Spool (Arm 2 Bucket 2)	1
4	Spool (Bucket 1)	1
5	Spool (Boom 1)	1
6	Spool (Travel)	1
7	Spool	1
8	Spring	1
9	Spring seat	1
10	O-ring	6
11	O-ring	1
12	Plug	1
13	Relief Valve Assembly	1
14	Cap	1
15	Spool end	4
16	Spring seat	8
17	Spring	4
18	O-ring	4
19	Plug	1
20	Back up ring	1
21	O-ring	1
22	Spring	2
23	Poppet	1
24	Relief Valve Assembly	2
25	Poppet	1
26	Spring	1
27	Poppet	1
28		
29	O-ring	1
30	Plug	1
31	Relief Valve Assembly	4
32	Check Valve Assembly	1
33	sleeve	1
34		
35	Plug	1
36	Back up ring	1
37	O-ring	1
38	Spring	1
39	Poppet	1
40	sleeve	1
41	O-ring	1
42	Back up ring	1
43	Plug	3
44	O-ring	3
45	Spring	3
46	Poppet	3
47	Socket head bolt	11
48	Socket head bolt	3
49	Plug	2
50	O-ring	2
51	Piston	1
52	Plug	1
53	Plug	1
54	O-ring	1
55	Spacer Assembly	1
56	Piston	1
57	Spring	1
58	Poppet	1

Precautions During Use
Installation

• Be careful that excessive force is not put on the valve by the piping.

• Tighten the installation bolts in the same manner.

• When welding work is done near the installation bolts, excessive heat or spatter can damage the seals, so be careful.

• To prevent foreign matter from entering the ports, do not remove the plugs from the ports until installation.

Running

• Operate only after confirming that the hydraulic circuit and hydraulic oil are clean.

• Use the hydraulic oil specified in this manual.

• Do not raise the pressure of the main relief valve or port relief valve set pressure.

• The difference between the main relief valve and port relief valve set pressure should be more than 2.0 MPa (20 kgf.cm^2).

• Perform warming up sufficiently before beginning actual operations.

In particular, to prevent sticking of the main spool due to heat shock because of low temperature of the hydraulic oil and valve at starting, be careful of the following points.

* **1.** When operating the services, do not induce overload or full travel conditions which will cause sudden and frequent operation of the relief valves. Operate steadily, enabling the hydraulic oil in the rams to circulate and warm each part uniformly.

2. Fine and combined operations cause heat build up, so do not perform sudden operations at low temperatures.

The following details refer to the illustrations at the beginning of this Section.

Operation

The control valve is constructed with the 4-spool and 5-spool sides overlapping and integrated into one.

When all spools are neutral

1. Neutral passage (Refer to Fig. 1,2)

The oil delivered by PR port passes through the (A) cavity by the 4-spool neutral passage, and is returned to the tank by TR port. Part of the oil passes through the (C) (D) (E) (F) passage and is returned to the tank by TL port. If the machine is started from cold, the oil also pushes open the negative control relief valve (B).

Pressure in (A) cavity is led from Psr port to the pump and controls the PR port delivery volume. (Negative control).

Also, when there is a large volume of oil flowing through the neutral passage due to a lag in the pump's delivery control, the low pressure relief valve, which is contained in the negative control relief valve, works to prevent the pressure of PSR port from becoming abnormally high.

The oil delivered by PL port passes through the neutral passage A of the 5-spool control valve via passage Y into the 4-spool passage W passing through (G) cavity, pushing open negative control valve (H) and flowing to the TR port. Part of the oil passes through the (C) (D) (E) (F) passage and is returned to the tank from the Tl port.

The pressure of (G) cavity is led from the PSL port to the pump and controls the PL pump delivery volume.

2. Signal Passage (Refer to Fig. 1,3,9)

The oil from the signal hydraulic source entering the P; port flows through the restriction (a) and is led to the PP port and passage (b), 5-spool travel spool signal land part, passing through passage (c) (d) and is released to the 4-spool tank passage.

Part of the oil entering PP port flows through restriction (I) and is led to PP port and passage (e), flows through each spool of the 5-spool signal land part and is released to the tank passage.

Also, the oil passing through restriction (J) flows through passage (f), land (k) and flows to the tank passage. Part of the oil flow from passage (g) (h) to land (L) and is released to the 4-spool tank passage.

Operation *(continued)*

Individual Operation

1. Travel Spool Switch (Refer to Fig. 1,3,4).
When the P_{bl1} (P_{al1}) is pressurised and the 5-spool travel spool is selected (Fig. 4), the neutral passage **A** is closed and downward flow is cut off, so the oil delivered from the P_L port flows from the 5-spool neutral passage **A** past the sleeve (M) into passage I to the spool neck, to the passage **K** (passage J) and flows to the cylinder port B_{Li} (A_{Li}).

When the P_{bR1} (P_{ar1}) port is pressurised and the 4-spool travel spool is selected to neutral, passage **a** is closed and downward flow is cut off, so the oil delivered from the P_R port flows from the 4-spool neutral passage **a** to the sleeve K(N), passage **f** to the spool neck, passage **g** (passage **h**) and flows to the cylinder port B_{RI} (A_{RI}).

The return oil from the cylinder port flows through the spool neck and is released to the tank.

When one side of the 4-spool (5-spool) travel spool is selected (Fig. 3,4), the signal land (K) (L) is closed but the oil entering from the signal port P_p flows through the restriction (I) (J) passage, land (K) (or restriction (I) (J) passage (f) (g) (h) then land (L) and is connected with the tank passage so the signal passage (f) pressure does not rise and the travel linearity spool maintains its indicated position due to spring force. (Fig.1)

When the above operations (4,5 spool simultaneous, or separate) are made, flow to the tank passage of the signal passage (b) is cut off so the P_t port pressure rises.

* Boom Spool Selection

2. Up (II speed confluence) (Refer to Fig. 1,3,5,8,).
When pilot port P_{aR2} is pressurised and the boom I spool is selected, the 4-spool neutral passage a is closed and the oil delivered from the P_R port flows from the 4-spool parallel passage **b** and pushes up the load check valve (O), flowing through passage **i** spool neck and passage **K** and pushes open the lock valve poppet (P) and flows into A_{R2} port.
When P_{aR2} is pressurised (Fig. 1,8) part of the oil flows from the outer passage through the P_2 port and flows to the shuttle (Q) passage z x, and from the P_3 port flows through the outer passage again and pressurises P_4 port and selects the boom II spool. At this time, due to the spool being selected (Fig. 8) and the flow to the neutral passage A from passage D being cut off, the oil delivered from P_L flows through passage B, pushes open load check valve (R) and flows through passage C H L1 (Fig. 3) L_2 (Fig. 5), converging with passage **K** from 4-spool passage **m**.

The return oil from cylinder port B_{R2} flows though passage **j** and through boom **I** spool neck and is released to the tank passage. (Fig. 5)

3. Lower (Refer to Fig. 6, 14).
When the pilot port P_{bR2} is pressurised and the boom I spool is selected (Fig. 6), the 4-spool neutral passage a is cut off and the oil delivered from the P_R port flows through the 4-spool parallel passage b, pushes open the load check valve (O) and flows through passage **i j** from cylinder port B_{R2}.
The return oil from cylinder port A_{R2} flows through the lock valve poppet (**P**) and, through passage K, flows to the spool neck and is released to the tank passage.

Operation *(continued)*

* Dipper Spool Selection

1. Dump (Refer to Fig. 9).

* When the pilot port P_{aL4} is pressurised and the arm I spool is selected, the oil delivered from P_L port through the 5-spool neutral passage A pushes up the sleeve (S) load check valve (T) and, through passage U, passes through the spool neck and passage V, pushing open the load sensing valve poppet (U) and flowing from the cylinder port A_{L4}.
Also, part of the oil delivered by P_L flows from 5-spool parallel passage B to the restriction (V), pushes open the load check valve (W) and converges in passage U.
The return oil from cylinder port B_{L4} flows through the spool neck from passage X and is released to the tank passage.

2. Crowd (Refer to Fig. 10, 15, 16).

When the pilot port P_{bl4} is pressurised and dipper **I** spool is selected (Fig. 10), the oil delivered from P_L through the 5-spool neutral passage **A** pushes up the sleeve (S) load check valve (T) and from passage **U** flows through spool neck and passage **X** and flows from the cylinder port B_{L4}. Also, part of the oil delivered from P_L flows through the restriction from the 5-spool parallel passage **b,** pushes open the load check valve (W) and converges in passage **U**.

* The return oil from cylinder port A_{L4} pushes open the load sensing valve poppet (U), flows through passage **V** and is released to the tank passage, but at this time, part of the oil flows through the spool hole (**X**), pushes open the regenerative circuit poppet (Y) inside the spool, flows through the restriction (Z) and converges in the passage U (Fig. 15,16).

3. II Speed Confluence

* When the dipper **I** spool is selected (Dump, Crowd: Fig. 9, 10), when the pilot port P_{bR4} is pressurised and dipper II spool is switched, the oil delivered from P_R port flows through 4-spool neutral passage a and pushes open load check valve (z) and converges into passage **U** from passage **t** or **Z** and at the same time pushes open the check valve (y) poppet (x) (Fig. 3). It flows through the outer passage from the P6 port, through passage **v** from A_{R4} port and flows through the spool restriction (w) and converges in passage u.

Operation *(continued)*

* Bucket Spool Selection

Dump: Crowd (Refer to Fig. 11).
When the pilot port P_{bR3} (P_{aR3}) is pressurised and the bucket I spool is selected, the 4-spool neutral passage a is cut off and the oil delivered from P_R flows through the 4-spool parallel passage b, pushes up the load check valve (v) and from the passage n flows through the spool neck and from passage P (q) flows to the cylinder port B_{R3} (A_{R3}).

The return oil from the cylinder port A_{R3} (B_{R3}) flows through the spool neck from passage q (P) and is released to the tank passage.

II Speed Confluence (Refer to Fig. 11, 12).
When the bucket I spool is selected, (Dump: Crowd: Fig. 11), when pilot port P_{aR4} is pressurised and bucket II is selected (Fig. 12), the oil delivered from P_L flows into passage Y w from the 5-spool neutral passage A and arm I spool land, flows through the bucket II spool hole (u), pushes up the poppet (t) and converges in bucket I passage n from passage o (Fig. 1).

Slew Spool Switch (Refer to Fig. 11).
When the pilot port P_{bL3} (P_{aL3}) is pressurised and the spool is selected, the 5-spool neutral passage A is cut off and the oil delivered from P_L port flows through the 5-spool parallel passage B and pushes open the load check valve (s) and flows through the spool neck from passage P and flows from passage R (Q) to cylinder port B_{L3} (A_{L3}).

The return oil from cylinder port A_{L3} (B_{L3}) flows through the spool neck and is released to the tank.

Spare Spool Switch (Refer to Fig. 5).
When the pilot port P_{bL2} (P_{aL2}) is pressurised and the spool is switched, the 5-spool neutral passage A is cut off and the oil delivered from the P_L port flows through the 5-spool parallel passage B and pushes up the load check (r). From passage M, it flows through the spool neck, through the passage o and flows to cylinder port B_{L2} (A_{L2}). Also, the oil delivered from the outside to the P_5 port flows through the load check valve (r) passage (q) and converges in passage M.

The return oil from cylinder port A_{L2} (B_{L2}) flows through the spool neck and is returned to the tank.

Travel Linearity Spool (Refer to Fig. 18).
When an excavator spool is selected, the signal passage is cut off, but when the travel spool is in neutral, the signal oil is released to the tank at the travel spool signal land (K) (L) so the pressure of the signal passage (f) does not rise and the travel linearity spool is in the neutral condition. (Fig. 1)
(When the boom is raised, it is selected to boom II. Fig. 8)
Also, when the spool at the front is switched, the flow to the tank passage of the signal passage (e) is cut off so the P_f port pressure rises.
(For travel linearity spool selection conditions, refer to the next item, 'Travel Combination Operations').

Operation *(continued)*

Combined Operations

1. Travel Combination Operations (Refer to Fig. 1, 13).
When travelling forward or backward (including spin turn) any spool other than the travel spool is selected or when operating the excavator, when the travel spool (left, right travel) spool is selected, the signal passage and tank passage are cut off at that spool signal land and the signal passage pressure rises to the relief set pressure.

The pressure of P_t, P_f ports rises and when the signal passage pressure rises, the pressure of the signal passage (f) connects to the straight travel spool recess (Fig. 1). It passes through the straight travel spool passage (p), (o) cavity pressure rises and the spool selects to the left as shown. (Travel forward state).

Whilst the boom is lifting (boom II selected), when the travel spool is selected the pressure passing through the (i) (j) passage rises, so the shuttle (Q) resists the spring force and moves to the right as shown (Fig. 13).

For this reason, passage x y is connected and the P_4 port oil flows from the outer piping through P_3 port and is released to the tank passage. The straight travel spool is then selected so the straight travel state is achieved.

(Fig. 1,13)

In this straight travel state, the oil delivered from P_R port activates the 4-spool traction motor, passes through passage d F and activates the 5-spool traction motor. (Fig. 13)

In this way, the left and right traction motors are activated so straight travel can be maintained while simultaneous actions with other services are carried out.

Also, the oil delivered to the P_L port is delivered to the 5-spool side from the 5-spool side parallel passage B. Part of the oil pushes open the load check (R) and is led from passage C G c to the 4-spool parallel passage b, activating other services. (Fig. 13)

2. Boom Lowering Stroke Regulation (Refer Fig. 7).
Puts pressure on the Ps port of the boom section and activates the piston, moving the boom I spool back a little as shown.
When the spool is pushed back, the spool neutral passage a is opened and delivers oil to other spool sections.

3. Slew Priority Circuit (Refer to Fig. 2).
When operating the dipper and slew simultaneously, when the dipper load is light, the flow of oil for the slew section upstream is obtained by means of the constrictions (v), so slew priority is maintained.

Relief Valve (Refer to Fig. 3, 5, 8, 9, 11).

P_L port is connected to the load check (n) and passage E and P_R port is connected to load check (m) and passage e. Both are connected to the relief valve which prevents the maximum pressure of the 4-spool and 5-spool pump from exceeding the set pressure. (Fig. 8) (=main relief valve).
The relief valve has a booster function so that when pressure is put on P_1 port, the set pressure of the high pressure side can be changed.

Also, there is a relief valve on each ram port of the boom I (Fig. 3,5), bucket I (Fig. 11), dipper I (Fig. 9, 5-spool sectional diagram J-J) and prevents the actuator pressure from becoming abnormally high due to outside forces. (=overload relief valve)
When the ram pressure becomes negative, the relief valve also functions to absorb oil from the tank and prevent cavitation. (Combination port relief valve).

Operation *(continued)*

* **Load Holding Valve**

* **1. Boom Section (refer to fig. 5, 6, 14)** *.*
When the boom is lowered (Fig 6), the spool moves to the right as shown. At the same time, when **PLC** is pressurised, the load holding valve piston **D** pushes the poppet **B,** connecting Dr port. The oil in the load holding valve poppet (P) spring cavity **C** is released to the Dr port and poppet (P) opens.

2. Dipper Section (refer to fig. 9, 10, 15) *.*

* During dipper crowd, the spool moves to the left as shown and the passage **W** from the load holding valve is connected to the tank passage. The oil in the load holding valve poppet spring cavity **A** side creates differential pressure between the ram port **B** and is released, opening the poppet. (Fig 10)

* During dipper dumping, the spool moves to the left as shown (Fig. 9) and when oil flows to passage **V** (Fig. 15-2) it resists the force of the spring **D** of the load holding valve poppet (U), pushes open the poppet and flows to **AL4** port.

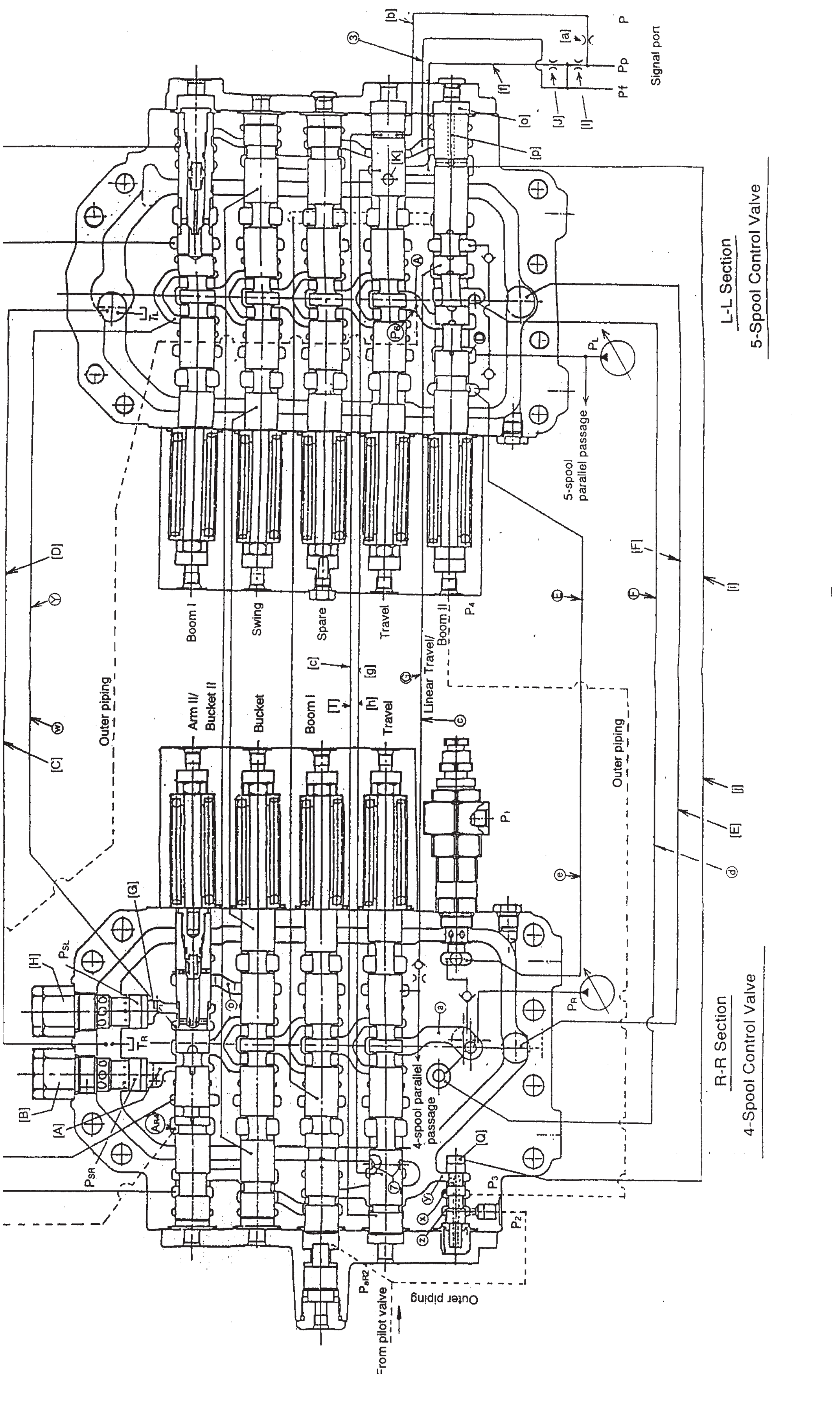
When the spool is in neutral, the pressure from the cylinder port **B** is fed through hole **C**, goes around the poppet spring cavity side **A** and, by the spring **D** force, seats the poppet.

Regenerative Circuit (Refer to Fig. 10, 16)

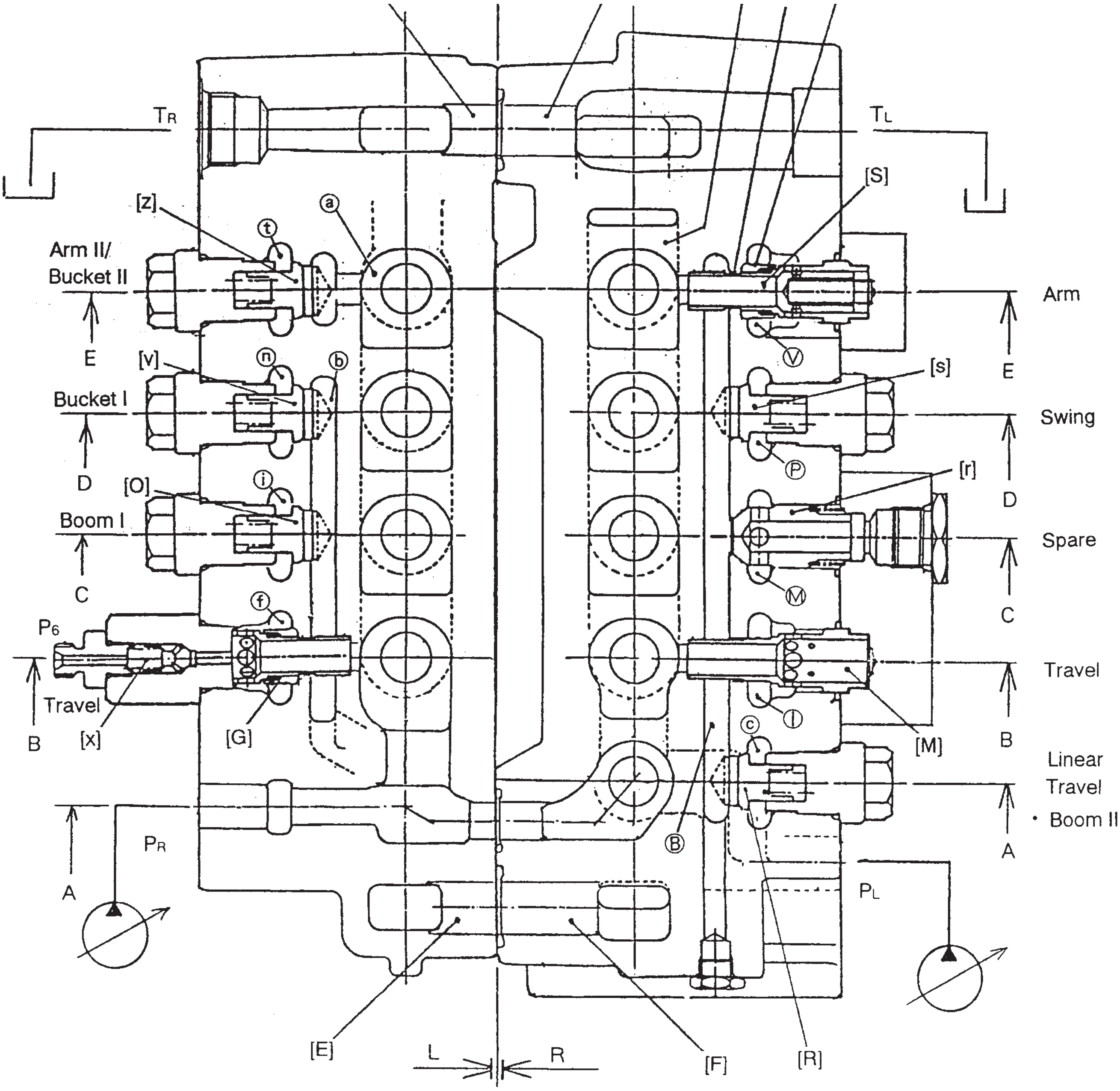
For this valve, a regenerative circuit is built into the dipper I spool.

During dipper crowd, (Fig. 10, 16), with the ram extending, the bottom side oil is insufficient and the pressure of passage **U** becomes lower than that of passage **V.** The pressure of passage **V** overcomes the spring **C** force and part of the oil which flows from the cylinder port **D** through the spool neck to the tank pushes open the poppet (Y) and by flowing through the constriction (Z), raises the pressure of passage **U** and prevents cavitation.

Operation *(continued)*

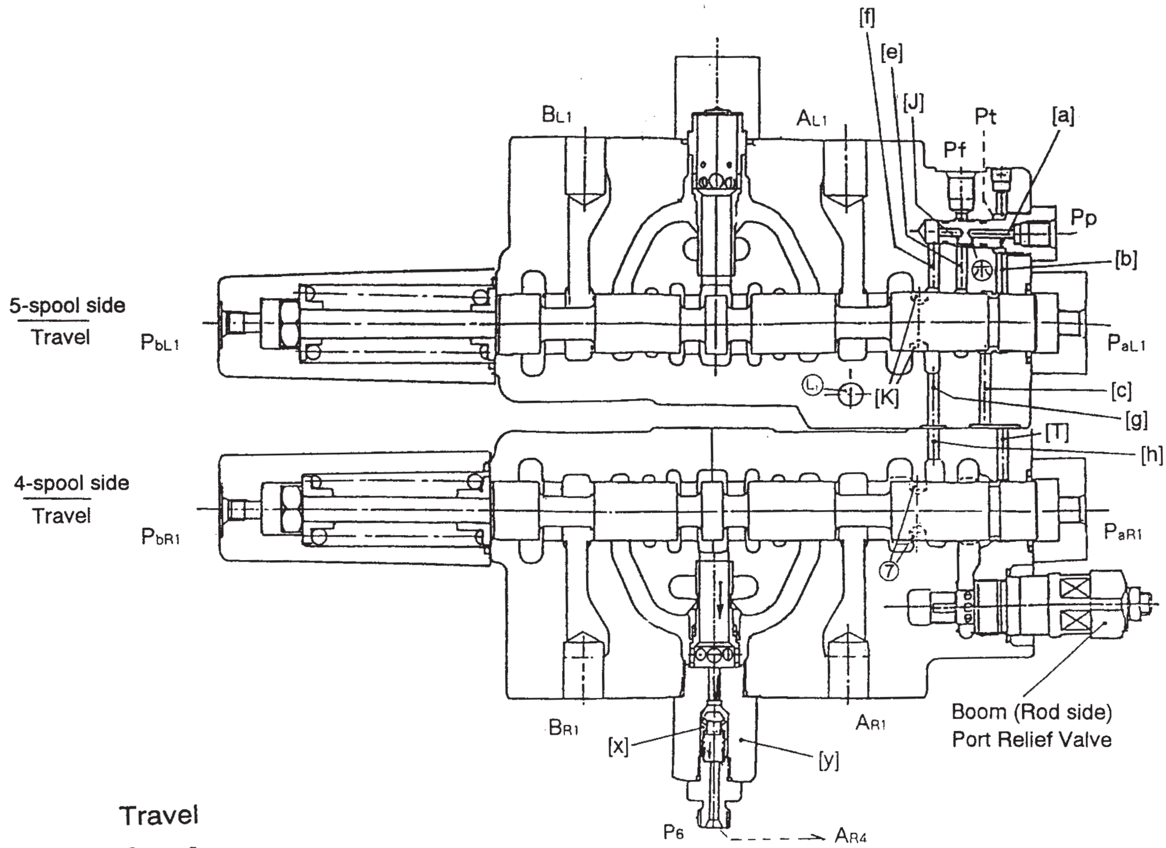


Operation *(continued)*

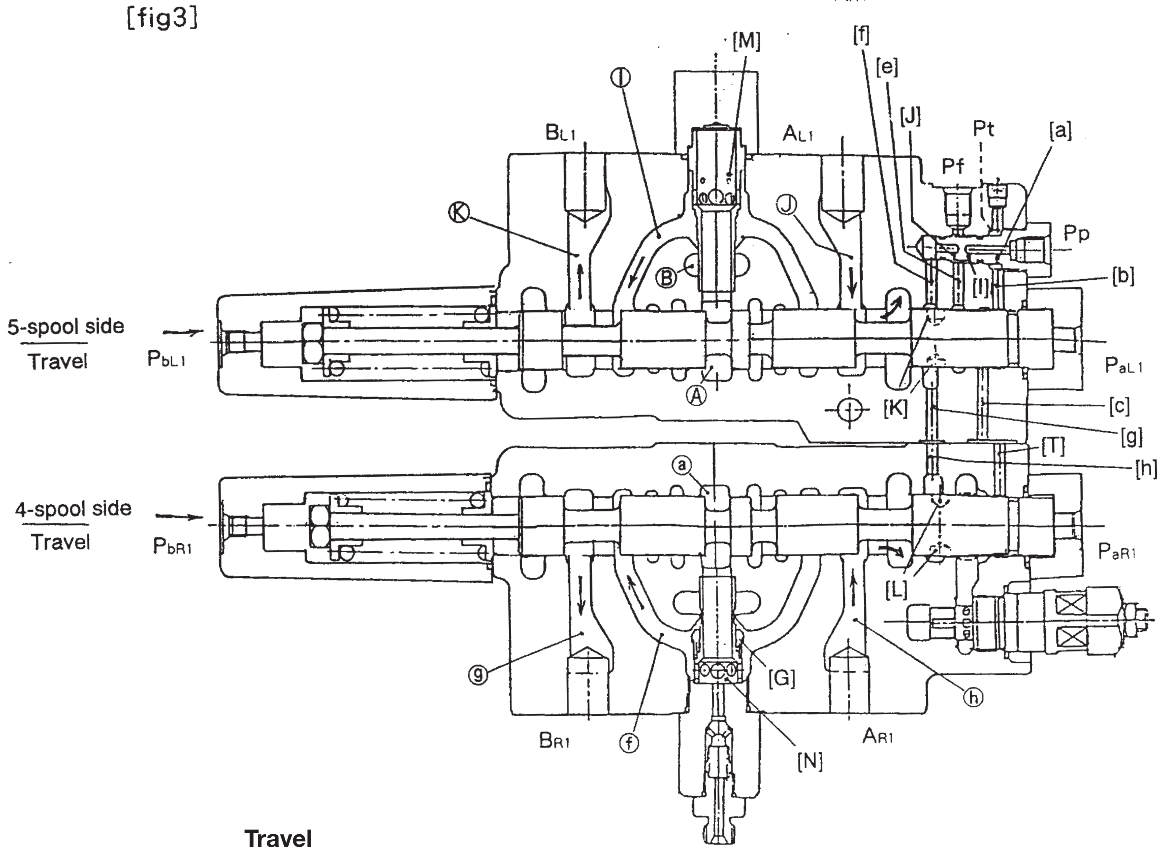


[fig2]

Operation *(continued)*



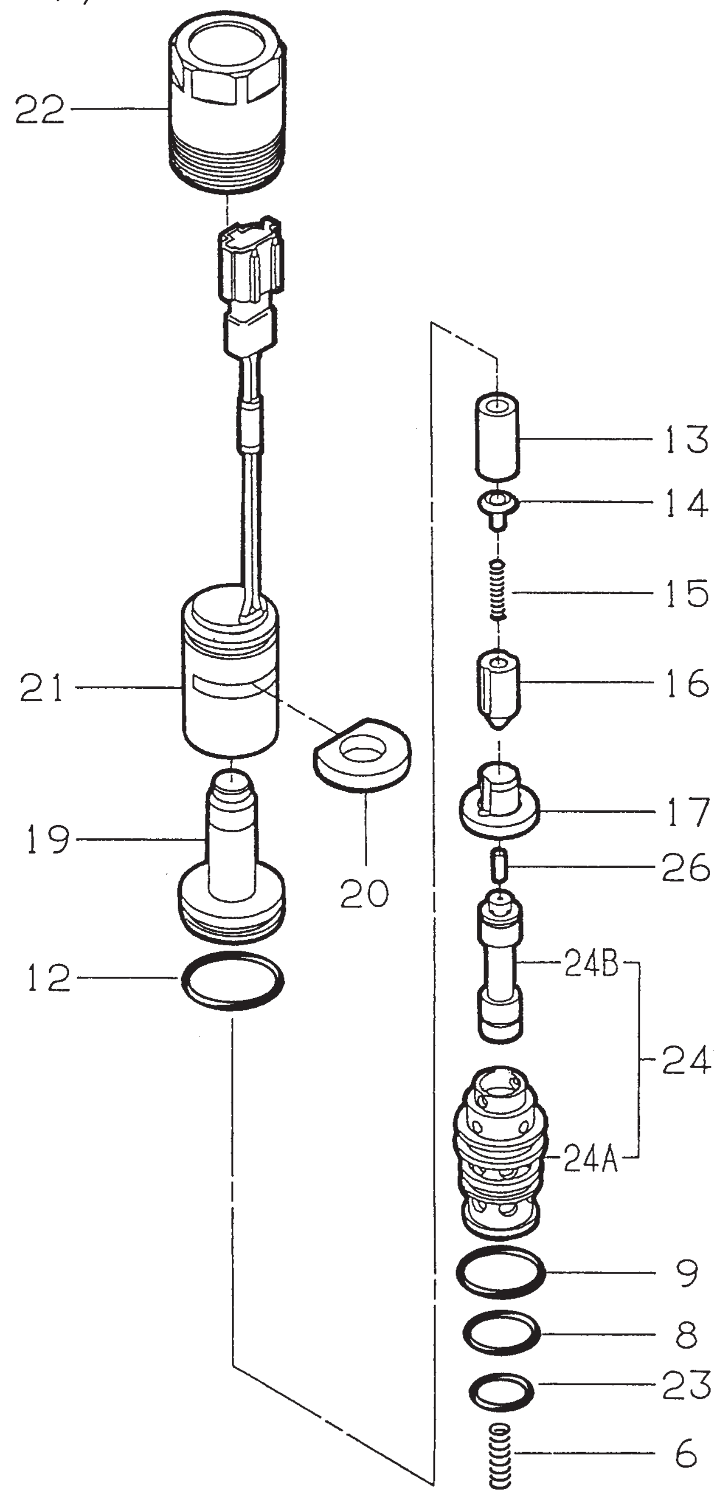
Travel
[fig3]



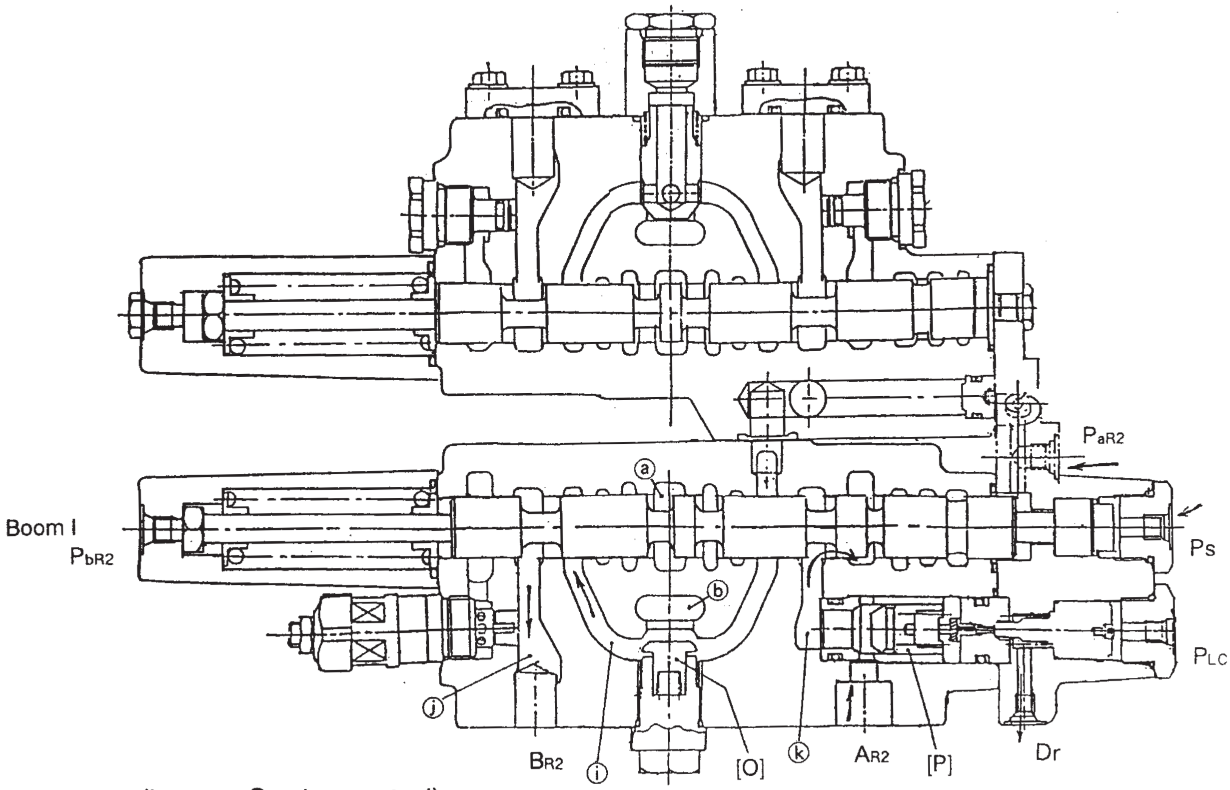
Travel
(Fig.4)

Operation ***(continued)***

ɘasure 1/2)

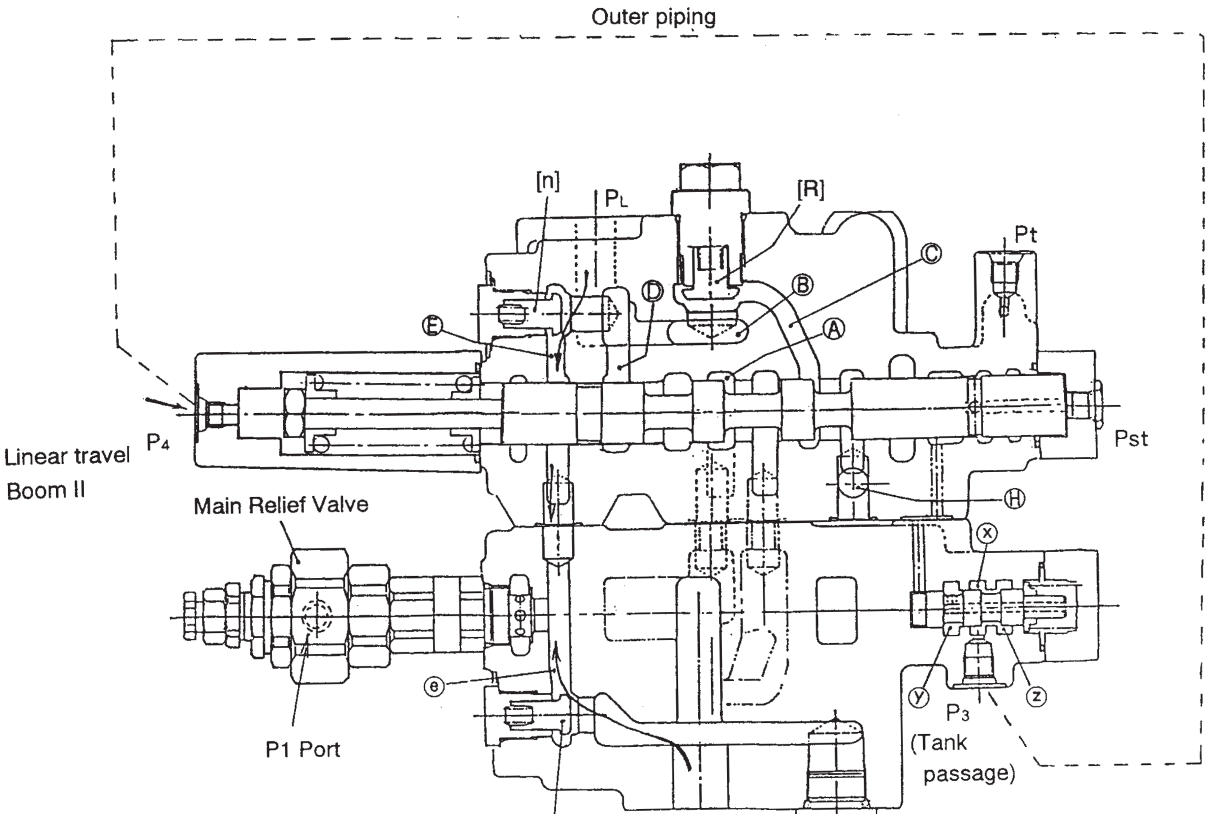


Operation *(continued)*



Boom (Lower: Stroke control)

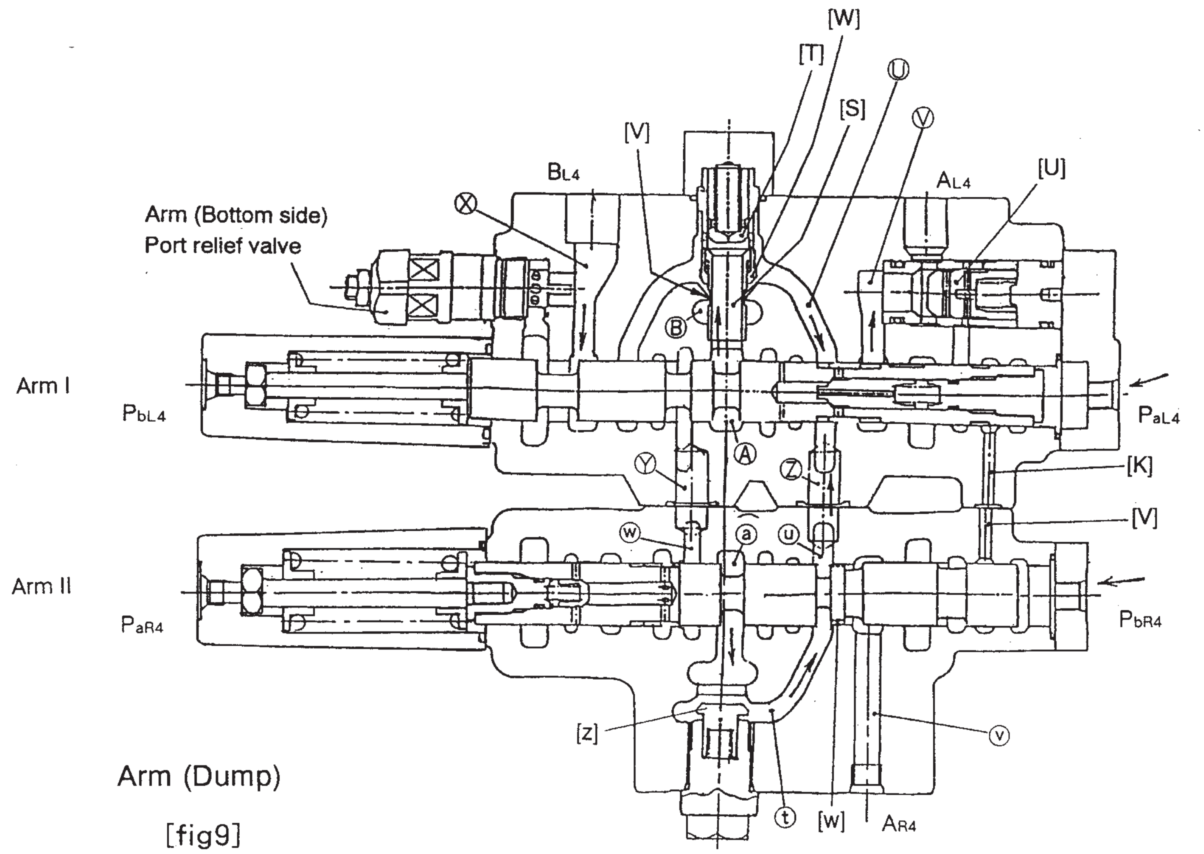
[fig7]



Boom II

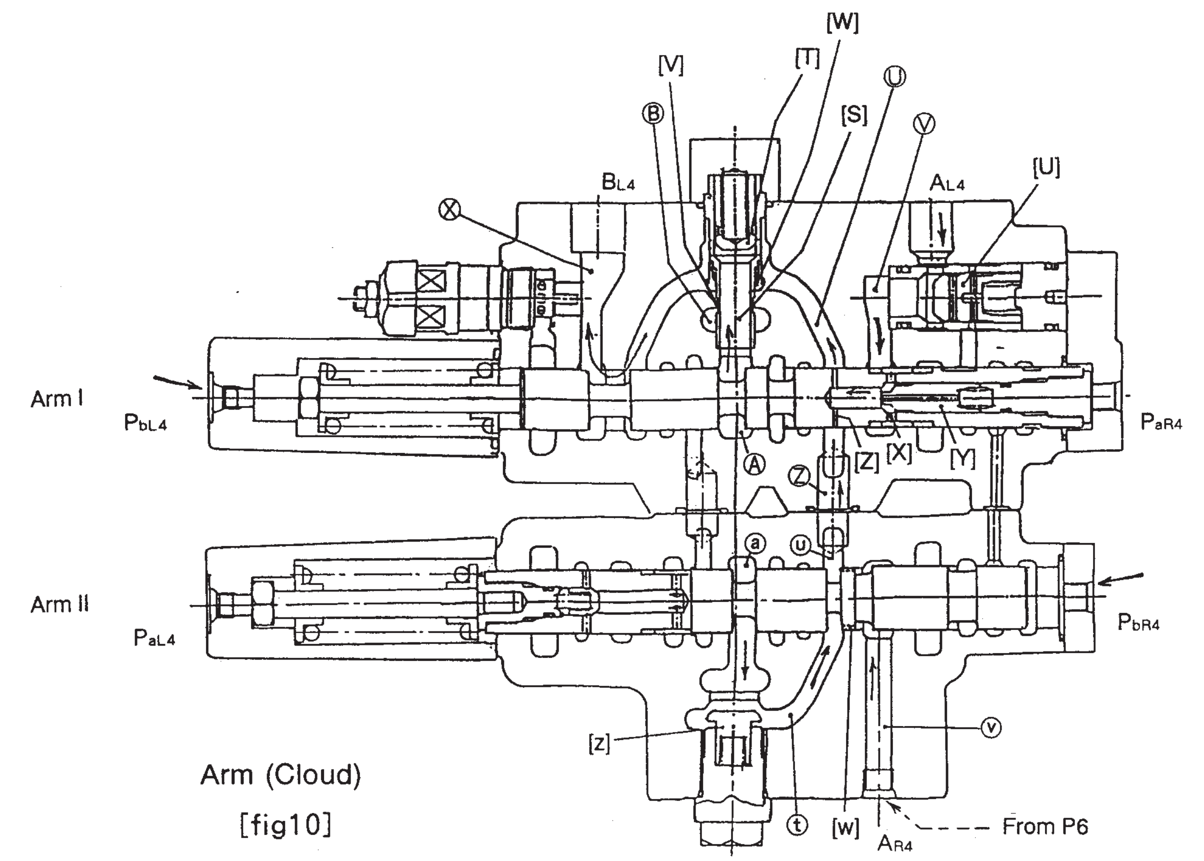
[fig8]

Operation *(continued)*



Arm (Dump)

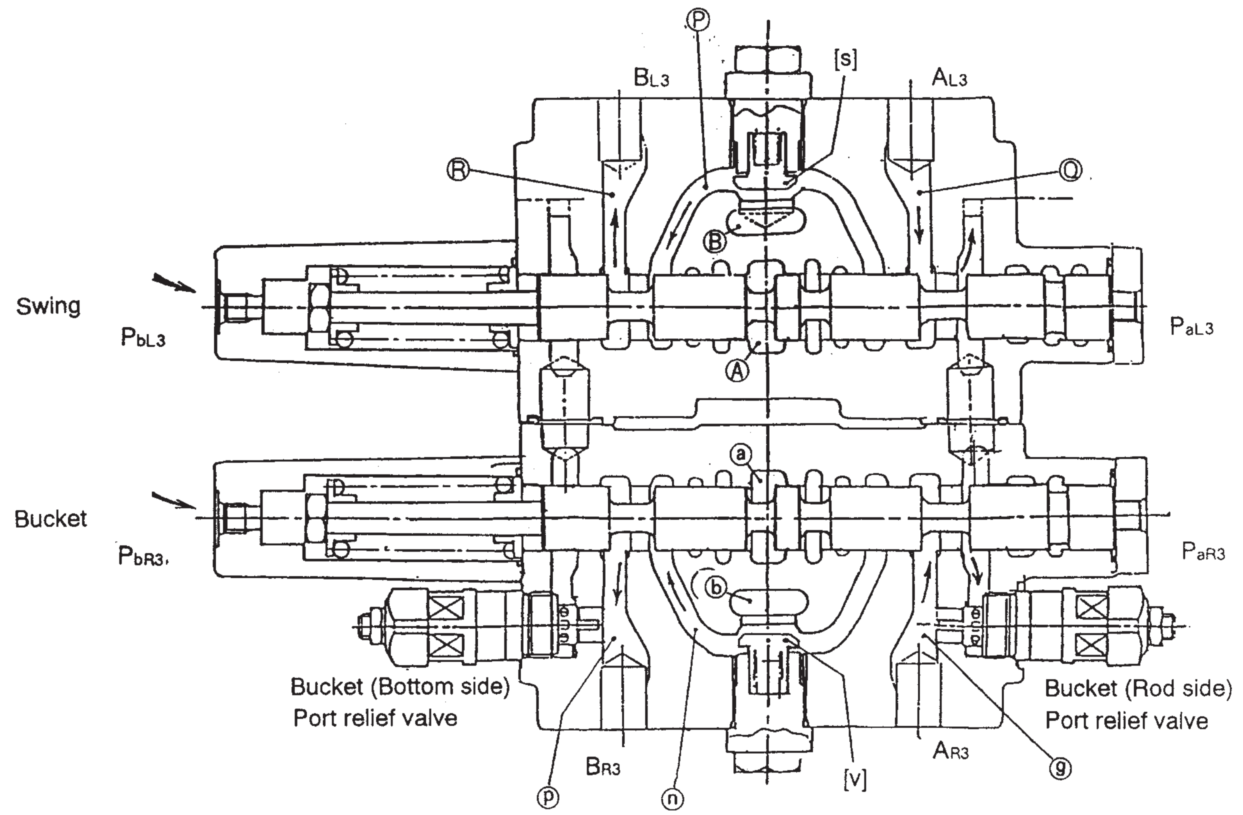
[fig9]



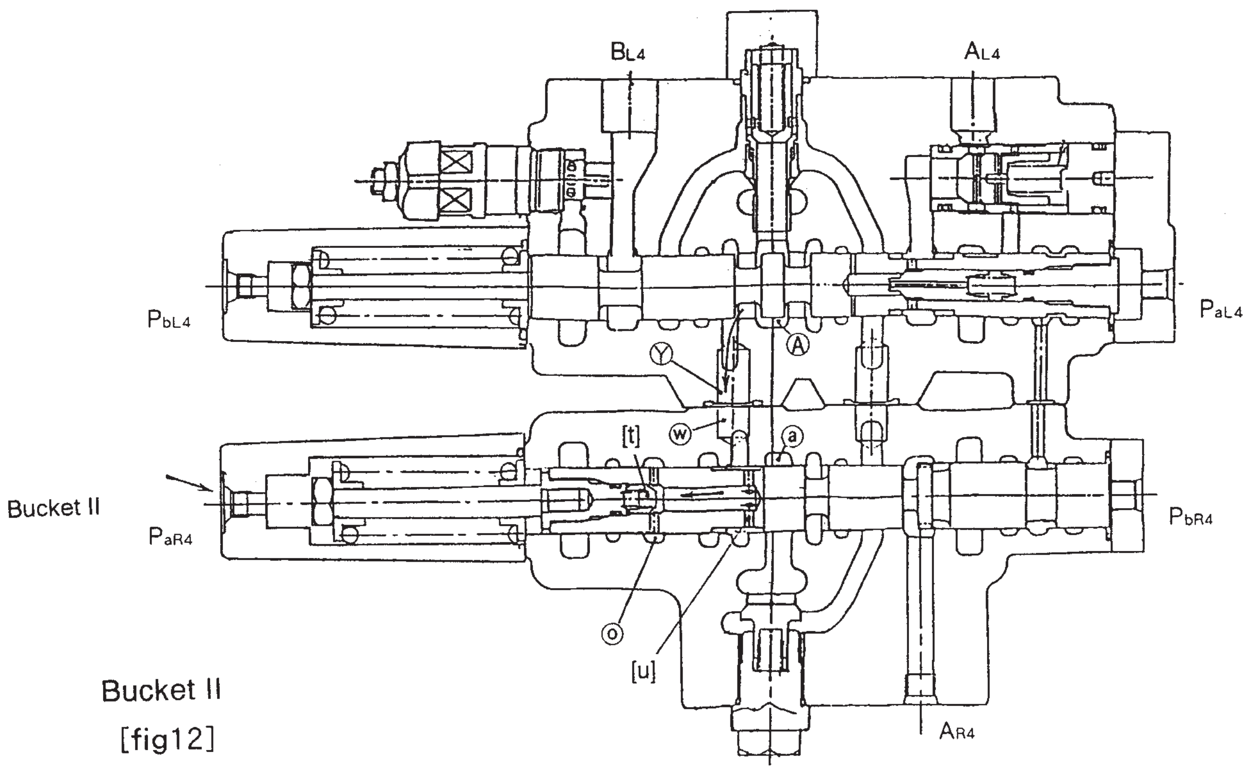
Arm (Cloud)

[fig10]

Operation *(continued)*

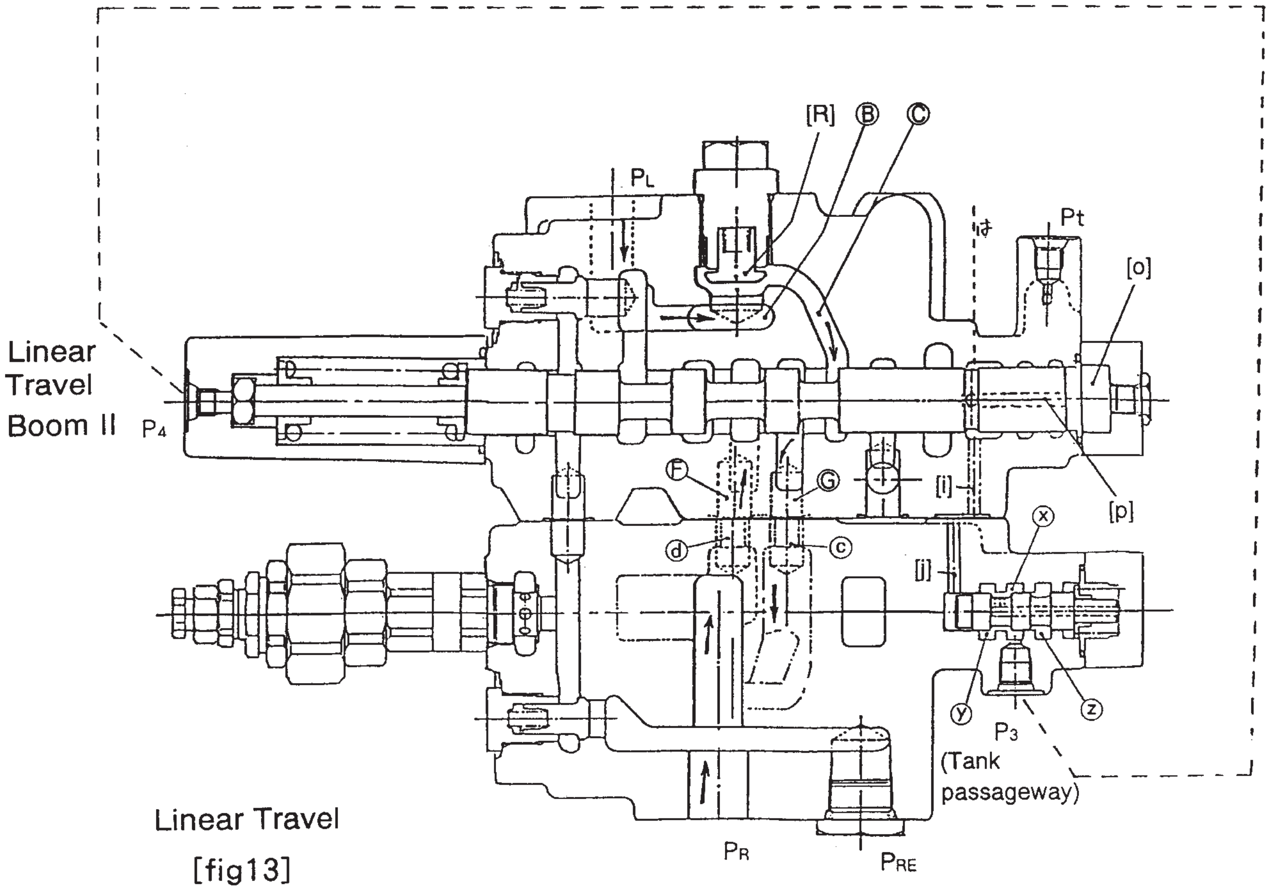


Swing
Bucket (Cloud)
[fig11]



Bucket II
[fig12]

Operation *(continued)*

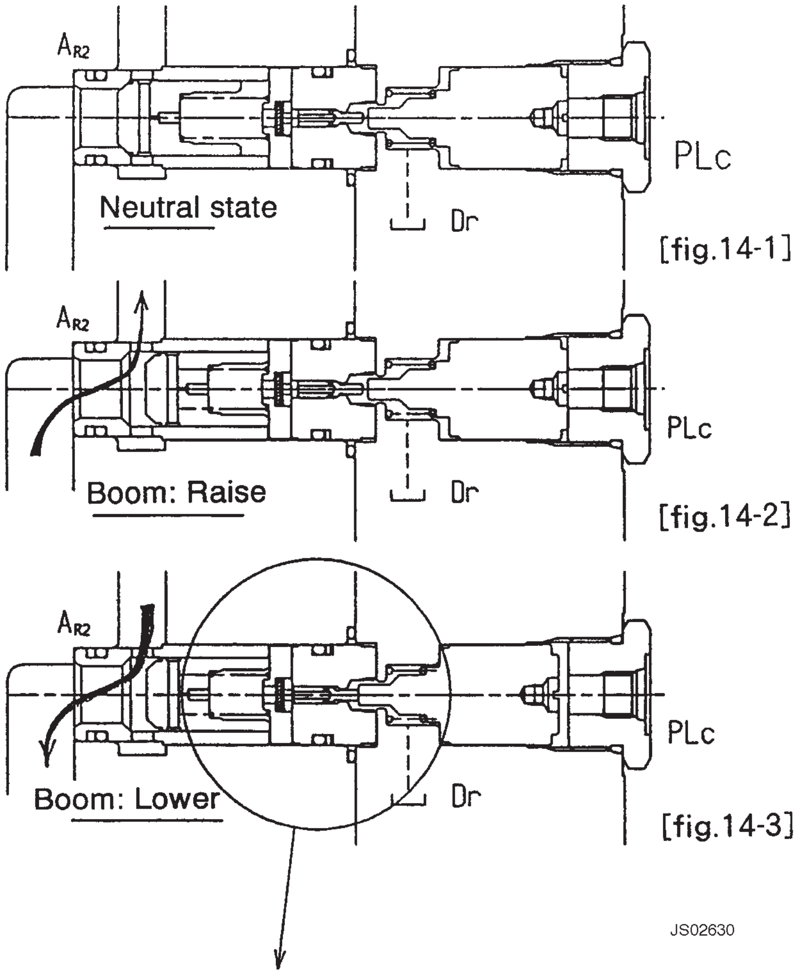


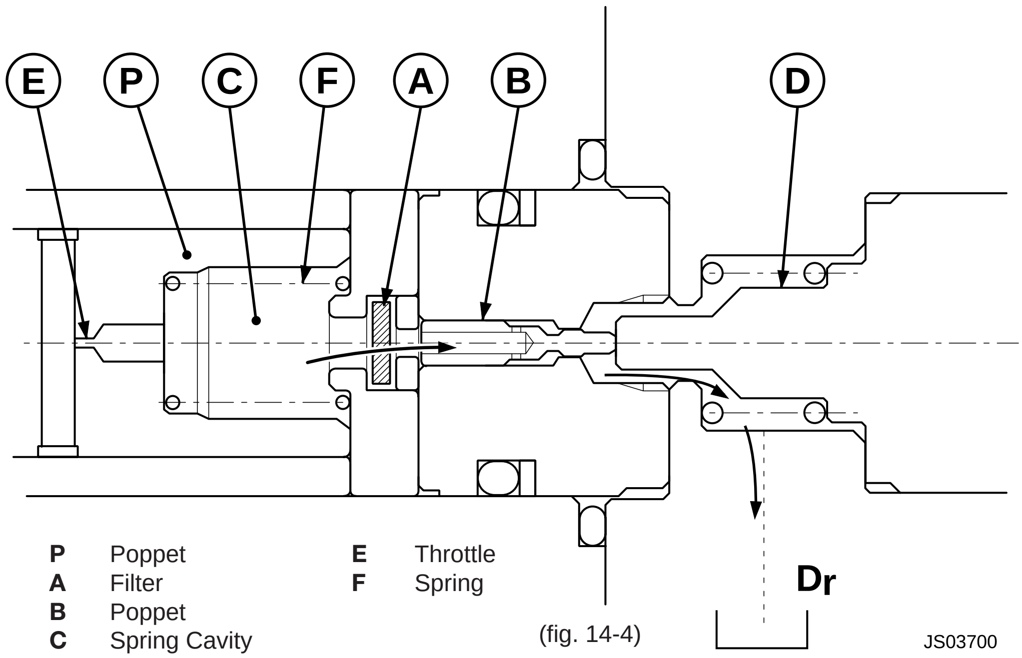
Linear Travel

[fig13]

Operation *(continued)*

*





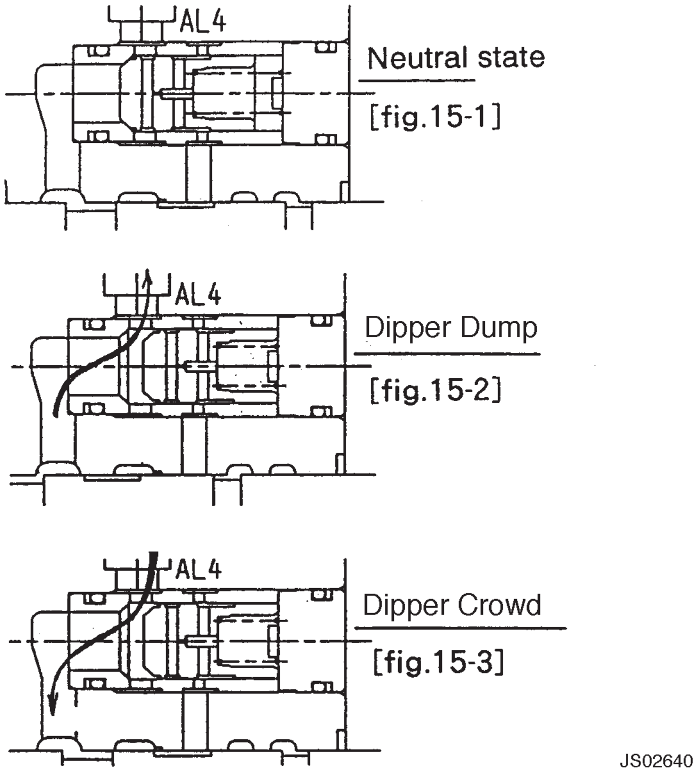
P	Poppet	**E**	Throttle
A	Filter	**F**	Spring
B	Poppet		
C	Spring Cavity		
D	Piston		

(fig. 14-4)

*** Load Holding Valve : Boom (fig. 14)**

Operation *(continued)*

*



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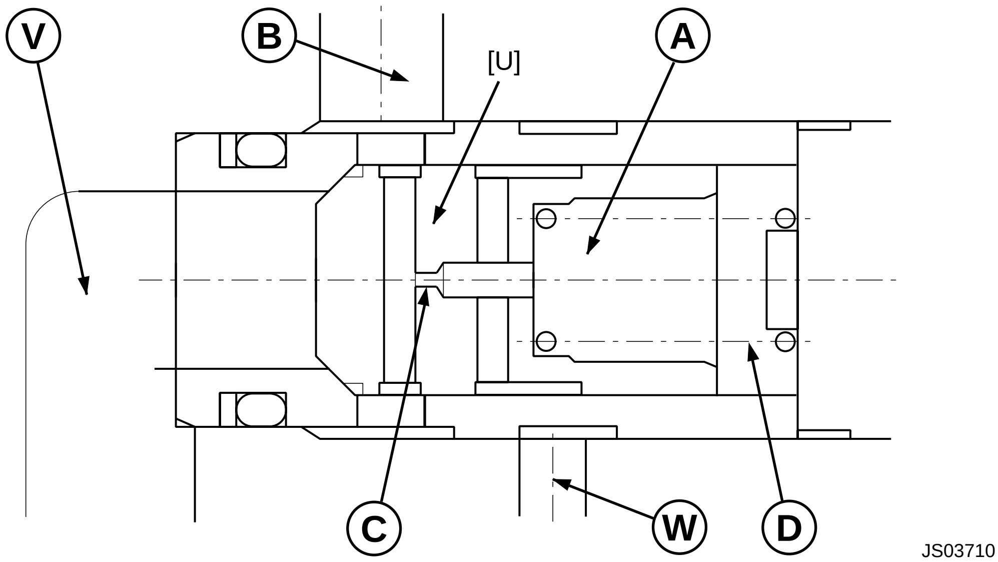
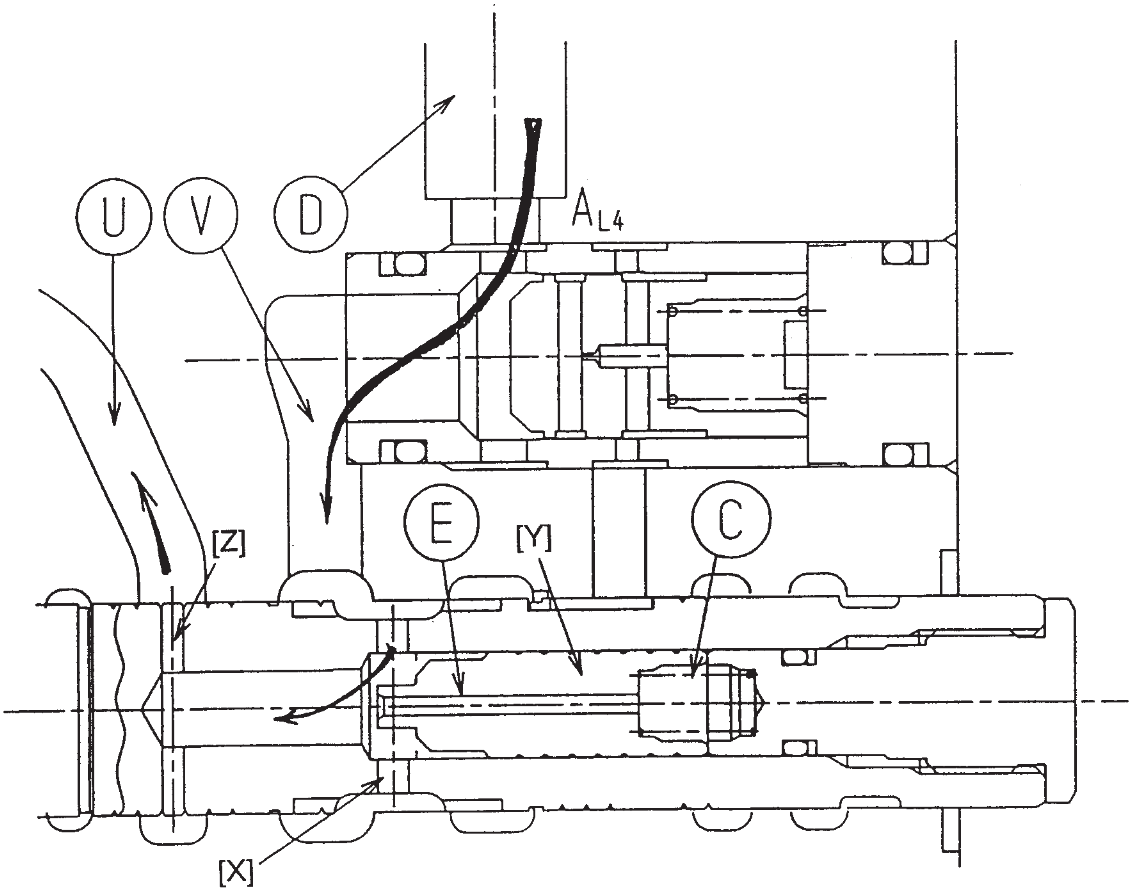


(U) Poppet
A Spring Cavity
B Ram port passage
C Throttle
D Spring
E Passage
F Passage

(fig. 15-4)

*** Load Holding Valve : Dipper (fig. 15)**

Operation *(continued)*



[Y] : Regenerative poppet
[X] : Spool inner passage
[Z] : Throttle
C : Spring
D : Cylinder Port
E : Popper inner passage
U : Passage
V : Passage

Regenerative Circuit [Arm: Cloud] [fig.16]

Control Valve Trouble Shooting

Control Valve in General

Symptoms	Possible Causes	Countermeasures
Spool sticking	1. Oil temperature is abnormally high.	Remove the obstruction.
	2. Hydraulic oil is dirty	Replace the hydraulic oil and clean the circuit at the same time.
	3. Port connector is tightened too much	Check the torque.
	4. Valve housing is deformed due to Installation	Loosen the installation bolt and check.
	5. Pressure is too high	Attach pressure gauge to pump port and ram port and check the pressure.
	6. Spool is bent	Replace the valve assembly.
	7. Return spring is damaged	Replace the damaged parts.
	8. Spring or cap is not on straight	Loosen the cap and after aligning, tighten.
	9. Temperature inside valve is not even.	Warm up the circuit.
Spool does not stroke	1. Valve is clogged inside with dirt	Remove the dirt (flushing).
Load cannot be maintained	1. Oil leakage from the ram	Check the ram.
	2. Oil is by-passing from the valve spool	Replace the valve assembly.
	3. Oil leakage from the port relief valve	Remove the port relief from the housing and clean the housing seat and relief valve seat.
	4. Oil leakage from the lock valve	Disassemble the lock valve and clean the poppet seat and sleeve, plug seat. If the seat is damaged, replace the poppet, or lap the poppet and seat.
When the spool is selected from neutral to raise position, the load falls.	1. Foreign matter in load check valve	Disassemble the check valve and clean.
	2. Check valve poppet or seat damaged	Replace the poppet or lap the poppet and seat part.

Control Valve Trouble Shooting *(continued)*

Relief Valve

Symptoms	Possible Causes	Countermeasures
Pressure does not rise at all	1. The main poppet, sleeve or pilot poppets are sticking open or foreign matter is in the valve seat.	Check whether foreign matter is in each poppet. Check whether each part is sliding smoothly. Clean all the parts.
Relief pressure is unstable	1. The pilot poppet seat is damaged.	Replace the damaged parts.
	2. The piston is sticking to the main poppet.	Remove the surface scratches. Clean all the parts.
Relief pressure is out of control	1. Wear due to foreign matter.	Replace the worn parts
	2. Lock nut and adjuster are loose.	Reset the pressure and tighten the lock nut to the rated torque.
Oil leakage	1. Damaged seat or worn O-ring.	Replace damaged or worn parts. Check whether each part is sliding smoothly.
	2. Parts are sticking due to foreign matter.	Check for scratches, cuts or foreign matter. Clean all the parts.

Hydraulic System

Symptoms	Possible Causes	Countermeasures
The hydraulic system is not working well or not at all	1. Pump problem.	Check the pressure or replace the pump.
	2. Foreign matter clogging inside the relief valve.	Disassemble the relief valve and clean.
	3. Relief valve trouble.	Check according to the maintenance procedures.
	4. Ram trouble.	Repair or replace.
	5. Load is too heavy.	Check the circuit pressure.
	6. Crack in the valve.	Replace the valve assembly.
	7. Spool does not stroke fully.	Check the spool movement and operation link.
	8. Oil level too low.	Replenish hydraulic oil.
	9. Filters inside circuit are clogged.	Clean filter or replace.
	10. Hose runs are kinked.	Check the hoses.

These procedures refer to the sectional drawings at the beginning of this section.

Dismantling

Notes:

1. All parts are manufactured with a high degree of precision and require the utmost care when handling. Do not let parts knock against each other and take extra precautions when handling parts to prevent them being dropped.

2. During dismantling, do not hit parts with excessive force if they are stuck and do not damage parts by twisting them or making burrs on bearing surfaces. Failure to follow these instructions will cause oil leaks leading to poor performance.

3. Label all parts during dismantling to ensure correct assembly.

4. Storing of the control valve in a dismantled or partly dismantled state could cause rusting of parts due to moisture or dirt. If the dismantling procedure must be interrupted, be sure to provide anti-rust treatment and keep the parts free from dirt and corrosion.

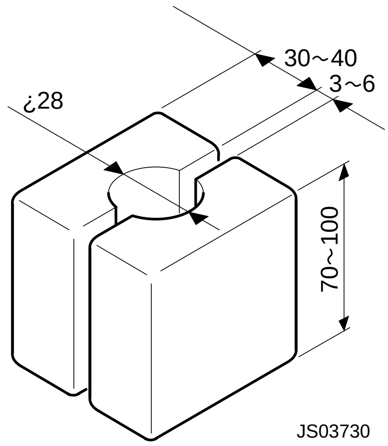
5. During assembly ensure that all parts are free from dirt and foreign matter and make sure that all parts are free from burrs and scratches. Remove minor burrs and scratches using and oil stone.

6. Use new 'O' rings and back-up rings.

7. During assembly, apply grease to 'O' rings.

8. Tighten all bolts to the quoted tightening torque.

9. Refer to the Control Valve Schematics when dismantling and assembly.



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* Dismantling, 5-spool control valve section

1. Loosen and remove the socket head bolts 58, 59 of the caps 11, 14.
Be careful that the 'O'-ring 7 15 does not fall off, and remove the bolts from the cap.

2. Pull out spools 2, 3, 4, 5, 6 from the valve housing 1 in the sub-assembly state.

3. Because each spool end has adhesive coating on the thread portion, heat the spool outer periphery at the threaded section to about 200~250 °C and loosen the spool end, plugs, etc. immediately after heating.

4. In order not to damage the spool periphery, insert the spool between hard wooden blocks shown above and fix in a vice during work.

5. Heat the spool 2 and remove the plug 16 (hexagonal A/F 24) and take out the spring 19 and poppet 20 from inside the spool.

6. Do not reuse the 'O'-ring 17 because heating was used during disassembly.

7. Heat spools 3, 4, 5, 6 and loosen the spool end 10 (Hexagonal A/F 22). Disassemble the spring seat 8 and springs 9, 68.

8. Attach tags to the springs 9, 68 and each spool to ensure correct assembly position and direction during reassembly.

9. Heat the spool 3 and remove the plug 19 (Hexagonal 24 A/F). Take out the spring 22 and poppet 23 from inside the spool and remove the 'O'-ring 21 and backup ring 20.

10. Do not reuse the 'O'-ring 21 and backup ring 20 because heating was used during disassembly.

11. Take out the spool 7 and spring seat 9 from the valve housing 1.

12. Take out the plug 35 (M10) from the valve housing and remove the 'O'-ring 37 and backup ring 36. Be careful not to lose the poppet 58.

13. Take out the spacer assembly 55, spring 38, poppet 39 and sleeve 40 from the valve housing and remove the 'O'-ring 41 and backup ring 42.

14. Remove the check valve assembly 32 (Hexagonal 36 A/F).

15. Take out the sleeve 33, spring 26 and poppet 25 from the valve housing 1.

16. Loosen the plug 43 (Hexagonal 27 A/F) and remove the 'O'-ring 44, spring 45 and poppet 46.

17. Loosen the plug 30 (Hexagonal 27 A/F) and remove the 'O'-ring 29, spring 22 and poppet 27.

Dismantling *(continued)*

18. Remove the main relief valve 13 (Hexagonal 32 A/F) from the valve housing.

19. Remove the port relief valve 31 (Hexagonal 31.5 A/F) from the valve housing.

20. Remove the negative control relief valve 24 (Hexagonal 36 A/F) from the valve housing.

21. If possible, do not disassemble the relief valve. Refer to Relief Valve dismantling and assembly.

22. The blind plugs 12 (Hexagonal 22 A/F) and 53 (Hexagonal 36 A/F) should not be disassembled unless there is a defect.

23. 52 (Hexagonal socket 5 A/F) is attached to the taper screw plug so do not disassemble unless necessary.

24. Remove plug 74 (M6) and remove the 'O'-ring 75 and backup ring 76.

25. Remove plug 56 (M6) and remove the 'O'-ring 54 and backup ring 55, then disassemble the spring 53, poppet 52, sleeve 51, backup ring 49 and 'O'-ring 50.

26. Loosen bolt 40 (Hexagonal 36 A/F) and separate the washer 39, plate 41 and 'O'-ring 38.

27. Loosen plug 65 (Hexagonal 36 A/F) and remove the 'O'-ring 66.

28. Loosen the socket head bolt 72 (Hexagonal 8 A/F) and remove the flanges 70, 71. Disassemble the sleeve 29, 46, poppet 32, 44, 47 and spring ring 31, 43, 48. Remove the 'O'-ring.

29. Loosen plug 21 (Hexagonal 27 A/F) and disassemble the 'O'-ring 22, spring 23 and poppet 24.

30. Loosen plug 26 (Hexagonal 27 A/F) and disassemble the 'O'-ring 25, spring 27 and poppet 28.

31. Remove the plug assembly 36 (Hexagonal 27 A/F).

32. Remove the relief valve 45 (Hexagonal 31.5 A/F) from the valve housing. Do not disassemble the relief valve unless necessary.

33. The blind plugs 13 (Hexagonal 31.5 A/F), 34 (Hexagonal socket 6 A/F), 37 (Hexagonal 31.5 A/F), 67 (Hexagonal 19 A/F), 78 (Hexagonal socket 10 A/F) should not be disassembled unless there is some defect.

34. 35 (Hexagonal socket 5 A/F) is attached to the taper screw plug and should not be disassembled unless there is some defect.

35. If possible, the 5-spool side valve housing and 4-spool side valve housing should not be separated.

36. Loosen the socket head bolt (Hexagonal 14 A/F) and remove the 'O'-rings 18, 61, 62, 63, 64.

* Dismantling, 4-spool control valve section

1. Loosen plug 49 and take out piston 51, 56 and spring). Remove 'O'-ring 50.

2. Loosen and remove the socket head bolt 47, 48 (Hexagonal socket 8 A/F) of the cap 2, 14. At this time be careful not to drop the 'O'-rings 10, 18 and spring 8 when removing from the cap.

3. Pull out the spool 3, 4, 5, 6 as a sub-assembly from the valve housing 1.

4. Heat the spool 3, 4, 5, 6 and loosen the spool end 15 (Hexagonal 22 A/F). Disassemble the spring seat 16 and spring 17.

5. Attach tags to the spring and each spool to insure the correct direction and position when reassembling.

* Assembly

Note:

1. During assembly, be careful when handling the 'O'-rings as follows.

a. Check for defects due to improper handling or from manufacturing.

b. Apply grease to the 'O'-ring and to the area where it is fitted.

c. Do not pull the 'O'-ring so hard that its shape is permanently changed.

d. Do not install the 'O'-ring in a twisted state. (It is difficult to return a twisted 'O'-ring to its original state and this can be the cause of oil leakage).

2. Be careful when handling the spools and check the following.

a. Excessive torque causes defective operation of the spool so observe the set torque.

b. Be sure that each spring and spool are reassembled in the original state.

3. Applying adhesives. (Male and female screw parts requiring adhesive).

a. Cleansing (Degreasing)
Steam degrease with acetate or use alkaline cleansing agent. Do not use gasoline or kerosene as cleansers.

b. Drying
Blow with clean air or dry naturally and dry the adhesive surface. If not dried sufficiently, the adhesion effect diminishes.

c. Primer application
Spray (Loctite Primer T), hardening agent, lightly on the adhesion surface and wait 3~5 minutes for it to dry.

b. Applying adhesive
Apply a small amount to the spool end and 2~3 threads of the plug male screw. Be careful that this surface does not come into contact with the spring seat when installing.

* Assembly, 5-spool control valve section

1. Assemble the poppet 20 and spring 19 into the spool 2. After completely degreasing the screw part of the plug (Hexagonal 24 A/F) 16 which has the 'O'-ring 17 and backup ring 18 attached (degrease the spool side too), apply adhesive (Loctite 271 or equivalent) and screw in the spool, with a torque of 9.8-12Nm (7.23-8.67lb/ft).

2. Assemble the spring seat 8 and spring 9, 68 in the spool end 10 (Hexagonal 22 A/F), apply adhesive to the thread and screw into the spool 3, 4, 5, 6 with a torque of 9.8-12Nm(7.23-8.67 lb/ft).

3. Install the spool assembly into the valve housing 1 in the same position and direction as when disassembling.

4. Assemble the sleeve 51 fitted with the 'O'-ring 50 and backup ring 49 into the valve housing, assemble the poppet 52 and spring 53 and push in the plug 56 complete with the 'O'-ring 54 and backup ring 55 (Check direction of plug 56).

5. Fit the cap 11, 14 with 'O'-rings 7, 15 fitted and tighten socket head bolts (Hexagonal socket 8 A/F) to the valve housing, with a torque of 39-44 Nm(28.93-32.53 lb/ft).

6. Install the port relief valve 45 (Hexagonal 31.5 A/F) to the valve housing, with a torque of 78-88 Nm (57.84-65.07 lb/ft).

7. Install the plug assembly 36 (Hexagonal 27 A/F), with a torque of 59-69 Nm (43.38-50.61 lb/ft).

8. Assemble the poppet 24, spring 23 into the valve assembly and install the 'O'-ring 22 to the plug 21 (Hexagonal 27 A/F) and screw it in, with a torque of 83-93 Nm (61.45-68.68 lb/ft).

9. Assemble the poppet 28 and spring 27 into the valve assembly and install the 'O'-ring 25 to the plug 26 (Hexagonal 27 A/F) and screw it in, with a torque of 267-275 Nm (195.21-202.44 lb/ft).

10. Assemble the poppet 28 and spring 31 to the sleeve 46 and assemble to the valve assembly. Install the poppet 47 and spring 48. Assemble the sleeve 29, poppet 44 and spring 43 with the flange 70 71 and tighten with socket head bolt 72 (Hexagonal socket 8 A/F), with a torque of 57-65 Nm (41.93-47.71 lb/ft).

11. Install the 'O'-ring 66 to the plug 65 (Hexagonal 36 A/F) and screw it in, with a torque of 118-127 Nm (86.76-93.99 lb/ft).

12. Assemble the spring and piston 51 56 to the cap 2 and tighten the plug 49 (Hexagonal 38 A/F) with 'O'-ring 50 fitted, with a torque of 93-108 Nm (68.68-79.53 lb/ft).

* Assembly, 5-spool control valve section *(continued)*

* **13.** Install the main relief valve 13 (Hexagonal 31.5 A/F) to the valve housing, with a torque of 78-88 Nm (57.84-65.07 lb/ft).

* **14.** Install the port relief valve 31 (Hexagonal 31.5 A/F) to the valve housing, with a torque of 78-88 Nm (57.84-65.07 lb/ft).

15. Install the negative control relief valve 24 (Hexagonal 36 A/F) to the valve housing, with a torque of 88-98 Nm (65.07-72.3 lb/ft).

16. Screw in the plug 53 (Hexagonal 36 A/F) with the 'O'-ring 54 fitted, with a torque of 83-93 Nm (61.45-68.68 lb/ft).

17. Assemble the poppet 25, spring 26 to the sleeve 3 and assemble in the valve housing.

18. Install the check valve assembly 32 (Hexagonal 36 A/F), with a torque of 265-275 Nm (195.21-202.44 lb/ft).

19. Assemble the poppet 27 and spring 22 into the valve housing and install the 'O'-ring 29 to the plug 30 (Hexagonal 27 A/F). Screw in, with a torque of 83-93 Nm (61.45-68.68 lb/ft).

20. Assemble the poppet 46 and spring 45 to the valve housing. Install the 'O'-ring 44 to the plug 43 (Hexagonal 27 A/F) and screw in.
If the plug 12 (Hexagonal 22 A/F) is disassembled, install the 'O'-ring 11 and tighten, with a torque of 49-59 Nm (36.15-43.38 lb/ft).

21. If the plug 53 (Hexagonal 36 A/F) is disassembled, install the 'O'-ring 54 and tighten, with a torque of 83-93 Nm (61.45-68.68 lb/ft).

22. If the plug 52 (Hexagonal socket 5 A/F) is disassembled, wrap seal tape around the plug periphery (leave one thread open from the end and wrap to the right 1.5~2 times so that the tape bites into the threads). Tighten, with a torque of 6.85-8.82 Nm (5.06-6.5 lb/ft).

23. Check for any disassembled parts not reassembled and then tighten.
The above tightening torque values are for the threads lubricated with hydraulic oil.

24. Install ‘O’-ring 38 in the valve housing and fit plate 41. Secure with bolt 40 (Hexagonal 14 A/F) and washer 38 tightened to a torque of 39-44 Nm (28.92-32.53 lb/ft).

25. If the plugs are disassembled, assemble as follows.

Plug (Hexagonal A/F) No.	'O'-ring No.	Tightening Torque Nm
12 (22)...	13.........................	49~59 Nm (36.15-43.38 lb/ft)
34 (Hexagonal socket 6 A/F).............	33.........................	34~39 Nm (25.3-28.92 lb/ft)
67 (19)...	33.........................	34~39 Nm (25.3-28.92 lb/ft)
78 (Hexagonal socket 10 A/F)	77.........................	88~98 Nm (65.07-72. lb/ft)
37 (31.5) Assembly replacement......................................		78~88 Nm (57.84-65 lb/ft)

26. When assembling the plug 35 (Hexagonal socket 5 A/F), wrap seal tape around the plug periphery (leave open one thread from the end and wrap 1.5~2 times to the right so that the seal tape bites into the thread), torque the plug with a force of 6.85-8.82 Nm (5.06-6.5 lb/ft).

27. Recheck for parts not reassembled and tightened.

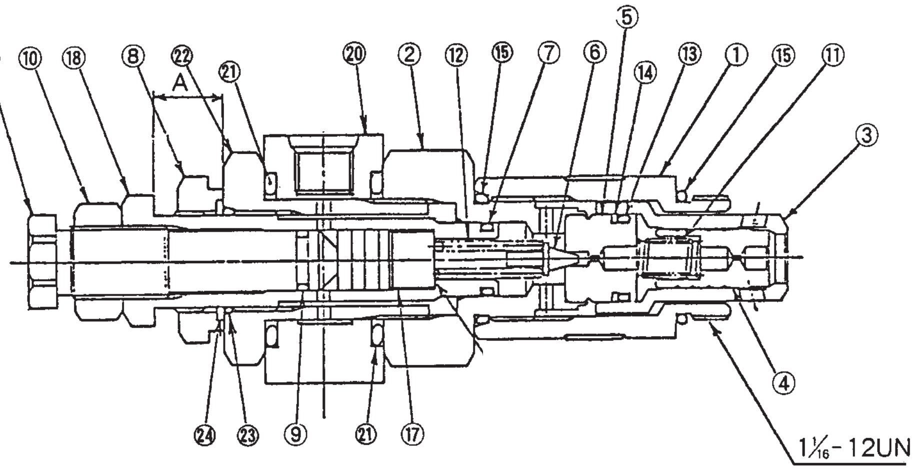
28. When assembling the 4-spool side and 5-spool side valves, attach the 'O'-rings 18, 62, 61, 63 to the bottom of the 5-spool side valve (21153-50103, 21153-50104) and secure with socket head bolts 3, tightening to a torque of 170-180 Nm (122.91-130.14 lb/ft).

* Assembly, 4-spool control valve section

1. Assemble the poppet 23 and spring 22 into the spool 3. After completely degreasing the thread part (and the spool side) of the plug 19 (Hexagonal 22 A/F), fit the 'O'-ring 21 and backup ring 20 attached, apply adhesive and screw into the spool, with a torque of 9.8-12 Nm (7.23-8.67 lb/ft).
2. Assemble the spring seat 16 and spring 17 to the spool end 3 (Hexagonal 22 A/F). Apply adhesive to the thread and screw into the spool 4, 5, 6, to a torque of 9.8-12 Nm (7.23-8.67 lb/ft).
3. Assemble the spool assembly into the valve housing 1 at the same position and direction as before.
4. Assemble the sleeve 40 with the 'O'-ring 41 and backup ring 42 attached and assemble the poppet 39, spring 38, and spacer assembly 55 and attach the 'O'-ring 37 and backup ring 36 to the plug 35 and assemble into the valve housing.
5. Assemble the spool 7 into the valve housing and install the spring seat 9 and spring 8.
6. Tighten the caps 2, 14 with 'O'-rings 10, 18 attached, with socket head bolts 47, 48 (Hexagonal socket 8 A/F) to the valve housing.
7. Assemble the spring and piston 51, 56 to the cap 2 and tighten the plug 49 (Hexagonal 38 A/F), with 'O'-ring 50 attached, to a torque of 93-108 Nm (68.68-70.53 lb/ft).
8. Install the main relief valve 13 (Hexagonal 31.5 A/F) to the valve housing, with a torque of 78-88 Nm (57.84-65.07 lb/ft).
9. Install the port relief valve 31 (Hexagonal 31.5 A/F) to the valve housing, with a torque of 78-88 Nm (57.84-65.07 lb/ft).
10. Install the negative control relief valve 24 (Hexagonal 36 A/F) to the valve housing, tightening to a torque of 88-98 Nm (65.07-72.3 lb/ft).
11. Screw in the plug 53 (Hexagonal 36 A/F) with the 'O'-ring 54 assembled, with a torque of 83-93 Nm (61.45-68.68.lb/ft).
12. Assemble the poppet 25, spring 26 to the sleeve 3 and assemble in the valve housing.
13. Install the check valve assembly 32 (Hexagonal 36 A/F), with a torque of 265-275 Nm (195.21-202.44 lb/ft).
14. Assemble the poppet 27 and spring 22 into the valve housing and install the 'O'-ring 29 to the plug 30 (Hexagonal 27 A/F) and fasten with torque of 83-93 Nm (61.45-68.68 lb/ft).
15. Assemble the poppet 46, spring 45 to the valve housing and install the 'O'-ring 44 to the plug 43 (Hexagonal 27 A/F) and screw in.
    * If the plug 12 (Hexagonal 22 A/F) is disassembled, install the 'O'-ring 11 and tighten, to a torque of 49-59 Nm (36.15-43.38 lb/ft).
16. If the plug 53 (Hexagonal 36 A/F) is disassembled, install the 'O'-ring 54 and tighten, to a torque of 83-93 Nm (61.45-68.68 lb/ft).
17. If the plug 52 (Hexagonal socket 5 A/F) is disassembled, wrap seal tape around the plug periphery (leave one thread open from the end and wrap to the right 1.5~2 times so that the tape bites into the threads) and tighten, to a torque of 6.85-8.82 (5.06-6.5 lb/ft).
18. Check for any disassembled parts not reassembled and tightened.
    The above tightening torque values are for threads lubricated with hydraulic oil).

Dismantling

Loosen the cap 1 (Hexagonal 31.5 A/F) and remove from plug 2. Remove the sleeve 3 and take out the main poppet 4 and spring 11.
Loosen hexagonal nut 10 (Hexagonal 22 A/F) and remove plug 19 (Hexagonal 19 A/F), piston 17, pilot poppet 6 and spring 12.
Loosen the nut 8 (Hexagonal 32 A/F) and remove the plug 18 (Hexagonal 26 A/F). Loosen the plug (Hexagonal 41 A/F) and remove the spacer 20.
The pilot seat 5 is firmly installed at the plug 2 end so do not disassemble it.



Cleaning, Inspection

Clean all the parts with clean oil and dry with compressed air. Inspect each part.

1. Check that the seat face of each poppet and sleeve end has no defects and even surface.

2. Check that the main poppet 3, sleeve 2, piston 19 and plug 17 slide smoothly.

3. Check that the springs have no defects, deformation or wear.

4. Check that there is no foreign matter clogging the main poppet, pilot seat orifice.

5. Check that the 'O'-ring and backup ring are not worn or deformed.

If a slight defect is found during the above inspection, remove by lapping.

If an abnormal part is found, replace the relief valve assembly.

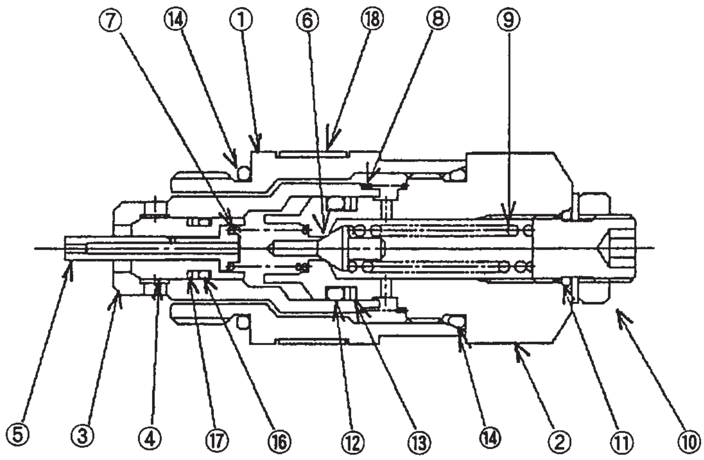
Assembly

Insert the main poppet 4 and spring 11 inside the sleeve 3 and secure with the pilot seat 5 which has 'O'-ring 13 and backup ring 14 assembled to it. (Be careful of the assembly position of 13, 14).
Assemble the spacer 20 with the attached 'O'-ring 21 and the plug 2. (Tightening torque 78~88 N•m (57.84-65.07 lb/ft) [Lubricated state]).
Assemble the nut 8, 'O'-ring 7 and 'O'-ring 23 and backup ring 24 to the plug 18. Screw in plug 18 to plug 22 and insert pilot poppet 6, spring 12, piston 17. Fit 'O'-ring 9 and hexagonal nut 10 to plug 19 and temporarily assemble it.
Attach 'O'-ring 15 to plug 2 and tighten cap 1 with ring 15 installed to the valve housing (tightening torque 78~88 Nm (57.84-65.07 lb/ft). Adjust pressure, see "Main Relief Valve Pressure".

Do not reuse 'O'-rings or backup rings. Replace with new ones.

Dismantling

Remove the plug 2 and disassemble the sleeve 3, main poppet 4, piston 5 and springs 7, 8.
Loosen the adjuster nut 10 and take out the pilot poppet 6 and spring 9.



Cleaning, Inspection

Clean all the parts with clean oil and dry with compressed air. Inspect each part.

1. Check that there are no defects on the seat surface of each poppet and sleeve end and that the contact surface is even.

2. Check that the main poppet 4 and sleeve 3 slide smoothly. Also check there are no scratches on the main poppet outer periphery and sleeve inner surface.

3. Check that the springs are not broken, deformed or worn.

4. Check that there is no foreign matter clogging the piston 5 hole. The end seat contact surface should be even.

5. Check that the 'O'-ring and backup rings are not worn or deformed.

If a small defect is found in the above inspection, remove it by lapping.
If an abnormal part is found, replace the relief valve assembly.

Assembly

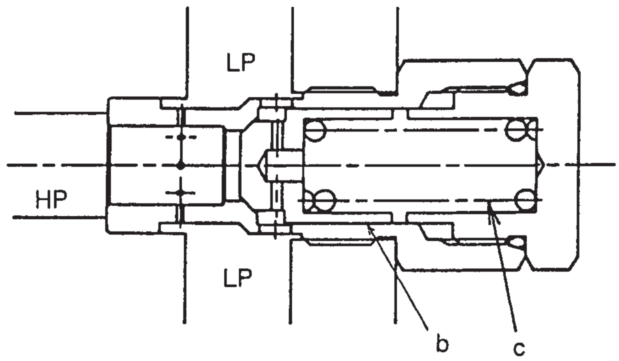
Install the 'O'-ring 16 and backup ring 17 (2 pcs) to the main poppet 4, assemble the piston 5 and insert into the sleeve 3.
After attaching 'O'-ring 12, backup ring 13 (2 pcs) and 'O'-ring 14 to the plug 2, assemble the sleeve 7, 8 mentioned above.
Tighten cap 1. (Torque 78~88 Nm) (57.84-65.07 lb/ft).
Insert the pilot poppet 6 and spring 9 into the plug 2 and temporarily assemble the adjuster nut 10 and 'O'-ring 11.
Attach 'O'-ring 14 to the cap 1 and assemble into the valve housing. Adjust pressure according to its application, see "Pressure Testing".

Do not reuse 'O'-rings and backup rings. Replace with new parts.

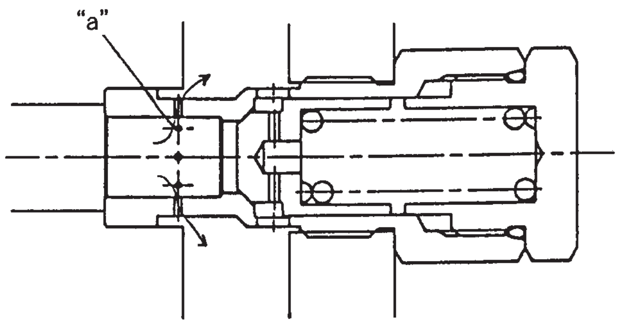
Operation

The negative control relief valve is situated between the neutral passage HP and low pressure passage LP and operates in the following manner.

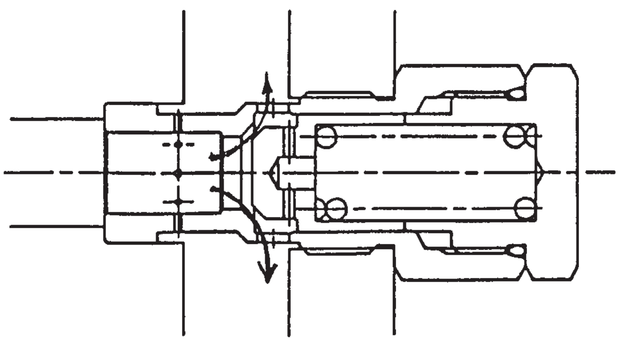
1. No passage of oil (Engine is stopped, spool at full stroke).



2. Spool is neutral (Negative control signal)
The oil from neutral passage HP flows through signal orifice "a" to the low pressure passage LP.
Pressure develops from signal orifice "a".

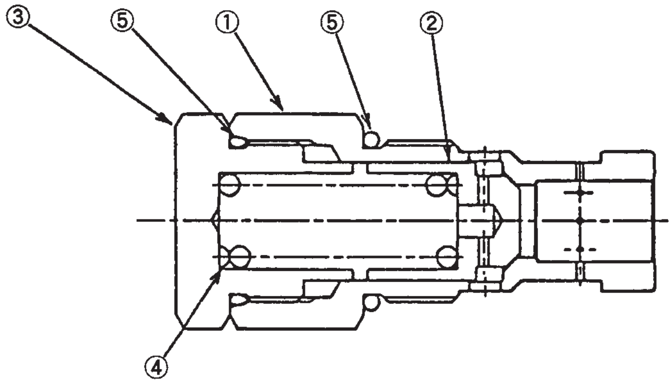


3. Low pressure relief operation
When an excessive amount of oil flows through neutral passage HP, it flows through the signal orifice and to the low pressure passage. At the same time poppet b, which is set by spring c, opens and HP flows to LP preventing the build up of abnormal pressure.



Dismantling

Remove plug 3 (Hexagonal 36 A/F) and remove spring 4 and poppet 2 from the plug 1 (Hexagonal 36 A/F). Keep the disassembled negative control relief parts in such a way that they can be assembled so as to achieve the same set relief pressure after reassembly.



Cleaning, Inspection

Clean all the parts with clean oil and dry with compressed air. Inspect each part.

1. Check that the poppet seat surface has no defects and that the contact surface is even.

2. Check that the poppet slides smoothly.

3. Check that the springs are not broken, deformed or worn.

4. Check that the 'O'-rings are not worn or deformed.

If a slight defect is found during the above inspection, remove it by lapping.

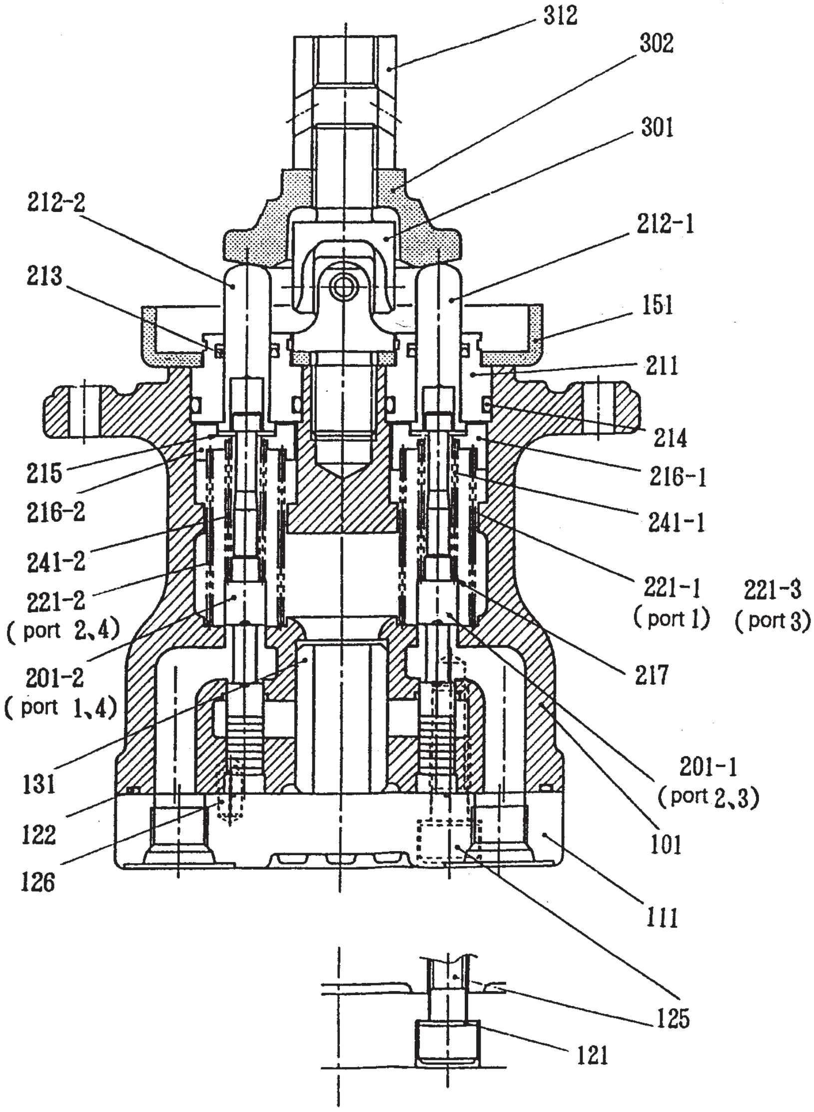
If an abnormal part is found, replace the relief valve assembly.

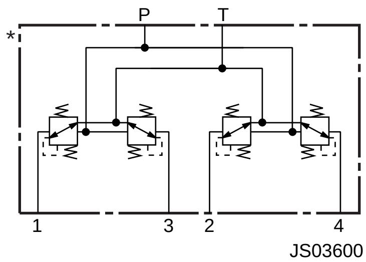
Assembly

Assemble the poppet 2 and spring 4 into the plug 1. Install the 'O'-ring 5 to the plug 3 and tighten at the plug 1. Torque 88~98 Nm (65.07-72.3 lb/ft).
Install the 'O'-ring 5 to the plug 1 and assemble to the valve housing.(Torque 88~98 Nm (65.07-72.3 lb/ft)

Do not reuse the 'O'-rings and backup rings but replace with new ones.

Schematics, Technical Data

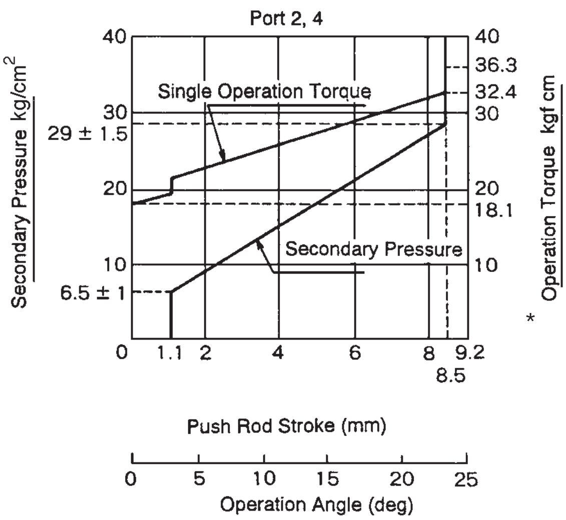




Symbol	Part Name	Qty	Symbol	Part Name	Qty	Symbol	Part Name	Qty
101	Case	1	211	Plug	4	221-2	Spring	2
111	Port plate	1	212-1	Push rod	2	221-3	Spring	1
121	Seal washer	2	212-2	Push rod	2	241-1	Spring	1
122	O-ring	1	213	Seal	4	241-2	Spring	1
125	Hexagonal socket bolt	2	214	O-ring	4	301	* Joint	1
126	Spring pin	1	215	Washer 1	8	302	* Disc	1
131	Bushing	1	216-1	Spring seat	2	312	* Adjusting Nut	1
151	Plate	1	216-2	Spring seat	2			
201-1	Spool	2	217	Washer 2	4		Seal kit 1 set	
201-2	Spool	2	221-1	Spring1			(121,122, 213, 214)	

Schematics, Technical Data

* Working pressure	40 kgf/cm^2 (38.6 bar, 568.9 lb/in^2)	
* Primary pressure	Max. 100 kgf/cm^2 (96.7 bar, 1422 lb/in^2)	
* Secondary pressure (differs for each machine type)	0~45 (maximum control pressure) kgf/cm^2 (0-43 bar, 639.2 lb/in^2)	
* Allowable back pressure	Max. 3 kgf/cm^2 (2.89 bar, 42.6 lb/in^2)	
Flow rate	20 l/m (4.39 imp gal)	
Control operation angles	Single handle	Alone ±19°
	Simultaneous	±25°
	Double handle	±26.5°
Weight	Single handle	Approx. 4.6 kg (2.08lb)
	Double handle	6 kg (2.72lb)



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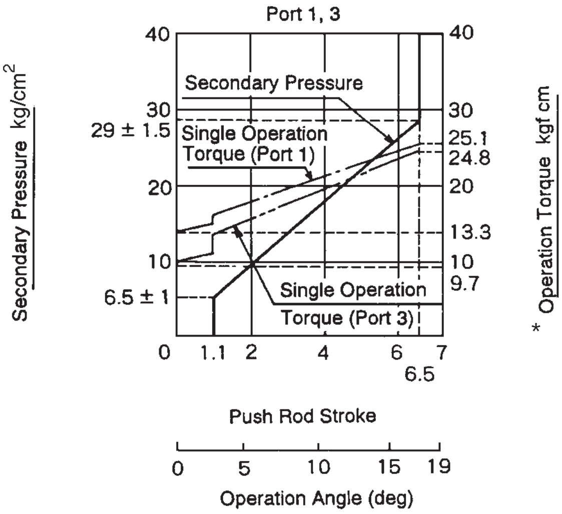

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JS02610

Operation

The structure of the pilot valve is shown in the assembly drawings (see previous page). The pressure reduction valve unit is built into the vertical bore in the casing.
The pressure reduction unit consists of the spools (201), secondary pressure setting springs (241), return springs (221), washers 1 (215), spring seats (216) and washers 2 (217). The secondary pressure setting springs are set to give a secondary pressure of 5~24 kgf/cm 2 (depending on the model). The spools are pressed against the push rods (212) by the return springs. When the handle is tilted, the push rods are forced down, pushing down the spring seats, to adjust the setting of the secondary pressure setting springs. An oil inlet (primary) port P and oil outlet (tank) port T are provided in the casing. In addition, secondary outlet ports 1,2,3 and 4 are situated on the lower surface of the casing.

Basic Functions

The pilot valve controls the stroke and direction, etc. of the control valve spool. This is achieved by providing a spring at one end of the control valve spool and applying the output pressure of the pilot valve to the other end. (There is also the method where the pilot valve output pressure is used on both ends of the control valve).
In order to provide this function, the pilot valve consists of the following:

1. Inlet port (P) which is supplied with oil from the pump.

2. A number of outlet ports (1,2,3,4) to supply the pressure from the inlet port to control valve spools.

3. Tank port (T), required to control the pressure output from 2.

4. Spools to connect the outlet ports to the inlet port and tank port.

5. Mechanism, including springs, to control the spools in 4 above.

Functions of the Major Parts

Oil supplied by the hydraulic pump is received by P port and the function of the spool (201) is to switch the pressurised oil from the inlet port P to the output port (1, 2, 3, 4) or alternatively, from the output port to the tank port (T). The springs (241) act on the spools and determine each outlet pressure. The push rods (212) are able to slide in the plugs (211) to adjust the compression of the springs. The handle acts through the disk (302) and adjusting nut (312) to move the push rods. The handle is able to rotate a full circle around the joint (301).
The springs (221) operate against the casing (101) and the spring seats (216) act, regardless of the outlet pressure, to return the push rods to their natural position, thus ensuring that the spools return to their neutral position. This spring also provides a resistive force which gives the controls a suitable "feel" to the operator.

Dismantling

Notes:

1. All parts are manufactured with a high degree of precision and require the utmost care when handling. Do not let parts knock against each other and take extra precautions when handling parts to prevent them being dropped.

2. During dismantling, do not hit parts with excessive force if they are stuck and do not damage parts by twisting them or making burrs on bearing surfaces. Failure to follow these instructions will cause oil leaks leading to poor performance.

3. Label all parts during dismantling to ensure correct assembly.

4. Storing of the control valve in a dismantled or partly dismantled state could cause rusting of parts due to moisture or dirt. If the dismantling procedure must be interrupted, be sure to provide anti-rust treatment and keep the parts free from dirt and corrosion.

5. During assembly ensure that all parts are free from dirt and foreign matter and make sure that all parts are free from burrs and scratches. Remove minor burrs and scratches using an oil stone.

6. Use new 'O'-rings and backup rings.

7. During assembly, apply grease to 'O'-rings.

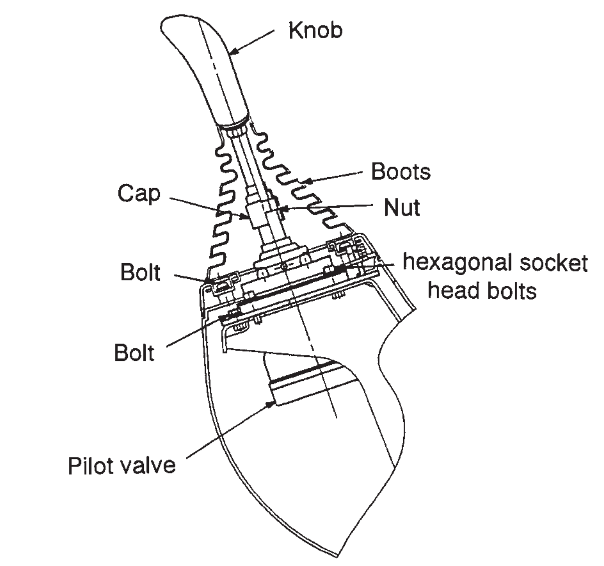
8. Tighten all bolts to the quoted tightening torque.

---

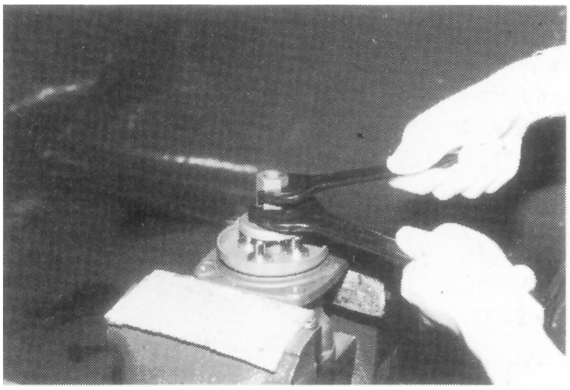
1. Remove knob from pilot valve.
Note: *Take care when removing the pilot valve because of the wiring loom.*

2. Remove the boots (cover) from the pilot valve.

3. Remove the piping. *(Attach tags to the connecting ends of the piping to facilitate reassembly)*.



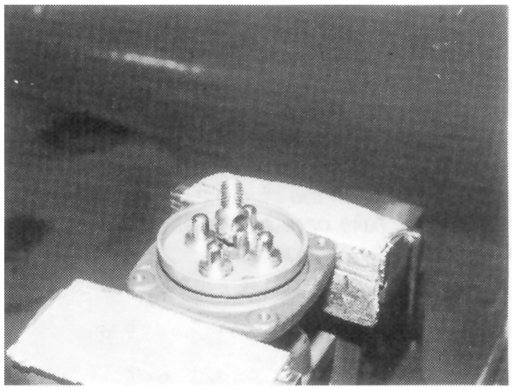
Dismantling *(continued)*



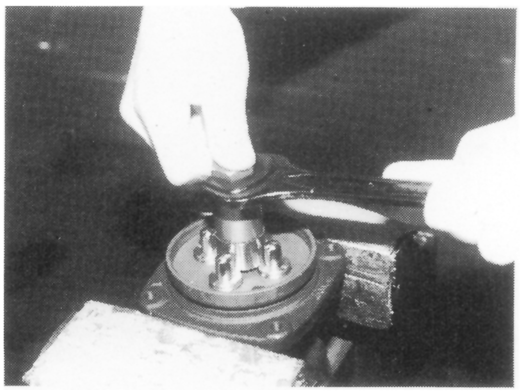
4. Wash the pilot valve (by itself) with kerosene.
Note: *Blank off the parts with plugs.*

5. Using a copper or lead plate for protection, secure the pivot valve in the vice.

6. Put spanners on the adjusting nut (312) and the flats of the disk (302) and remove them



7. Turn the joint to the left using a jig and loosen it. The jig is shown in position in the photograph.
(If the return springs (221) are strong, the plate (151), plug (211), push rod (212) will rise up when the joint is loosened.

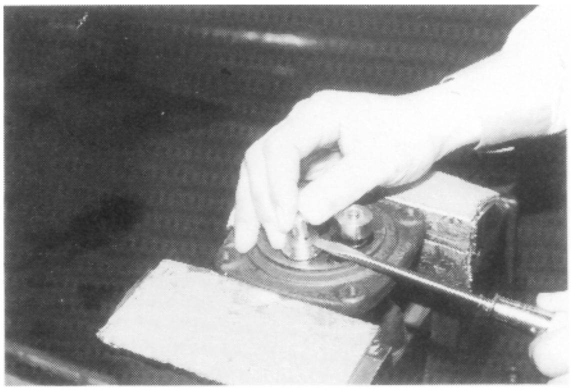


Dismantling *(continued)*

8. Remove the Plate (151)

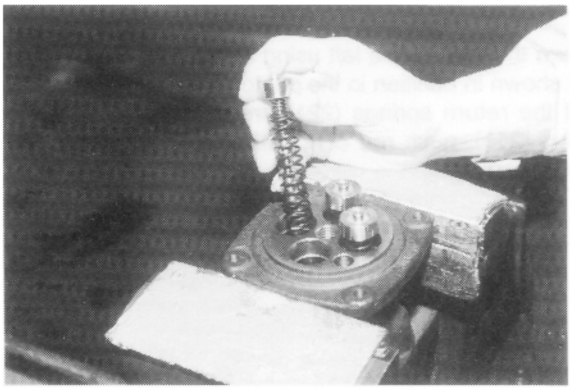
9. If the return springs (221) are weak, the sliding resistance of the 'O'-ring causes the plugs (211) to stick in the casing. In this case, remove the plugs with a straight-headed screwdriver.

Note: *Use the groove in the plug periphery, taking care not to damage the plug. Take care as the plugs may fly out due to the force in the return springs (221).*



10. Remove the pressure reduction assembly return springs (221) from the casing.

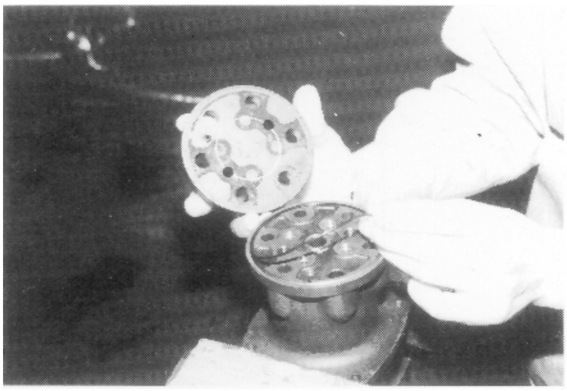
Note: *Make a note of the relationship of positions of the pressure reduction assembly and the hole in the casing to facilitate reassembly. (When reassembling, install in the same position as that before disassembly).*



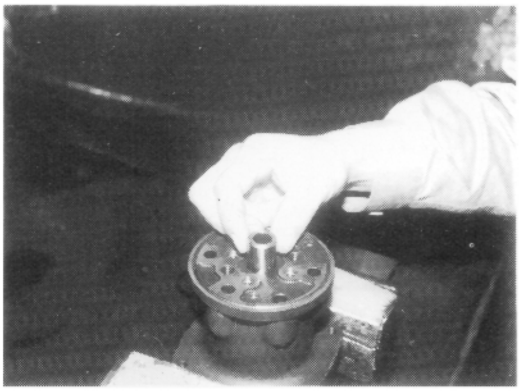
11. Loosen and remove the hexagonal socket head bolts (125) with an Allen wrench.

Dismantling *(continued)*

12. Remove the port plate (111) and 'O'-ring (122) from the casing.

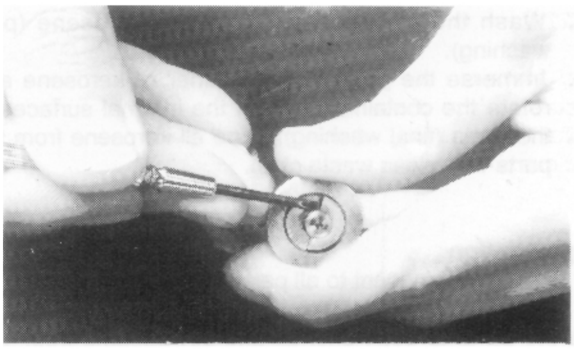


13. Remove the bushing (131) from the casing.



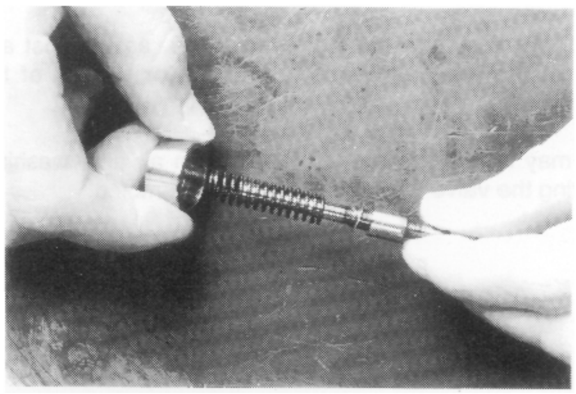
14. To disassemble the pressure reduction assembly, stand the spool (201) on a level work bench, pull the spring seat (216) down and remove the two semicircular washers 1 (215) with a small screwdriver.

Note: *Take care not to scratch the surface of the spool. Do not pull down the spring seat by more than 6 mm.*



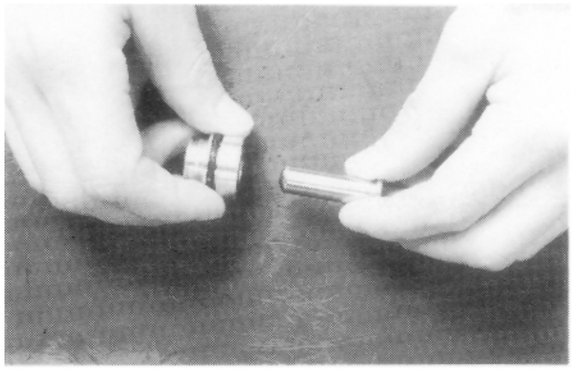
15. Separate the spool (201), spring seat (216), spring (241) and washer 2 (217).

Note: *Keep the parts of the assembly together until reassembly.*



Dismantling *(continued)*

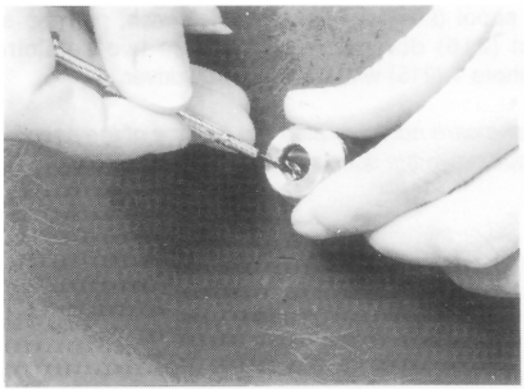
16. Remove the push rod (212) from the plug (211).



17. Remove the 'O'-ring (214) and the seal (213) from the plug (211). Use a small straight-headed screwdriver to remove the seal.

18. Wash all the parts

- **a.** Wash the parts in a container of kerosene (pre-washing).
- **b.** Immerse the parts in a container of kerosene and rotate the container to wash the internal surfaces of the parts (final washing). Wipe all kerosene from the parts with clean waste cloth.



Rust prevention

Apply rust-inhibiting agent to all parts.

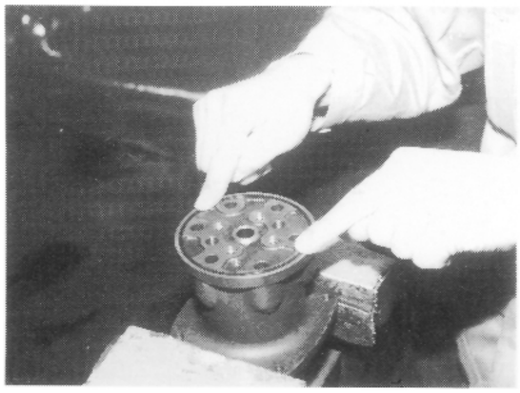
Leave the parts to soak until oil and dirt become free. The parts may be scratched if they are washed when dirty. Washing the parts in dirty kerosene may scratch the surfaces, impairing performance after reassembly. Make sure that the kerosene being used does not become too dirty.

Do not dry the parts with compressed air, as the dust and water in the air may cause scratching or rusting of the surfaces.

Parts may rust if they are left in the open air after washing, impairing the valve function after it is reassembled.

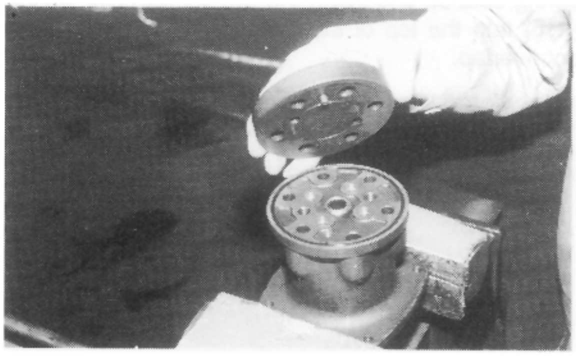
Assembly

1. Mount the bushing (131) and 'O'-ring (122) on the casing (101).



2. Attach the port plate with hexagonal socket head bolts (125) and seal washer (121) to the casing (101).

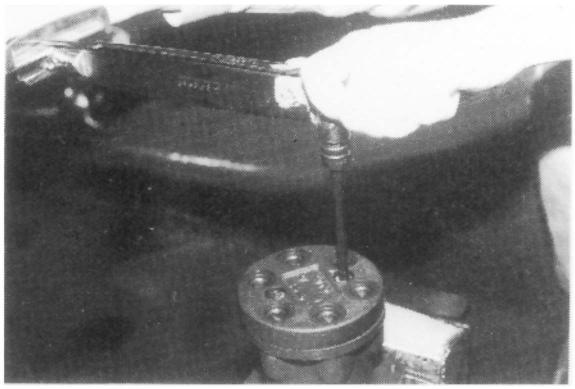
Note: *Align the plate so that the spring pins (126) enter the holes in the casing.*



Assembly *(continued)*

3. Tighten the hexagonal socket head bolts (125) to the specified torque. (300 kgf-cm).

Note: *Tighten the bolts alternately a little at a time until they are tightened to the specified torque.*



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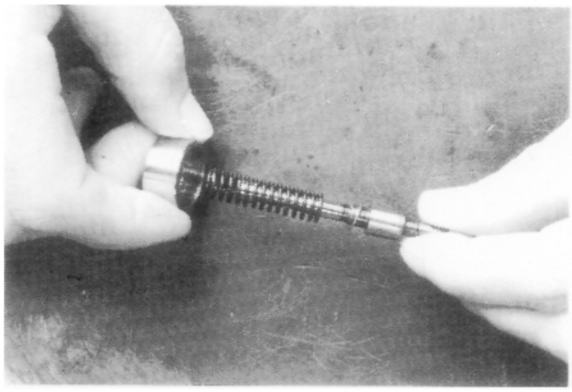
4. Mount the washers 2 (217), springs (241) and spring seats (216) in order onto the spools (201).



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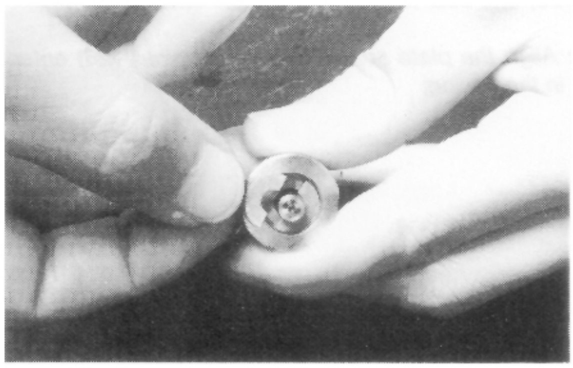
5. Stand each spool (201) on a level work bench, push the spring seat up and insert the two semicircular washers 1 (215) into the top of the spring seat, such that they do not overlap.

Note: *Install the washer 1 (215) so that its sharp edge side catches on the spool head.*

Do not pull down the spring seat by more than 6 mm.



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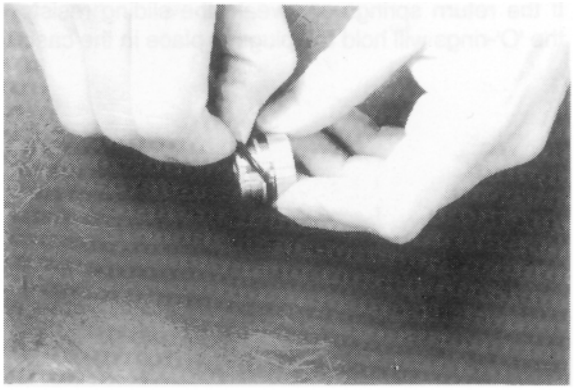
6. Mount the spring (221) into the case.

Mount the pressure reduction assembly into the casing.

Note: *Assemble them in the original positions before assembly.*

Assembly *(continued)*

7. Mount the 'O'-rings (214) into the plug (211).



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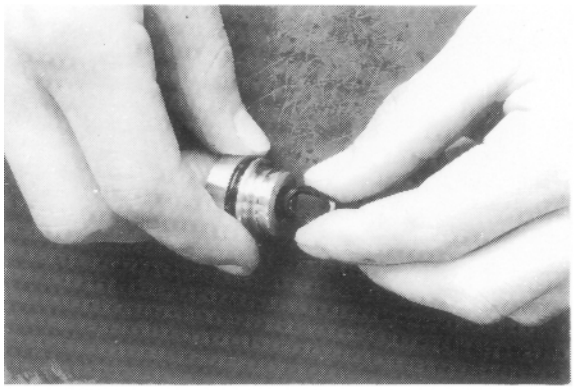
8. Mount the seals (213) into the plug (211).

Note: *Mount the seals so that the lips are as shown in the illustration.*



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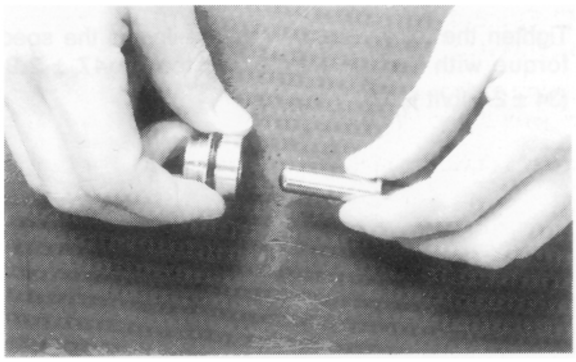
9. Mount the push rods (212) into the plug (211).

Note: *Apply hydraulic oil to the surfaces of the push rods.*



Assembly *(continued)*

10. Mount the plug assembly into the casing.
If the return springs are weak, the sliding resistance of the 'O'-rings will hold the plugs in place in the casing.

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11. Mount the plate (151).

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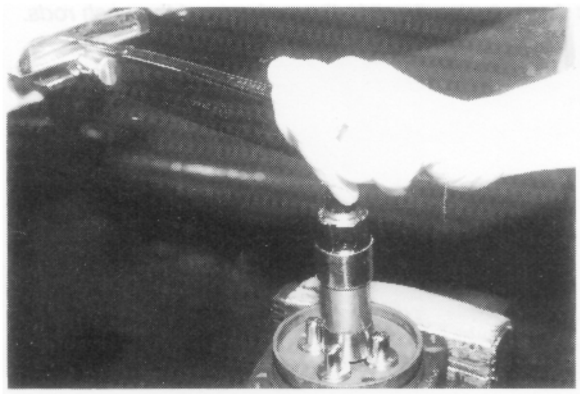
12. Tighten the joint (301) into the casing to the specified torque with the jig. Tightening torque 47 ± 2.9 Nm (34 ± 2.1 lb/ft).



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13. Mount the disk (302) to the joint.

Note: *Screw in the disk until it is in equal contact with all four push rods. (Do not over tighten).*

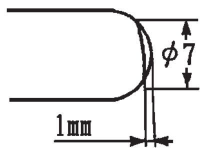
Assembly *(continued)*

14. Mount the adjusting nut (312) and tighten it to the specified torque, using a spanner on the flats of the disk. (Adjusting nut tightening torque 68.6 ± 4.9 Nm (50 ± 3.6 lb/ft).

Trouble Shooting

Symptoms	Possible Causes	Counter measures
* **1**. Low secondary pressure	**a**. Primary pressure is low.	Apply the correct primary pressure.
	b. Spring (241) is damaged.	Replace the spring.
	c. Clearance between the spools and casing is too large.	Replace the remote control valve assembly.
	d. The handle unit is loose.	Disassemble, reassemble or replace the handle unit.
* **2**. Unstable secondary pressure	**a**. Sliding parts are sticking	Repair the sticking part.
	b. Fluctuations in the tank line pressure.	Check return line and filter for blockage.
	c. Air is trapped in the piping.	Operate the valve several times to remove the air.
* **3**. High secondary pressure	**a**. The tank line pressure is too high.	Check return line and filter for blockage.
	b. Sliding parts are sticking.	Repair the sticking part.

Maintenance Specifications

Maintenance Item	Standard	Note
Leakage Amount	Replace if the leakage exceeds 1000cc/min with the handle in the neutral position or 2000cc/min during operation.	Condition Primary pressure 30 kgf/cm^2 (29 bar, 426.6 lb/in^2) Oil viscosity 23 cst
Spool	* Replace when the sliding contact faces are worn more than 10 micron or more than the non-sliding contact faces.	The conditions are approximately the same as for the leakage above.
Push rod	Replace if the tip is worn more than 1mm. 	
Play in the Operating Controls	Replace the parts if the wear in the pin, shaft and joint leads to play of more than 2mm.	
Actuation Stability	Consult Troubleshooting for Hydraulic Pump or Control Valve if abnormal noises, hunching or drops in primary pressure are experienced during operation. Replace the valve if the problem cannot be solved.	

Caution
1) It is recommended to replace the 'O'-rings and other seals at each disassembly, but if they are not damaged, they can be used again.
2) If the hexagonal socket head bolt (125) is loosened, always replace the washer (121).

Schematics, Technical Data

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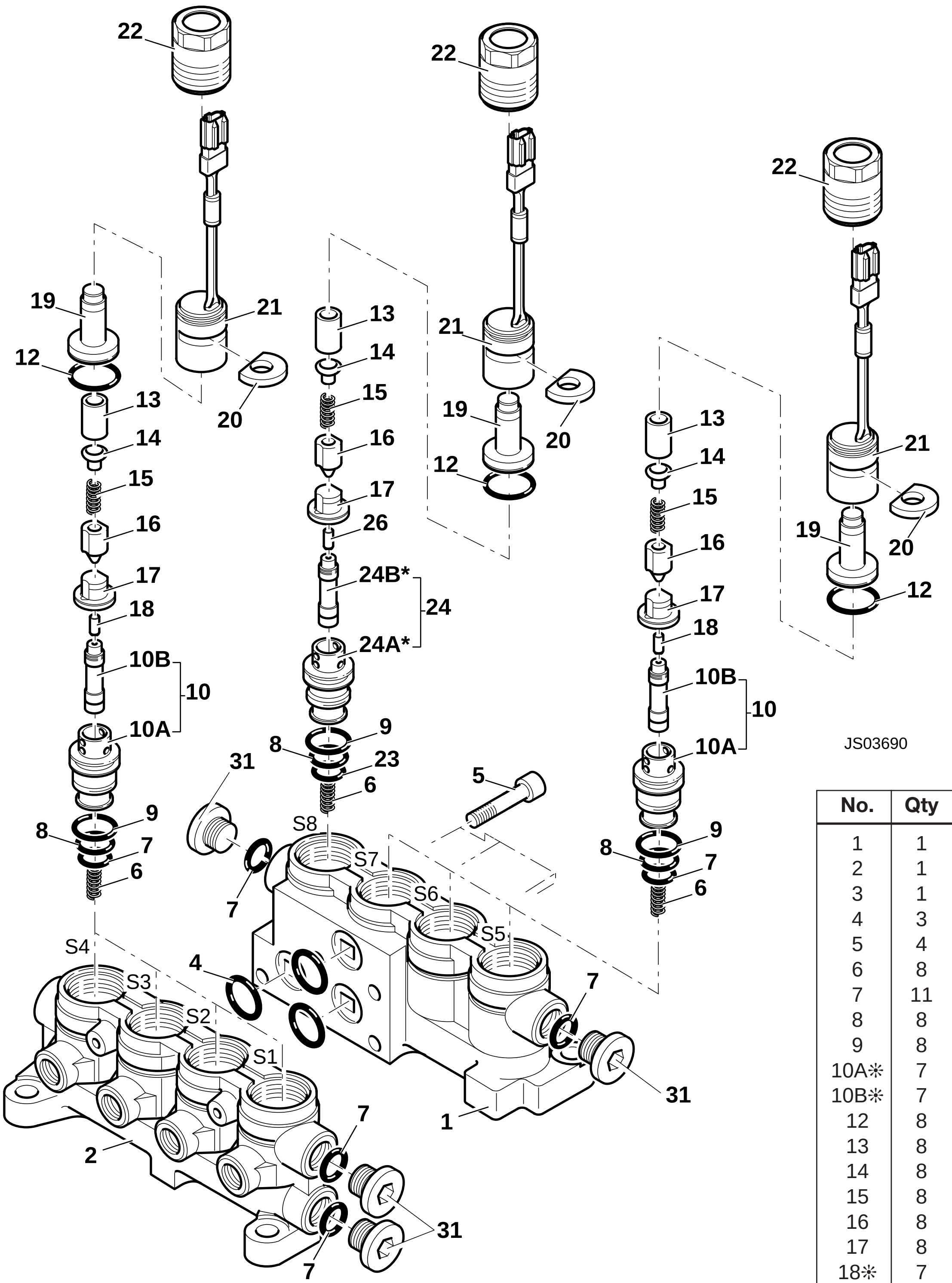
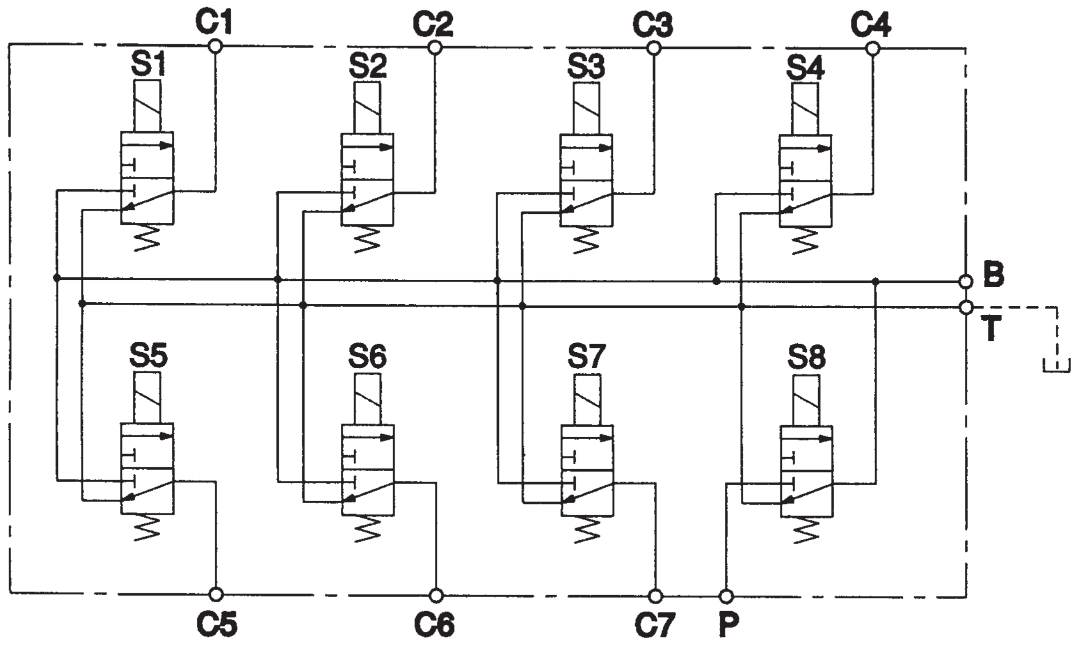


No.	Qty	Parts Name
1	1	Housing
2	1	Housing
3	1	Plug
4	3	O-ring
5	4	Socket head bolt
6	8	Spring
7	11	O-ring
8	8	O-ring
9	8	O-ring
10A❊	7	Body
10B❊	7	Spool
12	8	O-ring
13	8	Pipe
14	8	Spring seat
15	8	Spring
16	8	Plunger
17	8	Stopper
18❊	7	Rod
19	8	Inner housing
20	8	Spacing
21	8	* Coil assembly
22	8	* Cap
23	1	O-ring
24A❊	1	Body
24B❊	1	Spool
26❊	1	Rod
31	4	Plug

S1~S7	10A Body inner diameter	ø10mm
	10B Spool outer diameter	ø10mm
	18 Rod total length	8.6mm
S8	24A Body inner diameter	ø12mm
	24B Spool outer diameter	ø12mm
	26 Rod total length	9.0mm

Schmatics, Technical Data



Schematics, Technical Data

Rated Pressure	40 kgf/cm^2 (38.69 bar, 568.8 lb/in^2)
Rated Flow	5 l/min (1.09 imp gal)
Pressure Loss Characteristic	
P $\rightarrow$ B	<.967 bar (1.0 kgf/cm^2, 14.22 lb/in^2) at 10 l/min (2.199 imp gal) 31 cSt
* B $\rightarrow$ C1~C7	<1.93 bar (2.0 kgf/cm^2, 28.44 lb/in^2) at 5 l/min (1.099 imp gal) 31 cSt
B $\rightarrow$ T	<1.93 bar (2.0 kgf/cm^2, 28.44 lb/in^2) at 5 l/min (1.099 imp gal) 31 cSt
Inner leakage	
P $\rightarrow$ B	<70 cc/min at 3.8 bar (3.99 kgf/cm^2, 56.73 lb/in^2) 31 cSt (3.1 x 10.^{5} M^2/s)
B $\rightarrow$ T	<490 cc/min at 3.8 bar (3.99 kgf/cm^2, 56.73 lb/in^2) 31 cSt (3.1 x 10.^{5} M^2/s)
Hydraulic Oil	
Hydraulic Oil Temperature	-20~+95°C
Ambient Temperature	-30~+80°C
Connectors	
Connector Specifications	7222-1424-30
Housing	7114-1471
Terminal	DC 24 Volt
Rated Voltage	20~32 Volt
Allowable Voltage Range	Resistance Welding Time 20~30 Volt
Current	~0.6A at 24 Volt 20°C
Lead Wire	AVX 0.85 mm^2
Terminal Pull-out Strength	78.9 N (8 kgf less than 30 sec)
Degree of Waterproof	JIS-D-0203, S2
* Weight	11 kg (24 lb)
Insulation Resistance	More than 1 M (at 500 VM)
Degree of Shockproof	JIS-D-1601 3rd Class B Type Step 7 (6.9G)

Refer to illustrations at the end of this section.

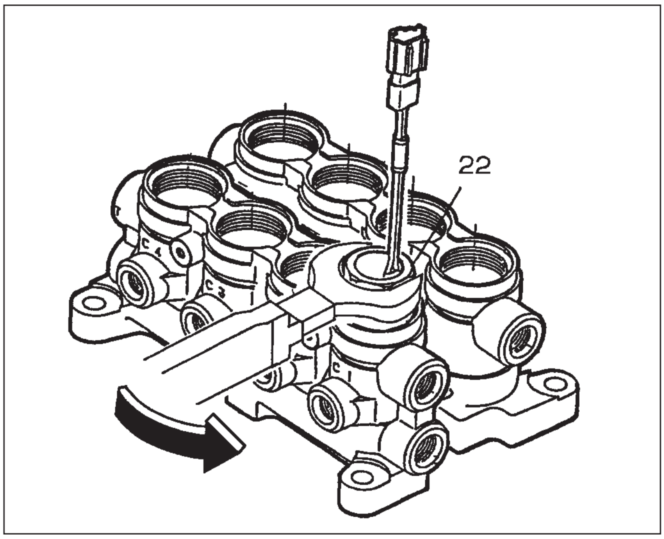
Dismantling

Notes:

1. *All parts are manufactured with a high degree of precision and require the utmost care when handling. Do not let parts knock against each other and take extra precautions when handling parts to prevent them being dropped.*
2. *During dismantling, do not hit parts with excessive force if they are stuck and do not damage parts by twisting them or making burrs on bearing surfaces. Failure to follow these instructions will cause oil leaks leading to poor performance.*
3. *Label all parts during dismantling to ensure correct assembly.*
4. *Storing of the solenoid valve in a dismantled or partly dismantled state could cause rusting of parts due to moisture or dirt. If the dismantling procedure must be interrupted, be sure to provide anti-rust treatment and keep the parts free from dirt and corrosion.*
5. *During assembly ensure that all parts are free from dirt and foreign matter and make sure that all parts are free from burrs and scratches. Remove minor burrs and scratches using an oil stone.*
6. *Use new 'O'-rings and backup rings.*
7. *During assembly, apply grease to 'O'-rings.*
8. *Tighten all bolts to the quoted tightening torque.*

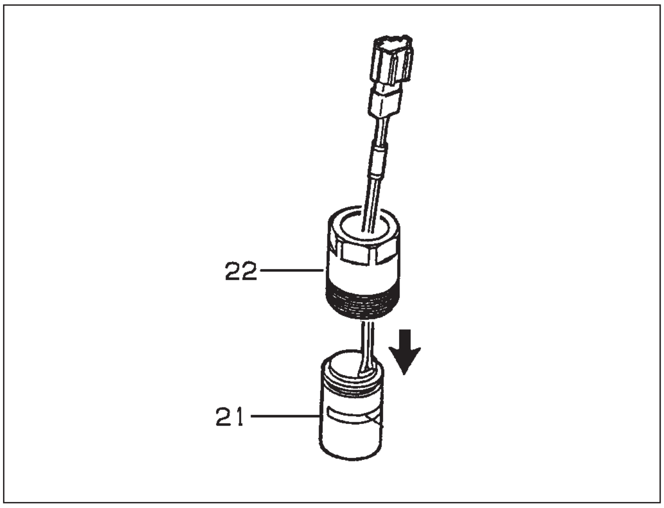
Dismantling

1. Use a socket or torque wrench to remove the screw (22).

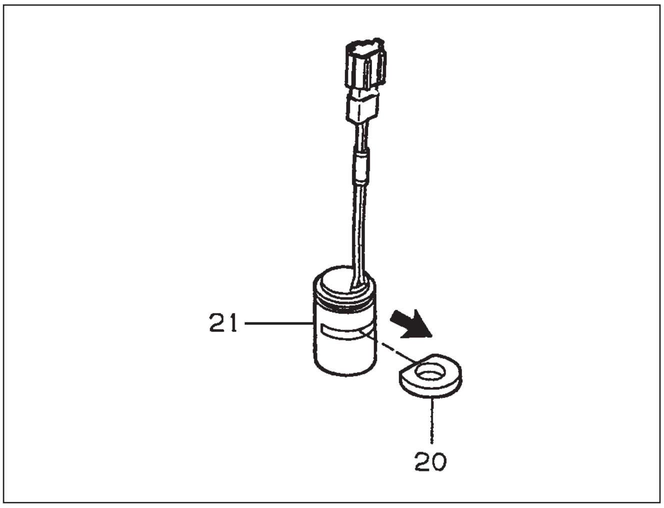


Dismantling *(continued)*

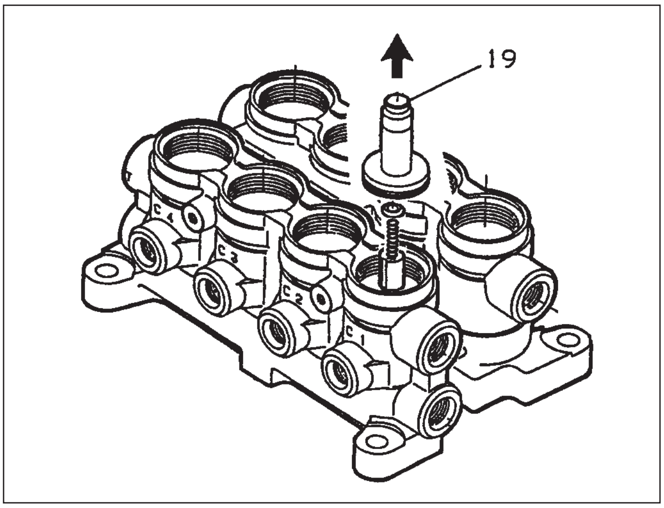
* **2.** Remove the coil assembly (21) from the cap (22).



3. Remove the spacer (20) from the coil assembly.

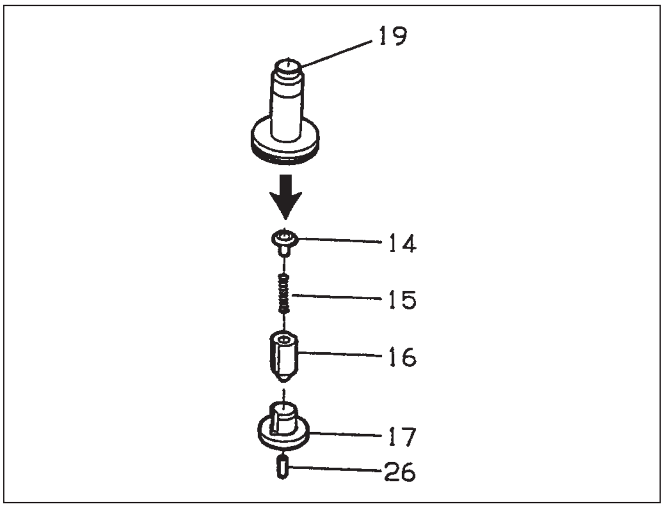


4. Remove the inner housing (19). Remove slowly so that the parts inside the housing do not fly out.



Dismantling *(continued)*

5. Remove the rod (26), stopper (17), plunger (16), spring (15), and spring seat (14). If the spring seat is stuck to the inside of the inner housing, use tweezers to remove it.



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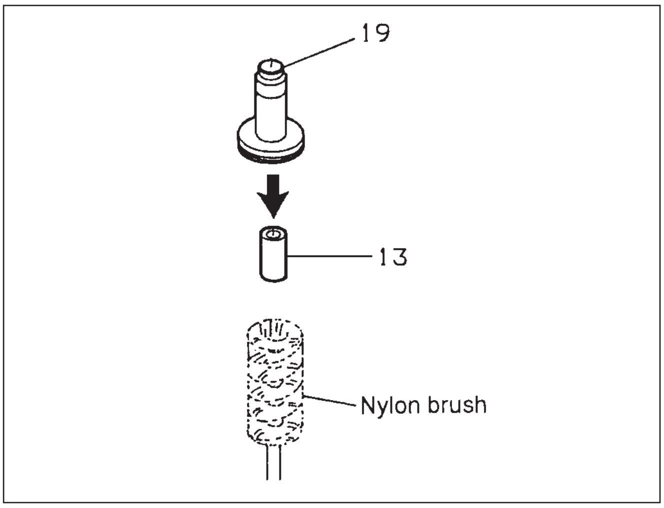
6. Pull out the pipe (13) from the inner housing using a nylon brush.



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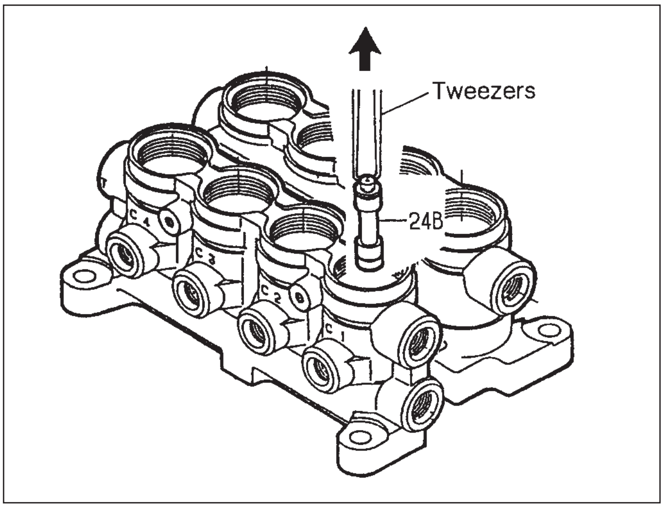
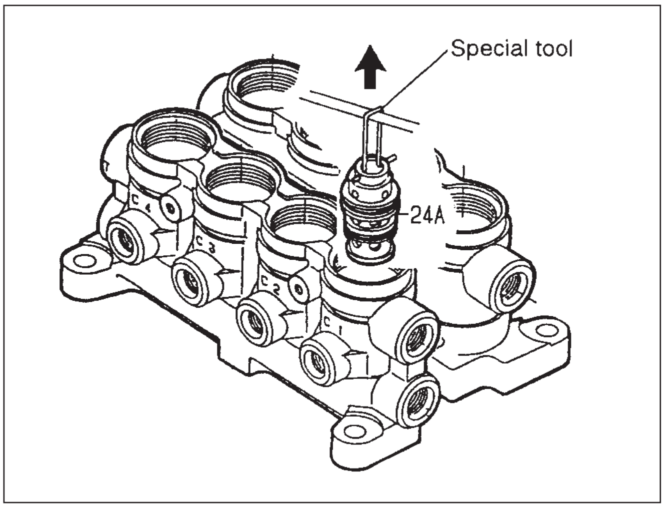
7. Slowly remove the spool (24B).



Dismantling *(continued)*

8. Remove the body (24A) with the special tool (A).



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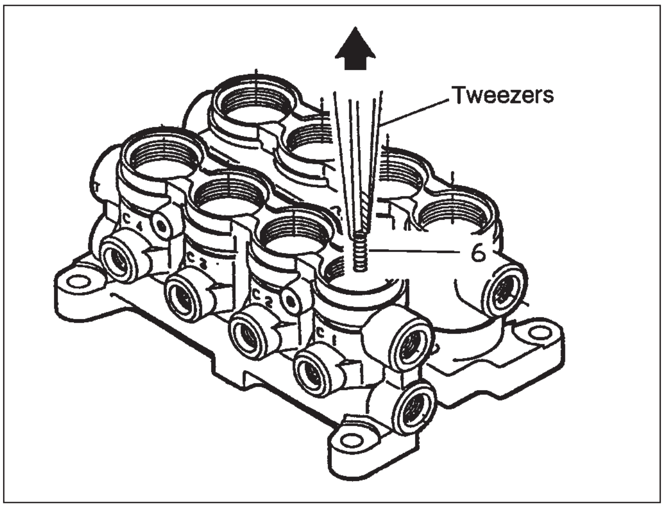
9. Remove the spring (6) using tweezers.



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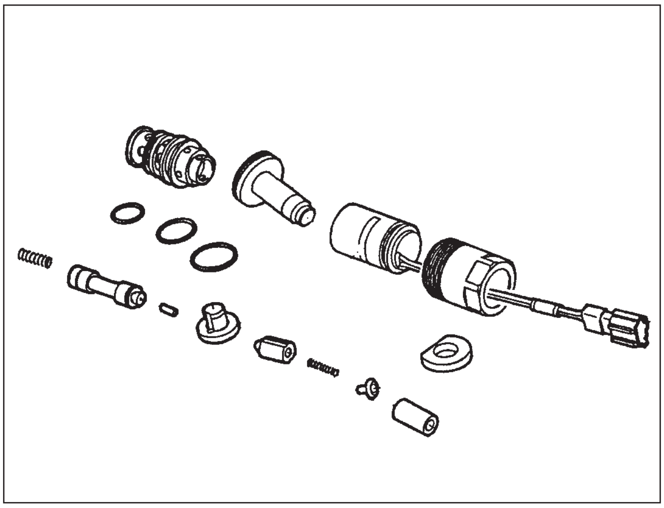
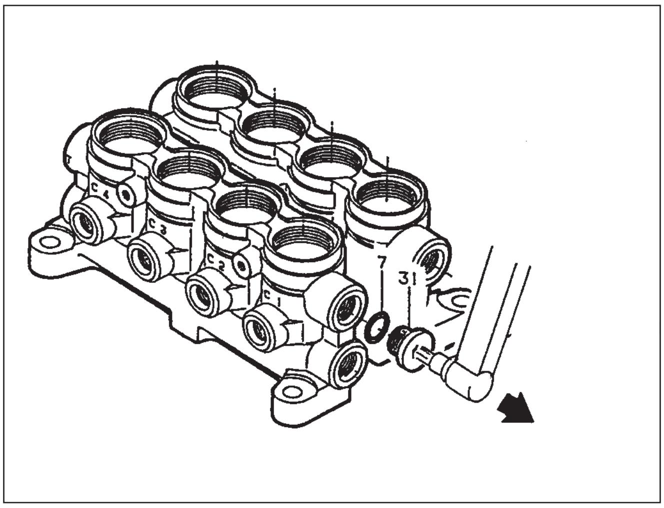
10. Line up the disassembled parts on a clean place in such a way to facilitate reassembly.

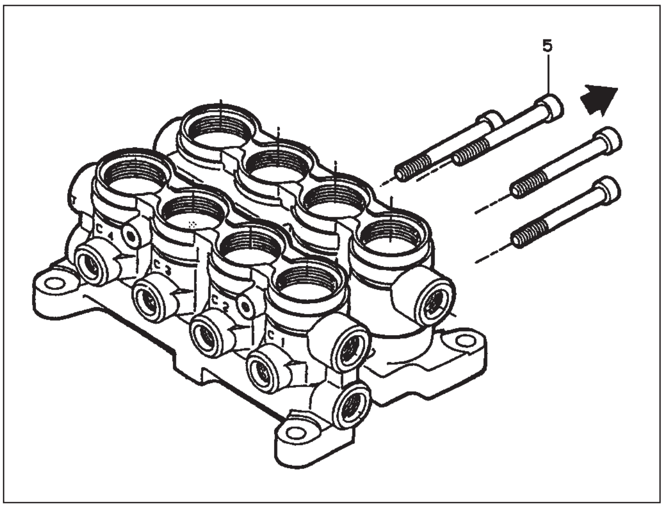


Dismantling *(continued)*

11. Use a socket or torque wrench to remove the plug (31).

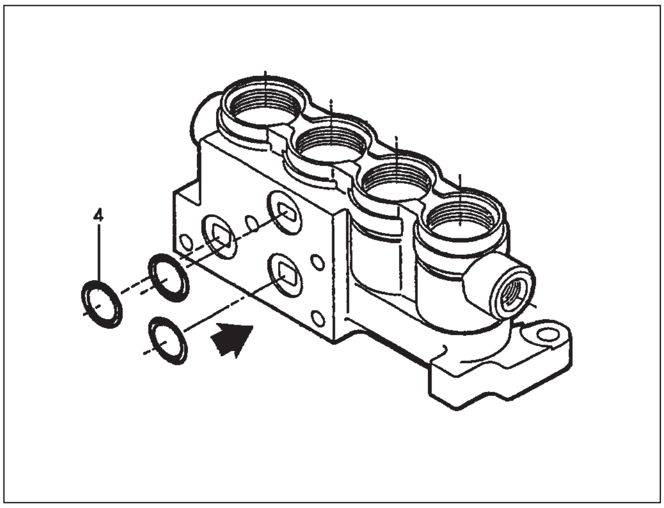


12. Use a socket or torque wrench to remove the socket head bolt (5).

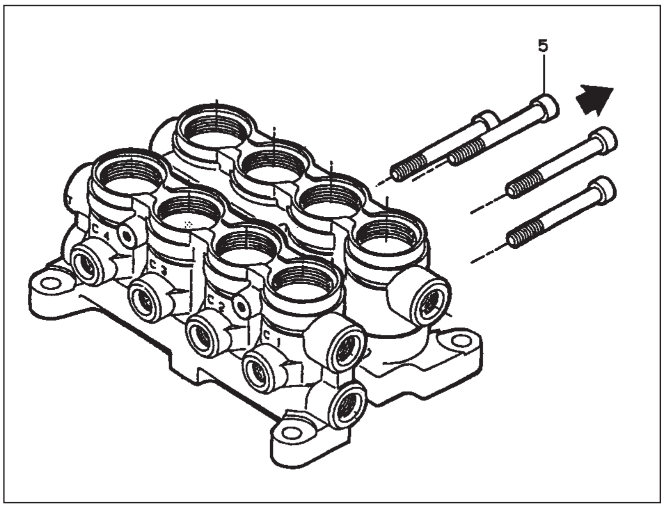


Assembly

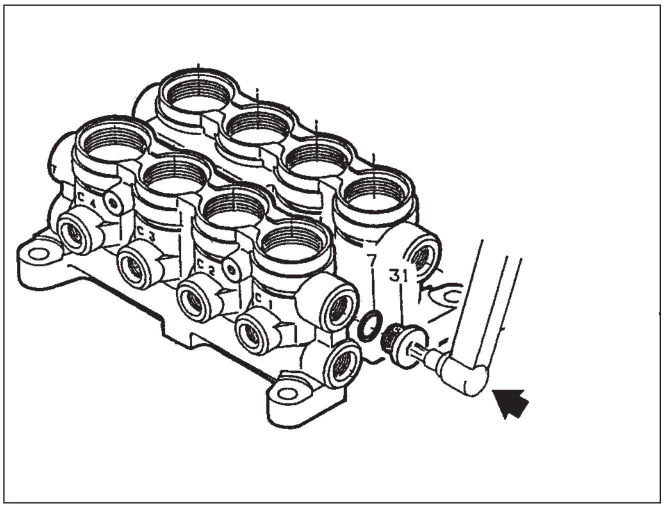
1. Install the 'O'-ring (4) on the housing (1).



* **2.** Use the socket head bolt for housing (1) and (2) and tighten to 24.5 + 4.9 Nm (18.08 + 0.5 kgf m).
- 0 Nm - 0 kgf m

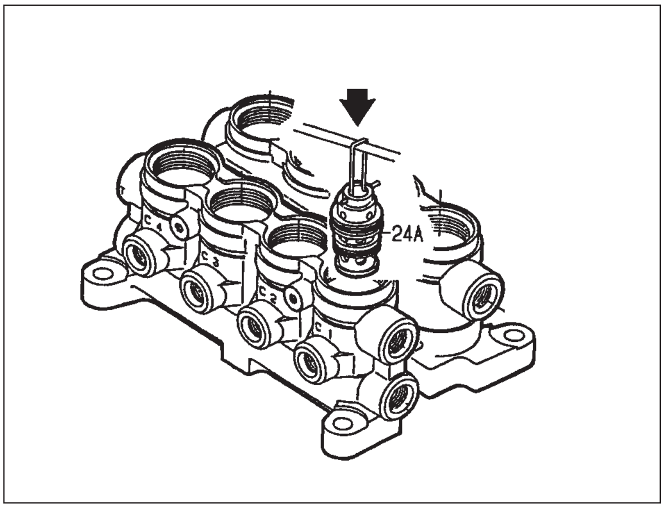


* **3.** Install the 'O'-ring (7) on the plug (31) and assemble to the housing, tighten to 19.6 + 4.9 Nm (14.47 + 0.5 kgf m).
-0 Nm -0 kgf m)

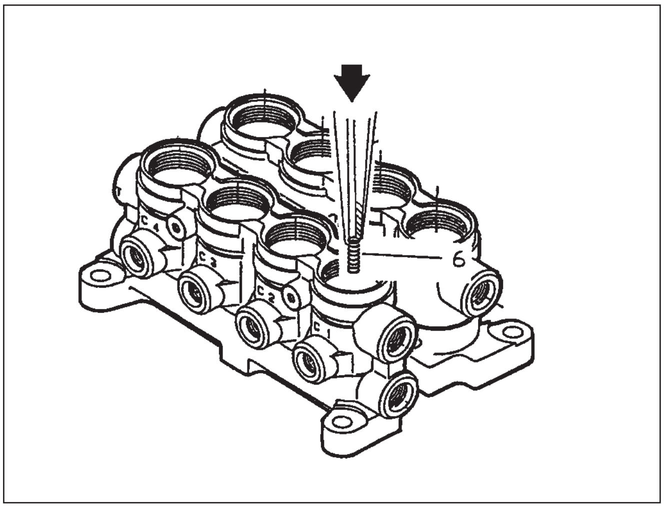


Assembly *(continued)*

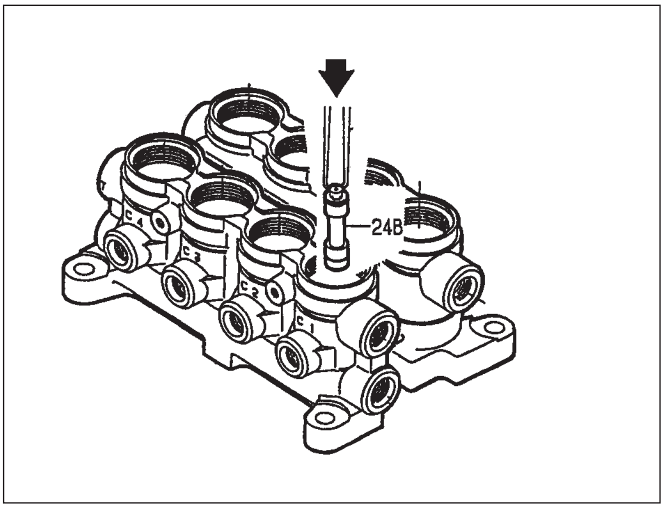
4. Install the 'O'-rings (8, 9, 23) on the body (24A) and use the special tool (B) on the housing and push it in.
The inner diameter of the S8 body is 12 mm.
(Apply grease to the 'O'-ring).



* **5.** Drop in the spring (6) from the middle of the body (24A). At this time, make sure it stays in line with the inner hole of the housing.

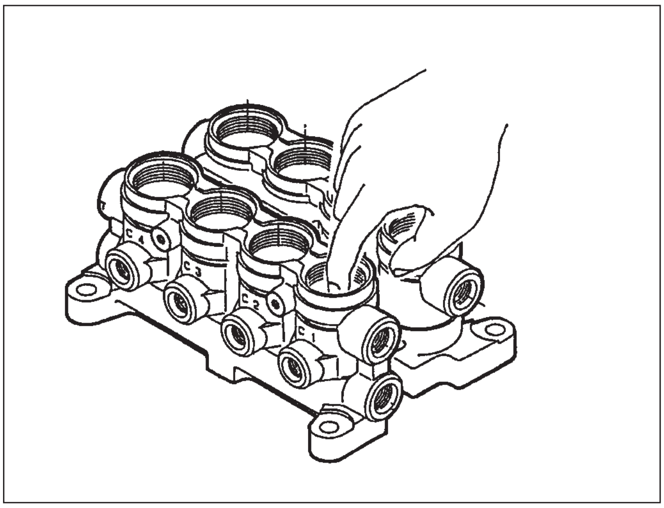


6. Gently insert the spool (24B) into the body. At this time, be careful not to damage the edge inside the body.
(Spool diameter for S8 is 12 mm).



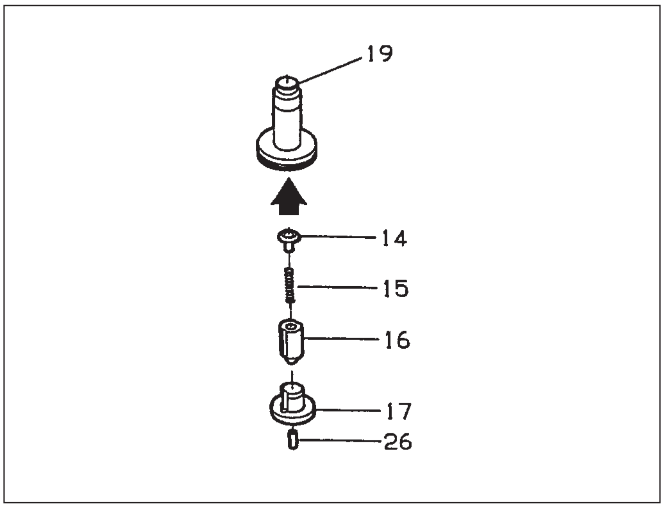
Assembly *(continued)*

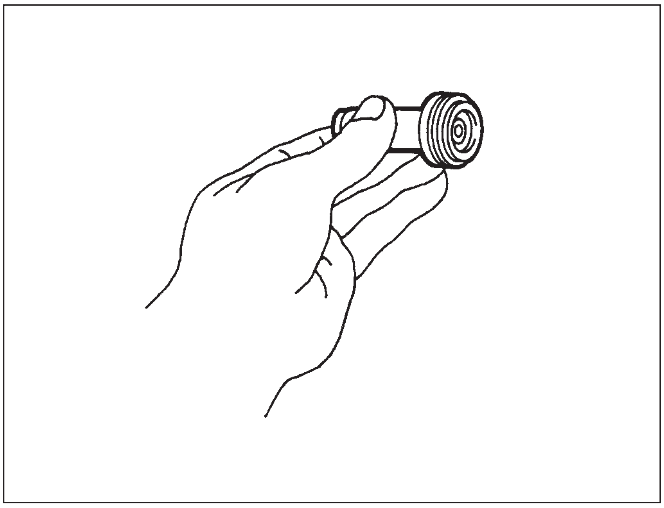
7. After inserting the spool, push the top of the spool with your finger and slide it. The spool should slide smoothly and if there is any resistance, do not use it.



---

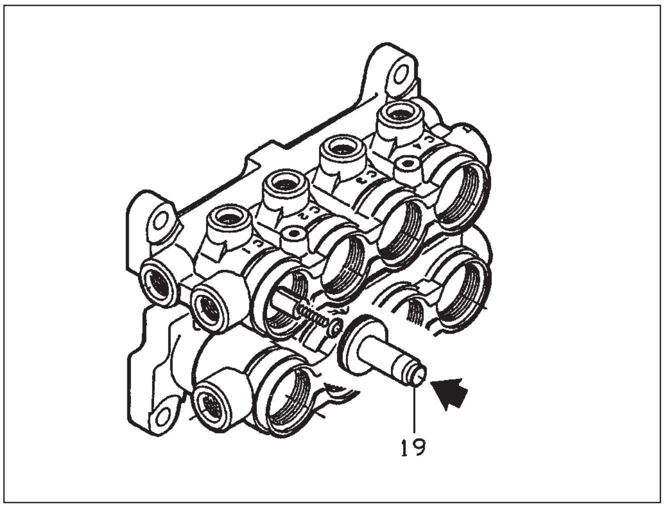
8. Fit the 'O'-ring to the inner housing (19) and install pipe (13), spring seat (14), spring (15), plunger (16), stopper (17) and rod (26) into the housing. (Rod for S8 total length is 9.0 mm).





Assembly *(continued)*

9. Place the housing horizontally and install the inner housing (19). Take care that parts which are assembled to the inner housing do not drop off. (Apply grease to the 'O'-ring).



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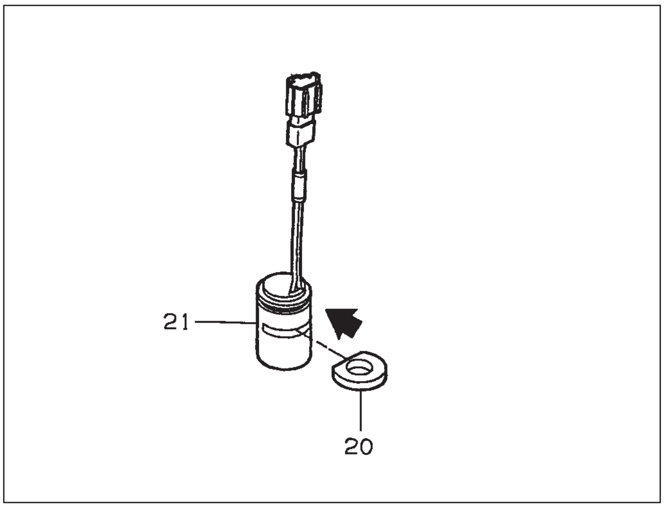
10. Install the spacer (20) to the coil assembly (21).



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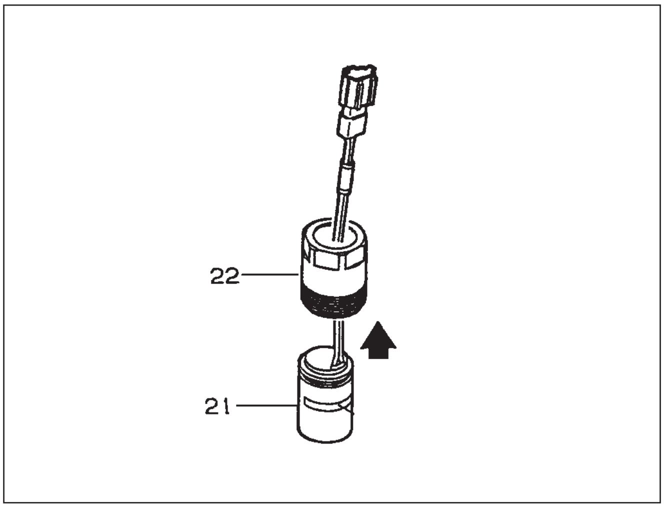
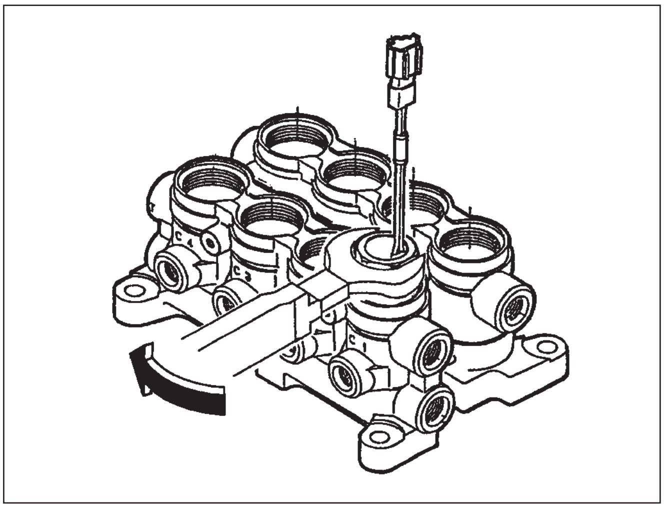
11. Install the housing (22) to the coil assembly.



Assembly *(continued)*

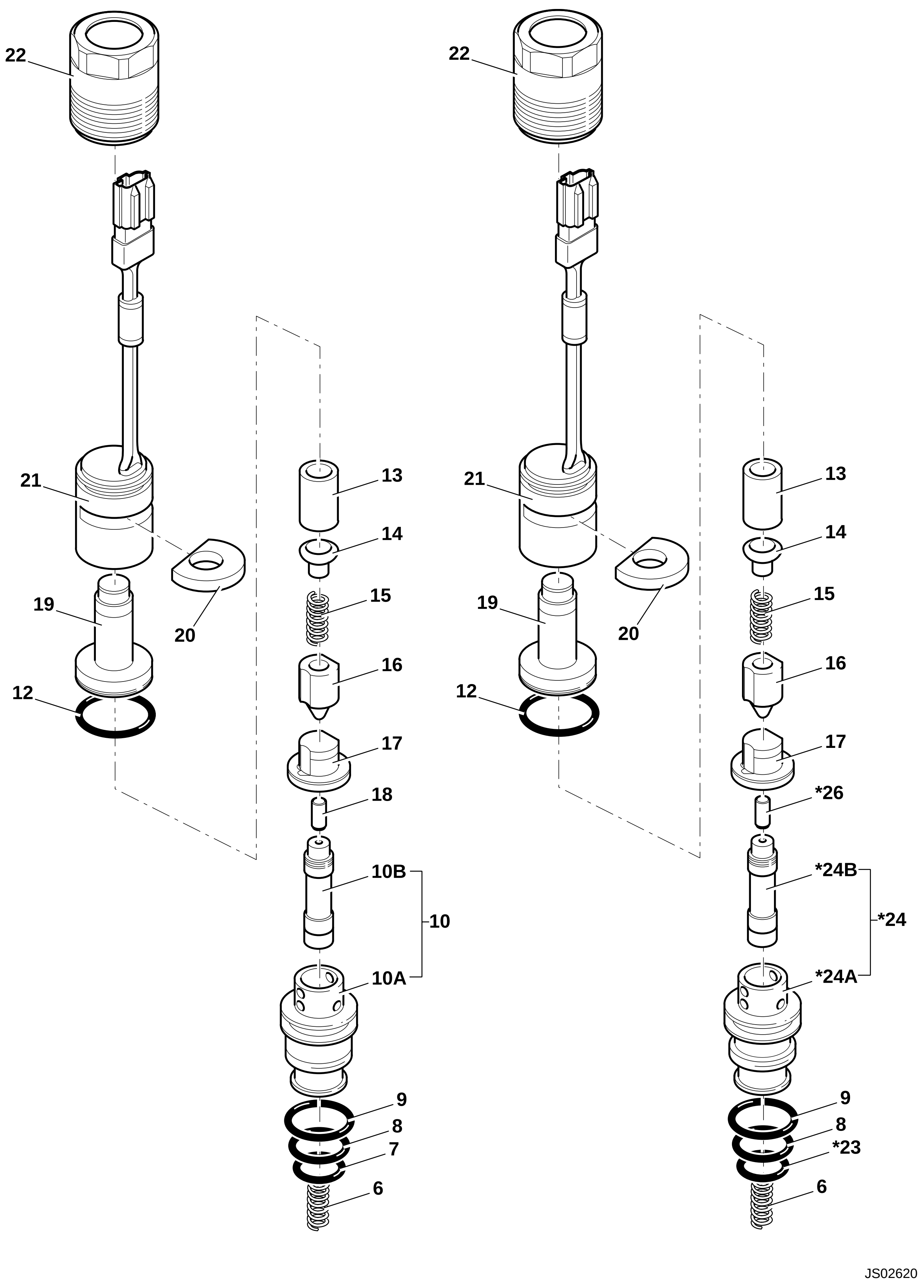
12. Apply anaerobic adhesive Loctite 242 to the screw thread and using a torque wrench, tighten it to 29.4 ± 9.3 Nm (21.1 ± 7.23 lb/ft).

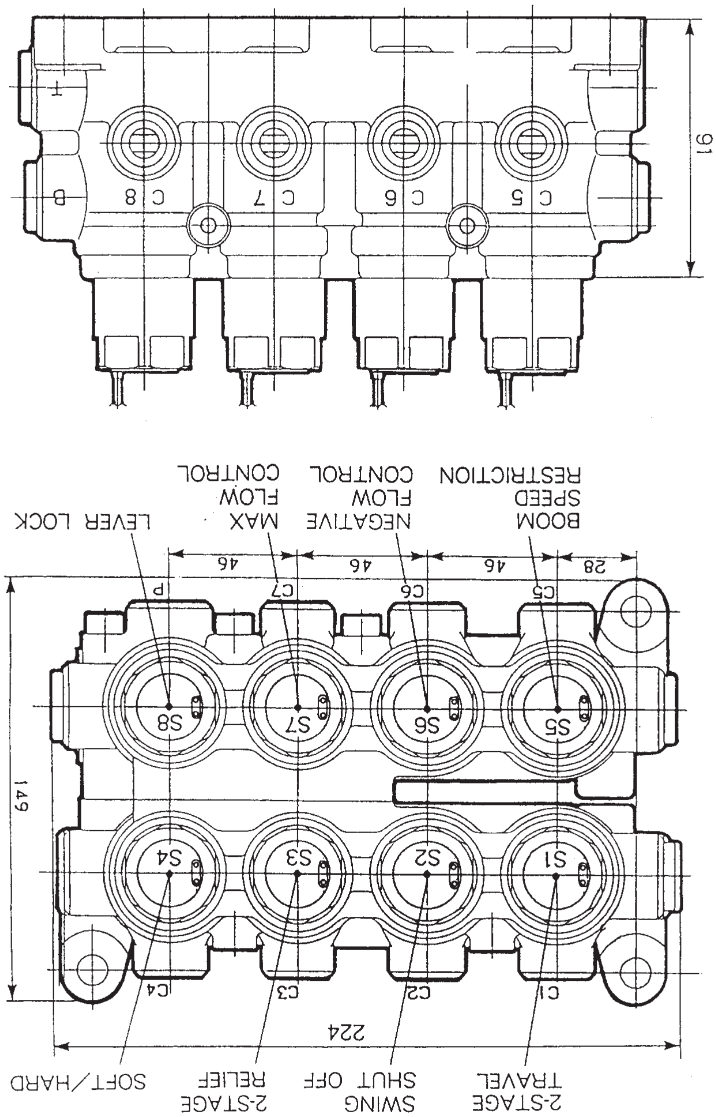


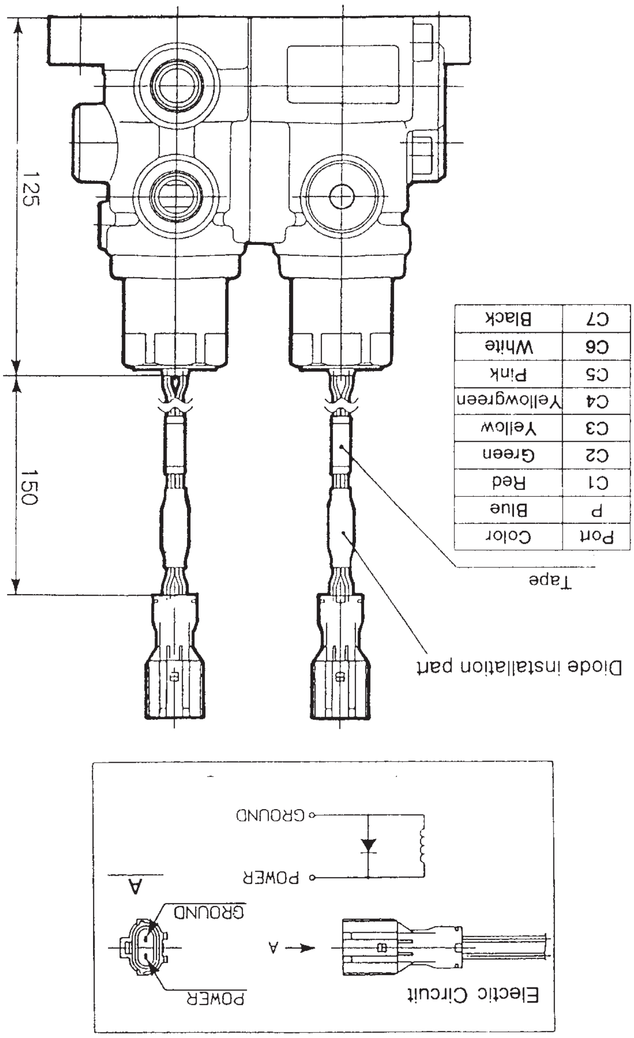
* **Solenoids S1, S3~S7**

The assembly procedure for the solenoids at housing positions C1 and C3 to C7 is identical to that described in steps 11 to 12, but note that O-ring **7**, body **10A**, spool **10B** (10 mm diameter) and rod **18** (8.6 mm long) are of different dimensions to items **23**, **24A**,**24B** and **26** respectively.

*

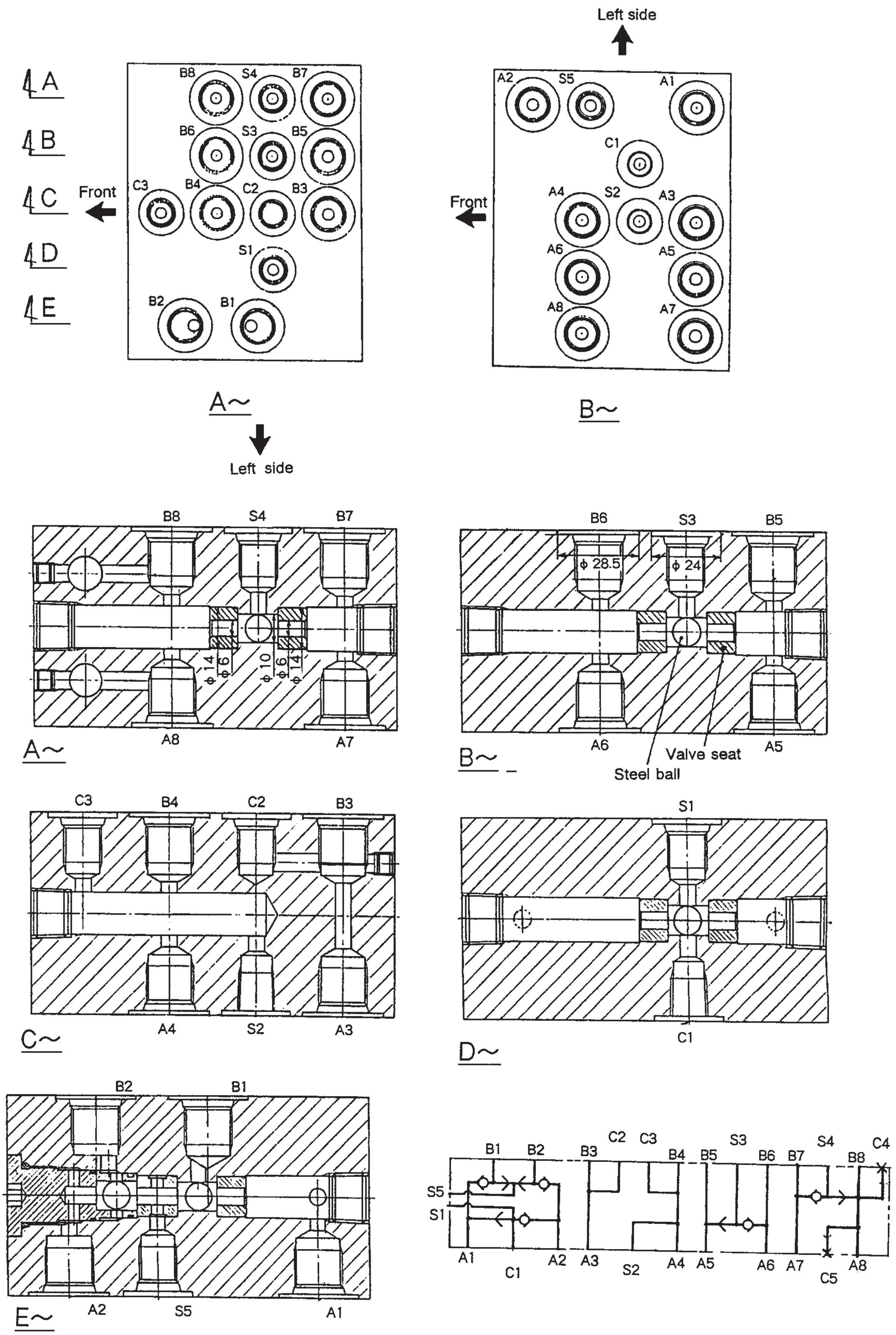

22
21
13
14
15
19
20
16
12
17
18
10B
10
10A
9
8
7
6
22
21
13
14
15
19
20
16
12
17
*26
*24B
*24
*24A
9
8
*23
6
JS02620





Port	Color
P	Blue
C1	Red
C2	Green
C3	Yellow
C4	Yellowgreen
C5	Pink
C6	White
C7	Black

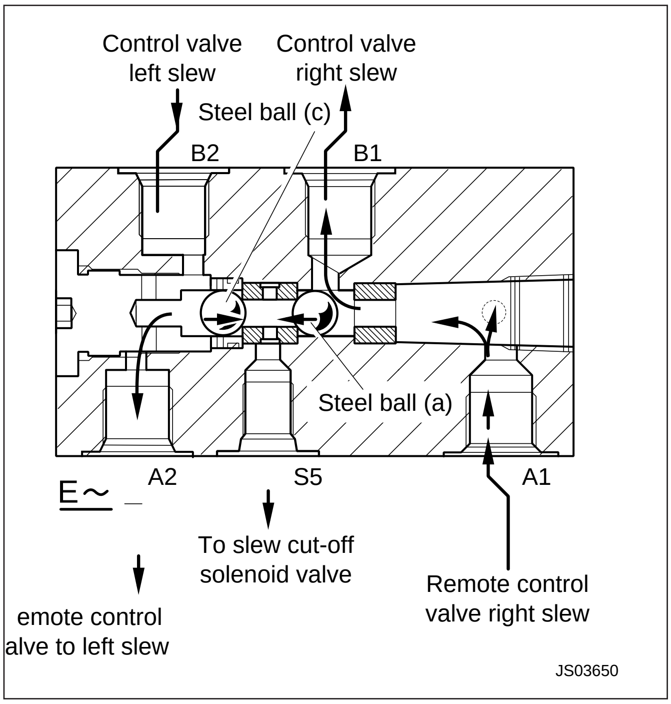
Schematic


A
B
C
D
E
Front
Left side
B8
S4
B7
B6
S3
B5
C3
B4
C2
B3
S1
B2
B1
A~
A2
S5
A1
C1
A4
S2
A3
A6
A5
A8
A7
B~
ϕ 14
ϕ 6
ϕ 10
ϕ 28.5
ϕ 24
Valve seat
Steel ball
C~
D~
E~
C4
C5

Operation

When right slew is selected, pressurised oil enters the **A1** port of the shuttle block from the remote control valve. The pressurised oil moves steel ball (a) to the left side and enters the right slew port of the control valve from the **B1** port.
The pressurised oil which enters the **A1** port goes passes the through hole (a) and is led to cavity (a) and moves the steel ball (b) to the left side and is then dispersed to **C1** and **S1** ports.
The return oil from the control valve enters **B2** port and moves the steel ball (c) to the right side and returns to the remote control valve from **A2** port.

*



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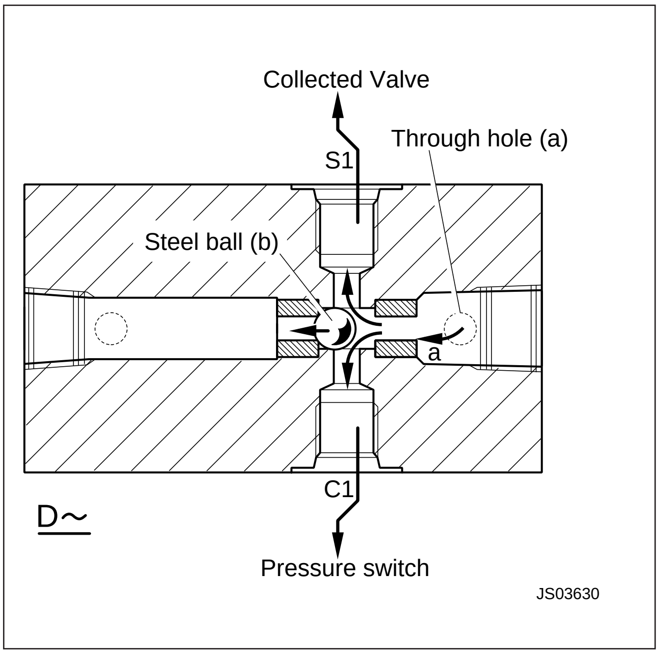
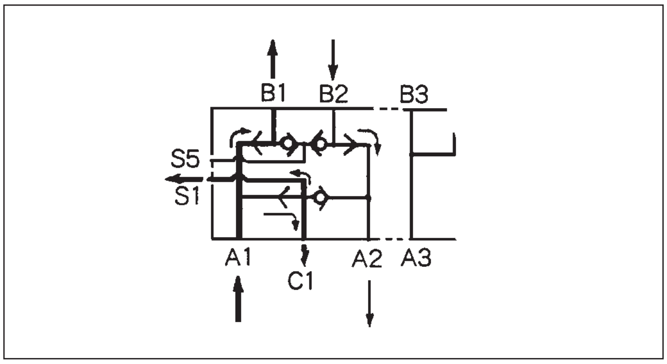
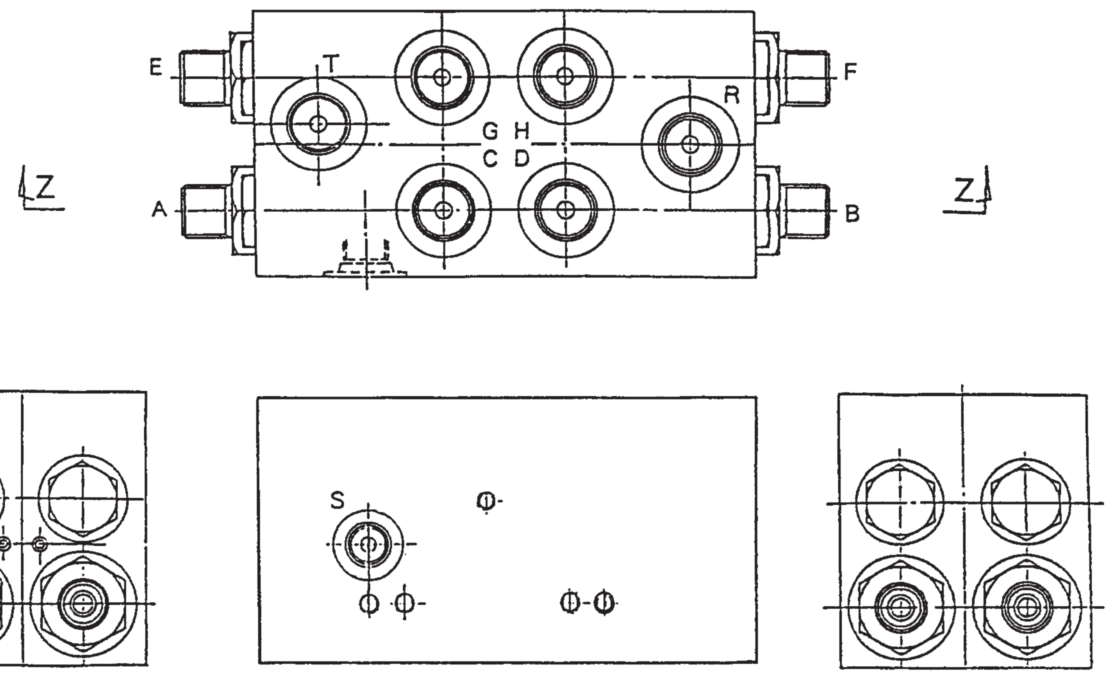




* **Key for illustrations opposite and on previous page**

A1	Right slew
A2	Left slew
A3	Boom up
A4	Boom down
A5	Bucket open
A6	Bucket close
A7	Dipper open
* A8	Dipper close
B1	Right slew
B2	Left slew
B3	Boom up
B4	Boom down
* B5	Bucket close
B6	Bucket open
B7	Dipper open
B8	Dipper close
C1	Slew pressure switch
C2	Boom up
C3	Boom up, down
S1	Collected valve
S2	Boom lowering pressure switch
S3	Bucket open
S4	Dipper close
S5	Slew shut-off

Schematic



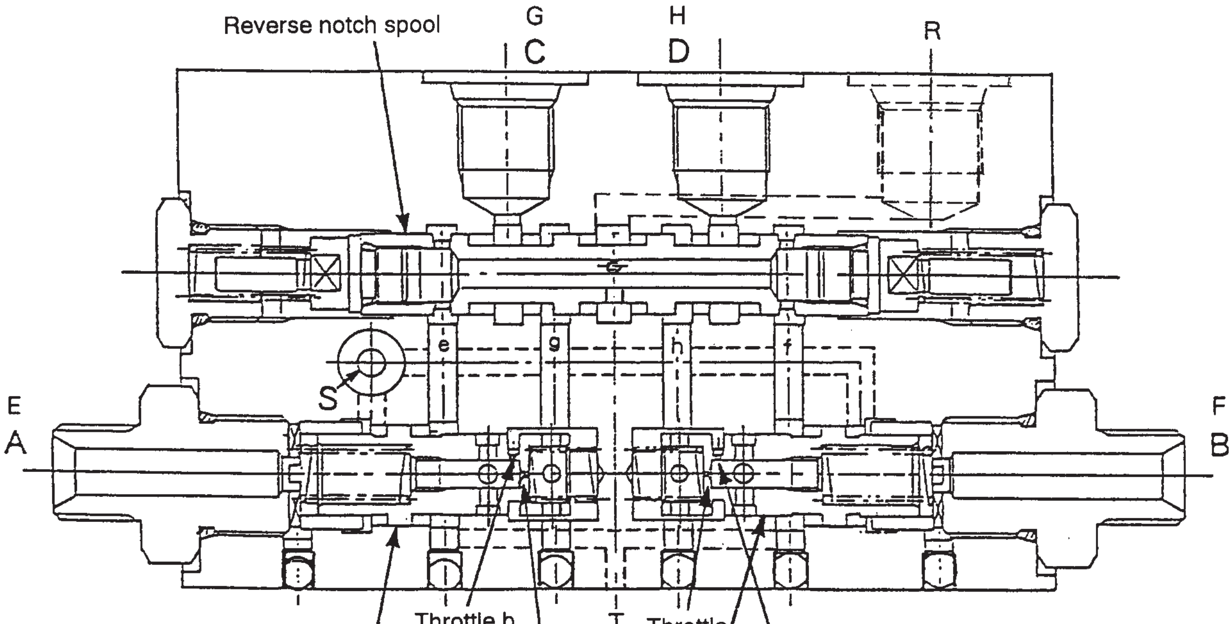
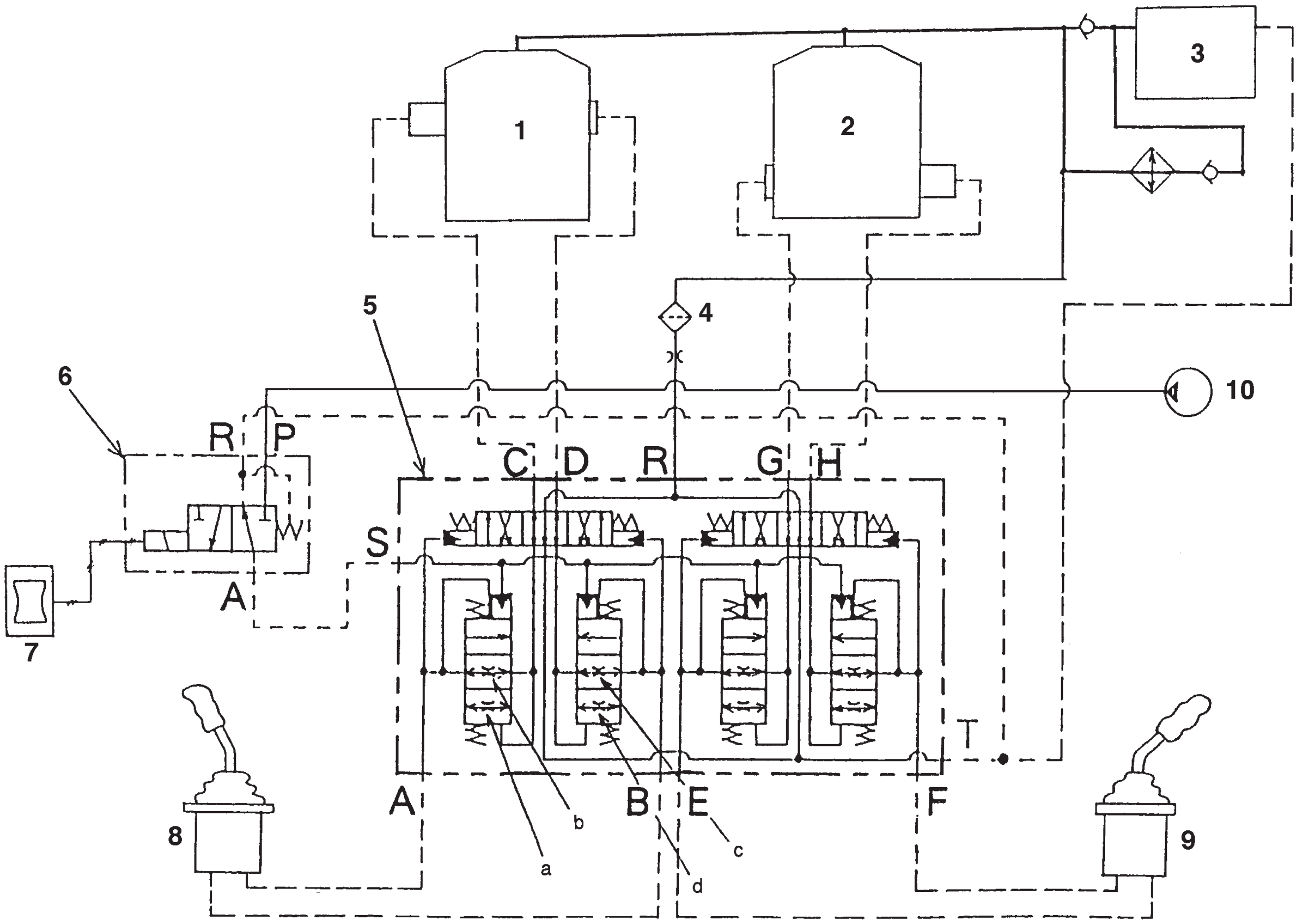


Fig. 1



Key
1 Dipper Control Valve
2 Boom Control Valve
3 Hydraulic Oil Tank
4 Filter
5 Cushion Valve
6 Solenoid Valve
7 Cushion Switch
8 Dipper Remote Control
9 Boom Remote Control Valve
10 Pilot Gear Pump

Operation

In the Soft State

When lever is in neutral (Refer to Fig. 1).

a. The hot oil separated from the oil cooler line enters the **R** port of the cushion valve.

b. It flows through the reverse notch spool interior and through passages e and f.

Then, after flowing through passages e and f, it flows through the outer periphery of the respective cushion spools, returning to the hydraulic oil tank through the **T** port of the cushion valve.

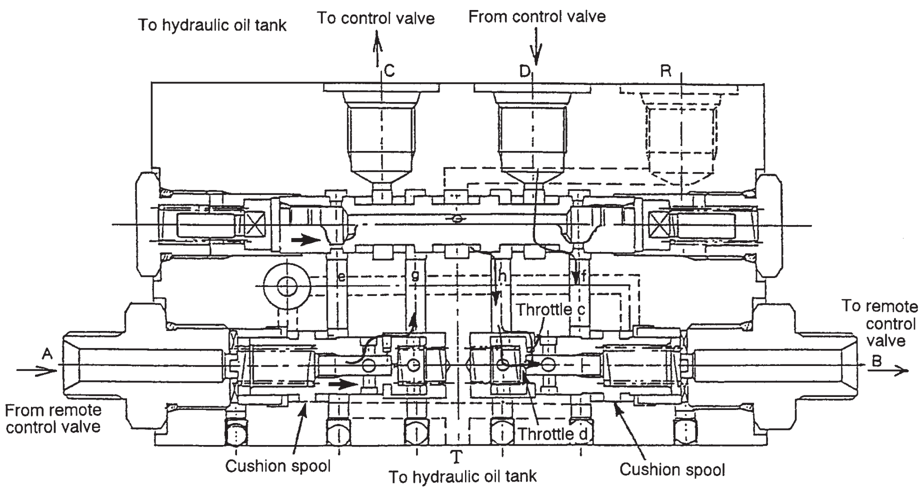
During Dipper Closing Operation

a. Pilot pressure enters the **A** port of the cushion valve from the remote control valve. Because this pilot pressure enters at the left end of the cushion spool and left end of the reverse notch spool, the respective spools move to the right.

b. The pilot pressure inside the cushion spool enters the g cavity through the spool hole. It then passes the reverse notch spool outer periphery and enters the control valve from **C** port.

c. The return oil (pilot pressure) from the control valve enters the f cavity after passing from the **D** port to the outer periphery of the reverse notch spool. It then passes through the cushion spool outer periphery and returns to the hydraulic oil tank from the **T** port.

d. At this point, the hot oil from **R** port flows through the h passageway and enters the right end of the cushion spool because the reverse notch spool is switched to the right, so the e and f passageways are closed. The hot oil passes through throttle **c** and **d** and enters the remote control valve from B port. *(The hot oil warms the remote control valve)*.



During Arm Closing Operation

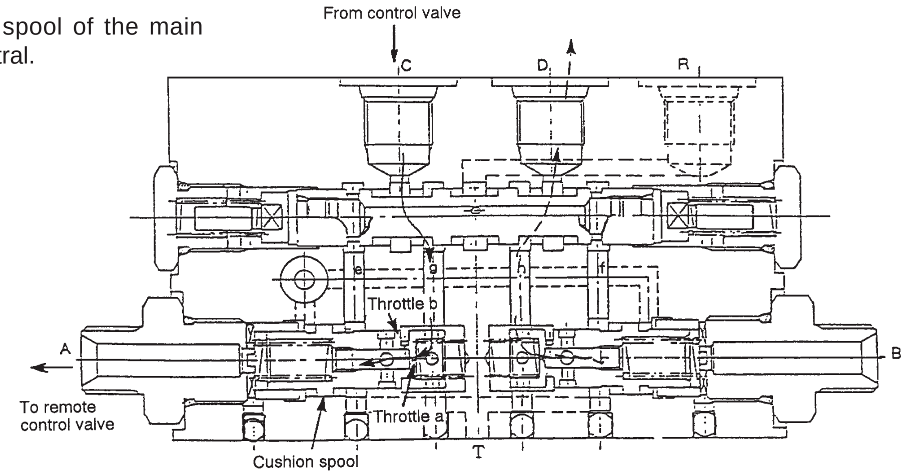
Operation *(continued)*

During Dipper Closed and Stopping

a. When the pilot pressure from the remote control valve stops, the reverse notch spool returns to neutral.

b. Also, the cushion spool returns to neutral and the pilot oil returning from the control valve passes through the throttle **a** and **b**. Because the cushion spool moves to the left side due to the differential pressure before and after the throttle, the pilot return oil is throttled by throttle **a**.

c. Due to this throttling effect, the spool of the main control valve slowly returns to neutral.



Normal State

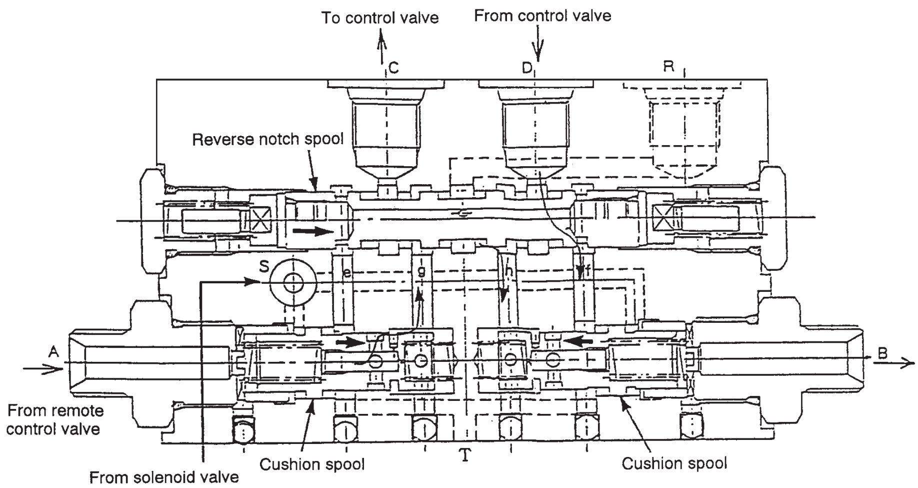
When the cushion switch is switched to the normal position, the solenoid valve is selected and the pilot pressure (40 kgf/cm ^{2}) of the gear pump enters the **S** port of the cushion valve.

All the cushion spools (Boom, dipper - total of 4) are selected forcibly to the inner side.

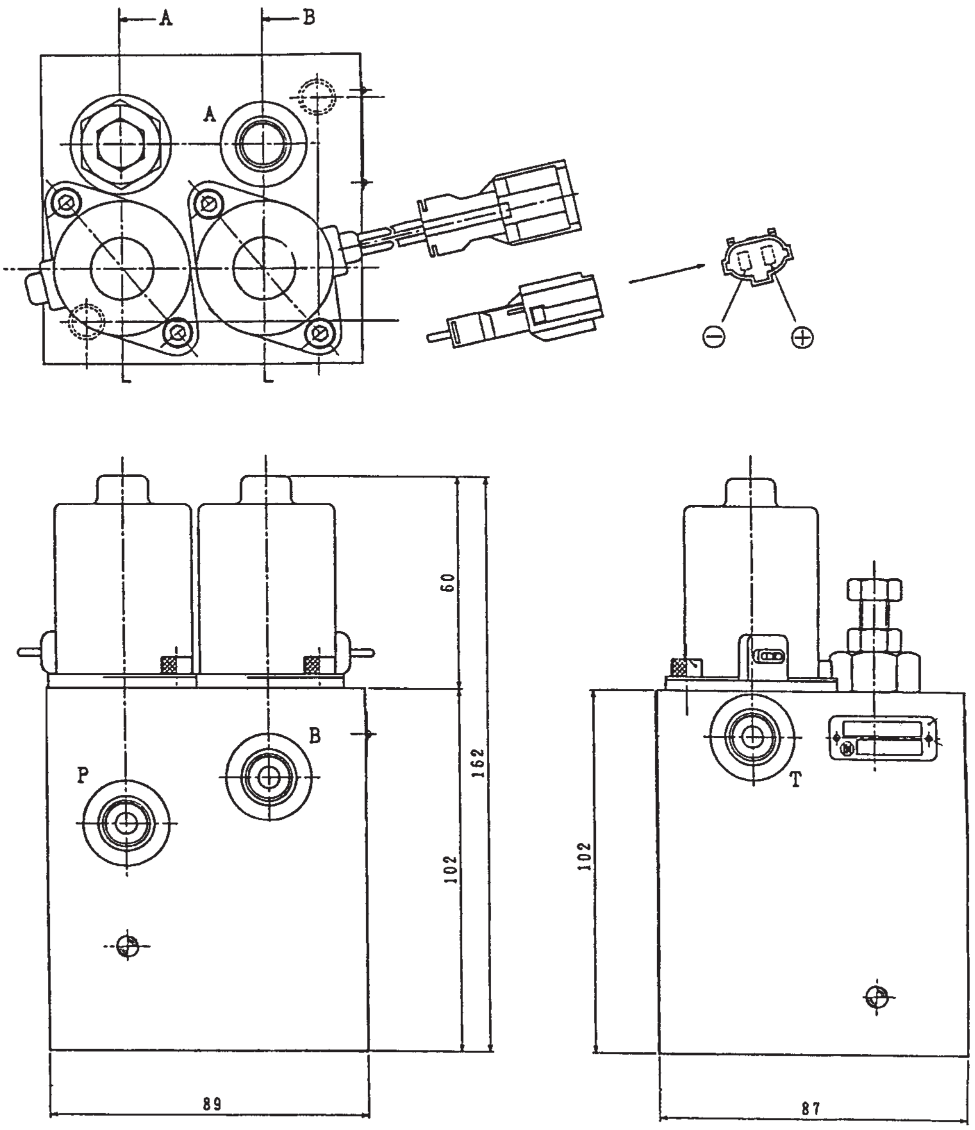
Because the cushion spool is forcibly pushed down, the pilot pressure does not pass through the throttle of the cushion spool during the dipper closing or stopping operations but passes through the cushion valve inside.

The hot oil from **R** port returns to the hydraulic oil tank from the **T** port when the lever is at neutral.

When the lever is being moved, it flows to the remote control valve.



Schematic



Solenoid Part		**Valve Part**	
1. Voltage	DC24V	1. Working Pressure	3.9 MPa (40 kgf/cm^2)
2. Consumed Power	12W	2. Working Flow	16 l/min
3. Other	* Surge Suppressor	3. Decompressor Pressure	

	JS200/240
Pressure	1.5^{+0} MPa (15^{+0} kgf/cm^2)

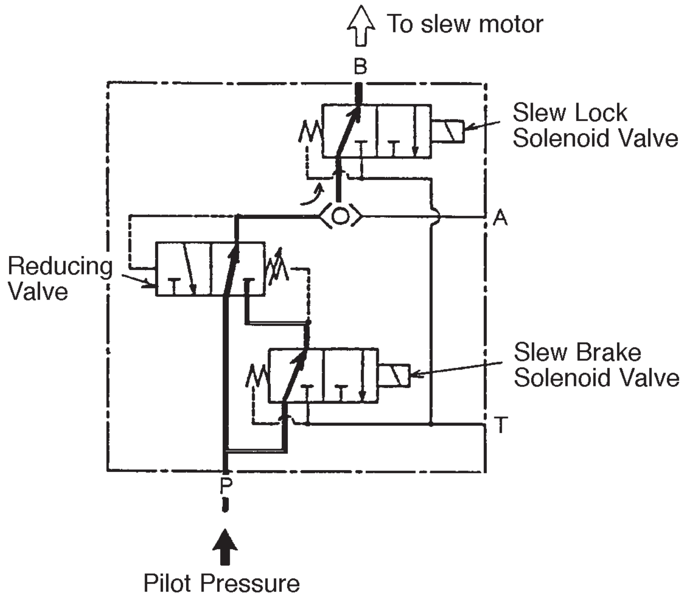
Operation

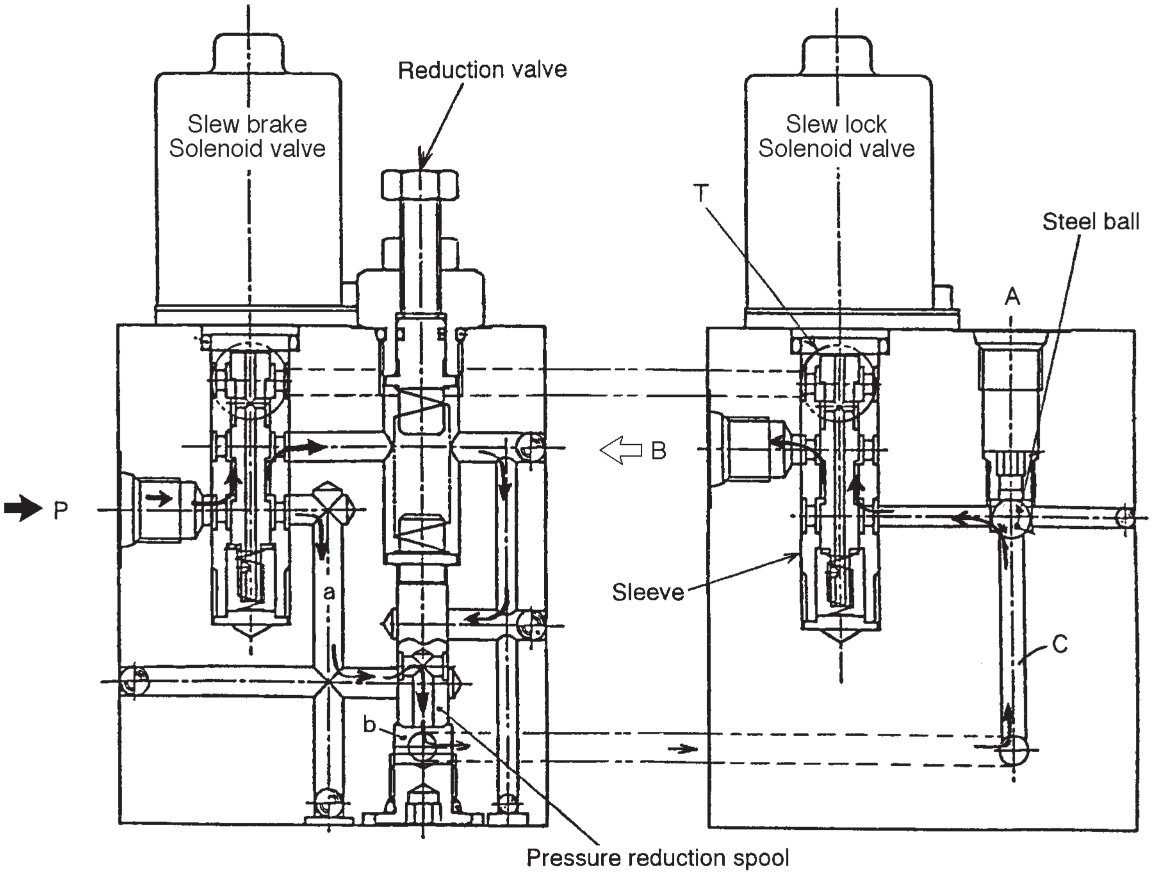
* Hydraulic Brake Release

The pilot pressure (40 kgf/cm2) enters **P** port of **A** section and passes through the outer periphery of the sleeve of the solenoid valve for slew brake and enters passageway **a**.

It then passes the lower side of the inner passage way of the reducing spool and enters gallery b. Gallery **b** is connected to the **C** passageway of the **B** section.

The pressurised oil which entered **C** passageway pushes up the steel ball and passes through the outer periphery of the spool of the solenoid valve for slew lock and exhausts through **B** port. The pressure of 40 kgf/cm2 enters the brake gallery of the slew motor and releases the mechanical brake.





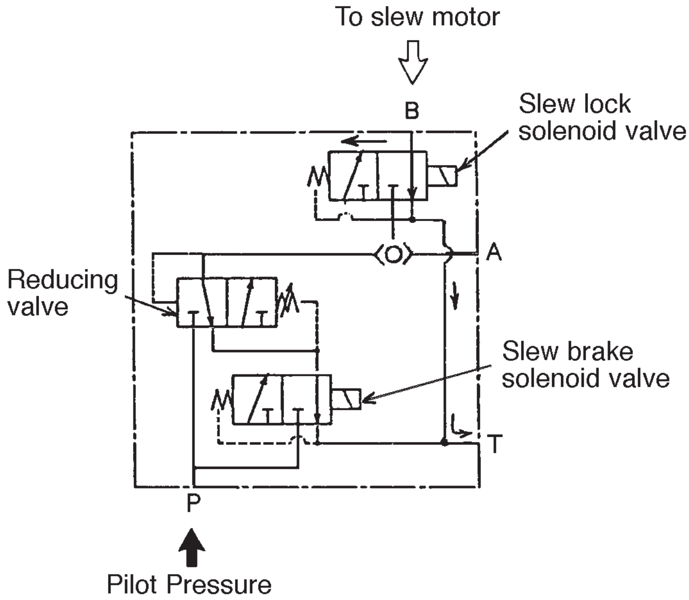
Operation *(continued)*

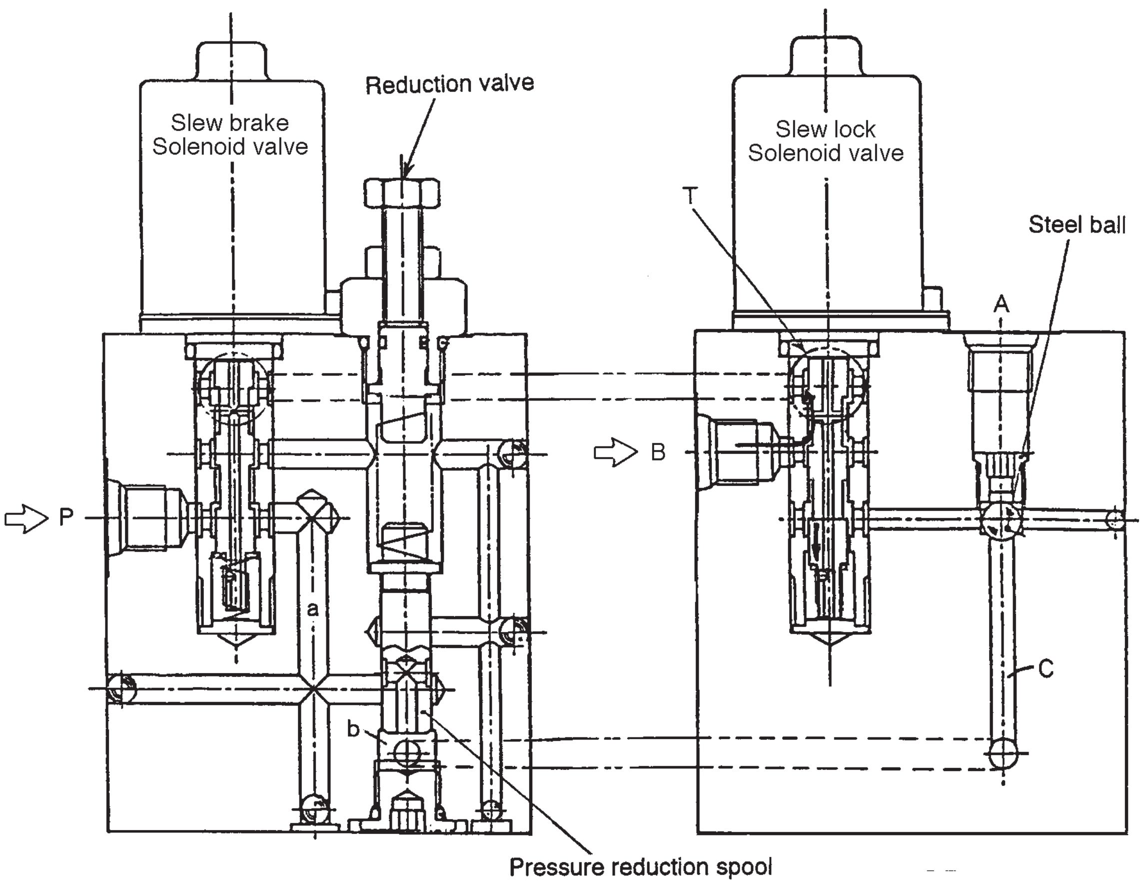
* **Hydraulic Slew Brake - 100% Engagement**

When the solenoid valve for slew lock is put **ON** (locking the slew lock switch), the spool moves downwards. The pressurised oil from passageway **C** is stopped by the spool.

Also, the pressurised oil from port **B** of the slew motor flows through the spool passage and to the tank port.

Because the pressurised oil for brake release runs off to the tank due to the solenoid for slew lock being selected, the slew motor brake gallery pressure is fully applied onto the brake.





Operation *(continued)*

*** Hydraulic Slew Brake - 50% Engagement**

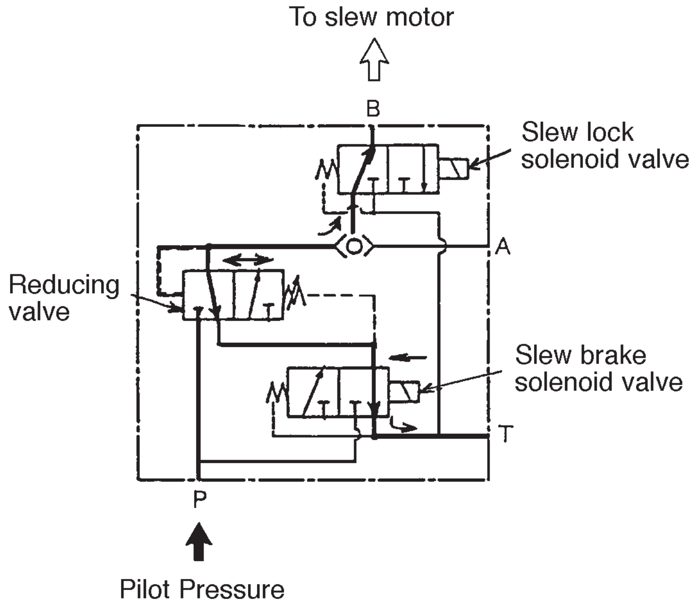
When the slew lever is placed in neutral and 5 seconds have passed, an electric signal enters the solenoid valve for slew brake from the controller and the spool is selected. *(In the figure, it moves down-ward)*.

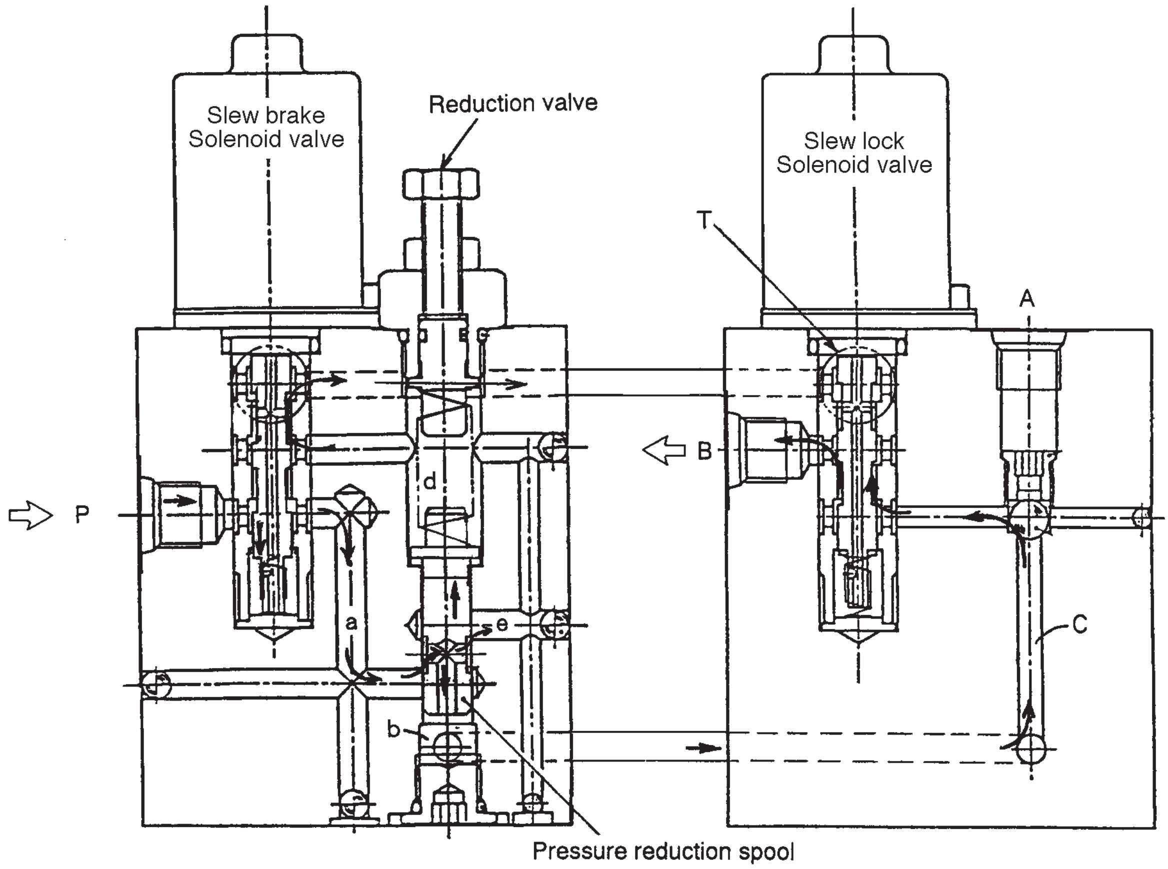
The oil of the spring cavity **d** of the reducing pressure spool is connected to the tank passageway.

The pressurised oil which enters through **P** port flows to gallery **a** , **b** and tries to push up the reducing spool.

The pressurised oil is throttled from gallery **b** and flows to **e** and **d** and then the tank. Also, it flows from gallery **b** to **c** to the solenoid valve for slew lock to **B** to the brake gallery of the slew motor.

The reducing valve rises by a set amount only and oil enters the brake gallery of the slew motor, applying the brake at 50%.





Specifications

Ram	JS200/JS200LC		JS240/JS240LC	
Boom Ram Left & Right	Cylinder Inside Diameter:	125mm	Cylinder Inside Diameter:	130mm
	Rod Diameter:	85mm	Rod Diameter:	90mm
	Max. Contraction:	1790mm	Max. Contraction:	1843mm
	Stroke:	1295mm	Stroke:	1278mm
	Dry Weight:	176kg	Dry Weight:	214kg
Dipper Ram	Cylinder Inside Diameter:	135mm	Cylinder Inside Diameter:	150mm
	Rod Diameter:	100mm	Rod Diameter:	105mm
	Max. Contraction:	2150mm	Max. Contraction:	2234mm
	Stroke:	1580mm	Stroke:	1632mm
	Dry Weight:	275kg	Dry Weight:	341kg
Bucket Ram	Cylinder Inside Diameter:	120mm	Cylinder Inside Diameter:	135mm
	Rod Diameter:	80mm	Rod Diameter:	90mm
	Max. Contraction:	1583mm	Max. Contraction:	1687mm
	Stroke:	1012mm	Stroke:	1073mm
	Dry Weight:	146kg	Dry Weight:	211kg

Precautions during use JS200/JS240

1. Precautions when installing the ram on the machine

When installing and removing from the machine, suspend the ram safely.

Suspending the ram by the piping is not only dangerous, but can also cause damage to the cylinder.
Secure the rod with a band. It is very dangerous if the rod should fly out unexpectedly. Also, the rod can be damaged and become unusable.

Welding after installing the ram may result in damage.

If electric welding is done even at a point away from the ram, there may be sparking inside the ram and it will become necessary to replace the ram with a new one.

When painting the machine, mask the ram.

If paint adheres to the rod surface or to the wiper ring and the ram is worked, the wiper ring cannot function properly and foreign matter from the outside and paint can easily enter the ram and cause damage to the seals, drastically shortening the life of the ram.

Install the ram only when it is clean.

2. Caution During Use

Use only under designated conditions.

If hydraulic oil other than the designated oil is used, the seals quickly degenerate and become damaged. If the relief valve is set at a value higher than specified, it may cause ram damage and is dangerous.
In high temperature environments (Approx. 90°C and above) or low temperature environments (Below -20°C), seals quickly become damaged. Special seal materials are necessary so check to see if the ram that you are using is suitable or not.
The number one cause of ram oil leakage is due to rod damage. Be careful not to damage the rod.

Warm up sufficiently before beginning work.

In cold conditions the rod seals may be frozen so if the ram is operated at maximum pressure and maximum speed, the seals will be damaged.
There is a large amount of air in a new ram or one which has been left for a long time, so the ram will not operate smoothly. Also, if pressure is applied suddenly without bleeding the air, high temperature will be generated due to adiabatic compression and the seals may burn.
Before beginning work, always move the ram at full stroke with no load and expel air from the cylinder.

When stopping or storing, do it at a safe and fixed position.

The installed ram cannot maintain the same position for a long period of time.
The oil inside the ram may leak and due to the temperature change in the hydraulic oil, the hydraulic oil volume changes. For that reason, the ram expands and contracts, causing unexpected movement to the machine which is dangerous. Stop or store the machine in a safe and fixed position.

3. Maintenance, Inspection Points.

Carry out daily maintenance and inspection.

The key point for correct long-term ram function is daily maintenance and inspection. Carry out maintenance and inspection so that the ram functions fully at all times. Always remove any mud, water, dust or oil film adhering to the rod and keep it in normal condition. However, when cleaning the wiper ring and seals, do not get them wet with water but wipe clean with a rag. If leaving for more than one week, apply anti-rust oil to the rod surface.

Use genuine JCB parts when replacing parts.

If parts other than genuine JCB parts are used, the desired results may not be obtained. Use only genuine JCB parts.

Caution during disassembly and reassemble.

Disassembling the ram while it is still installed on the machine can be dangerous as unexpected movements of the machine can occur. Remove the ram from the machine and then disassemble.
If reassembled with dirty hands, foreign matter can enter the ram causing a shorter life span and also the other hydraulic equipment may be damaged. Reassemble in a clean state.
Follow the instructions in the diagrams regarding torque tightening for screwed parts. If the torque is too high or too low, it can cause damage.

Bucket Ram
Removal

WARNING
Hydraulic Pressure

Hydraulic fluid at system pressure can injure you. Before disconnecting or connecting hydraulic hoses, stop the engine and operate the controls to release pressure trapped in the hoses. Make sure the engine cannot be started while the hoses are open.

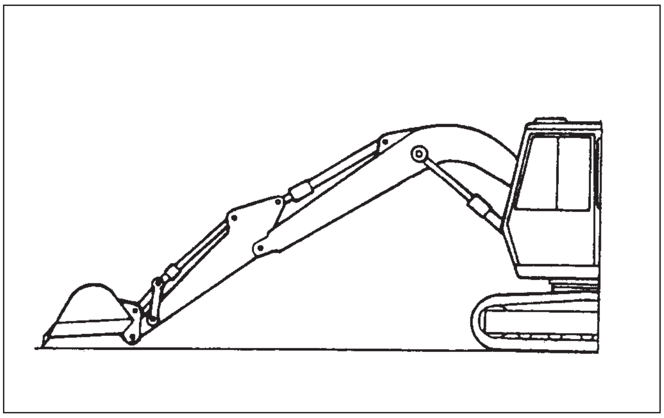
INT-3-1-11/1

WARNING
Lifting Equipment

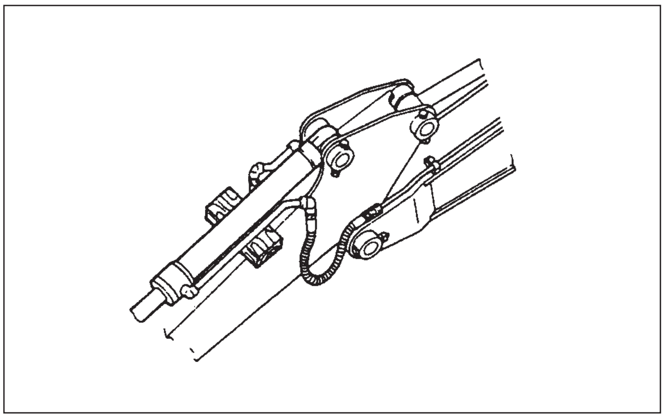
You can be injured if you use faulty lifting equipment. Make sure that lifting equipment is in good condition. Make sure that lifting tackle complies with all local regulations and is suitable for the job. Make sure that lifting equipment is strong enough for the job.

INT-1-3-7

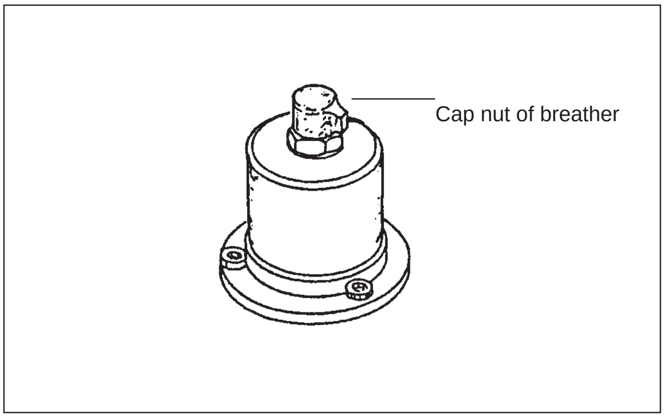
1. Prepare the Machine, and lower the attachment to the ground.



2. Place a wooden block under the bucket ram.

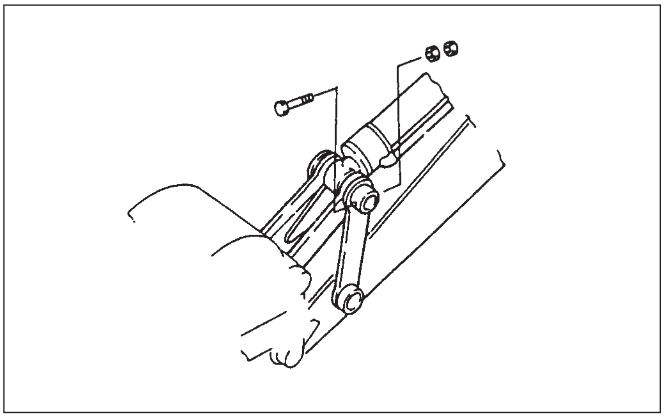


3. Stop the engine, remove the key.
Release the Tank pressure, ***see Releasing the Tank Pressure***.

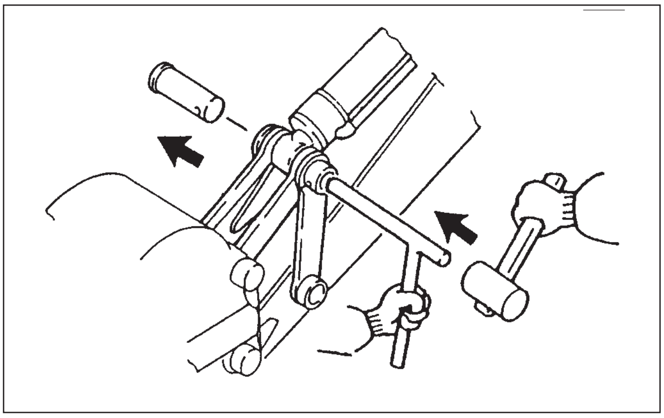


Bucket Ram *(continued)*

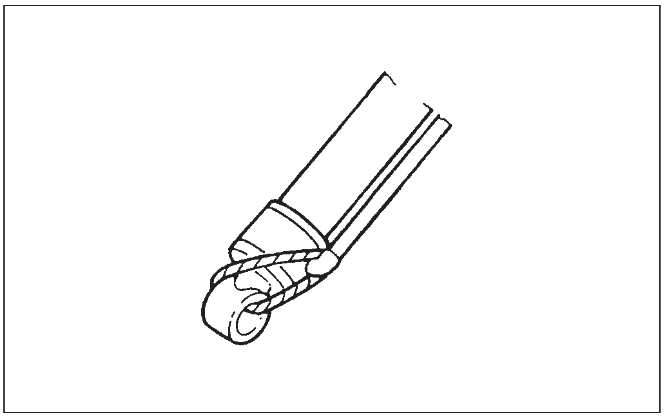
4. Remove nuts and bolts.



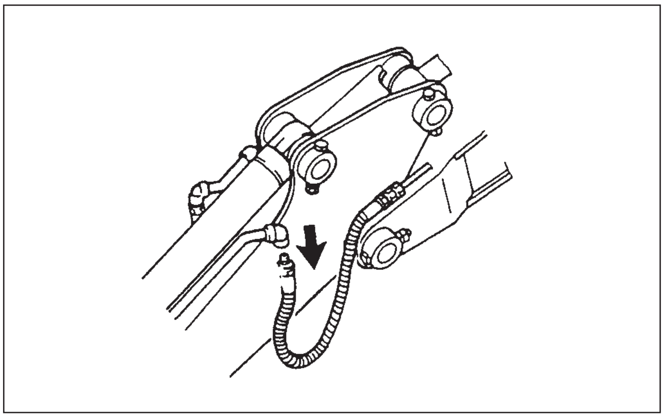
5. Push the pin out using a bar and hammer.



6. Restrain the eye end of the bucket ram rod to the ram cylinder to prevent the ram rod from extending.

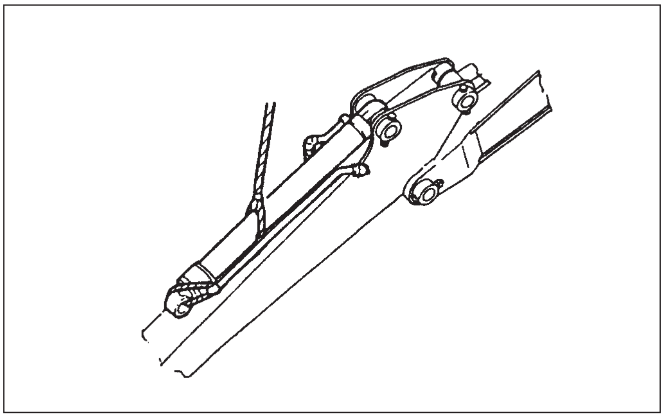


7. Remove the bucket ram hoses, and install plugs or caps to prevent contamination.

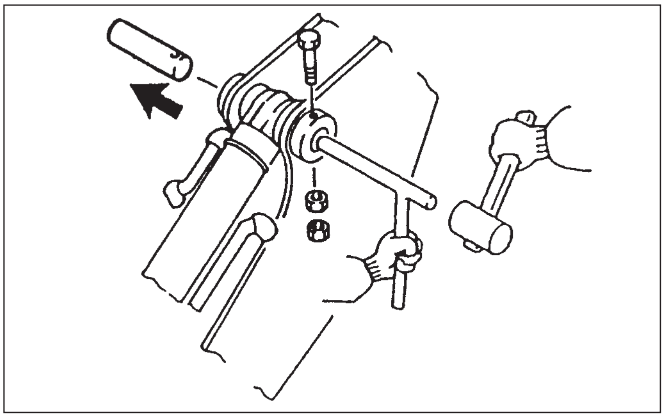


Bucket Ram *(continued)*

8. Attach a sling and lift the bucket ram.

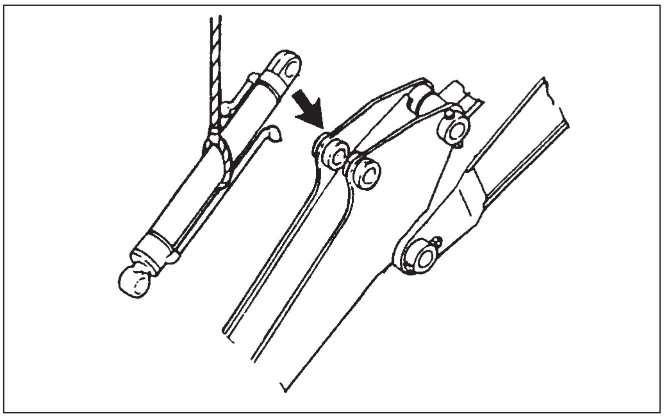


9. Remove the nuts and bolts. Push out the pin using a bar and hammer.

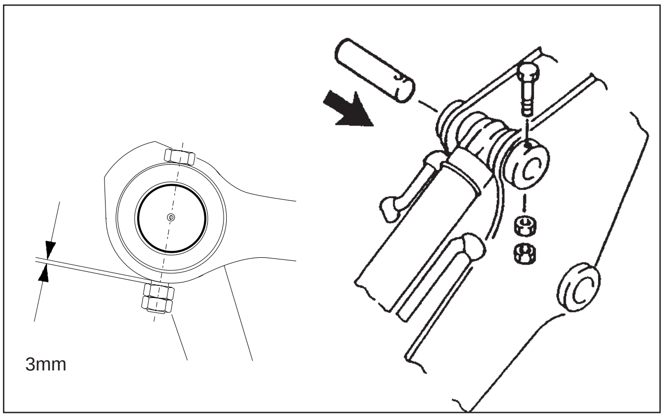


Installation

1. Attach a sling to the bucket ram and lift it into the dipper.

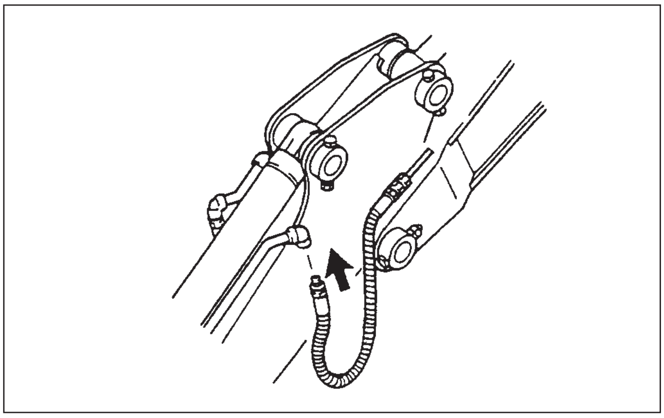


* **2.** Install the pin, bolt and nuts. When checking or refitting JS machine pivot pins, the retaining nuts and bolts should not be fastened up tight but must have approximately 3mm of play so that the pin is free from tension.

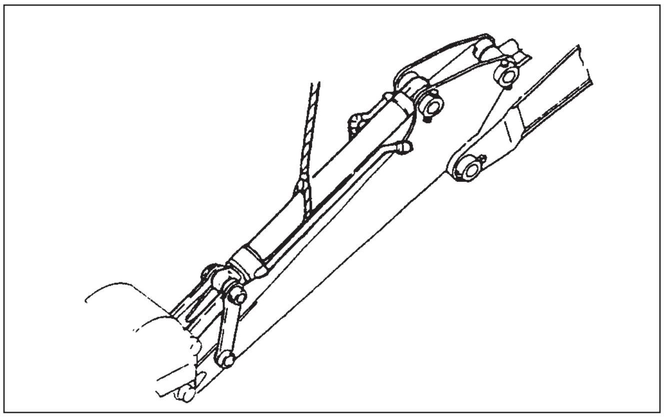


Bucket Ram *(continued)*

3. Connect the hose to the bucket ram.

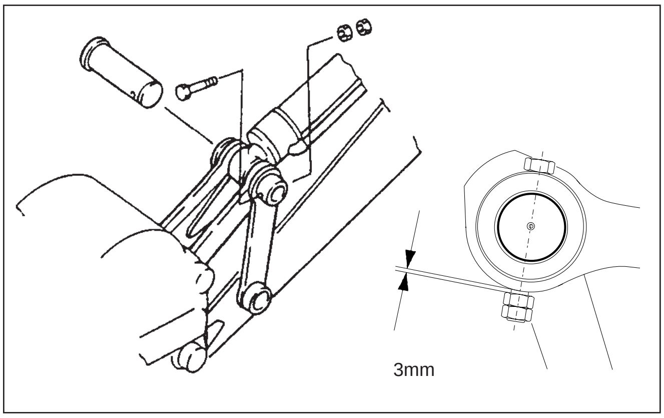


4. Hoist the bucket ram to align with the link.



* **5.** Install the pin, bolt and nuts. When checking or refitting JS machine pivot pins, the retaining nuts and bolts should not be fastened up tight but must have approximately 3mm of play so that the pin is free from tension.

Note: *Stroke the ram to release entrapped air. After releasing the air, check for oil leakage*



Dipper Ram

WARNING

Hydraulic Pressure

Hydraulic fluid at system pressure can injure you. Before disconnecting or connecting hydraulic hoses, stop the engine and operate the controls to release pressure trapped in the hoses. Make sure the engine cannot be started while the hoses are open.

INT-3-1-11/1

WARNING

Lifting Equipment

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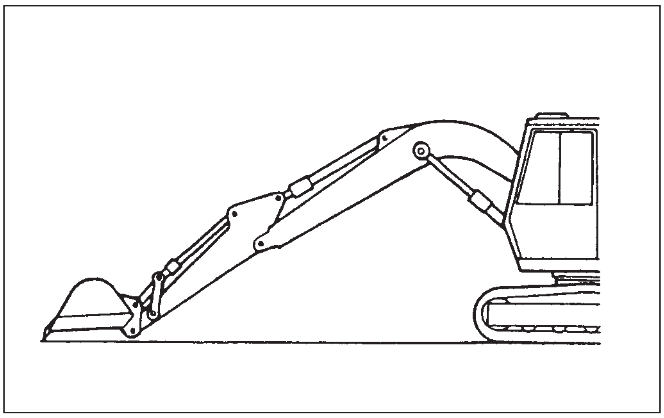
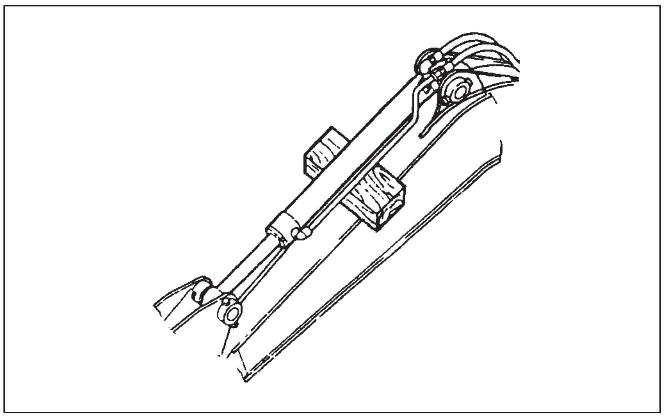
INT-1-3-7

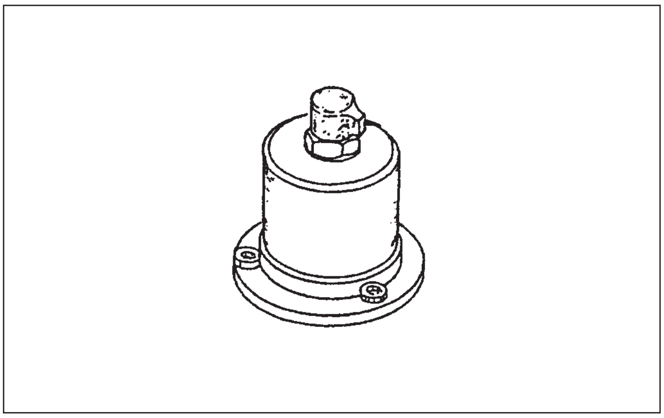
1. Prepare the Machine, and lower the attachment to the ground.



2. Place a wooden block under the Dipper ram.

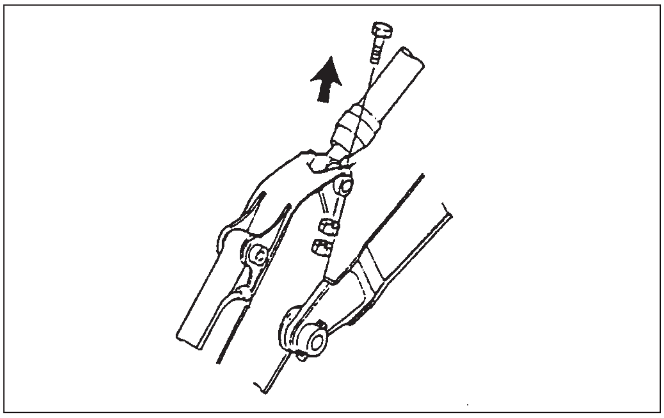


3. Stop the engine, remove the key.
Release the Tank Pressure.
See Releasing the Tank Pressure.

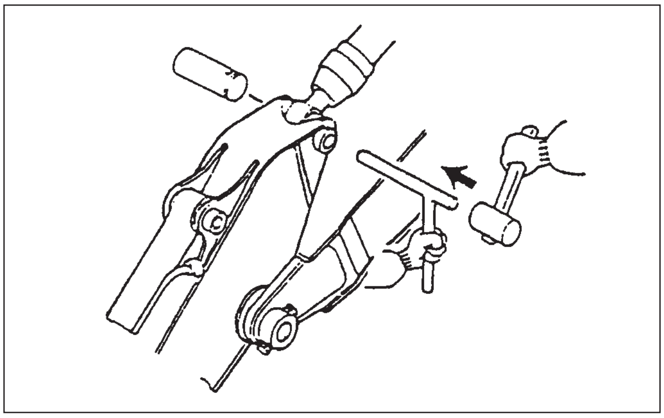


Dipper Ram *(continued)*

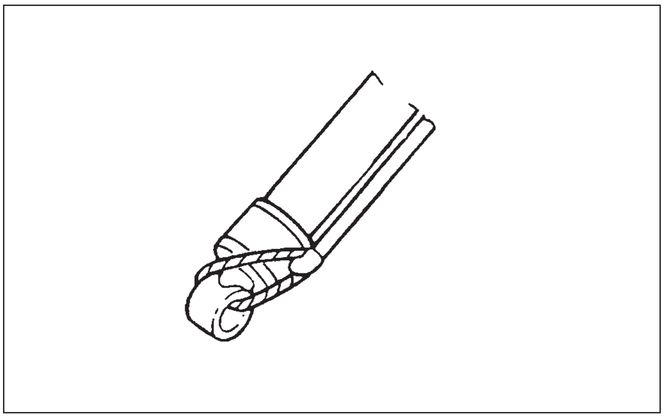
4. Remove the nuts and bolts.



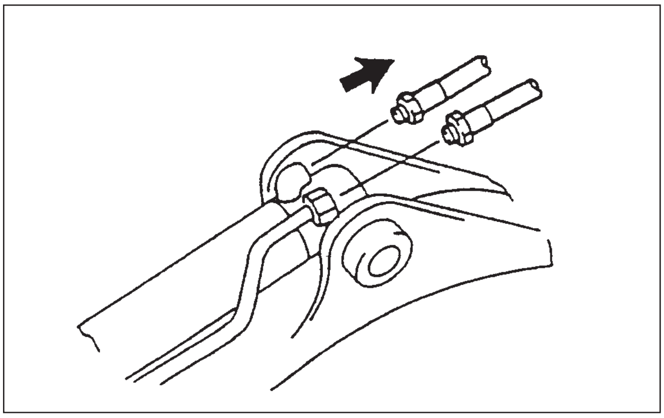
5. Push out the pin, using a bar and hammer.



6. Restrain the eye end of the Dipper ram rod to the ram cylinder to prevent the rod from extending.

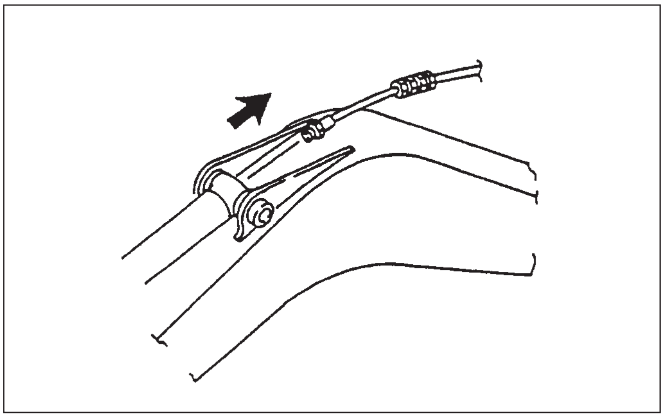


7. Remove the Dipper ram hoses, and install plugs or caps to prevent contamination.

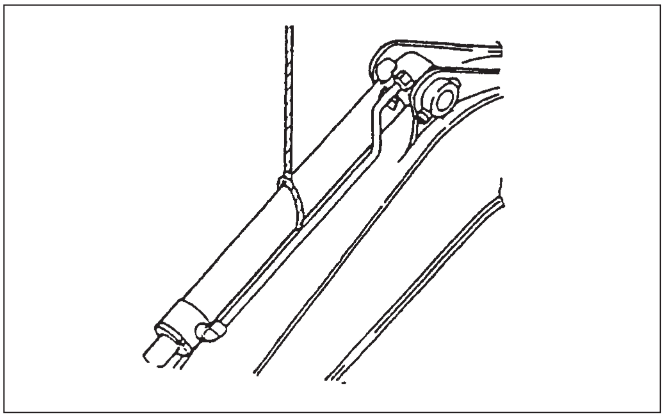


Dipper Ram *(continued)*

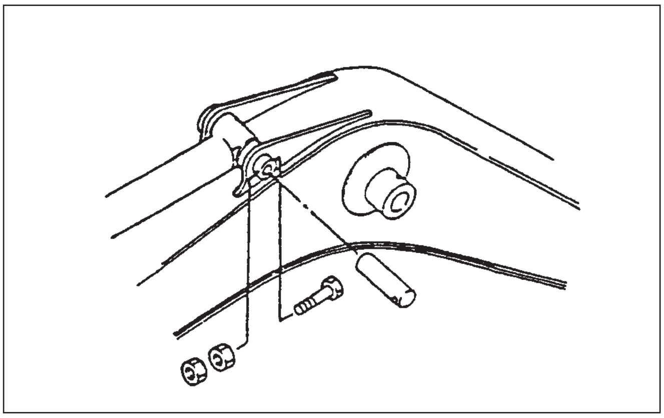
8. Remove the grease tube, from the Dipper ram.



9. Attach a sling and lift the Dipper ram.

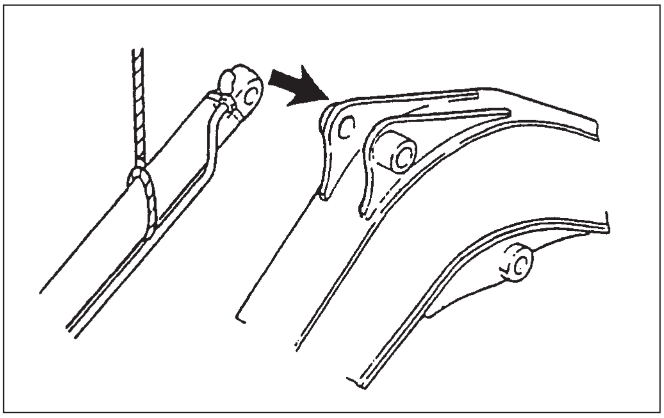


10. Remove the nuts and bolts, push out the pin using a bar and hammer. Lift the ram from the boom.



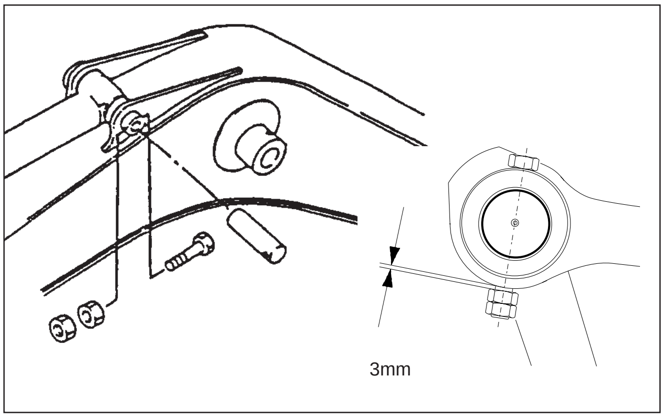
Installation

1. Attach a sling and lift the Dipper ram onto the boom.

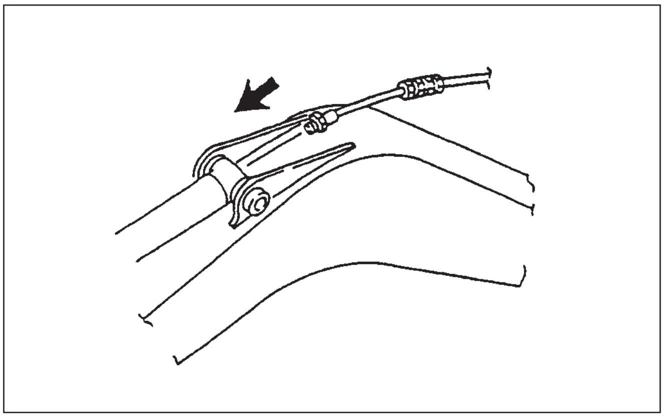


Dipper Ram *(continued)*

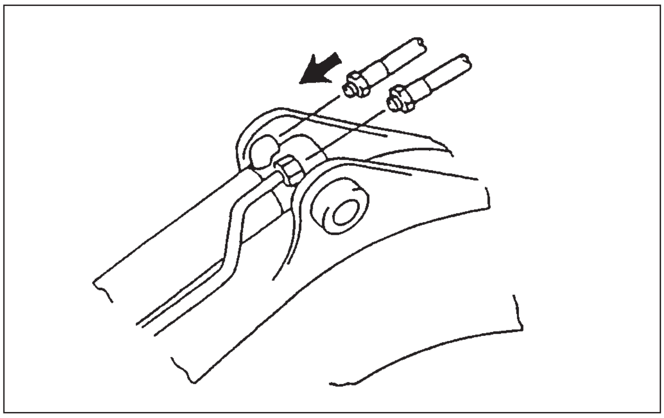
* **2.** Install the pin, bolts and nuts. When checking or refitting JS machine pivot pins, the retaining nuts and bolts should not be fastened up tight but must have approximately 3mm of play so that the pin is free from tension.



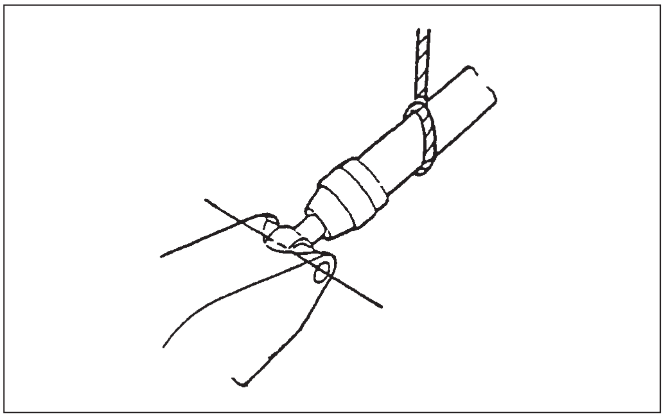
3. Install the grease tube to the Dipper ram.



4. Connect the hoses to the Dipper ram.



5. Hoist the Dipper ram to align the ram eye end with the dipper pin position.

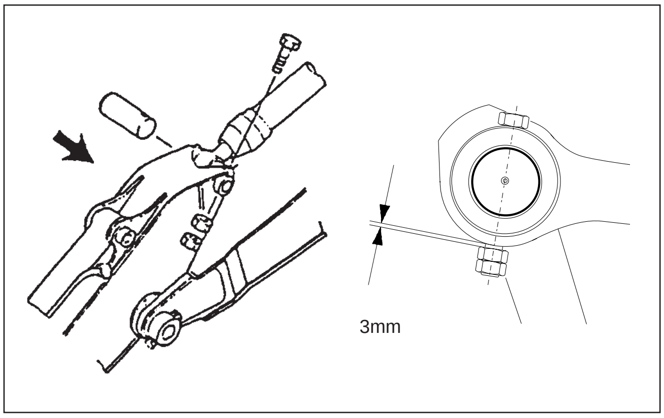


Dipper Ram *(continued)*

*

6. Install the pin, bolt and nuts. When checking or refitting JS machine pivot pins, the retaining nuts and bolts should not be fastened up tight but must have approximately 3mm of play so that the pin is free from tension.

Note: *Stroke the ram to release entrapped air. After releasing the air, check for oil leakage.*



Boom Ram

⚠ WARNING

Hydraulic Pressure

Hydraulic fluid at system pressure can injure you. Before disconnecting or connecting hydraulic hoses, stop the engine and operate the controls to release pressure trapped in the hoses. Make sure the engine cannot be started while the hoses are open.

INT-3-1-11/1

⚠ WARNING

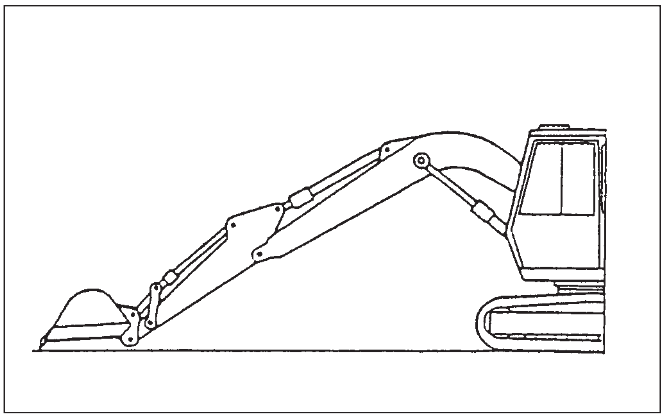
Lifting Equipment

You can be injured if you use faulty lifting equipment. Make sure that lifting equipment is in good condition. Make sure that lifting tackle complies with all local regulations and is suitable for the job. Make sure that lifting equipment is strong enough for the job.

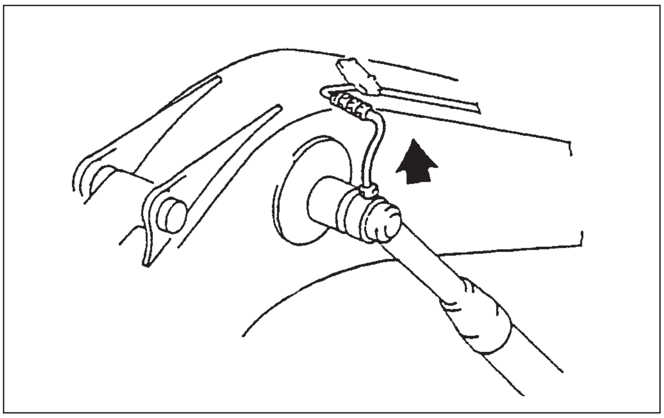
INT-1-3-7

1. Prepare the Machine, and lower the attachment to the ground.

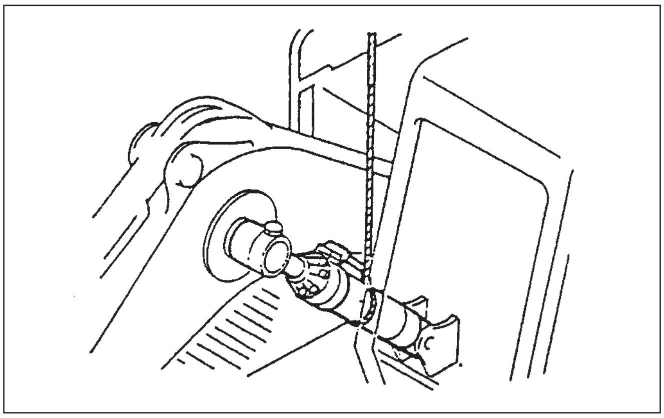
   Stop the engine, remove the key.



2. Remove the greasing tube.



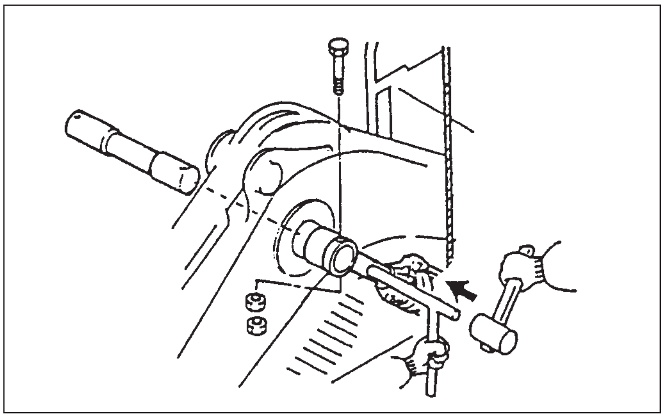
3. Attach a sling for lifting the boom ram.



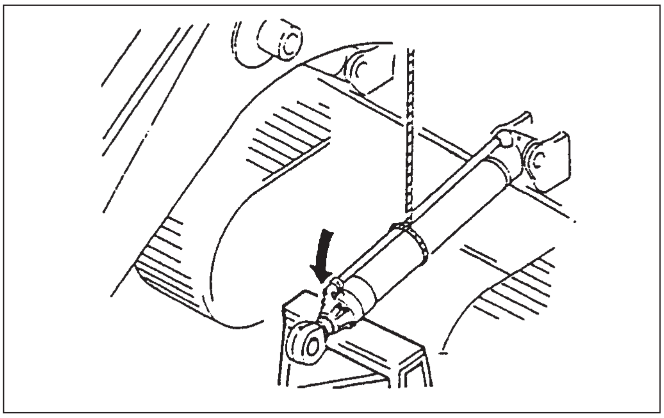
Boom Ram *(continued)*

4. a. Remove the nuts, bolt and collar.

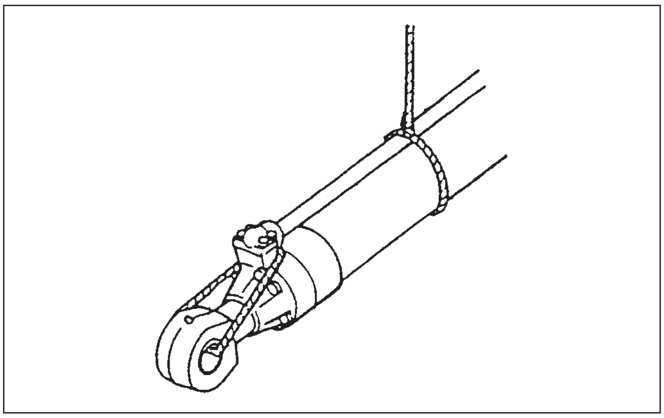
b. Push out the pin, using a bar and hammer.



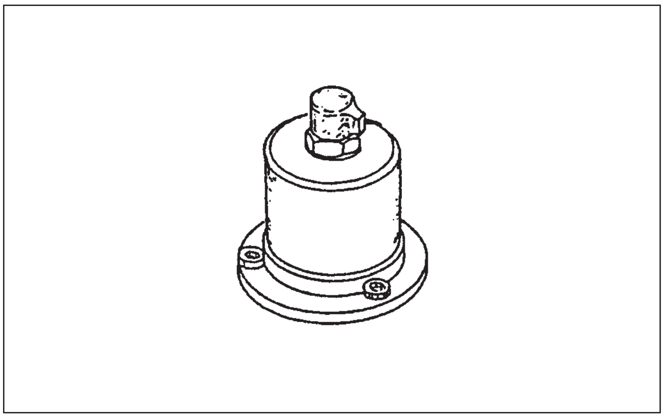
5. Lower the Boom ram and place it on a stand.



6. Restrain the eye end of the Boom ram rod to the ram cylinder, to prevent movement of the rod.

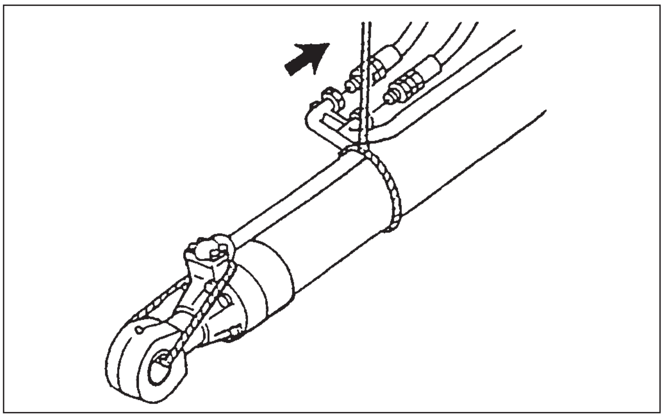


7. Release the Tank Pressure.
See Releasing the Tank Pressure.

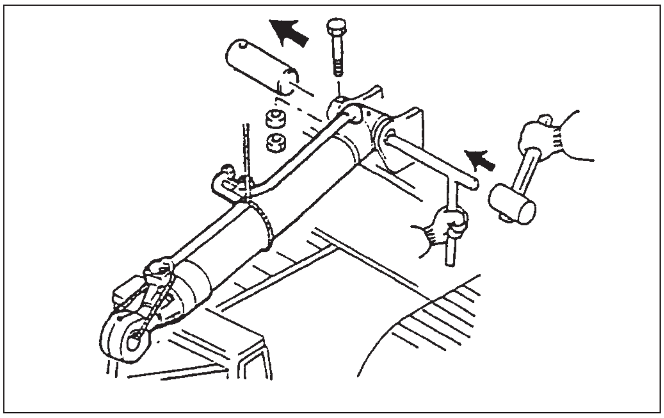


Boom Ram *(continued)*

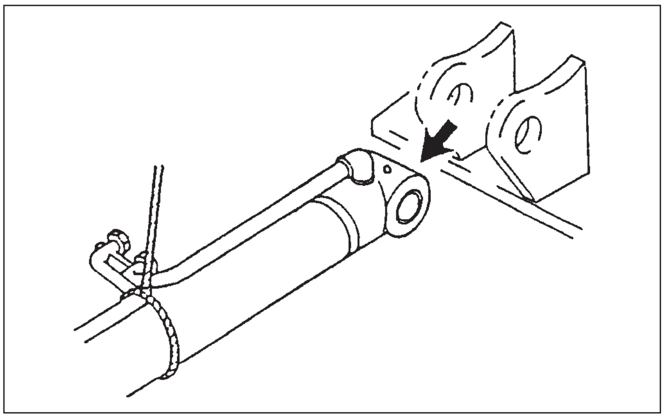
8. Remove the boom ram hoses, and install plugs or caps to prevent contamination.



9. Remove the nut and bolt and push out the pin with a hammer and bar.

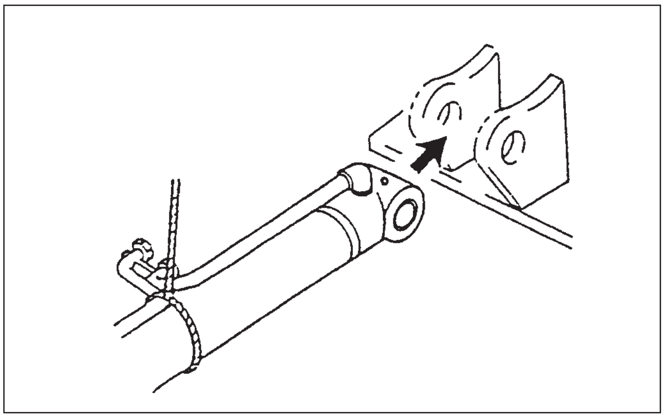


10. Lift the boom ram away from the unit.



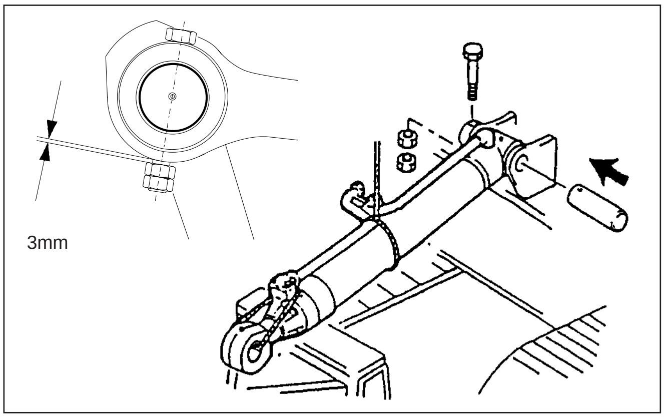
Installation

1. Attach a sling to lift the boom ram.
Align the main frame to the installation position.

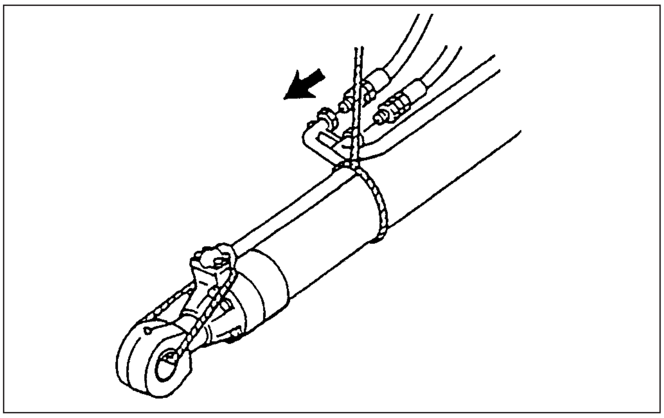


Boom Ram *(continued)*

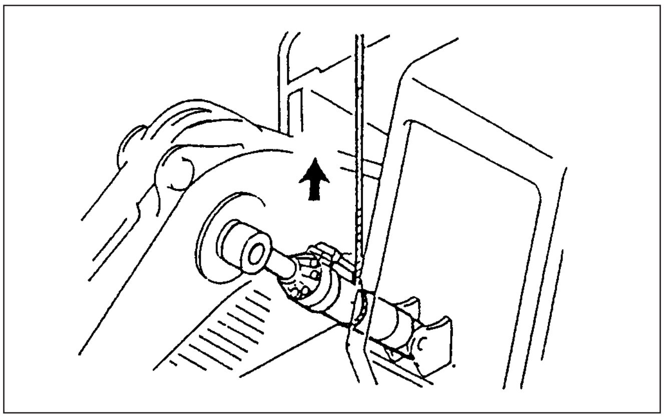
* **2.** Install the pin and then the bolt and nuts. When checking or refitting JS machine pivot pins, the retaining nuts and bolts should not be fastened up tight but must have approximately 3mm of play so that the pin is free from tension.



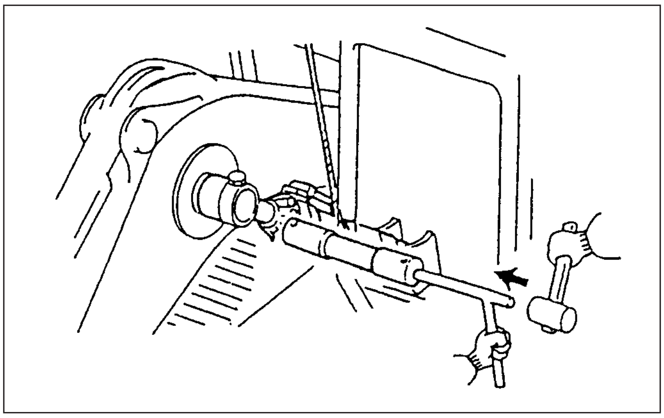
3. Install the hoses to the boom ram.



4. Lift the boom ram and align the rod eye end with boom pin position.

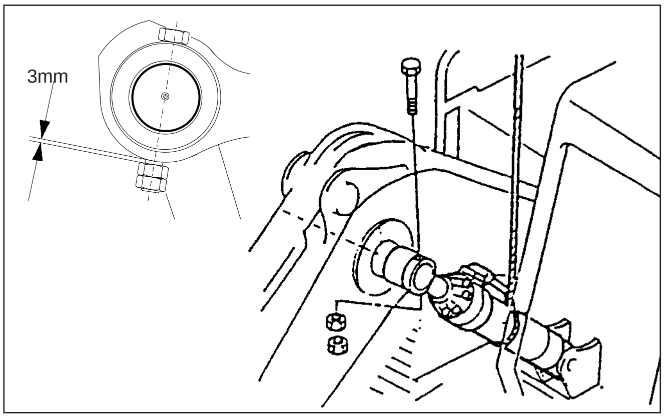


5. Install the pin with a bar and hammer.



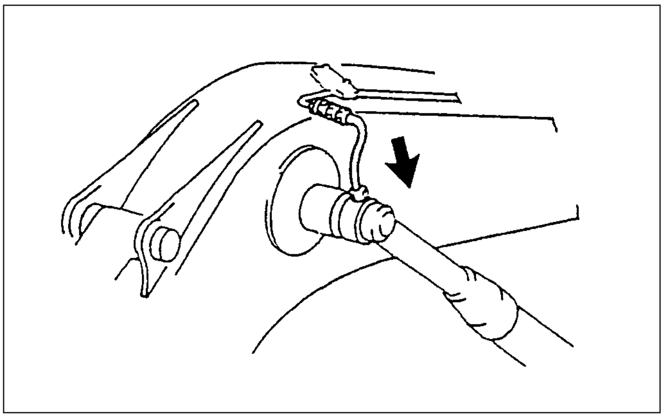
Boom Ram *(continued)*

* **6.** Install the collar and then the bolt and nuts. When checking or refitting JS machine pivot pins, the retaining nuts and bolts should not be fastened up tight but must have approximately 3mm of play so that the pin is free from tension.



7. Connect the greasing tube.

Note: *Stroke the ram and release entrapped air. After releasing the air, check for oil leakage.*



Disassembly JS200/JS240

Details of Service Tools used in the dismantling and Assembly procedures are given in **Service Tools**, Section 1 .

Before starting work, clean all surfaces with a suitable solvent and dry with compressed air.

Each part is precision made, so handle with care and do not force any part as this may cause damage.

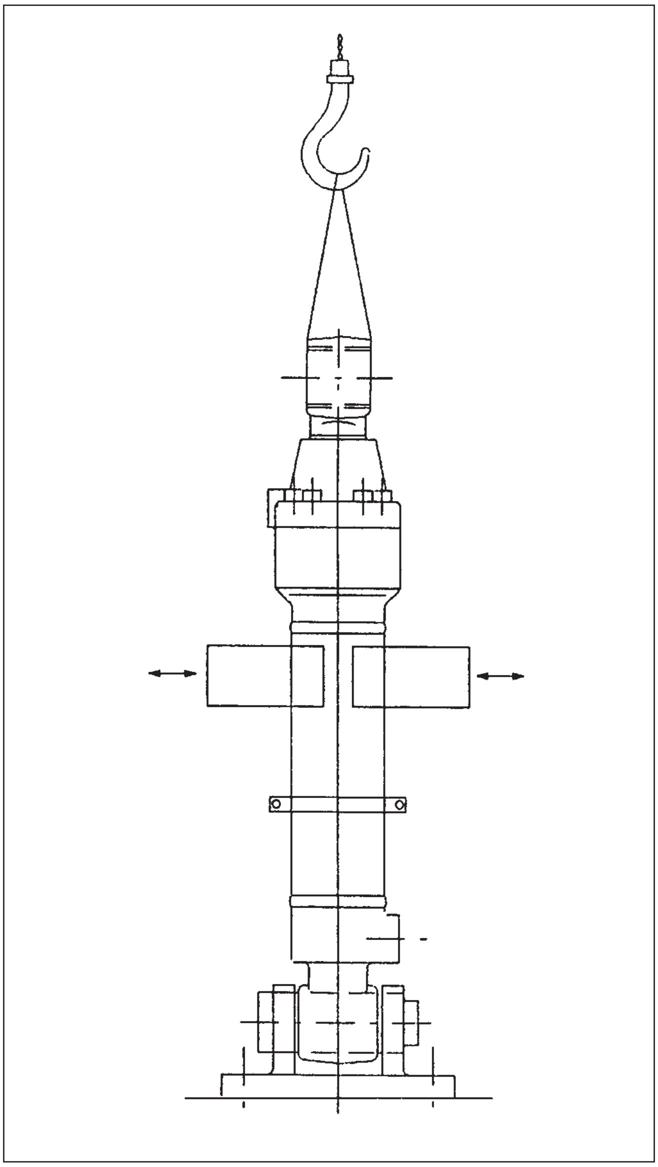
Protect the dismantled parts if they are to be left for a period of time.

1 Drain the oil

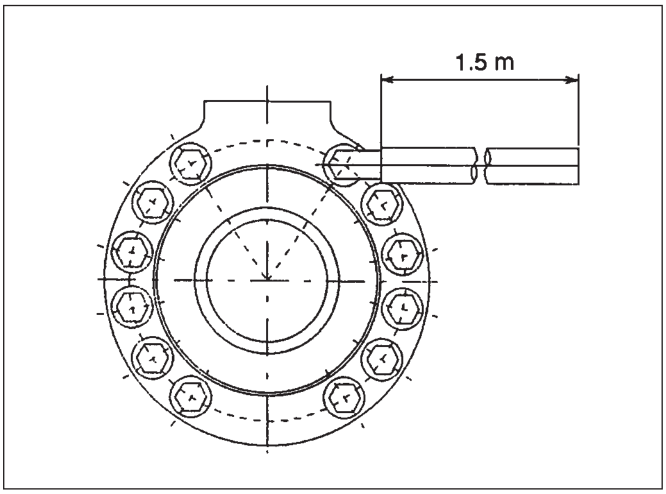
2 Disconnect the external piping.

3 Secure the ram.

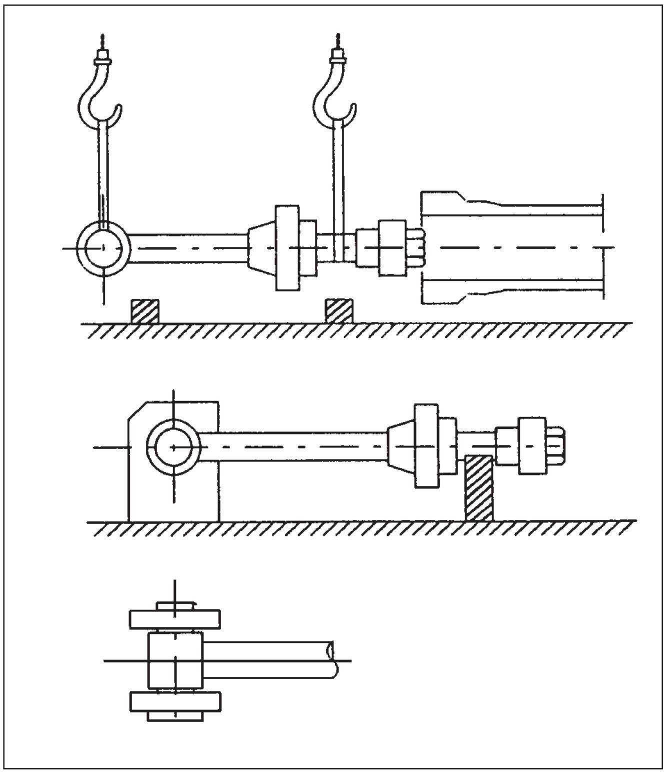
* **Note:** Fix the ram in a vertical or horizontal position. The vertical position is more favourable for disassembly/reassembly work. Use the bottom pin hole for preventing the ram from turning on its axis and for fixing the ram in the axial position.



* Remove the cylinder head cap screws (12 off) with an Allen wrench. Use an extension pipe such as shown in the figure below to facilitate bolt loosening.



Disassembly JS200/JS240 *(continued)*



4 **Remove the piston rod.**

Make sure that the piping ports are opened.

Catch the oil coming out from the rod side (cylinder head side) port.

With the piston rod extended fully, remove the cylinder head carefully.

Lay down the piston rod and the cylinder head together on wood blocks.

* **Note:** Once all the bolts are removed, do not lift the piston rod, as the cylinder may fall suddenly when separating.

WARNING

* **You can be injured if you use faulty lifting equipment. Make sure that lifting equipment is in good condition. Make sure that lifting tackle complies with all local regulations and is suitable for the job. Make sure that lifting equipment is strong enough for the job.**

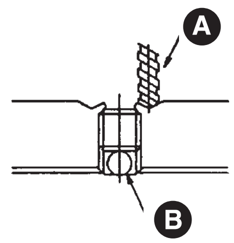
INT-1-3-7

WARNING

* **Raised equipment can fall and injure you. Do not walk or work under raised equipment unless safely supported.**

13-1-1-6

When pulling out the piston rod from a horizontally positioned ram, be careful to prevent the rod from falling just after it leaves the cylinder. During removal of the piston rod, support it horizontally on blocks.

* 

JS00120

* 5 **Secure the piston rod.**

Use the flat rod head or the rod end eye to prevent the piston rod from rotating.

* 6 **Remove the piston nut.**

Remove the set screw, noting the following:

After being installed, the set screw is crimped at two places with a punch.

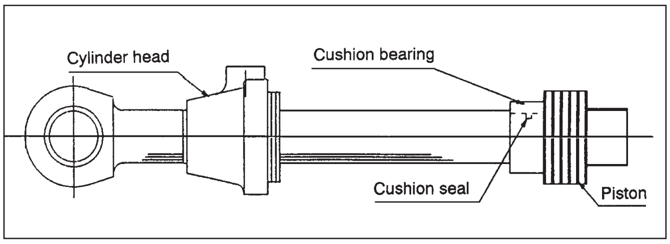
Remove the crimped portions with a drill **A**, then loosen the set screw. Remove the steel ball **B** located below the end of the set screw.

Remove the piston nut.

* **Note:** The piston nut was torque tightened on assembly. A torque 1.5 times the tightening torque is necessary to loosen the piston nut. Prepare a power wrench using a hydraulic cylinder (see **Ram Piston Head Nut - Removal and Fitting**).

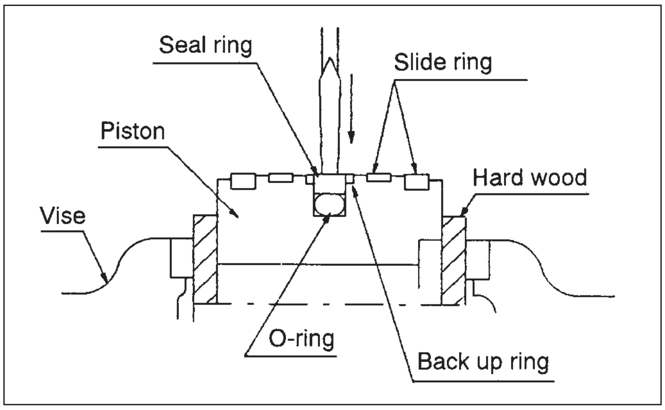
Disassembly JS200/JS240 *(continued)*

Remove the piston, cushion bearing, cushion seal, cylinder head in that order. *(There is no cushion seal for the bucket ram)*.



7. **Remove the piston seal.**
   The slide ring can be easily removed by hand.
   To move the seal ring, put a screwdriver against the seal ring as shown and hammer the driver until the seal ring is cut out.
   Remove the 'O'-ring by prying it with a pry bar.

Note: *Discard the removed seals. Do not reuse.*

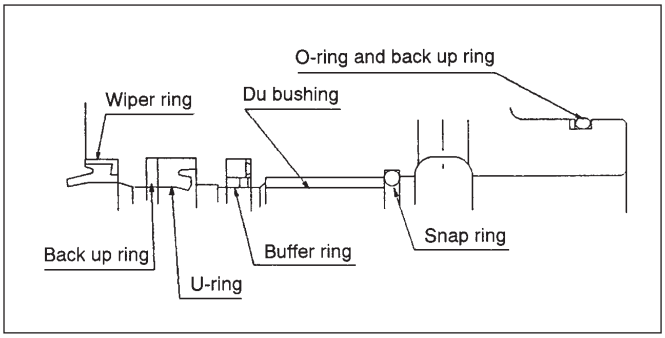


8. **Remove the buffer ring.**
   A buffer ring *(Teflon ring)* is installed in a groove in the cylinder head inside wall. To remove, thrust a sharp-tipped tool into the buffer ring, pull out the ring from the groove to allow insertion of a pry bar under the ring and pry the ring out with a pry bar.

Note: *Discard the removed seals.*

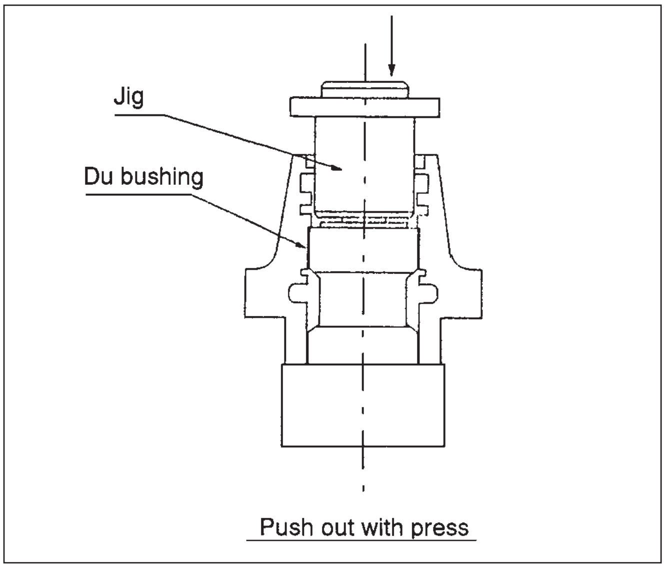
9. **Remove the U-ring, back up ring and wiper ring.**
   Remove the U-ring and back up ring with a screwdriver.
   To remove the press-fitted wiper ring, pull it out after thrusting a sharp-tipped tool such as a screwdriver into the rubber of the ring.

Note: *Discard the removed seals.*



10. **Removing the Du bushing.**
    Pry the snap ring with a screwdriver and remove it from the cylinder head.
    Remove the Du bushing using a jig and push out with a press.

Note: *Cleaning and storage.*
After cleaning the removed parts with Kerosene, coat with hydraulic oil and cover for storage.
If left as disassembled, rust and dust may adhere and prevent full performance after reassembly.



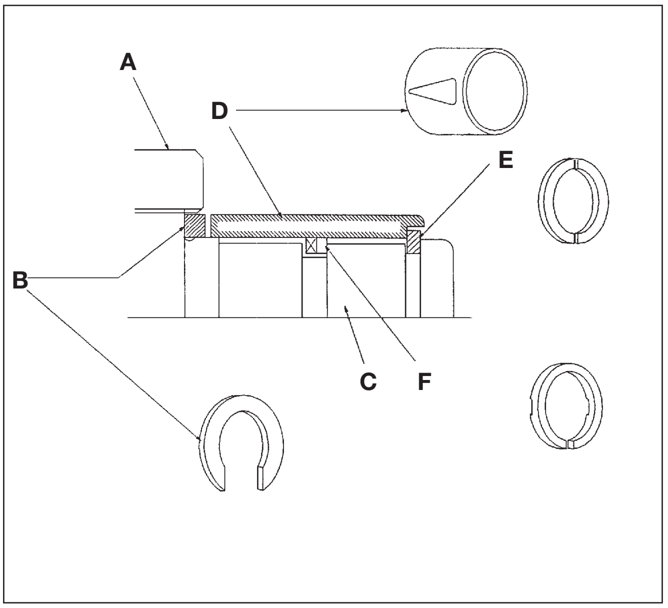
Disassembly JS200/JS240 *(continued)*

11. Dismantling the retraction side cushion (dipper ram). When there is a cushion bearing installed on the piston rod, after removing the nut **A**, disassemble as indicated below.

a. Tap the snap ring **B** on the piston rod end **C** with a plastic hammer and remove.

b. Push the cushion bearing **D** back so that the stopper **E** can be removed.

c. Pull off the cushion bearing **D** then widen the slit of the cushion seal **F** and remove.



Assembly JS200/JS240

Clean each part in a suitable solvent and dry using compressed air.

Inspect all parts and replace as required.

Care must be taken not to let dust or dirt adhere to parts after cleaning and that parts do not become dented, scratched or damaged.
Fit new 'O'-rings, and seals when assembling together with a new back up ring.

Take care to install the back up ring in the proper position.

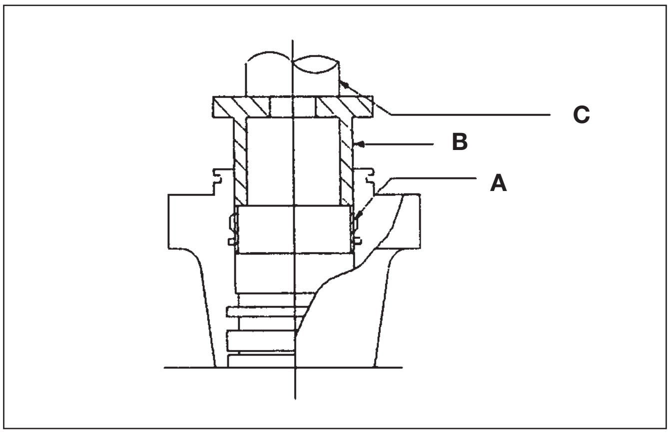
Apply grease and or hydraulic oil to all new oil seals and 'O'-rings, and clean hydraulic fluid to all sliding parts before installation.

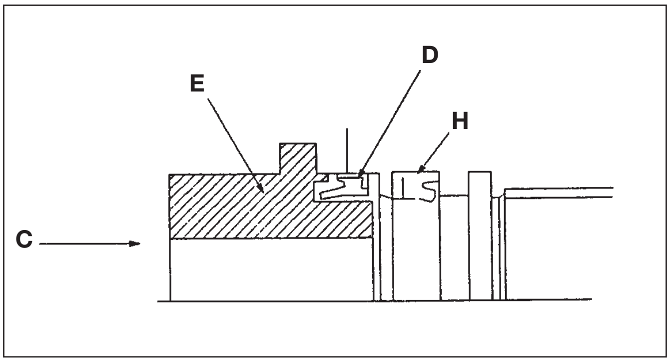
1. Cylinder head assembly.

a. Assemble the Du bushing **A** using a jig **B** and press **C**.

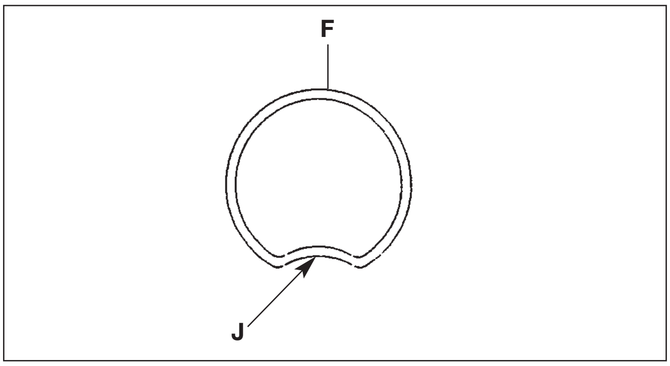
b. Assemble the wiper ring **D** using a jig **E** and press **C**.

c. Assemble the back up ring **F** and U-ring **G.**





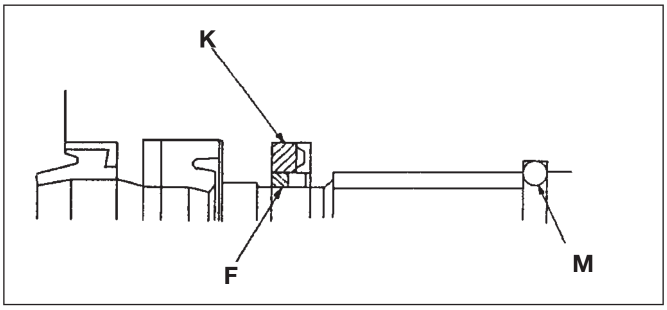
2. Buffer ring assembly.
Note: *After installing the square ring K in the groove, bend the buffer ring F into a U-shape (J) and set it in the groove H, then press on the outer circumference of the ring to fit it into place. Bending the ring in too small a radius causes wrinkles which remain in the ring after installation. Keep the bending radius at 6 mm or greater. Make sure there are no wrinkles in the ring after installation.*



Assembly JS200/JS240 *(continued)*

Note: *Be careful to install the seal in the proper direction. Installing it backwards causes extremely high pressure to build up between it and the U-ring and could cause deformation of the cylinder head.*

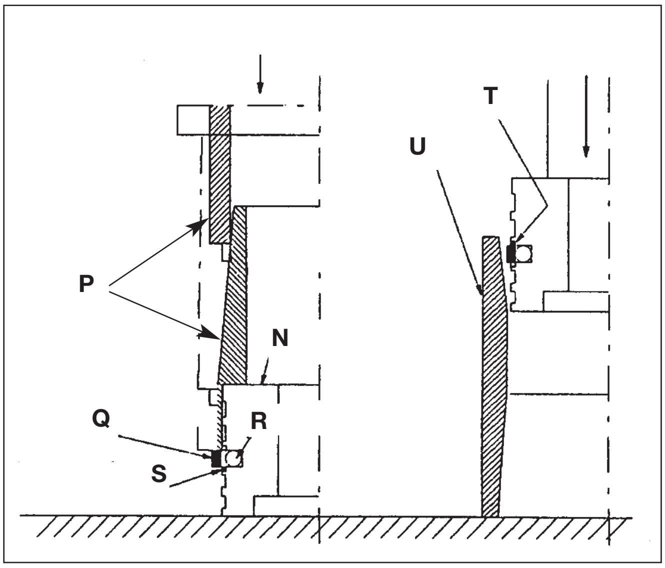
a. Install the snap ring **M** to prevent the Du bushing **A** from coming off.

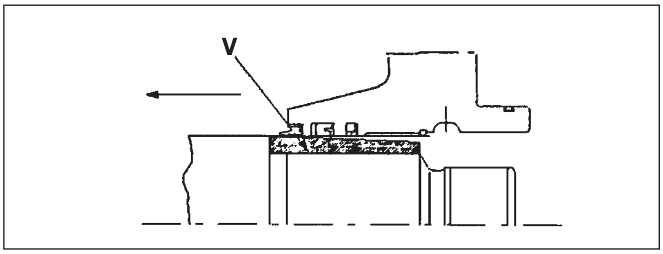


3. Piston Assembly.

a. Place the piston **N** on the press and using the jig **P** as shown, install the seal ring **Q** (pre-assemble the 'O'-ring **R** and one back up ring **S** beforehand).

b. After attaching the seal ring **Q** and one more back up ring **T**, correct the seal ring **Q** with the corrective jig **U** so that it does not remain extended.





4. Piston Rod Assembly.

a. Secure the piston rod.

b. Fit the cylinder head onto the piston rod using assembly jig **V**.

Note: *Do not get the wiper ring **D** and the O-ring **H**, caught on the stepped portion.*

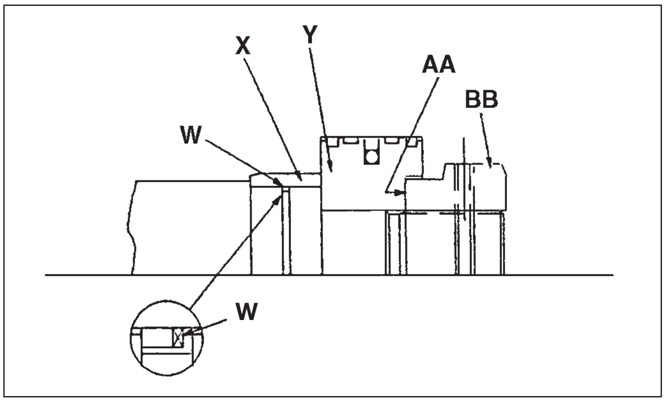
c. Fit the cushion seal **W**, cushion bearing **X** and piston **Y** in place.

Note: *The cushion seal W is unnecessary for the bucket cylinder.*

Where there is a cushion at the retraction side (end of piston rod), assemble the cushion bearing as detailed in paragraph 5 before fitting the piston **Y**.

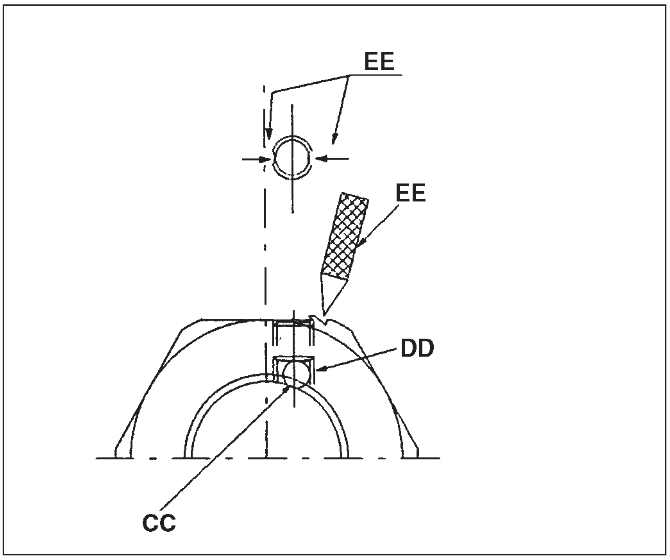
d. Insert a shim **AA** and tighten the piston nut **BB** to the specified torque.

Note: *Face the cushion seal slit **W** towards the piston side.*



Assembly JS200/JS240 *(continued)*

e. After tightening the piston nut **BB**, insert the steel ball **CC** and install the set screw **DD**, tighten it to the specified torque, then stake the set screw in two places with a punch **EE**.



5. Retraction side cushion assembly (dipper ram)

Where there is a cushion at the retraction side *(end of piston rod **JJ**)* assemble the cushion bearing as follows:

a. Expand the slit of the cushion seal **HH** and place the seal on the end of the piston rod **JJ**.

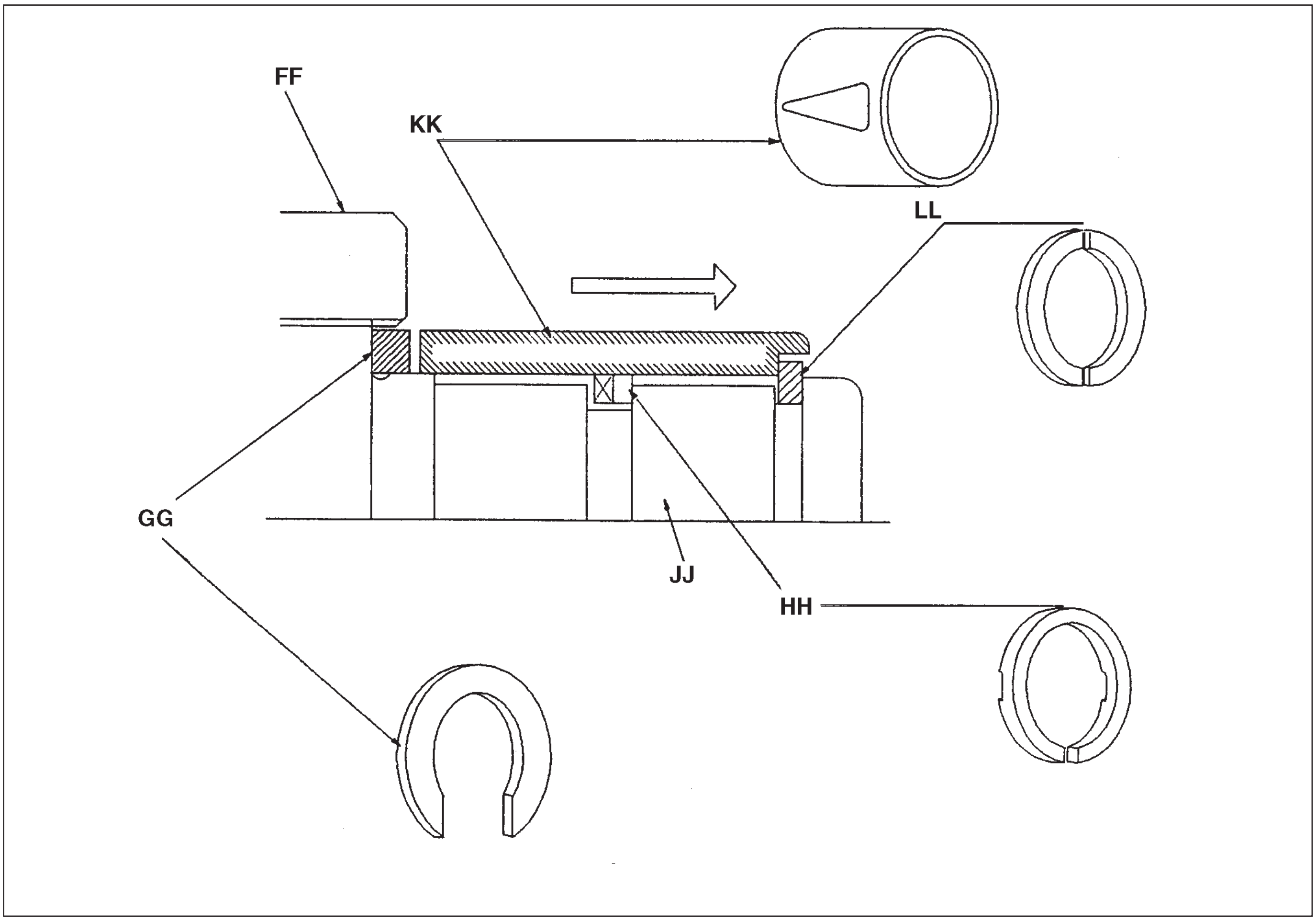
b. Insert the cushion ring **KK** on the **P** surface and install the stopper **LL**.

Note: *While fitting the stopper **LL**, take care that it does not break.*

c. More the cushion ring **KK** to the right until it is in contact with the stopper **LL**.

d. Tap the snap ring **GG** with a plastic hammer to install.

e. Install the piston nut **FF** after assembling the snap ring **GG**.



Assembly JS200/JS240 *(continued)*

6. Assemble the piston rod into the cylinder.

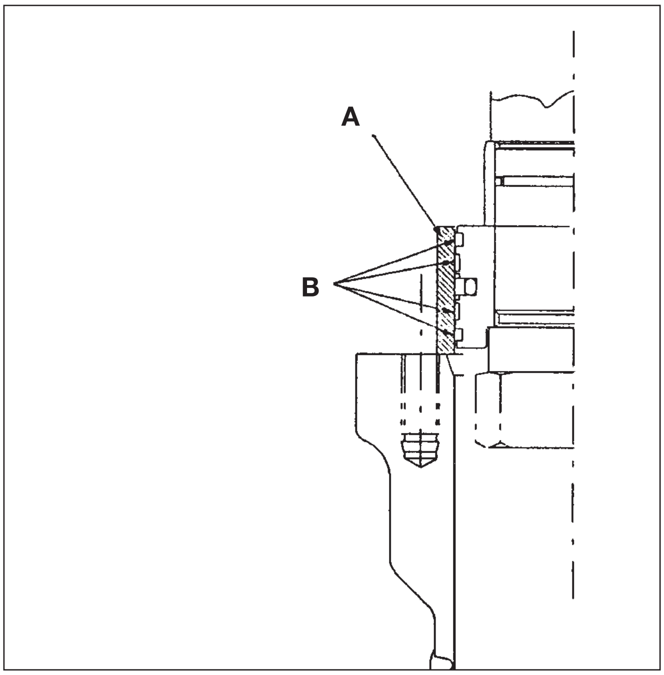
a. Secure the cylinder vertically or horizontally, insert the piston into the cylinder.

b. If the cylinder is vertical the piston rod will enter under its own weight. If horizontal, it must be helped in.

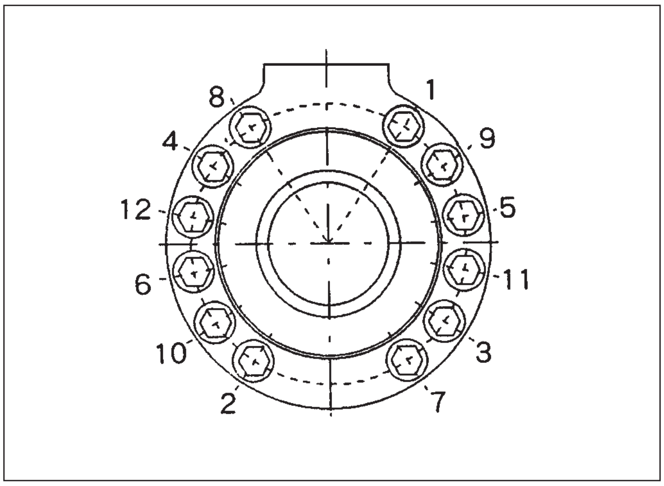
Note: *When inserting the piston into the cylinder take care to prevent the slide rings from falling off.*

c. Use a jig **A** (split nylon pipe) to compress the slide rings **B** during insertion.

e. Phase the gaps of slide rings **B** at 180°.



7. Position the cylinder head as shown.
Install the mounting bolts, temporarily tighten them in the order shown and re-tighten the bolts to the specified torque in the sequence shown.



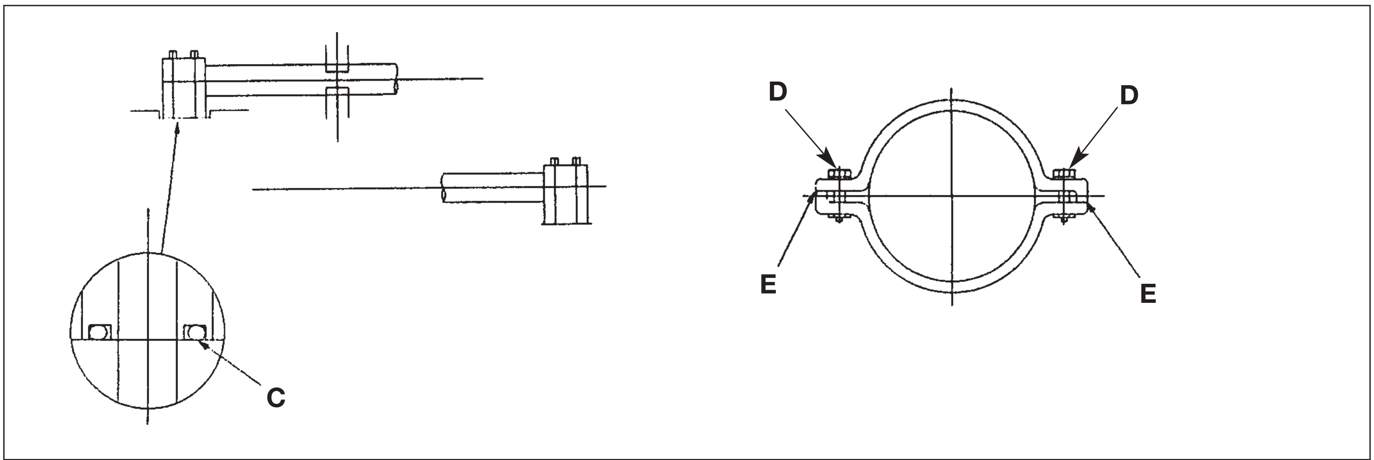
8. Installing the piping.

a. Make sure the 'O'-rings **C** are properly installed in the respective grooves.

b. Fasten the bolts at each port first.

c. Fasten the bolts to the specified torque.

d. Fasten the piping band screws **D** equally on both sides to the specified torque so that the gap clearances **E** are eliminated.

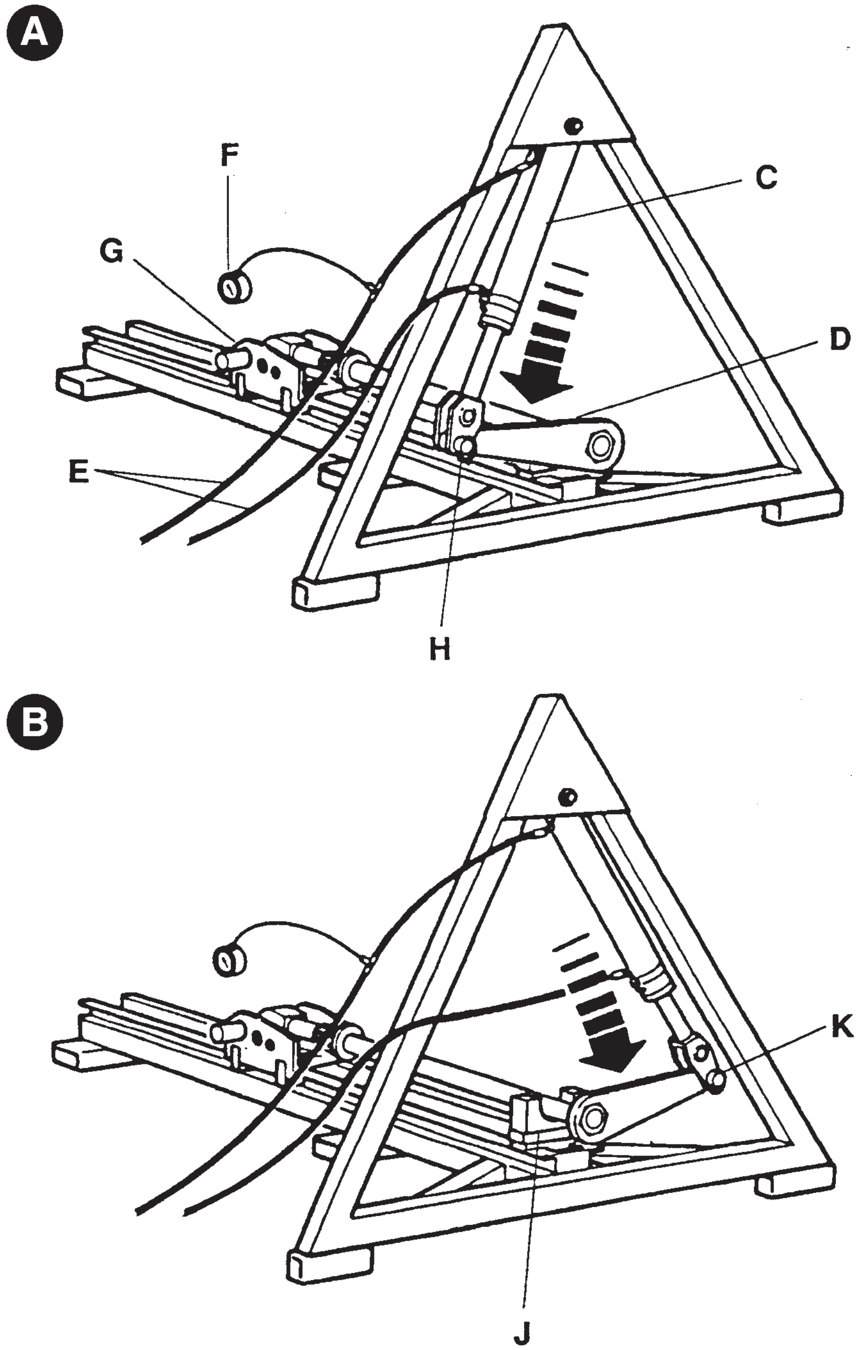


Assembly JS200/JS240 *(continued)*

9. Inspection after Assembly

<table>
<tr><td>No-load Operation Inspection</td><td colspan="6">Operations are smooth and there are no abnormalities with each part after full stroking more than five times with no load.</td></tr>
<tr><td>Measurement</td><td colspan="6">Confirm the maximum extension and stroke.</td></tr>
<tr><td>Inspection</td><td colspan="6">There is no looseness, permanent deformation or outer leakage after applying the test pressure shown in the diagram for three times to each stroke end.</td></tr>
<tr><td>Outer Leakage</td><td colspan="6">Check the oil leakage amount at the rod.</td></tr>
<tr><td rowspan="7">Inner Leakage Inspection</td><td colspan="6">unit ml/10min</td></tr>
<tr><td>inner diameter mm</td><td>oil leakage amount</td><td>inner diameter mm</td><td>oil leakage amount</td><td>inner diameter mm</td><td>oil leakage amount</td></tr>
<tr><td>32</td><td>0.4</td><td>100</td><td>4.0</td><td>160</td><td>10.0</td></tr>
<tr><td>40</td><td>0.6</td><td>125</td><td>5.6</td><td>180</td><td>12.6</td></tr>
<tr><td>50</td><td>1.0</td><td>140</td><td>6.0</td><td>200</td><td>15.6</td></tr>
<tr><td>63</td><td>1.6</td><td></td><td></td><td>220</td><td>20.0</td></tr>
<tr><td>80</td><td>2.3</td><td></td><td></td><td>250</td><td>22.0</td></tr>
</table>

Ram Piston Head Nut



JS00980

Ram Piston Head Nut (cont'd)

Due to the high piston nut tightening torques used on the rams, it is necessary to use a special rig (see opposite) for ram piston head nut fitting and removal (see **Service Tools** - page 1/5-4 for the component parts of the rig).

As shown in illustrations **A** and **B**, the rig uses a modified lift ram **C** acting on a heavy-duty ring spanner **D** to loosen or tighten the piston nut. Hydraulic power to operate the rig may be obtained from a suitable hydraulic power pack (maximum pressure required 150 bar (2175 lb/in^2) or from the auxiliary circuit of a JCB machine equipped with quick-release couplings. In either case, small bore hoses **E** (Part No. 892/00137 - 2 off) must be used to connect the rig to the power source to limit the speed of operation of ram **C**. In addition **F**, test point (Part No. 892/00262) and pressure gauge (Part No. 892/00279) should be fitted in the line to the piston side of the ram **C** to measure the tightening pressure being applied.

See the table on page 75 -12 for details of the pressure necessary to achieve the required tightening torques.

Nut Removal

It is assumed that the ram has been removed from the machine, hydraulic piping removed and the piston rod assembly separated from the cylinder.

Note: Before using the nut removal/fitting rig, operate the rig cylinder over its full range for 5 or 6 strokes to remove all air from the cylinder.

1 Install the piston rod assembly in the dismantling/assembly rig with the piston rod supported by block **J**.

2 Secure the eye end of the piston rod to the rig at position **G**, using a suitable pivot pin.

3 Fit a ring spanner to the piston nut and connect it to the eye end of ram **C** at position **H**.

4 Power the ram slowly downwards, noting the pressure at which the piston nut first moves on the piston rod. (The pressure should be 1.0 to 1.5 times the tightening pressure for the particular size).

5 Remove the piston nut.

6 Remove the piston rod assembly from the rig and then proceed with dismantling as detailed earlier for individual rams.

Nut Fitting

Before assembly ensure that all components have been thoroughly cleaned and all new seals, backing rings and 'O'-rings are available. Smear all seals, etc. with hydraulic fluid.

1 Assemble the piston rod components as detailed earlier for individual rams.

2 Install the piston rod assembly in the nut removal/fitting rig with the piston rod supported by block **J**.

3 Secure the eye end of the piston rod to the rig at position **G**, using a suitable pivot pin.

4 Fit a ring spanner to the piston nut and connect it to the eye end of ram **C** at position **K**.

5 Using the rig, tighten the piston head nut **H** to the torque specified for individual rams by powering the ram slowly downwards. The torque being applied is indicated by gauge **F** (see table on page 75 - 12).

6 Remove the piston rod assembly from the rig and insert into the ram cylinder as detailed earlier for individual rams.

Ram Piston Head Nut (cont'd)

Nut Fitting (cont'd)

JS200

Ram Location	Piston Nut AF (mm)	Piston Nut Torque Nm (lbf ft)	Gauge Pressure bar (lb/in^2)
Boom	95	5000 (3700)	35 (500)
Dipper	100	9340 (6912)	65 (935)
Bucket	90	7140 (5284)	50 (715)

JS240

Ram Location	Piston Nut AF (mm)	Piston Nut Torque Nm (lbf ft)	Gauge Pressure bar (lb/in^2)
Boom	100	5790 (4285)	40 (580)
Dipper	115	13200 (9769)	90 (1320)
Bucket	100	9340 (6912)	65 (935)

Note: The gauge pressures in the above table assume that the rig is used with spanners having 500 mm centres (see **Service Tools, Hydraulics, Ram Dismantling and Assembly, Spanner Requirements**).

Reconditioning

Structure and Characteristics of Special Jigs for Repair of Rams

Inserting seal ring and correction jig.

a. Jig components

Part no	Part Name	Qty	Note
WDB 2052	Seal ring inserting and correction jig set	1	
	Inner Guide	(1)	
	Outer Guide	(1)	
	Plate	(1)	
	Collection	(1)	

* ***Note:*** *For the above Part No. the tube diameter is 120 mm.*

b. Special characteristics
Because the seal ring is hard, it requires a lot of time to insert it without a special jig. By using the special jig, anyone can insert the seal ring on the piston quickly, easily and accurately without damaging the seal ring.

Bushing removal jig

a. Jig components

Part no	Part Name	Qty	Note
WDB 2166	Jig set for pulling out bushing	1	Also to be used for press-fitting bushing
	Chuck assembly	1	
WDB 2166-1	Retainer	1	Also to be used for press-fitting wiper ring
	Block	1	Prepare locally
	Lever	1	Prepare locally
	Allen wrench	1	

* ***Note:*** *For the above Part No. the tube diameter is 120 mm.*

b. Special characteristics
Because the bushing is press-fitted by the hydraulic press at the central part of the cylinder head, it requires a lot of time and work in order to remove the bushing from the cylinder head quickly, easily and accurately without damaging the inside of the cylinder head.

Reconditioning *(continued)*

Bushing press-fitting jig

a. Jig components

Part no	Part Name	Qty	Note
WDB 2166	Bushing press-fitting jig set	1	Also to be used for removing bushing
	Chuck assembly	1	
WDB 2166-1	Retainer	1	Also to be used for press-fitting wiper ring

* ***Note:*** *The above Part No. indicates those for rod diameter 80 mm.*

b. Special characteristics
If this special jig is used, anyone can press-fit the bushing into cylinder head quickly, easily and accurately without damaging the cylinder head.

Wiper ring press-fitting jig

a. Jig components

Part no	Part Name	Qty	Note
WDB 2166-1	Jig for press-fitting wiper ring (Retainer)	1	Also to be used for removing bushing

* ***Note:*** *The above Part No. indicates those for rod diameter 80 mm.*

b. Special characteristics
By using this special jig, anyone can press-fit the wiper ring easily, quickly and accurately into the specified groove of the cylinder head evenly without deforming or damaging it.

Cylinder head insertion guide jig

a. Jig components

Part no	Part Name	Qty	Note
WDB 2174	Cylinder head insertion guide jig	1	

* ***Note:*** *The above Part No. indicates those for rod diameter 80 mm.*

b. Special characteristics
By using this special jig, anyone can slide the cylinder head assembly onto the piston rod quickly, easily and accurately without damaging any of the seals.

Reconditioning *(continued)*

Jig Table

For inserting and correcting seal ring

Note: The mark O in the table below indicates KCH type.

		Cylinder inner diameter													Unit: mm
		80	90	95	100	105	110	115	120	125	130	135	140	150	160
JS200/ 200LC	Boom									O					
	Dipper											O			
	Bucket								O						
JS240/ 240LC	Boom										O				
	Dipper													O	
	Bucket											O			
	Boom														
	Dipper														
	Bucket														
Jig No.		WSB 2162	WDB 2163		WDB 2049	WDB 2120	WDB 2050	WDB 2051	WDB 2052	WDB 2054	WDB 2164		WDB 2055	WDB 2056	WDB 2057

* **For pulling out and press-fitting bushing**

Note: The mark O in the table below indicates KCH type.

		Piston rod diameter													Unit: mm
		50	55	60	65	70	75	80	85	90	95	100	105	110	
JS200/ 200LC	Boom								O						
	Dipper											O			
	Bucket							O							
JS240/ 240LC	Boom									O					
	Dipper												O		
	Bucket									O					
	Boom														
	Dipper														
	Bucket														
Jig No.							WDB 2165	WDB 2166	WDB 2167	WDB 2168	WDB 2169	WDB 2170	WDB 2171	WDB 2172	

Reconditioning *(continued)*

For press-fitting wiper ring (Can be used for pulling out and press-fitting bushing)

Note: The mark O in the table below indicates KCH type.

		Piston rod diameter											Unit: mm		
		50	55	60	65	70	75	80	85	90	95	100	105	110	
JS200/ 200LC	Boom								O						
	Dipper											O			
	Bucket							O							
JS240/ 240LC	Boom									O					
	Dipper												O		
	Bucket									O					
	Boom														
	Dipper														
	Bucket														
Jig No.							WDB 2165-1	WDB 2166-1	WDB 2167-1	WDB 2168-1	WDB 2169-1	WDB 2170-1	WDB 2171-1	WDB 2172-1	

Note: The jig for press-fitting the wiper ring can also be used for pulling out and press-fitting the bushing.
The jig is set for KCH type only.

Jig for inserting cylinder head
Note: The mark O in the table below indicates KCH type.

		Piston rod diameter											Unit: mm		
		50	55	60	65	70	75	80	85	90	95	100	105	110	
JS200/ 200LC	Boom								O						
	Dipper											O			
	Bucket							O							
JS240/ 240LC	Boom									O					
	Dipper												O		
	Bucket									O					
	Boom														
	Dipper														
	Bucket														
Jig No.							WDB 2173	WDB 2174	WDB 2175	WDB 2176	WDB 2177	WDB 2178	WDB 2179	WDB 2180	

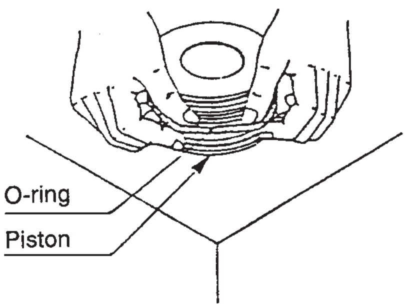
Note: The jig is set for the KCH type only.

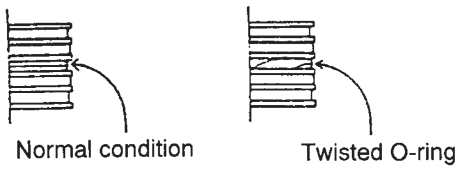
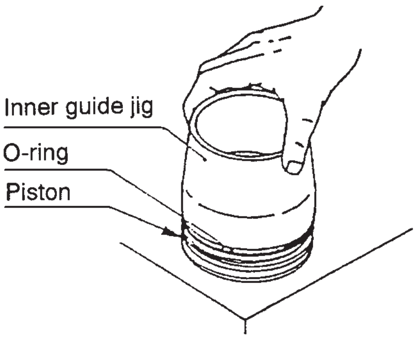
Reconditioning *(continued)*

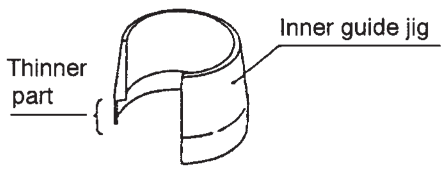
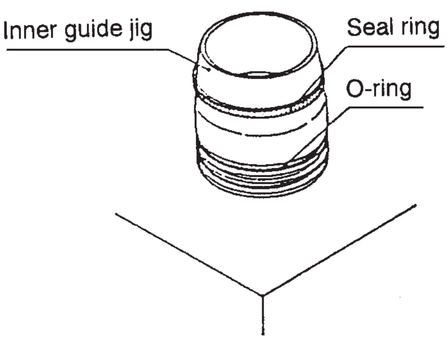
Jig Usage

Note: The special jigs are different, according to the cylinder diameter, so choose the appropriate jig from the table. The lower part of the inner guide jig is very thin, so be careful with handling and storage.

Procedures for inserting, correcting the seal ring.

<table>
<tr><td>1. O-ring installation
</td><td>Stretch the 'O'-ring by hand and fit it into the piston groove.

Be sure not to twist the 'O'-ring. A twisted 'O'-ring may cause oil leakage.
</td></tr>
<tr><td>2. Attaching the inner guide jig
</td><td>Fit the inner guide jig on the upper section of the piston.

Carefully fit the thinner end of the inner-guide jig on the upper section of the piston.
</td></tr>
<tr><td>3. Seal ring installation
</td><td>Apply a thin coat of lubricant to the inner guide jig periphery and then set the seal ring on the inner guide jig.

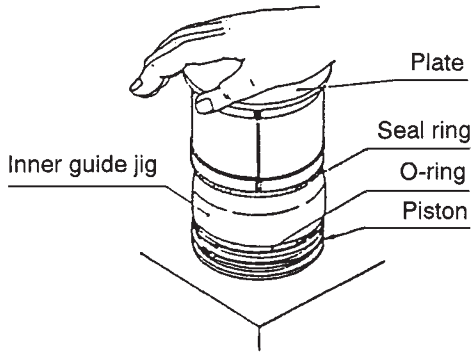
Make sure that any foreign matter like dust, chipped metal and lint do not adhere to the outer surface of the inner guide jig.</td></tr>
</table>

Reconditioning *(continued)*

Jig Usage *(continued)*

<table>
<tr><td>

4. Outer guide jig fitting



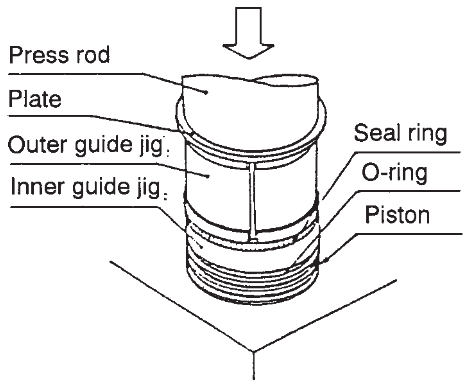
</td><td>

Put the plate on the outer guide jig and then continue to push the plate by hand until the seal ring touches the outer guide jig.

Be sure to set the seal ring straight on the inner guide jig.

</td></tr>
<tr><td>

5. Press-fitting



</td><td>

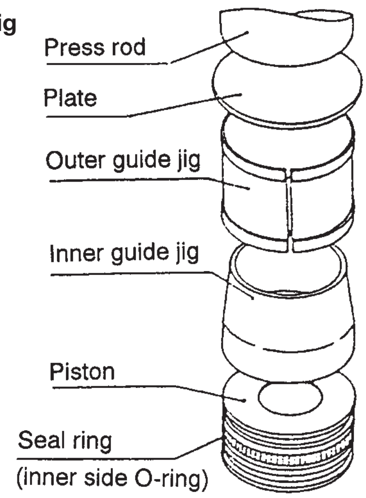
Continue to press the plate on the outer guide jig by hydraulic press until the seal ring fits into the groove.

Be sure to press the plate carefully so that the seal ring will fit straight on the inner guide jig and into the groove.

Finish this work quickly.

</td></tr>
<tr><td>

6. Removal of jig



</td><td>

After confirming that the seal ring is completely fitted into the piston groove, remove the jigs in the following order.

1. Remove the press rod.

2. Remove the plate.

3. Remove the outer guide jig.

4. Remove the inner guide jig.

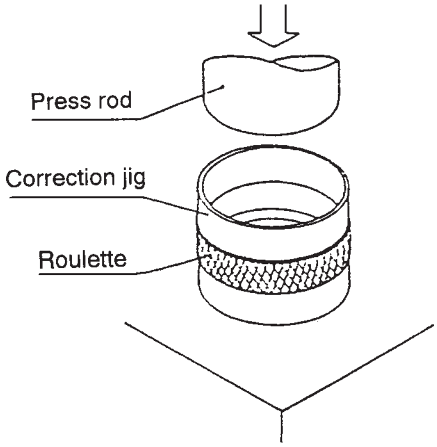
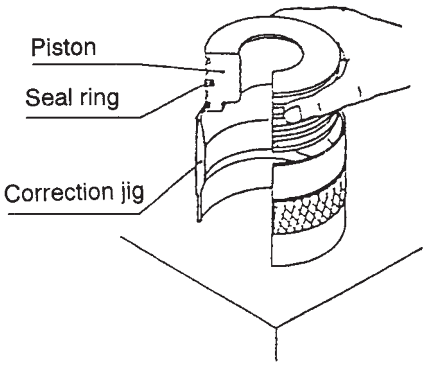
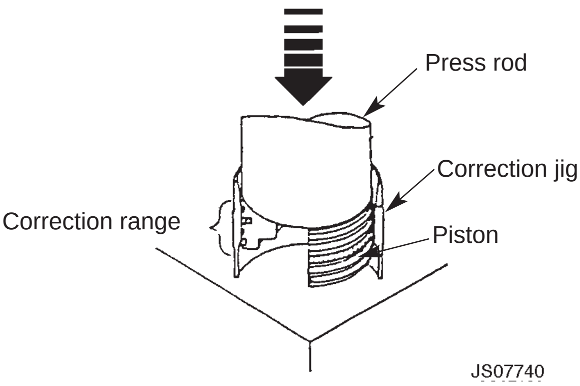
The fitting of the seal ring is completed at this stage.

Next, correct the fitting of the seal ring using the correction jig.

</td></tr>
</table>

Reconditioning *(continued)*

Jig Usage *(continued)*

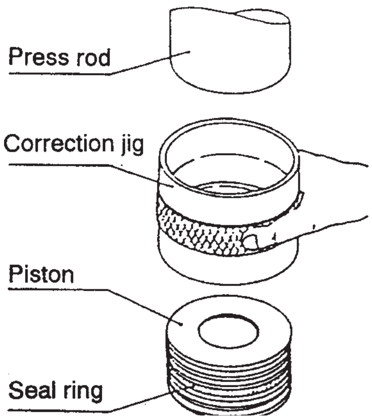
7. Correction jig preparation 	Set the correction jig underneath the press. Apply a thin coat of lubricant to the tapered section of the correction jig and place the jig with the tapered section facing up. Be careful that no dust, chipped metal and lint adheres to the jig.
8. Inserting the piston 	Slowly insert the piston, with the seal ring fitted, into the correction jig. Insert the piston evenly inside the correction jig.
9. Press fit 	Press the piston slowly with a press rod that has smaller diameter than the piston, until the seal ring fits correctly in the groove. **Note:** Stop pressing temporarily for three to five seconds when the piston reaches the point of correction and then repress the piston to the end.

*

Reconditioning *(continued)*

Jig Usage *(continued)*

10. Removal of correction jig



After completion of the correction of the seal ring, remove the jig in the following order.

1. Remove the press rod.

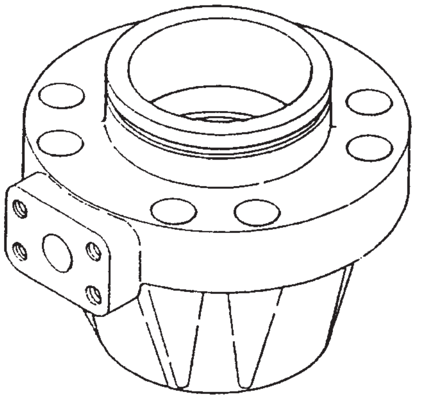
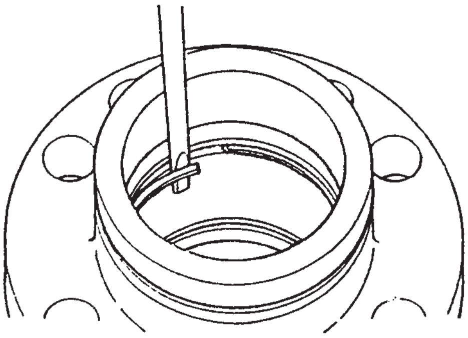
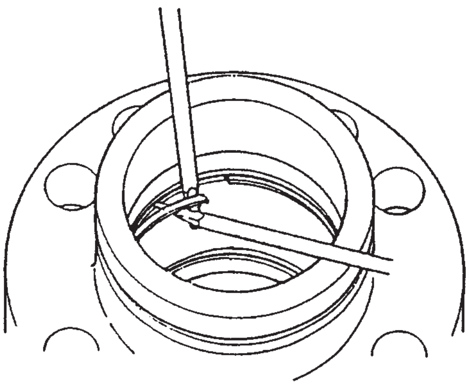
2. Remove the correction jig.

This completes the fitting and correction of the seal ring.

Reconditioning *(continued)*

Bush removal

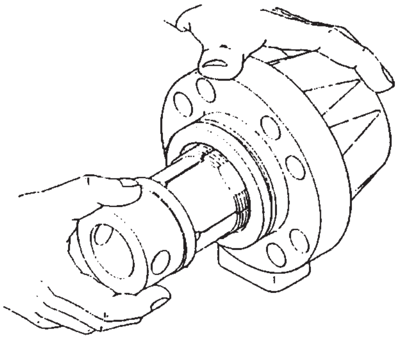
Note: The jigs differ, depending on the piston rod diameter, so please refer to the table and select the appropriate jig.
The chuck blade section is a very important part, so handle and store with utmost care.

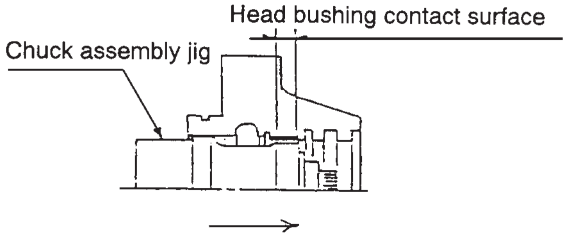
1. Cylinder head setting 	Place the cylinder head on the work bench with the cylinder tube connecting surface facing up. The work bench should be clean so that no dust or other foreign matter can cause damage to the pipe joint .
2. Removing snap ring  	Remove the bushing securing snap ring. Secure the cylinder head in a vice, etc. and with the end of a special tool, pull out the snap ring and remove.

Reconditioning *(continued)*

Bush removal *(continued)*

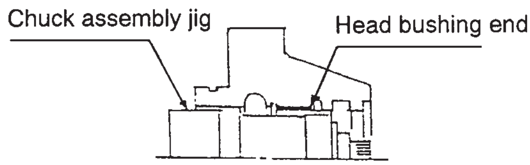
3. Setting the chuck assembly (jig)



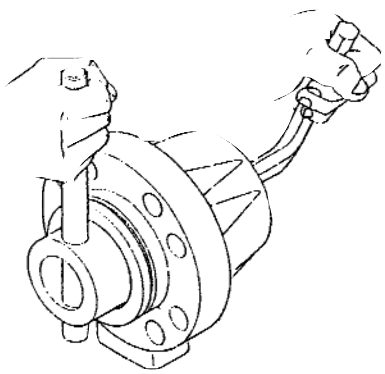


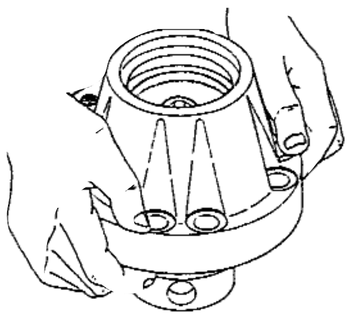
Gradually insert the chuck assembly into the cylinder head until its blade end reaches the bushing end.

1. Insert the chuck assembly into the cylinder head, taking care that parts of the blade do not damage the inner circumferential surface.
2. Be careful that the blade does not jump out from the bushing end surface.



4. Temporary tightening





1. Fit the Allen wrench into the chuck assembly adjuster head and at the same time insert the lever into the chuck assembly rear hole.
2. Tighten enough so that when the cylinder head is lifted, the jig will not fall off.

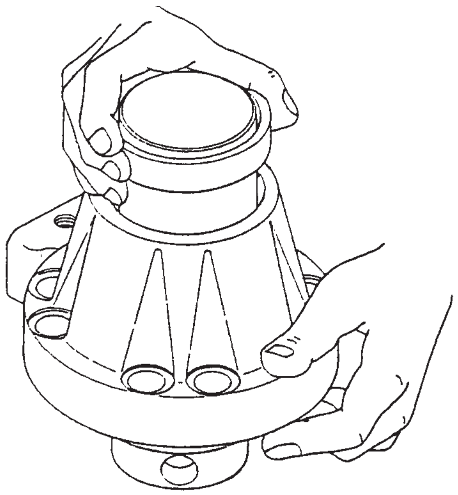
Note: *Tightening torque less than 5 kgf m is sufficient.*

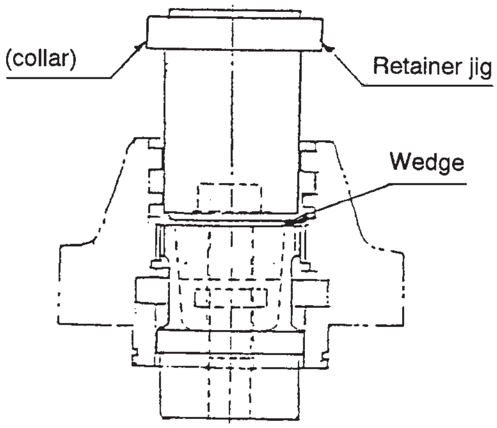
Move the cylinder head with the chuck assembly attached, by grasping it on both sides with both hands, to the press bench, taking care not to drop it.

Reconditioning *(continued)*

Bush removal *(continued)*

5. Attaching the retainer

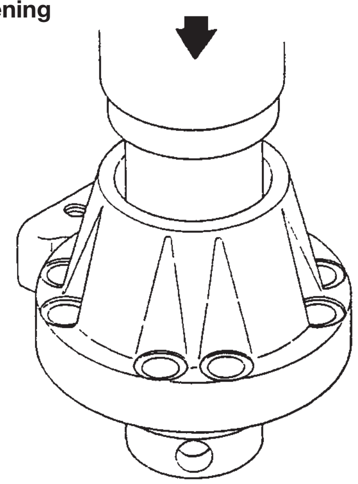




Gently place the retainer on the stepped portion of the wedge inside the chuck assembly (jig).

1. Place so that the larger diameter (collar) is facing up as shown in the figure.
2. Keep the press work bench clean so that dust, chipped metal and other foreign material do not cause damage to the bottom of the chuck assembly.

6. Tightening



Press the upper part of the retainer gradually so that the blade part of the chuck assembly jig digs into the bushing surface part of the retainer (jig).

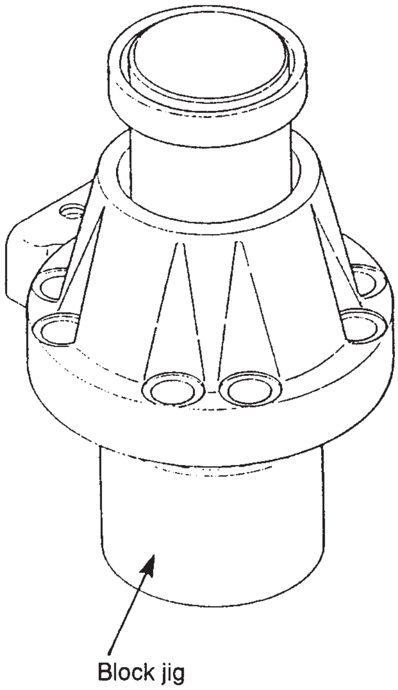
Note: *Press load should be 2~3 tons.*

If necessary use a retainer when pressing.

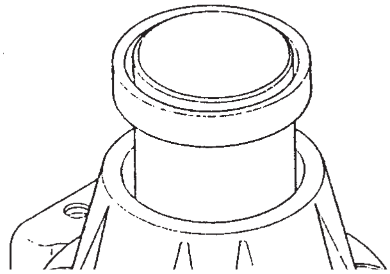
Reconditioning *(continued)*

Bush removal *(continued)*

7. Block (jig) preparation

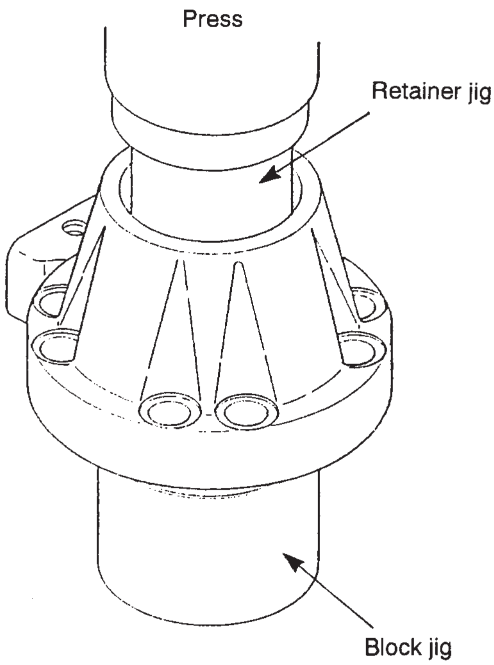


Prepare a block and align the shaft centre while placing the cylinder head on the block. Choose a block suitable in shape and size from the table below.



Division	d1	d2	h	Nominal size
For ø 75	82	110	80	75
80	87	112	80	80
85	92	124	80	85
90	97	130	80	90
95	102	136	80	95
100	107	140	80	100
105	112	146	80	105
110	117	150	80	110

8. Removing bushing



1. Position the block *(jig)* and cylinder head assembly *(retainer jig and chuck assembly)* underneath the press.
2. Gradually press the retainer *(jig)* upper surface until the bushing falls out from the cylinder head *(the sound of the bottom surface of the chuck assembly jig hitting the work bench will be heard)*.

Note: *Normally it falls out with a load of less than 3 tons.*

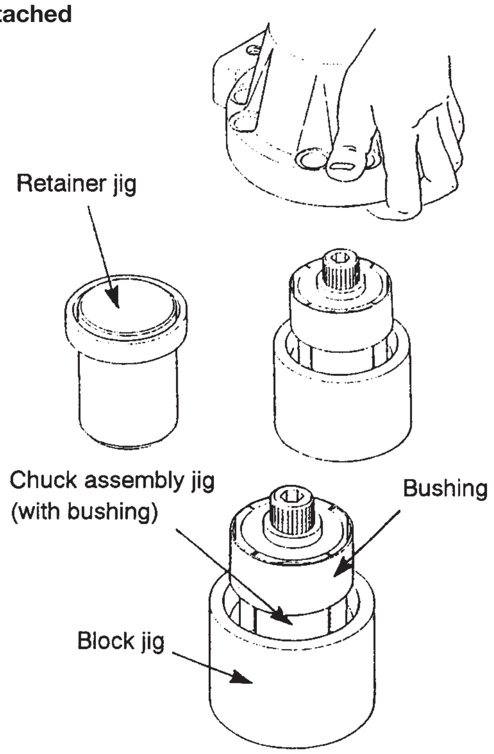
The press ram stroke varies with the cylinder head size and is about 32~52 mm.

1. Use a retainer when pressing.
2. When the shaft centre of the block and cylinder head assembly are not aligned, stop the press work and move the block, aligning the shaft centre, and proceed.

Reconditioning *(continued)*

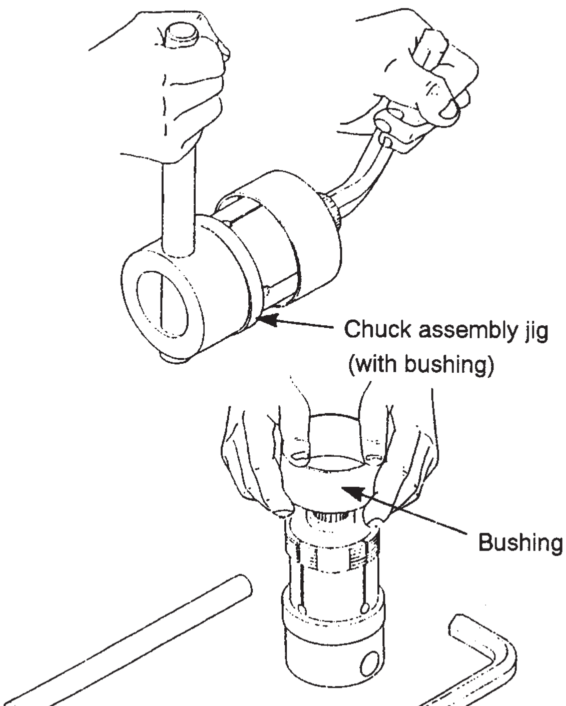
Bush removal *(continued)*

9. Removing chuck assembly (jig) with bushing attached



1. After removing the cylinder head assembly (retainer jig and chuck assembly jig attached) from under the press, remove the retainer from the cylinder head and, grasping both sides of the cylinder head, move it to another place.
2. Remove the chuck assembly with bushing attached and move to the work bench.

10. Removing bush

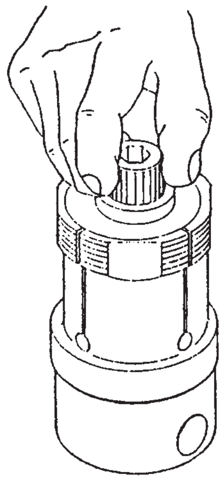


1. Place the chuck assembly with bushing (jig) on the work bench horizontally and insert the Allen wrench into the chuck assembly adjuster head section. At the same time insert a lever into the round hole of the chuck assembly rear section.
2. Use the lever and Allen wrench so they are pushed down front and back and loosen the adjuster.
3. Place the chuck assembly vertically and turn the adjuster with your finger until the wedge rises about 5 mm.
4. After confirming that the bushing is not touching the chuck blade section, gently remove the bushing from the chuck assembly.

Keep the work bench clean so that no dust or foreign matter adheres to or damages the bottom surface of the chuck or the outer periphery. Also be sure that the work bench is level.

Reconditioning *(continued)*

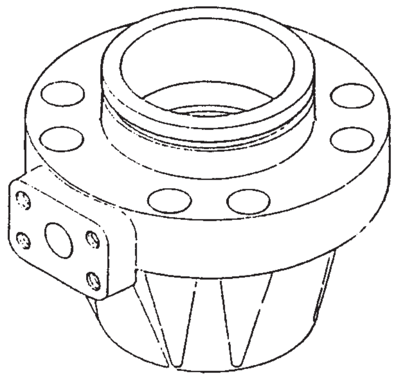
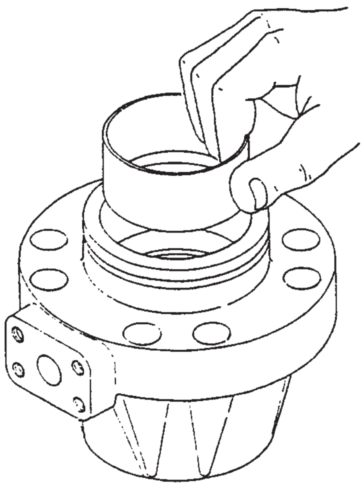
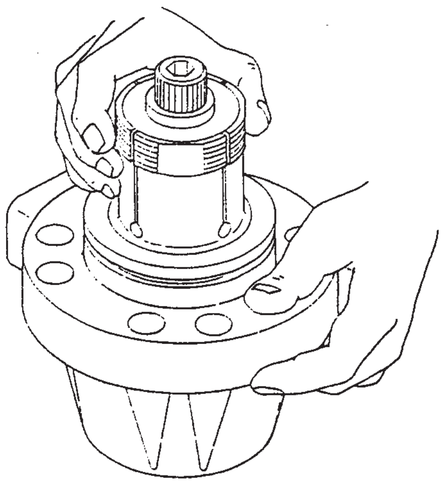
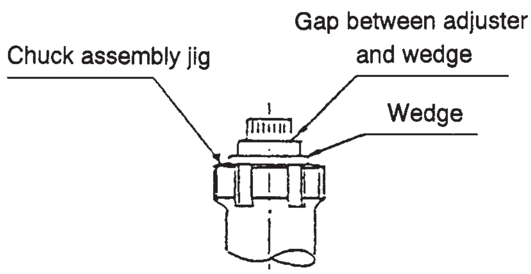
Bush removal *(continued)*

11. Retightening the adjuster 	With the chuck assembly (jig) and bushing removed, turn the adjuster with your fingers until there is no gap between the adjuster and the wedge upper surface. ***Note:*** *Do not remove the adjuster and wedge from the chuck assembly .*

Reconditioning *(continued)*

Bush Assembly

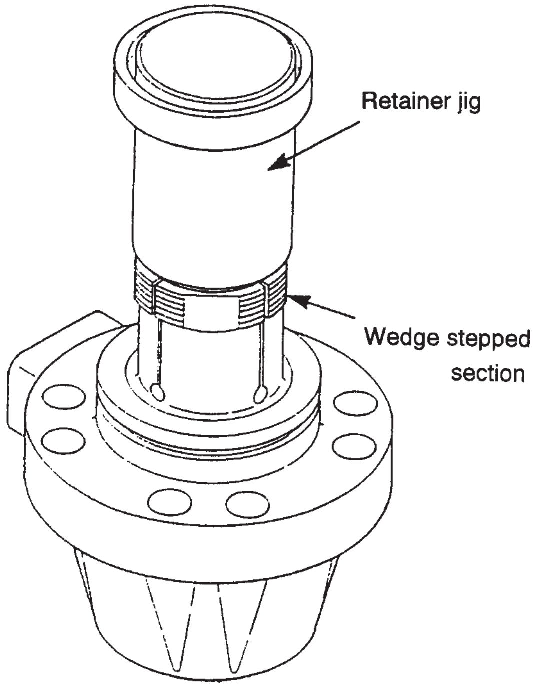
Note: *The jigs differ, depending on the piston rod diameter, so please refer to the table and select the appropriate jig. The chuck blade section is a very important part, so handle and store with utmost care.*

1. Cylinder head setting 	Set the cylinder head on the press bench with the tube connecting surface facing up. **1.** Keep the work bench clean so that dust or other foreign matter does not damage the bottom surface of the cylinder head. Also make sure that it is level. **2.** Use compressed air to remove the foreign matter.
2. Temporary setting of bushing 	Temporarily place the bushing evenly inside the cylinder head inner diameter. Verify that there is no foreign matter adhering to the inner and outer peripheral surfaces.
3. Attaching chuck assembly (jig) 	Supporting the chuck assembly with your fingers, gradually attach it to the cylinder head. Verify that there is no gap between the chuck assembly adjuster and wedge. 

Reconditioning *(continued)*

Bush Assembly *(continued)*

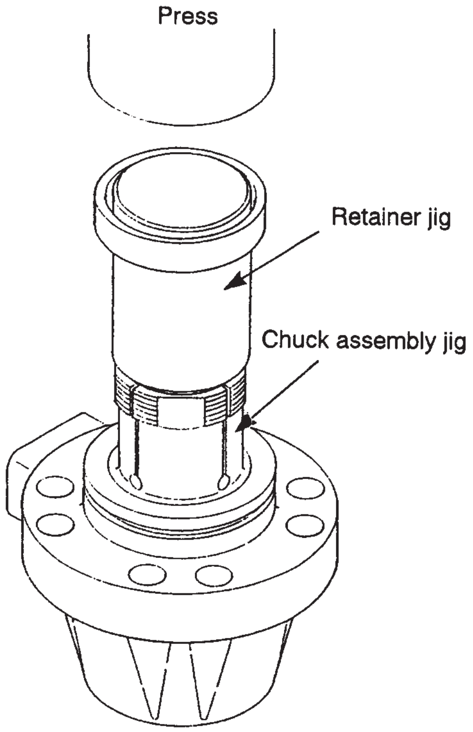
4. Attaching the retainer (jig)



Gently place the retainer so that its end is aligned with the wedge stepped section of the chuck assembly jig.

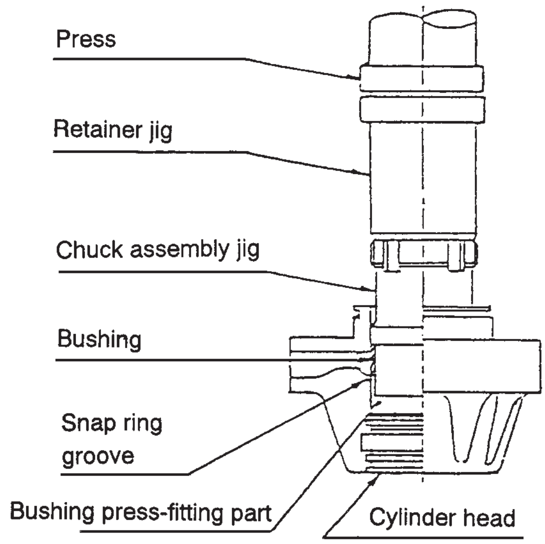
Place the retainer so that the larger diameter part is facing up as shown.

5. Preparation for press-fitting



Place the cylinder with the retainer (jig) and chuck assembly (jig) attached underneath the press.

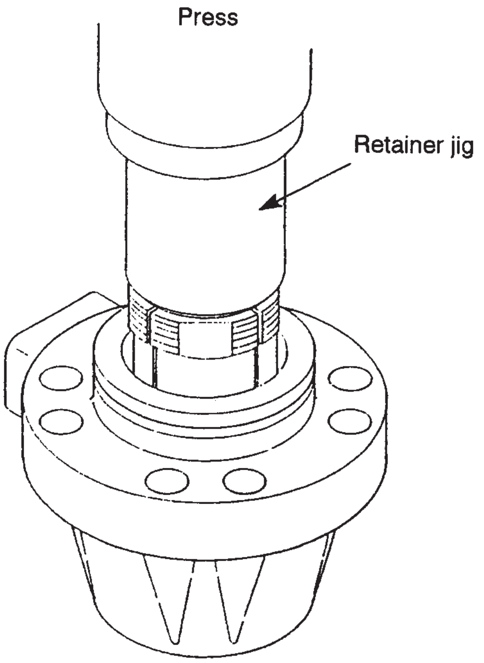
Adjust so that the shaft centre of the press (ram) is in line with that of the retainer and chuck assembly.



Reconditioning *(continued)*

Bush Assembly *(continued)*

6. Press-fitting the bushing

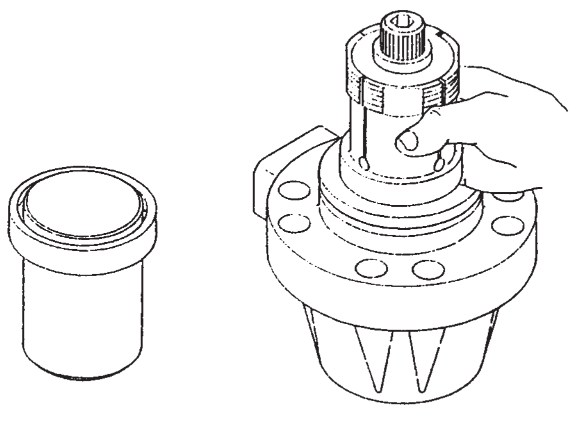


At the press, push on the bolt head of the adjuster and gradually press-fit the bushing into the specified position in the cylinder head.

The press load should be less than 5 tons.

Verify that the bushing end surface is below the snap ring groove.

7. Removal of retainer (jig) and chuck assembly (jig)

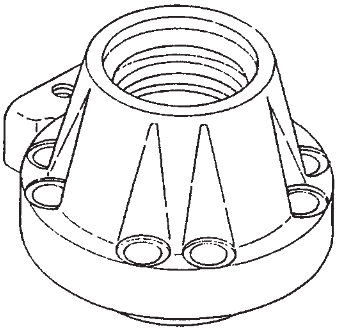
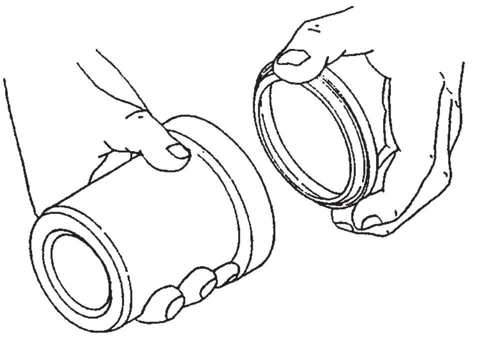
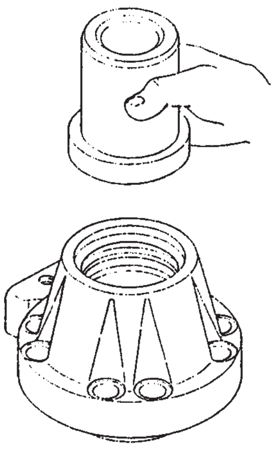


After the press-fitting of the bushing is completed, remove the retainer and chuck assembly from the cylinder head. Continue attaching the seals and press-fitting the wiper ring.

Verify that the bushing is press-fitted correctly.

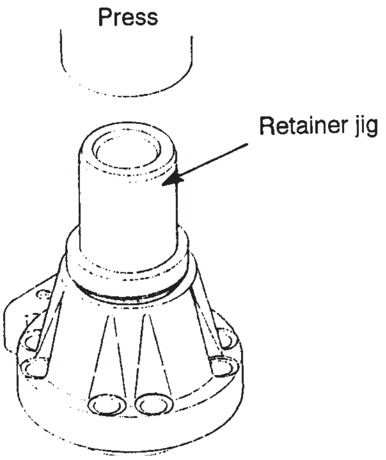
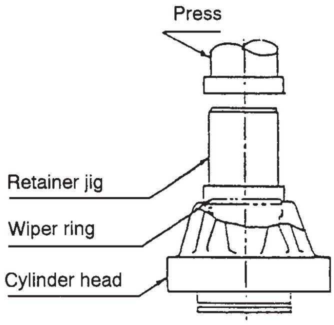
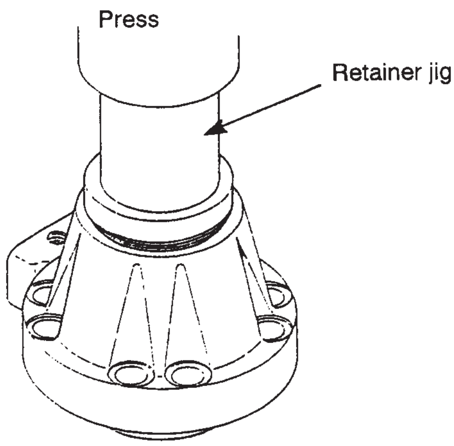
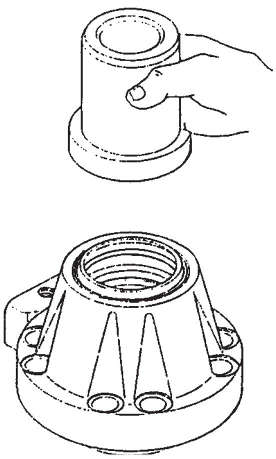
Reconditioning *(continued)*

Wiper Ring Assembly

1. Setting the cylinder head 	Set the cylinder head on the work bench with the tube connecting surface facing down. Keep the work bench clean so that no dust or other foreign matter can damage the bottom surface of the cylinder head.
2. Inserting the wiper ring 	Face the lip side of the wiper ring to the groove of the retainer (jig) and insert. Verify that there is no foreign matter in the groove where the wiper ring or the retainer is to be inserted.
3. Attaching the retainer (jig) 	Gently attach the retainer, with the wiper ring inserted, facing down onto the upper part of the cylinder head. Gently place the retainer on the cylinder head, making sure that it is level with the work bench.

Reconditioning *(continued)*

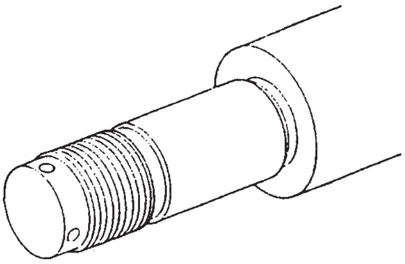
Wiper Ring Assembly *(continued)*

4. Preparation for press-fitting  	Move the cylinder head with the retainer (jig) on it underneath the press. Adjust so that the shaft centre of the press (ram) and retainer are in line. 
5. Press-fitting wiper ring  	Pressing on the head section of the retainer (jig), press-fit the wiper ring into the specified position in the cylinder head. The press load should be less than 1 ton. Press fit until the retainer's collar reaches the cylinder head end surface.
6. Removal of retainer 	After the wiper ring press-fitting is completed, remove the retainer from the cylinder head. Verify that the wiper ring is properly press-fitted.

Reconditioning *(continued)*

Cylinder Head Assembly

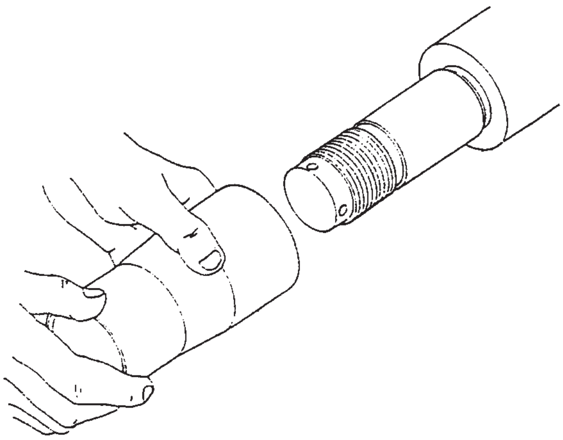
1. Fixing the piston rod

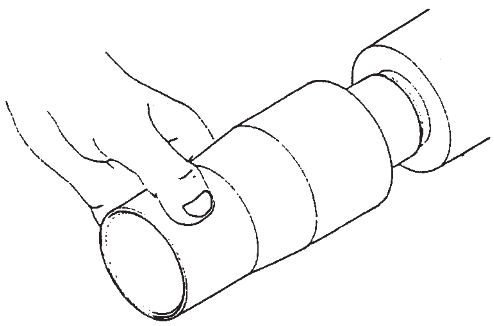


Fix the piston rod so that the threaded part is facing you.

Handle the piston rod with care so that no damage is done to its outer peripheral surface.

2. Attaching guide (jig)





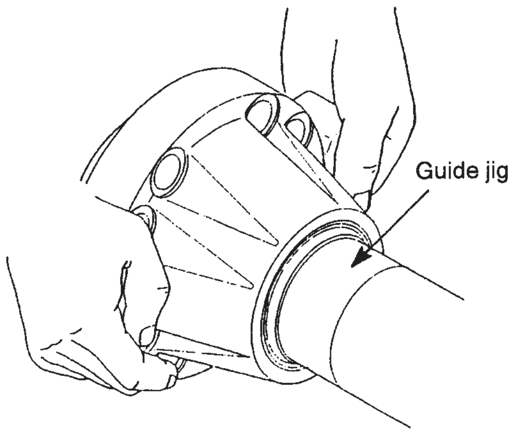
Insert the guide with the larger diameter first until it reaches the stepped part of the piston rod.

1. When inserting the guide onto the piston rod, be careful not to damage the thread part of the piston rod.
2. Be careful that the thread part of the piston rod and the outer peripheral surface of the stepped part are not damaged by dust or other foreign matter.

Reconditioning *(continued)*

Cylinder Head Assembly *(continued)*

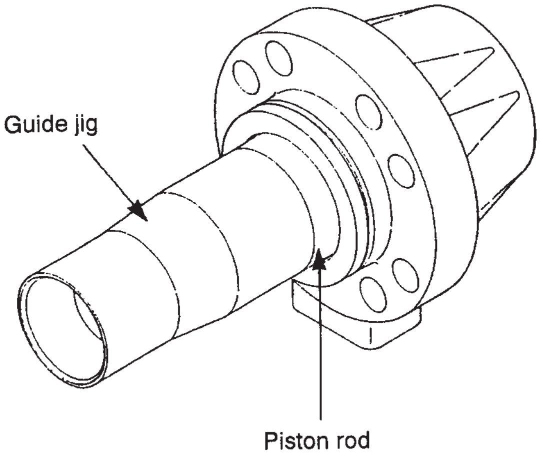
3. Inserting the cylinder head

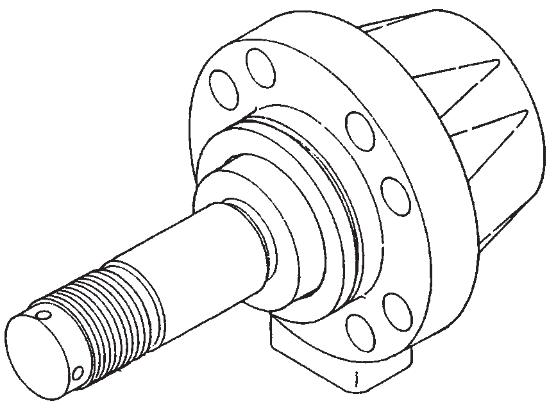


Insert the cylinder head onto the piston rod, wiper ring side first, to the specified position, sliding on the peripheral surface of the guide (jig).

1. Support the cylinder assembly with both hands and be careful not to drop it.
2. If oil is thinly coated on the peripheral surface of the guide and piston rod, the cylinder assembly can be inserted smoothly.

4. Removal of Guide (jig)





After verifying that the cylinder head assembly has been completely inserted on the piston rod, remove the guide from the piston rod. Next, assemble the piston, etc. on the piston rod.

When removing the guide, be careful not to damage the threaded part of the piston rod.

Trouble Shooting

Hydraulic ram trouble and its remedies.
It is not easy to find the part causing the trouble. In the chart below, possible problems are listed. Repair is difficult so refer to the estimated cause and treatment listed in the chart. In the chart, the general phenomenon, estimated causes and treatment are shown. However, machine trouble is most often caused, not by just one faulty part, but its relationship with other parts. Not all of the possible causes and treatments are listed in the chart below, therefore, it may be necessary for the person responsible for repairs to make further investigations to find the cause of the trouble.

Item	Symptoms
1	Oil leakage from piston rod sliding part
2	Oil leakage from cylinder head meeting part
3	Oil leakage from pipe and cylinder tube welded part
4	Faulty operation

Item	**Symptoms**	**Related Parts**	**Trouble**	**Treatment**
1	Piston rod sliding part oil leakage	Piston rod	On the sliding surface, there are scratches and rust that can be felt by the fingernail.	**1.** Use an oil stone and remove the scratch and make the sliding surface smooth. (Less than 1.5 S). If oil leakage continues even though the rod surface is made smooth, the scratch may cause damage to the U-ring and other seals, so disassemble and inspect. **2.** If the scratches and rust cover such a wide area that they cannot be repaired by an oil stone, replace the piston rod and U-ring, wiper ring and seals and the piston rod bearing member.
			The plating is peeling.	Re-plate or replace the piston rod. Also inspect the seal and piston rod bearing member and replace if damaged.
		Rod packing (Buffer ring, U-ring)	Foreign matter is biting into the inner and outer surfaces of the packing.	Remove foreign matter. If there is damage to packing, replace it.
			There is a scratch on the inner and outer surface of the packing.	Replace.
			The lip and groove parts are locally carbonized (burned).	Possibly due to burning caused by adiabatic compression from air remaining inside the ram. After replacing the packing, first operating the ram at low-pressure, low speed to sufficiently bleed the air.

Trouble Shooting *(continued)*

Item	Symptoms	Related Parts	Trouble	Treatment
1	Piston rod sliding part oil leakage	Rod packing (Buffer ring, U-ring)	Packaging rubber elasticity is gone and breaks into pieces.	The packing life or hydraulic oil deterioration and high temperature are possible reasons. **1.** Renew hydraulic oil. **2.** Check the hydraulic oil temperature. (Below 80 C is advisable). **3.** Check if high temperature locally.
			Lip is deficient all around.	Replace. It is possible that abnormal high pressure is working on the packing. **1.** Check the operation pressure, cushion pressure. **2.** Part which is attached to the buffer ring may be abnormal. Inspect the buffer ring.
		Back up ring	The protrusion of the heel of the packing is excessive.	As a rule, replace the rod packing at the same time. (It is desirable to replace parts which are attached to the buffer ring at the same time). It is possible that abnormal high pressure is the cause. Check the same as above (heel of packing protruding).
		Wiper ring	Foreign matter is biting into the lip. The lip is damaged.	Remove the foreign matter.
			There are also other abnormal damage.	Replace.
		Bushing	Wear is large and the clearance with piston rod exceeds the *maximum permissible value. (*Refer to maintenance standards for maximum permissible value.)	Replace.
			Large scratch on the sliding part.	Replace. Also inspect the piston rod.
		Cylinder head	Scratches, rust on the seal attachment parts.	Remove scratch, rust with oil stone. If it cannot be repaired, replace the cylinder head.

Trouble Shooting *(continued)*

Item	Symptoms	Related Parts	Trouble	Treatment
2	Oil leakage from cylinder head joint	O-ring	Foreign matter biting on inner and outer diameter. O-ring damaged.	• Remove foreign matter. • Replace 'O'-ring if damaged. • Inspect inside tube: if any scratches or rust, make surface smooth with oil stone. • Inspect cylinder head 'O'-ring groove: if any scratches or rust, make surface smooth with oil stone. • Inspect back up ring: if any deformation or protrusion, replace. Confirm the above and replace 'O'-ring.
		Back up ring	Deformation, protrusion	• Replace with 'O'-ring.
		Cylinder head	Looseness	• Disassemble cylinder head and inspect 'O'-ring and back up ring. • Check tube and cylinder head thread for damage. If any damage, replace. • After inspection, tighten to specified torque.
		Bolt	Looseness, stretching, broken	Replace all bolts and tighten to specified torque.
		Cylinder tube	Abnormal bulge	Replace with new parts. Oil leakage from connecting parts may be caused by abnormal pressure (including cushion pressure). Inspect the tube for bulges, deformation and check the circuit pressure.
3	Oil leakage from pipe and cylinder tube welded seam	Cylinder tube pipe (hollow piston rod)	Crack in welding	Replace with new parts. • Cracks will develop into fractures. Fractures are very dangerous, so if any cracks are found, stop work immediately and replace with new parts. • Welding on top of cracks will have no effect.

Trouble Shooting *(continued)*

Item	Symptoms	Related Parts	Trouble	Treatment
4	Poor operation 4-1 Movement not smooth	Piston rod cylinder tube	Bending is more than the specified limit. (Bending distortion: Refer to maintenance standards)	• Replace with new part. The seal and sliding part material may be damaged too, so inspect. If abnormal, replace.
		Cylinder tube	There is a recess	• Replace with new part. As above, inspect the seal and sliding part material.
		Piston rod cylinder rod sliding part	Abnormal wear, damage of sliding area Foreign matter intruding on piston and cylinder head sliding area	• Replace with new part. As above, inspect the seal and sliding part material. • Remove foreign material. As above, inspect the seal and sliding part material.
	4-2 Inner oil leakage. Piston rod extends when work stops or lowers abnormally during work. Also, specified operating speed is not achieved.	Piston seal	Scratches, wear are present	• Replace with new part. Inspect the cylinder tube inner surface also.
		Cylinder tube	Scratches, rust on inside	• Remove the scratches, rust by honing or with an oil stone and make the surface smooth. If the scratch is deep and cannot be repaired, replace cylinder tube. • Replace piston seal.
		Piston Nut	Loose nut	• Tighten to specified torque.
		Valves	Leak from valve	• Inspect the valve leakage amount and service.
	Note: *Hydraulic oil expands and contracts due to changes in temperature and pressure. Accordingly, the ram also expands and this can be mistaken for internal leakage. When inspecting for internal leakage, do so at set conditions.*			

Trouble Shooting *(continued)*

Item	Symptoms	Related Parts	Trouble	Treatment
4	4-3	Air	Air remaining inside ram Operation is unsteady	• Bleed the air. For rams that do not have an air bleeder, operate back and forth several times at low pressure and low speed to bleed the air. For rams with an air bleeder, remove the load to reduce the pressure then loosen the air bleeder and completely bleed the air. ***Note:*** *The ram may expand if it is stopped suddenly. This is due to the compression of the hydraulic oil. This occurs especially with long stroke rams.*
	4-4 Heavy shock loading when changing from extension to retraction and back	Pin bushing Pin	Gap between installation part and pin bushing is too large	Measure the pin and pin bushing and replace parts if measurements exceed the specifications.
	4-5 Noisy operation	Oil supply	Insufficient oil	• Add oil.
		Pin bushing Pin	Scuffing at connecting part	• Replace with new part and add oil.
	Note: *If left in the state where operation is poor, the ram will no longer move and other parts will be effected adversely. Inspect early and carry out appropriate measures.*			

Maintenance Specifications

In order to ensure long life of the hydraulic ram, carry out inspection and maintenance regularly. If an abnormal point is found, repair as soon as possible referring to the troubleshooting chart.

Inspection, Maintenance Point	Inspection, Maintenance Contents	Daily	Monthly	Annually	Note
Appearance	Is the ram kept clean (especially the rod sliding part)?	O			
	Is there oil leakage from piping installation and fixing points?		O		
	Is there any peeling paint, separation or rust?	O			
Operation	Are the movements smooth and are there any abnormal sounds?	O			
	Is the response good?	O			
	Is there oil leakage from the sliding parts?	O			
	Is there internal leakage?			O	
	Is the working pressure normal?		O		
	Is the set pressure for the overload relief valve normal?		O		
Hydraulic Oil	Is the hydraulic oil dirty or deteriorated?		O		
	Is the hydraulic oil replaced periodically?			O	
	Are the filters inspected periodically?		O		
Installation with Main Body	Is the pin greasing sufficient?		O		
	Is there any abnormal sound at the pins or seizure?	O			
	Is there backlash or wear in the pins?	O			
	Is the pin seal normal?		O		
	Are the installation screws loose or missing?	O			
	Tightening of the installation screws?			O	
Piston Rod	Are the sliding parts worn?			O	When the rod sliding part is exposed for a long period of time apply anti-rust oil to the rod.
	Are there scratches or dents on the sliding parts?	O			
	Is there coating separation on the sliding parts?	O			
	Are the sliding parts bent?		O		
	Are there cracks in the welding or other damage?	O			
Ram Cylinder (Including Piping)	Are the bolts, nuts loose?	O			
	Are the bolts, nuts tightened?			O	
	Are there cracks in the welding or other damage?	O			
	Are there big depressions or dents in the cylinder?	O			

Maintenance Specifications JS200/JS240

Use Limit

Piston Rod Outer Diameter Wear Limit

Nominal diameter (mm)	Minimum outer diameter (mm)	Treatment
55~80	-0.023	Replace or replate
85~120	-0.027	Replace or replate

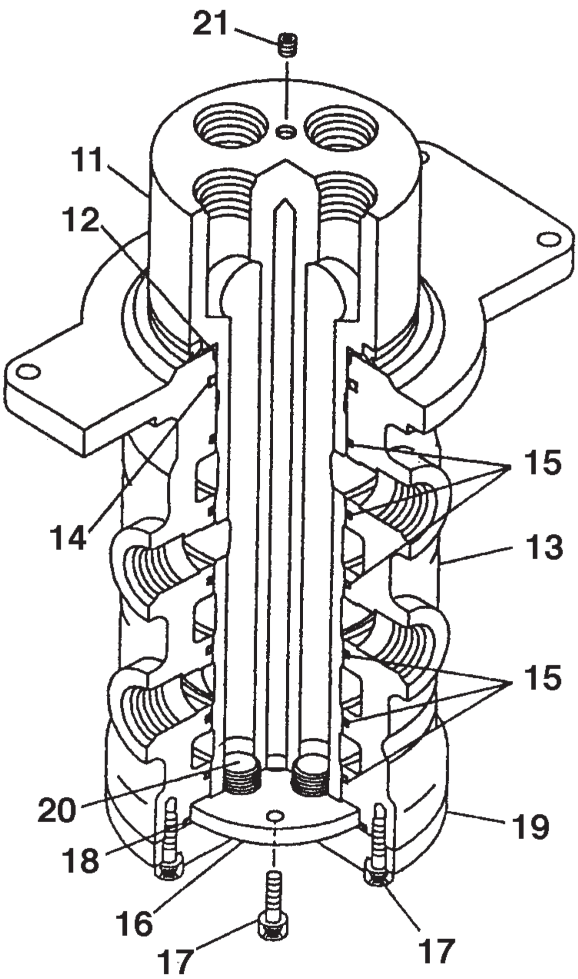
Rod Bushing Inner Diameter Wear Limit

Nominal diameter (mm)	Standard inner diameter (mm)	Maximum inner diameter (mm)	Treatment
55~75	+0.06~+0.19	+0.30	Bushing replacement
80~120	+0.06~+0.195	+0.30	Bushing replacement

Piston Slide Ring Thickness Wear Limit Section

Nominal diameter (mm)	Standard thickness (mm)	Maximum thickness (mm)	Treatment
95~160	2.42~2.48	2.37	Replace slide ring
165~250	2.92~2.98	2.87	Replace slide ring

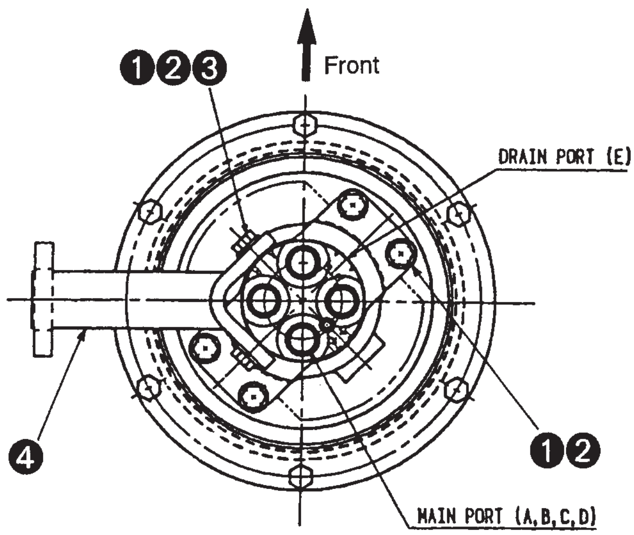
Schematic, Technical Data

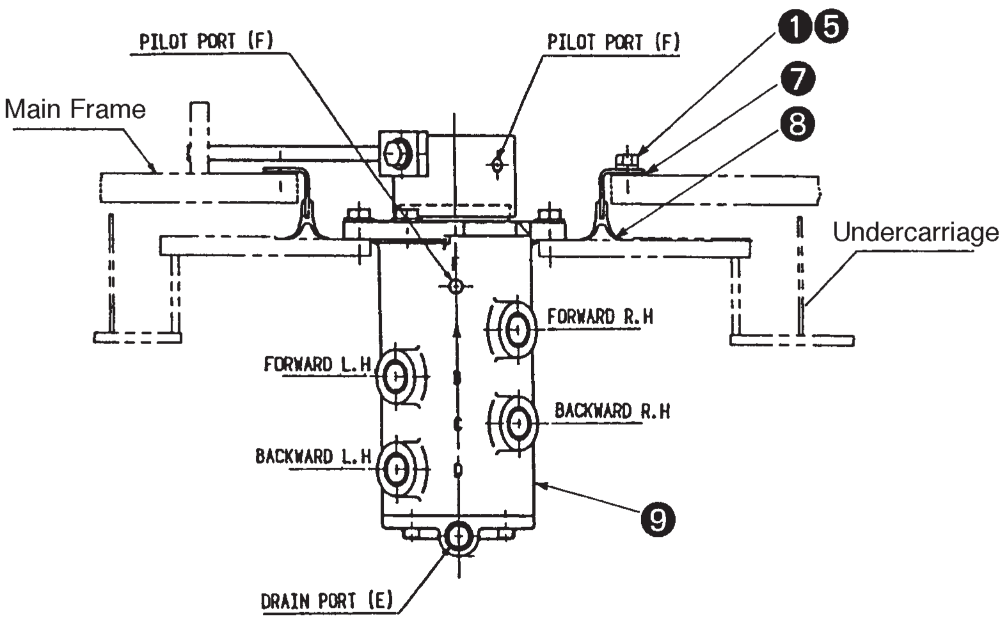


Item	Part Name
11	Axle
12	V-ring
13	Rotor
14	O-ring
15	Packing ring
16	Thrust plate
17	Hexagonal socket head bolt
18	O-ring
19	Cover
20	Plug
21	Plug

Schematic, Technical Data *(continued)*

Item	Part Name
1	High strength bolt
2	High strength washer
3	Loctite 262
4	Lock bar
5	Seal washer
6	Seal cap
7	Rubber packing
8	Seal ring
9	Rotating joint assmebly
The unit weighs 35kg.	





Operation

The rotary coupling consists of the inner axle and outer rotor with packing rings, 'O'-rings, thrust plate and cover. In the axle and rotor, there are pairs of ports and oil passages each pair being sealed from the others by packing rings and 'O'-rings. Both the axle and rotor can rotate and the oil can flow freely through the oil grooves.

The coupling is located in the centre of the machine between the lower and upper sections and rotates around the slew centreline. It receives the supply and return pressurised oil passing from the control valve to the traction motor and is not affected by the rotation of the lower and upper sections, allowing the machine to slew 360° in both directions.

Dismantling JS200/JS240

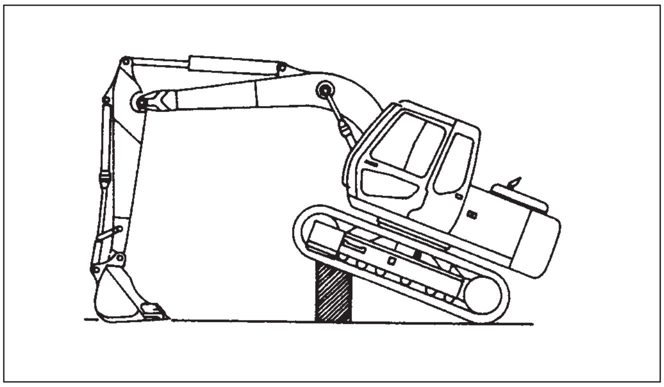
Refer to the sectional illustration on the previous page as a guide to the dismantling and assembly procedures.

Details of the service tools used in the dismantling and assembly procedures are given in Section 1, Service Tools.

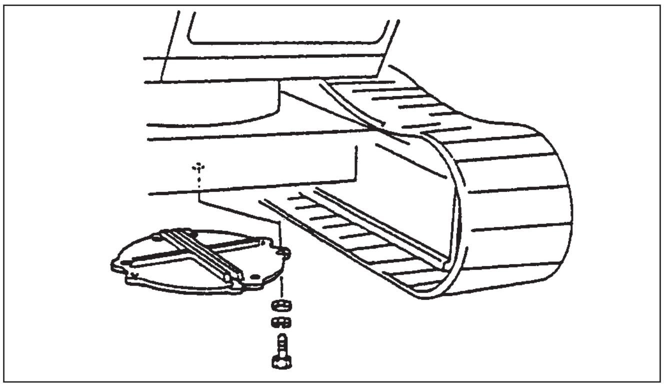
1. Prepare the machine.

a. Stop the machine and release the hydraulic pressure *(See Releasing Tank Pressure)*.

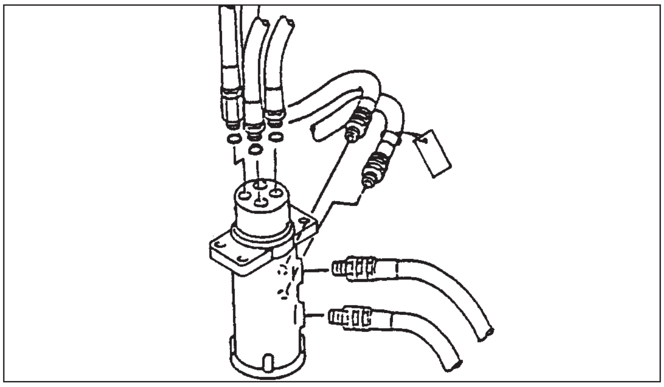
b. Jack up the machine and insert wooden blocks under the tracks.



2. Remove the access panel.



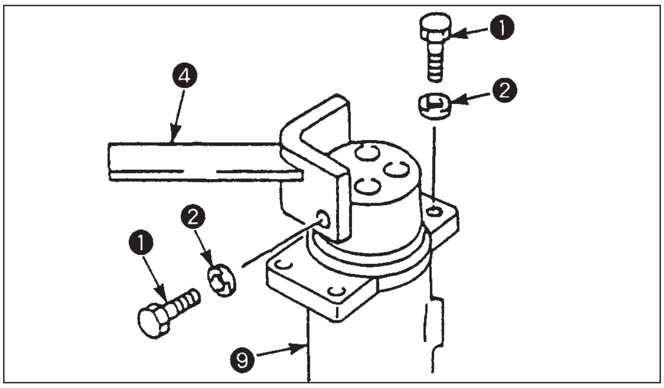
3. Attach identification tags to the rotary coupling hoses for reconnection purposes. Remove the hoses and install blind plugs and caps to prevent contamination.



4. Remove the Coupling.

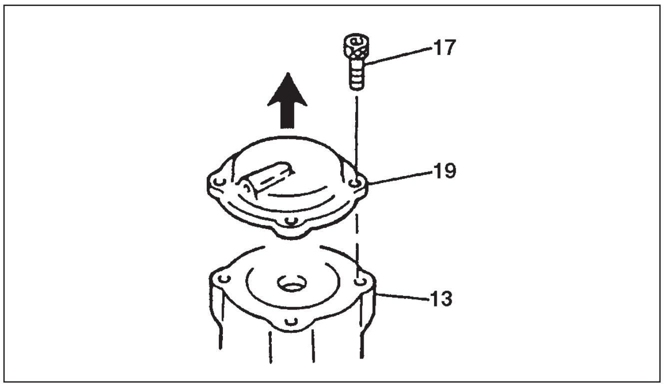
Remove the lock bar (4), remove the rotary coupling installation bolt (1).

Lift out the rotary coupling.



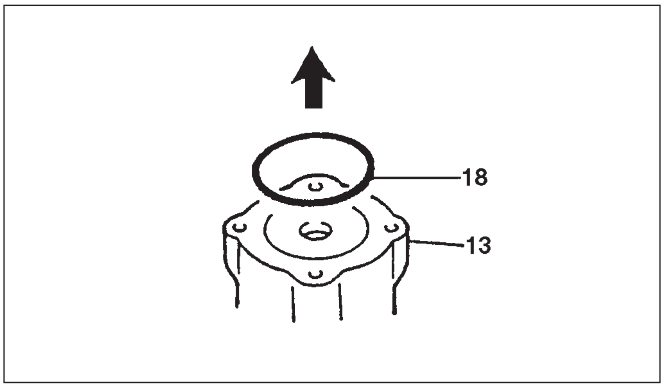
Dismantling JS200/JS240 *(continued)*

5. Remove the cover 19 with the bolt 17.

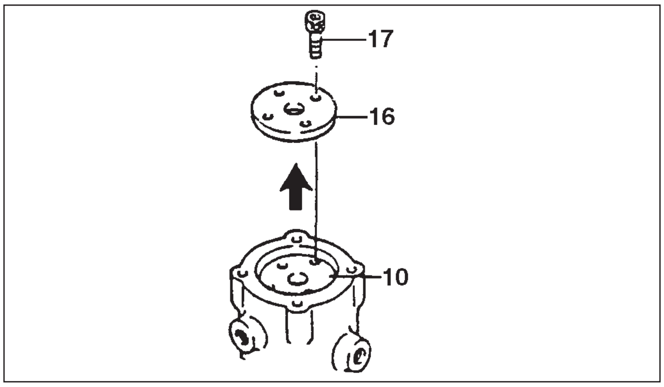


6. Remove the 'O'-ring 18.

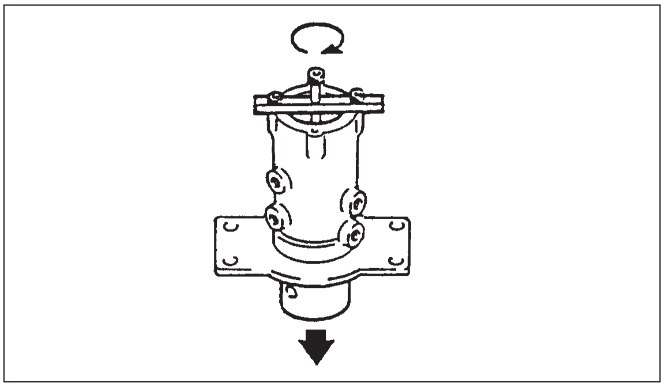
Do not reuse the 'O'-ring 18.



7. Remove the thrust plate 16 with the bolt 17.



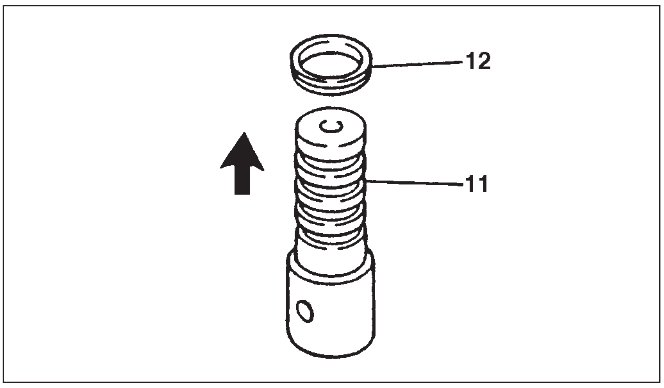
8. Using a jig push off the axle 11 from the rotor 13.
Do not hit with a hammer.



Dismantling JS200/JS240 *(continued)*

9. Remove the V-ring 12 from the axle 11.

Note: *Do not reuse the V-ring 12.*



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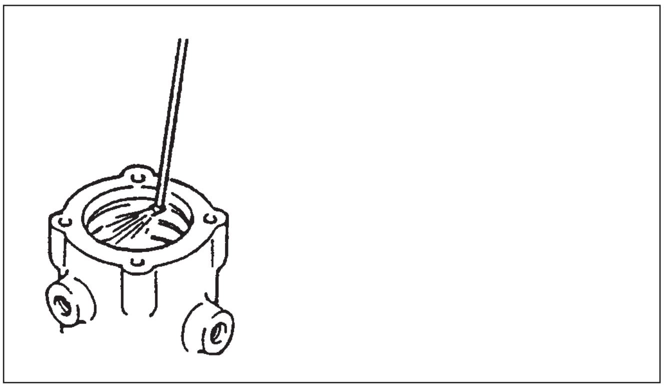
10. Remove the 'O'-ring 14, and packing ring from the rotor 13.

Note: *Do not reuse the packing ring 15.*



Assembly JS200/JS240

Inspect the parts for signs of wear, pitting, scratching, discolouration etc. Polish out scratches using a fine grade oil stone.

Before assembly, thoroughly clean all parts using a suitable solvent: Do NOT use solvents on 'O'-rings, backup rings and seals.

Fit new 'O'-rings, backup rings and seals.

Lubricate all 'O'-rings, backup rings and seals, with clean hydraulic fluid before fitting.

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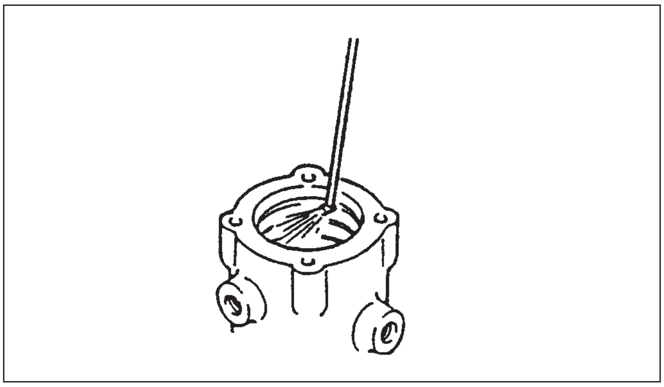
1. **a.** Clean the rotor 13 with cleaning fluid or compressed air.
b. After cleaning, check to see if there are any scratches or roughness on the inner side of the rotor or grooves.



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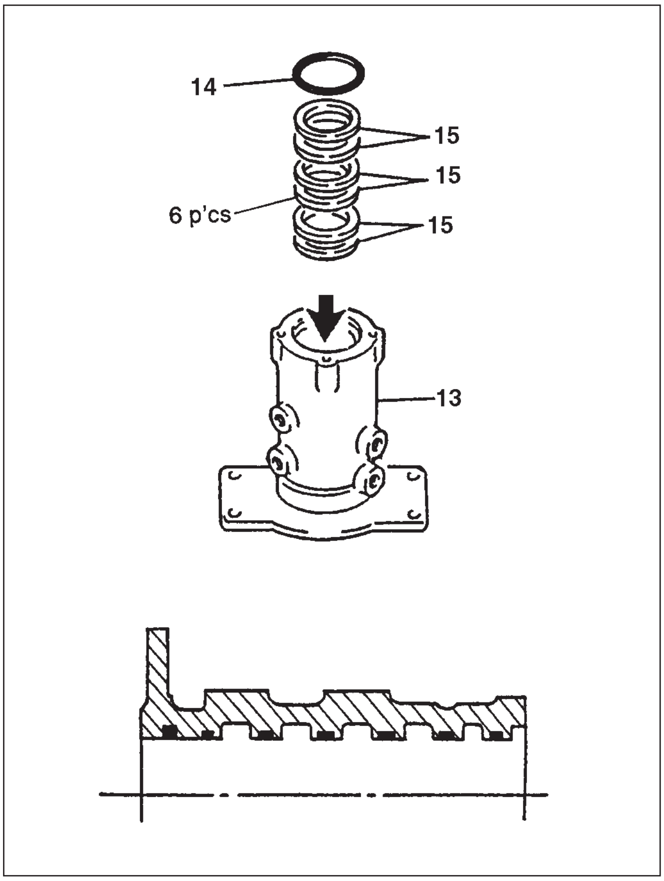
2. Check the number of packing rings 15 and 'O'-rings 14. Coat with Vaseline and install in the order below.

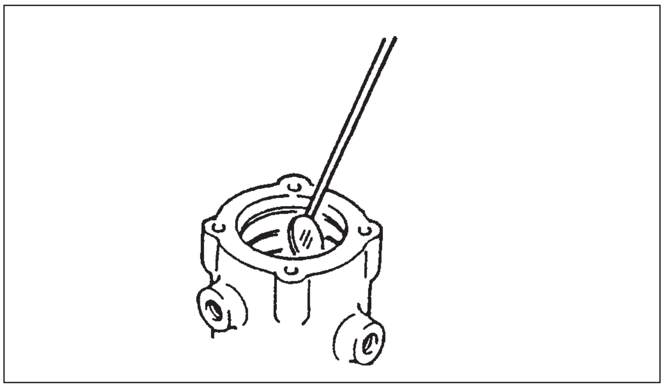
a. Set one packing ring in each groove starting from the 2nd groove from the top.

b. Set the 'O'-ring in the top groove.

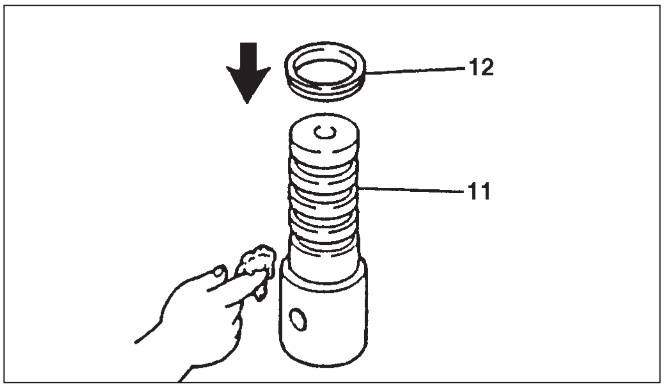


Assembly JS200/JS240 *(continued)*

3. After installing the 'O'-ring, packing ring and packing, check with a mirror to see if they are installed correctly.
After checking, coat with grease then check once more for any protrusion, twisting, etc.

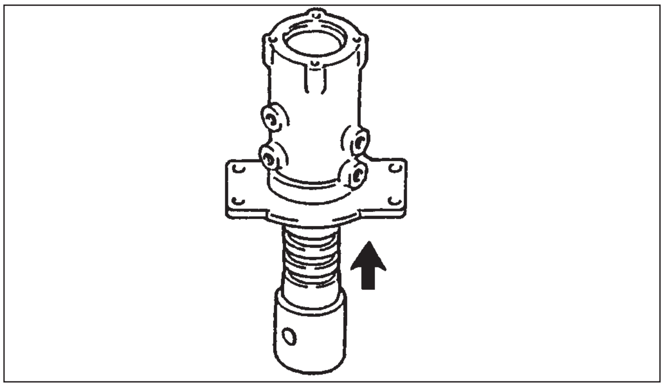


4. Install the V-ring 12 on the axle 11 and grease adequately.
Take care to prevent contamination of the grease by water or dirt.

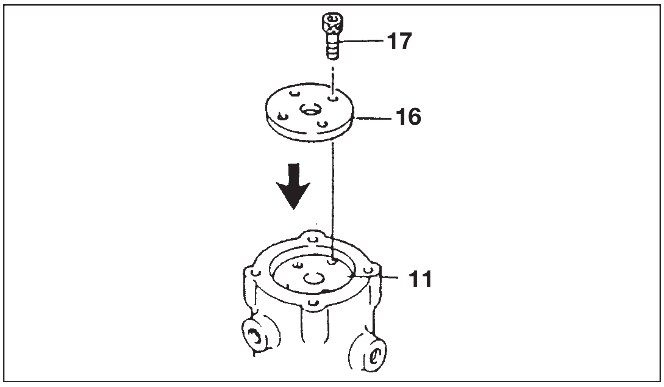


5. Install the axle 11 to the rotor 13.

Note: *Set the V-ring 12 so that it will not be cut or scratched.*

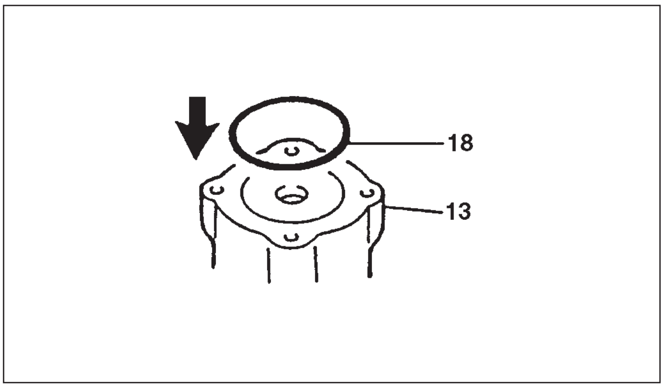


6. Install the thrust plate.

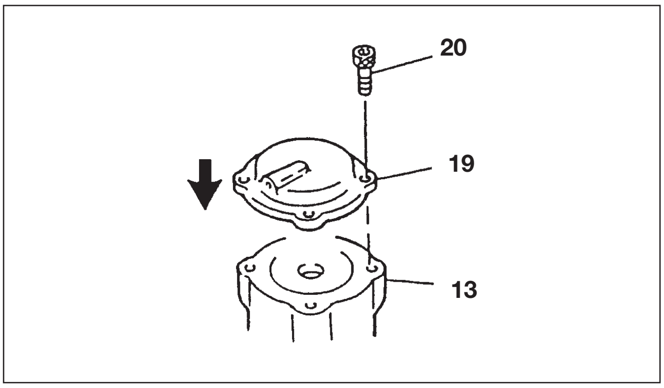


Assembly JS200/JS240 *(continued)*

7. Install the 'O'-ring.

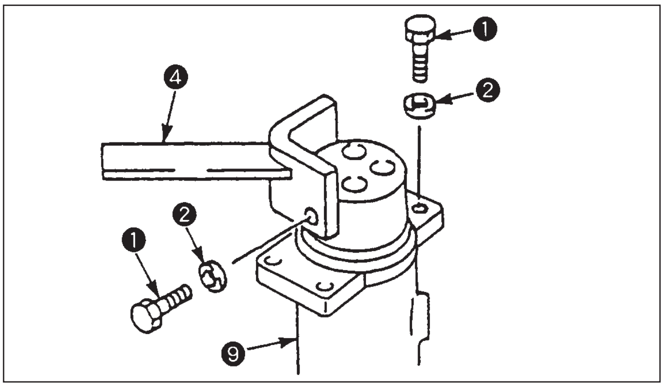


8. Install the cover.

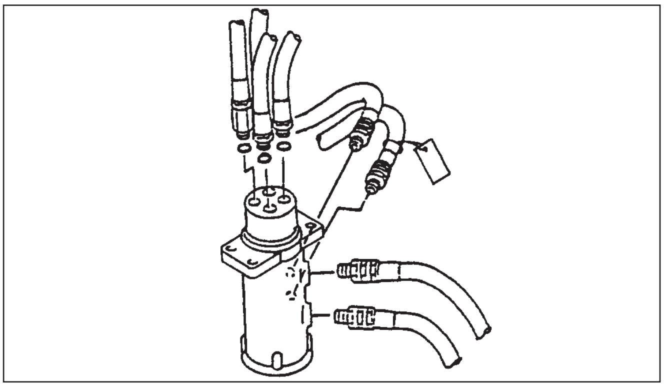


9. Align the coupling (9) to the lower frame and tighten the rotating joint installation bolt (1) and.

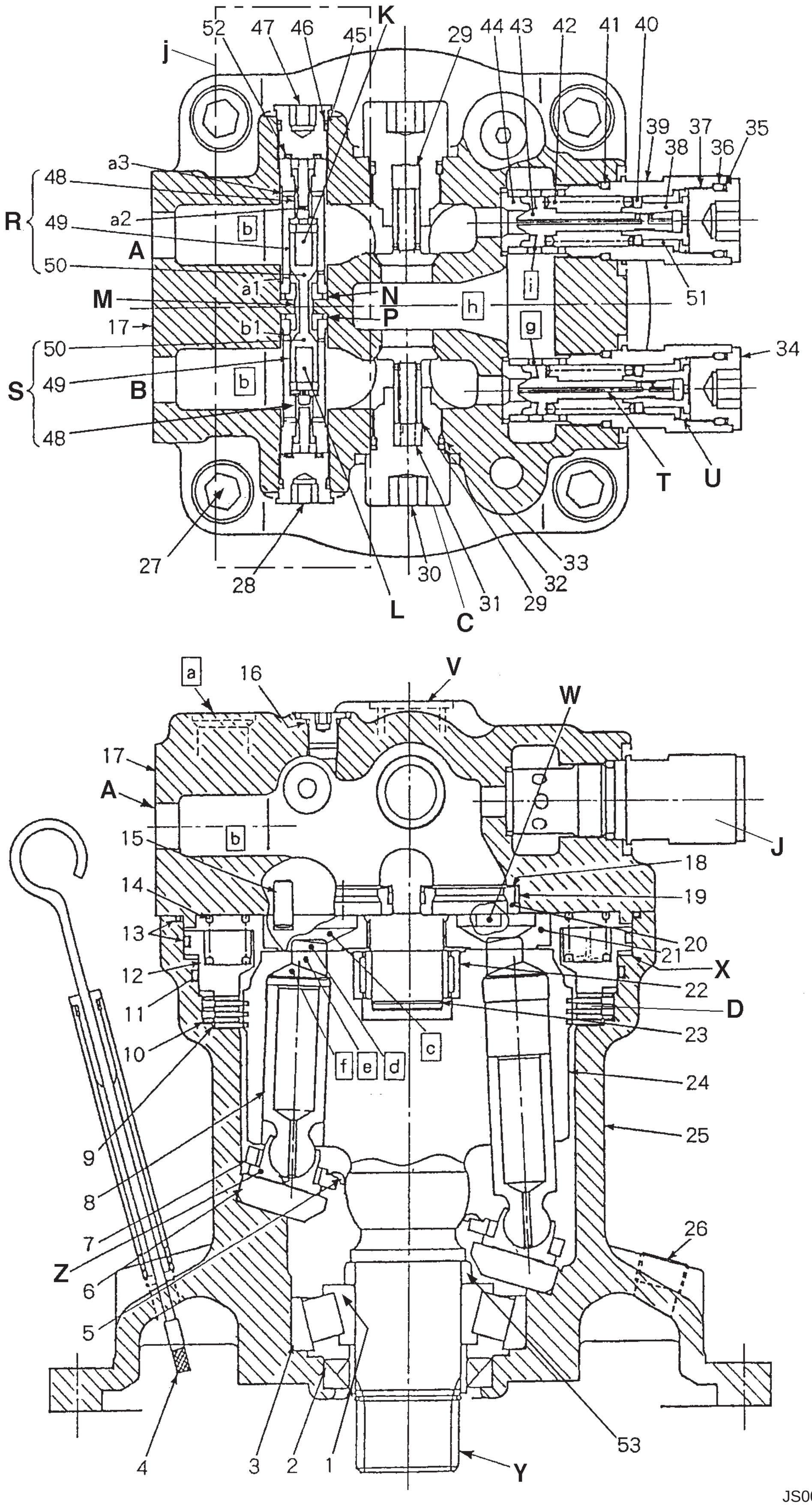
Tighten the lock bar installation bolt (1) and washer (2) to the specified torque, 109-127 Nm (11.1-12.9 Kgf/m, 80.28-93.28 lb/ft) and install the lock bar.



10. Reconnect the hoses, and install the access cover, remove the wooden block, lower the machine to the ground.
Start the machine and check for leaks.



* Hydraulic Motor Components

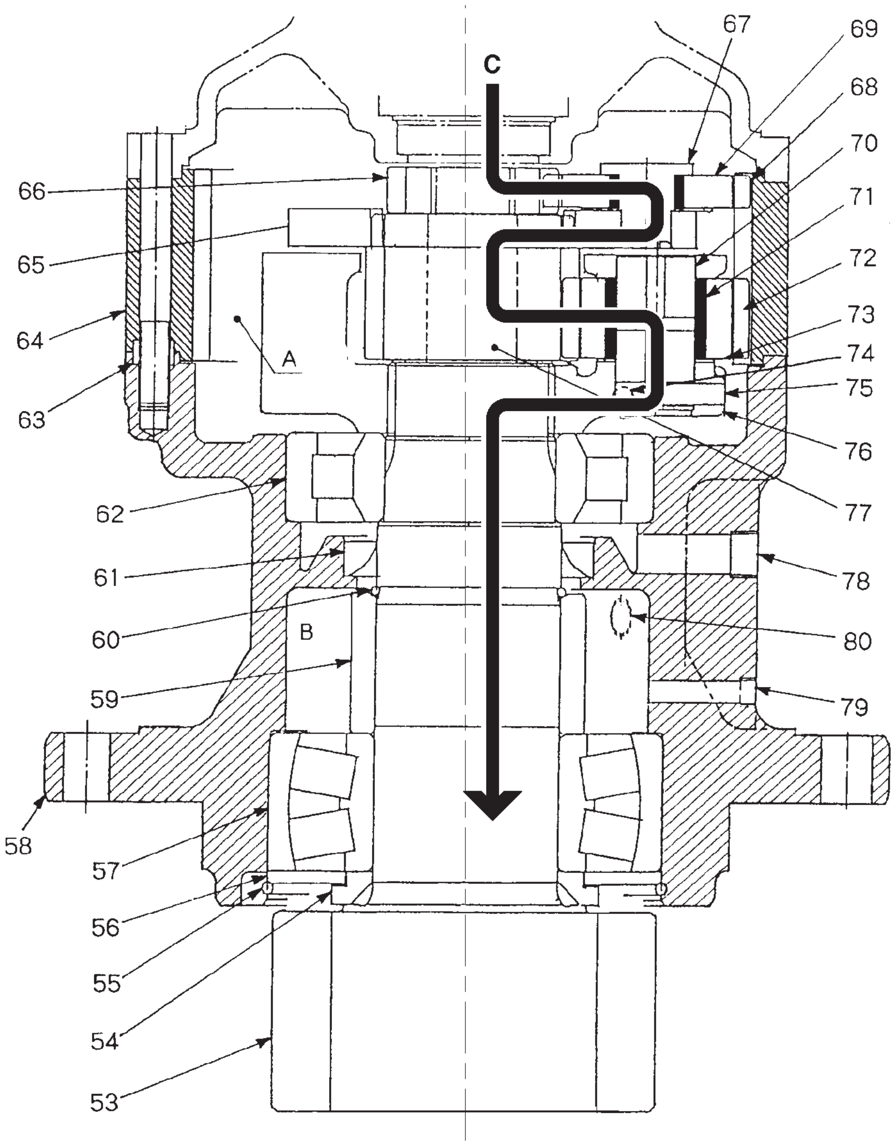


Key

- **a** Drain port
- **a1**, **b1** Pilot port
- **a2**, **a3** Pilot hole
- **b**, **c**, **d**, **e** Flow paths
- **f** Piston bore
- **g**, **h**, **i** Flow paths
- **j** By pass valve
- **A** Inlet port
- **B** Outlet port
- **C** Anti-cavitation check valve
- **D** Mechanical brake
- **J** Cross-line relief valve
- **K** A side cavity
- **L** B side cavity
- **M** Intermediate cavity
- **N** A side seat
- **P** B side seat
- **R** Anti-pendulum valve
- **S** Anti-pendulum valve
- **T** Pilot hole
- **U** Spring chamber
- **V** Make-up port
- **W** Piston
- **X** Mechanical brake release port
- **Y** Motor output shaft
- **Z** Slipper foot

Note: Item numbers are referred to on the following pages.

* Reduction Gear Components

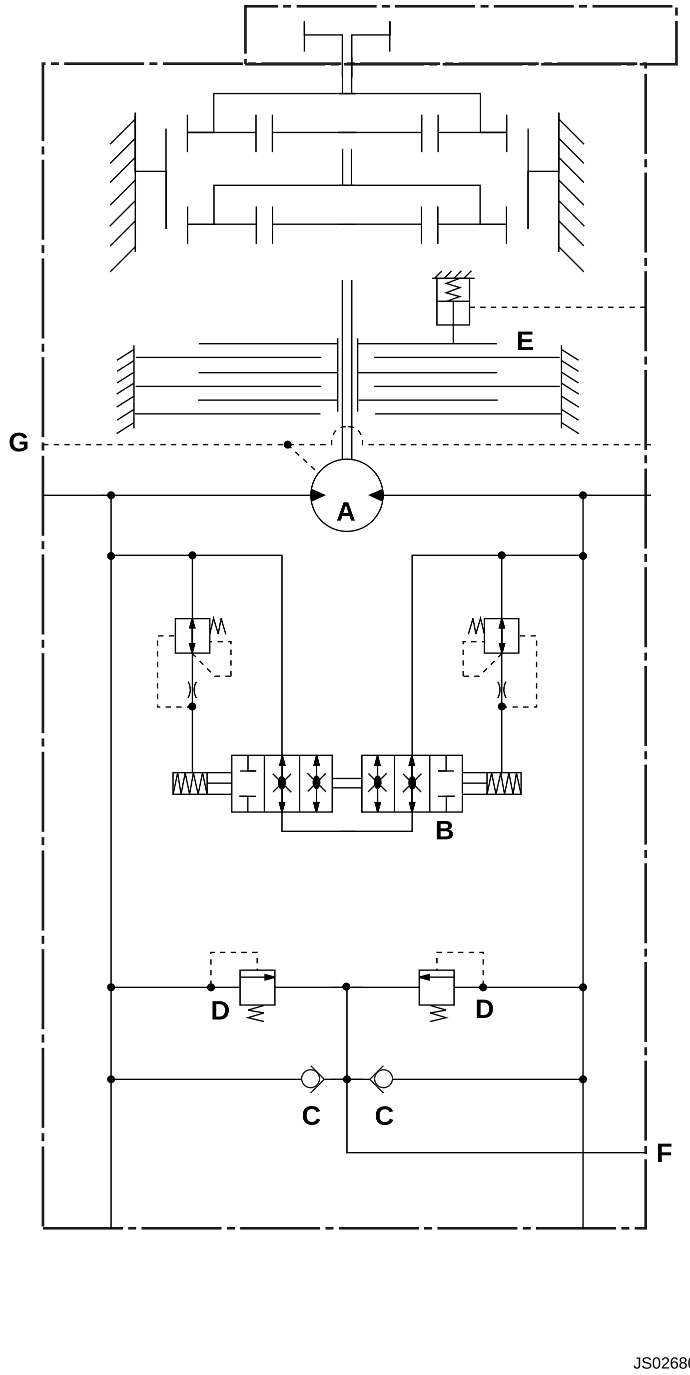


Key

A A chamber
B B chamber
C Torque path

Note: Item numbers are referred to on the following pages.

* Hydraulic Circuit

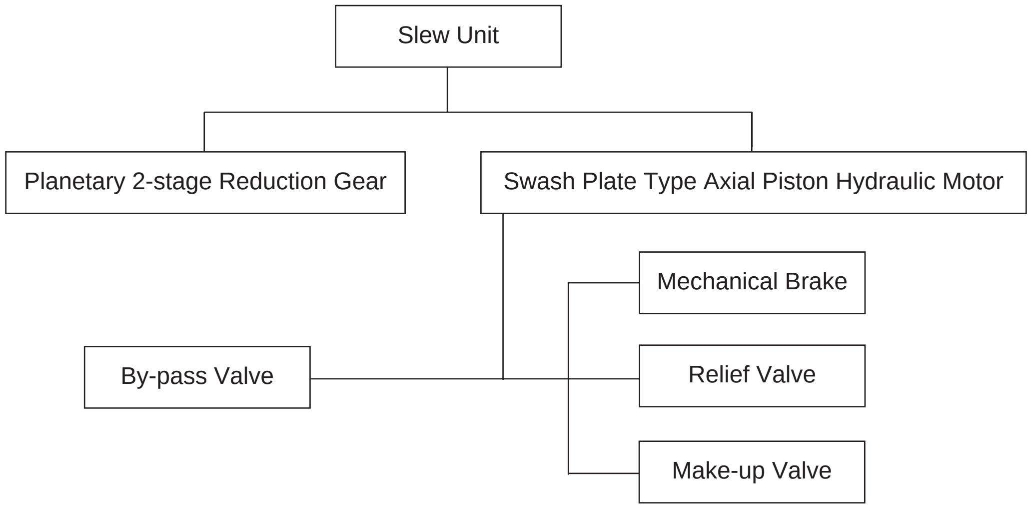


Key

A Hydraulic motor (151 cm^3/rev)
B Bypass/Anti-pendulum valve
C Anti-cavitation check valve
D Relief valve (285 kgf/cm^2 @ 155 l/min)
E Mechanical brake
F Tank line
G Drain line

* Operation

Slew Motor Configuration



The above diagram indicates the relationships between the main components of the slew motor, whose working principles are described on the following pages.

* Operation *(continued)*

Hydraulic Motor Working Principles

(illustration reference page 83 - 1)

Oil supplied from the pump via the control valves enters port **A** (or port **B**) on cover **17** and is discharged from port **B** (or port **A**).

Oil which leaks past and through clearances between the sliding parts returns to the tank via the drain port **a** in cover **17**.

The pressurised oil supplied to port **A** passes through path **b** in cover **17** and path **c** in bush **20**. It is supplied for 180° of each revolution of the motor, passing through path **d** in balance plate **21** (which has crescent-shaped ports to switch between supply and discharge), through path **e** of cylinder **24** and then to piston bores **f** of the cylinder.

Oil pressure in bores **f** of the piston assemblies **8** forces the pistons down on the angled swash plate **6** via slipper feet **Z**. The angle of the swash plate causes the slipper feet to 'slide' around the plate, rotating the cylinder assembly **24** to produce torque at the output shaft **Y**.

In this way, each of piston assemblies **8** is supplied with pressurised oil during its stroke from the top dead point to the bottom dead point and this hydraulic pressure is converted to torque which turns cylinder assembly **24**. The oil is discharged during the piston stroke from the bottom dead point to the top dead point.

The oil discharge path is the reverse of the supply path described above and the oil is discharged from port **B**. The output torque of the hydraulic motor is determined by the supply pressure and the rotational speed.

Mechanical Brake Working Principles

The mechanical brake serves as a parking brake for the machine.

Friction plate **9** is splined to the periphery of cylinder assembly **24** and mating plate **10** is connected to housing **25**. When the servo pressure at the brake release port **X** is zero, the spring **14** force acts through brake piston **12** to press the friction and mating plates together, locking cylinder **24** (output shaft) to housing **25** so that it cannot rotate. When the servo pressure at brake release port **X** is 40 kgf/cm^2 (568 lbf/in^2), the pressure at the brake piston overcomes the spring force and the brake piston moves to the end face between the friction and mating plates, releasing the brake.

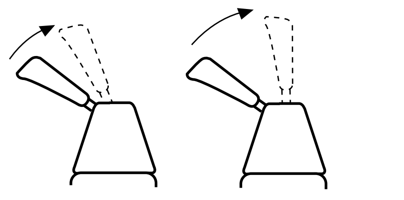
Make-Up Valve Working Principles

1 Under partial hydraulic cross-line relief braking (relief valve not functioning).

When slowing down the slew structure with the hand control valve lever in the half-way position, the volume of oil supplied to port **A** from the pump is reduced. If the rotational speed of the slew structure is relatively high, the motor acts as a pump and causes a negative pressure to develop at **c** and oil must be supplied to avoid cavitation. If the pressure at port **B** is lower than the cross-line relief valve operating pressure and the supply of oil from the control valve is insufficient to provide the amount of oil needed, the make-up check valve assembly **29 - 31** operates to make up the insufficiency at **c** from the make-up port **V**.

2 Under full hydraulic braking (cross-line relief valve functioning).

When the lever is rapidly moved to the neutral position from the position in paragraph **1**, the supply of oil from the pump to port **A** drops to zero, but the slew structure continues to rotate due to inertia. In this case, port **B** cross-line relief valve **J** operates and the oil from the relief valve passes through the paths **g** and **h**, pushes open port **B** make-up check valve **29** and is supplied to paths **b** and **c**. As oil is short by the amount of leakage past motor pistons, the make-up check valve opens and oil is supplied to paths **b** and **c** from the make-up port to prevent cavitation.



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* **Operation *(continued)***

Relief Valve Working Principles

1 On starting

Due to the superstructure's inertia there is a build-up of pressure in the motor when it begins to slew. To prevent damage, excess pressure is diverted between ports **A** and **B** via poppet valves **43** (part of cross-line relief valve **J**).

2 When the brake is applied (cushioning)

When the slew control valve is returned to neutral the oil return path from the motor is closed. While the superstructure is coming to a halt it is, in effect, 'driving' the motor as a pump. This results in a pressure build-up at the outlet port (**A** or **B** depending on slew direction). This increased pressure opens poppet valve **43**, which allows oil to flow via paths **g** and **h**, opening check valve **29** and relieving the pressure into cavity **C**.

At the same time, oil flows between the two ports via the cross-line relief valve **J**, which has already been partially opened by poppet valve **43**.

The result is a 2-stage relief action which momentarily delays the pressure build-up as the superstructure comes to a halt. This reduces the shocks arising due to sudden braking.

3 Anti-Pendulum Feature

While the superstructure is coming to a halt, as described in **2**, it drives the motor as a pump. The initial result is a braking effect on the superstructure. However, the resulting pressure build-up in port **A** (or **B**, depending on direction) tends to cause the superstructure to 'bounce back' a little. The process repeats itself to create what is known as a 'pendulum effect'.

To prevent this happening, check valves **50** and flow control valves **48** work together to divert oil pressure between ports **A** and **B** until the superstructure has come to a halt.

Reduction Gear Structure and Working Principles (illustration reference page 83 - 2)

Power transmitted by the hydraulic motor output shaft is transmitted to second sun gear **77** via first sun gear **66**, planetary gear **69** and holder **65**. Power is then transmitted to output shaft **53** via second sun gear **77**, planetary gear **72** and holder **76**. The output shaft is constructed with an integral pinion and is supported in gear case **58** by bearings **57** and **62**.

Due to the severe conditions under which the output shaft operates, an oil seal **61** is provided in the centre of gear case **58** to protect the bearings from metal waste worn from the gears. The bearing in chamber **A** is lubricated with gear oil and the bearing in chamber **B** with grease.

Maintenance Specifications

*

Item	Inspection and Maintenance Standards
Balance Plate **21**	The crescent-shaped ports in the balance plate, which are in sliding contact with the end face of the cylinder assembly shaft, act to switch between high and low oil pressure. Any damage to the sliding contact face will increase leakage, causing a decrease in volumetric efficiency and an increase in slip. Any seizure of the sliding contact face causes a reduction in mechanical efficiency and can lead to further damage. If the grooves or marks depths are less than 0.03 mm (.001 in), the plate can be corrected using fine emery cloth. If the wear is greater than 0.03 mm (.001 in), the plate should be renewed. The plate should be renewed if it shows any sign of seizure.
Piston assembly **8** slipper feet	Correct any damage to the sliding contact face of the slipper feet by using fine emery cloth. Renew the motor if the depth of any slipper foot oil groove is less than 0.45 mm (.018 in) or if the slipper foot surfaces are seriously damaged.
Piston assembly **8** pistons	The external surfaces of the piston assemblies should be practically unworn. The motor should be renewed if a piston assembly shows any sign of seizure.
Cylinder assembly **24** piston bores	The piston bores should be practically unworn. The motor should be renewed if the bores show any sign of seizure or are badly damaged.
HYDRAULIC MOTOR Taper roller bearing **3** Needle bearing **22** REDUCTION GEAR Self-aligning roller bearing **57** Roller Bearing **62**	The bearings should be renewed if any slight damage is noticed on the contact surfaces of the rollers or needles. It is recommended that all bearings be renewed on reassembly of the motor because bearings can be damaged when the motor is dismantled.
HYDRAULIC MOTOR Oil seal **2** REDUCTION GEAR Oil seal **61**	Renew any oil seal if damage to the lip is apparent. New seals must be used when reassembling the motor.
HYDRAULIC MOTOR O-rings **11**, **13**, **33**, **36**, **41**, **45**, **52**	Renew any 'O'-ring that appears to be damaged. New 'O'-rings must be used when reassembling the motor.
HYDRAULIC MOTOR Back-up ring **32**, **35**, **46**	The back-up rings must be renewed when reassembling the motor.

⚠ CAUTION

If the machine is operated at full load, before its initial run-in procedure is complete, it may cause scuffing and seizing which can adversely effect the service life of the machine.

8-3-1-5

⚠ WARNING

Hydraulic Fluid

Fine jets of hydraulic fluid at high pressure can penetrate the skin. Do not use your fingers to check for hydraulic fluid leaks. Do not put your face close to suspected leaks. Hold a piece of cardboard close to suspected leaks and then inspect the cardboard for signs of hydraulic fluid. If hydraulic fluid penetrates your skin, get medical help immediately.

INT-3-1-10/1

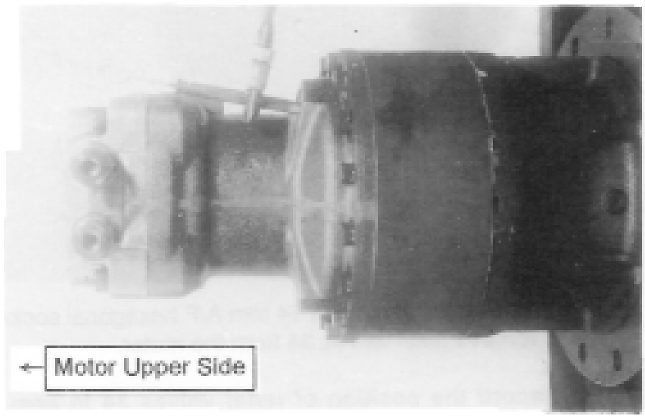
⚠ WARNING

Hydraulic Pressure

Hydraulic fluid at system pressure can injure you. Before disconnecting or connecting hydraulic hoses, stop the engine and operate the controls to release pressure trapped in the hoses. Make sure the engine cannot be started while the hoses are open.

INT-3-1-11/1

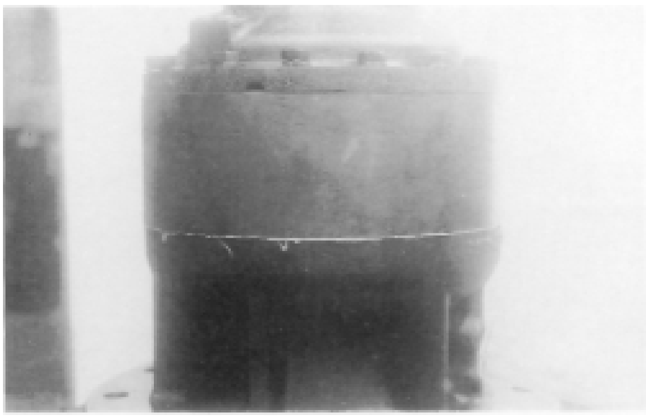
* Motor Assembly/Cylinder Assembly Dismantling



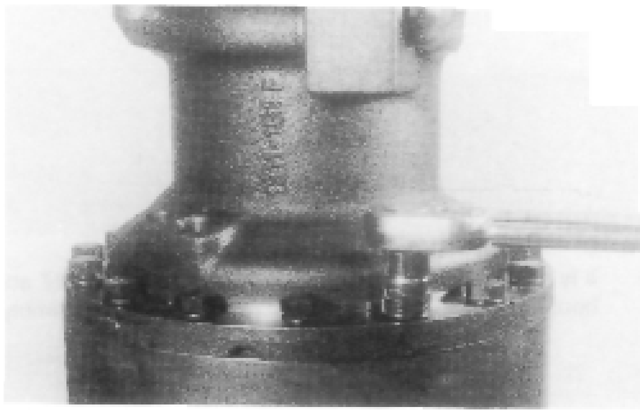
Refer to the sectional drawing on page E/83-1 as a guide to dismantling and assembling.

Before attempting to dismantle the slew motor assembly, the inlet and outlet ports should be blanked and the outer surfaces washed down with a suitable solvent to remove all dirt and dust. Dry using compressed air.

1 Remove the level gauge with a pipe wrench.



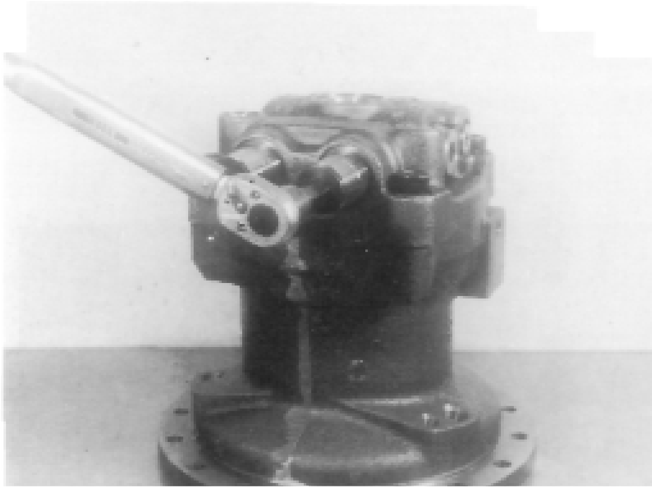
2 Remove plug **26** with an 8 mm Allen key and drain the gear oil.



3 Loosen the bolts with a 19 mm socket wrench and remove the motor.

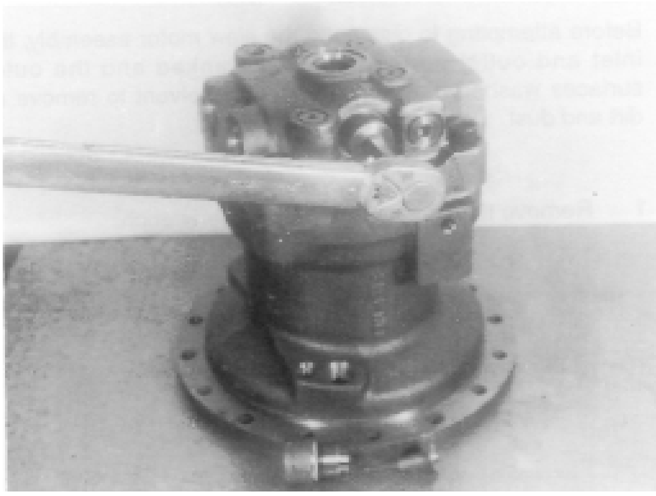
Note: Before removing the motor from the reduction gear, it is advisable to make an alignment mark on the mating faces to facilitate reassembly.

* **Motor Assembly/Cylinder Assembly Dismantling (cont'd)**



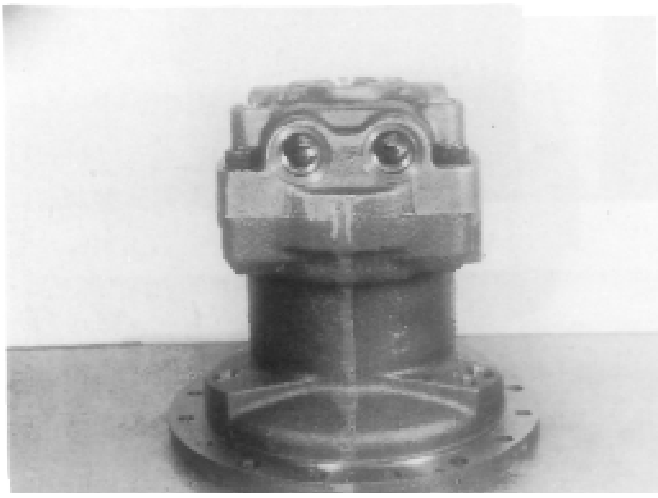
4 Remove the caps **37** with 14 mm A/F hexagonal sockets and remove relief valves **34** from the motor.

Note: Record the position of relief valves **34** to ensure correct reassembly.

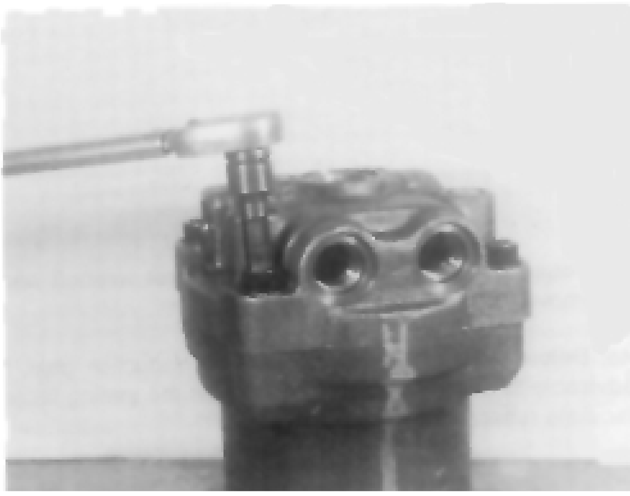


5 Remove the caps **30** with a 14 mm A/F hexagonal key and take out the springs **31** and check valves **29**. Remove by-pass valve assembly by unscrewing cap **28** using a 10 mm A/F hexagonal key.

Note: Record the relative positions of the parts to ensure correct reassembly.

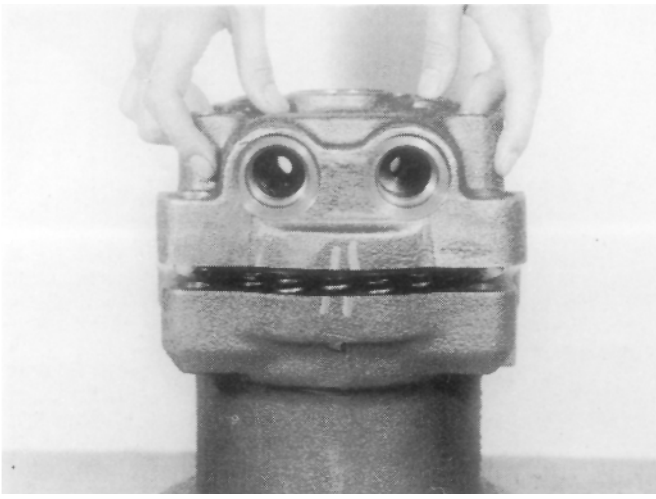


6 It is advisable to make alignment marks on cover **17** and housing **25** with white paint, etc. to facilitate reassembly.

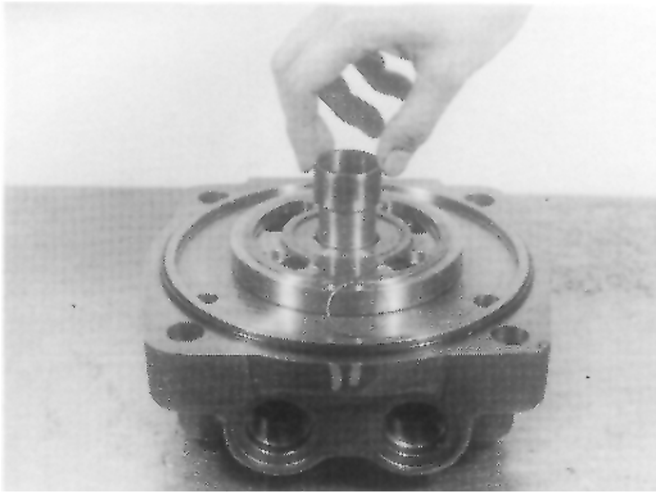


7 Loosen the bolts attaching cover **17** and housing **25** with a 12 mm hexagonal key.

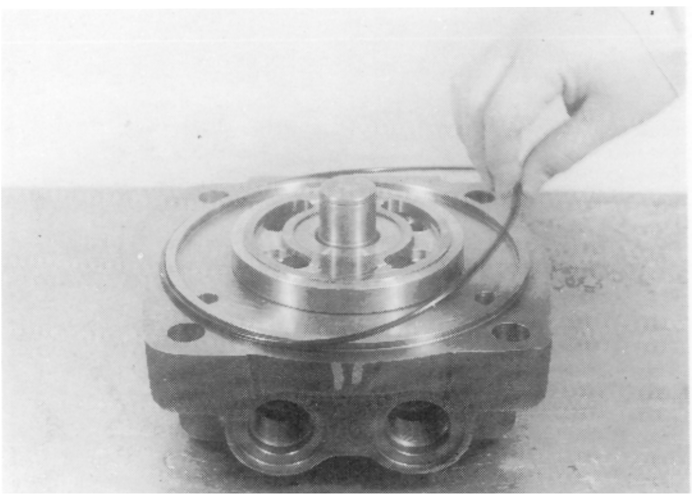
* Motor Assembly/Cylinder Assembly Dismantling (cont'd)



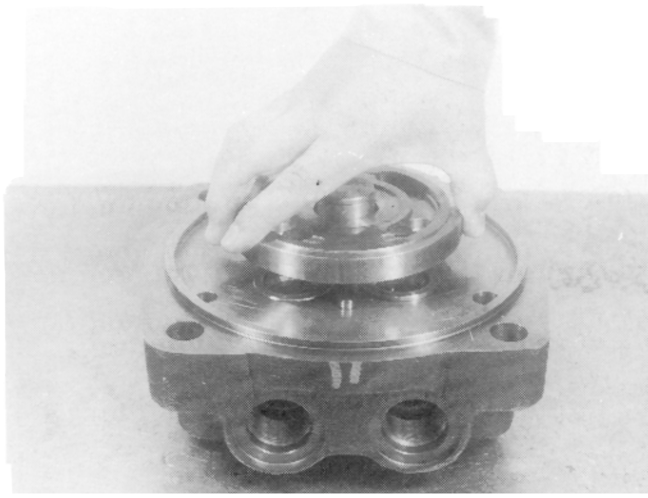
8 Place the motor with the main shaft downwards and lift off cover **17**.



9 Remove snap ring **23** and remove the inner ring of needle bearing **22**.



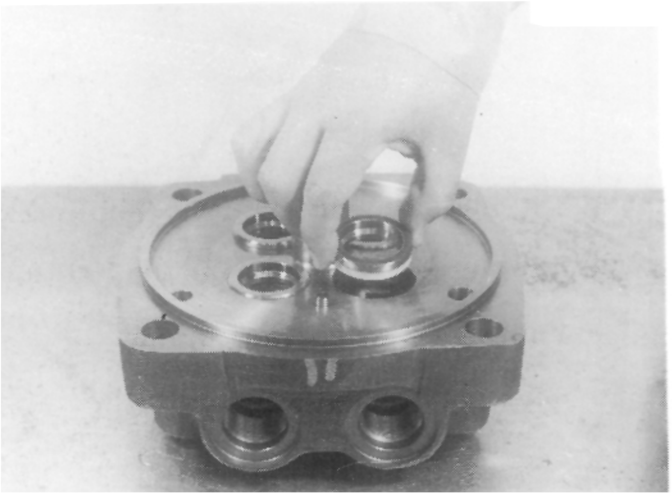
10 Remove 'O'-ring **13**.



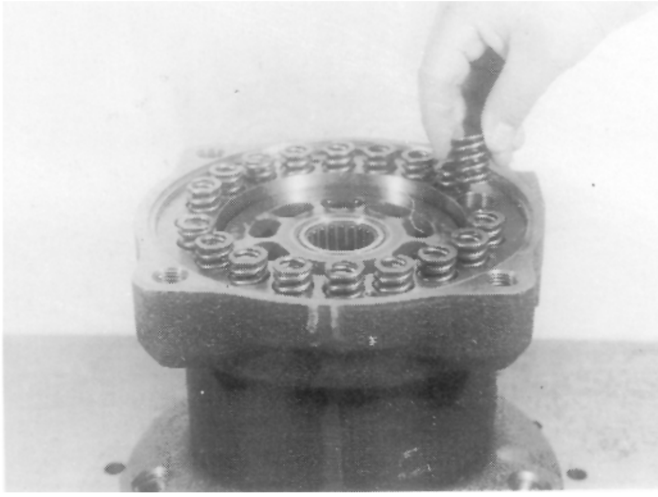
11 Remove balance plate **21**. Remove the pins **15** from the balance plate.

Note: The balance plate **21** must be reinstalled correctly on cover **17**. (The alignment of the hair groove and round groove which select high and low pressure is very important. Before removing the balance plate, note the correct relationship with cover **17**.)

* Motor Assembly/Cylinder Assembly Dismantling (cont'd)

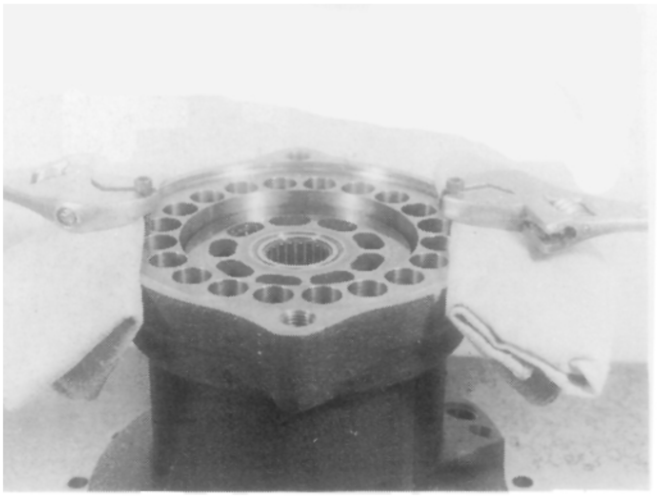


12 Remove the bushings **20** with Teflon rings **19** and the plate springs **18**.

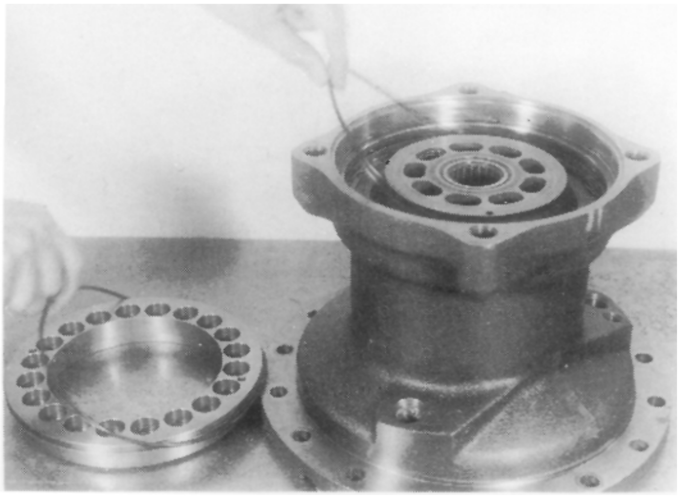


13 Remove the springs **14** from brake piston **12**.

Note: Keep the springs in the order in which they are to be reinserted.

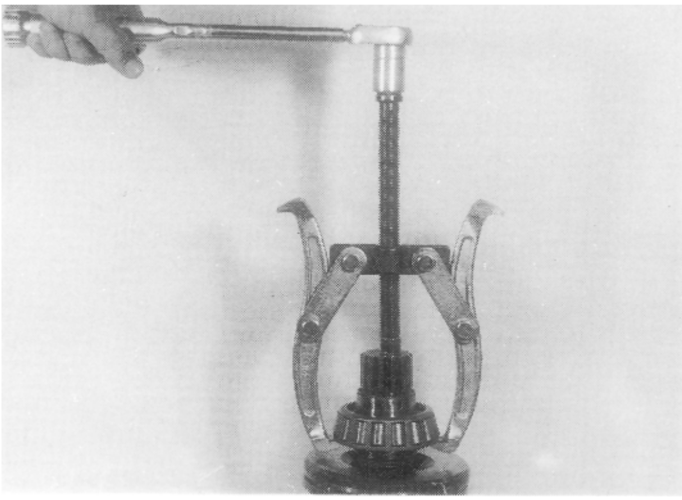


14 It may be difficult to remove brake piston **12** from housing **25** due to resistance caused by 'O'-rings **11** and **13**. Therefore remove brake piston **12** using the tapped M6 holes as shown in the photograph.

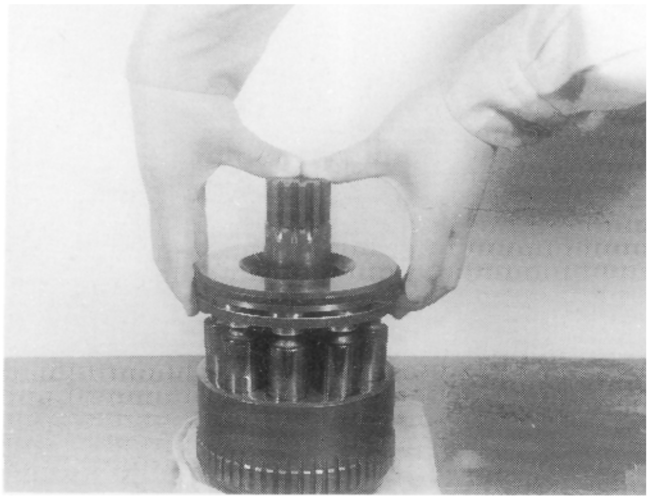


15 Remove 'O'-ring **11** from housing **25** and 'O'-ring **13** from brake piston **12**.

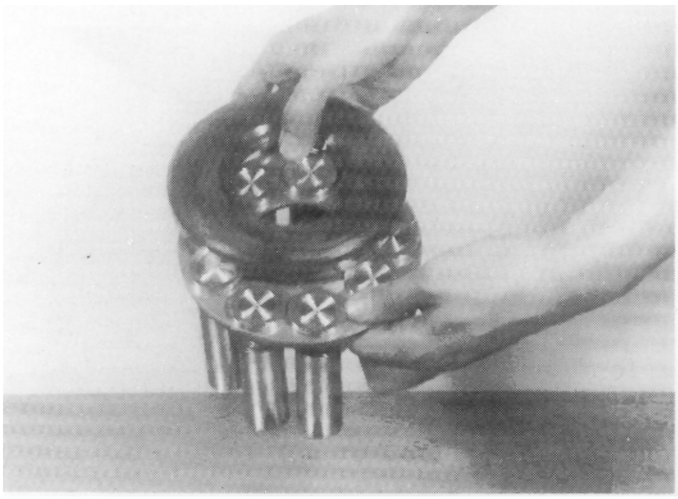
* Motor Assembly/Cylinder Assembly Dismantling (cont'd)



16 Attach a puller to the inner ring of taper roller bearing **3** at two places and on the end of cylinder **24** spline, then extract bearing inner ring **1**. Take out collar **53**.

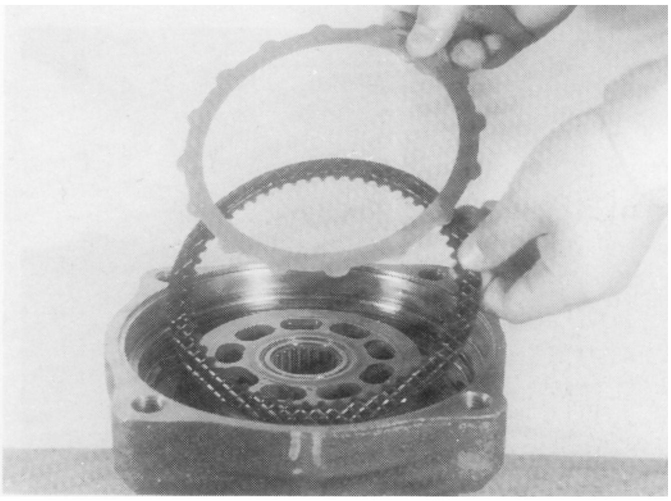


17 Remove swash plate **6**, piston assemblies **8** and retainer plate **7** together from cylinder **24**.



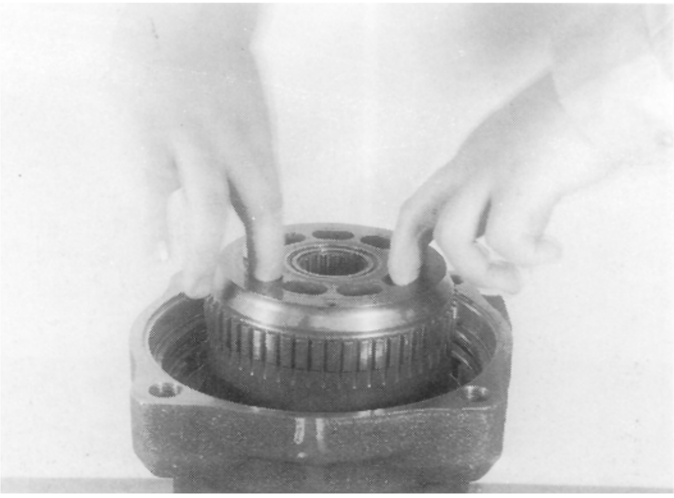
18 Slide swash plate **6** from the sliding faces of the piston assemblies.

Note: Take care not to damage the swash plate during handling.



19 Remove friction plate **9** and mating plate **10**.

* Motor Assembly/Cylinder Assembly Dismantling (cont'd)

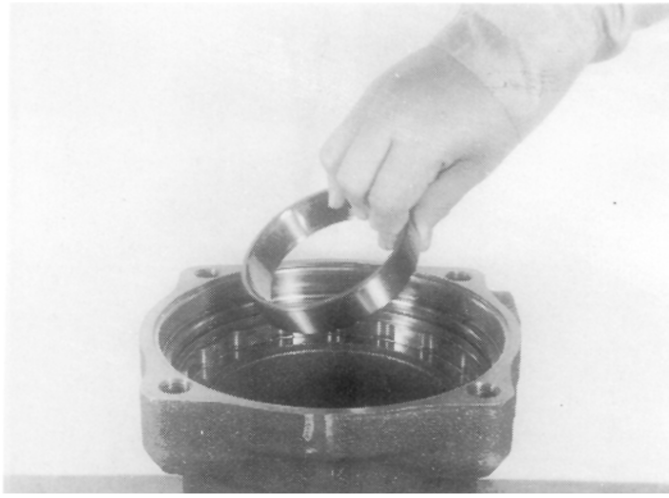


20 Hold the end of cylinder **24** by hand and pull out the cylinder assembly from housing **25**.

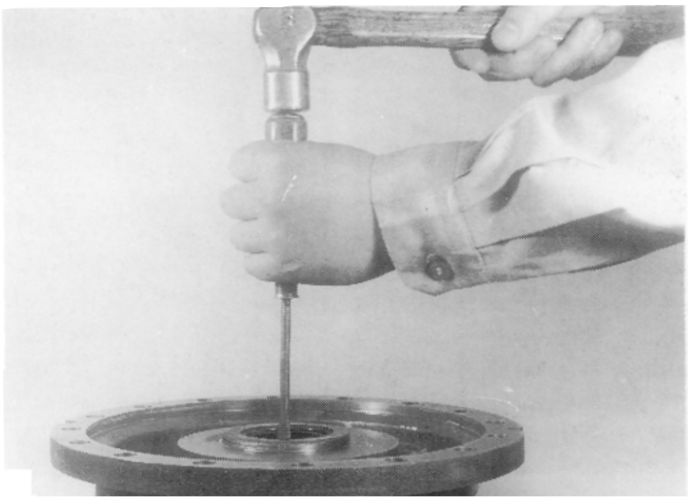
Note: The oil seal **2** and the outer ring of taper roller bearing **3** remain in the housing.

The end face of the cylinder should be protected by clean cloth to prevent it from being damaged.

Make alignment marks or write numbers on the piston bores and the piston assemblies so that the piston assemblies can be replaced in the same bores during reassembly.

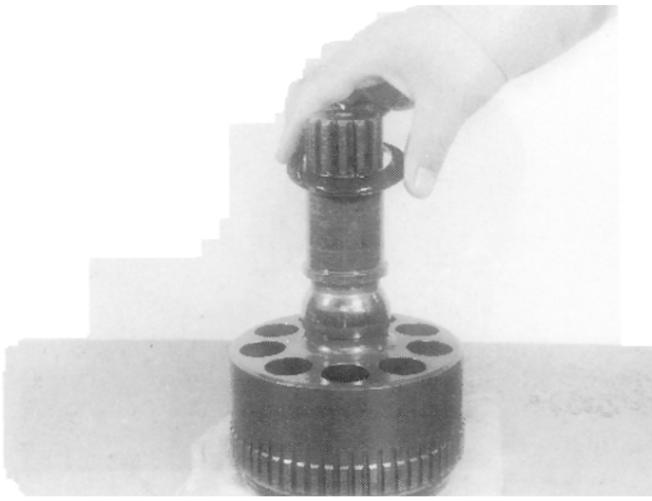


21 Remove the outer ring of taper roller bearing **3** from the housing.



22 Tap oil seal **2** with a screwdriver and hammer to remove it from housing **25**.

Note: The oil seal cannot be reused.



23 Remove the spring from cylinder **24**.

* Motor Assembly/Cylinder Assembly Assembly

Refer to the sectional drawing on page 83 - 1 as a guide to dismantling and assembling.

Check all parts before assembly and remove any scratches with a fine oil stone or carborundum paper. Wash with a suitable solvent and blow dry.

Replace all seals with new ones.

Apply clean hydraulic oil to all sliding faces during assembly.

CAUTION

Cleaning

Cleaning metal parts with incorrect solvents can cause corrosion. Use only recommended cleaning agents and solvents.

INT-3-2-11

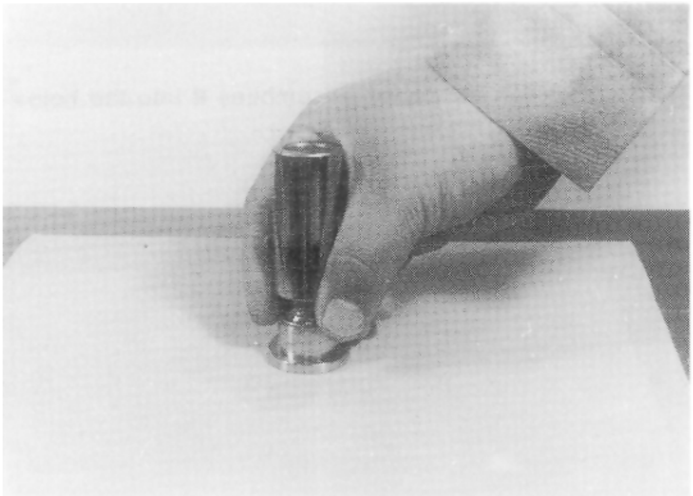
CAUTION

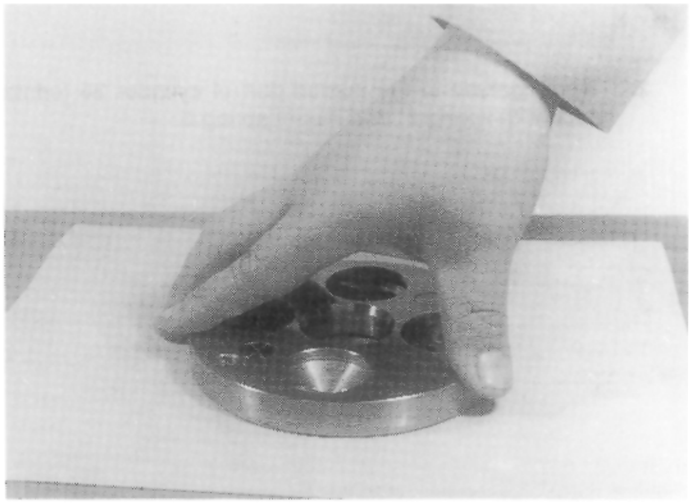
'O'-rings, Seals and Gaskets

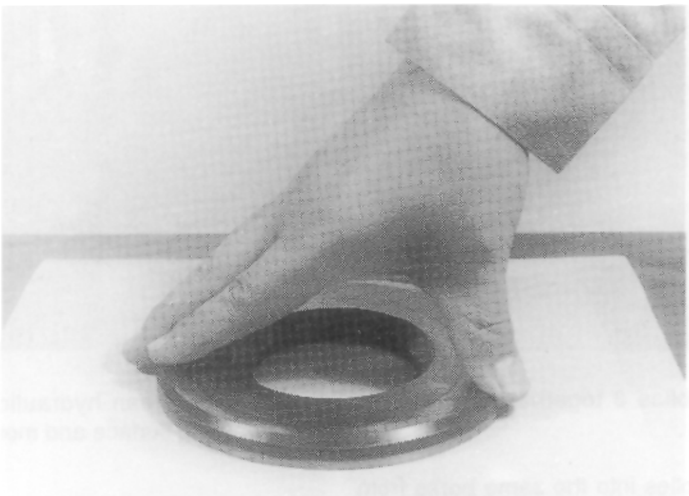
Badly fitted, damaged or rotted 'O'-rings, seals and gaskets can cause leakages and possible accidents. Renew whenever disturbed unless otherwise instructed. Do not use Trichloroethane or paint thinners near 'O'-rings and seals.

INT-3-2-12

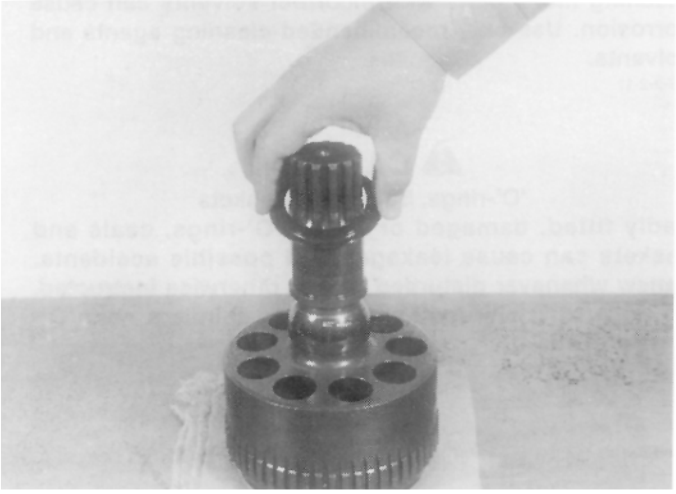
1 Lap the sliding contact faces of piston assemblies **8**, balance plate **21** and swash plate **6** with very fine paste on a flat surface.



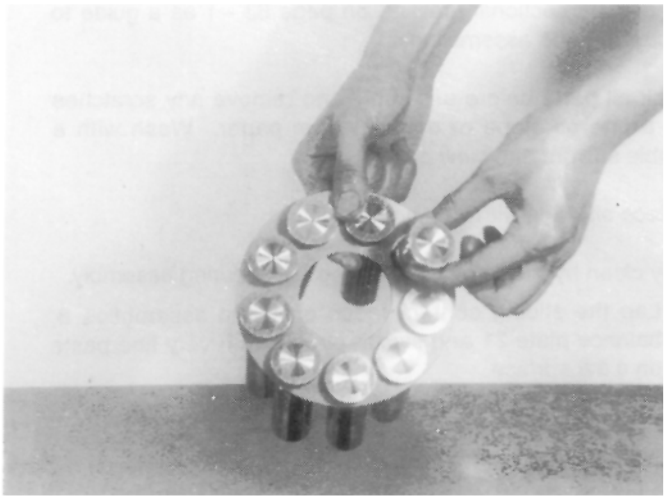




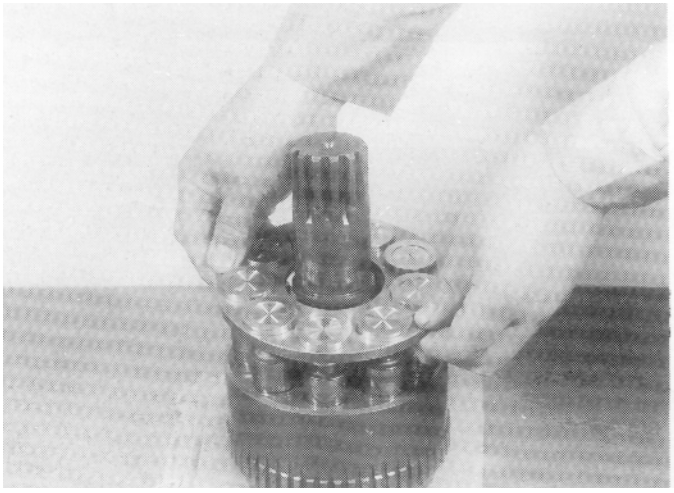
* **Motor Assembly/Cylinder Assembly Assembly (cont'd)**



2 Apply grease to the curved part of cylinder **24** (contact face with spring **5**) and mount spring **5**.



3 Position the piston assemblies **8** into the holes of retainer plate **7**.



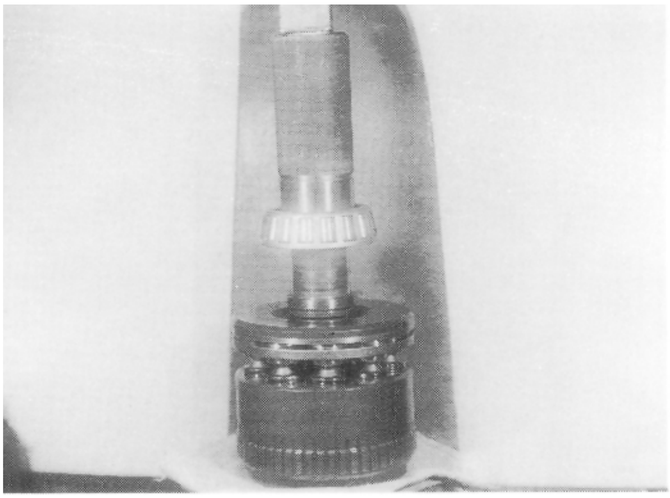
4 Mount the piston assemblies **8** together with retainer plate **7** into cylinder **24**.

Note: Insert the piston assemblies into the same bores from which they were removed.

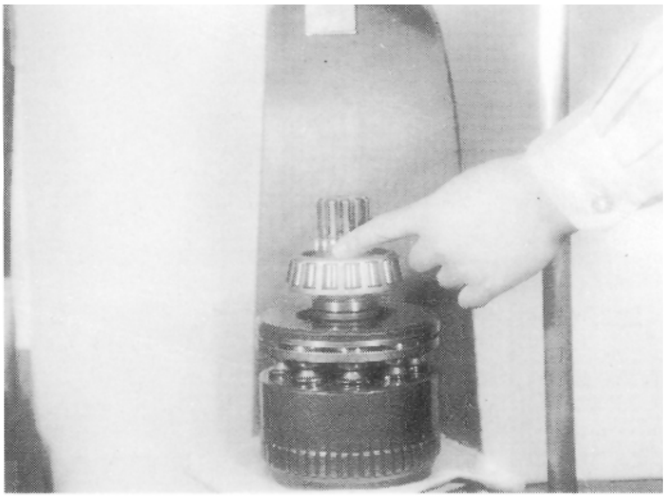
Apply clean hydraulic oil to all cylinder **24** bores before reassembling.

5 Apply clean hydraulic oil to piston assembly **8** shoe sliding surface and mount the swash plate **6**.

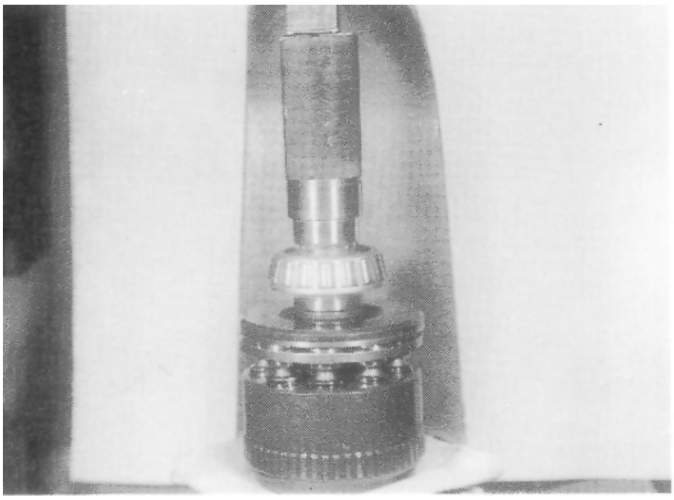
* Motor Assembly/Cylinder Assembly Assembly (cont'd)



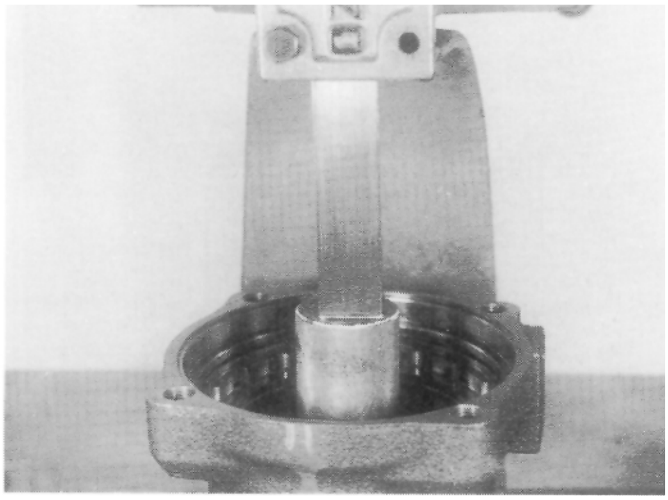
6 Mount collar **53** and inner ring of taper roller bearing **1** on motor output shaft **24**.



7 Apply a thin coat of JCB Retainer where the inner ring is mounted on motor output shaft **24**.

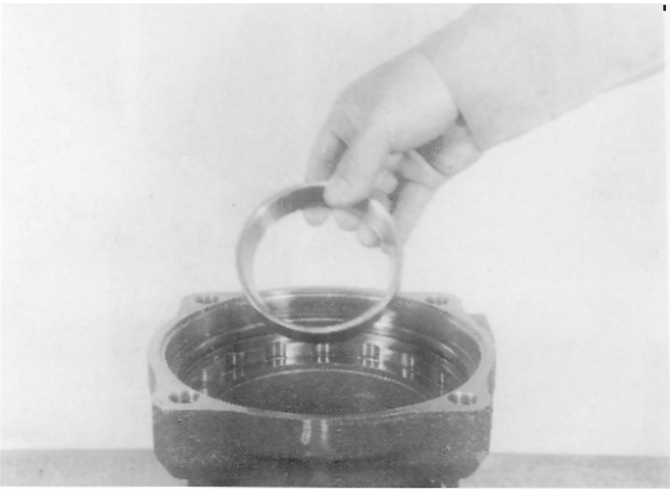


8 Using a jig, (see **Special Tools**, Section 1) mount inner ring **1** on output shaft **24**.

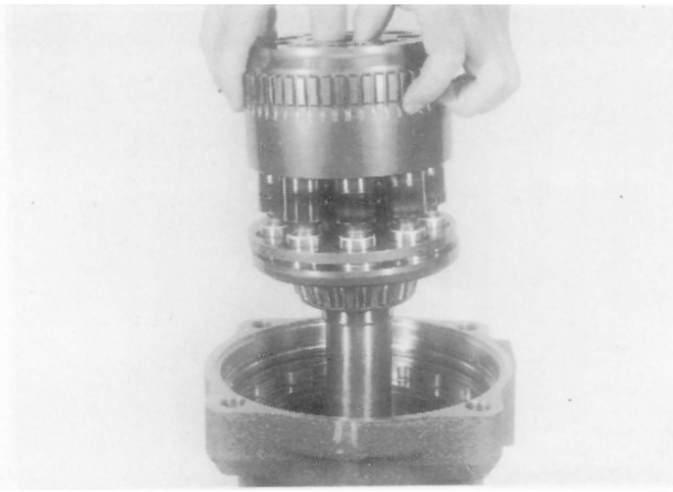


9 Apply grease to the lip of seal **2** and use a press and jig (see **Special Tools**, Section 1) to force fit the seal into position.

* Motor Assembly/Cylinder Assembly Assembly (cont'd)

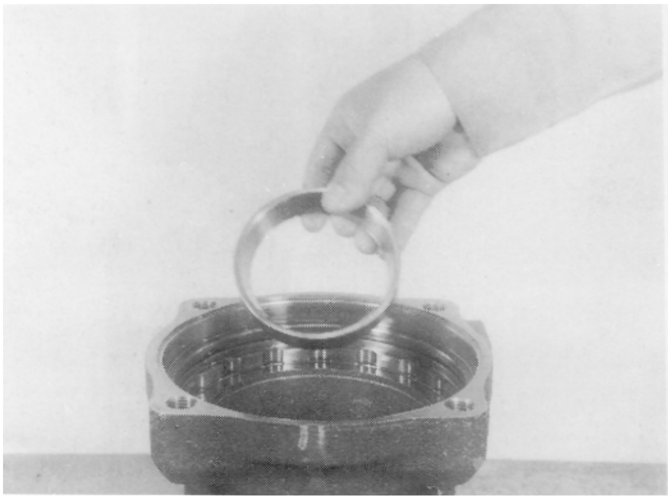


10 Mount the outer ring of the taper roller bearing into housing **25**.



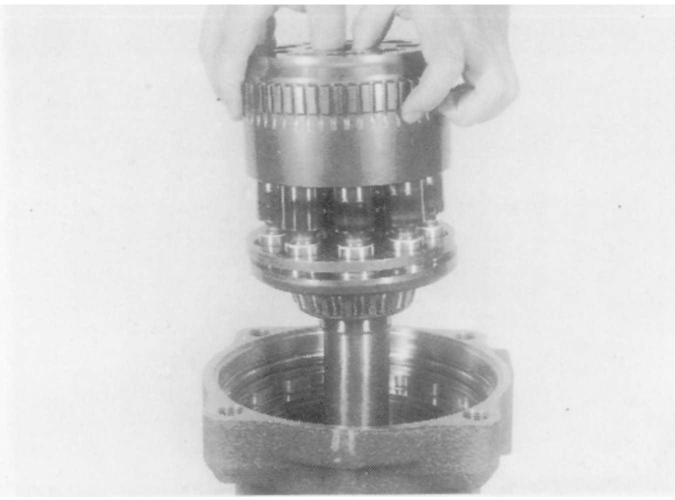
11 Hold the end of cylinder **24** by hand and carefully insert the cylinder assembly into housing **25**. Use the seal protector on the splines.

Note: The splines of the cylinder assembly protrude beyond the housing, so use a guide of 30-50 mm (1.2-1.9 in) on the lower part of the housing. Verify that spring **5** is inserted correctly into the back face of retainer plate **7**.



12 Mount friction plate **9** and mating plate **10**.

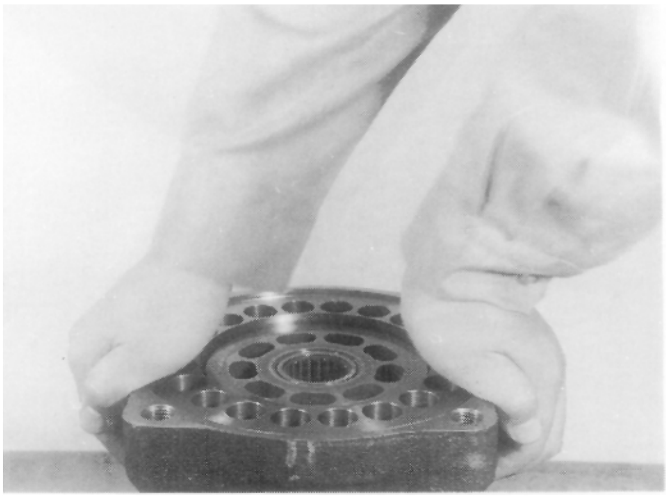
Note: Apply hydraulic oil to both faces before mounting the plates.



13 Mount 'O'-ring **11** in housing **25** and 'O'-ring **13** on piston **12**.

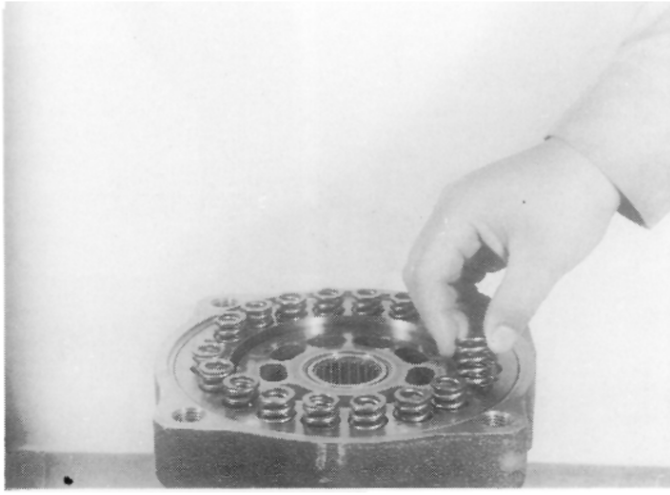
Note: Grease the 'O'-rings before mounting.

* Motor Assembly/Cylinder Assembly Assembly (cont'd)



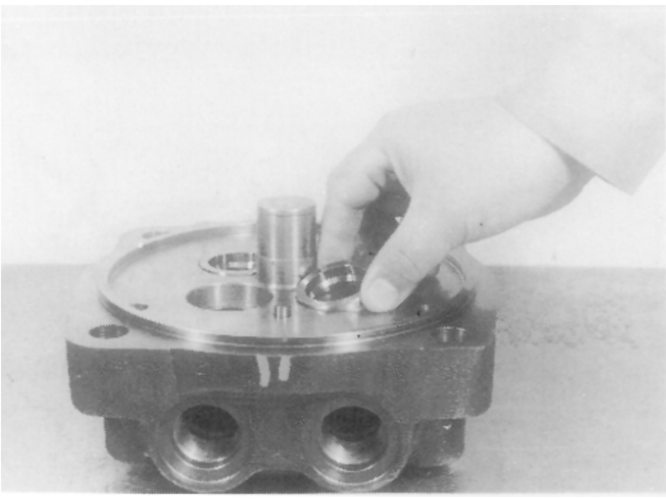
14 Apply hydraulic oil to the sliding surface around piston **12** and slide it into housing **25**.

Note: It is difficult to insert piston **12** into the housing due to O'-rings **11** and **13**. Hold the piston horizontally and push it into the housing with one movement.



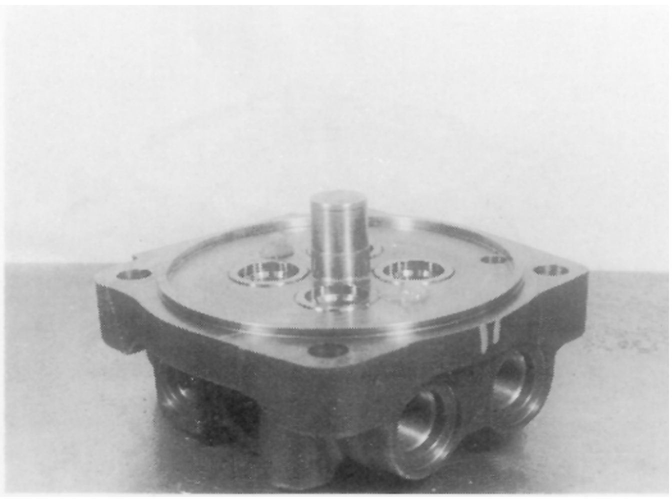
15 Insert the brake unit springs **14** back into brake piston **12**.

Note: Insert the springs **14** the same order as they were found during dismantling.



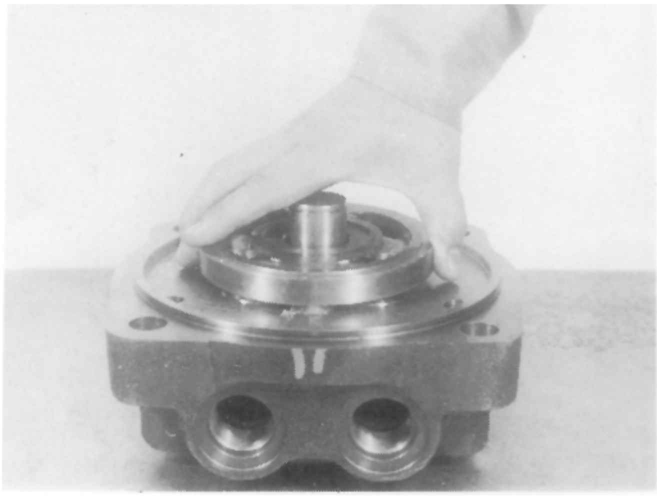
16 Mount the bushings **20** with Teflon rings **19** and the plate springs **18** into the bushing holes in cover **17**.

Note: Apply a coating of grease to the end faces and peripheries of the bushings **20** and to the Teflon rings **19** before mounting them, as this helps prevent them from falling out when the cover is mounted onto the housing.

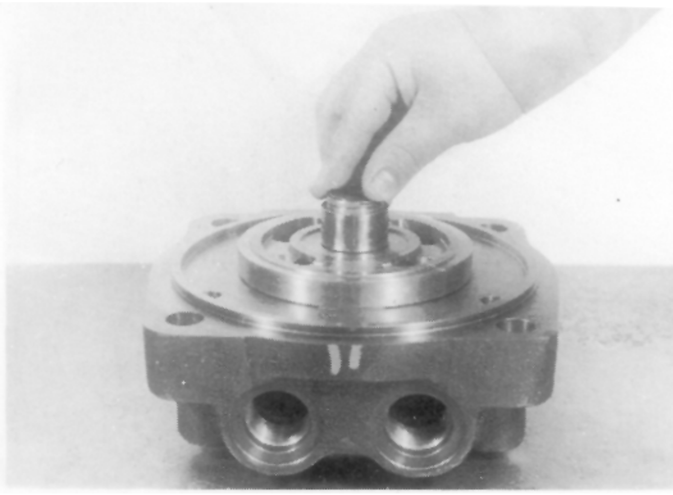


17 Generously grease the pins **15** and insert into cover **17**.

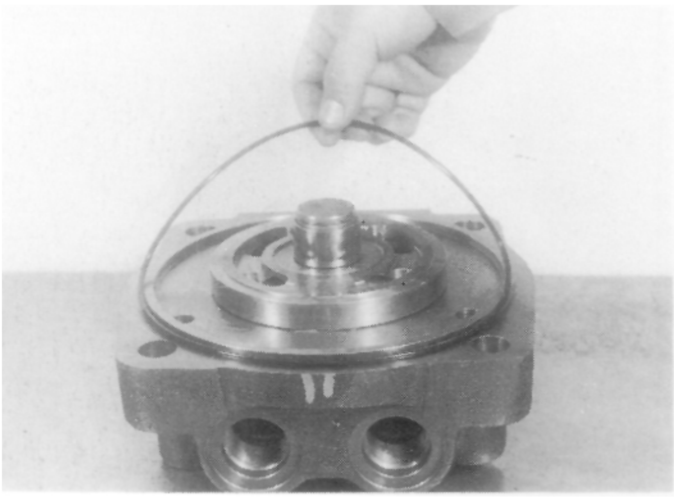
* Motor Assembly/Cylinder Assembly Assembly (cont'd)



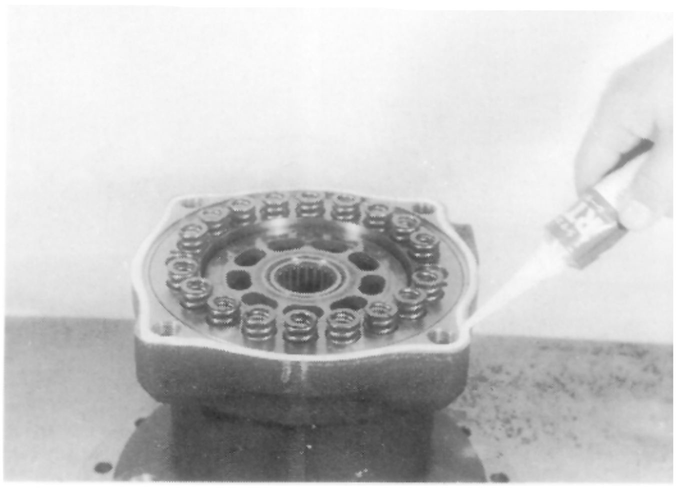
18 Mount balance plate **21** onto cover **17**.



19 Press needle bearing **22** inner ring into cover **17** and attach snap ring **23**.

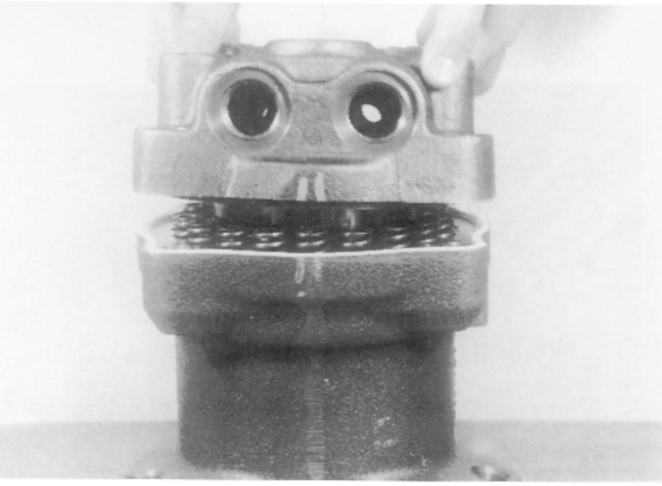


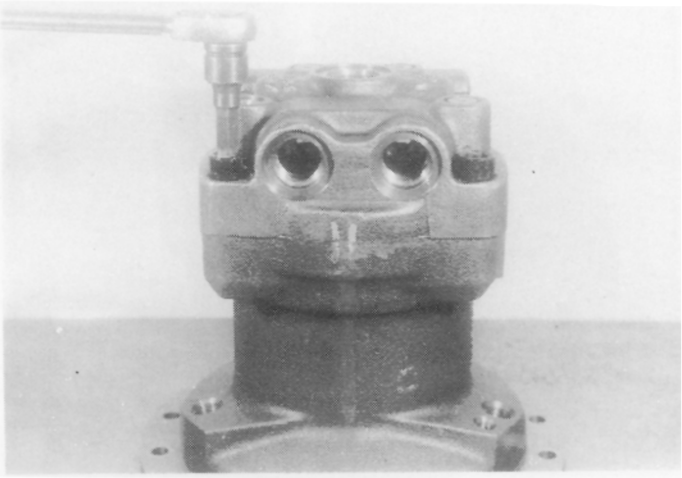
20 Apply grease to the 'O'-ring and install 'O'-ring **13** to cover **17**.



21 To prevent oil leakage from the cover bolt holes apply JCB Multi-gasket to the surface.

* Motor Assembly/Cylinder Assembly Assembly (cont'd)

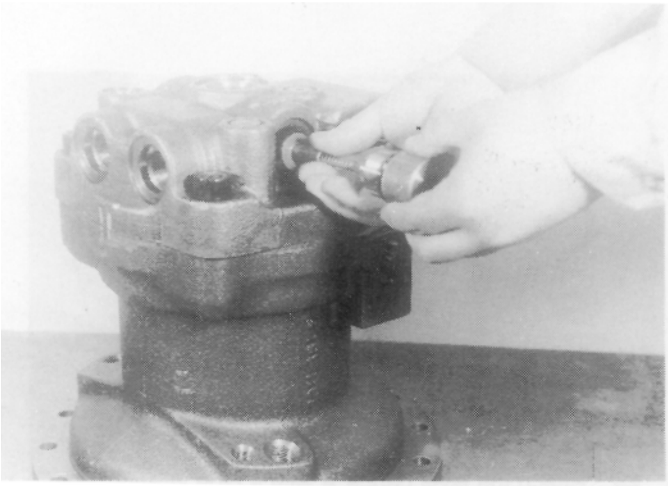


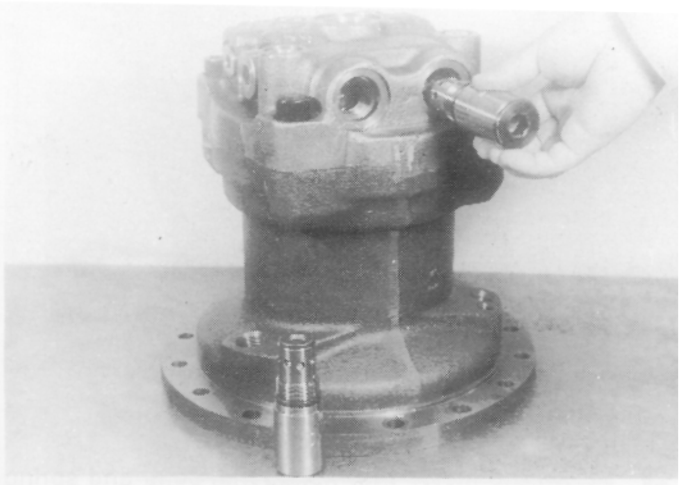


22 Lift cover **17** and balance plate **21** by hand and mount them carefully on housing **25**.

Take care that balance plate **21** and bushings **20** do not fall out while mounting cover **17**. Align housing **25** and cover **17** alignment marks which were made before dismantling.

23 Tighten the cap screws **27** (with a 12 mm A/F hexagonal socket) which attach cover **17** to housing **25** to a torque of 157 Nm (116 lbf ft).





24 **Assembling the Make-up and by-pass valves.**

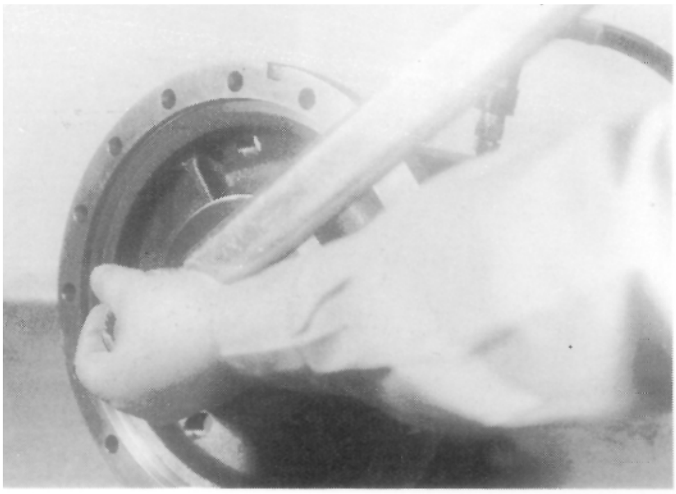
Assemble the check valves **29** and springs **31** in cover **17** and tighten the caps **30** (14 mm A/F hexagonal sockets) to a torque of 137 Nm (101 lbf ft).

Assemble by-pass valve assembly **28** to cover **17** and tighten the caps (10 mm A/F hexagonal sockets) to a torque of 78.65 Nm (58 lbf ft).

25 Insert the relief valve assemblies **34** into cover **17** and tighten the caps **37** (14 mm A/F hexagonal sockets) to a torque of 78.65 Nm (58 lbf ft).

Note: Ensure that the relief valves are replaced in their original positions.

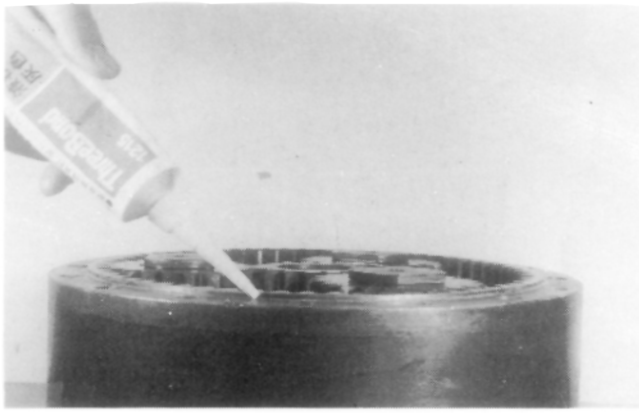
* Motor Assembly/Cylinder Assembly Assembly (cont'd)



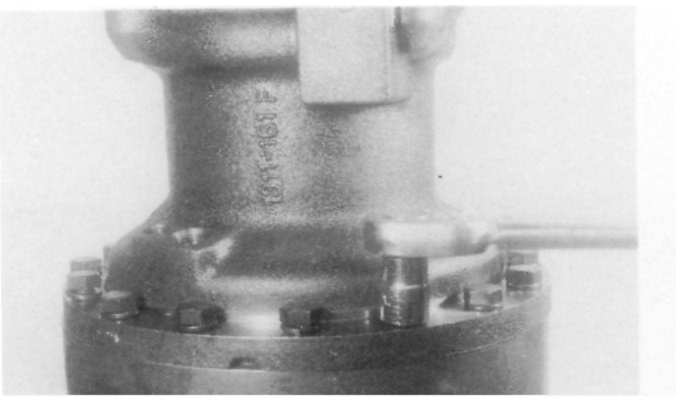
26 Final checks after assembling.

Open the inlet and outlet ports and apply 30 kgf/cm^2 (427 lbf/in^2) pilot pressure to the brake release port. (Take care as oil will be discharged from the drain port). Check that the drive shaft can be rotated smoothly for at least one full revolution by applying a torque of approx. 39.32 Nm (29 lbf ft).

Note: If the shaft does not turn, the unit has not been assembled correctly so dismantle again and inspect.

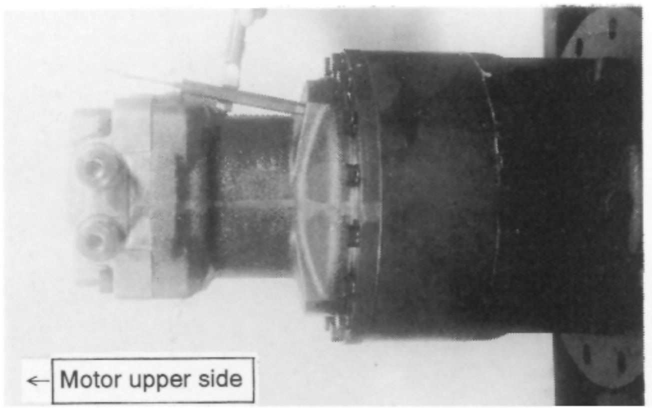


27 Degrease the mating faces of the gear unit ring gear **64** and motor housing **25** and apply Multi-gasket to the ring gear.

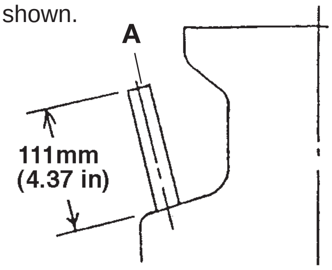


28 Attach the motor with hexagonal bolts and spring washers.

Size: 19 mm
Tightening torque: 103 Nm (76 lbf ft).

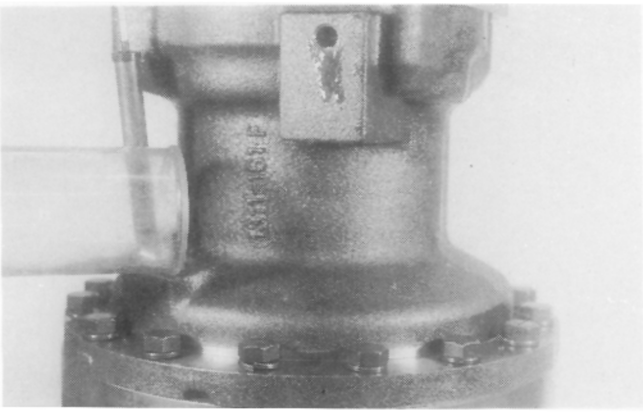


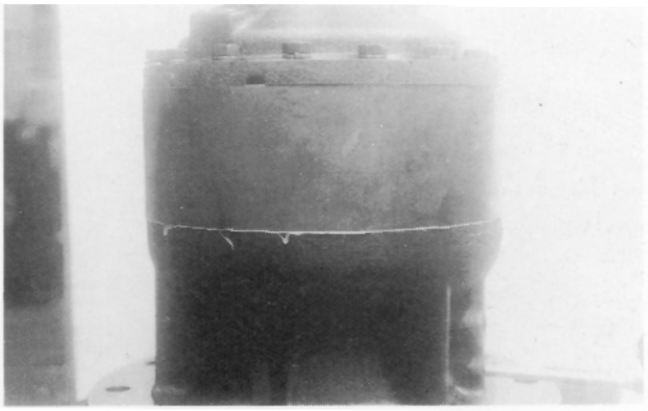
29 Attach the level gauge **A** with a pipe wrench, setting the height as shown.



JS00230

* Motor Assembly/Cylinder Assembly Assembly (cont'd)





30 Insert plug **26** with an 8 mm Allen key and tighten to torque of 39.32 Nm (29 lbf ft).

Fill with gear oil through the filler port.

Note: Fill the hydraulic motor case with hydraulic oil before connecting the piping to the drain port.

See **Fluids and Lubricants**, Section 3, for type and quantity of oil.

31 Apply grease (type and capacity is given in **Fluids and Lubricants**).

Note: Bleed air in the chamber from the air bleed port before filling with grease, as a build-up of internal pressure can damage the oil seal.

After the unit is filled, run it for around 10-15 minutes at zero load, and at low speed and verify that there is no abnormal noise or vibration. Gradually bring the system into high speed and loaded operation.

* Relief Valves
Dismantling

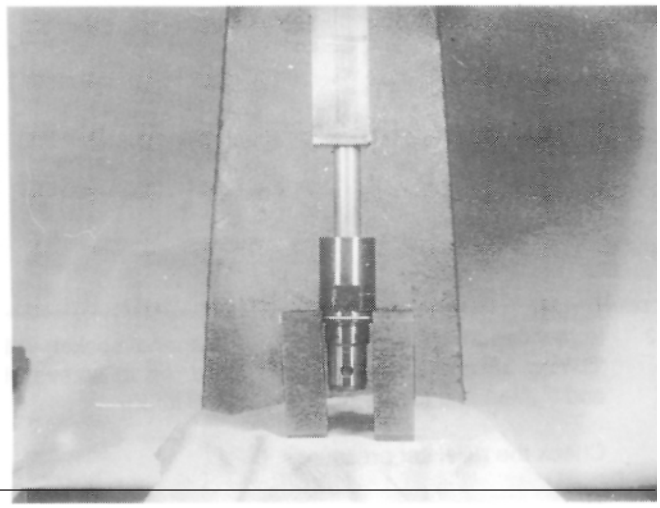
Refer to the sectional drawing on page E/83-1 as a guide to dismantling and assembling.

Take steps during dismantling to ensure that all the parts are returned to their original positions.

Clean the parts with a suitable solvent and blow them dry. Replace all used 'O'-rings

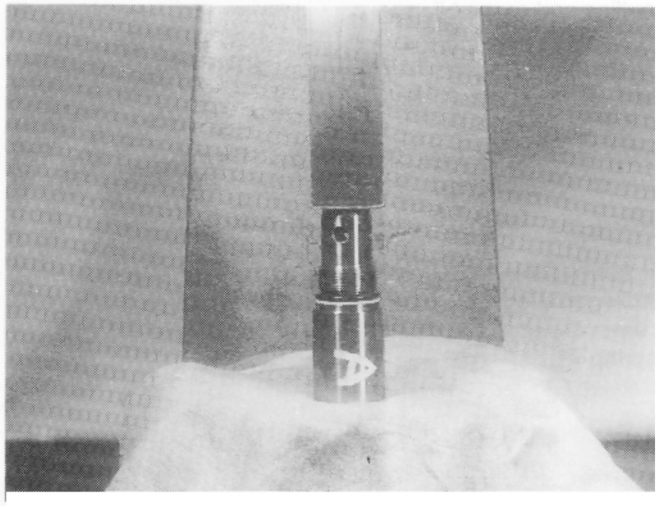
1 If not already done, remove cap **37** (with a 14 mm A/F hexagonal socket) from the relief assemblies **34** and remove piston **38**, liner **51**, shim **40**, poppet **43** and spring **42**.

2 The seat **44** is press-fitted into sleeve **39**. Remove it using a soft object, taking care not to scratch the seat face.



* Relief Valves Assembly

1 Press fit seat **44** into sleeve **39** which has an 'O'-ring **41**.



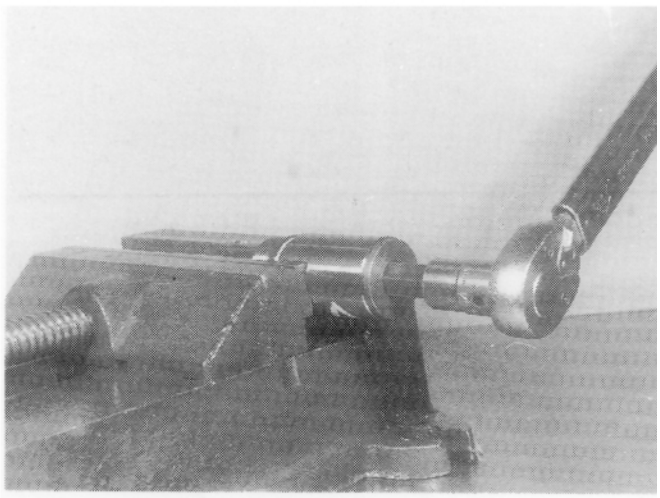
2 Mount poppet **43**, spring **42**, shim **40**, piston **38**, liner **51** onto sleeve **39**.

3 Screw cap **37** (with a 14 mm A/F hexagonal socket) with 'O'-ring **36** and back-up **35** mounted, on to sleeve **39** and tighten to a torque of 157 Nm (116 lbf ft).

Check the relief set pressure.

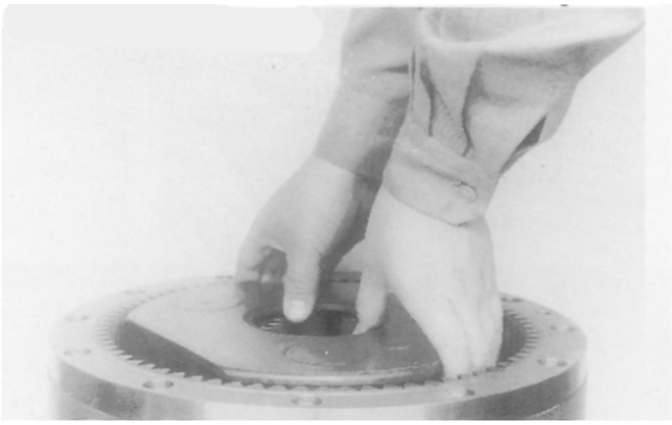
The correlation between the set pressure of the relief valve and the adjusting shims is shown below. However, adjustment must not be attempted if the pressure cannot be checked.

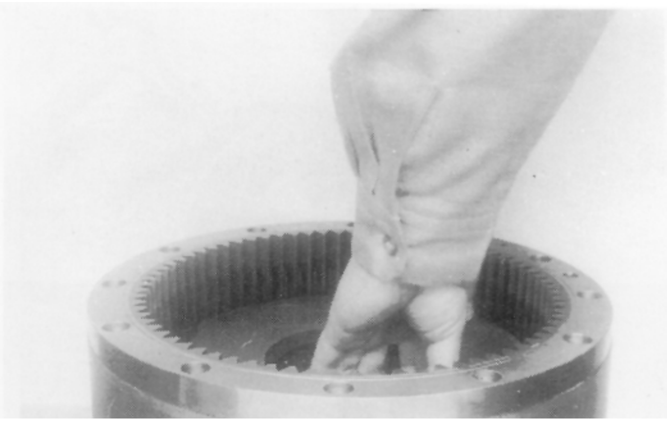
A 0.1 mm (0.003 in) shim equals 5 kgf/cm^2 (71 lbf/in^2) approximately.



* Reduction Gear Dismantling

Refer to the sectional drawing on page E/83-2 as a guide to dismantling and assembling.





1 Removal of the sun gear, 1st stage holder assembly.

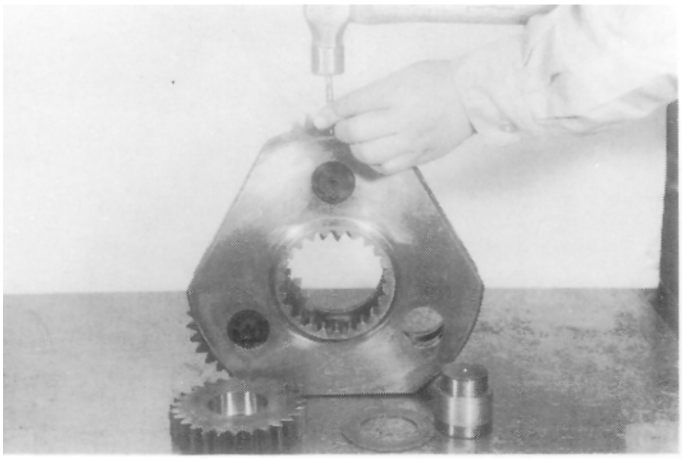
Remove sun gear **66** and 1st stage holder assembly **65**.

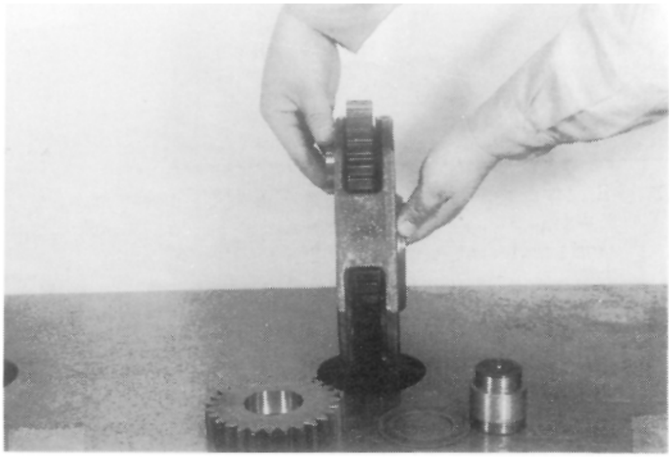
* **⚠ WARNING**

You can be injured by flying metal splinters when driving metal pins in or out. Use a soft faced hammer or drift to remove and fit metal pins. Always wear safety glasses.

INT-3-1-3

2 Remove the spur gear and 2nd stage holder assembly **76**.





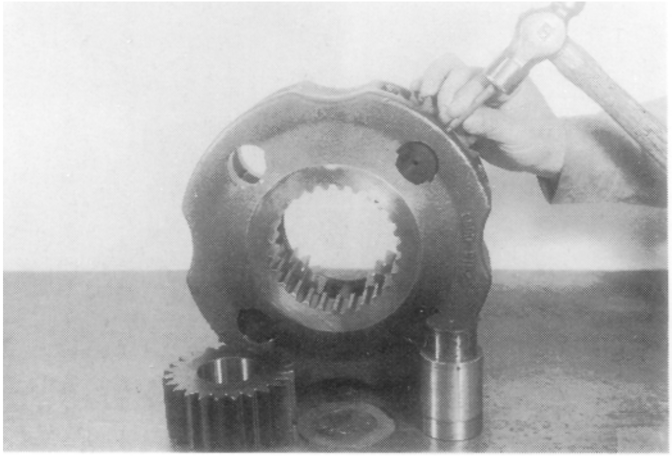
3 Dismantling of the 1st stage holder assembly.

Drive the spring pins into shaft **67**.

Note: The spring pins cannot be reused.

4 Support planetary gears **69** by hand and withdraw shaft **67** from holder **65**.

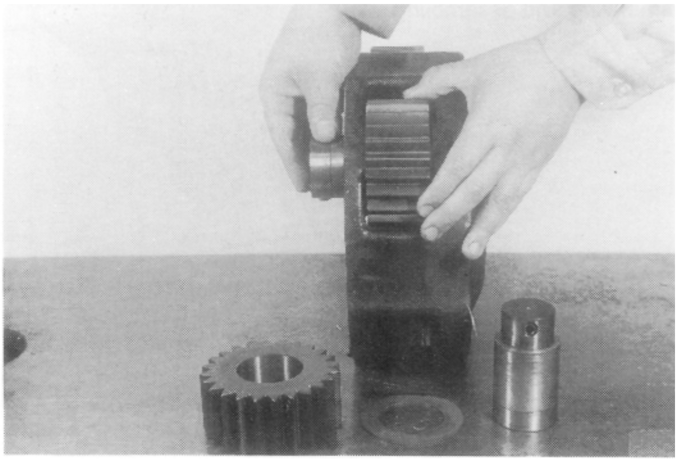
* Reduction Gear Dismantling (cont'd)



5 Dismantling of 2nd stage holder assembly.

Drive spring pins **75** into shaft **70**.

Note: The spring pins cannot be reused.

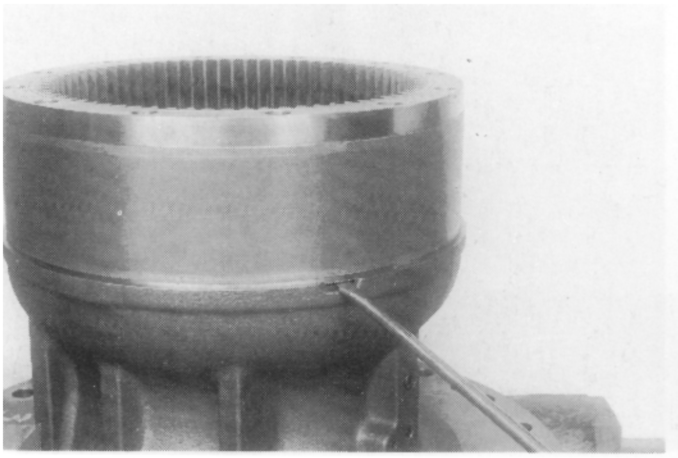


6 Support planetary gears **72** by hand and withdraw shaft **70** from holder **76**.

* **WARNING**

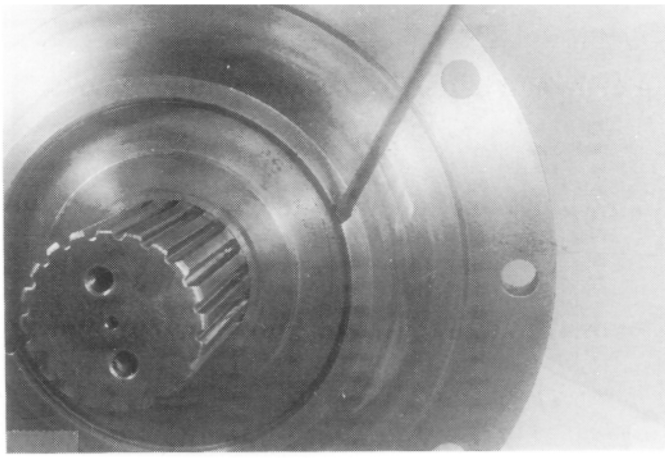
You can be injured by flying metal splinters when driving metal pins in or out. Use a soft faced hammer or drift to remove and fit metal pins. Always wear safety glasses.

INT-3-1-3



7 Ring gear removal

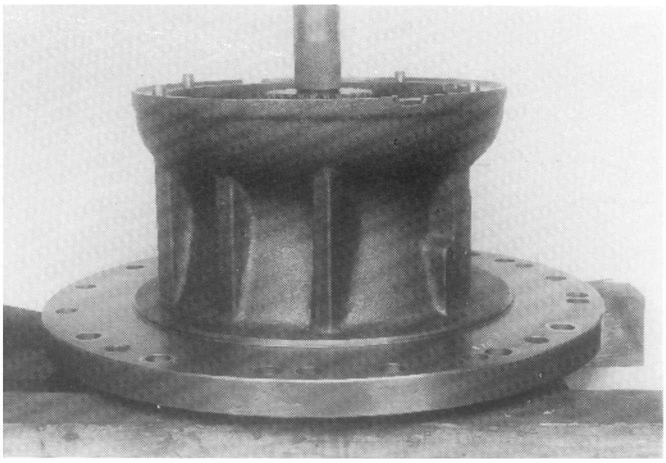
Remove ring gear **64** from gear case **58**. JCB High Strength Gasketing is applied on the assembly to prevent oil leaks from between the ring gear and gear case. To remove ring gear **64** use the notch on gear case **58**.



8 Removal of pinion gear assembly.

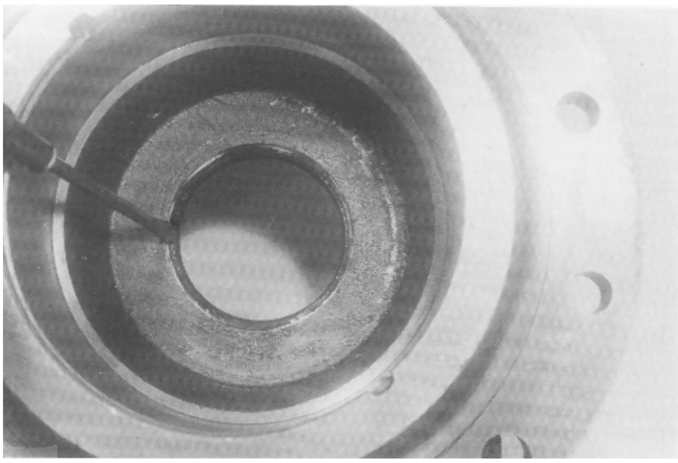
Remove snap ring **55** with a screwdriver using the notch in the case for leverage.

* Reduction Gear Dismantling (cont'd)

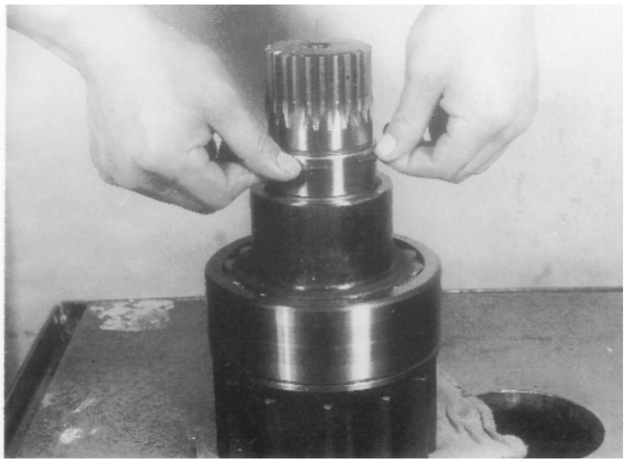


9 Support the flange part of gear case **58** on 300 mm (11.8 in) blocks and press shaft end with a hydraulic press to push out shaft **53**, collar **54**, plate **56**, self-aligning roller bearing **57**, snap ring **60** and collar **59** from the assembly.

10 Remove the roller bearing **62** from gear case **58**.



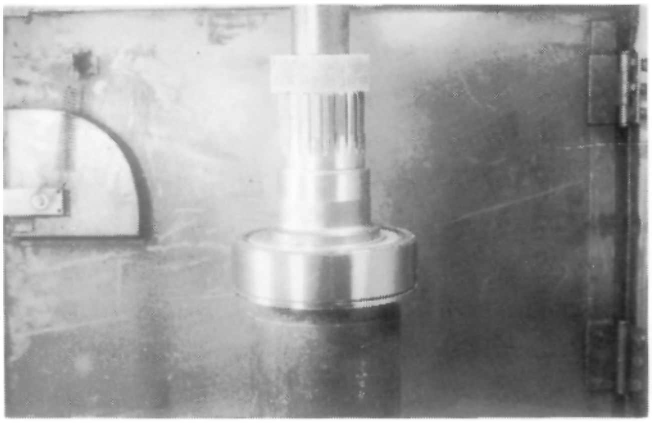
11 Remove and discard oil seal **61** from gear case **58** by tapping.



12 Remove snap ring **60** from pinion shaft **53** and remove collar **59**.

Note: Before removing collar **59**, make a note of which way round it is, to ensure correct reassembly.

* Reduction Gear Dismantling (cont'd)



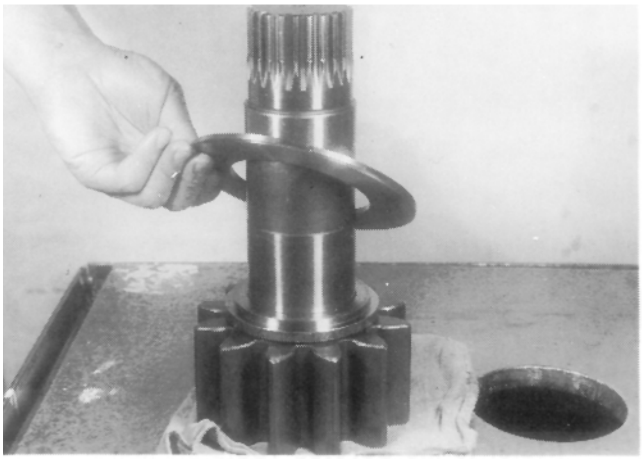
13 Carry out the following procedure only when bearing **57** is damaged or badly worn, and dismantling is necessary.

Support the self aligning roller bearing **57**, then press the motor end of shaft **53** to remove bearing **57**, plate **56** and collar **54** from the shaft **53**.

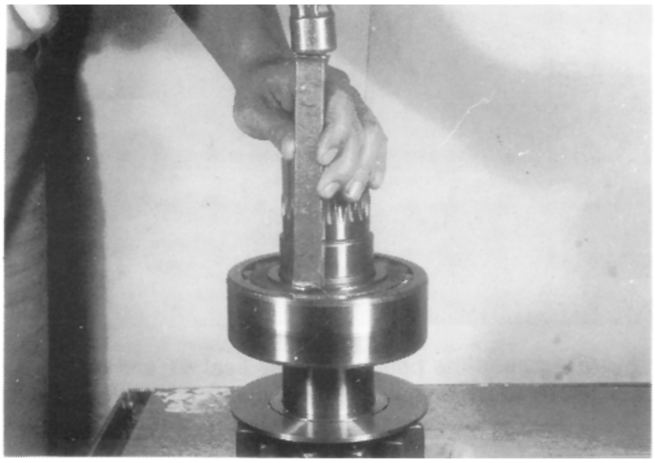
* Reduction Gear Assembly

Refer to the sectional drawing on page E/83-2 as a guide to dismantling and assembling.

Apply clean hydraulic fluid to all sliding contact faces during assembly.

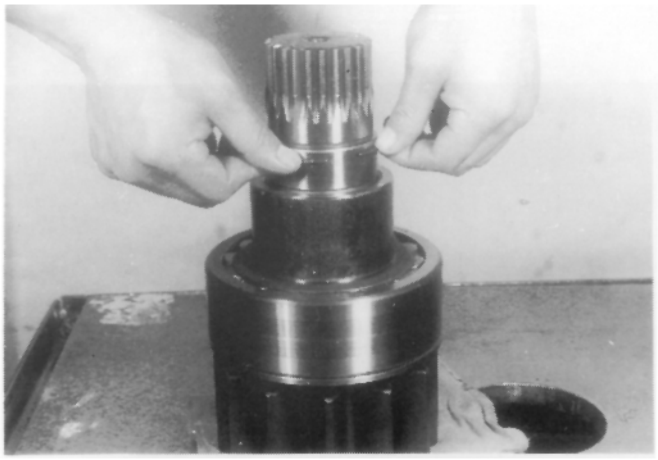


1 Position collar **54** on pinion shaft **53** and mount the plate **56**. Take care to mount in the correct direction.



2 Heat the bearing **57** to 50 °C above ambient temperature and press fit it on the pinion shaft.

Note: Do not heat to a temperature greater than 100 °C.

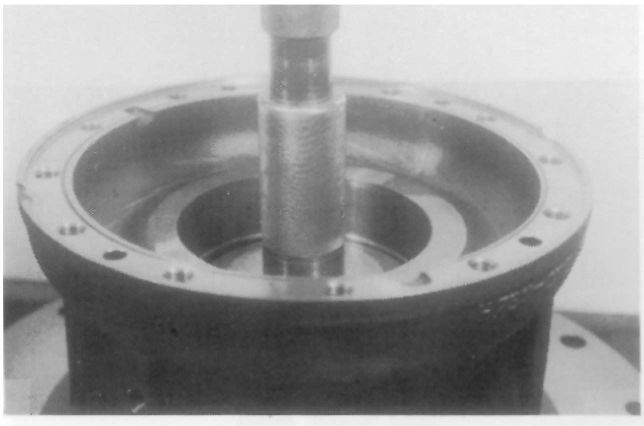


3 Mount collar **59** and put snap ring **60** in position. Take care to mount the collar in the correct direction, as noted in **Dismantling**.

4 Grease the rollers of bearing **57**.

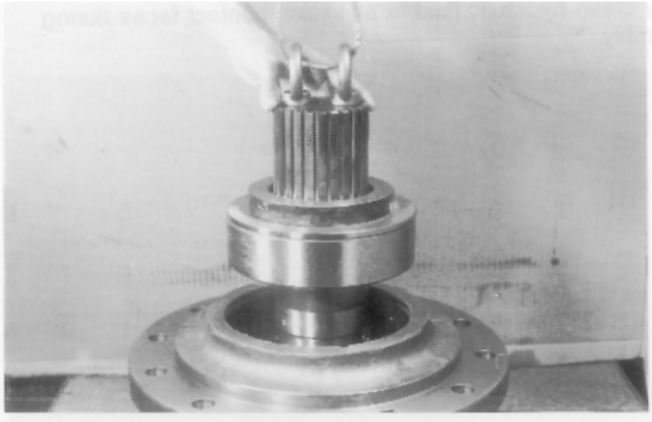
Note: Although the total grease capacity is 1000 cc, only 400 cc is used in the above procedure; the rest should be added after assembly.

* Reduction Gear Assembly (cont'd)



5 Degrease the periphery of oil seal **61** and its mounting face in gear case **58** and apply JCB High Strength Retainer to these surfaces. Press the oil seal into the gear case using a jig. Grease the oil seal after it has been pressed into place.

Note: Refer to seal press-fitting jig in the **Service Tools** section.

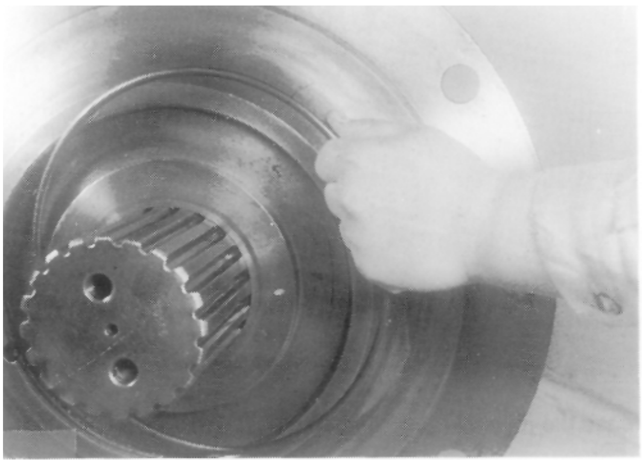


6 Use the seal protector to prevent the splines of pinion shaft **53** from scratching the lip of the oil seal.

(Refer to the **Service Tools** section for the seal protector.)

a Turn gear case **58** so that the output shaft is upwards and mount the pinion shaft assembly **53** onto the gear case using an M16 eye bolt screwed into the tapped hole in the output end of the pinion shaft.

b To prevent the seal protector hitting the work bench, place 150 mm (6 in) blocks under gear case **58**.



7 Mount the snap ring **55**.

To make it easy to remove the snap ring again, position the gap in the snap ring approx. 30 mm (1.2 in) away from the notch in the gear case.

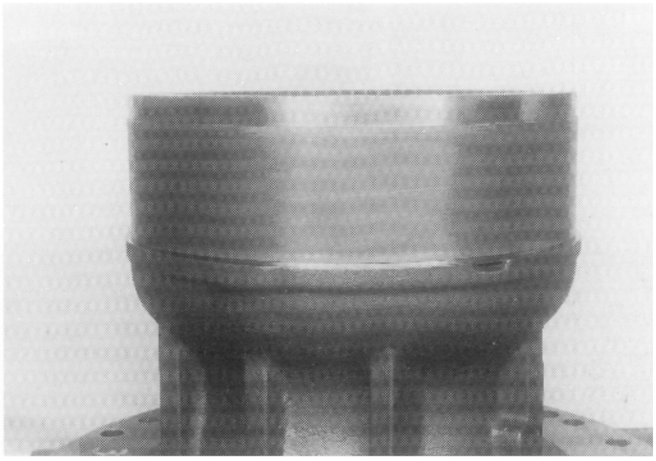
8 Turn the output shaft of the gear case downwards. Heat the inner ring of the roller bearing **62** to 50°C over the ambient temperature and mount it on the shaft.

* Reduction Gear Assembly (cont'd)

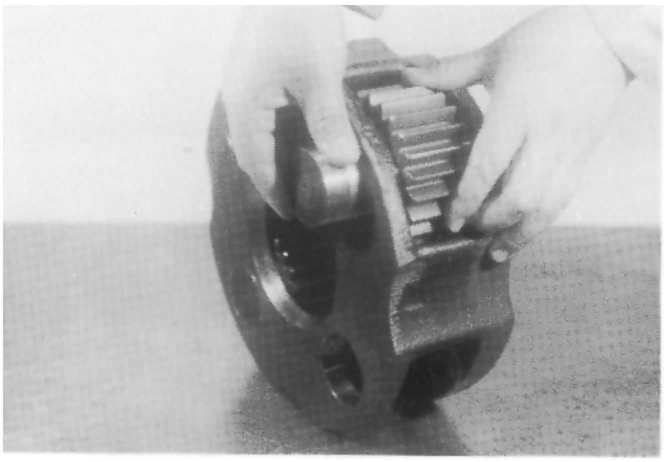
9 Ring gear mounting

a Degrease the contact surfaces of gear case **58** and ring gear **64**.

Mount the collars **63** on the gear case and apply JCB Multi-gasket. Also apply a thin coat on the gear case.



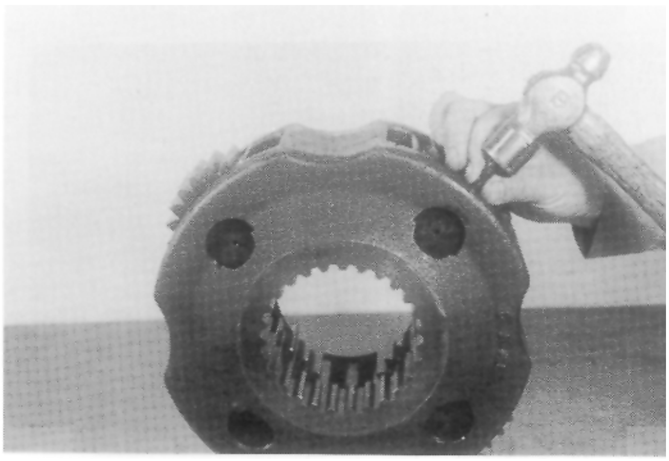
b Mount ring gear **64**.



10 Holder assembly mounting

a Insert the planetary gear **72**, bushing **71** and thrust plate **73** into holder **76** and then insert shaft assembly **70**.

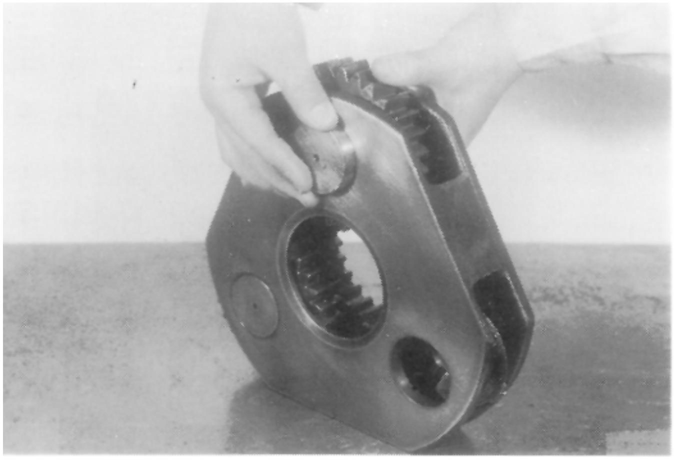
Note: Apply gear oil to the internal surface of the spur gear and shaft assembly outer surface.



b Drive in spring pins **75**.

Note: Drive in the pins with the splits facing towards planetary gears **72**.

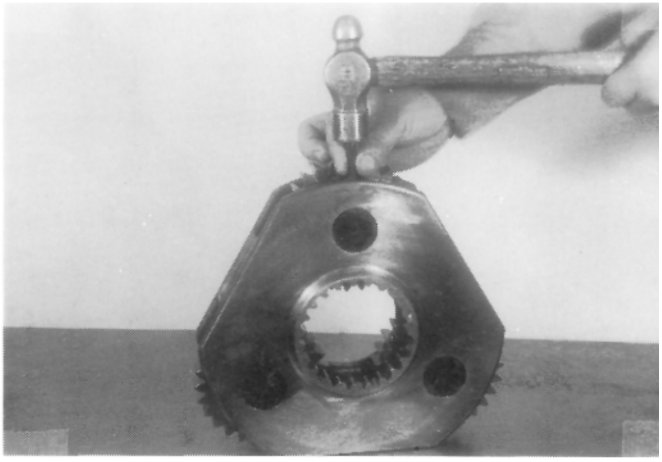
* Reduction Gear Assembly (cont'd)



11 Holder assembly 65 **mounting**

a Insert planetary gear **69** and the thrust plate into holder **65** and insert shaft assembly **67**.

Note: Apply gear oil to the spur gear internal surface and shaft assembly outer surface.



b Drive in the spring pin.

Note: Drive in the pins with the splits facing towards planetary gear **69**.

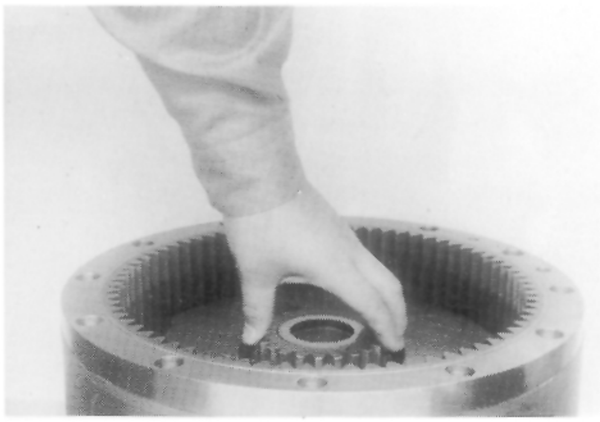
⚠ WARNING

You can be injured by flying metal splinters when driving metal pins in or out. Use a soft faced hammer or drift to remove and fit metal pins. Always wear safety glasses.
INT-3-1-3

12 Holder assembly 76 **and spur gear mounting**

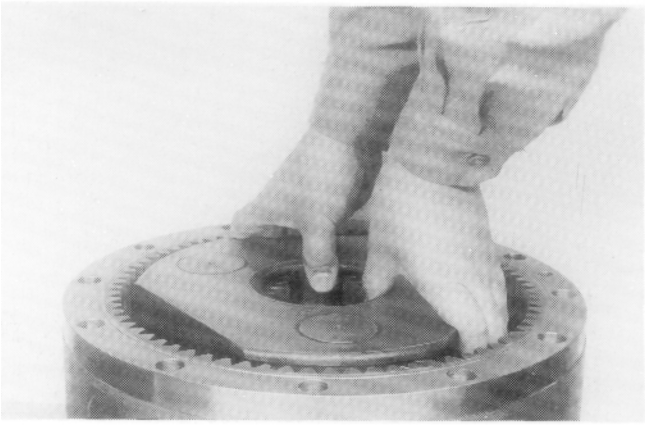
a Carefully lower holder assembly **76** so that it meshes correctly with the internal teeth of ring gear **64**.

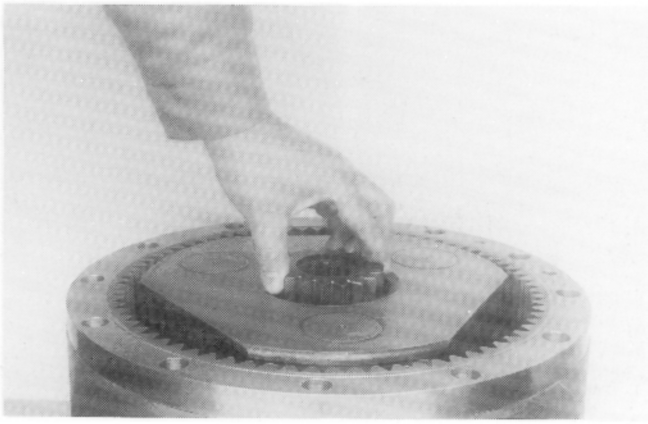
Turn the holder assembly slightly to engage the splines of pinion shaft **53**.



b Insert the sun gear **77** so that the teeth mesh with planetary gears **72**.

Reduction Gear Assembly (cont'd)

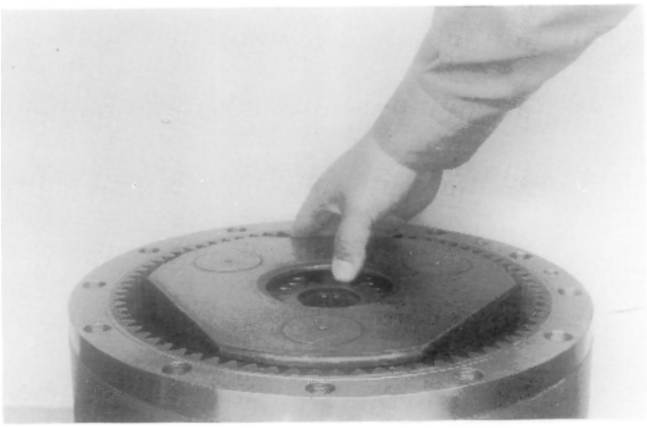




13 Sun gear 1st stage holder assembly mounting

a Carefully lower the holder assembly so that it meshes correctly with the internal teeth of ring gear **64**. Turn the holder assembly slightly to mesh the teeth of the spur gear with the teeth of holder **65**.

b Carefully insert sun gear **66** and mesh the teeth of planetary gear **69**.



14 Turn the 1st stage holder assembly by hand to check that the output shaft rotates smoothly.

Fault Finding

Table 1.

Symptom	Cause	External Inspection	Countermeasure	Repair
Motor does not run	Internal damage to the motor.	Measure the oil drain volume.	High possibility of damage to the sliding surfaces if the supply volume is approximately equal to the drain volume. Dismantle and inspect.	Refer to Table 2.
	Internal damage to the motor.	Open the motor inlet and outlet ports and apply 20 kgf/cm^2 (284 lbf/in^2) pilot pressure to the brake release port. Try to rotate the shaft with a torque of approx. 39.32 Nm (29 lbf ft).	High possibility of internal damage to the motor if the supply shaft does not rotate smoothly when this torque is applied. Dismantle and inspect.	Renew damaged parts or renew the motor assembly.
	Relief valve in circuit not set correctly.	Measure pressure.	Reset to the prescribed setting.	
Excessive slip	Wear or damage to the motor sliding surfaces or to the high-pressure seal.	Measure the oil drain volume.	Leakage is too high if the oil drain volume exceeds 5 l/min (1.1 gal/min). Dismantle and inspect.	Refer to table 2.
	Oil hot and excessive leakage in the motor.	Measure the oil temperature.	Reduce the oil temperature.	Refer to table 2.
Abnormal heating	Seizure of motor sliding parts or circuit.	Check for any metallic matter deposited in motor drain oil or drain filter. Apply a 30 kgf/cm^2 (427 lbf/in^2) pilot pressure to the brake release port and try to rotate the shaft with a torque of approx. 39.32 Nm (29 lbf ft).	If metallic matter is discovered or the supply shaft does not rotate smoothly when torque is applied, there is a high possibility of internal damage to the motor. Dismantle and inspect.	Repair or renew the damaged parts. Renew the motor assembly.
Leakage from oil seals	Damage or wear to oil seal lip.			Renew the oil seals.
	Damage or wear of the shaft seal.			Repair the problem or renew the motor assembly.
	Abnormal pressure in the casing.	Check the pressure in the casing and measure the drain volume.	Set the pressure in the casing below 3 kg/cm^2. (43 lbf/in^2) Dismantle and inspect if drain volume is excessive.	Renew the oil seal. Repair or renew the damaged parts. Renew the motor assembly.

Fault Finding (cont'd)

Symptom	Cause	External Inspection	Countermeasure	Repair
Insufficient torque	Wear or seizure of the motor sliding surfaces.	Open motor inlet and outlet ports and apply 20 kgf/cm^2 (284 lbf/in^2) pilot pressure to the brake release port.Try to rotate the shaft with a torque of approx. 39.32 Nm (29 lbf ft).	High possibility of internal damage to the motor if the supply shaft does not rotate smoothly when this torque is applied. Dismantle and inspect.	Inspect the parts and bearing according to Table 2 a-e and renew any defective parts.
	Relief valve in the circuit is not set correctly.	Measure relief pressure.	Reset to the prescribed setting.	
	Internal damage to the motor.	Check if any metallic matter is deposited in the motor drain oil or drain filter.	High possibility of internal damage to the motor if metallic matter is discovered. Dismantle and inspect.	Repair or renew damaged parts. Renew the motor assembly.
Abnormal noise	Large amount of air mixed in the oil.	Check the oil in the tank and motor casing.	Thoroughly bleed the air.	
	Loosening of bolts or pipes	Check if the piping connections, attachment mounting bolts, motor attachment bolts or other bolts are loose.	Tighten to the specified torque.	
Oil leakage from mating surfaces	O-ring is damaged			Renew O-rings.
	Seal face is damaged.			Repair seal face or renew.
	Bolts are loose.	Check the bolt tightness.	Tighten the bolts to the correct torque.	

Table 2.

No.	Part Inspected	Repair
a	Wear of the sliding surface of balance plate **21**.	Repair or renew the part
b	Damage to sliding surface of cam plate **6**.	Repair the part or renew the motor.
c	Damage to sliding surface of the piston assemblies **8**.	Repair the part or renew the motor.
d	External wear to the piston assemblies **8**.	Repair the part or renew the motor.
e	Wear to piston bores in cylinder assembly **24**.	Renew the motor.
f	Damage to Teflon ring **19** or 'O'-rings **52**.	Renew the part.

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Dismantling and Assembly 7 - 1
Maintenance Specification 8 - 1

* **Track Gearbox**
Dismantling and Assembly 9 - 1

* ***Note:*** *Slew Motor Assembly is covered in Section E.*

Torque Specifications JS200/JS240

Component	Nm	kgfm	lb/ft	Remarks
Traction motor Locating Bolts	266.6 - 311.6	27.2 - 31.8	196 - 229.9	Apply 262

Traction Motor

This table refers to the Traction Motor sectional drawing

Component	Nm	kgfm	lb/ft	Part No.	Remarks	Qty
Plug	118 ±5.9	12 ±0.6	86.76 ±4.3	2-14,-17	PF$^1/_2$	1,1
Orifice	2.45 ±0.49	0.25 ±0.05	1.8 ±0.36	2-22,-23		2,2
Plug	9.8 ±1.0	1.0 ±0.1	7.23 ±0.72	2-8	NPTF$^1/_{16}$	10
Plug	118 ±5.9	12 ±0.6	86.76 ±4.3	2-17		1
* Cap Assy	373 ±20	38 ±2	274.7 ±14.46	2-6		2
Nut	37.2 ±4.7	4.0 ±0.5	28.92 ±3.6	2-16		1
Socket Head Bolt	108 ±10	11 ±0.1	79.5 ±7.23	2-6.5		4
Plug	137 ±10	14 ±1	101.2 ±7.23	2-2.4		2
Plug	9.8 ±1.0	1.0 ±0.1	7.23 ±0.72	2-8	NPTF$^1/_{16}$	10
Plug	29.4 ±2.9	3 ±0.3	21.6 ±2.16	2-19	PT$^1/_4$	5
Plug	39.2 ±4.9	4 ±0.5	28.9 ±3.61	2-24	PT$^3/_8$	1
Orifice	2.45 ±0.49	0.25 ±0.05	18 ±0.36	35	M5	1
Plug	9.8 ±1.0	1.0 ±0.1	7.23 ±0.72	34	NPTF$^1/_{16}$	5
Plug	7.8 ±1.0	0.8 ±0.1	5.78 ±0.72	28	PT$^1/_8$	1
Plug	12.3 ±2.5	1.25 ±0.25	9.03 ±1.8	27	PT$^1/_4$	1
Bolt socket head	191 ±15	19.5 ±1.5	140.9 ±10.8	21		16
Plug	58.8 ±4.9	6 ±0.5	43.38 ±3.6	26	PT$^1/_2$	3
Bolt socket head	58.8 ±4.9	6 ±0.5	43.38 ±3.6	25		16
Bolt socket head	294 ±19	30 ±2	216.9 ±14.46	16		4
Bolt socket head	417 ±25	42.5 ±2.5	307.27 ±18.07	17		16
Bolt socket head	108 ±10	11 ±1	79.5 ±7.23	20		13
Relief valve	373 ±20	38 ±2	274.74 ±14.46	2-6		2

Gearbox

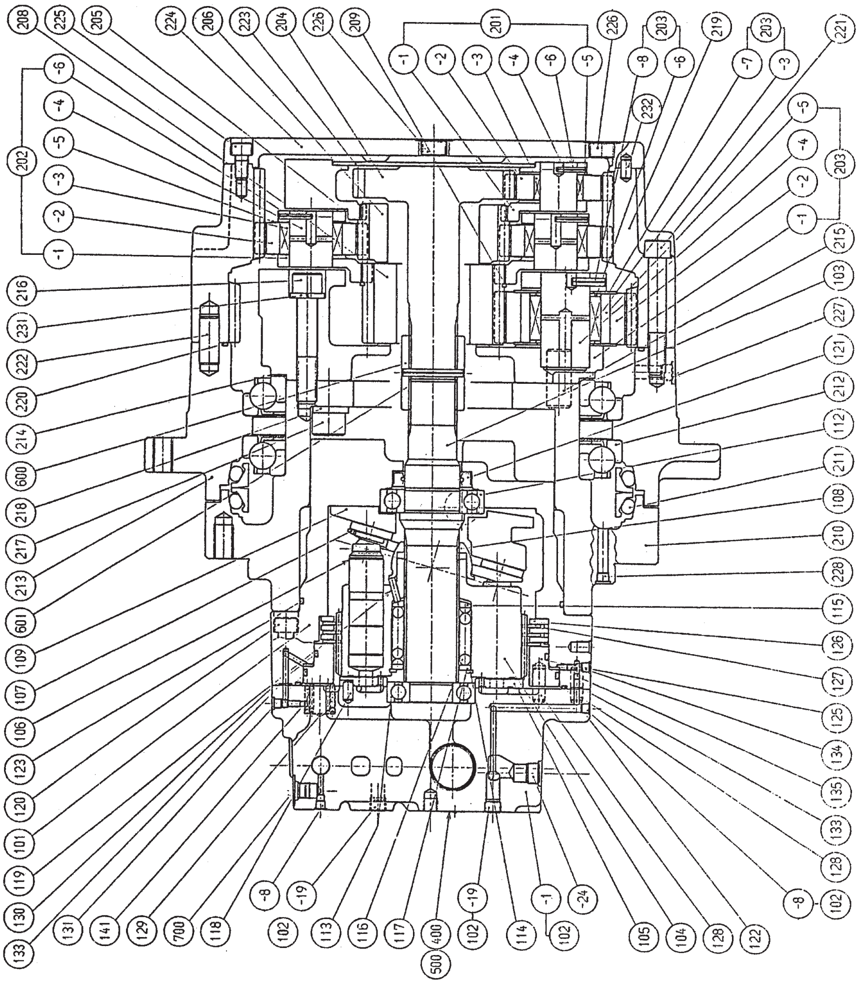
This table refers to the Gearbox sectional drawing

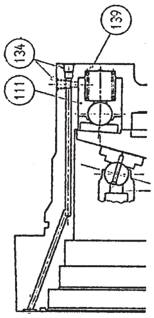
Item	Component	Nm	kgfm	lb/ft	Remarks	Qty
13	Ring Nut				M320 x 2	1
1	Socket head bolt				M10 x 25	10
2	Plug				M22 x 1.5	2
22	Socket head screws				M12 x 90	3

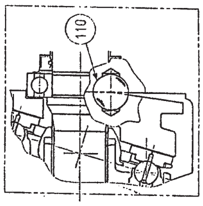
Schematics, specifications

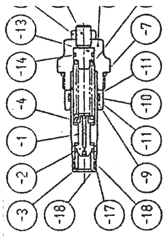
			JS200	JS240
Displacement	Motor * cm3/rev	1st	157.8	164.4
		2nd	92.9	98.2
	Reduction gear, etc. value * cm3/rev	1st	7004	7297
		2nd	4123	4359
Cross over relief Valve	Cracking pressure	MPa (kgf/cm2)	31.1 {317} at 1.2 l/min	
	Full flow pressure	MPa (kgf/cm2)	35.3 {360} at 40 l/min	
Double counter balance valve	Plunger switch pressure	MPa (kgf/cm2)	0.6~1.3 {6~13}	
	Check valve cracking pressure	MPa (kgf/cm2)	less than 0.03 {0.3}	
2-speed switch valve	Pilot pressure for 2-speed switch	MPa (kgf/cm2)	3.9 {40}	
	1→2	MPa (kgf/cm2)	23.2 {237}	
	2 →1	MPa (kgf/cm2)	25.3 {259}	
Reduction gear	Structure		Planetary gear 3 step reduction gear	
	Speed		1/44.384	
Parking brake	Parking brake torque KNm {kgf/cm2}	Motionless	more than 20.94 {2135}	
		Moving	more than 16.67 {1700}	
	Release pressure	MPa (kgf/cm2)	less than 1.4 {14}	
Pressure MPa (kgf/cm2)			34.3 {350}	
Supply flow L/min		1st speed	198.7	212.2
		2nd speed	198.7	212.2
* Output torque kNm {kgf m}		1st speed	0.862 {87.9}	0.898 {91.6}
		2nd speed	0.507 {51.7}	0.536 {54.7}
Output revolutions rpm		1st speed	1259	1291
		2nd speed	2139	2161
Drain pressure Mpa {kgf/cm2}		Normal	less than 0.2 {2.0}	
		Maximum instant	less than 0.5 {5.0}	
Oil temperature		°C	-20 ~ +95	
Total dry weight		kg	270	

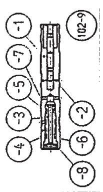
Schematics, specifications

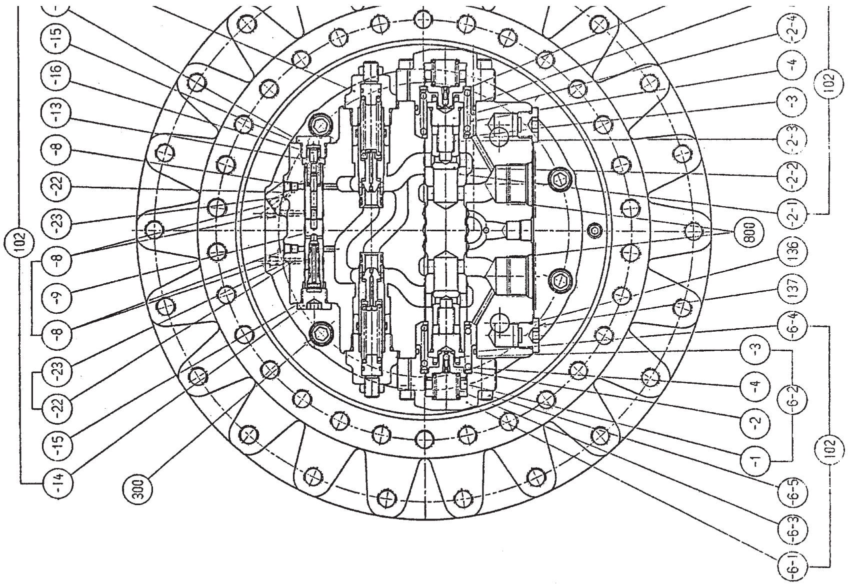












Operation

Traction Motor Assembly
The traction motor assembly consists of a counter balance valve, cross-over relief valve, 2-speed switch mechanism, swash plate-type axial piston motor with parking brake function and the gearbox.
The piston motor converts the liquid energy of the pressurised oil sent from the hydraulic pump to mechanical energy and transmits high speed low torque power to the reduction gear. The gearbox converts this to low speed high torque power and transmits it to the crawler.

Its characteristics are:-

a. The parking brake is self-contained and when the motor stops, the mechanical brake works.

b. The motor is designed to be small, light-weight and compact and is contained within the gearbox.

c. The counter balance valve and the cross-over valve make-up the braking system.

d. The counter balance valve controls motor speed in relation to the supply amount and prevents motor runaway.

e. The cross-over valve alleviates the shock at starting and stopping times and gives good feeling performance.

f. It is possible to change the motor speed to high and low by the 2-speed switch valve.

g. It is possible to automatically select the motor speed according to the motor load by the automatic 2-speed function.

When reading the operations section, refer to the schematics, specifications section in conjunction with the accompanying section illustrations.

Operation

Swash Plate Type Axial Piston Motor

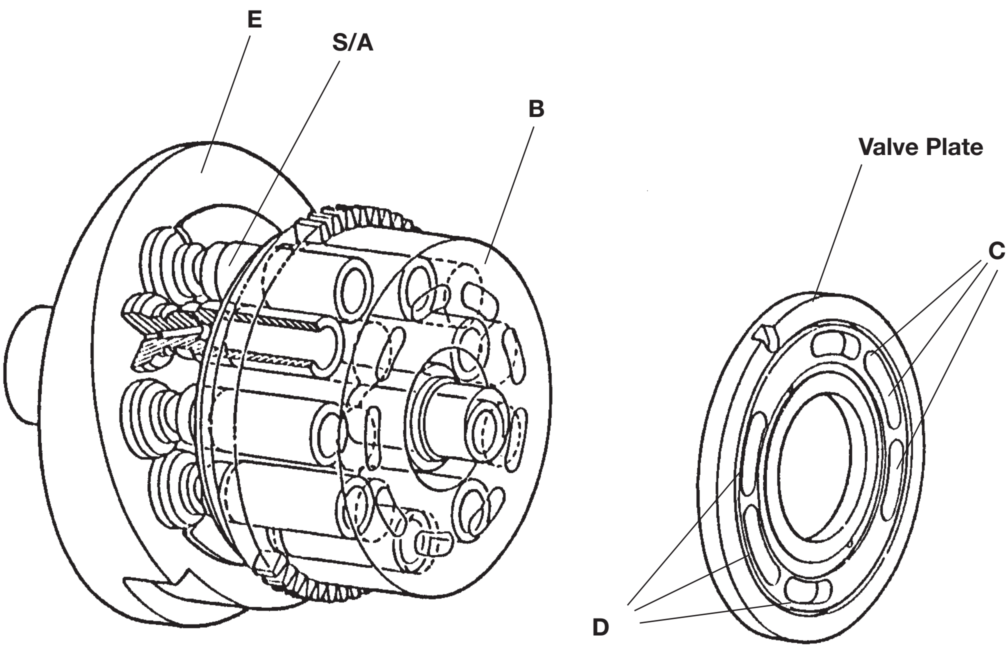


Fig.1 Swash Plate Type Axial Piston Motor

Nine pistons **S/A** are integrated in the Cylinder block **B**. The valve plate which has two sets of half-moon ports **C** and **D** (High/low pressure switching valve) is in contact with the face of the Cylinder block.

When high-pressure oil (pressure **P**) is guided to port **C**, the force presses against the swash plate at the rate of force **F = P X A**, (**A**: cross-sectional area of piston) per piston sub-assembly. The corresponding reaction force works on the pistons on the high-pressure side generating rotation of the Cylinder block. Through the spline, torque is transmitted to the shaft and the shaft rotates.

The piston motor's output torque and revolution speed are dependent on the pressure (**P**) and flow-in rate (**Q**), calculated as follows:

$$T = \frac{P x D x \eta_m}{2 x \pi x 10^2}$$

$$N = \frac{Q x 10^3 x \eta_v}{D}$$

T: Output torque (Nm)
N: Revolution speed (rpm)
P: Effective drive pressure (Pa)
Q: Flow - in rate (l/min)
D: Displacement volume (cm^3/rev)
η m: Machine efficiency
η v: Volume efficiency

Operation *(continued)*

Counterbalance Valve

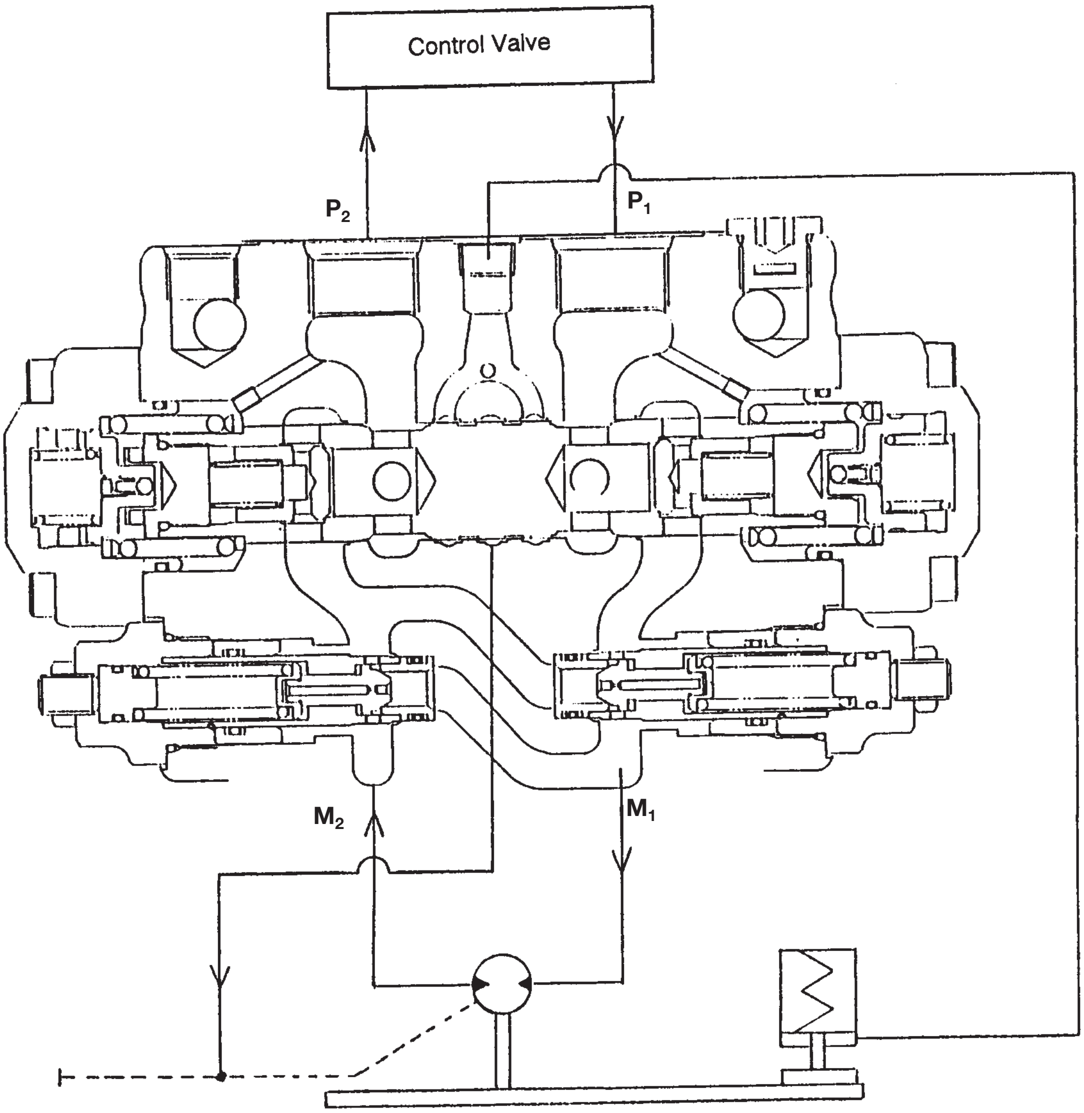


Fig.2 Counterbalance Valve

The counterbalance valve serves to prevent the sudden stoppage of the axial piston motor and control its overrun. When in neutral, the control valve's pressure is generated at ports **P1** or **P2** so ports **M1** and **M2** are blocked by the flange and check valve so the motor does not rotate.

Operation *(continued)*

Counterbalance Valve *(continued)*
Counterbalance Operation

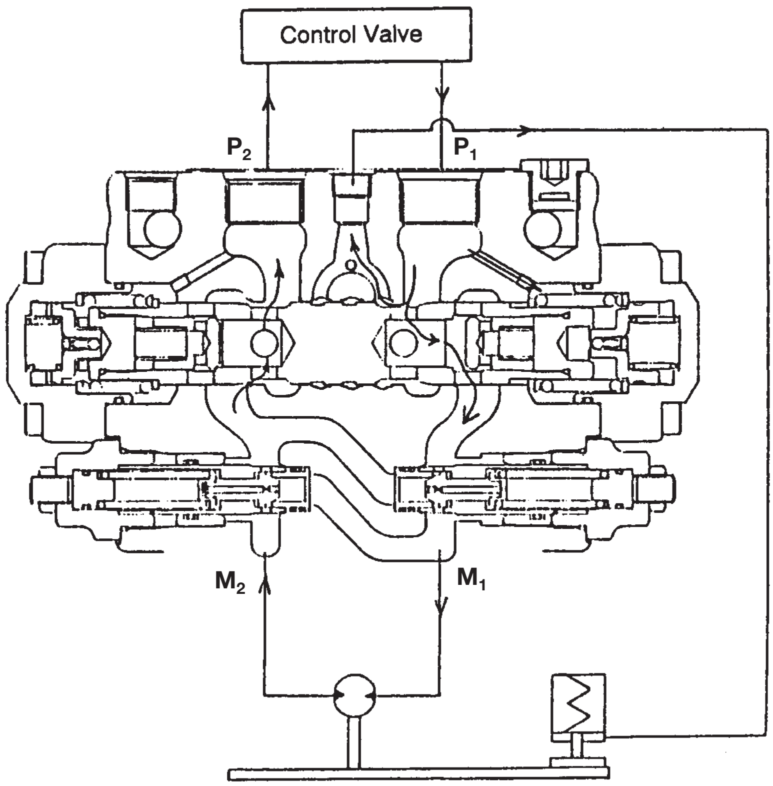


Fig. 3 Counterbalance Valve (Counterbalance)

When hydraulic oil delivered from the hydraulic pump is guided to **P1** port of the counterbalance valve through the control valve, the hydraulic oil goes through the check valve and flows into the piston motor from **M1** port and tries to rotate the motor.

On the other hand, the return oil from the piston motor can flow from **M2** port to the counterbalance valve, but is prevented by the check valve, so the pump delivery pressure rises. The boosted hydraulic oil at **P1** port side goes past the orifice and works on the flange face, and resisting the spring on the opposite side with a force proportional to the pressure, it tries to move the plunger to the right side.

When a certain pressure is reached, the plunger moves towards the right and the hydraulic oil of **M2** port passes through the notch of the plunger outer perimeter and generates back pressure at **M2** port while flowing to **Ps** port and returns to the tank through the control valve. When the pump delivery pressure rises, the plunger opening enlarges and the **M2** port back pressure decreases. In this way, the opening of the plunger automatically adjusts the return side passageway area so the piston motor will rotate at a speed suitable to **P1** port side pressure, that is, the **P1** port side flow rate.

Operation *(continued)*

Counterbalance Valve *(continued)*
Brake Function

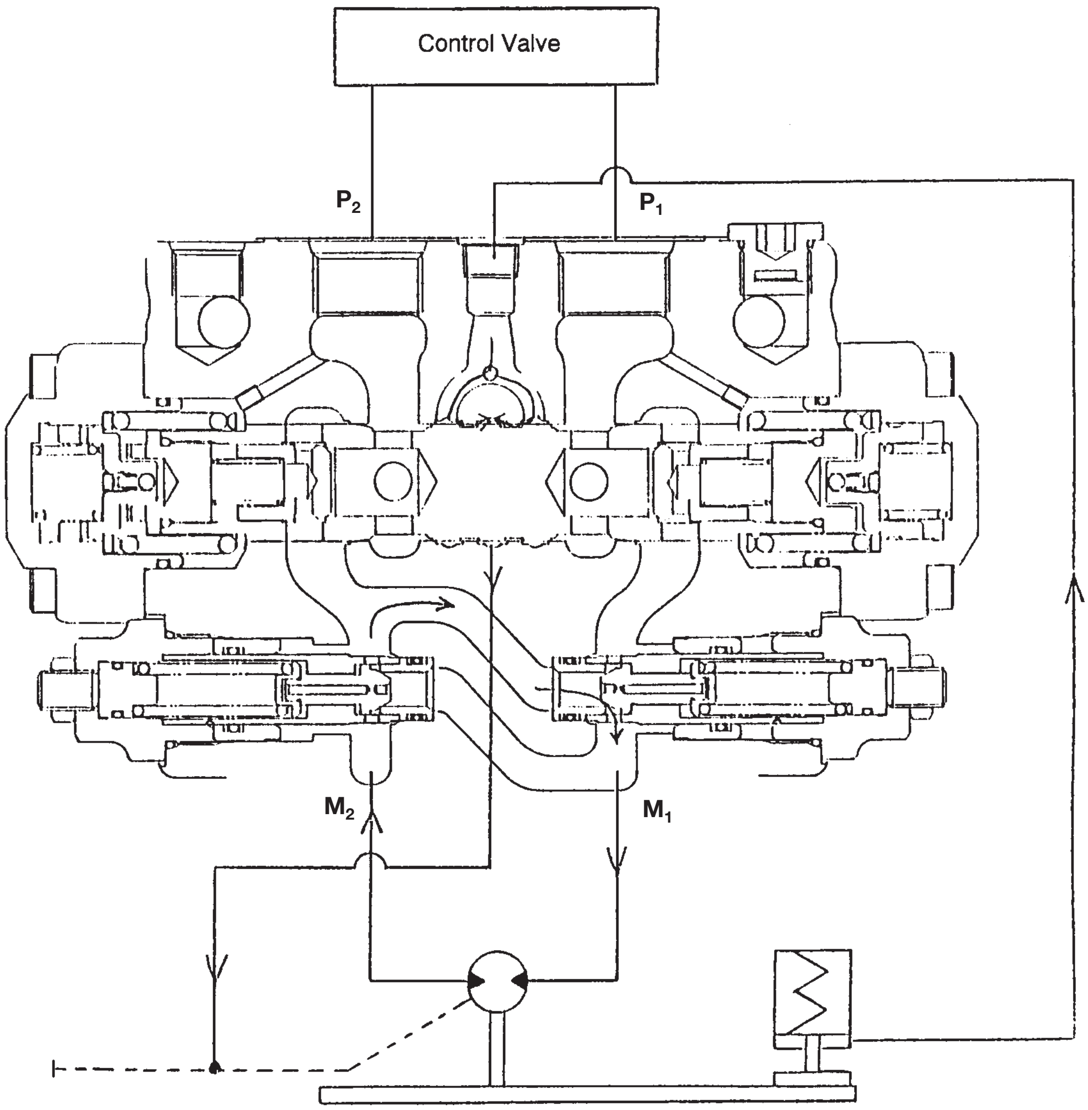


Fig. 4 Counterbalance Valve (Brake)

When the control valve is returned to neutral, the pressurised oil from the pump is blocked, and pressure at **P1** and **P2** become equal, and the plunger tries to return to neutral position by the spring. When the plunger moves, the plunger opening becomes smaller and because the piston motor continues to rotate due to inertia (motor pumping function), the pressure at **M2** port side rises and braking occurs. At this time, when the **M2** port side pressure reaches the relief valve set pressure, the relief valve works and allows oil to escape to **M1** port side, absorbing shock pressure caused by inertia of **M2** port side while also preventing **M1** port side cavitation.

Operation *(continued)*

Shuttle Function

The counterbalance valve has a shuttle function. When the plunger moves from the position in Fig. 5-1 to that of Fig. 5-2, the parking brake release port **P3** is opened to guide the pressurised oil to the brake releasing cylinder cavity. This releases the parking brake. When the motor stops, the counterbalance valve becomes as shown in Fig. 5-1 and **P3** port is blocked and the drain port in the motor case is opened. The pressurised oil in the brake is exhausted into the motor case to activate the brake.

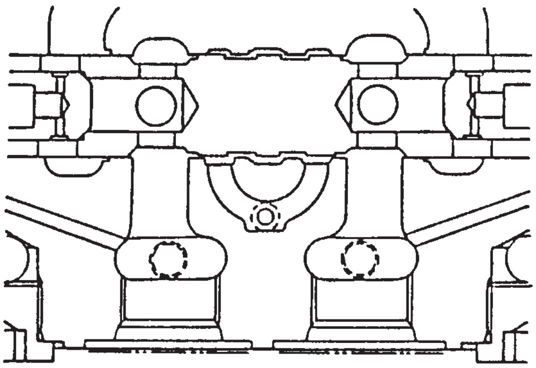


Fig 5-1. Shuttle Function

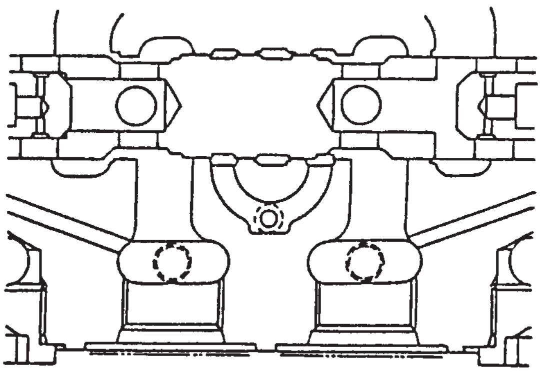


Fig 5-2. Shuttle Function

Relief Valve

The relief valve determines the drive force and brake force which controls the machine travel and is located on the cross line. This valve also provides the shockless function which reduces shock during acceleration.

The relief valve is constructed as shown in Fig. 6.

a. Area differential type directly driven relief valve

b. Shockless piston

With the shockless type relief valve, reduction of shock and stress on the structure is achieved.

Relation of relief valve set pressure and adjuster amount

Per one rotation approx. 8.6 Mpa {88 kgf/cm^2}

Do not make adjustments unless there are problems.

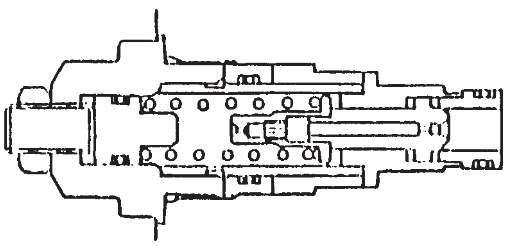


Fig 6. Relief Valve Section.

Operation *(continued)*

Relief Valve *(continued)*

The relief valve works in the following two stages.

First Stage: Refer to Fig. 6-1

When the relief valve starts operating, the shockless piston moves to keep the spring cavity at low pressure. The pressure receiving area of the poppet equals the area of the poppet seat (**S1**) and so it is considerably larger than the pressure receiving area (**S1-S2**) when the relief is normally set. Since the relief operating pressure in this state is low, it is kept at low pressure (about on third of the normally set pressure). The low pressure holding time depends on the poppet orifice diameter, the shockless piston pressure receiving area and the piston stroke.

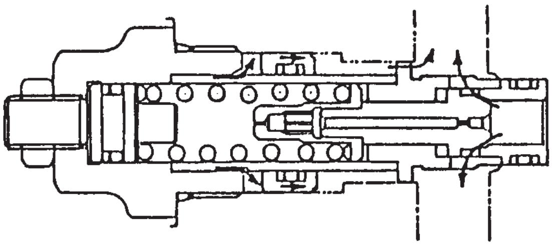


Fig. 6-1 First Stage of Relief Valve Working

Second Stage: Refer to Fig. 6-2

When the movement of the shockless piston is completed, the pressure in the spring cavity of the relief valve increases to make the pressures on both sides of the poppet equal. Accordingly, the relief valve works at the normal set pressure.

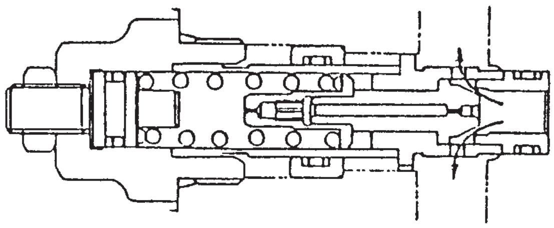
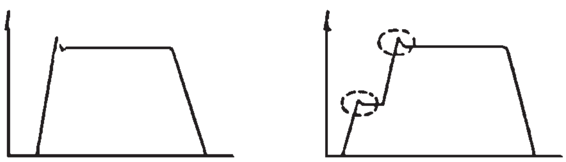


Fig. 6-2 Second Stage of Relief Valve Working

Below is a comparison of the normal type and shockless type.



Operation *(continued)*

2-Speed Switch Mechanism

2-Speed Switch Mechanism Assembly
The swash plate has three surfaces, **A, B** and **C** as illustrated in Fig. 7, being assembled in a slantable state in the motor case with two steel balls.
The 2-speed switch valve is assembled inside the base plate.

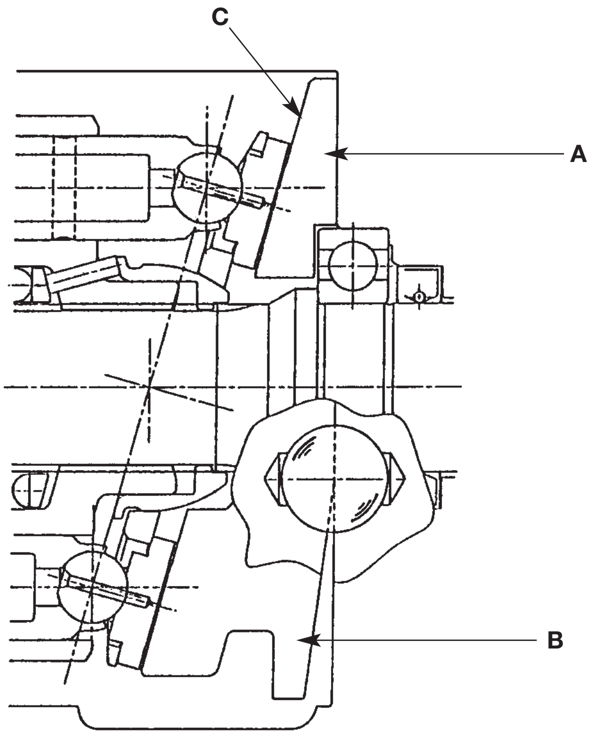


Fig. 7 2-Speed Mechanism Assembly

The following instructions refer to the illustrations following this section.

2-Speed Mechanism

Refer to Fig. 8-2

When the 2-speed mechanism is in the position as illustrated, the motor driving pressure works on the 2-speed control piston. The swash plate is slanted to the position where the resultant thrust force of the piston sub-assembly and the spring force are balanced with the thrust force of the 2-speed control piston. The swash plate settles when surface **B** comes into contact with the motor case and the motor is then in second, or high speed.

Refer to Fig. 8-1

When the 2-speed valve is in the position as illustrated, the 2-speed control piston cavity is connected to the motor case drain and the swash plate is pushed by the resultant force of the piston sub-assembly thrust force and spring force. The swash plate settles when surface **A** comes into contact with the motor case and the motor is in first or low speed.

When the engine stops, the swash plate is pressed by spring force to bring the surface **A** into contact with the motor case. The motor changes into first, or low speed.

Operation *(continued)*

Automatic 2-speed

Refer to Fig. 8-1
With pilot pressure **Ps = 0**, the 2-speed valve is maintained in the position as illustrated and the motor speed is first, or low.

Refer to Fig. 8-2
During travel on level ground when the motor load pressure is below the set pressure **P**, if pilot pressure **Ps** is operated, the pressure inside cavity **B** of the 2-speed valve is low, (**F2<F1**) and the 2-speed valve is held in the illustrated state and the motor speed changes to second or high.

Refer to Fig. 8-3
When the motor load pressure rises and reaches the set pressure **P** after going uphill or steering operations are done with the pilot pressure **Ps** operated, the pressure inside cavity **B** of the 2-speed valve also rises, (**F2>F1**) and the 2-speed valve moves to the state shown and the motor speed changes to first or low.
When the motor drive pressure drops lower than the set pressure **P**, the pressure inside cavity **B** of the 2-speed valve also drops (**F2<F1**), the 2-speed valve moves as shown in Fig. 8-2 and the motor speed changes to second, or high.

Parking Brake
The parking brake is a pressurised off type comprising a disk (wear-resistant material) as the rotary section, brake piston and spring.

Refer to Fig. 9
As explained on page F/3-6 at the shuttle function of the counterbalance valve, pressurised oil is guided to the cylinder cavity for parking brake release through port **P3**. The force corresponding to the pressure receiving area is fed to the brake piston. This force overcomes the spring force to press the brake piston upward, and this releases the parking brake. When parking or stopping the machine, the pressurised oil in the parking brake cylinder is released to the motor case drain, and the brake piston is pushed by the spring force, applying the parking brake.

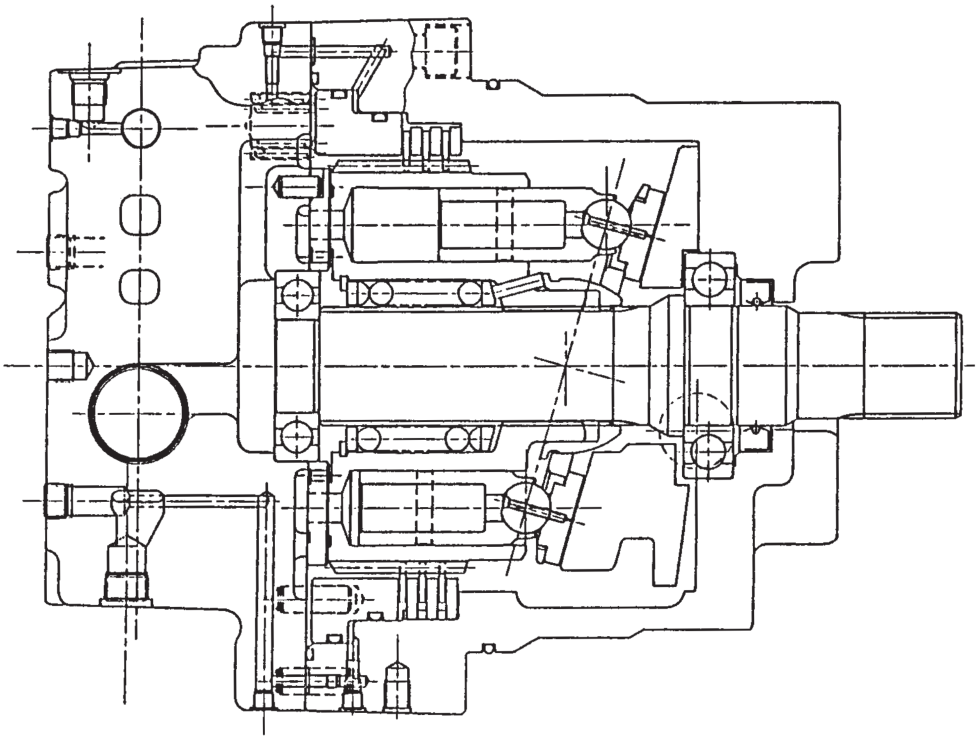


Fig. 9 Parking Brake

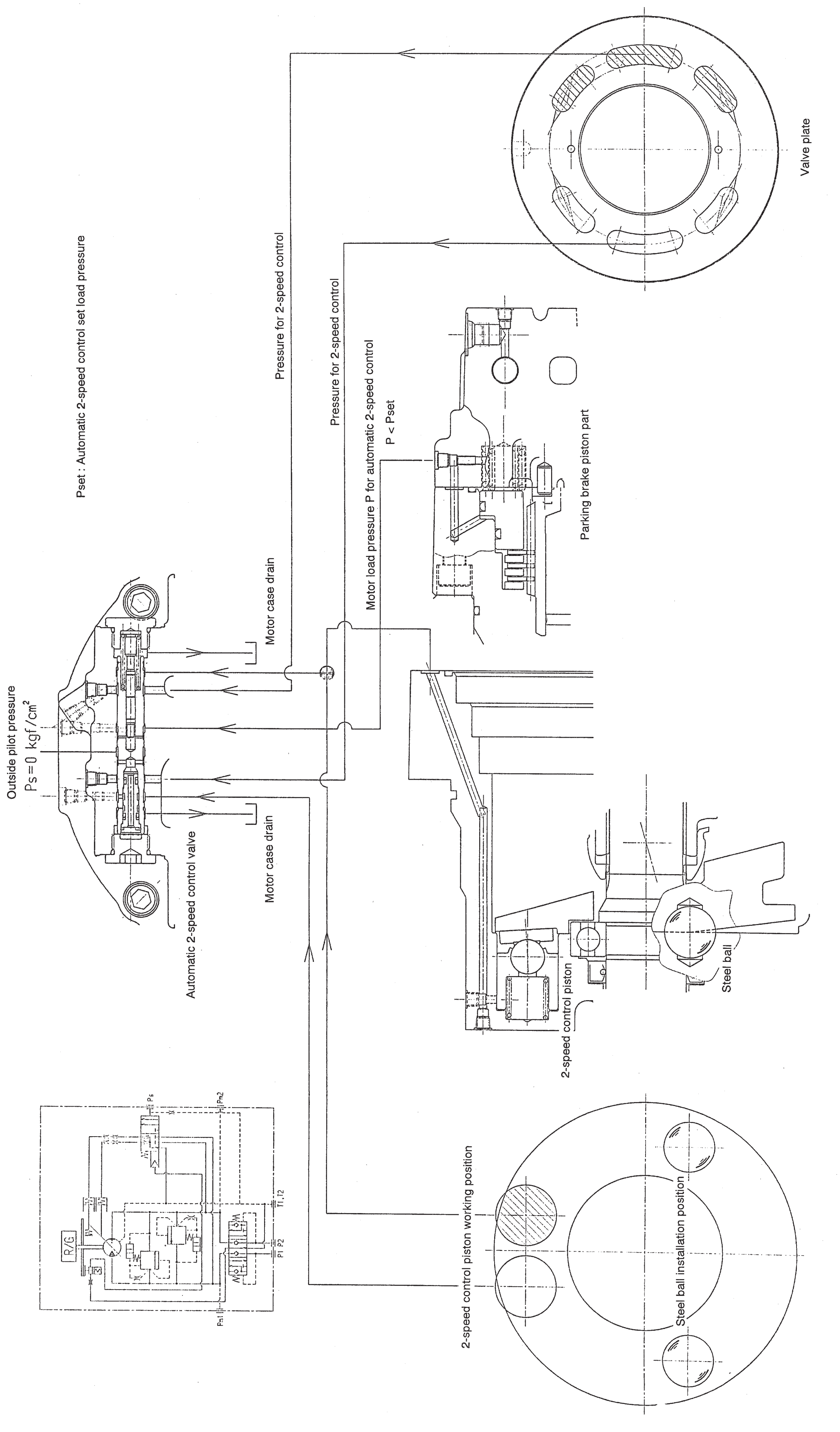


Fig. 8-1 1st Speed Fixed Mode

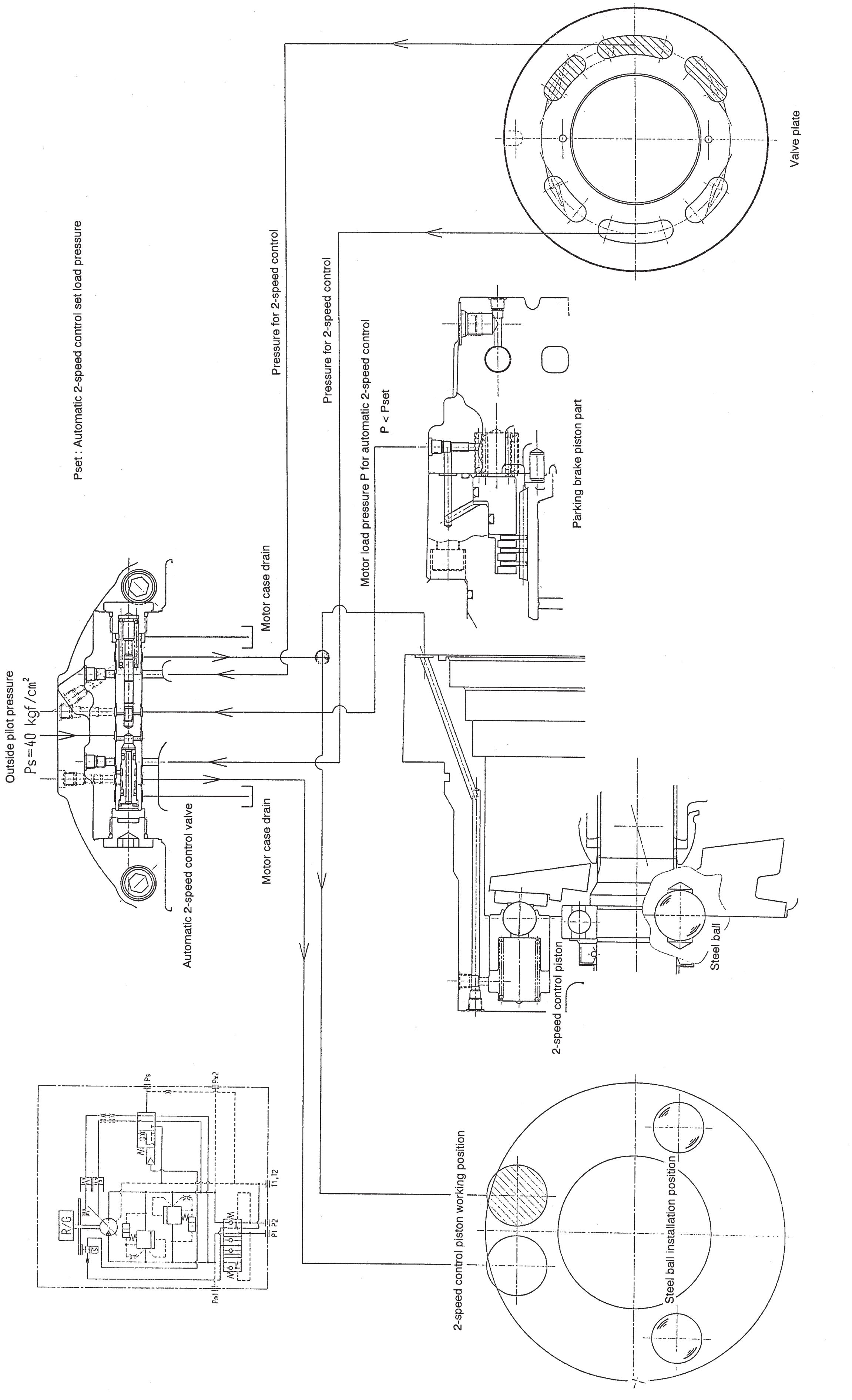


Fig. 8-2 Automatic 2-Speed Mode in 2nd Speed State

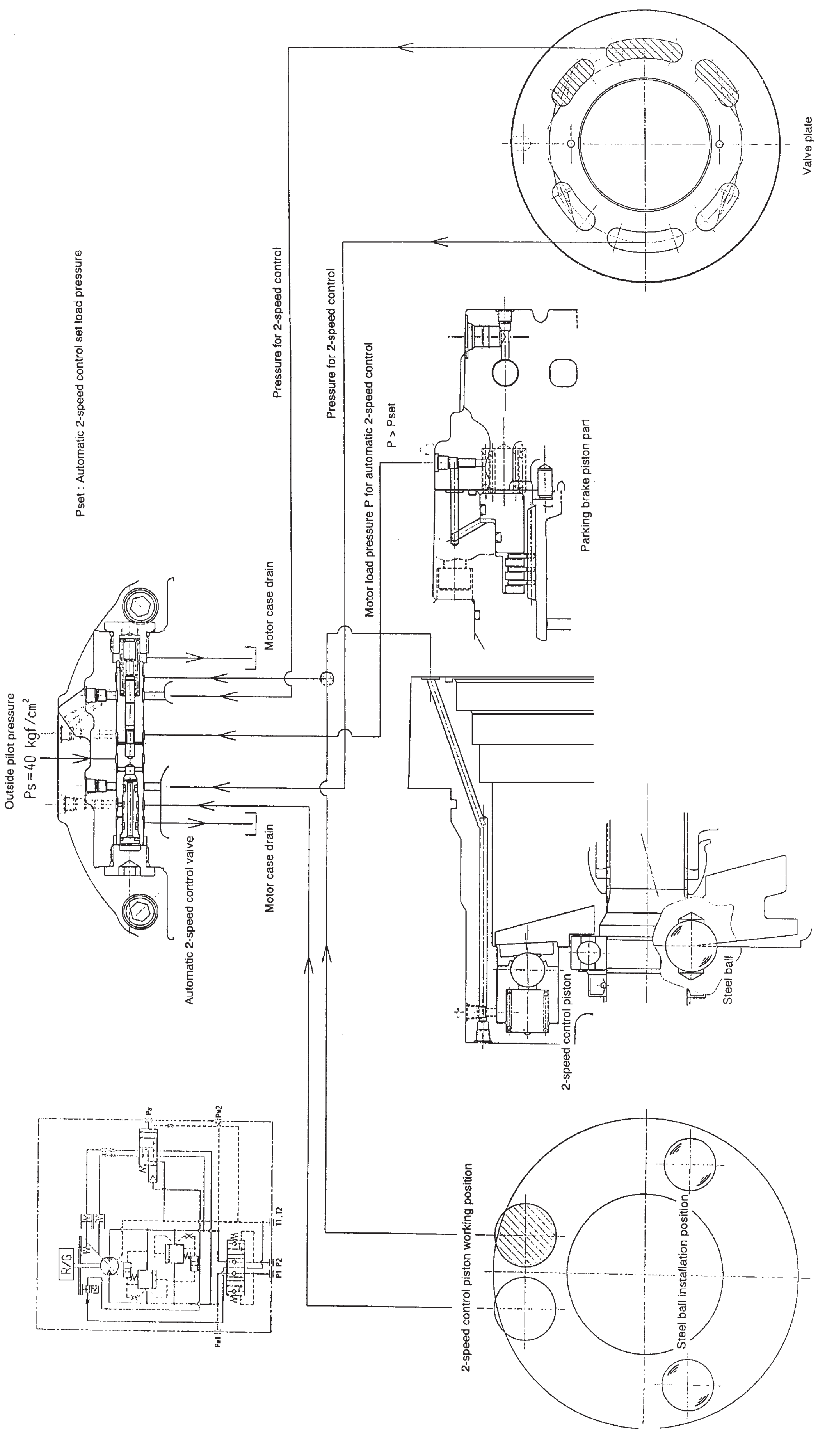


Fig. 8-3 Automatic 2-Speed Mode in 1st Speed State

Precautions during Installation

Before installation, check the overall condition of the axial piston motor, are any parts loose, are **P1**, **P2** drain ports and pilot ports completely sealed so that contaminants cannot enter the axial piston.

Rotation Direction
The relationship between the flow direction of the hydraulic oil and the rotation direction is as shown below.

Arrow	Oil input port	Oil output port	Rotation direction (viewed from output shaft end of motor)
	P1	P2	Rotation to right (clockwise)
	P2	P1	Rotation to left (counterclockwise)

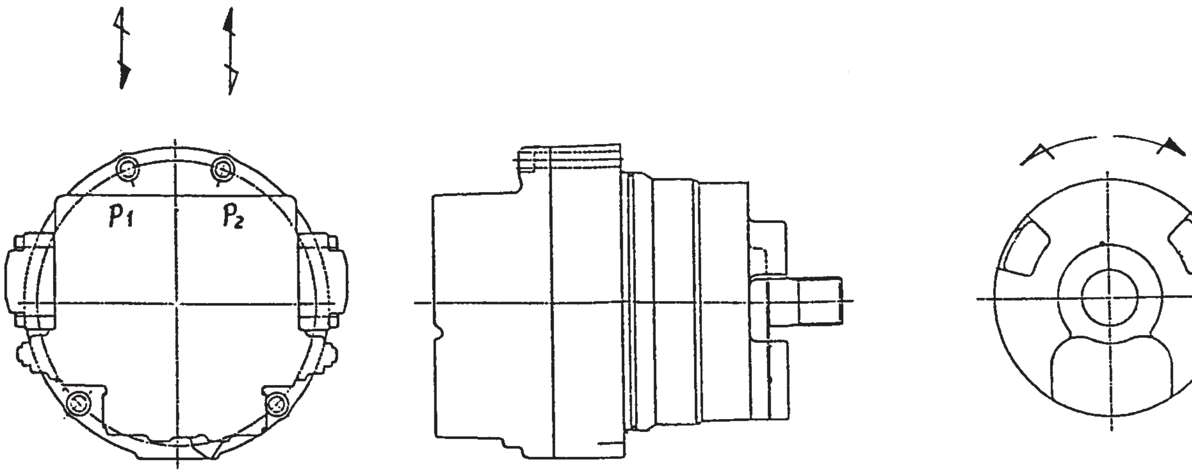


Fig 9. Rotational Direction

Precautions during Installation *(continued)*

Install the new or repaired and inspected traction motor on the machine and perform the inspection and starting preparations described below.

a. Fully fill the piston motor case with clean hydraulic oil. Also bleed air from each part of the piping.

Fill gearbox casing to level **A**.

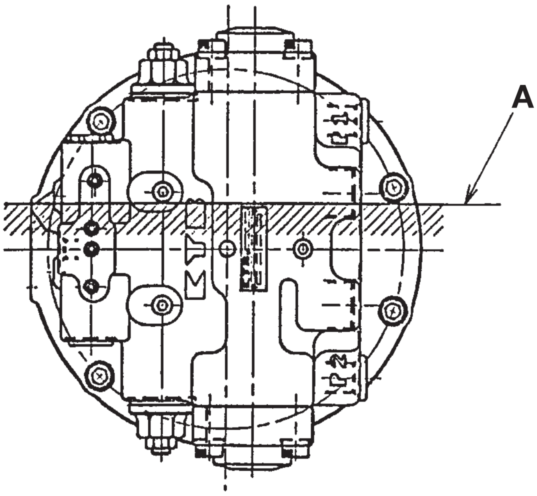


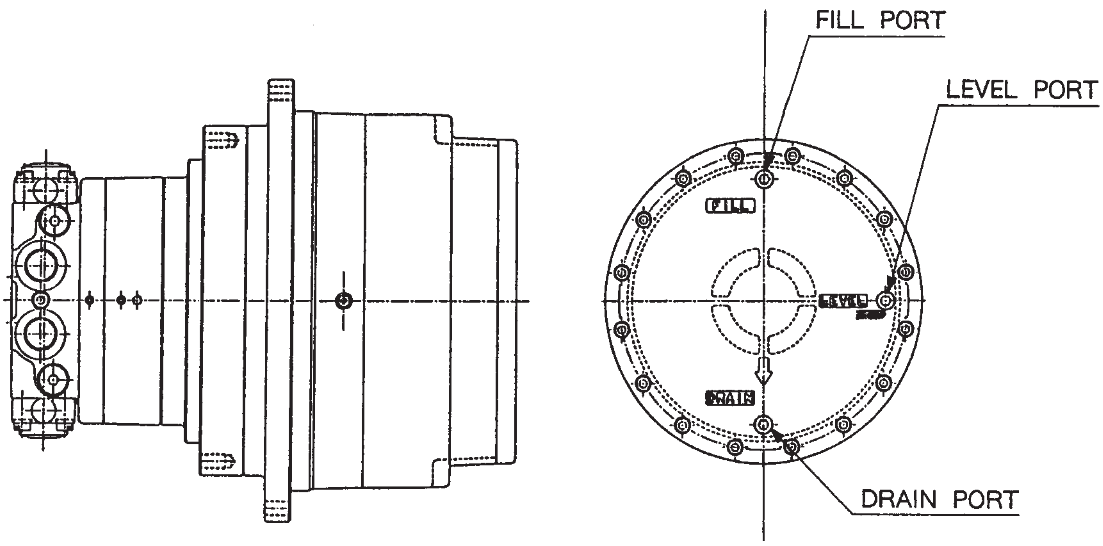
Fig 10.

Note: *When using a hand pump or small capacity electric pump for filling with hydraulic oil, be careful that the inner case pressure does not exceed 0.3 MPa (3 kgf/cm^2). Oil Capacity is 400 cm^3.*

b. Initial Operation

First run at low speed, repeating the operations. At this time, air remaining in the circuit may cause abnormal sounds in the valve, so continue running at low speed. Also check for oil leakage from the equipment.

After air bleeding and checking for oil leakage is completed, confirm that abnormal noise or vibration does not occur in the traction motor due to running with a load on the motor.



Fault Finding

Piston Motor

Fault	Possible cause	Countermeasure or remedy
1. Motor does not run	**1.** Device other than the piston motor or reduction gear may have malfunctioned.	Check whether or not the specified pressurised oil is delivered to the motor input side and then inspect each device and repair if necessary.
	2. Sliding area of motor is abnormally worn allowing the pressurised oil to escape.	Replace the excessively worn part. Remove scratches and burrs from the surface and completely clean all parts. Reassemble the parts.
	3. Improper operation resulting from damage of important motor part. In this case, abnormal noise is heard from the motor itself.	Disassemble and replace the damaged part. Completely clean all parts and reassemble.
	4. Relief valve is activated because the motor is excessively loaded.	Check the load state and operate the machine under a load which matches the relief pressure.
2. Motor revolution speed is insufficient	**1.** Oil not supplied to motor at specified rate due to problems in hydraulic pump, pressure control valve, etc.	Check whether the specified pressurised oil is delivered to the motor input side and then inspect each device and repair if necessary.
	2. Specified revolution speed cannot be achieved due to reduced volume efficiency of motor.	After disassembly, check for abnormal wear of the sliding area and repair or replace worn parts.
3. Motor revolution speed varies greatly	**1.** Pressurised oil escaping through the drain port due to wear on the sliding area of the motor. Also, revolution speed variation resulting from wear in the bearing.	Disassemble and replace excessively worn parts. Completely clean all parts and reassemble them.
	2. Motor load is excessive and the automatic 2-speed function is working.	Check the load state and operate the machine under a load which matches the automatic 2-speed set pressure.
4. Oil leaks	**1.** Oil leaks due to damage of the oil seals or 'O'-rings.	Replace a broken oil seal or 'O'-ring with a new one. When inserting the oil seal, be careful not to damage the lip. Since the safe working temperature limit of the oil seal and 'O'-ring is up to 80°C, it is necessary to take steps to prevent the hydraulic oil temperature from exceeding 80°C.

Fault Finding *(continued)*

	Fault	Possible cause	Countermeasure or remedy
*	**4. Oil Leaks (continued)**	**2.** Motor case excessively pressurised resulting in oil leakage. Oil seal pressure resistance Ordinary 0.2 MPa {2 kgf/cm^2} Maximum 0.5 MPa {5 kgf/cm^2}	Repair the motor and replace oil seal. When inserting new oil seal, be careful not to damage the lip.
		3. Due to clogging, etc. by foreign matter in drain pipe, pressure rises causing the oil seal to leak. Oil seal pressure resistance Ordinary 0.2 MPa {2 kgf/cm^2} Maximum 0.5 MPa {5 kgf/cm^2}	Clean the clogged drain piping. There should not be more than 0.3 MPa {3 kgf/cm^2} pressure on the oil seal. Renew oil seal. When inserting new oil seal, be careful not to damage the lip.
*	**5. Abnormal noise, excessive revolution variation and pressure variation due to cavitation.**	**1.** When the motor works as a pump, when the closed circuit is used, when the boost pressure is low (standard: 0.4~0.5 MPa {4~5 kgf/cm^2}) or when the double counterbalance valve operates incorrectly, negative pressure is generated on the suction side of the motor, resulting in cavitation.	Recheck the hydraulic circuit and repair or replace the double counterbalance valve. Disassemble the motor and replace any abnormally worn or broken parts. After cleaning all parts, reassemble them.

Parking Brake

Fault	Possible cause	Countermeasure or remedy
1. Oil Leaks	**1.** Disk is worn.	Replace the disk. Completely remove foreign matter and repair damaged areas. After cleaning, reassemble.
	2. Disk surface has changed in quality or the contact is incorrect.	Grind and recondition the affected area. Reassemble after cleaning and replace if change in quality of the surface is excessive.
	3. Spring is deformed or damaged.	Replace the spring. Completely remove foreign matter and reassemble after cleaning.
2. Abnormal heat generated from brake drag.	**1.** Brake release incorrect. **1)** Oil leaks due to broken 'O'-ring. **2)** Orifice is clogged.	Replace the broken 'O'-ring. Reassemble after cleaning.

Fault Finding *(continued)*

Relief Valve

Fault	Possible cause	Countermeasure or remedy
1. Motor does not run or rotation speed is slow.	**1.** Relief valve closing incorrectly. ***1)*** *Foreign matter is clogging components.*	Completely remove foreign matter, repair damaged part and reassemble after cleaning. Replace if damage or leakage is excessive.
	2) *Spring is broken*	Replace the spring. Completely remove foreign matter, repair the damaged part and reassemble after cleaning. Replace if damage or leakage is excessive.
	2. The cracking pressure of relief valve is low. ***1)*** *Spring is deformed* ***2)*** *Poppet orifice is clogged*	Replace relief valve sub assembly. After cleaning, reassemble.
2. Motor does not stop or stops slowly.	**1.** Relief valve closing incorrectly. ***1)*** *Foreign matter is clogging components.* ***2)*** *Spring is broken.*	Completely remove foreign matter, repair damaged part and reassemble after cleaning. Replace if damage or leakage is excessive. Replace the spring. Completely remove foreign matter, repair the damaged part and reassemble after cleaning. Replace if damage or leakage is excessive.
	2. The cracking pressure of relief valve is low. ***1)*** *Spring is deformed.* ***2)*** *Poppet orifice is clogged.*	Replace relief valve sub assembly. After cleaning, reassemble.
3. Excessive shock when travel is stopped.	**1.** Shockless function does not work. ***1)*** *Foreign matter caught up in shockless piston section.* ***2)*** *Spring is deformed.* ***3)*** *Relief pressure set too high.*	Completely remove foreign matter, repair damaged part and reassemble after cleaning. Replace if damage or leakage is excessive. Replace the spring. Completely remove foreign matter, repair the damaged part and reassemble after cleaning. Replace if damage or leakage is excessive. Readjust the relief valve set pressure.

Fault Finding *(continued)*

Double Counterbalance Valve

Fault	Possible cause	Countermeasure or remedy
1. Motor does not run or rotation speed is slow.	**1.** Plunger is not switched ***1)*** *Pressurised oil from the pilot not there.* ***2)*** *Foreign matter caught between plunger and body.* ***3)*** *Orifice is clogged.* ***4)*** *Foreign matter caught between dumper piston and cap.*	Inspect the piping for damage. Completely remove foreign matter, repair the damaged part and reassemble after cleaning. Replace if damage or leakage is excessive. Completely remove foreign matter, repair the damaged part and reassemble after cleaning. Replace if damage or leakage is excessive. Reassemble after cleaning. Completely remove foreign matter, repair the damaged part and reassemble after cleaning. Replace if damage or leakage is excessive.
2. Motor does not stop or stops slowly.	**1.** Plunger does not return. ***1)*** *Foreign matter is caught.* ***2)*** *Spring is broken.* ***3)*** *Spring is not assembled correctly.* ***4)*** *Orifice is clogged.*	Completely remove foreign matter, repair the damaged part and reassemble after cleaning. Replace if damage or leakage is excessive. Replace spring. Completely remove foreign matter, repair the damaged part and reassemble after cleaning. Replace if damage or leakage is excessive. Assemble spring in specified position. Reassemble after cleaning.
3. Rotation varies.	**1.** Plunger does not return. ***1)*** *Foreign matter is caught.* ***2)*** *Orifice is clogged.*	Completely remove foreign matter, repair the damaged part and reassemble after cleaning. Replace if damage or leakage is excessive. Reassemble after cleaning.
4. Abnormal noise is heard.	**1.**Plunger does not return. ***1)*** *Foreign matter is caught.* ***2)*** *Spring is broken.* ***3)*** *Orifice is clogged.*	Completely remove foreign matter, repair the damaged part and reassemble after cleaning. Replace if damage or leakage is excessive. Replace spring. Completely remove foreign matter, repair the damaged part and reassemble after cleaning. Replace if damage or leakage is excessive. Reassemble after cleaning.
5. Travel not linear.	**1.** Dumper piston or cap is abnormally worn.	Replace dumper piston and cap. Completely remove foreign matter, repair the damaged part and reassemble after cleaning.

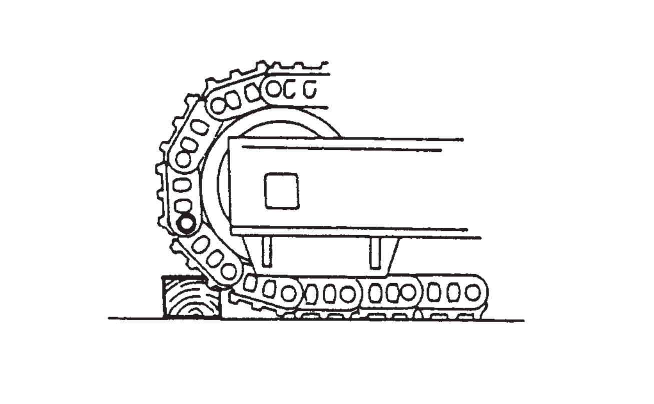
Fault Finding *(continued)*

2-Speed Control Function

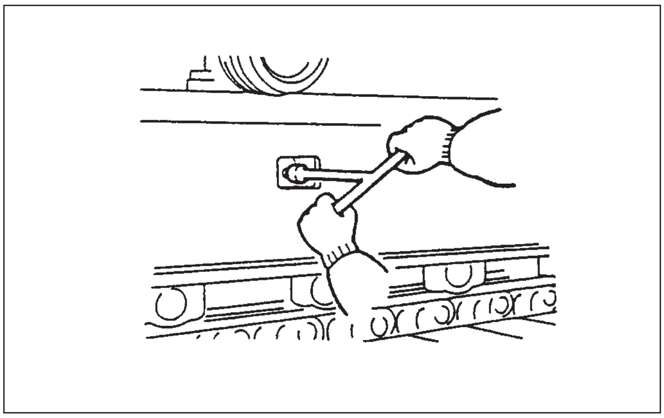
Fault	Possible cause	Countermeasure or remedy
1. Travel is not linear	**1.** Plunger is not switched ***1)*** *Foreign matter is caught between plunger and body.* * ***2)*** *Spring is not assembled correctly.* ***3)*** *Spring is broken.* * ***4)*** *Foreign matter is trapped in spool galleries.*	 Completely remove foreign matter, repair the damage and reassemble after cleaning. Replace if damage or leakage is excessive. Assemble spring in specified position. * Renew spring. Completely remove foreign matter, repair the damage and reassemble after cleaning. Replace if damage or leakage is large.
	2. Pressurised oil leaks due to abnormal wear of 2-speed control piston	Replace the 2-speed control piston. Completely remove foreign matter and reassemble after cleaning.
	3. 2-speed control piston is not assembled correctly	Assemble 2-speed control piston to the specified position.
	4. Steel ball is abnormally worn.	Replace steel balls. Completely remove foreign matter and reassemble after cleaning.
	5. Set pressure is rising due to abnormal wear of spools.	Replace spool. Completely remove foreign matter and reassemble after cleaning.
	6. The orifice of the 2-speed piston cavity drain is incorrect.	Confirm orifice diameter.
	7. The orifice of the 2-speed piston cavity drain is clogged.	Reassemble after cleaning.
	8. Number of washers is different and set pressure is different on the left and right.	Reassemble using correct number of washers.
2.Will not go into 2nd.	**1.** Plunger is not switched ***1)*** *Foreign matter is caught between plunger and body.* * ***2)*** *Foreign matter is trapped in spool galleries.*	 Completely remove foreign matter, repair the damage and reassemble after cleaning. Replace if damage or leakage is excessive. Completely remove foreign matter, repair the damage and reassemble after cleaning. Replace if damage or leakage is excessive.
	2. Pressurised oil leaks due to abnormal wear of 2-speed control piston.	Replace the 2-speed control piston. Completely remove foreign matter and reassemble after cleaning.
	3. 2-speed control piston is not assembled correctly.	Assemble 2-speed control piston to the specified position.
	4. The orifice of the 2-speed piston cavity drain is clogged.	Reassemble after cleaning.
3.Will not go into 1st.	**1.** Spring is not assembled correctly.	Assemble spring to specified position.
	2. Spring is broken.	Replace spring. Completely remove foreign matter, repair the damage and reassemble after cleaning. Replace if the damage or leakage is excessive.
	3. Set pressure is rising due to abnormal wear of spools.	Replace spool. Completely remove foreign matter, repair the damage and reassemble after cleaning. Replace if the damage or leakage is excessive.

Removal

1. Move the track link until the master pin is over the take-up roller in the position shown, place a wooden block under the track shoe as shown.



2. Slacken the check valve to bleed out the grease.



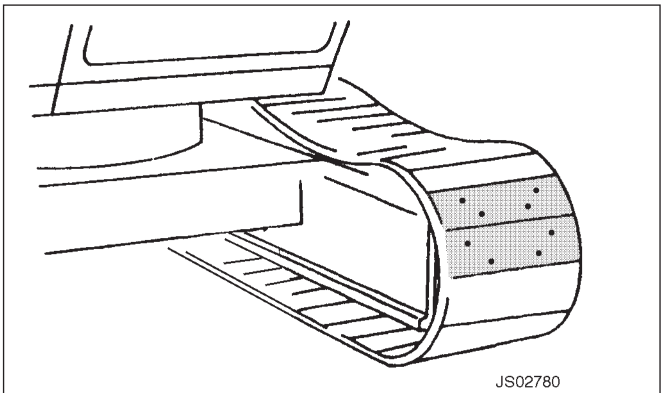
⚠ WARNING

Slacken the check valve slowly and stop when grease is released. The grease and valve are under extremely high pressure and could cause injury if suddenly released.

TRANS 6-2

* **3.** Disconnect the track link by removing the locking pin and knocking out the master pin.

*



JS02780

a. Remove bolts and lift off the track shoes adjacent to the master pin.

b. Position a suitable hydraulic press so that its ram aligns with the master pin.

c. Insert the spacer bar between the master pin and the hydraulic ram.

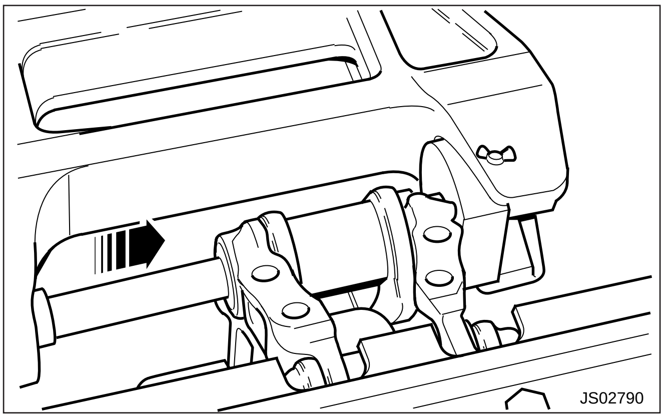
d. Slowly operate the hydraulic ram and press out the master pin.

⚠ WARNING

Stand clear and to one side of the track while you remove the master pin. When the master pin is removed the track could fall forward and injure you.

TRACK 1-1

e Remove the seal rings from each side of the chain link.



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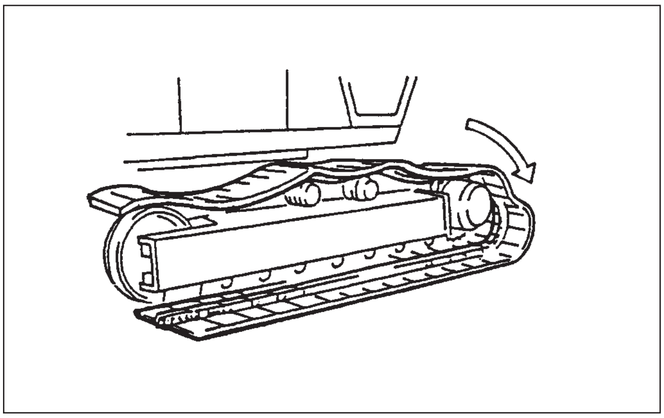
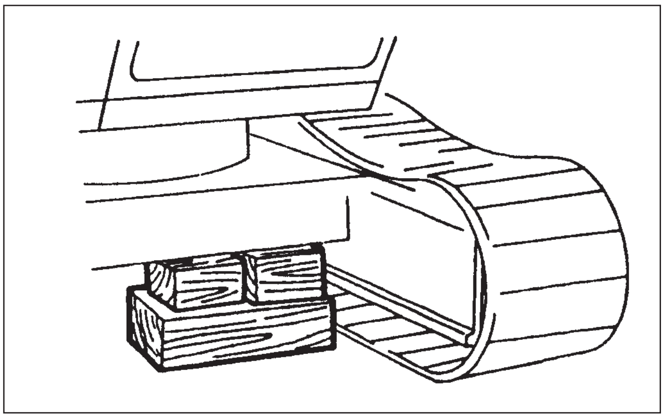
Removal *(continued)*

4. Operate the traction motor to remove the track.



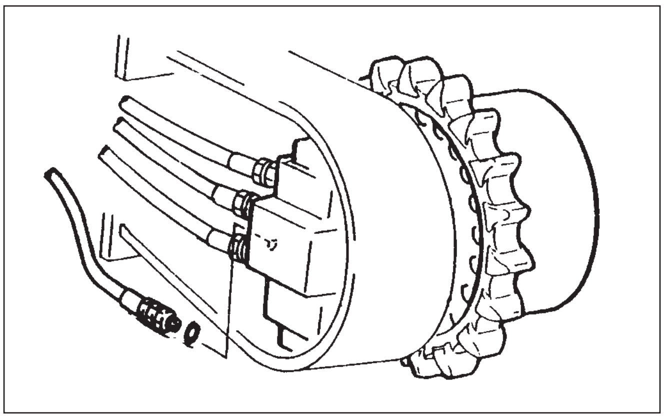
5. Lift the side of the undercarriage high enough to permit drive sprocket removal. Support with wooden blocks.



6. Stop the engine and operate the control lever to relieve pressure in the hydraulic system.

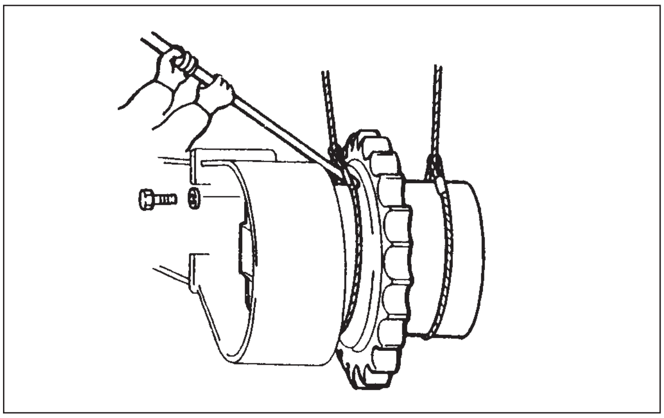
Release pressure in the hydraulic tank *(See* ***Releasing Tank Pressure*** *in* ***Routine Maintenance****)*.

7. Remove the motor cover, attach identification tags to the motor hoses, disconnect the hoses from the motor and install plugs and caps.



Removal *(continued)*

8. Support the motor so that the cables are in tension, then remove the motor installation bolts.

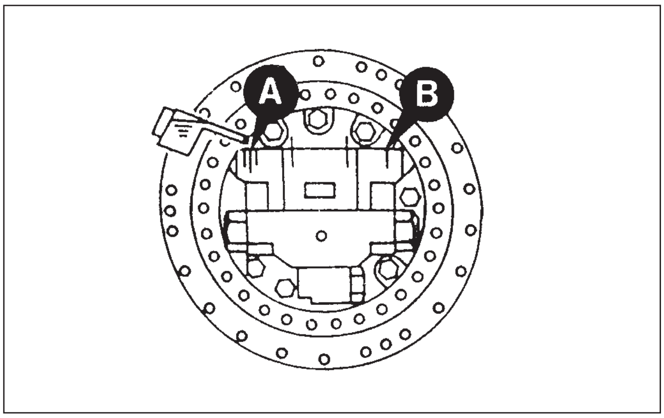


Replacement

1. Before fitting, clean the gearbox and bleed air out as follows:

Turn the gearbox so that the hydraulic oil ports are facing upwards.

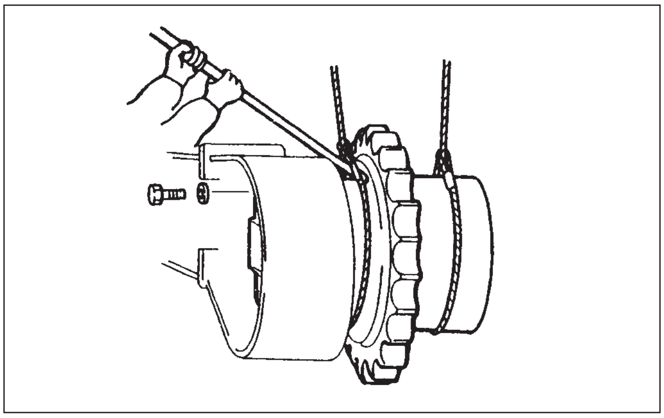
Remove plugs from ports **A** and **B**. Fill the motor through port **A** with the specified hydraulic oil. Fit plugs to ports **A** and **B**.



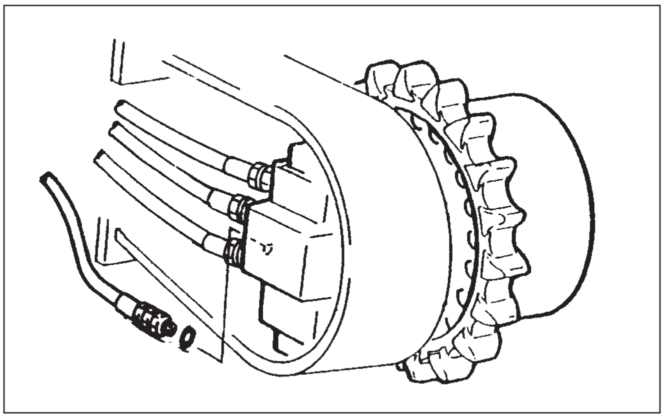
2. Lift the gearbox and position it on the undercarriage. Install the bolts and washers, using Loctite 262 on the bolt threads. Tighten the bolts in a diagonal sequence.

Torque Settings

267-312 Nm (196-229 lbf ft)



3. Remove plugs and install the hoses to the motor.



Replacement *(continued)*

* **4.** **a.** Install the covers over the motor.

b. Check the amount of oil in the gearbox.

c. Bleed air from the motor *(see **Motor Bleeding**)*.

d. If the traction motor has been dismantled and serviced, carry out the functional tests detailed under **Testing** later in this section.

e. Install the drive sprocket *(see **Drive Sprocket**, **Replacement**, Section J)*.

f. Remove the wooden blocks.

g. Position the lower frame on the track.

h. Move the track link by reversing step 1 of ***Removal**.*

i. Clean the seal ring housings in the chain link. Insert the seal rings and clamp into position.

j. Using a plastic hammer, tap the upper link down to align holes.

***Note:** As the links overlap, the seal rings will be held in position. Remove 'G' clamps.*

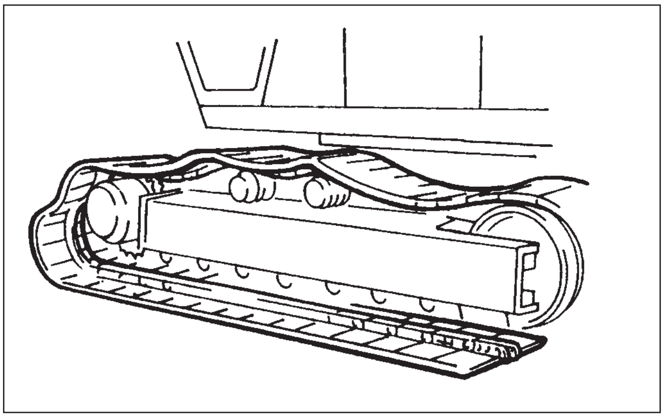
k. Insert the pointed guide pin from the inner face and tap through its full length.

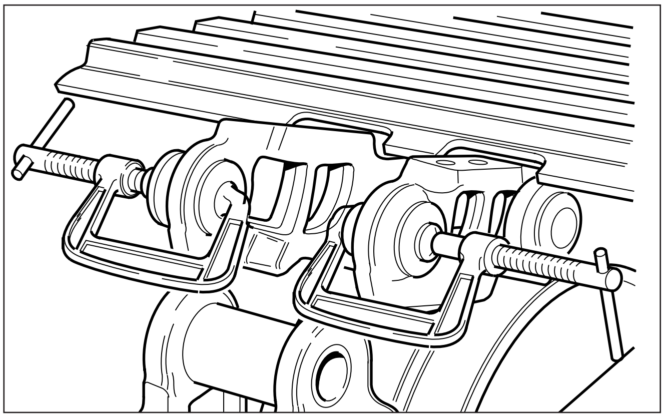
l. Position a suitable hydraulic press so that its ram aligns with the guide pin.

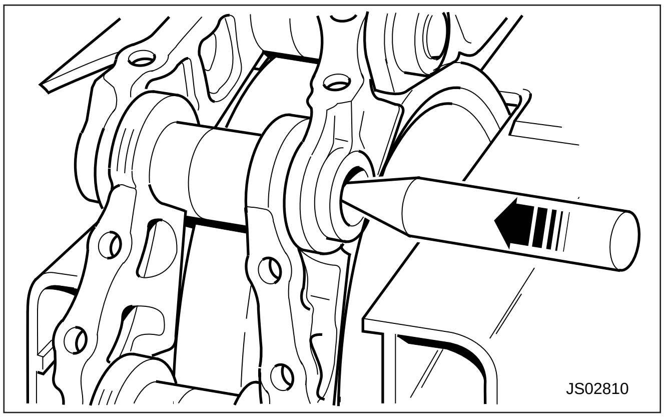
m. Insert the master pin into its locating hole.

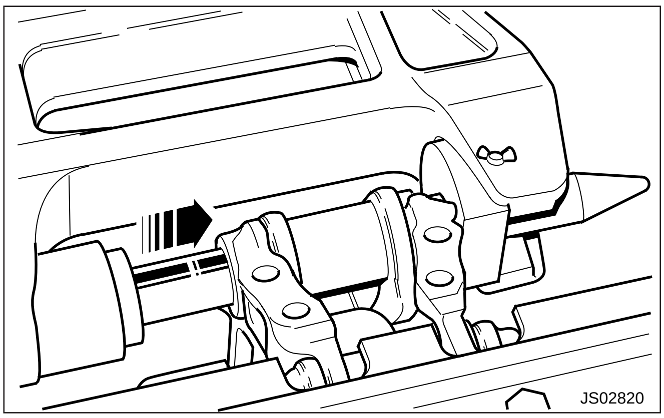
n. Slowly operate the hydraulic ram and press the master pin into position.

o. Re-locate the track shoes and tighten the bolts *(see **Checking Shoe Plate**, **Routine Maintenance**, Section 3).*



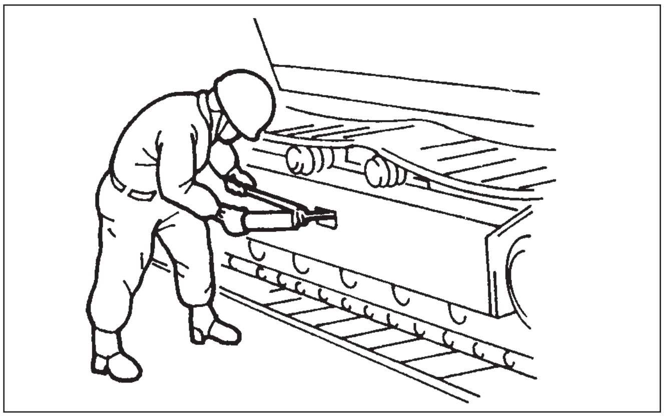






* Replacement *(continued)*

5 Apply grease through the check valve to adjust the track tension *(see **Tracks and Running Gear, Checking/Adjusting the Track Tension**, Section 3).*



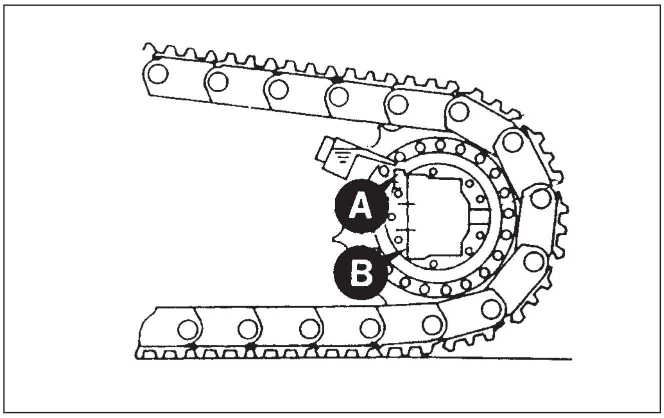
Motor Bleeding

Bleeding must be done whenever a track motor is being fitted.

Note: *If a track gearbox assembly is being fitted to the machine with the motor attached, follow the procedure given under **Track Gearbox Removal and Replacement**.*

When the motor is being fitted to a gearbox already fitted to the machine, bleed the air from the motor by one of the three methods detailed below.

Note: *Method **1** will take considerable time as air in the motor is very difficult to purge. Methods **2** or **3** may be quicker.*



Method 1

After fitting the motor but before connecting the pipework, remove plug from upper drain port **A** but make sure that a plug is fitted to lower drain port **B**.

Fill the motor with specified hydraulic oil through port **A**. Connect the pipes.

Method 2

Fit the motor and connect all pipes except the two drains. Remove plug from port **A**. Make sure that a steel plug is fitted to bottom drain port **B**.

Run the engine and operate the track control lever slightly so that the sprocket does not turn. If necessary, prevent the sprocket from turning by means of a steel bar or tube jammed in the track. Return the lever to neutral when air-free oil flows from port **A**. Connect the drain pipes.

Method 3

Fit the motor and connect all pipes. Prevent the sprocket from turning by means of a steel bar or tube jammed in the track. Run the engine and fully select the track control lever for about 1 minute. This will fill the motor case with oil.

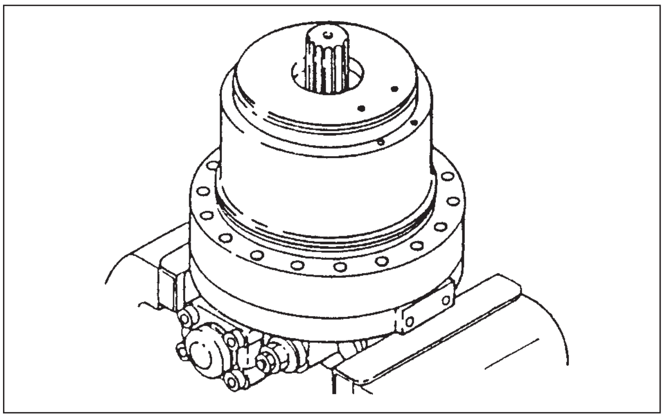
Dismantling

Note: *The numbers in the following section refer to the illustrations on pages F/7-15 and F/7-16.*
Before starting the dismantling, drain the oil, clean all the surfaces with a suitable solvent and dry with compressed air.
Discard all 'O'-rings and seals which are disturbed during dismantling.

1. With the motor/gearbox assembly removed from the machine as described in the previous section.
Unscrew the three socket head screw and separate the hydraulic motor from the gearbox.

2. Remove the O ring from its groove in the motor.

3. Fix the motor into a suitable vice or jig with the shaft facing upwards.

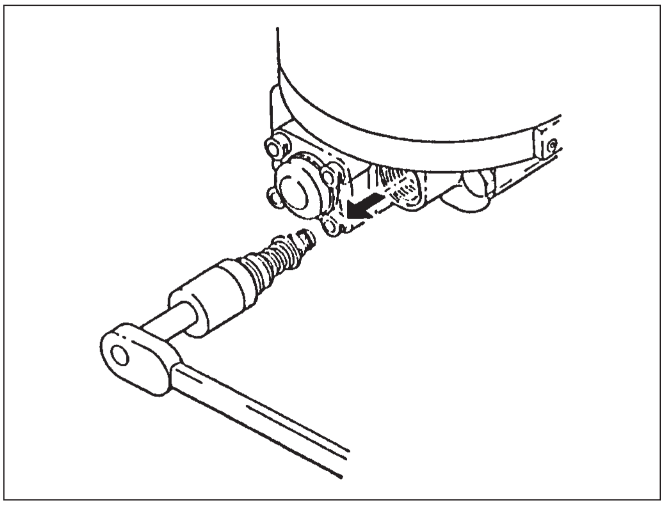


4. Base plate disassembly

a. Relief valve disassembly.
* Loosen the plug (2-7-6) and remove the relief valve sub-assembly (2-7).

* **b.** The (2-7-6) plug and (2-7-1) relief housing are press fitted but the (2-6-2) poppet is not.
Remove the (2-7-3) poppet seat from the (2-1) housing using the poppet seat removal jig.

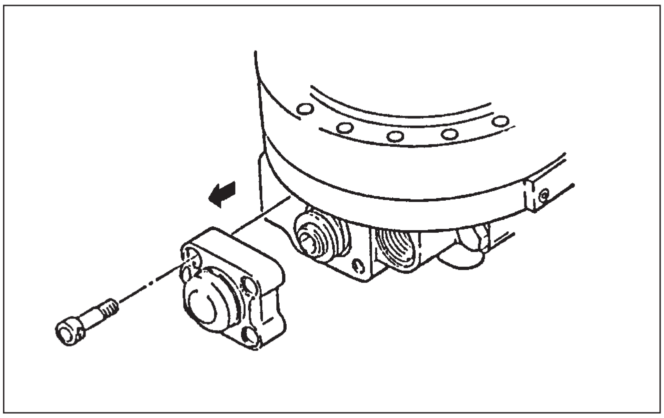
* ***Note:*** *When removing the (2-7) relief valve sub-assembly, the relief set pressure will be lost if the (2-7-16) nut and (2-7-15) set screw are loosened, so take care not to loosen them. Do not disassemble the relief valve unless absolutely necessary.*



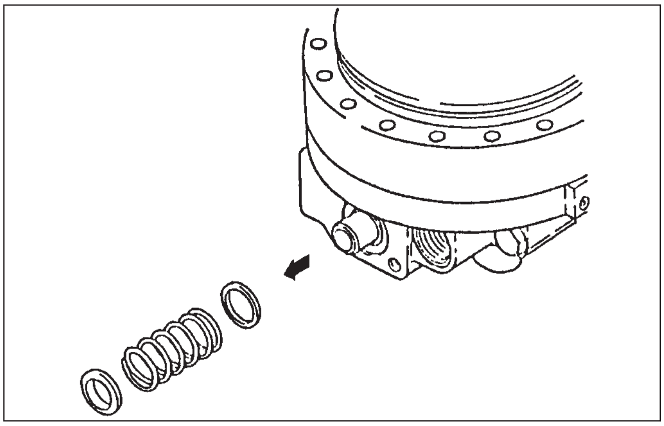
Dismantling *(continued)*

3. Counterbalance valve disassemble
Loosen (2-6-5) socket head bolt and remove the (2-6) cap.

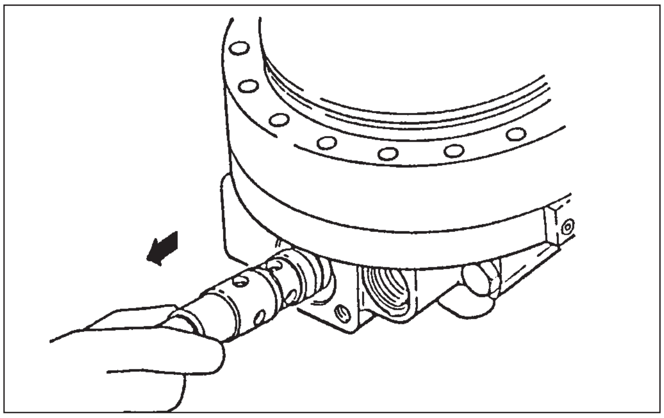
Note: *Since the cap is loaded by a spring, loosen the socket head bolt halfway and while pressing the cap by hand, remove the socket head bolt.*



4. Remove (2-5) spring seat, (2-4) spring and (2-3) spring seat.



5. Pull out the (2-2) plunger assembly.
While turning the plunger, pull it out slowly, being careful not to damage the outer circumference.



6. 2-speed control valve disassembly

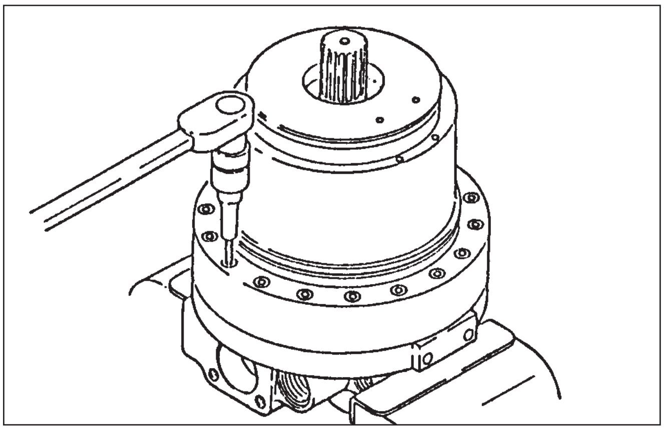
a. Loosen (2-14) (2-17) plugs and remove (2-9) valve assembly, (2-13) spring, (2-16) spring guide.
While turning the (2-9) valve assembly, pull it out slowly.
Be careful not to damage the outer circumference.

Dismantling *(continued)*

7. Base plate disassembly

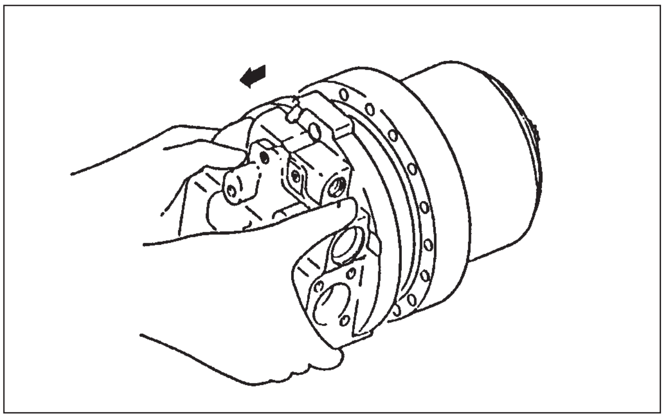
a. Loosen (20) socket head bolt.

Note: *Since the base plate is forced upwards by springs, loosen the bolts evenly.*



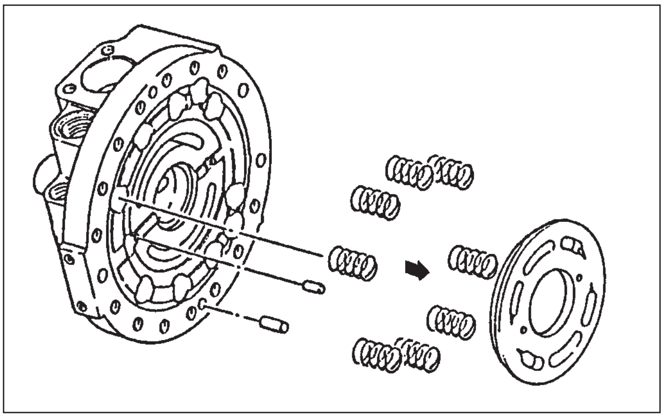
8. Remove the (20) socket head bolts and using a screwdriver, etc. remove the (2-1) base plate.

Note: *Do not pry off the base forcibly as the (28) pin may stick.*



9. Remove the (5) valve plate, (28) pin, (22) 'O'-ring, (33) 'O'-ring and (29) (41) springs.

Note: *When pulling out (28) pin, if using pincers, be careful not to damage the outer circumference.*
Be careful not to damage the sliding surface of the (5) valve plate.

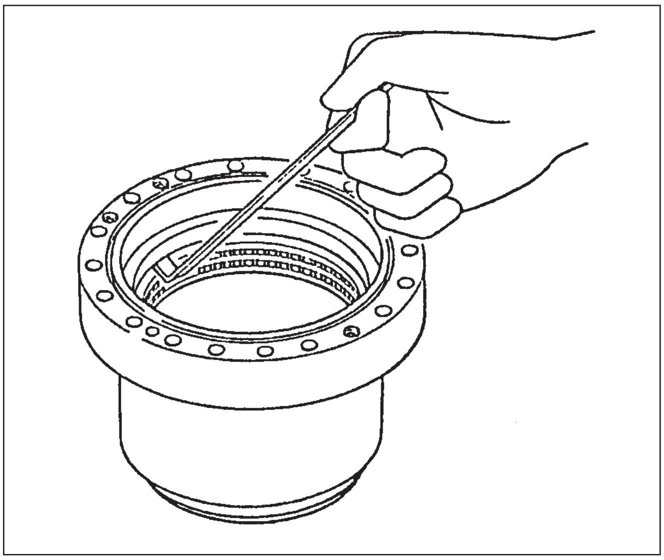


Dismantling *(continued)*

10. Brake piston disassembly

* **a.** Through the (1) case (35) orifice, apply compressed air to remove the (25) brake piston from the (1) case and also remove the (26) disk and (27) friction plate.

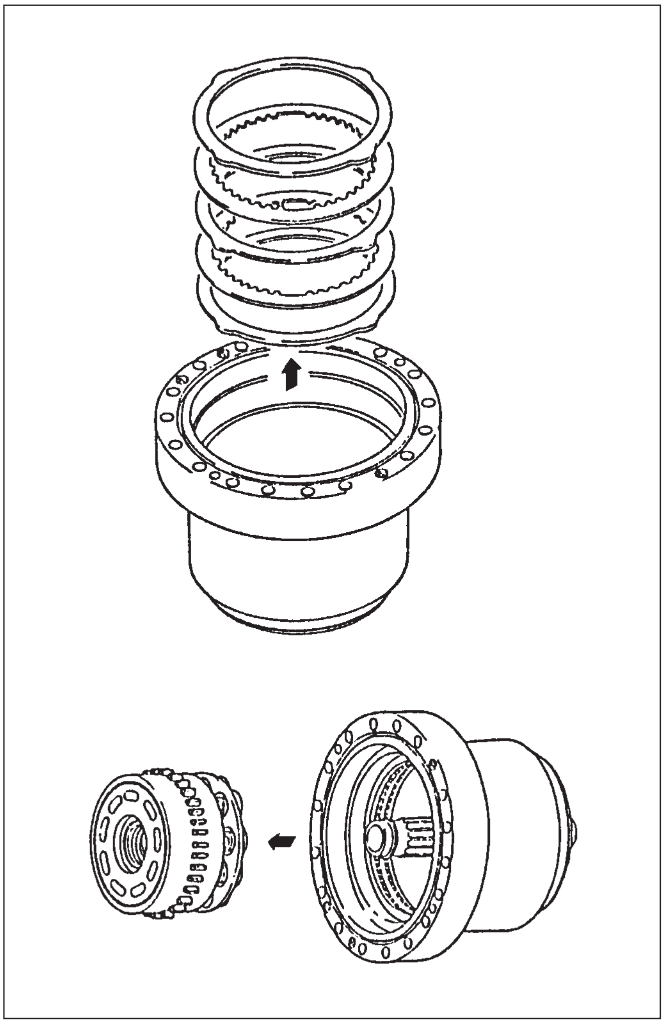
Note: *Because the brake piston may fly out due to the compressed air, take sufficient care to do the work safely.*
Be careful not to damage the sliding surface of the disk.



11. Cylinder rod disassembly

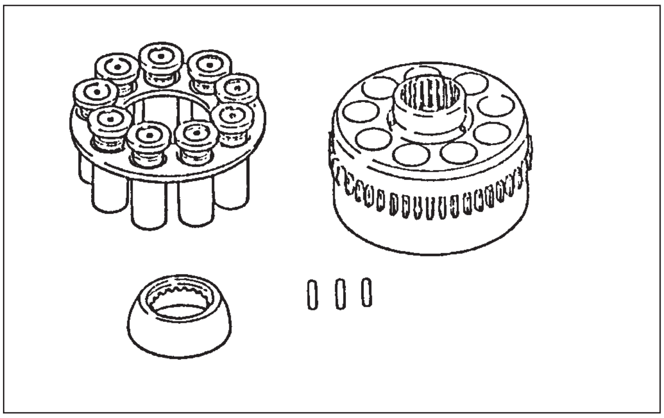
a. Place the (1) case horizontally on the working bench and remove the (4) Cylinder block, (6) piston S/A, (7) retainer plate, (8) retainer holder, (19) pin, (14) snap ring, (15) spring seat, (16) spring and (17) spring seat from the (1) case.

Note: *Be careful not to damage the sliding surface of the cylinder block, piston and swash plate.*

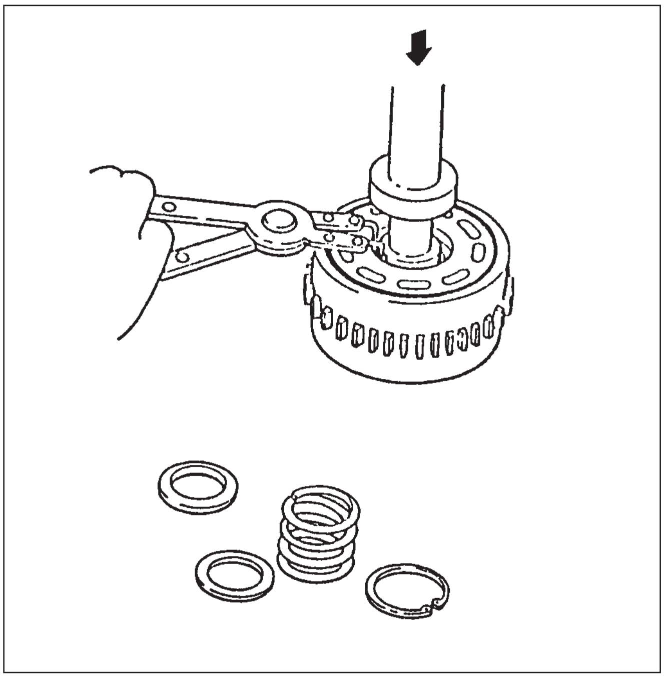


Dismantling *(continued)*

12. Remove the (6) piston, (7) retainer plate, (8) retainer holder and (19) pin from the (4) cylinder block.

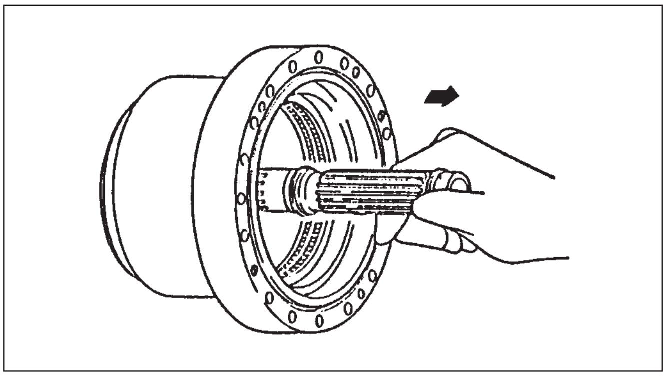


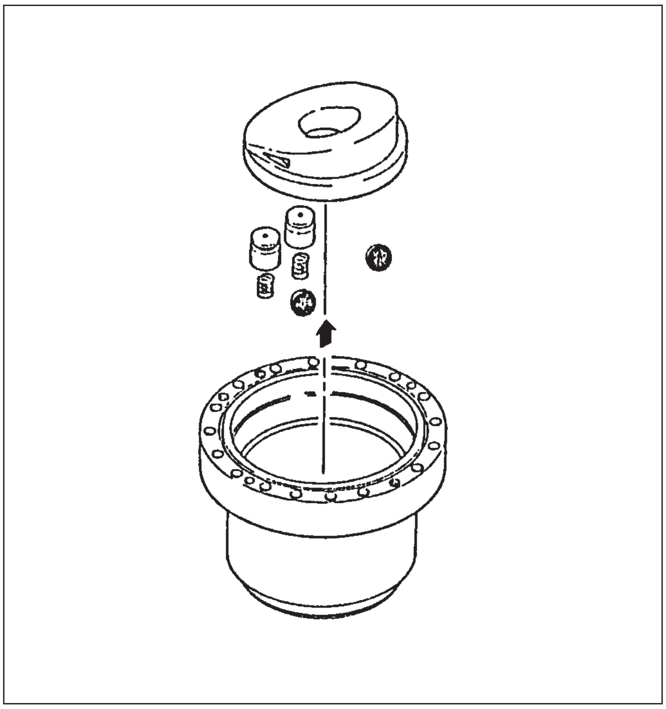
13. Remove the (14) snap ring using a jig or press and remove the (15) spring seat, (16) spring and (17) spring seat.



Dismantling *(continued)*

14. Remove the (3) shaft from the (1) case and remove the (9) swash plate, (11) piston, (40) spring and (10) steel ball from the (1) case.





15. Plunger disassembly

* Push through a Ø10 mm bar in the (2-2) plunger Ø11 mm hole and fix with a vice then loosen the (2-2-4) plug.

Note: *Unless absolutely necessary, do not disassemble. When fixing with a vice, use a copper plate so as not to damage the plunger sliding area.*

16. Remove the (2-2-3) spring and (2-2-2) check valve.

* **17. Cap disassembly**

Remove the (2-6-2) piston and (2-6-3) spring from the (2-6-1) cap.

Note: *Do not disassemble the piston unless necessary.*
The disassembly is now complete.

Assembly

Assembly is essentially a reverse of the dismantling procedure in the previous section.

Exchange or repair any parts not in accordance with instructions laid down in the ***Maintenance Standards***.

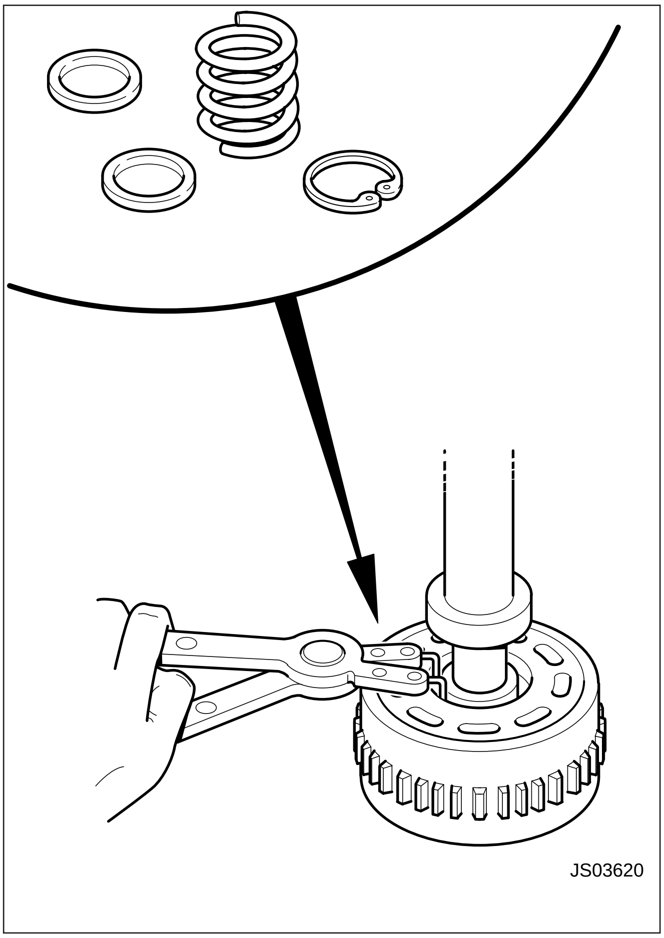
Ensure that all parts are cleaned in the appropriate solvent and dried with compressed air.

Apply a thin film of hydraulic fluid to all sliding parts, bearings and other contact surfaces before assembly.

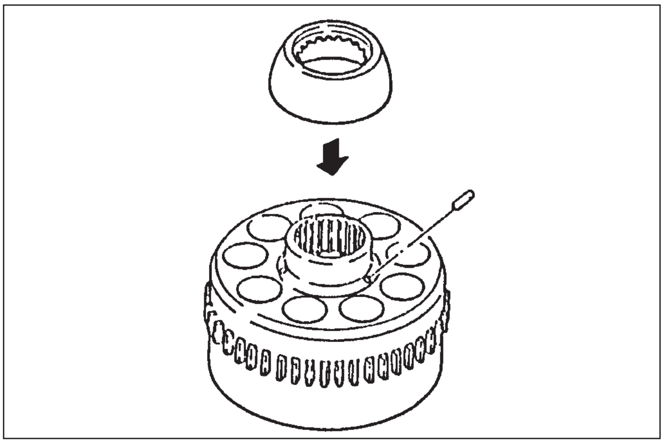
Replace all 'O'-rings and seals, where appropriate cover with petroleum jelly before fitting.

1. **Cylinder block assembly**
   Assemble the (17) spring seat, (16) spring and (15) spring seat to the (4) cylinder block and fit the (14) snap ring.

*



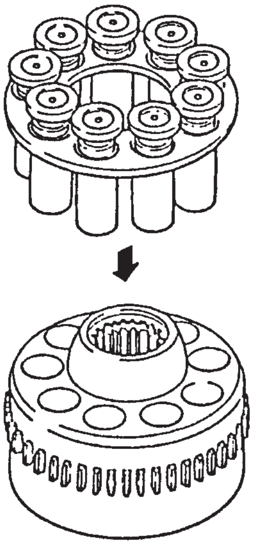
* 2. Apply grease to the (19) pin and assemble at the three holes on the (4) cylinder block then assemble the (8) retainer holder to the (4) cylinder block.



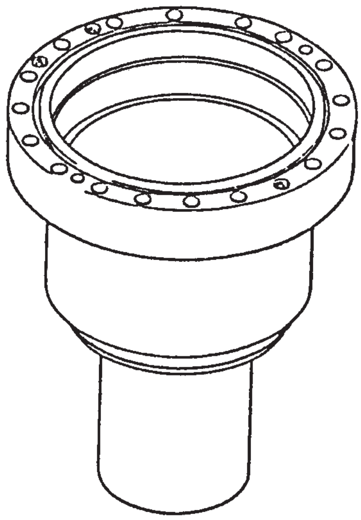
Assembly *(continued)*

3. Assemble the (6) piston into the (7) retainer plate and insert into the (4) cylinder block.

Note: *Assemble them so that the small diameter of the inner taper of the retainer plate comes into contact with the flange of the piston shoe. Coat hydraulic oil on the piston bores of the cylinder block and then insert the piston.*

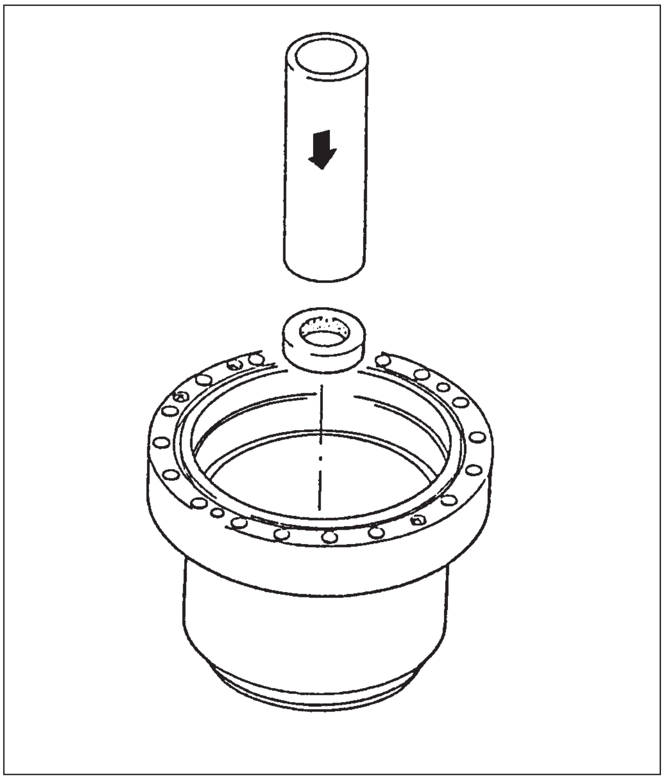


4. Fix the (1) case on the work bench.

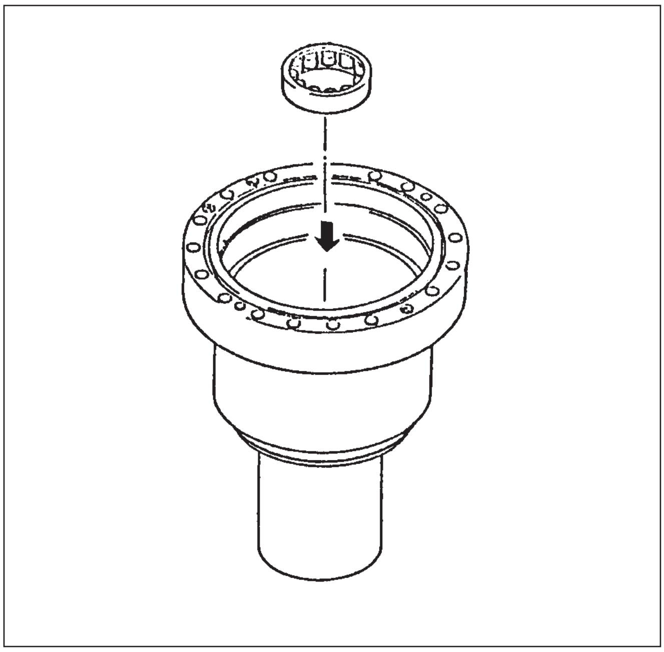


Assembly *(continued)*

5. Assemble the (21) oil seal to the (1) case.

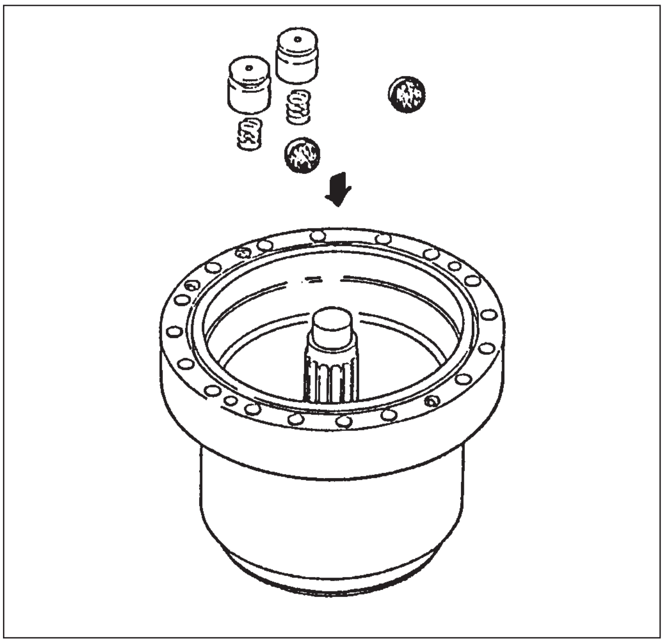


6. Assemble the (12) ball bearings into the (1) case.



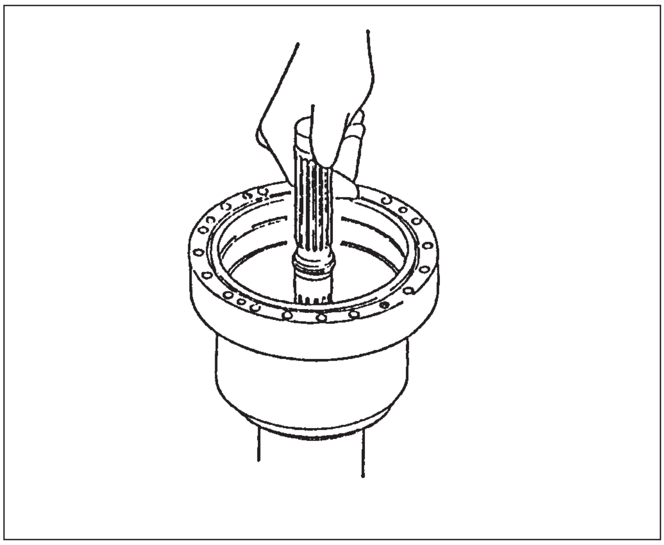
Assembly *(continued)*

7. Assemble the (10) steel balls, (40) spring and (11) piston into the (1) case.



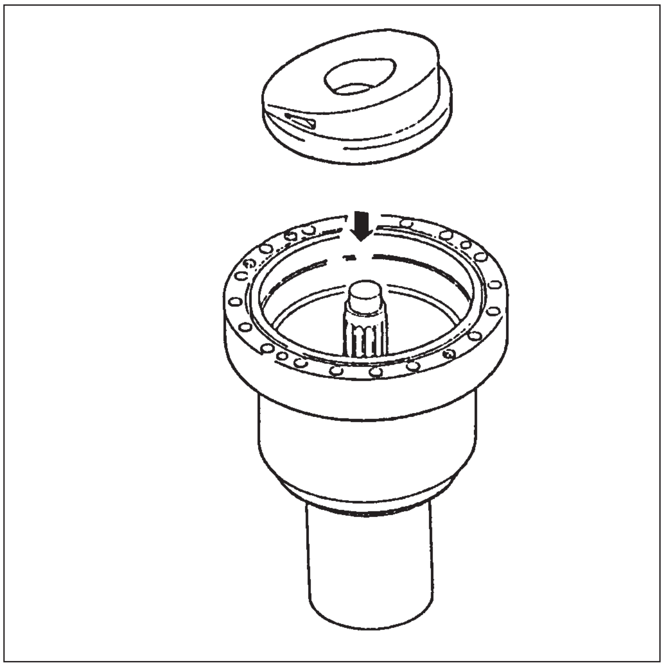
8. Install the (3) shaft into the (1) case.

Note: *Be careful not to damage the oil seal lip.*



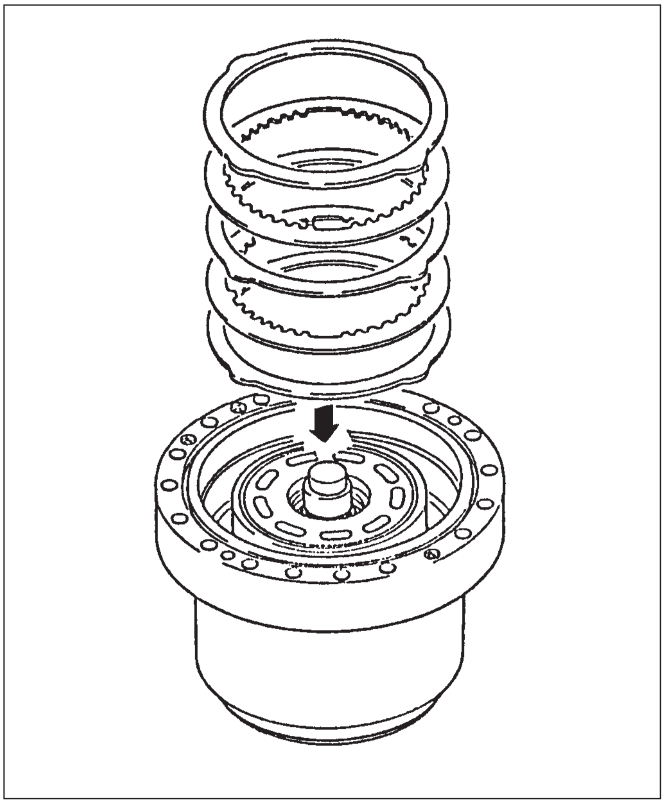
Assembly *(continued)*

9. Assemble the (9) swash plate to the (1) case.



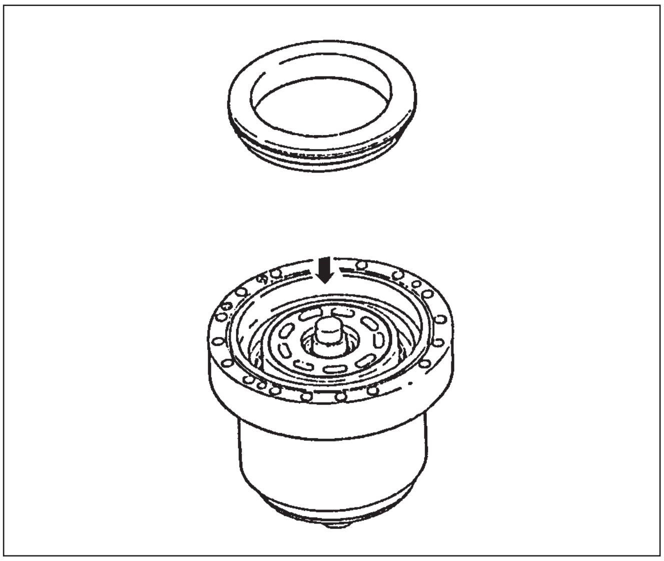
10. Place the (1) case on the work bench horizontally and insert the (4) cylinder block into the (1) case.
Next, assemble the (26) disk and (27) friction plate in order.

Apply hydraulic oil to the (9) swash plate before assembling the (4) cylinder block. Check to see that the (4) cylinder block is rotating smoothly and the (6) piston is moving back and forth.



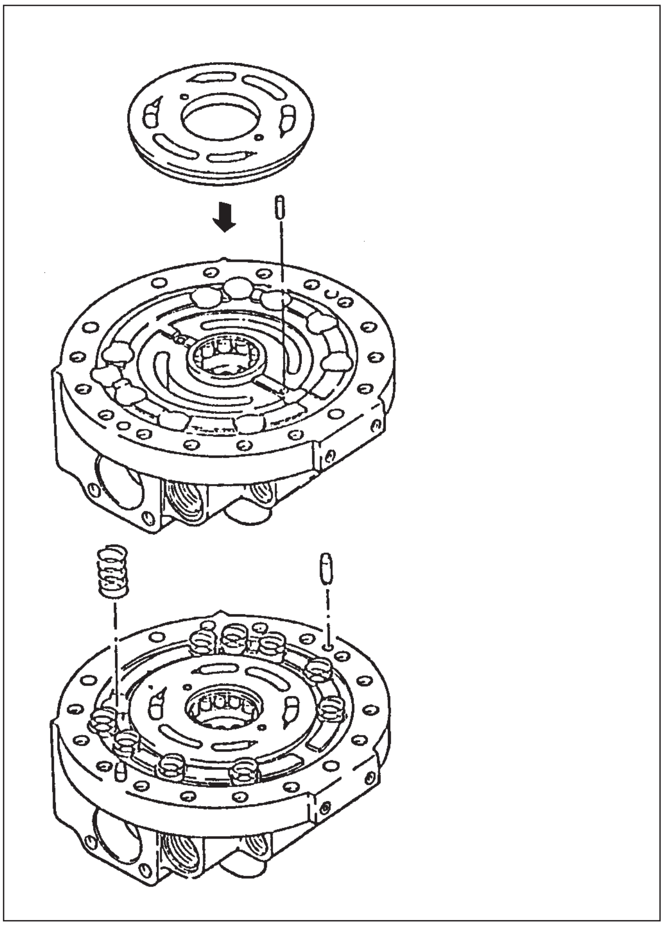
Assembly *(continued)*

* **11.** Assemble (30) (31) 'O'-rings which have been greased into (25) brake piston.
Assemble the (25) brake piston into the (1) case.
Align so that the two pinholes of the (25) brake piston and the two pinholes of the (1) are aligned in a straight line.



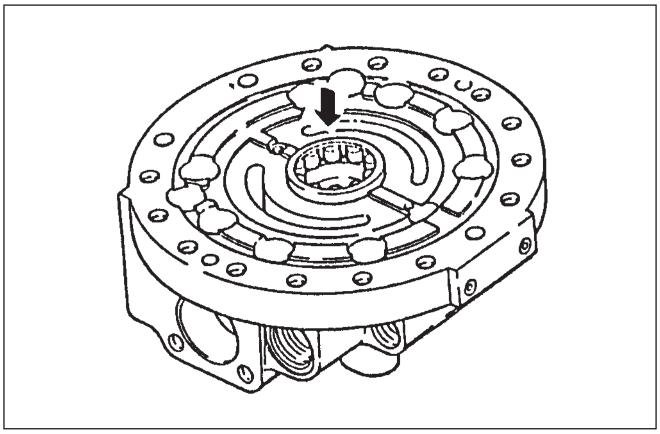
12. Place the jig for aligning the brake piston and lightly tap the head of the jig with plastic hammer evenly and insert the (25) brake piston.

13. Assemble the (22) (33) 'O'-rings in the (1) case.



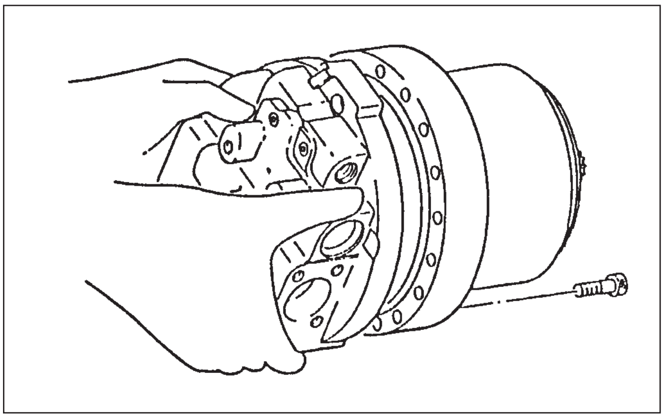
14. Fix the (2-1) base plate on the work bench and assemble the (13) ball bearing, (28) four pins, (18) pin, (5) valve plate and (29) (41) springs.

Note: *Apply grease to the non-sliding areas of the valve plate and base plate.*
Be careful not to damage the sliding area of the valve plate.
To prevent the springs from falling, coat them with grease.



Assembly *(continued)*

15. Fix the (1) case in a vice and assemble the (2-1) base plate to the (1) case and tighten with (20) socket head bolts.



Note: *Coat the sliding surfaces of (4) cylinder block and (5) valve plate with hydraulic oil.*
Be careful not to drop the (5) valve plate.
Align the (28) pin and (1) case pinhole.
Tighten the socket head bolts at the specified torque.
108 ± 10 Nm (11 ± 1.0 kgf/m, 79.5 ±7.2 lb/ft)

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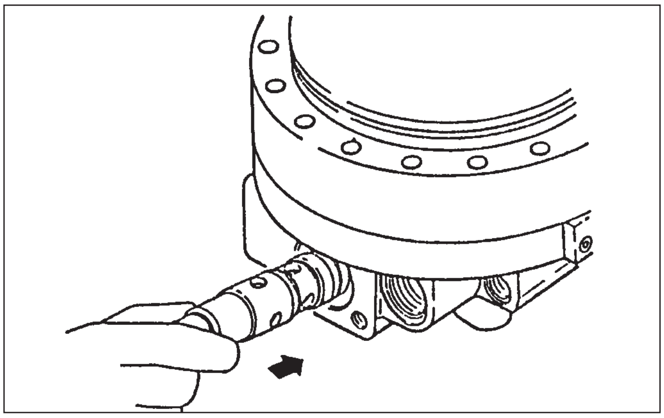
16. Plunger assembly

* **a.** Attach Ø10 mm bar to the Ø11 mm hole of the (2-2-1) plunger and fix with a vice.
Assemble the (2-2-2) check valve and (2-2-3) spring in order.

b. Assemble (2-2-4) plug which has (2-2-5) 'O'-ring attached to it into the (2-2-1) plunger and tighten to the specified tightening torque. 137 ± 10 Nm (14 ± 1.0 kgf/m, 101.2 ± 7.2 lb/ft)

---

* **17.** Assemble the (2-2-1) plunger into the (2-1) base plate.



Note: *Coat the plunger sliding part with hydraulic oil and then assemble it.*
Slowly turn the plunger as you assemble it.
Check that the plunger moves smoothly.

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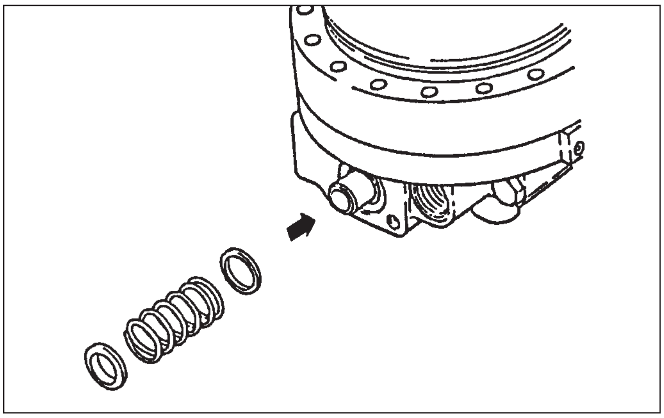
18. Cap Assembly

Assemble the (2-6-3) spring and (2-6-2) piston in order to the (2-6-1) cap.

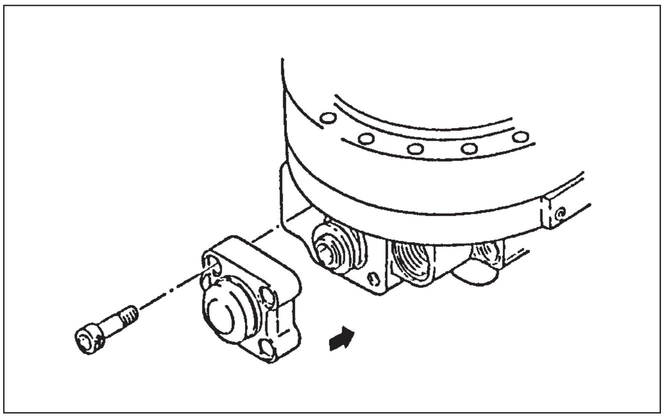
Assembly *(continued)*

19. Assemble the (2-3) spring and (2-5) spring seat in order.

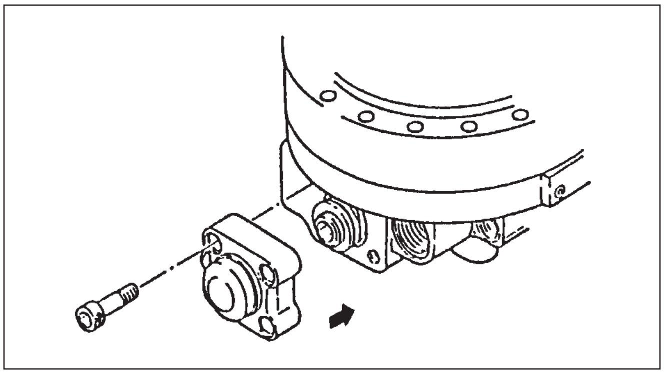


20. Assemble the (2-6-1) cap to the (2-1) base plate and fasten with (2-6-5) socket head bolts.

Note: *Because it is pushed upwards by the spring, press down by hand and tighten the socket head bolts to the specified tightening torque.*
* *108 ± 20 Nm (11 ±2 kgf/m, 79.5 ± 14.75 lb/ft).*



21. Assemble the (2-7) relief valve (S/A) to the (2-1) base plate and tighten to the specified torque. 373 ± 20 Nm (38 ± 2 kgf/m, 274.85 ± 14.47 lb/ft).



22. Assemble the (2-9) valve assembly to the (2-1) base plate.

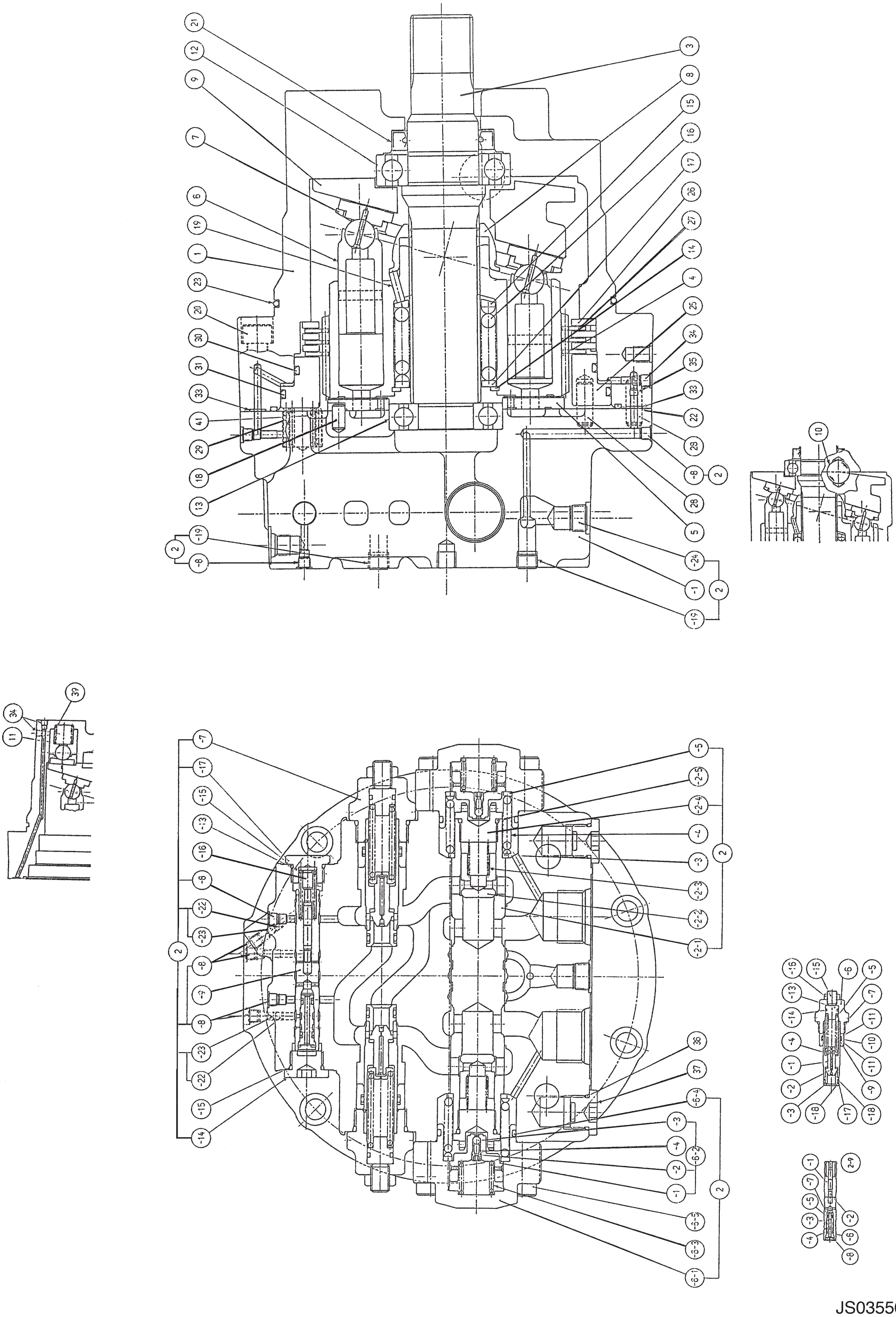
Note: *Take care to assemble the valve in the correct order. If assembled in reverse, the motor may become damaged.*

23. After assembling the (2-14) plug, tighten to the specified torque.
   a. Next, assemble the (2-16) spring guide, (2-13) spring to the (2-17) plug and then assemble it to the (2-1) base plate.

Note: *Tighten (2-17) plug to the specified torque. 118 ± 5.9 Nm (12 ± 0.6 kgf/m, 86.8 ± 4.27 lb/ft).*

24. The motor can now be mated to the gearbox using a new ‘O’ ring in the groove on the motor and using the three socket head screws.

*



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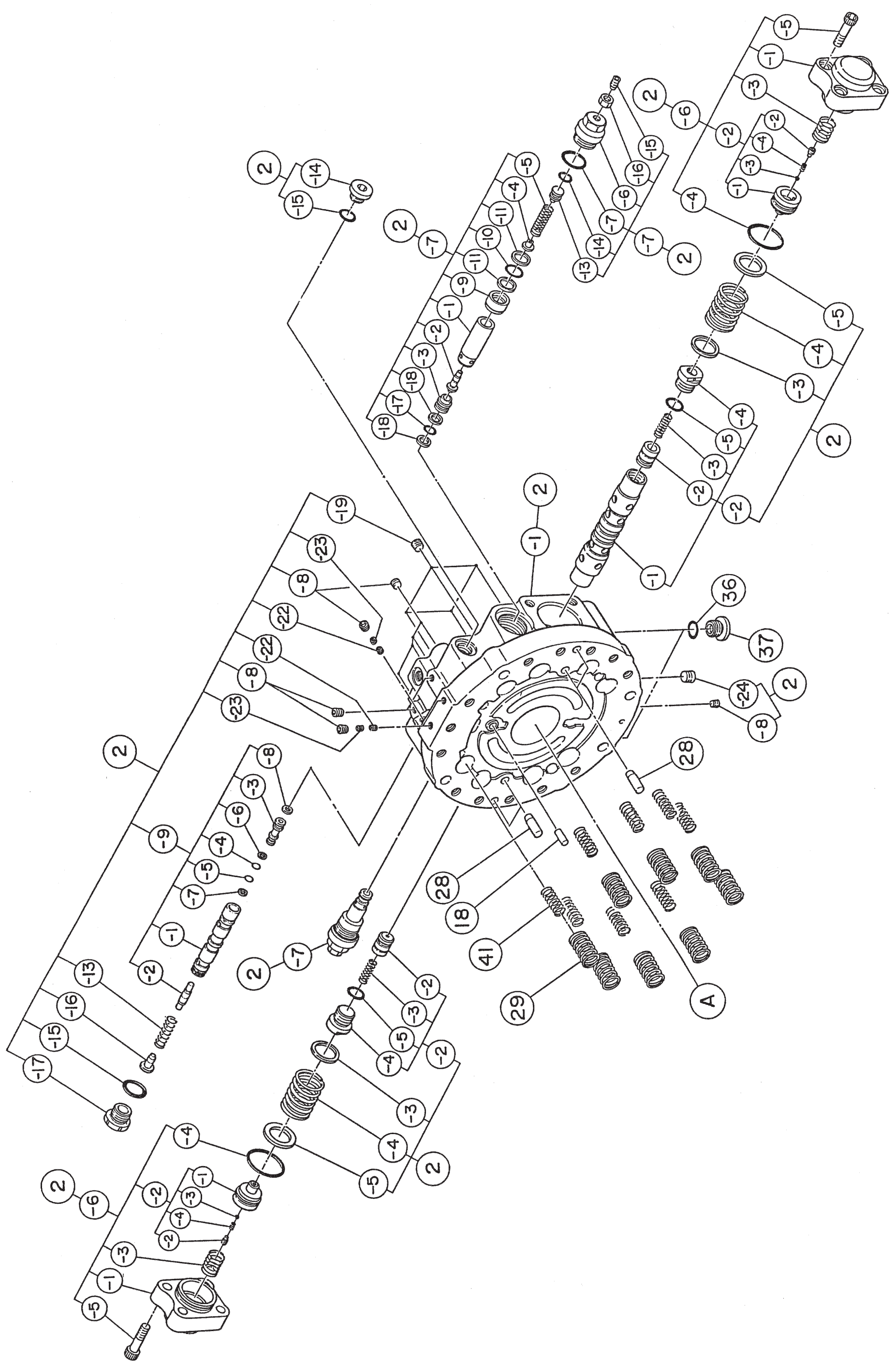


Maintenance Specifications

If the seals are disassembled, replace them even though no damage is observed.

Part Name	Appearance	Standard Value	Allowable Value	Replaceable Part
(6) Piston	**1.** Deeply scarred or rough surface is observed on sliding area.			Cylinder block kit
	2. The clearance to the block bore is excessive.	0.030	0.060	
	3. Backlash is excessive in shoe ball section.	0.15	0.4	
(4) Cylinder Block	**1.** Deeply scarred or rough surface is observed on sliding area.	Roughness 0.2a	No seizure and scar deeper than 0.02mm	Cylinder block kit
	2. The inside of the bore is excessively worn.			*See note 1.* When scar cannot be completely removed, replace.
	3. The engaged tooth is abnormally worn or broken.			
(5) Valve Plate	**1.** Deeply scarred, thermally seized, unevenly worn or rough surface is observed on sliding area.	Roughness 0.2a	0.8a No seizure and scar deeper than 0.02mm	Cylinder block kit *See note 1.* When scar cannot be completely removed, replace.
(7) Retainer Plate (8) Retainer Holder	**1.** Deeply scarred, thermally seized, unevenly worn or rough surface is observed on sliding area.	Roughness 0.2a	0.8a	Retainer plate kit
(9) Swash Plate	***1.** Deeply scarred, thermally seized, unevenly worn or rough surface is observed on sliding area.	Roughness 0.2a	0.8a No seizure and scar deeper than 0.02mm	* Swash plate steel ball *See note 2.* When scar cannot be completely removed, replace.
	***2.** Deeply pitted, thermally seized on the contact area with the steel ball.	* Ball seating depth 14.3	* Ball seating depth 14.5	* Swash plate steel ball *See note 2.* When scar cannot be completely removed, replace.

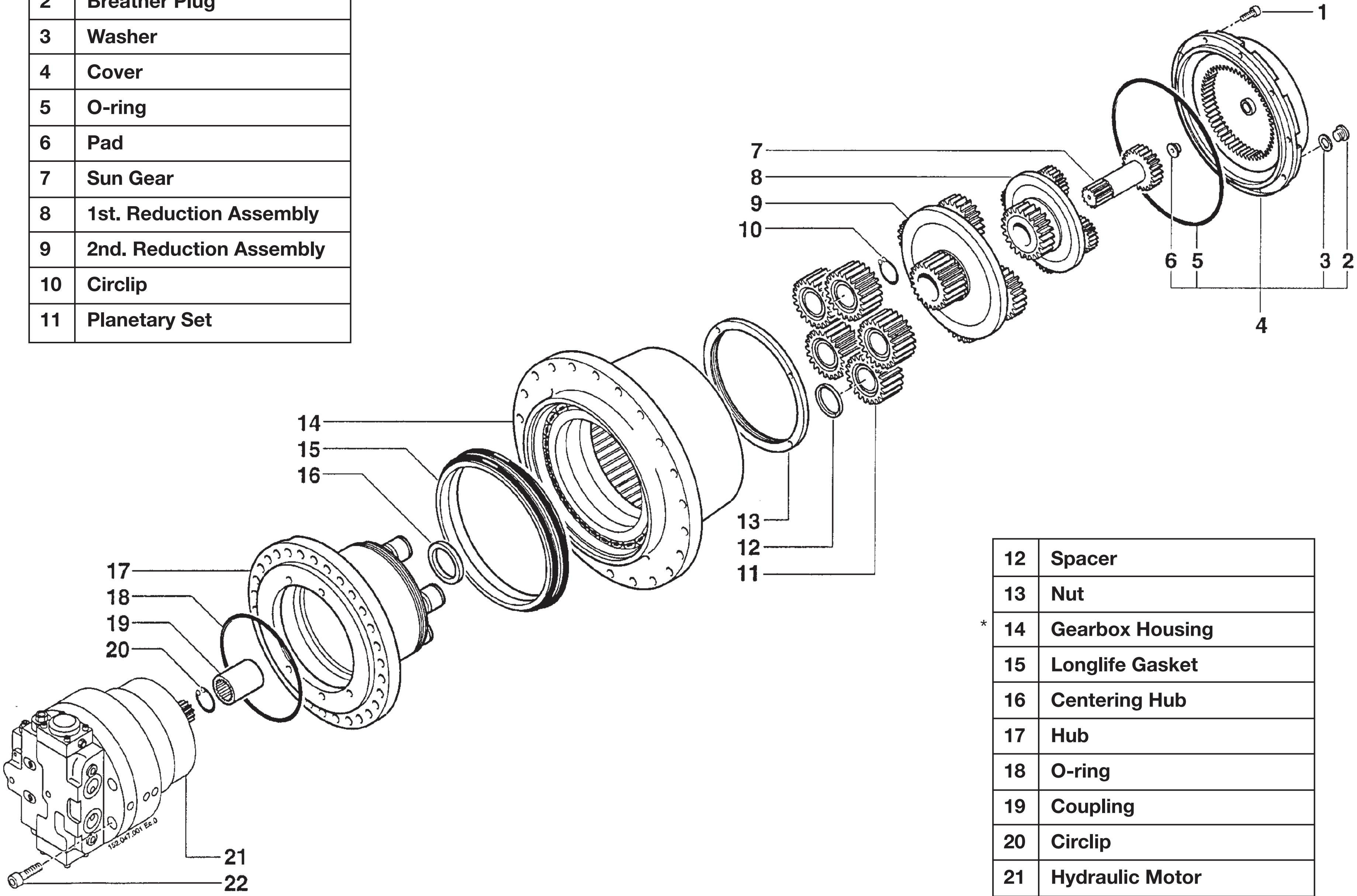
* ***Note 1**. Lap, using very fine grade paste.*

* ***Note 2**. Use very fine grade paste and lap with a steel ball.*

Maintenance Specifications *(continued)*

Part Name	Appearance	Standard Value	Allowable Value	Replaceable Part
(3) Shaft	**1.** Sliding area of the (21) oil seal is deeply scarred or rough surface is observed.			Cylinder block kit
	2. Abnormally worn or broken teeth of the engaged teeth are observed.	0.030	0.060	
(25) Brake piston	**1.** All sliding areas are deeply scarred or rough surface is observed.	0.15	0.4	
(27) Disk plate	**1.** The disk (wear-resistant material) is deeply scarred or has peeling.	Roughness 0.2a	No seizure and scar deeper than 0.02mm	Cylinder block kit
(12) Ball bearing	**1.** Flaking, peeling is observed on the TENSOMEN.			*See note 1.* When scar cannot be completely removed, replace.
(13) Ball bearing	**2.** Pressure mark is observed on the TENSOMEN.			
	3. Abnormal rotation (abnormal sound, roughness, etc.) is observed.	Roughness 0.2a	0.8a No seizure and scar deeper than 0.02mm	Cylinder block kit *See note 1.* When scar cannot be completely removed, replace.
(11) Piston	**1.** All sliding areas are deeply scarred or rough surface is observed.			
	2. Clearance with case is excessive.	* 0.020	* 0.040	
	3. Shoe ball backlash is excessive.	* 0.5	* 1.0	
(10) Steel ball	**1.** Seizure is observed on the contact area with the (9) swash plate.			Swash plate Steel ball

* ***Note 1**. Lap, using very fine grade paste.*



1	Screw
2	Breather Plug
3	Washer
4	Cover
5	O-ring
6	Pad
7	Sun Gear
8	1st. Reduction Assembly
9	2nd. Reduction Assembly
10	Circlip
11	Planetary Set

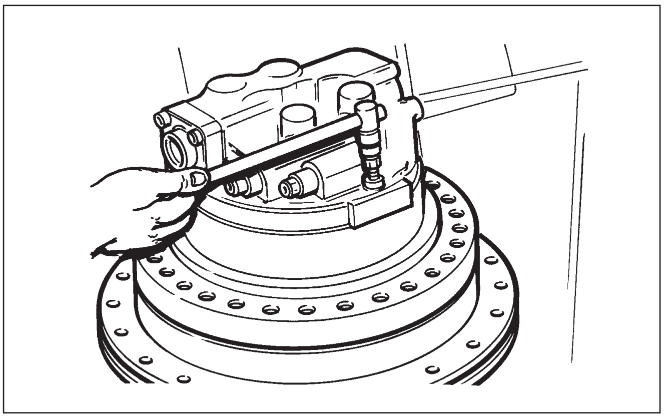
12	Spacer
13	Nut
* 14	Gearbox Housing
15	Longlife Gasket
16	Centering Hub
17	Hub
18	O-ring
19	Coupling
20	Circlip
21	Hydraulic Motor
22	Screw

Dismantling

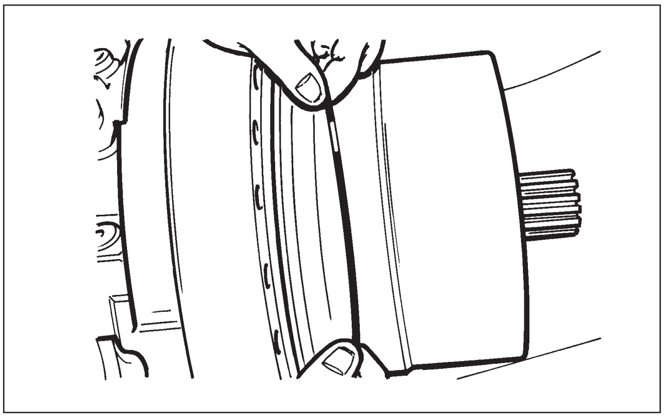
Note: *The numbers in the following section refer to the illustration at the start of this Section. Before starting dismantling drain the oil. (See* ***Routine Maintenance****.) Clean all surfaces with a suitable solvent and dry with compressed air.*

Discard all 'O'-rings and seals which are disturbed during dismantling.

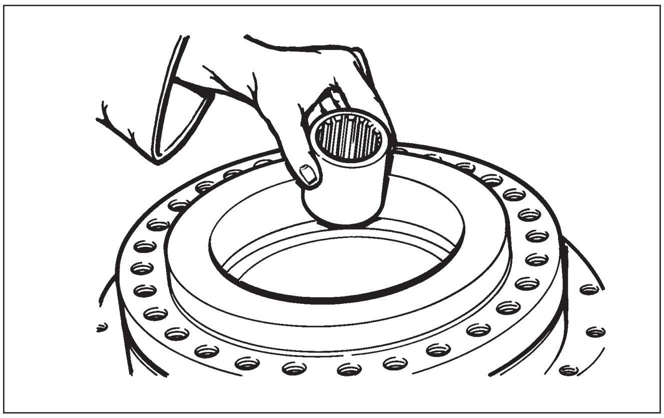
1. Remove the (22) three socket head screws, and remove the hydraulic motor from the gearbox.



2. Remove the (18) 'O'-ring, from its groove on the (21) motor.

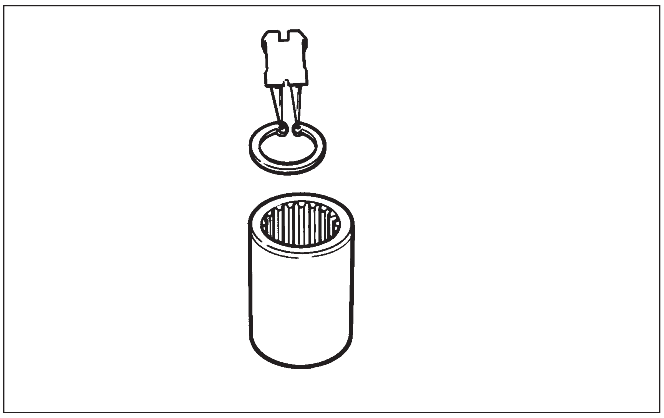


3. Remove the (19) coupling.

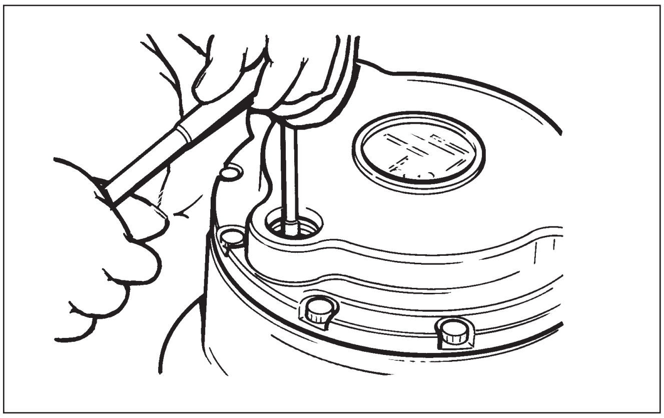


Dismantling *(continued)*

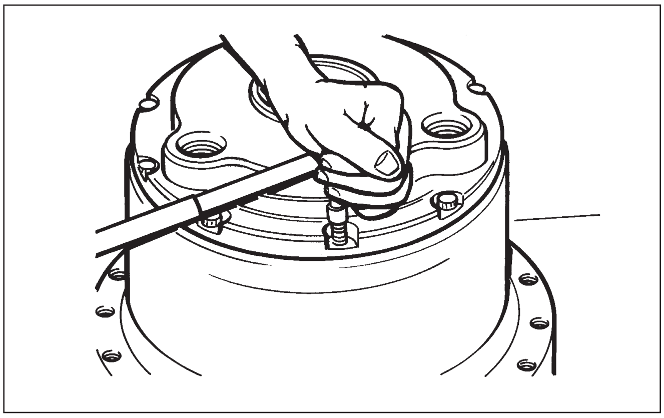
4. Using pliers remove the (20) circlip, from the (19) coupling.



5. Turn the gearbox around, unscrew and remove the (2) two plugs, from the end of the (4) cover.

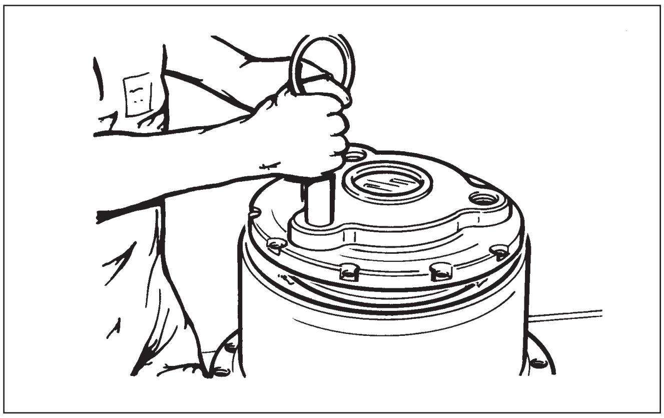


6. Remove the (1) socket head screw.



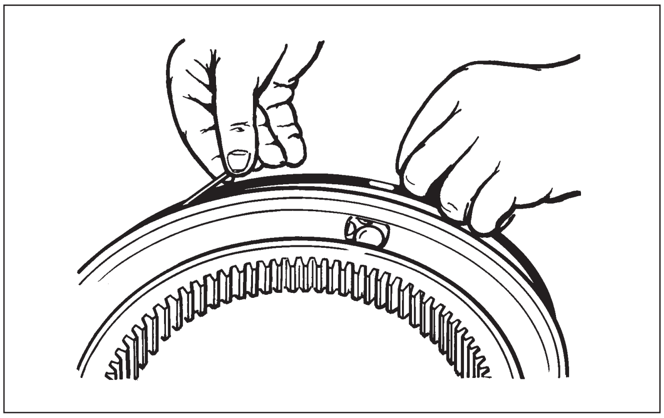
7. Remove the (4) end cover.

Note: *Screws M22 x 1.5 can be inserted in the two open oil plug holes to aid the cover removal.*

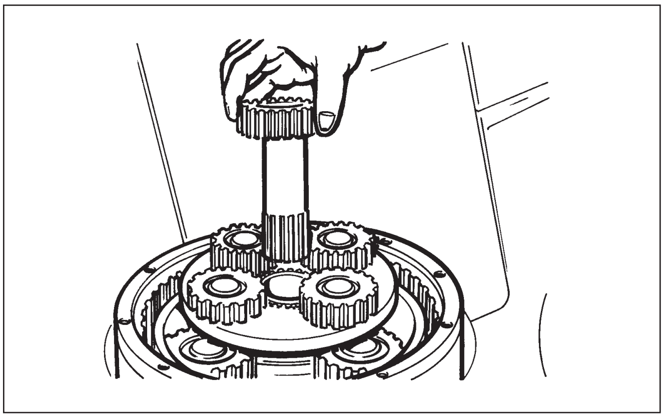


Dismantling *(continued)*

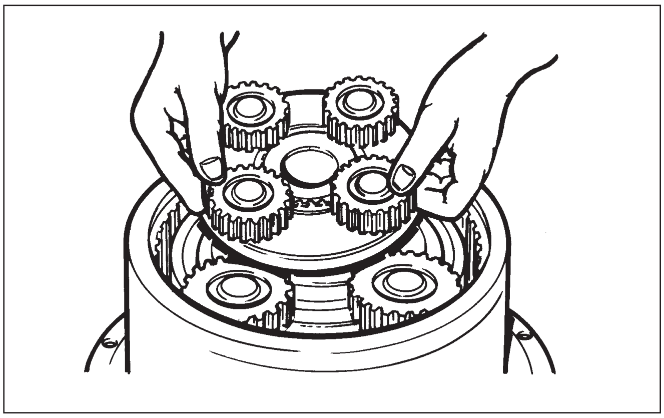
8. Remove the (5) 'O'-ring, from its groove in the (4) end cover.



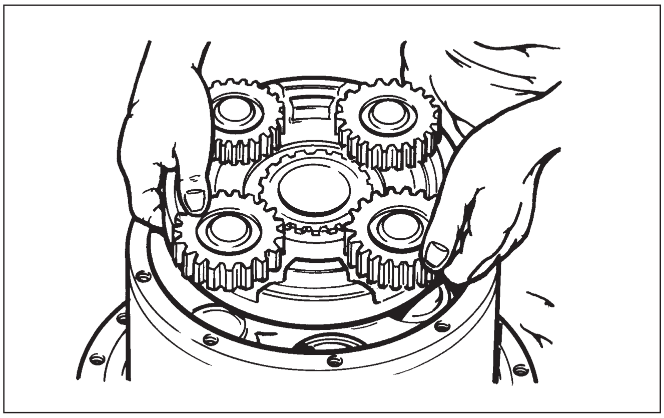
9. Remove the (7) first stage sun gear.



10. Remove the (8) first reduction assembly.

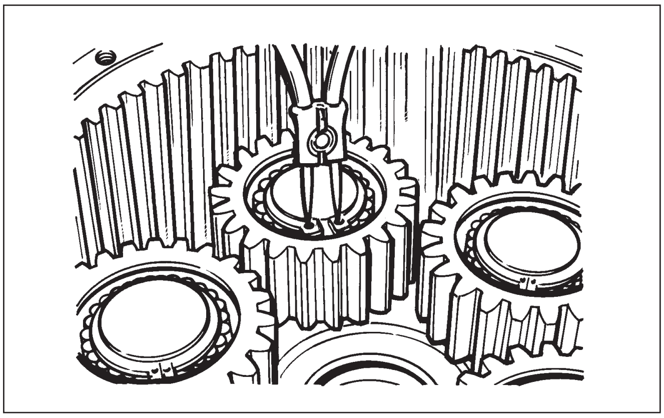


11. Remove the (9) second reduction assembly.

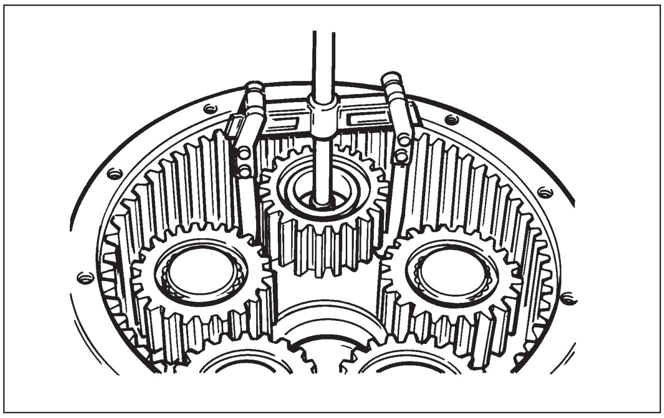


Dismantling *(continued)*

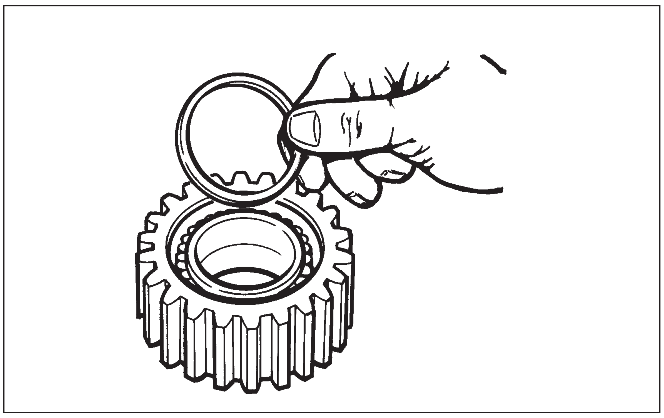
12. Remove the (10) circlip, from the planet assembly of the third reduction assembly.



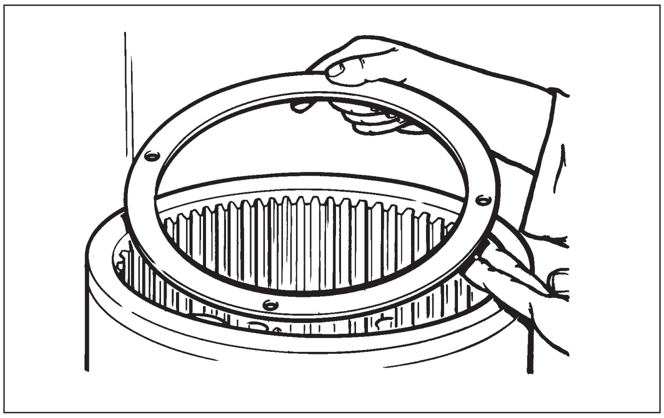
13. Use a puller and remove the (11) five planet gears off the third reduction assembly.



14. Remove the (12) spacers, positioned on the back of the planet gears of the third reduction assembly.



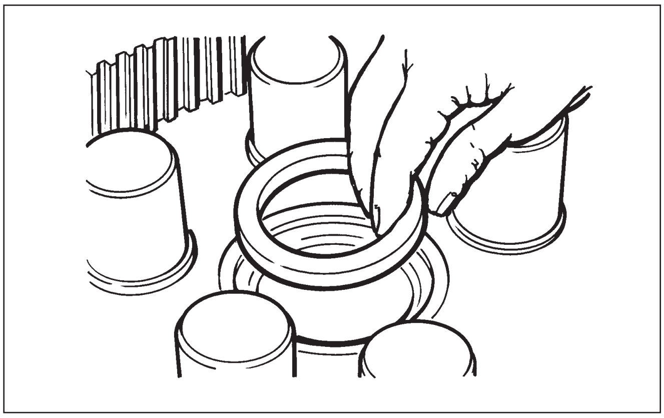
15. Using a punch, remove the deformed section of the (13) ring nut. Use the special tool, unscrew the (13) ring nut.



Dismantling *(continued)*

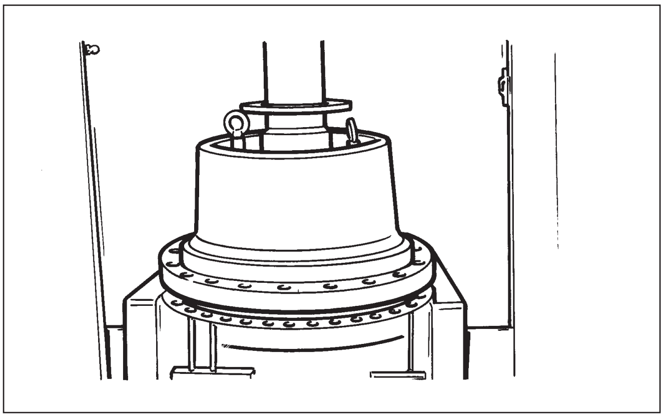
16. Remove the (16) centering ring, from the (17) flanged hub.

Note: *This operation must be carried out only when the hub is to be replaced.*

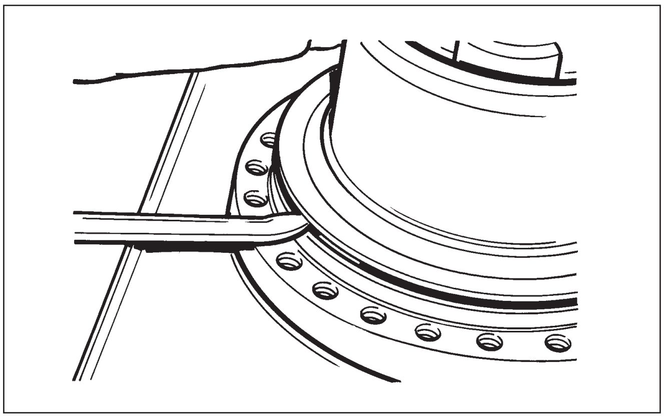


17. Using a press and a drift, remove the (17) flanged hub, from the (14) gearbox housing.

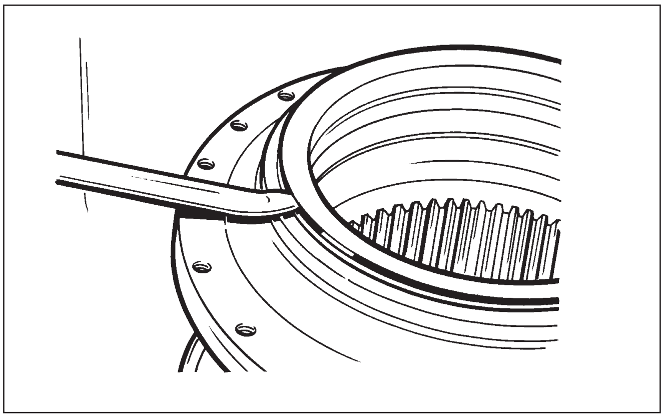
Note: *To prevent oil leaks it is advisable to replace the lifetime seals, (both the metal ring and 'O'-rings) at this time. Seal replacement can only be done with the gearbox removed from the machine.*



18. Remove the (15) half seal, from the (17) flanged hub.



19. Remove the (15) half seals, from the (14) gearbox housing.



Assembly

Assembly is a reversal of the Dismantling procedure.

Note:

1. *Exchange or repair all parts that are found to be damaged. In the case of a damaged planet gear, do not replace the single gear but the whole reduction stage.*

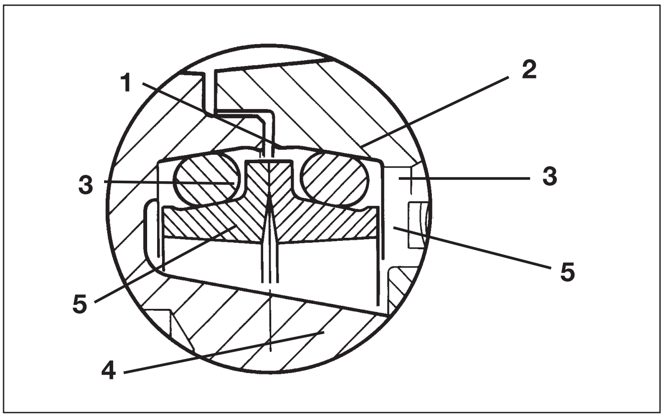
2. *Ensure that all the parts are cleaned in the appropriate solvent and dried with compressed air.*

3. *Apply a thin film of hydraulic fluid to all sliding parts, bearings and other contact surfaces before assembly.*

4. *Replace all O-rings and seals and thoroughly clean the grooves that they sit in. Cover the O-rings and seals with petroleum jelly.*

Half Seal Installation

The half seals used in re-assembly require a specific technique to install. Follow the instructions detailed below.



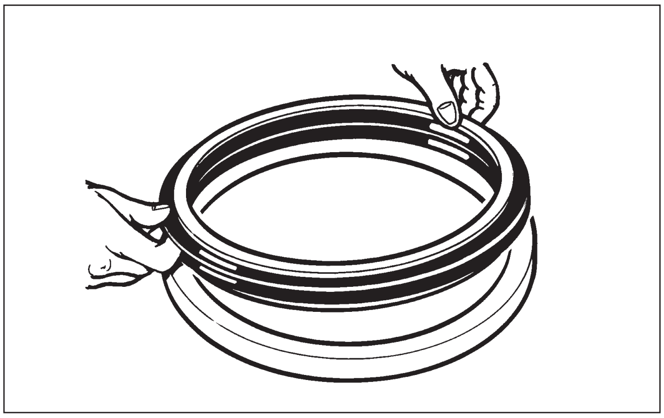
A. Carefully clean the seats **1** and **2** using a small wire brush or solvent. The surfaces in contact with the O-ring **3** must be perfectly clean and dry.

B. Make sure that the sealing surfaces **4** of the metal rings are free from scratches and abrasions and foreign substances and are clean and dry.

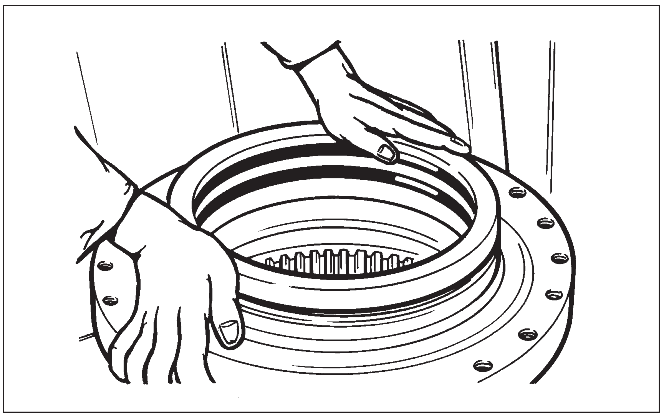
C. Carefully clean the contact surface of the metal rings **5** and remove dust and fingerprints. Lubricate them with a thin film of oil. Take care not to oil the other components.

Assembly *(continued)*

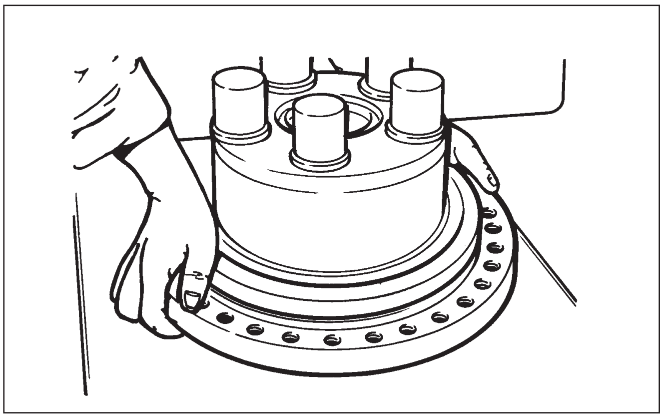
1. Fit a (15) half seal, on the tool.



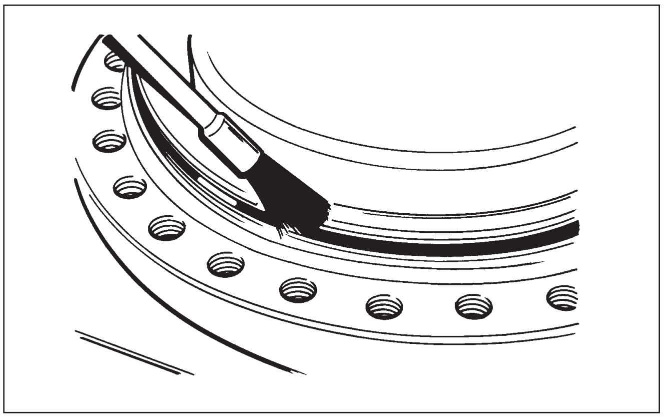
2. Fit the (15) half seal, inside the (14) gearbox housing.



3. Assemble, by using the same tool, the (15) half seal, on the (17) flanged hub.
Carefully clean the metal faces of the half seals.

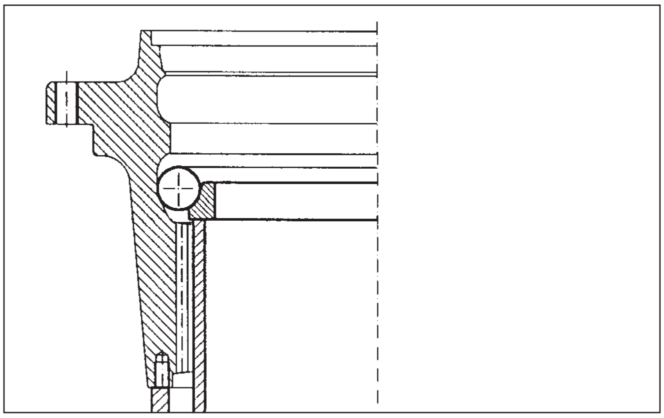


4. Lubricate the metallic face of the half seal with a thin film of oil.

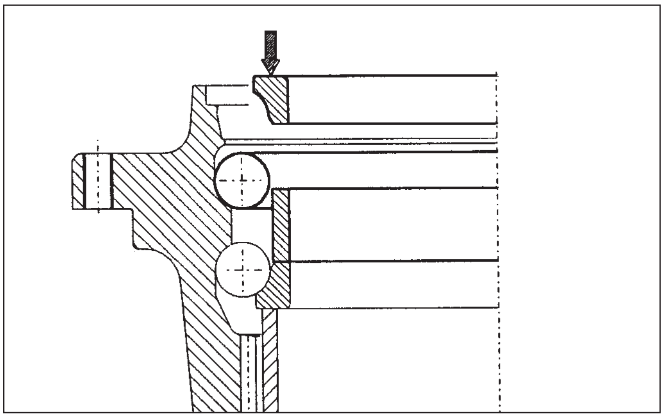


Assembly *(continued)*

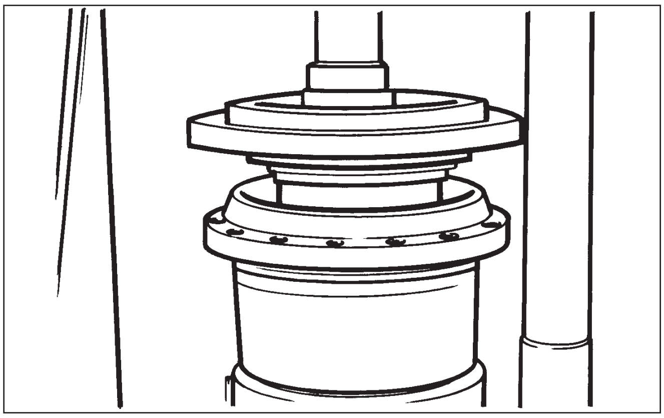
5. Fit the lower ball bearing sets in the housing, holding the inner raceway in position with the spacer tools **S1** and **S2**.



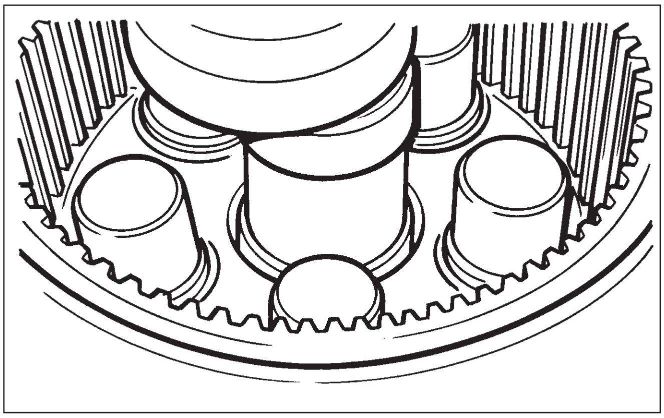
6. Place the bearing spacer into position and drop the upper ball bearing sets into position. Then fit the inner race.



7. Place the (17) flanged hub, inside the (14) gearbox housing.
Using a press and a metal drift, push the (17) flanged hub, against the shoulder on the (14) gearbox housing, until it is seated.

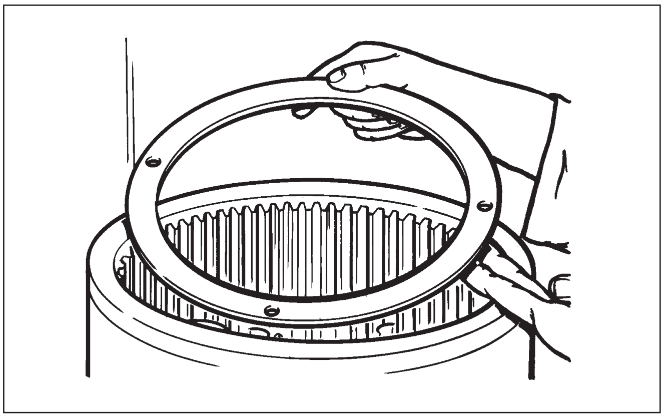


8. By using a press and a drift, assemble the (16) centering ring onto the (17) flanged hub.

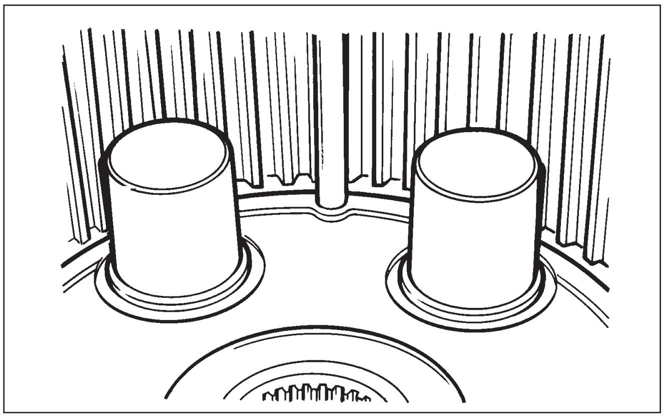


Assembly *(continued)*

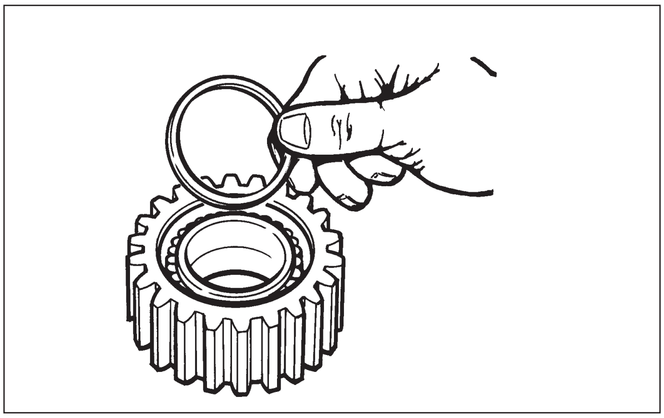
9. Using the special tool screw a new (13) ring nut.



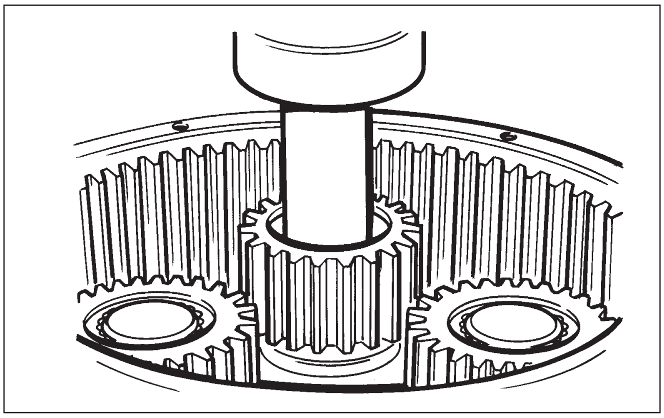
10. Deform the (13) ring nut, at a position next to a space on the (17) flanged hub.



11. Place the (12) spacers, on the back of the planet gears of the third reduction assembly.

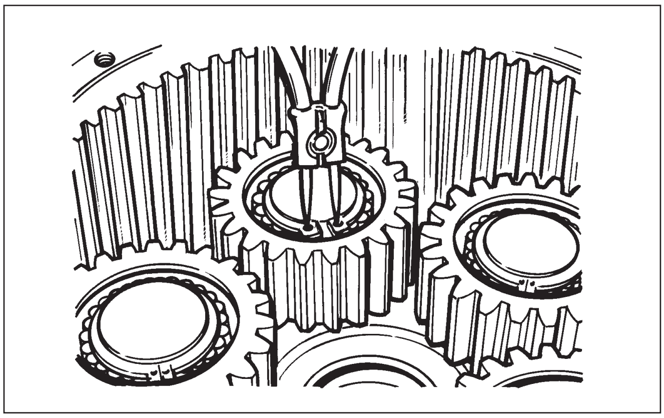


12. Place the (11) five planet gears of the third reduction assembly onto the (17) flanged hub.
Using a press, push on the special tool until assembly of the (11) five planet gears onto the (17) flanged hub is complete.

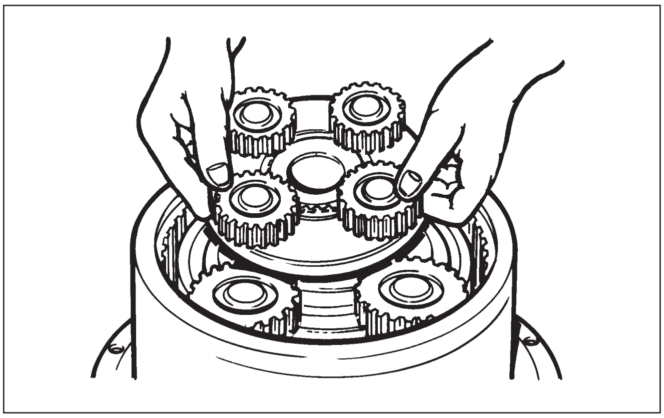


Assembly *(continued)*

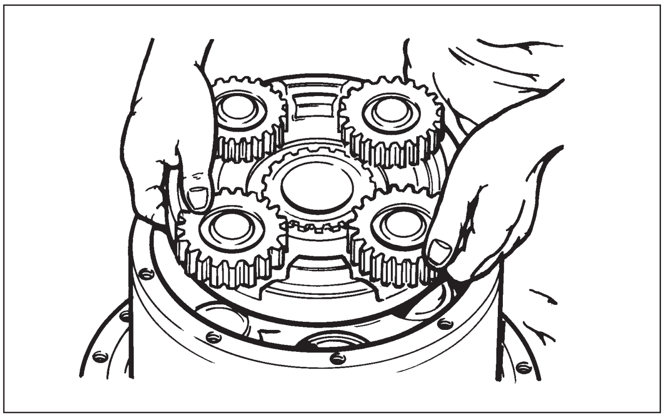
13. Using circlip pliers, place the (10) circlip, into its groove.



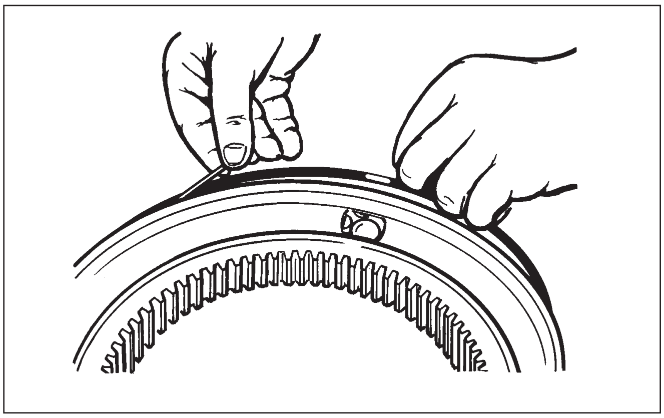
14. Insert the (9) second reduction assembly.



15. Insert the (8) first reduction assembly.

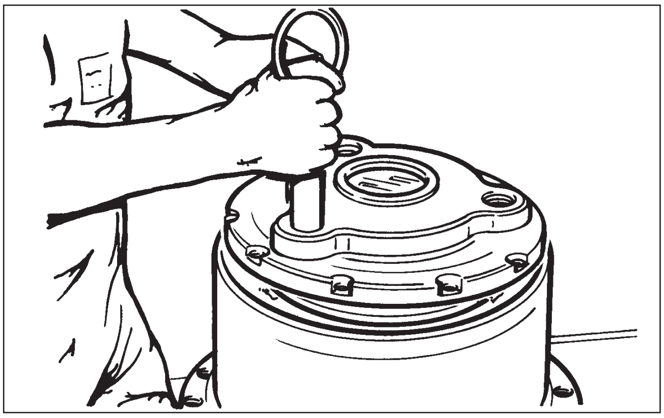


16. Position the (5) O-ring, into its groove in the (4) end cover.

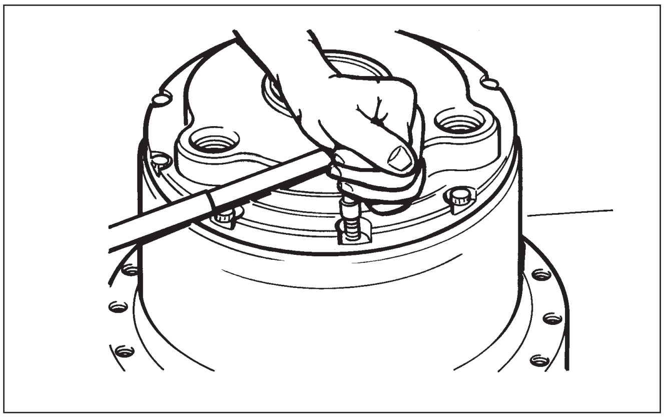


Assembly *(continued)*

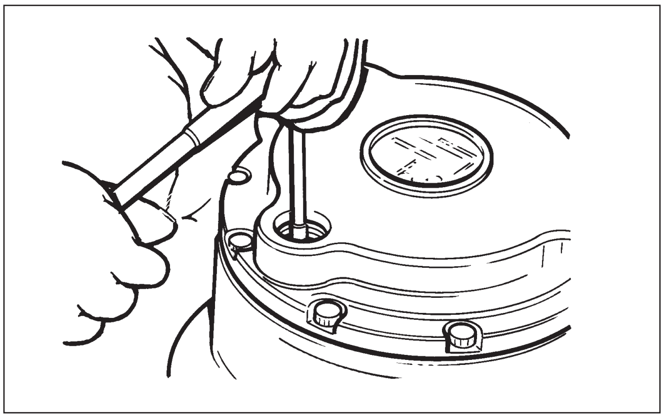
17. Fit the (4) end cover, on the (14) gearbox housing.



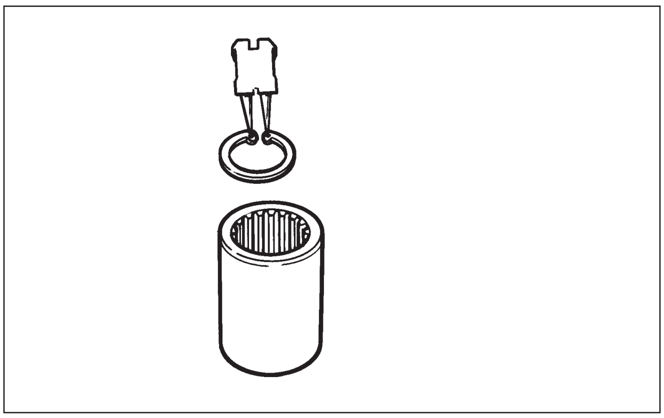
18. Fix the (4) end cover, with the (1) socket screws.



19. Tighten the two plugs, **Item 2**.

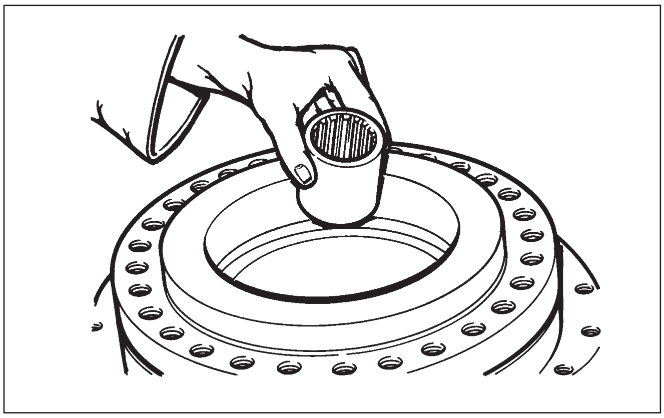


20. Rotate the gearbox and by means of circlip pliers, place the (20) circlip, into its groove inside the (19) coupling.

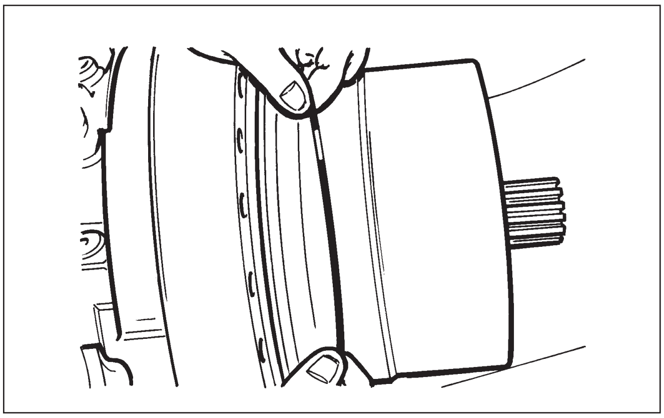


Assembly *(continued)*

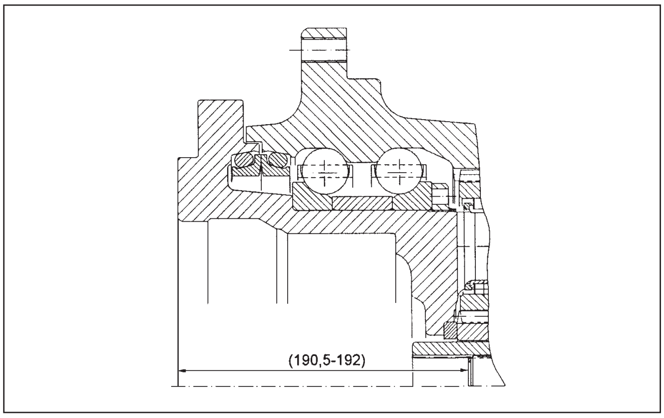
21. Insert the (19) coupling.



22. Fit the (18) O-ring into the groove on the (21) hydraulic motor.

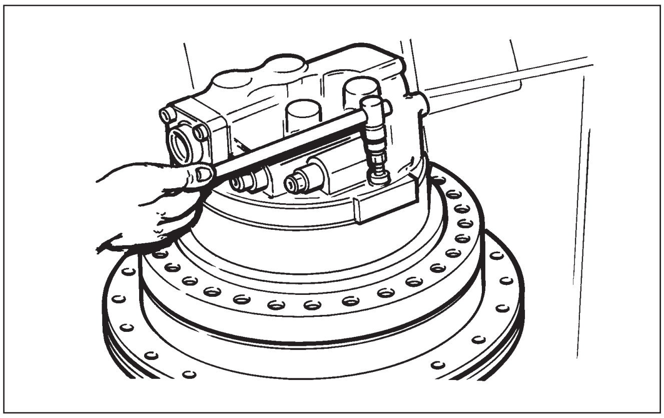


23. After mounting the (17) hub into the (14) bearing assembly, check the axial dimension of the gearbox determined by the input side shoulder of the (17) hub, with the (20) circlip, inside the (19) coupling.



24. Position the (21) hydraulic motor into the gearbox and secure the (22) socket screws.

The gearbox should now be filled with the correct amount and grade of oil. *See **Lubricants and Capacities***. The assembly is now complete.



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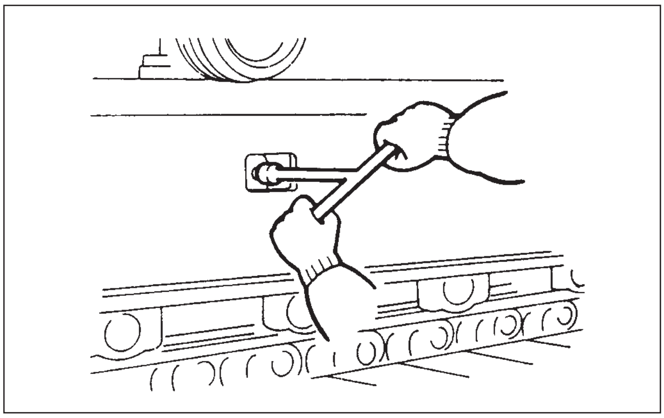
Torque Specifications JS200/JS240

Component	Nm	kgfm	lb/ft	Remarks
Drive sprocket fastening bolts	267-312	27.2-31.8	196.65-229.91	Apply 262
* Idler wheel installation bolts	267-312	27.2-31.8	196.65-229.91	Apply 262
* Top roller installation bolts	521-608	53.1-62	383.91-448.26	Apply 262
* Bottom roller installation bolts	371-432	37.8-44.1	273.29-318.84	Apply 262
* Recoil unit installation bolts	380-443	38.7-45.2	279.8-326.79	Apply 262
Track shoe bolt	775.1-931.6	77-95	556.71-686.85	Apply 262

Note: *Install the drive sprocket with the chamfer to the body side.*

Removal

1. Slacken the check valve to bleed out grease.

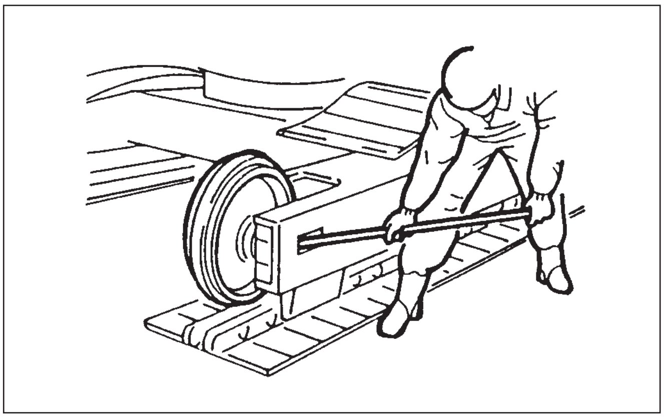


WARNING

When opening the check valve always stand to one side and loosen a little at a time until grease starts to come out. If you over-loosen too much grease could spurt out or the valve cover fly out and cause serious injury.

8-3-4-5

* **2.** Disconnect the track link *(see **Track Motor/Reduction Gearbox**, **Removal and Replacement**, Section F)*. Move the idler wheel and recoil assembly to the end of the undercarriage using a bar.

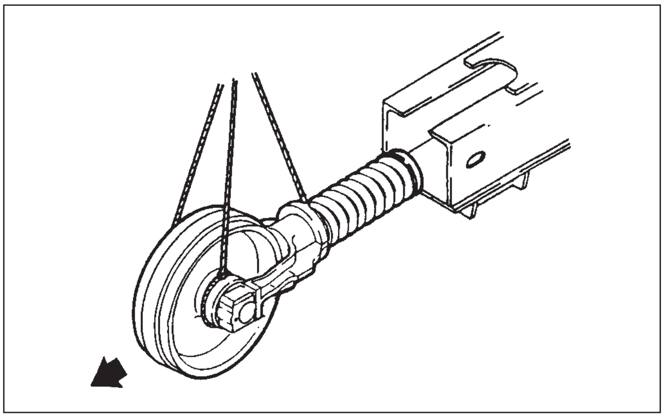


WARNING

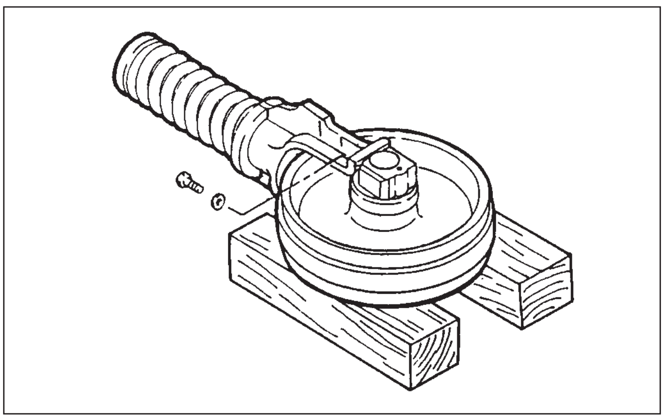
Stand clear and to one side of the track while you remove the master pin. When the master pin is removed the track could fall forward and injure you.

TRACK 1-1

3. Fasten a sling around the idler wheel and recoil assembly and remove it from the undercarriage.



4. Remove the bolts and remove the idler wheel from the recoil unit.



WARNING

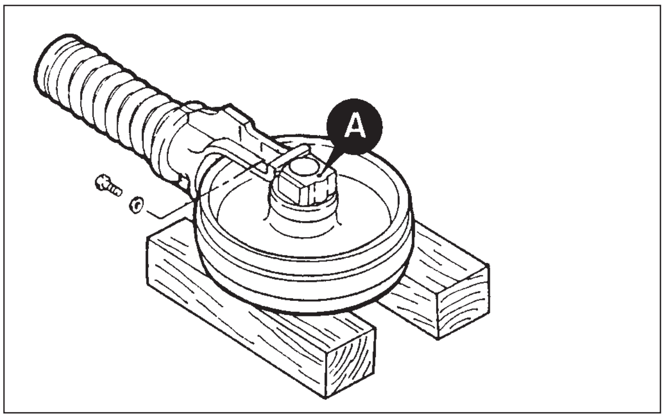
RECOIL UNITS ARE DANGEROUS. They must not be dismantled without using suitable tools to compress the spring safely. The spring pressure can cause serious injury if suddenly released. Scrap units must be made harmless by compressing the spring in a hydraulic press and cutting through the end of the shaft before slowly releasing the pressure.

TRACK 1-10

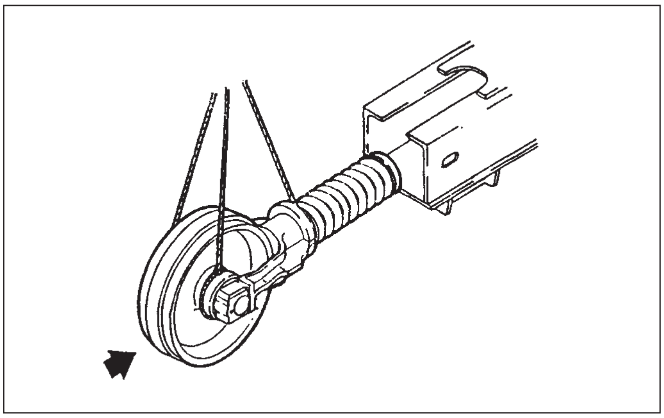
* ***Note:*** *see **Removal, Grease Cylinder**, for Recoil Spring*
* *dismantling details.*

Replacement

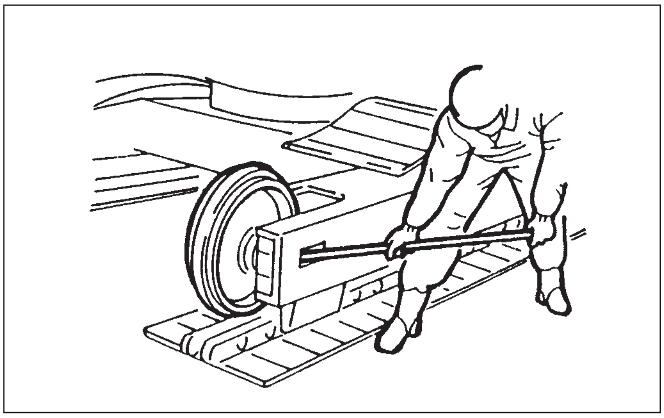
1. Before fitting the idler wheel, check the oil level at **A**. If required, top up with the specified oil *(see section 3)*. Assemble the idler wheel to the recoil unit and fit the mounting bolts.



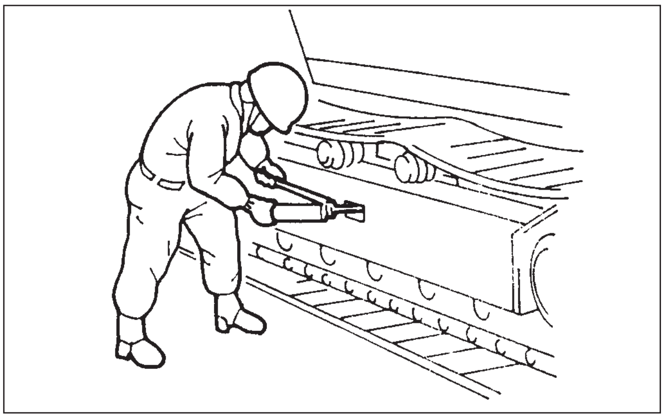
2. Fasten a sling around the idler wheel and recoil assembly and enter it into the undercarriage.



3. Position the idler wheel in the undercarriage using a bar.

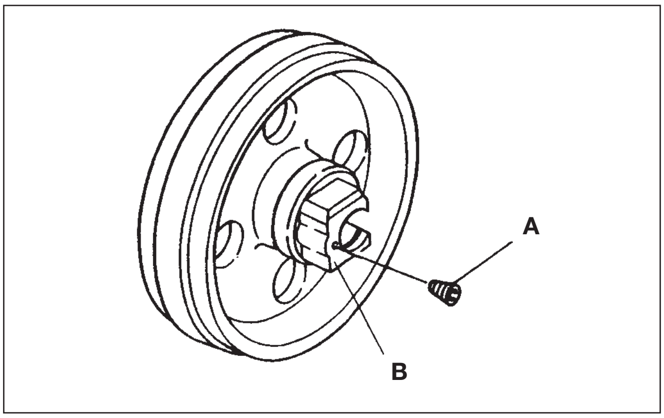


* **4.** Connect the track link *(see **Track Motor/Reduction Gearbox**, **Removal and Replacement**, Section F).*

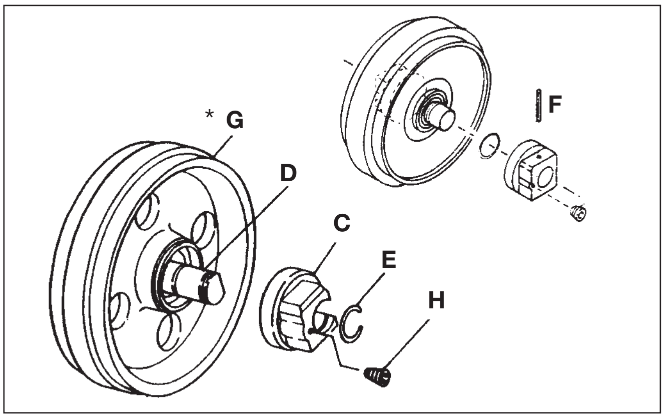


Dismantling

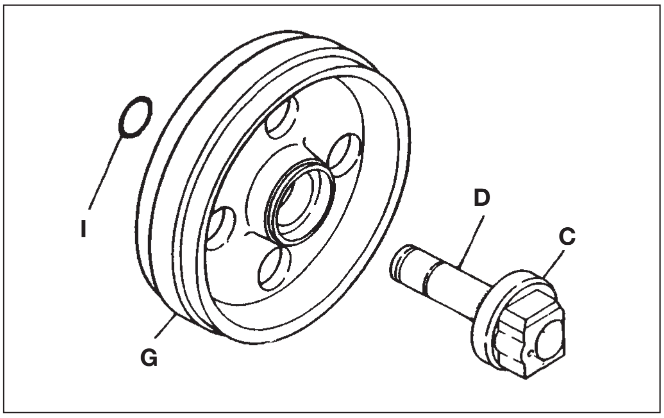
1. Clean the idler wheel with a suitable solvent. Remove the plug **A** from hub **B** and drain the oil.



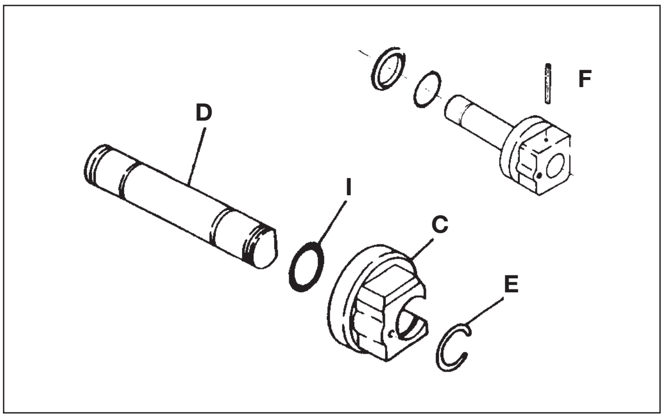
2. On one side of the unit only, remove the wire clip **E** or roll pin **F** and separate the hub **C** from shaft **D**.



3. Remove 'O'-ring **I** from shaft **D**. Pull out the shaft **D** from the idler wheel **G**.

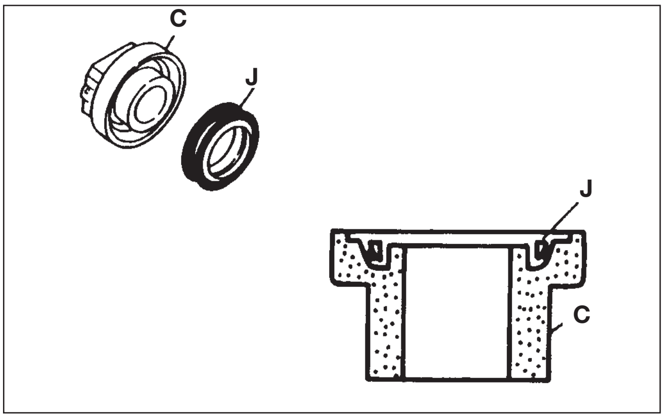


4. Remove the wire clip **E** or roll pin **F** and separate hub **C** from shaft **D**. Remove 'O'-ring **I** from shaft **D**.**3. Remove 'O'-ring I from shaft D. Pull out the shaft D from the idler wheel G.4. Remove the wire clip E or roll pin F and separate hub C from shaft D. Remove 'O'-ring I from shaft D.**

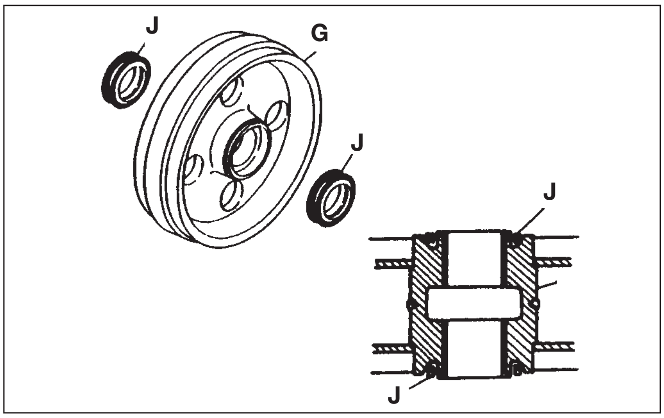


Dismantling *(continued)*

5. Remove floating seal **J** from each hub **C** using a pry bar.

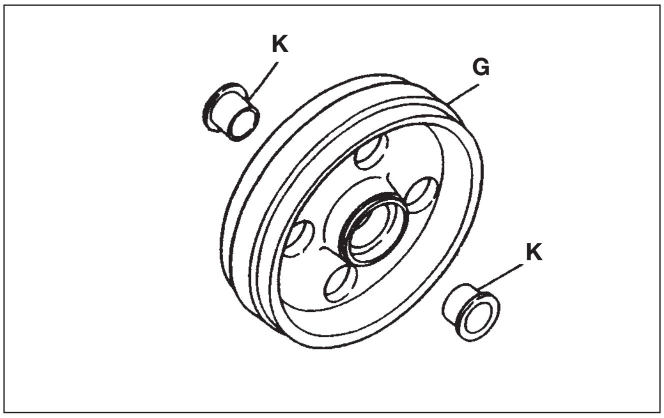


6. Remove floating seal **J** from each side of idler wheel **G** using a pry bar.



7. If badly worn or damaged, remove the bushes **K** from idler wheel **G** using a press or puller.

Protect parts from moisture and dust if left dismantled for some time.

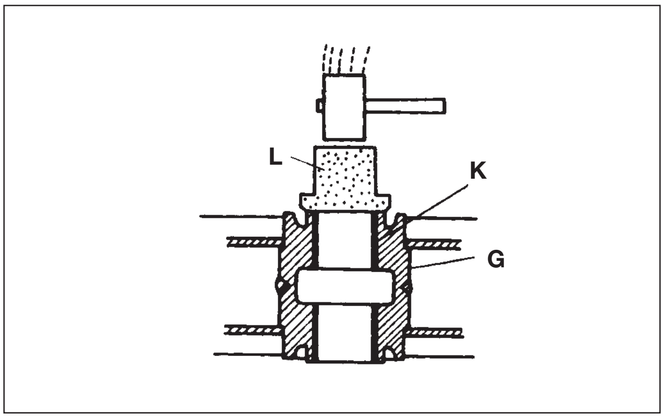


Assembly

1. Clean all parts thoroughly in a suitable solvent. Dry shaft and bore of idler wheel using compressed air in a place free of dust and moisture.

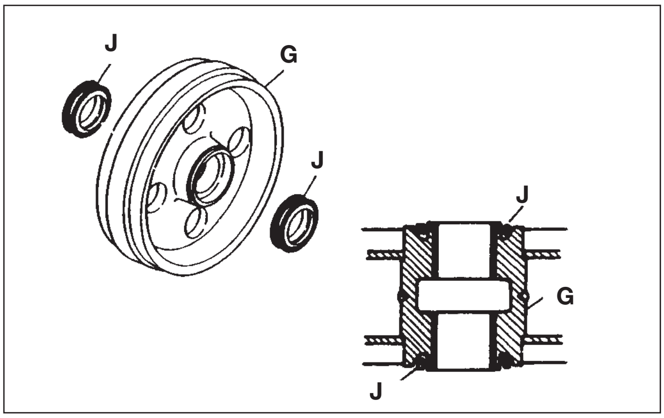
Check components for wear as detailed under **Wear Limits**. Polish out scratches and roughness using an oil stone. Then apply a coat of engine oil to all parts.

Carefully drive the new bushes **K** into the idler wheel **G**, using a suitable dolly **L**.

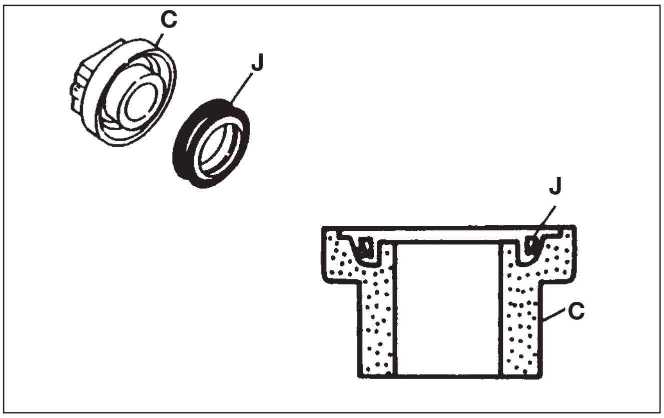


Assembly *(continued)*

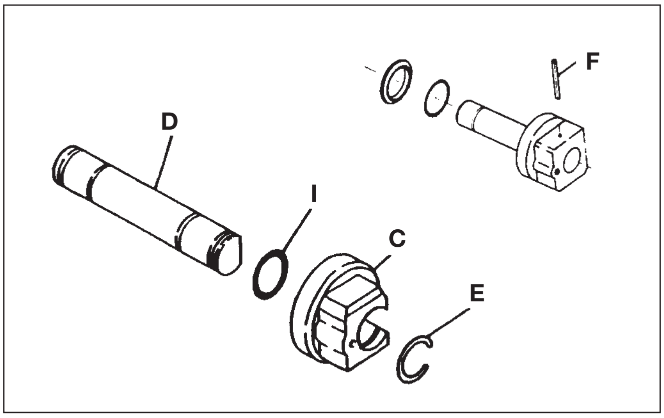
2. Apply a coating of grease and install a new floating seal **J** into each side of the idler wheel **G**.



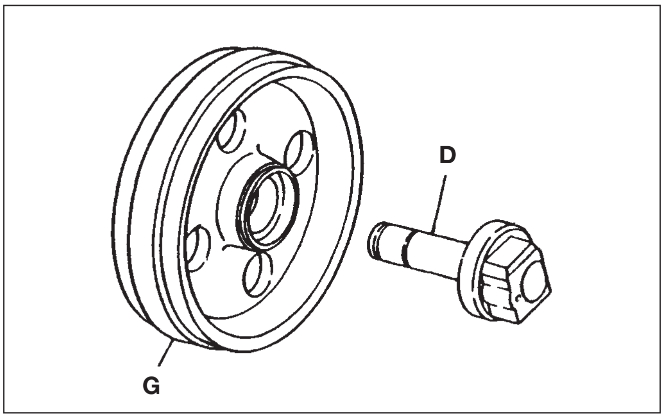
3. Apply a coating of grease and install a new floating seal **J** into hub **C**.



4. Grease a new 'O'-ring **I** and install on one end only of shaft **D**. Install shaft **D** into hub **C**. Fit new wire clip **E** or roll pin **F**.



5. Coat shaft **D** with grease. Clean the metallic face of the seal, coat the metallic face with engine oil and insert the shaft into the idler wheel **G**.

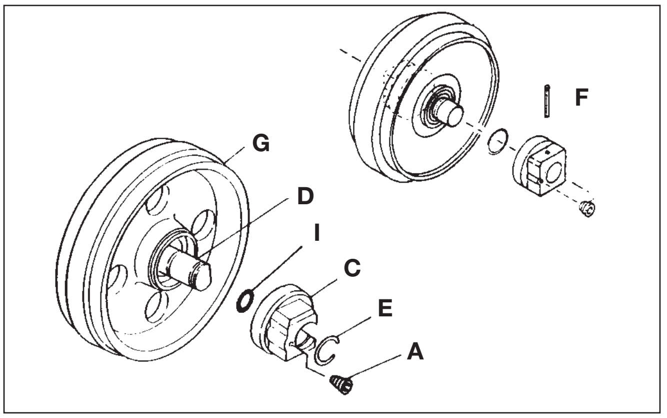


Assembly *(continued)*

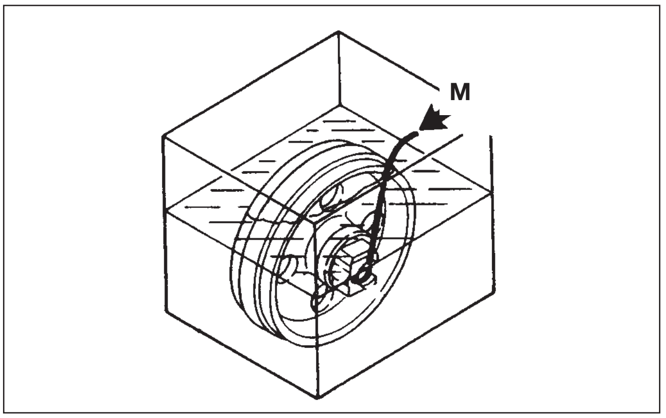
6. Apply grease to a new 'O'-ring **I** and install it on the shaft **D**.

Clean the metallic face of the seal, coat the metallic face with engine oil and install the hub **C** onto the shaft **D**. Fit new wire clip **E** or roll pin **F**.

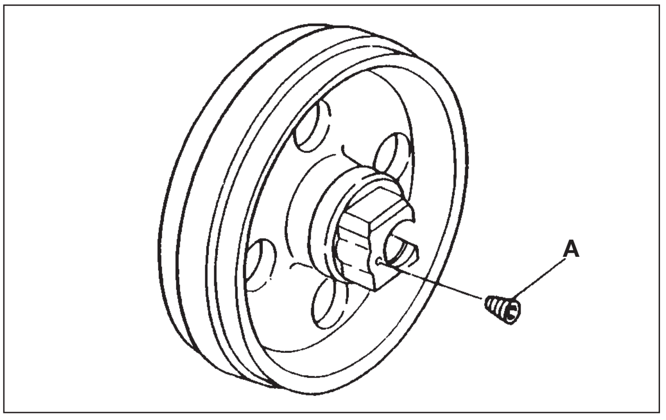
Wrap sealing tape around the plug **A** with one thread remaining uncovered. Insert this plug but leave the other one out until after testing.



7. Using extreme care to prevent water entering the assembly, lower it into a tank of water. Connect compressed air at **M** and apply pressure of 1.9 bar (28 lbf/in^2). Check for air bubbles.



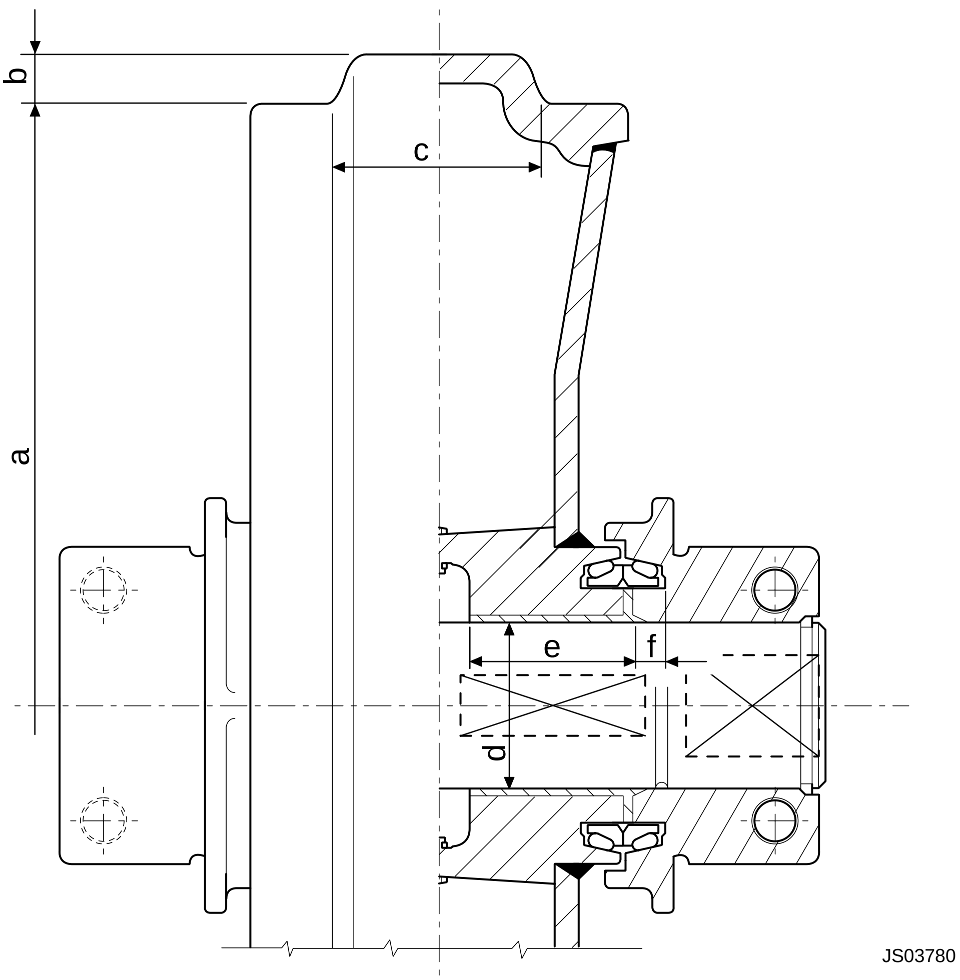
8. Remove the assembly from the tank. Dry with compressed air. Add the specified oil *(see Section 3)*. Install plug using an appropriate pipe sealant.



Wear Limits

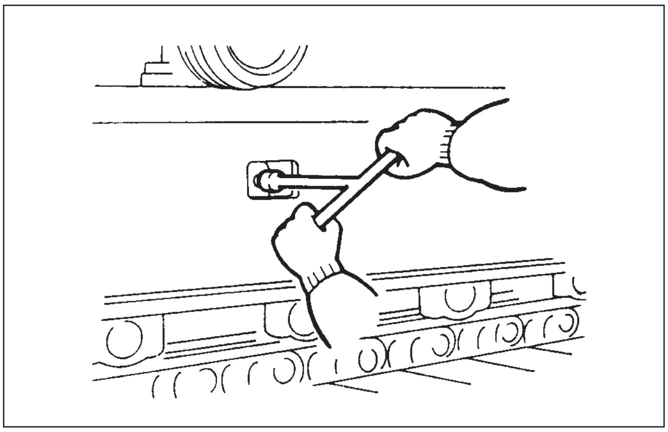
Item	Dimension	Machine	Standard Size mm	Standard Size in	Service Limit mm	Service Limit in	Action
Wheel Diameter	a	JS200 JS240	494	* 19.4	490	19.29	Build up or renew
	b	JS200 JS240	21	* 0.8			Build up or renew
Wheel Width	c	JS200 JS240	84	3.3	80	3.14	Build up or renew
Shaft Diameter	d	JS200	65	2.55	64.5	2.53	
	d	JS200	70	2.75	69.5	2.73	
Bush Bore	d	JS200	65	2.55	65.0	2.59	Renew
	d	JS200	70	2.75	70.8	2.78	Renew
Length over Bush/Seal	e	JS200	69	2.71	68.6	2.7	Renew
	e	JS240	74	2.91	73.6	2.89	Renew
Hub	f	JS200	12.4	.48	11.9	.46	Renew
	f	JS240	15.9	.62	15.4	.60	Renew

*



Removal

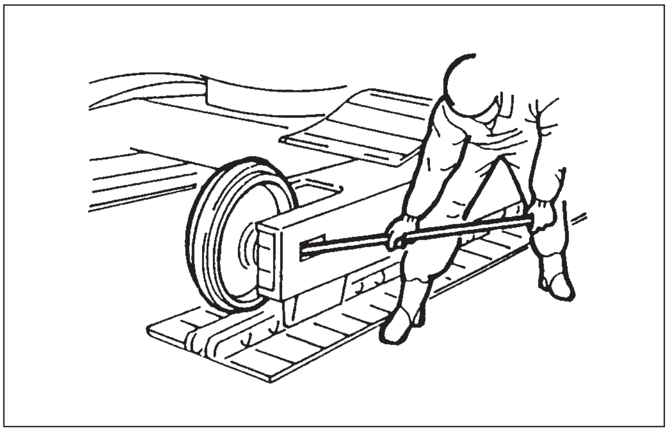
1. Slacken the check valve to bleed out grease.



WARNING

When opening the check valve always stand to one side and loosen a little at a time until grease starts to come out. If you over-loosen too much grease could spurt out or the valve cover fly out and cause serious injury.
8-3-4-5

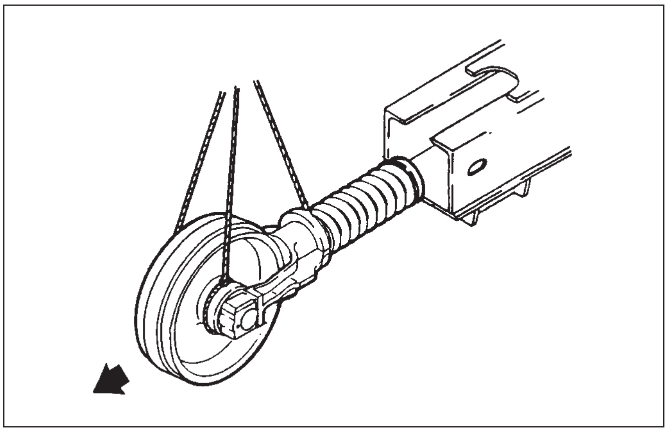
* **2.** Disconnect the track link *(see **Track Motor/Reduction Gearbox**, **Removal and Replacement**, Section F)*. Move the idler wheel and recoil assembly to the end of the undercarriage using a bar.



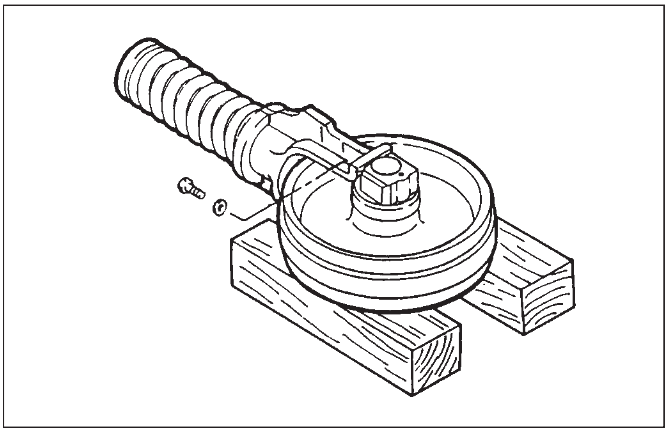
WARNING

Stand clear and to one side of the track while you remove the master pin. When the master pin is removed the track could fall forward and injure you.
TRACK 1-1

3. Fasten a sling around the idler wheel and recoil assembly and remove it from the undercarriage.



4. Remove the bolts and remove the idler wheel from the recoil unit.



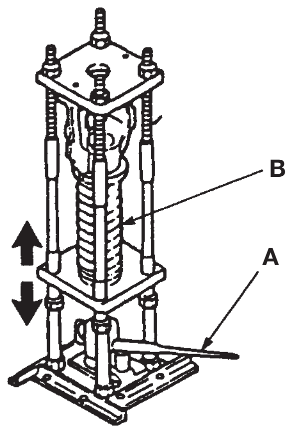
Removal *(continued)*

* **⚠ WARNING**

RECOIL UNITS ARE DANGEROUS. They must not be dismantled without using suitable tools to compress the spring safely. The spring pressure can cause serious injury if suddenly released. Scrap units must be made harmless by compressing the spring in a hydraulic press and cutting through the end of the shaft before slowly releasing the pressure.

TRACK 1-10

* ***Note:*** *If it becomes necessary to dismantle the recoil spring assembly, the following procedure should be used.*



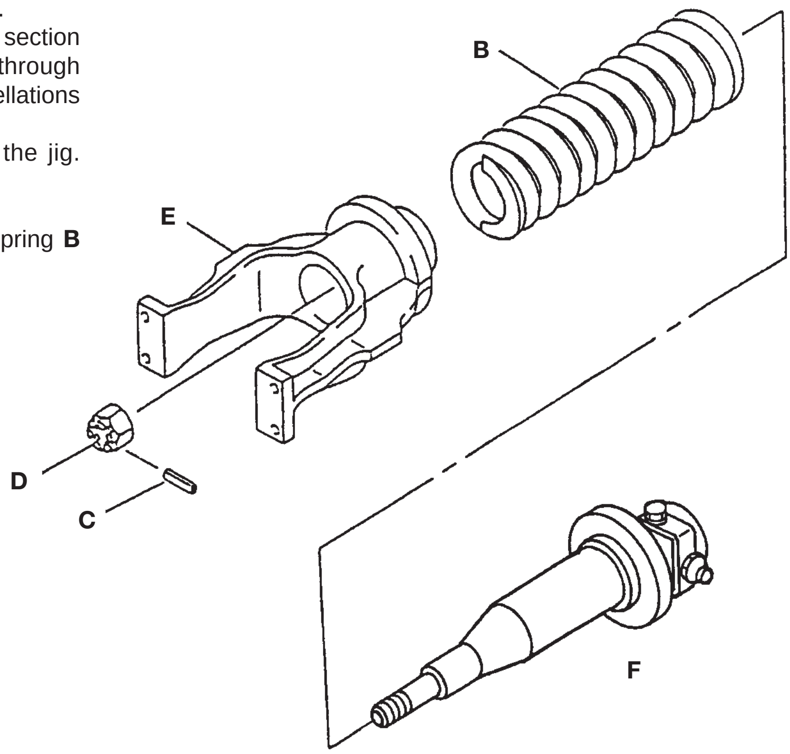
5. Prepare the jig for Recoil Spring Disassembly.
Place the re-coil spring unit as shown.
Jack up the hydraulic jack **A** and compress the Recoil Spring **B**.

6. Remove the Recoil Spring.
* Pull out the Spring Pin **C** and remove the castellated nut **D**. Let the jack **A** down to relieve the pressure on the recoil spring **B**.
* Remove the components from the jig, firstly the yoke **E**, spring **B** and finally, the grease cylinder **F**.

Replacement

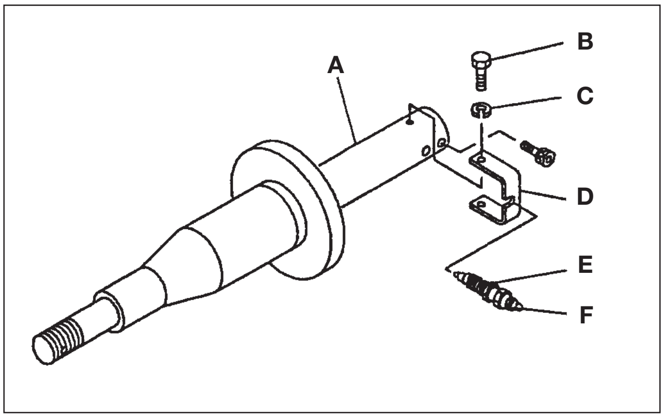
* **1. Reassembly of Components.**

a. Set the components in the jig, firstly the grease cylinder **F**, then place the spring **B** on top, and finally, the yoke **E**.
* **b.** Extend jack **A** and compress recoil spring **B**.
* **c.** Install the castellated nut **D** on the threaded section of the grease cylinder **F** which protrudes through the yoke **E**. Tighten nut **D**, aligning the castellations with the pin hole.
* **d.** Remove the recoil spring assembly from the jig. *See "**Recoil Spring Installation**".*
* **e.** Renew and install spring pin **C**.
* **f.** Release jack **A** carefully and allow recoil spring **B** to expand. Remove assembly from the jig.

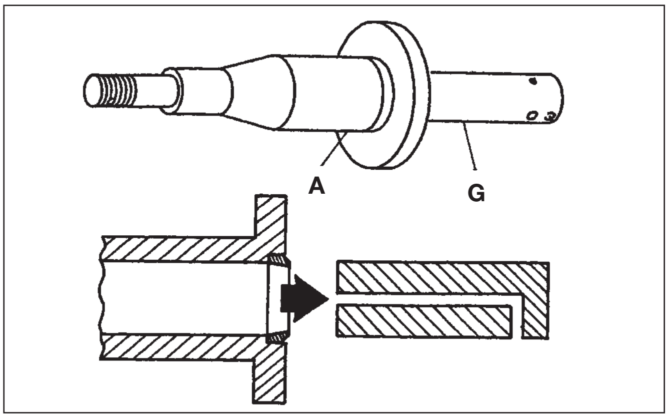


Dismantling

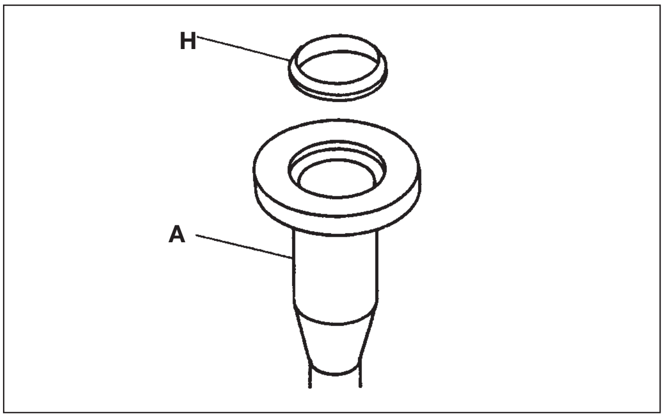
1. Clean the grease cylinder **A** with an appropriate detergent.
Remove bolt **B** and washer **C**, remove the bracket **D**. Remove the check valve **E**, together with the grease nipple **F** from the cylinder **A**.



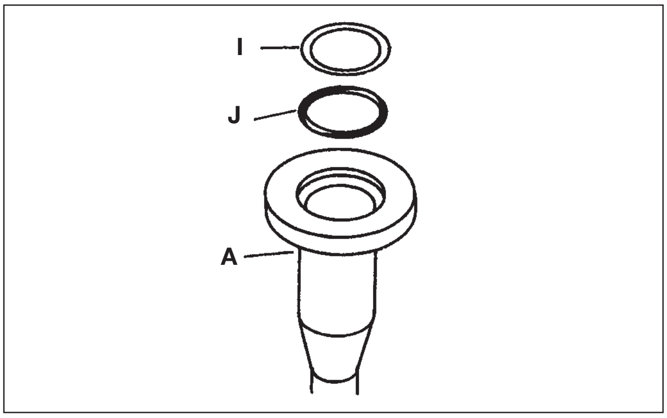
2. Pull out the Piston Rod **G** from the grease cylinder **A**.



3. Remove the Dust Seal **H** from the grease cylinder **A**.

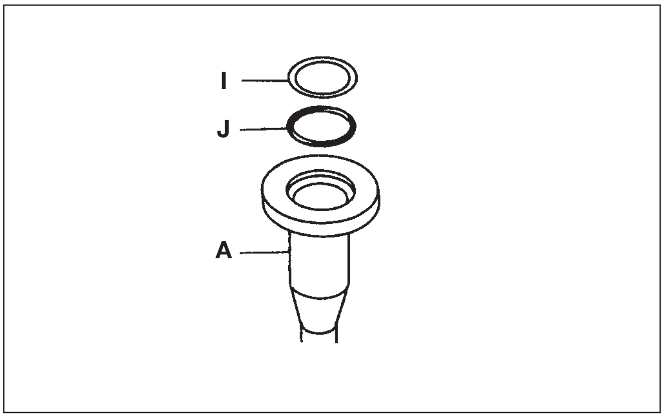


4. Remove the Back-up ring **I** and 'O'-ring **J** from the grease cylinder.

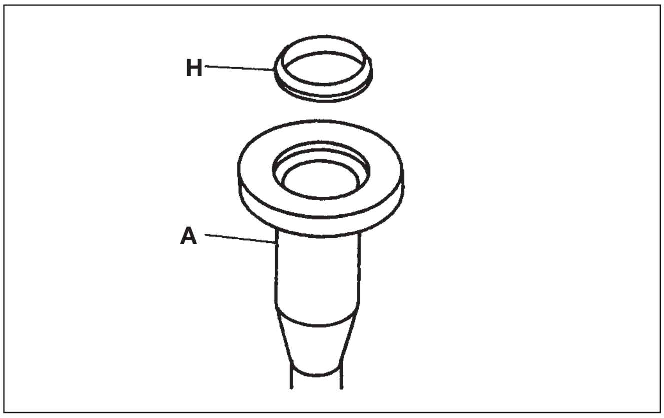


Assembly

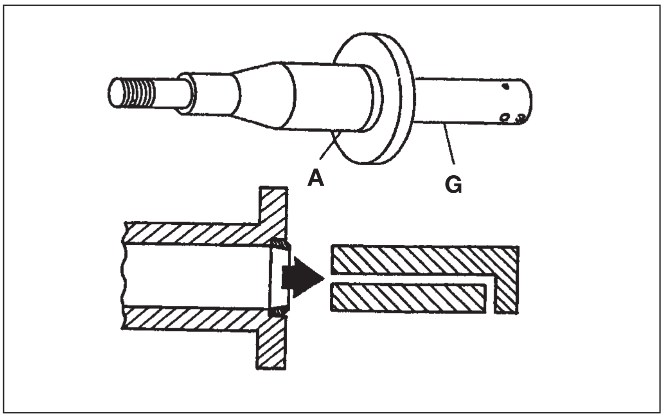
1. Install a new greased 'O'-ring **J**, to the grease cylinder **A**.
Install a new back-up ring **I**.



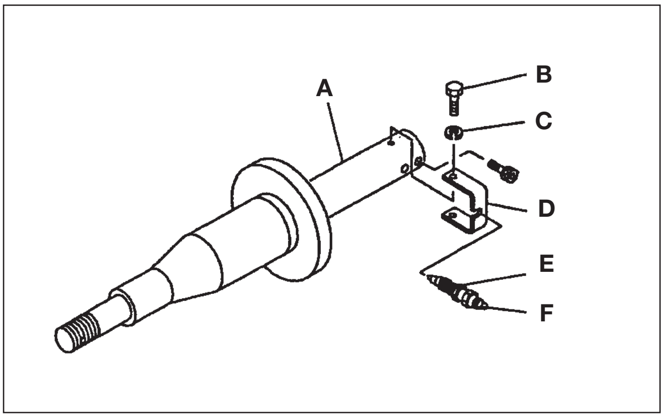
2. Install the dust seal **H** using a suitable jig and hammer to the grease cylinder **A**.



3. Coat the piston rod **G** with grease.
Insert the piston rod **G** into the grease cylinder **A**.

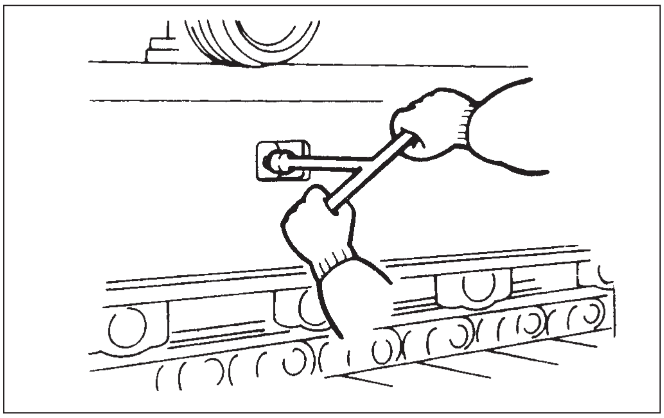


4. Install the check valve **E**, with the grease nipple **F**, to the grease cylinder **A** torque to 58.84 Nm (43.4 lb/ft).
Fasten the bracket **D** to the grease cylinder **A** using the bolt **B** and washer **C**.



Removal

1. Slacken the check valve to bleed out grease.

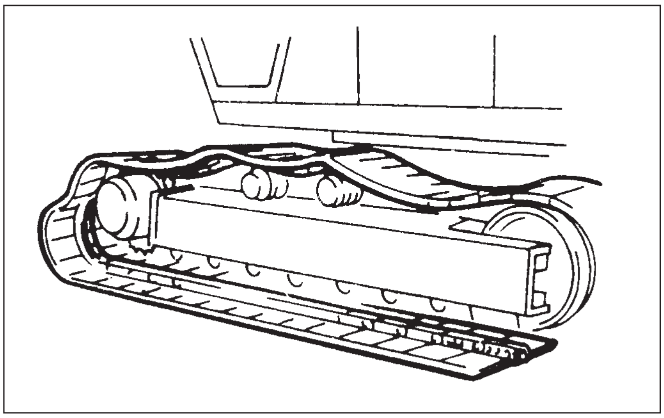


WARNING

When opening the check valve always stand to one side and loosen a little at a time until grease starts to come out. If you over-loosen, too much grease could spurt out or the valve cover fly out and cause serious injury.

8-3-4-5

2. Disconnect the track link.

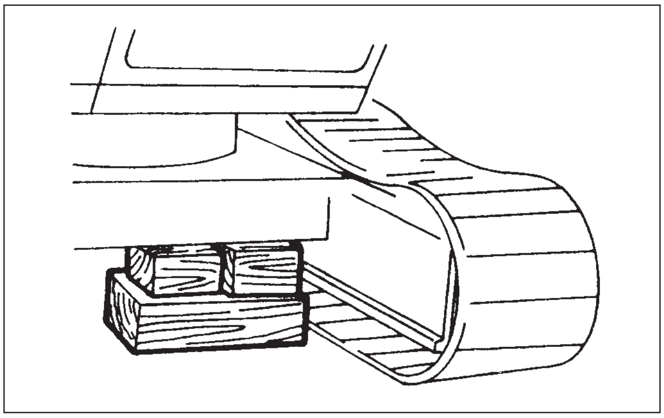


WARNING

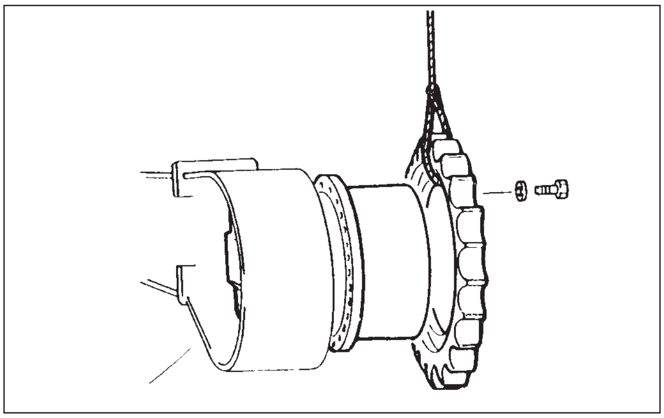
Stand clear and to one side of the track while you remove the master pin. When the master pin is removed, the track could fall forward and injure you.

TRACK 1-1

3. Lift the side of the undercarriage high enough to permit drive sprocket removal. Support with wooden blocks.



4. Support the drive sprocket, remove the bolts and lever it away from the gearbox unit.

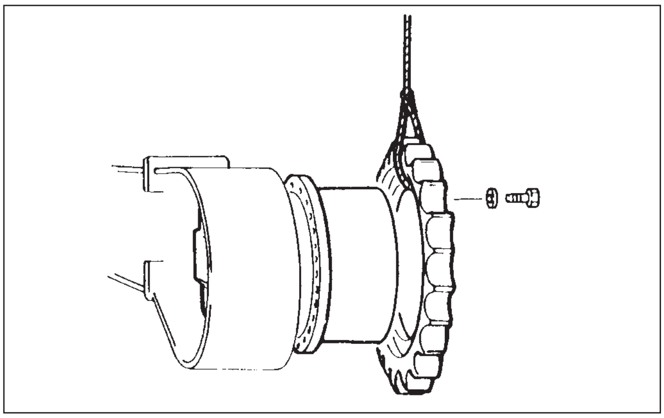


Replacement

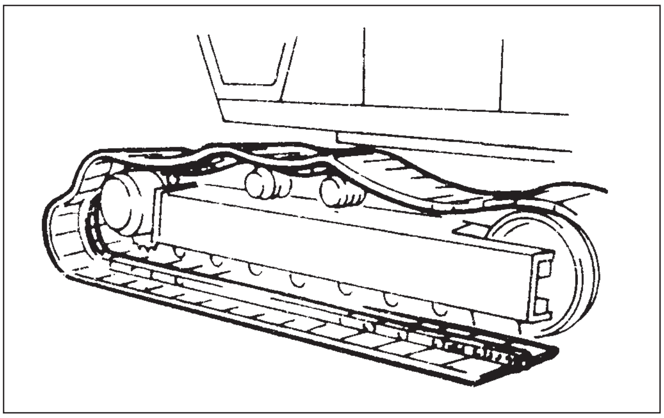
1. Support the sprocket and position it on the gearbox. Install the bolts and washers, using Loctite 262 on the bolt threads. Tighten the bolts in a diagonal sequence.

Torque Settings

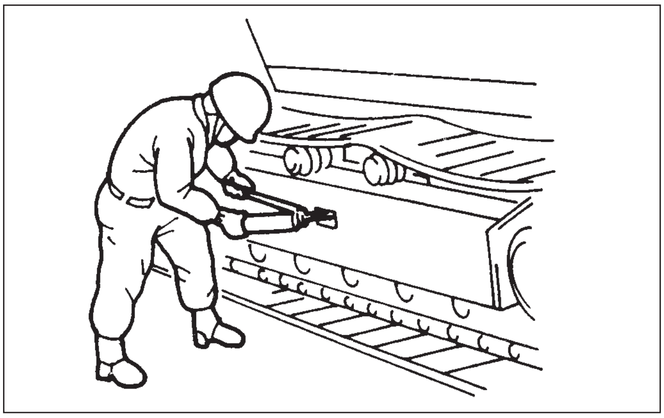
Machine	Nm	lbf ft
JS200	267.312	196-230
JS240	267.312	196-230



2. Remove the wooden blocks. Connect the track link.

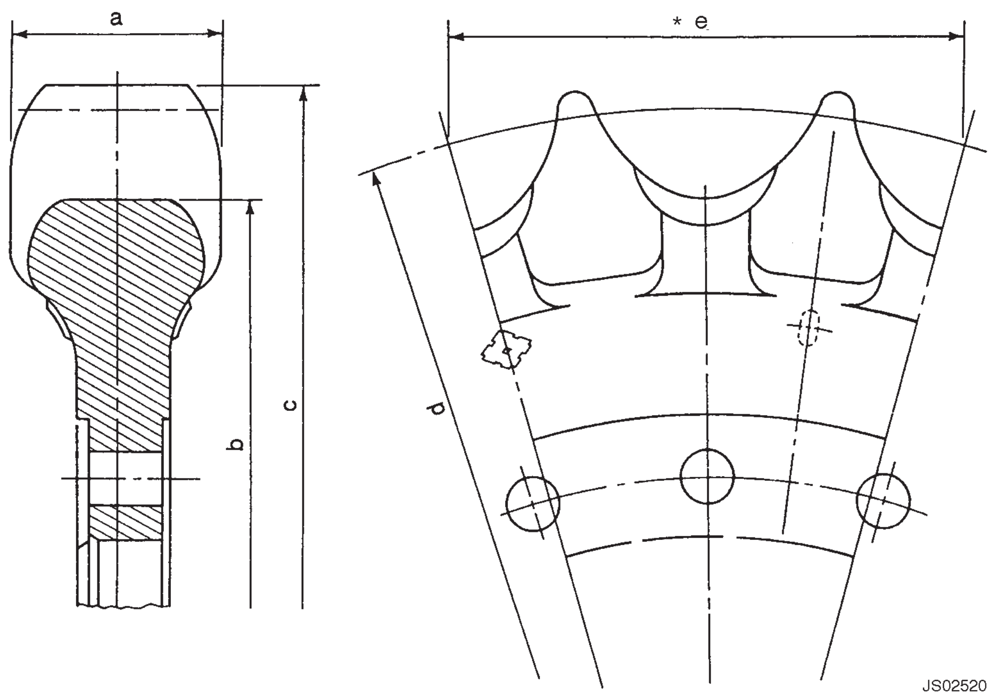


3. Apply grease through the check valve to adjust the track tension *(see Section 3)*.



Wear Limits

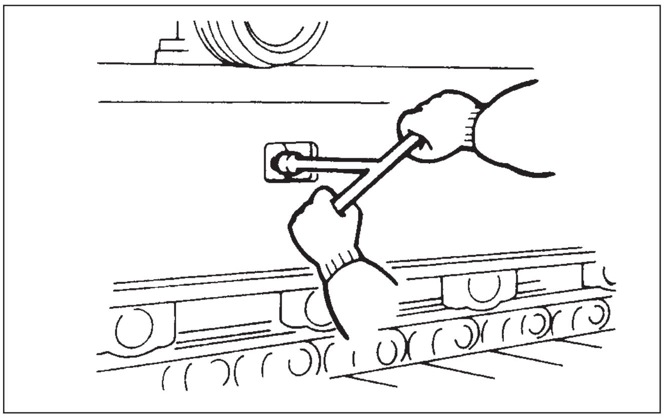
Item	Dimension	Machine	Standard Size mm	in	Service Limit mm	in	Action
Width	a	JS200 JS240	66	2.59	60	2.59	Renew
Diameter	b	JS200 JS240	582.5	22.93	576.5	22.69	Renew
Diameter	c	JS200 JS240	659	25.9	65.3	25.7	Renew
Diameter	d	JS200 JS240	644.6	25.37			Renew
Centres	e	JS200 JS240	190	7.4			Renew



JS02520

Removal

Note: *The following procedure is applicable to all top rollers but as there are visual differences, the illustrations show only a typical unit.*

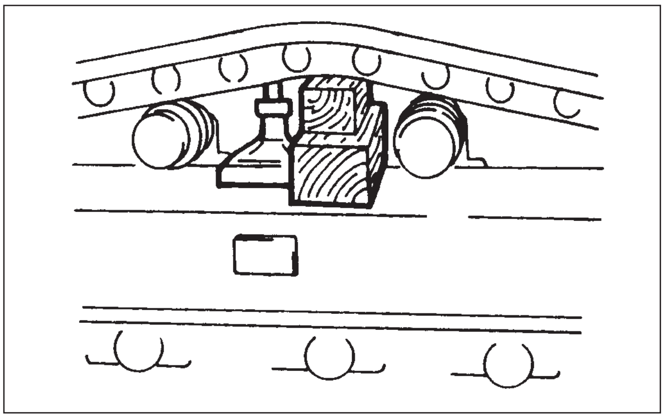


1. Slacken the check valve to bleed out grease.

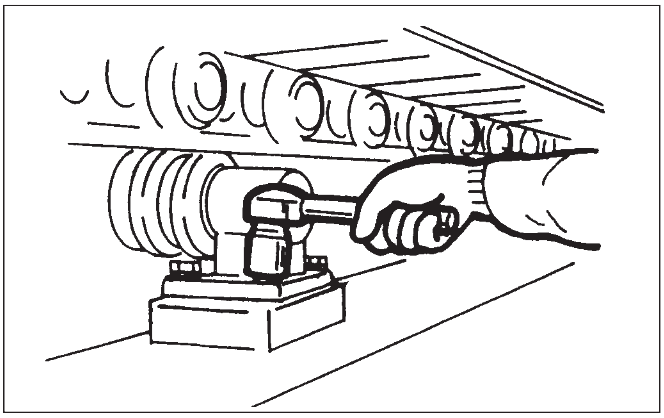
⚠ WARNING

When opening the check valve, always stand to one side and loosen a little at a time until grease starts to come out. If you over-loosen too much, grease could spurt out or the valve cover fly out and cause serious injury.

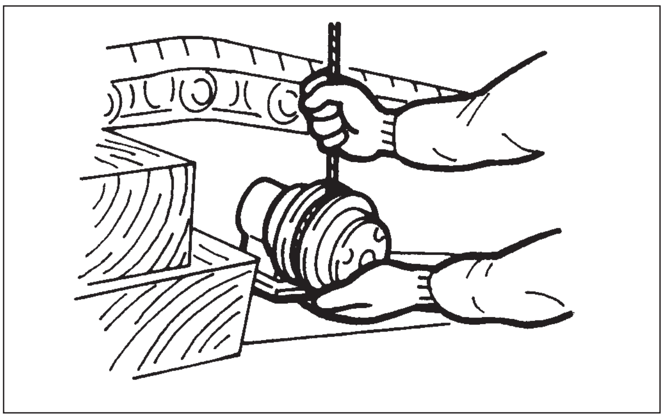
8-3-4-5



2. Jack up the track high enough to permit roller removal. Put wooden blocks between track link and side frame.



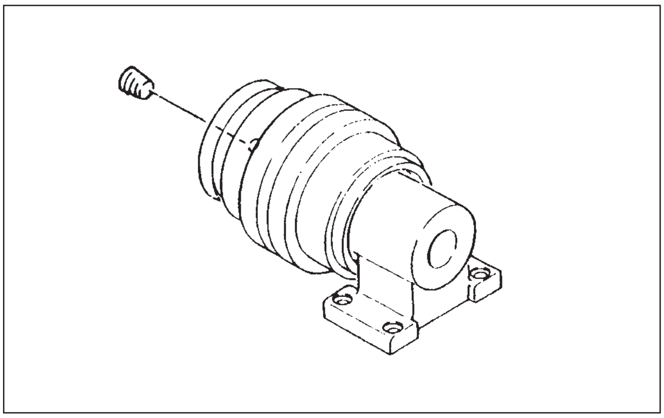
3. Remove the mounting bolts, and tap the upper roller with a copper mallet to separate it from the side frame.



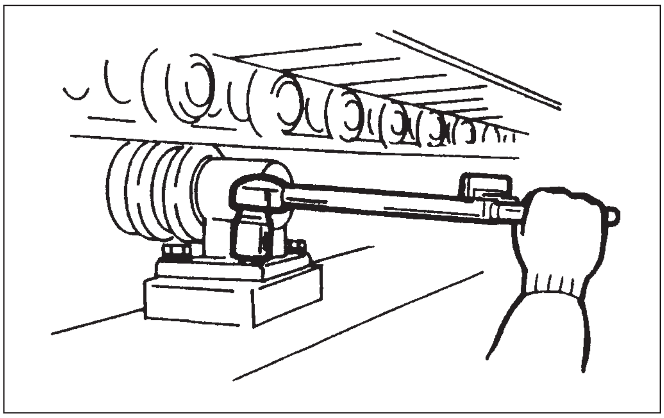
4. Fasten a sling to the upper roller, and completely remove the upper roller bolt and remove the upper roller.

Replacement

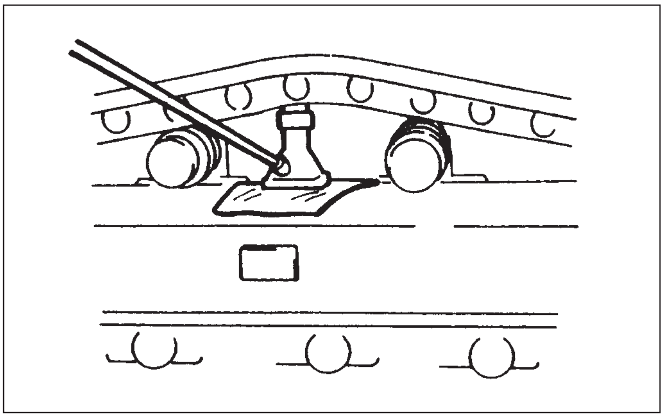
1. Before fitting the roller, add the specified oil *(see Section 3)*. Install plug using an appropriate pipe thread sealant.



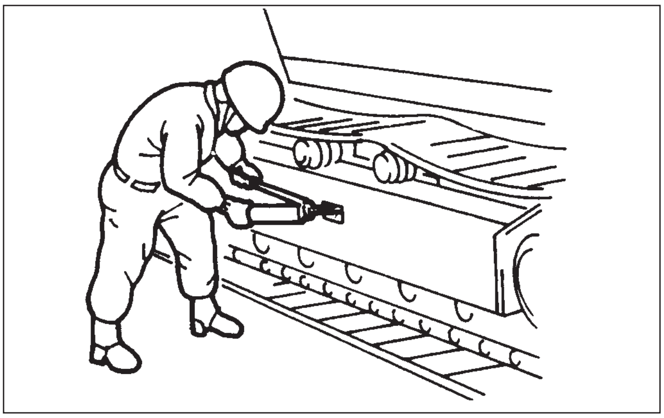
2. With the track supported as shown under Removal, install the roller. Apply Loctite 262 to the threads and fit the mounting bolts.

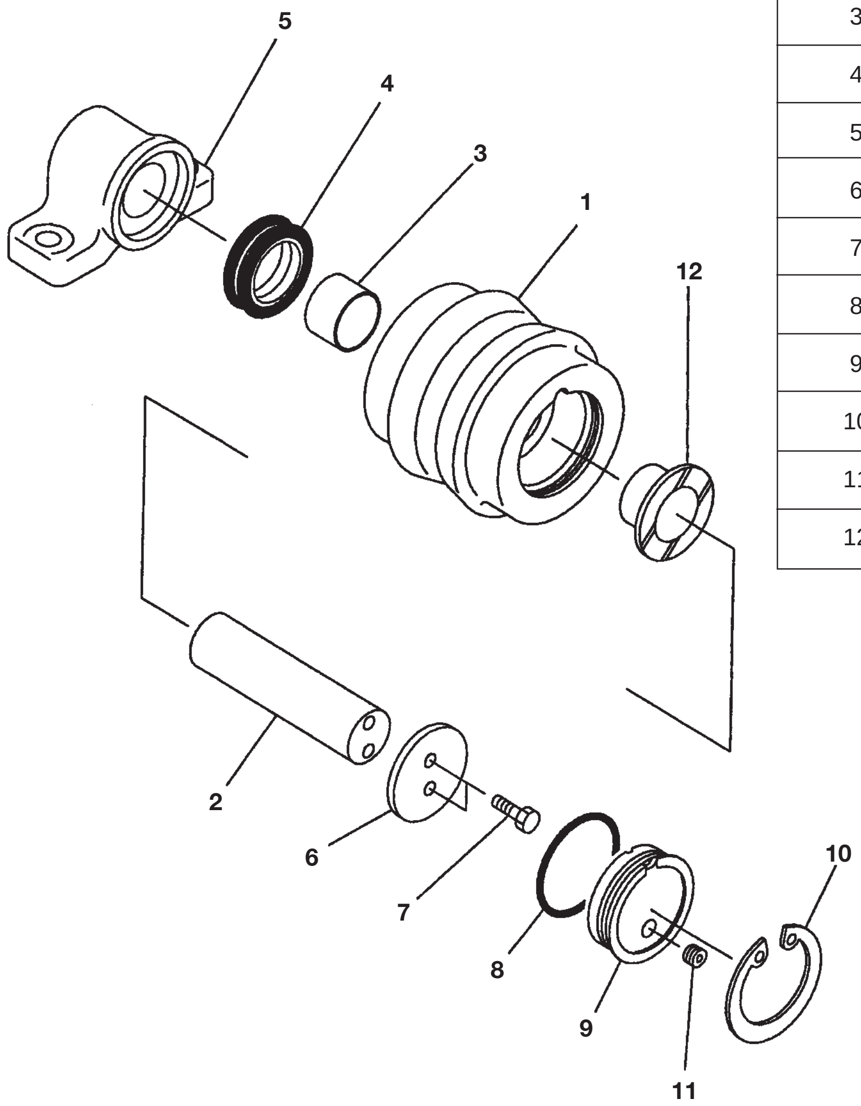


3. Remove the wooden blocks and jack.



4. Apply grease through the check valve to adjust the track tension *(see* "***Checking/Adjusting the Track Tension)***.

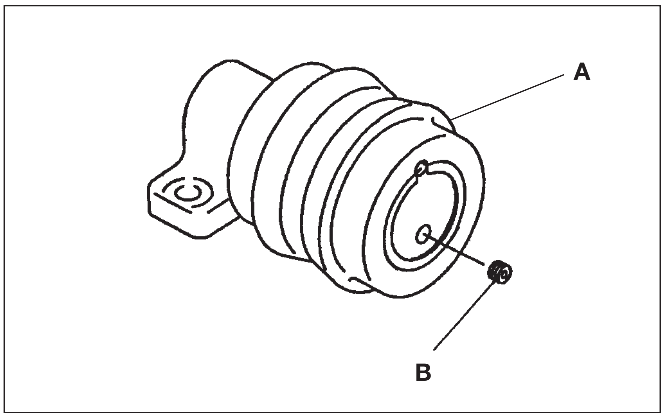




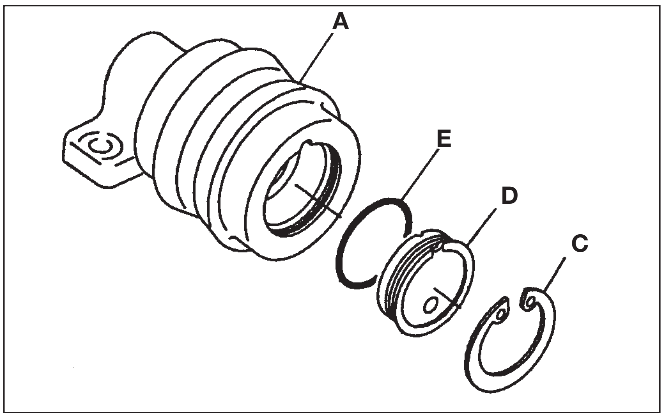
Item	Part Name
1	Roller
2	Shaft
3	Bushing
4	Floating seal
5	Bracket
6	Thrust plate
7	Hexagonal bolt
8	O-ring
9	Cover
10	Snap ring
11	Plug
12	Bushing

Dismantling (Two and Four bolt pedestal).

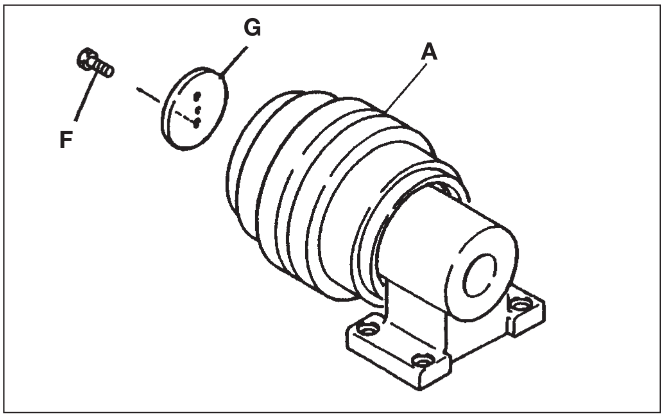
1. Clean the upper roller **A** with an appropriate detergent. Remove the plug **B** from the cover and drain the oil.



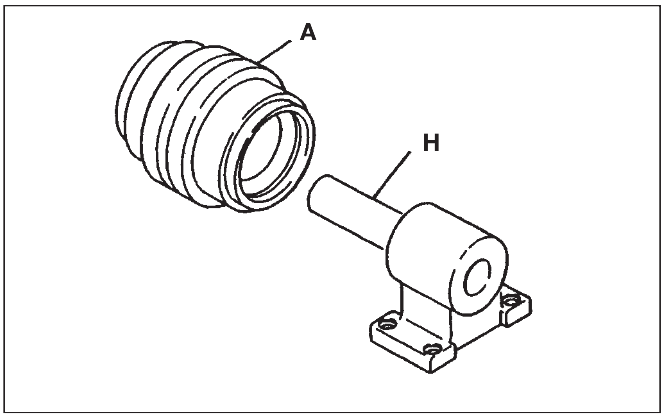
2. Remove the retaining ring **C**, and remove cover **D**. From cover **D**, remove 'O'-ring **E** and discard.



3. Remove bolt **F**, and the thrust plate **G** from the end of the shaft.

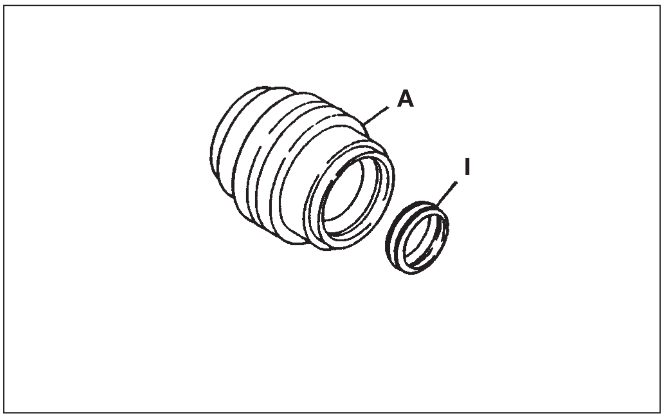


4. Pull the upper roller **A** from the shaft **H**.

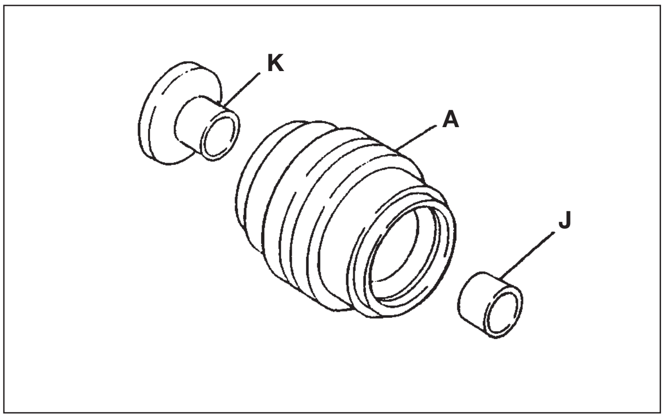


Dismantling *(continued)*

5. Remove the floating seal **I** from the upper roller **A**.

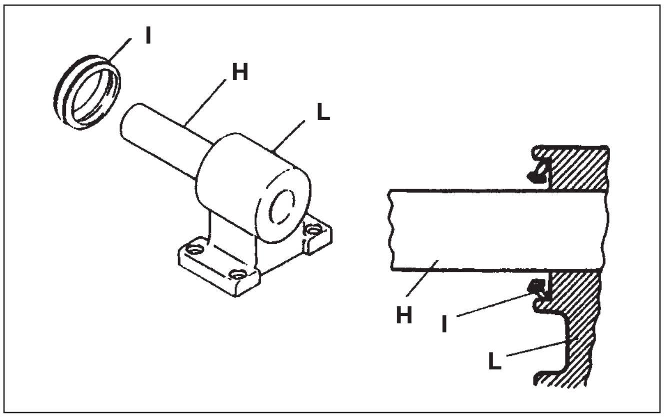


6. If badly worn or damaged, remove the bushes **J** and **K**, from the roller **A**.



7. Remove seal **I** from bracket **L** using a pry bar.

Protect parts from moisture and dust if left dismantled for some time.

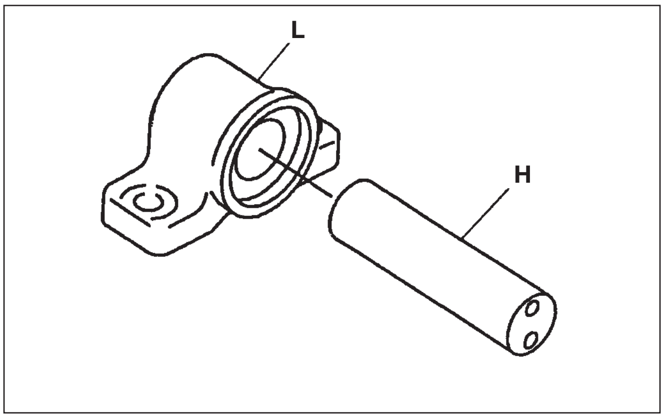


Assembly

1. Clean all parts thoroughly in a suitable solvent. Dry shaft and bore of roller using compressed air in a place free of dust and moisture.

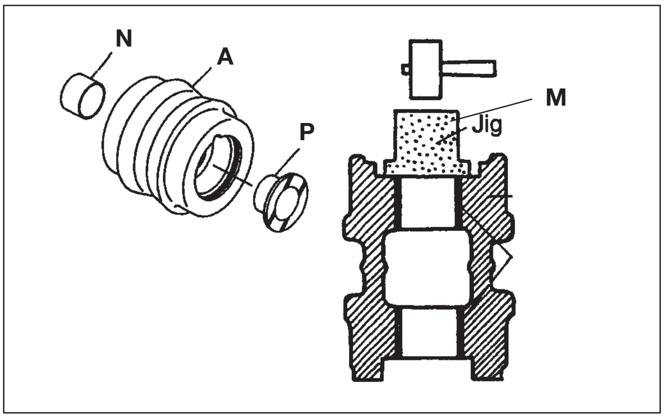
Check components for wear as detailed under (**Wear Limits**). Polish out scratches and roughness using an oil stone. Then apply a coat of engine oil to all parts.

If a new shaft or bracket are required, press-fit shaft **H** into bracket **L**, taking care to protect the threads of the tapped holes in the end of the shaft.

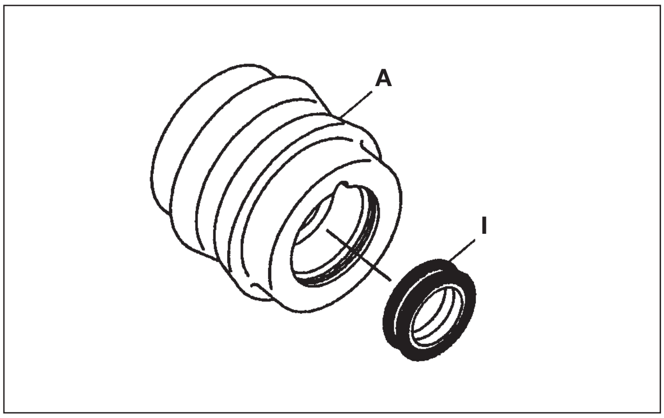


Assembly *(continued)*

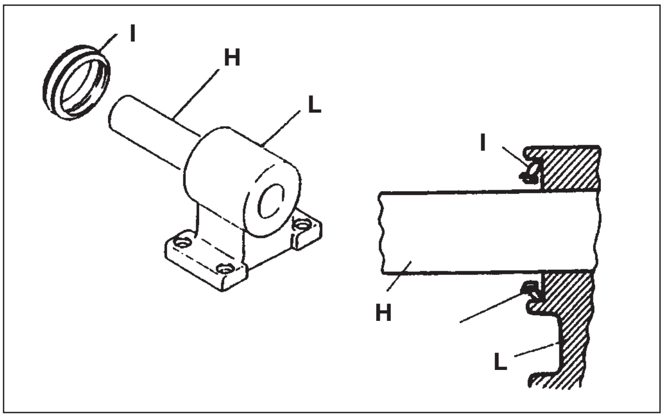
2. Using a jig **M**, and hammer, insert the bushing **N**, and **P** into the roller **A**.



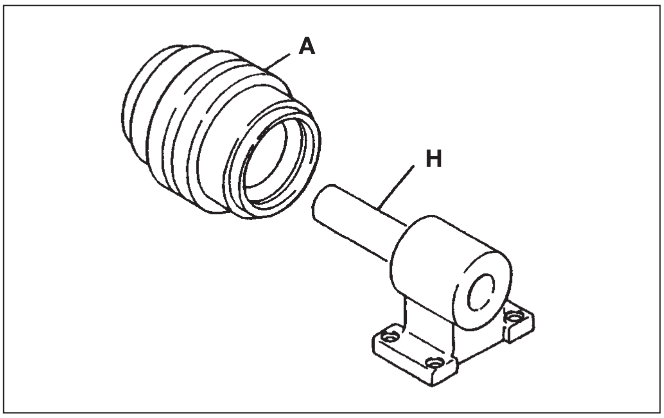
3. Install the new floating seal **I** into the roller **A** coat oil onto the floating seal surface.



4. Install the new seal **I** into the bracket **L**.
Coat the metallic face of the seal with engine oil.

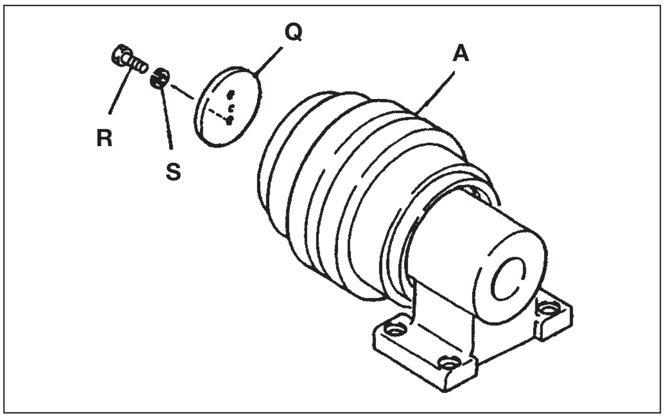


5. Coat the shaft **H** with grease. Install the roller **A** onto the shaft **H**.

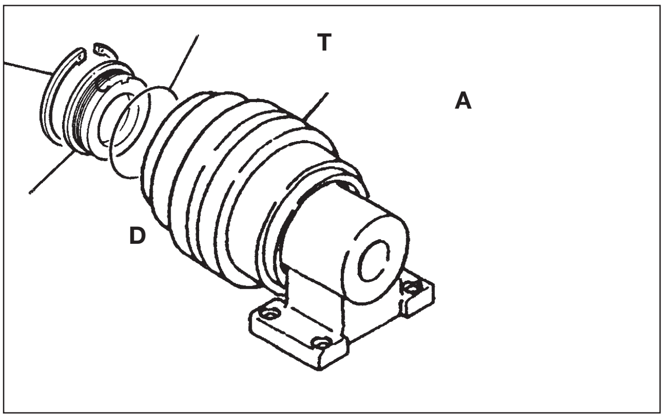


Assembly *(continued)*

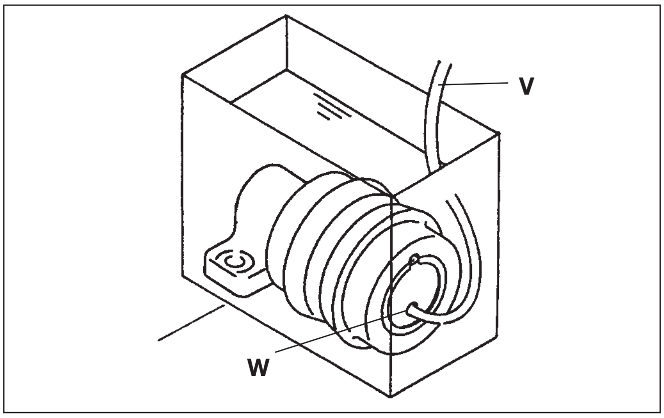
6. Apply grease to the inside face of the thrust plate **Q** and install it on the shaft using bolt **R** and washer **S**.



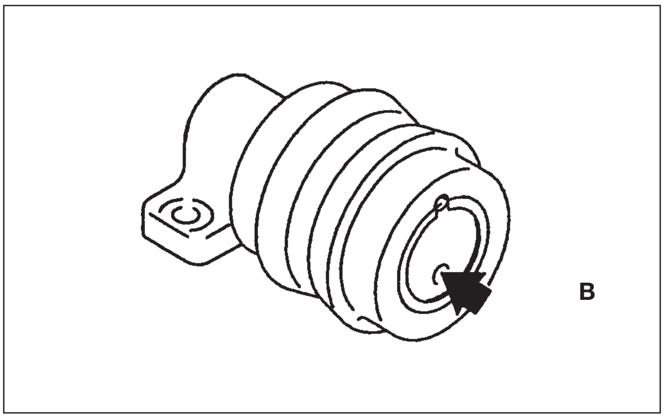
7. Apply grease to a new 'O'-ring **T** and install it onto cover **D**. Install the cover **D** to the roller **A**. Retain with the retaining ring **C**.



8. Using extreme care to prevent water entering the assembly, lower it into a tank of water. Connect a compressed air pipe **V** to the port **N**, check for air bubbles.
Apply a pressure of 1.9 bar (28 lb/in ^{2}).

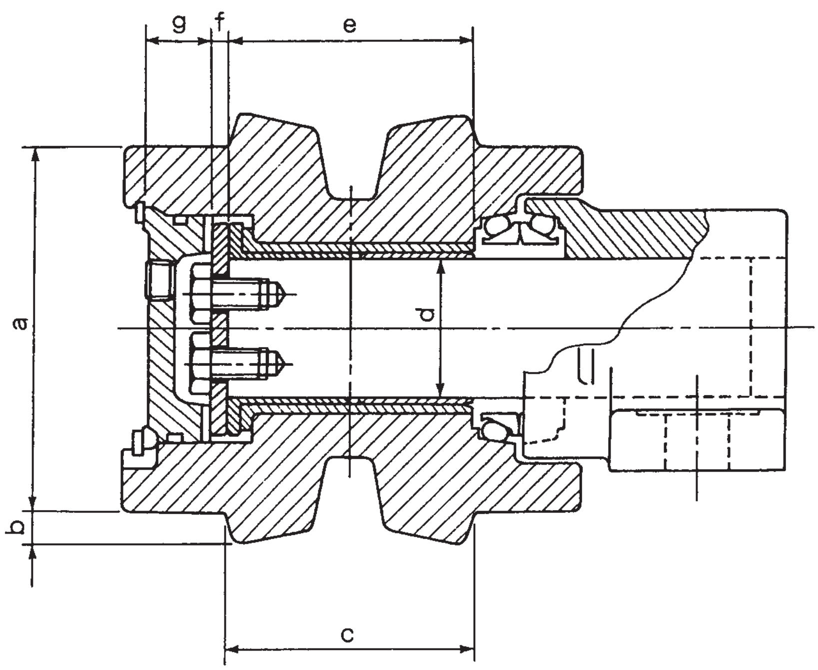


9. Remove the assembly from the tank.
Dry with compressed air. Add the specified oil *(see **Routine Maintenance**)*.
Install plug **B** using an appropriate pipe thread sealant.



Wear Limits

Item	Dimension	Machine	Standard Size mm	Standard Size in	Service Limit mm	Service Limit in	Action
Carrier Roller	a	JS200 JS240	120	4.72	112	4.40	Renew
	b	JS240 JS240	0	.39			Renew
	c	JS200 JS240	85	3.34	79	3.11	Renew
Inner Flange width	d	JS200 JS240	46	1.81	45.5	1.79	Renew
Outer Flange width	d	JS200 JS240	46	1.81	46.8	1.84	Renew
Shaft Diameter	e	JS200 JS240	83	3.26	82.6	3.25	Renew
Length	f	JS200 JS240	5.5	.21	5	.19	Renew
Collar	g	JS200 JS240	23	.90	22.5	.88	Renew



Removal

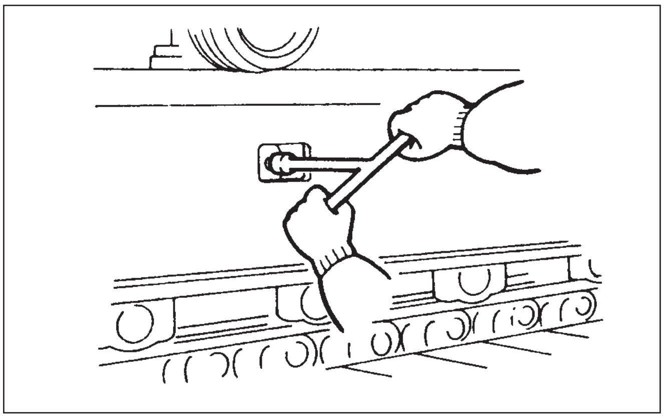
***Note:** The following procedure is applicable to all bottom rollers, but as there are visual differences, the illustrations show only a typical unit.*

1. Slacken the check valve to bleed out grease.

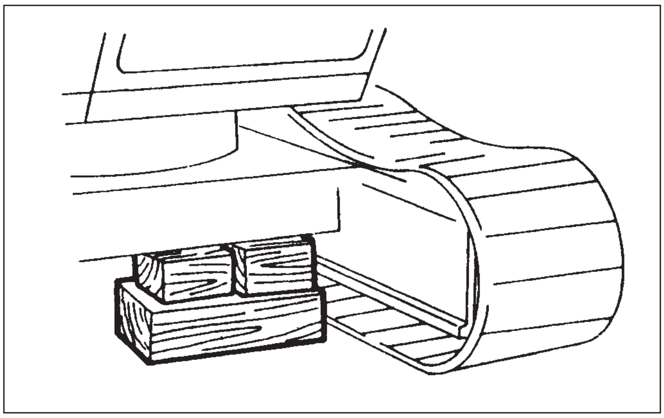
WARNING

When opening the check valve always stand to one side and loosen a little at a time until grease starts to come out. If you over-loosen too much, grease could spurt out or the valve cover fly out and cause serious injury.

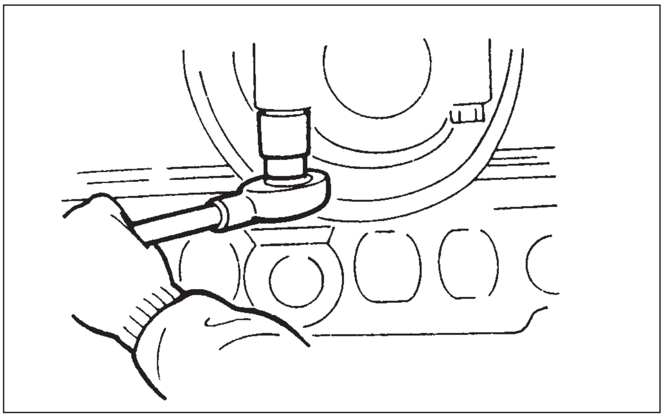
8-3-4-5



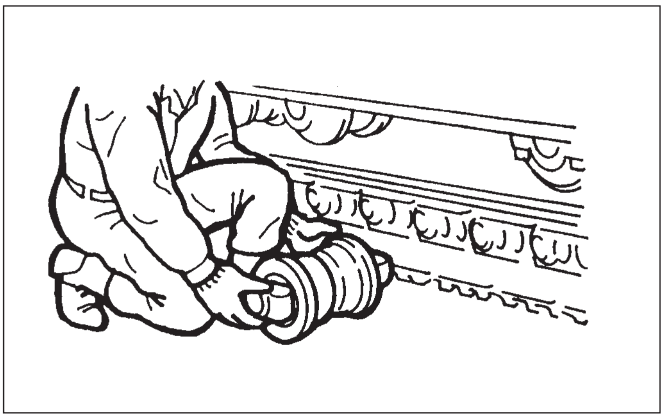
2. Lift the side of the undercarriage high enough to permit bottom roller removal. Support with wooden blocks.



3. Remove the mounting bolts, and tap the bottom roller with a copper mallet to separate it from the side frame.



4. Remove the roller.

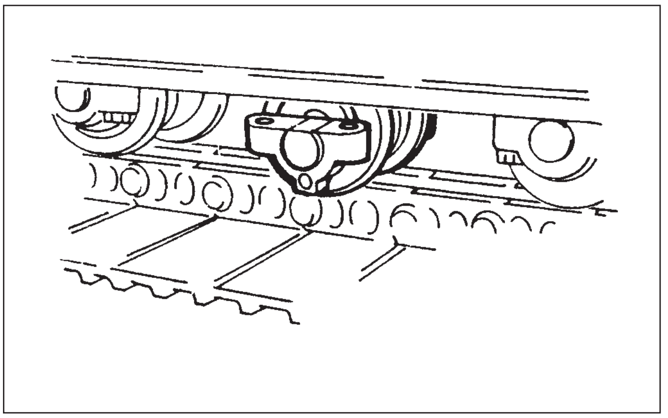


Replacement

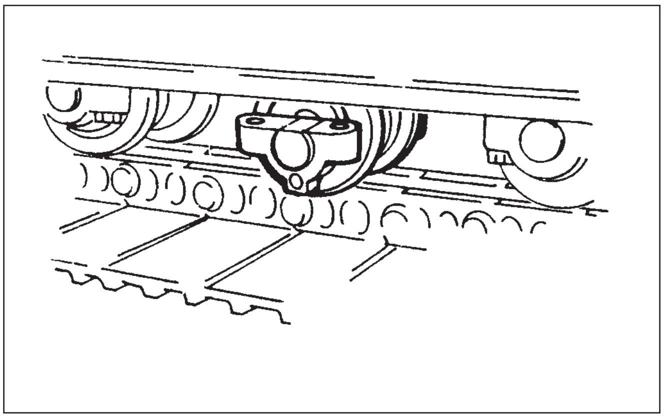
1. Before fitting the roller, add the specified oil *(see Section 3)*. Install plug **A** using an appropriate pipe thread sealant.

With the undercarriage lifted and supported as shown under Removal, position the roller on the track link as shown.

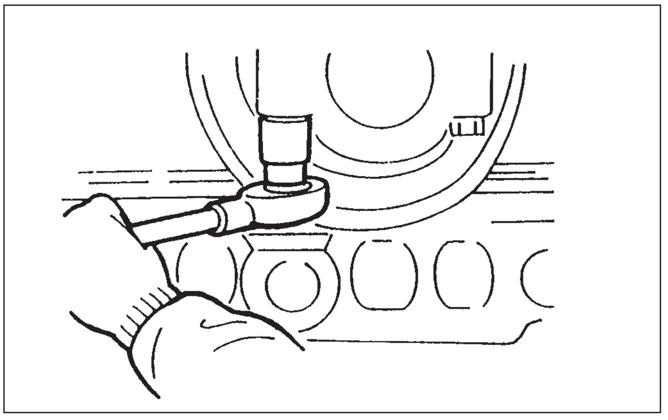
Align the holes in the brackets with the tapped holes in the undercarriage.



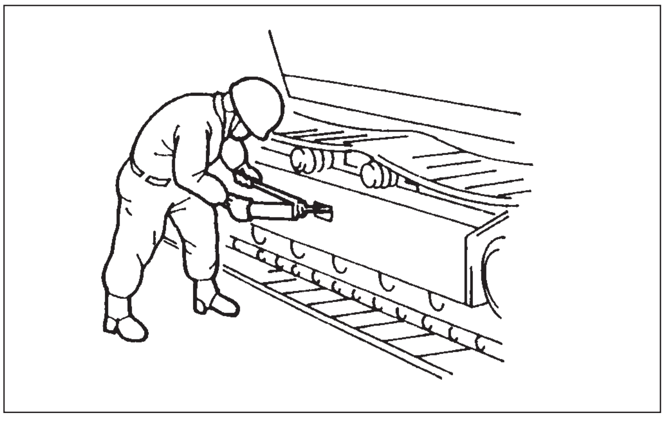
2. Lower the undercarriage sufficient to allow the mounting bolts to be installed.

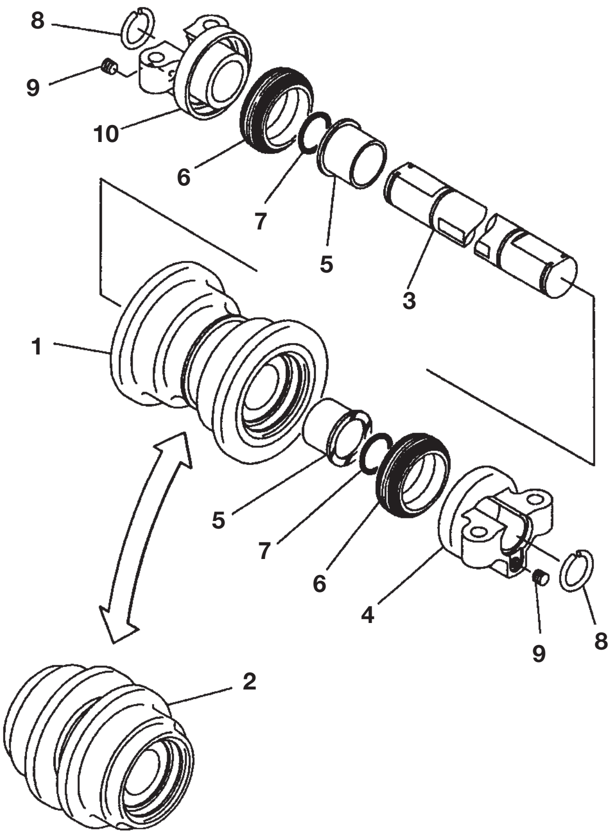


3. Apply Loctite 262 to the threads and install the mounting bolts.



4. Apply grease through the check valve to adjust the track tension *(see Section 3)*.



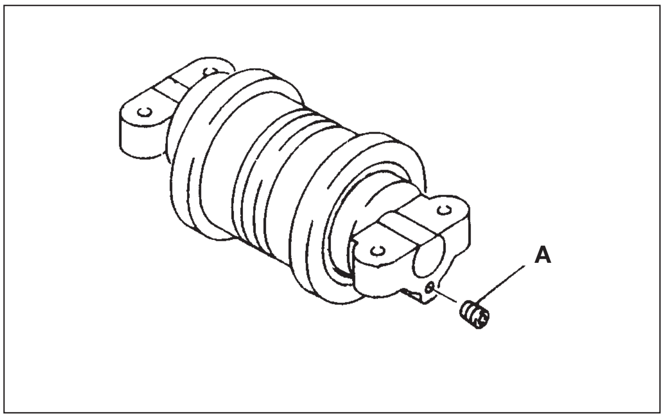


Item	Part Name
	Roller assembly(outer flange)
1	Roller (outer flange)
	Roller assembly (inner flange)
2	Roller (inner flange)
3	Shaft
4	Collar
5	Bushing
6	Floating seal
7	O-ring
8	Wire clip
9	Plug
10	Collar

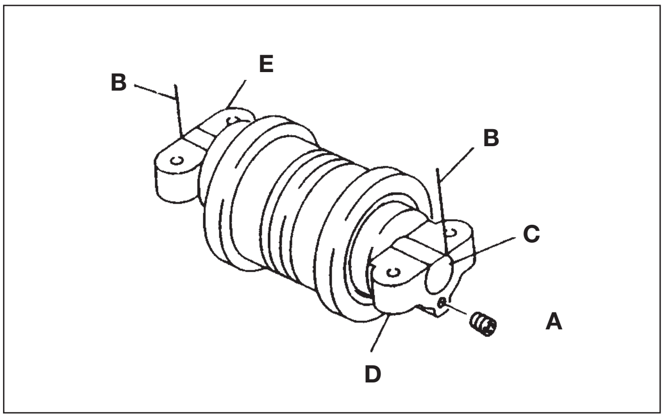
Dismantling

Note: *The following procedure is applicable to all bottom rollers, but as there are visual differences, the illustrations show only a typical unit.*

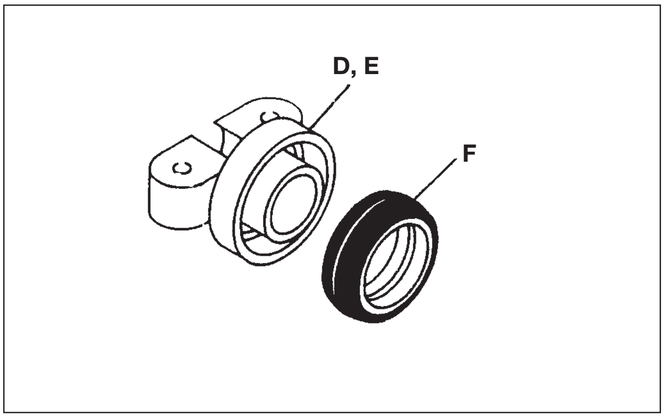
1. Clean the roller with a suitable solvent. Remove the plug **A** and drain the oil.



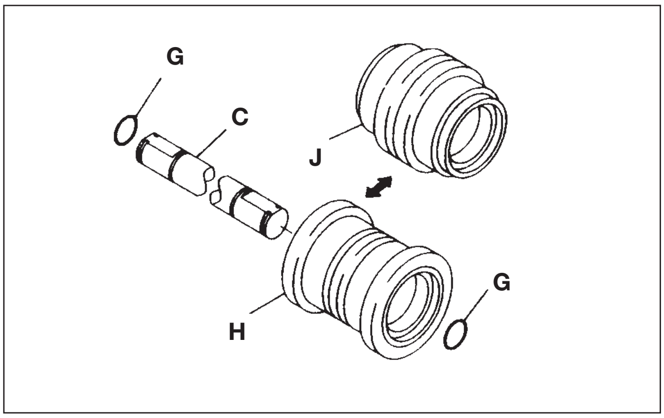
2. Remove locking wire **B** from each end of the shaft **C**. Remove brackets **D** and **E** from shaft **C**.



3. Remove seal **F** from brackets **D** and **E**, using a pry bar.

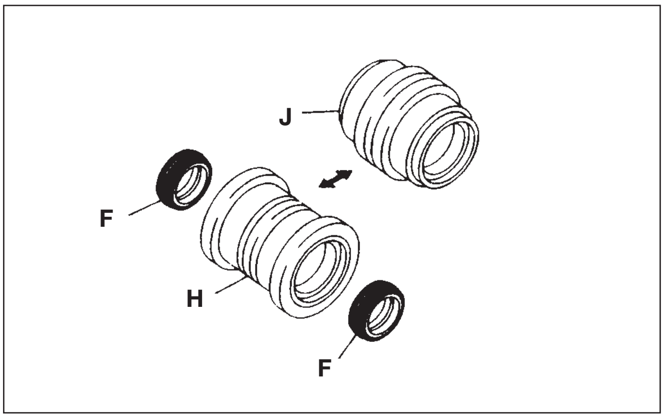


4. Remove 'O'-rings **G** from shaft **C**. Pull out shaft **C** from roller **H** or **J**.



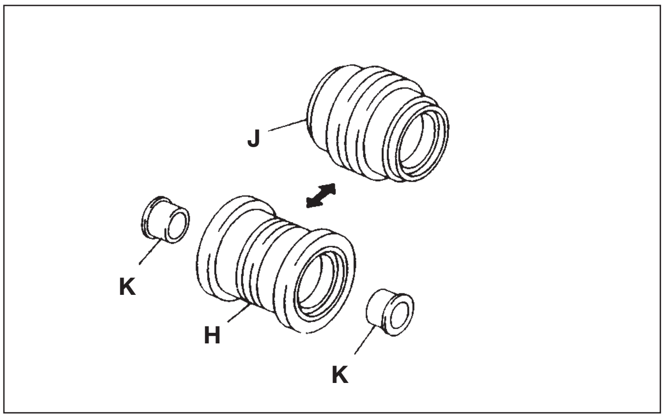
Dismantling *(continued)*

5. Remove seals **F** from roller **J** or **H** using a pry bar.



6. If badly worn or damaged, remove the bushes from roller **J** or **H**, using a press or puller.

Protect parts from moisture and dust if left dismantled for some time.

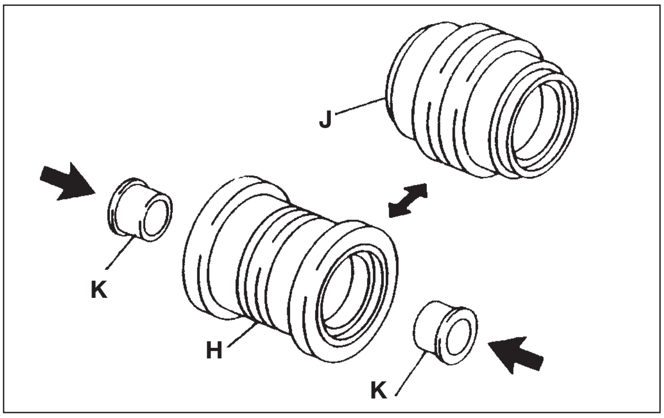


Assembly

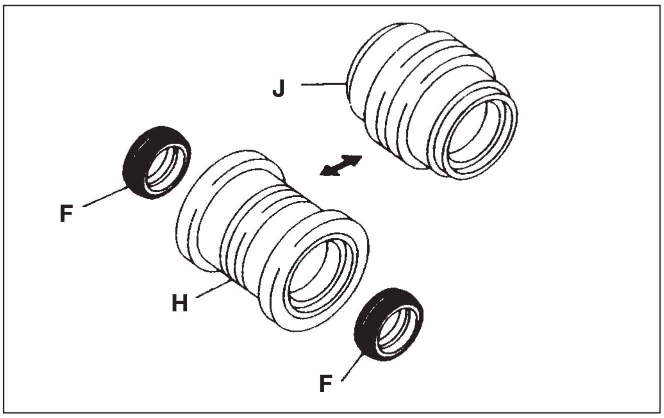
1. Clean all parts thoroughly in a suitable solvent. Dry shaft and bore of roller using compressed air in a place free of dust and moisture.

Check components for wear as detailed under Wear Limits. Polish out scratches and roughness using an oil stone. Then apply a coat of engine oil to all parts.

Drive bushes **K** into roller **J** or **H**, using a dolly and hammer.



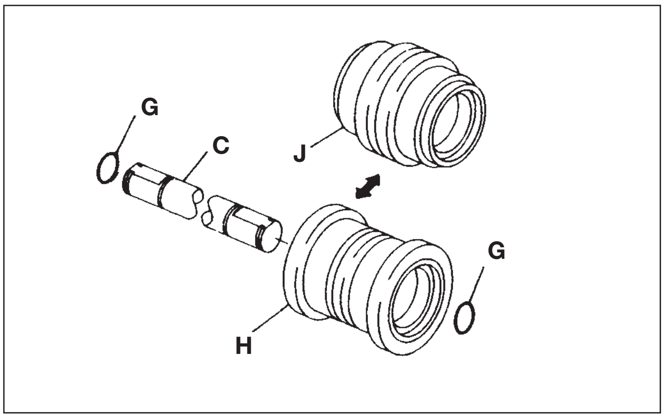
2. Install new seals **F** into roller **J** or **H**.



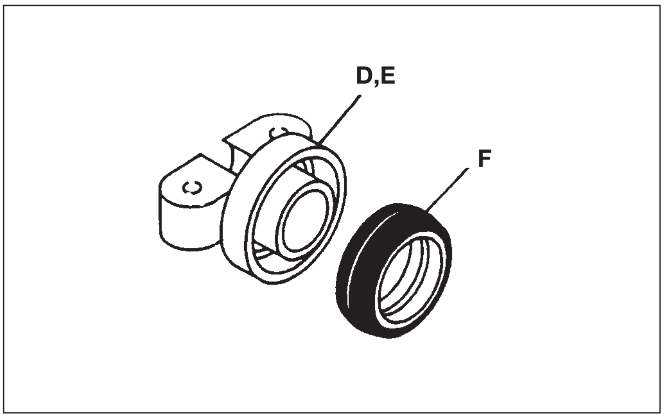
Assembly *(continued)*

3. Coat shaft **C** with grease. Insert the shaft into roller **J** or **H**.

Apply grease to new 'O'-rings **G** and install them on shaft **C**.

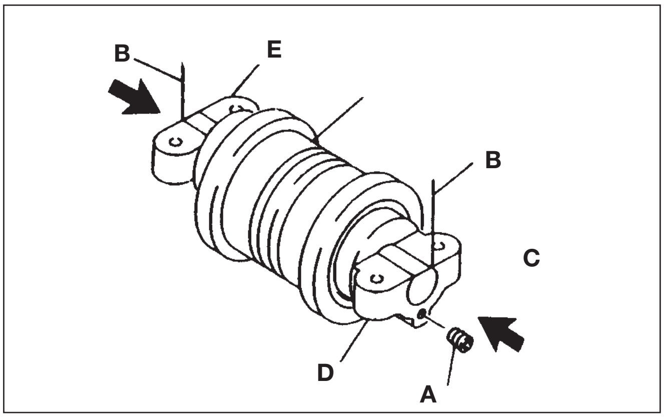


4. Install a new seal **F** into brackets **D** and **E**. Coat the metallic face of each seal with engine oil.

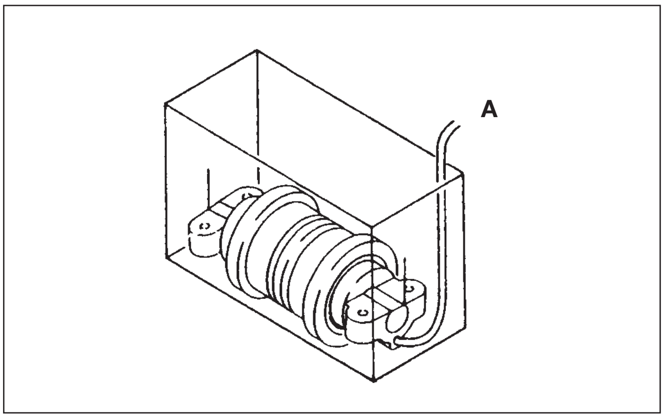


5. Press brackets **D** and **E** onto shaft **C** and insert new locking wires **B**.

Wrap sealing tape around one plug **A** with one thread remaining uncovered. Insert this plug, but leave the other one out until after testing.

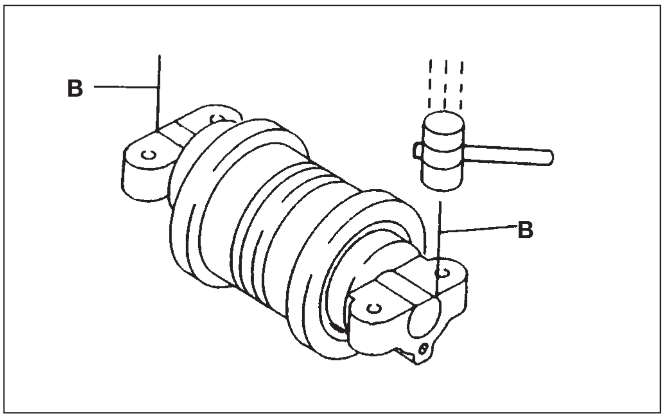


6. Using extreme care to prevent water entering the assembly, lower it into a tank of water. Connect compressed air at **A** and apply pressure of 1.9 bar (28 lbf/in ^{2}). Check for air bubbles.

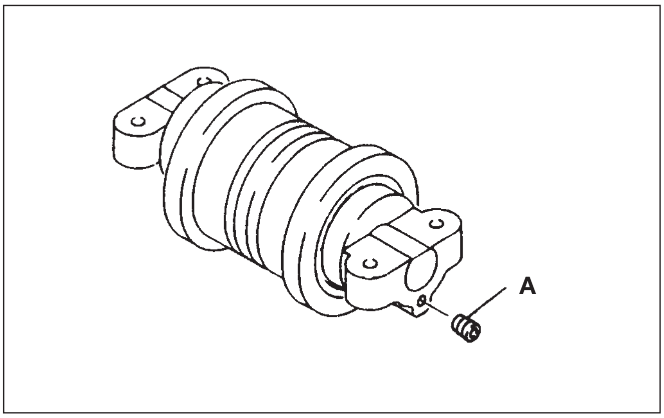


Assembly *(continued)*

7. Hammer in locking wires **B**.



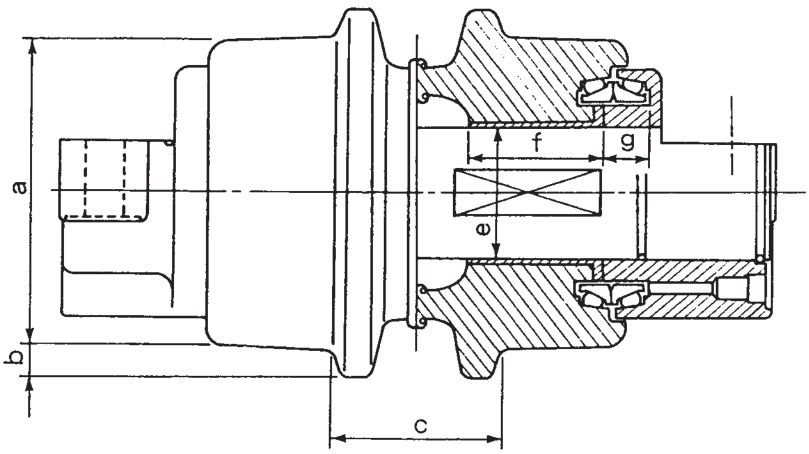
8. Add the specified oil *(see Section 3)*. Install plug **A** using an appropriate pipe thread sealant.



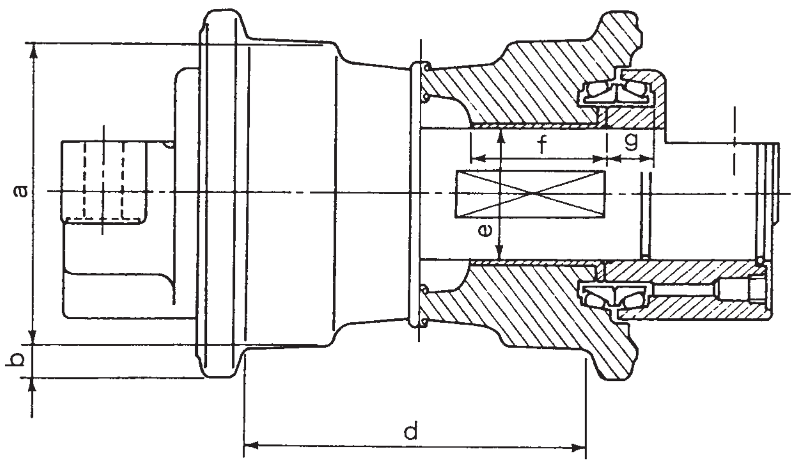
Wear Limits

Item	Dimension	Machine	Standard Size mm	Standard Size in	Service Limit mm	Service Limit in	Action
Roller Diameter	a	JS200	150	5.9	142	5.5	Renew
	a	JS240	160	6.3	152	5.98	Renew
	b	JS200 JS240	150	5.9			Renew
Inner Flange width	c	JS200 JS240	86	3.38	80	3.14	Renew
Outer Flange width	d	JS200 JS240	173	6.8	170	6.7	Renew
Shaft Diameter	e	JS200	65	2.5	64.5	2.53	Renew
	e	JS240	70	2.7	69.5	2.73	Renew
Length	f	JS200	69	2.7	68.6	2.7	Renew
	f	JS240	74	2.9	73.6	2.9	Renew
Collar	g	JS200	28.8	1.13	28.3	1.11	Renew
	g	JS240	26.8	1.05	26.3	1.03	Renew

Lower Roller (inside)



Lower Roller (outside)



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Technical Data

Type	Isuzu A4BG1T, 6 cylinder in-line, turbocharged, direct injection diesel.
Model	
- JS200	A-6BG1TQB-04
- JS210	A-6BG1TQB-04
- JS220	A-6BG1TQB-04
- JS240	A-6BG1TQB-05
- JS260	A-6BG1TQB-05
Bore	105mm (4.13 in)
Stroke	125mm (4.92 in)
Swept Volume	6,494cm^3 (396 in^3)
Compression Ratio	17.5 : 1
Compression Pressure at 200 rev/min	31 bar (450 lbf/in^2)
Firing Order	1, 5, 3, 6, 2, 4
Valve Clearance (cold)	
- Inlet	0.4 mm (0.016 in)
- Exhaust	0.4 mm (0.016 in)
Dry Weight (approximately)	458 kg (1078 lb)

Fuel System

Max. Speed (No Load)	
- JS200	Less than 2100 rev/min
- JS210	Less than 2100 rev/min
- JS220	Less than 2100 rev/min
- JS240	Less than 2300 rev/min
- JS260	Less than 2300 rev/min
Injection Timing (static)	12° BTDC
Injector Opening Pressure	185 bar (2630 lbf/in^2)

Induction System

Air Cleaner Type	2 stage, dry element with in-cab warning indicator.

For further details, see engine service manual, Publication No.	9806/2120

Note: New engines **DO NOT** require a running-in period. The engine/machine should be used in a normal work cycle immediately; glazing of the cylinder bores resulting in excessive oil consumption, could occur if the engine is gently run-in. Under no circumstances should the engine be allowed to idle for extended periods; (e.g. warming up without load).