

CONTENTS

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0.2 USING THE SERVICE MANUAL

0.2.1 Manual introduction

The purpose of this manual is to assist Dealers and Distributors with the efficient repair and maintenance of the 15 and 16 Mini-excavators.

Following the procedures as detailed together with using the special tools where appropriate, will enable the operations to be completed within the time stated in the Repair Time Schedule (RTS).

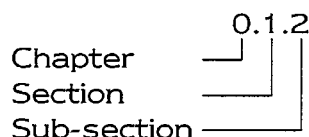
0.2.2 The structure of the manual

This manual has been divided into 15 Chapters using the same numbering system as the Operator's Book and the Parts Catalogue.

Each Chapter is divided into three Sections. The three Sections are Data, Maintenance and Troubleshooting.

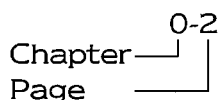
Some Sections are further divided into Sub-sections.

The Contents at the front of this manual lists all Chapters, Sections and Sub-sections with corresponding page numbers using the following numbering system for identification.



0.2.3 Page numbers

The page numbers are shown at the bottom of each page in sequential order. Each Chapter starts at page 1. The Chapter number is also included on each page.



0.2.4 Highlight symbols

Throughout this manual the following symbols are used to draw your attention to areas where special care is required, to prevent accident, injury, damage to equipment or to give you additional information.



WARNING

A warning gives the reader information (or a command) which, if disregarded, could cause injury or death. Because of its importance, any warning precedes the Instruction(s) which, in the act of being performed, could be dangerous.



CAUTION

A caution provides the reader with advice, which, if disregarded, could cause damage to the equipment.



Note

A note furnishes additional information to assist the reader when reading a particular paragraph.

0.2.5 Special tools

The use of the special tools mentioned in the text contributes to safe, efficient and profitable repair. Some operations are impracticable without their use.

SERVICE AND INSPECTION SCHEDULE - 15 and 16

Copies of this form may be completed and retained to form an accumulating record of maintenance to enhance resale value of the machine.

PLANT No. _____ SERIAL No. _____ DATE __/__/__ HRS _____

Schedule	✓	X	Corrective Action Taken
10 HRS OR DAILY CHECK:			
Engine oil level			
Engine coolant level			
Hydraulic oil level			
Any fluid leaks			
Control lever operation			
Fan belt tension			
Warning lamp operation			
Hourmeter/Gauge operation			
Horn/Lamps operation			
Engine start/run/stop function			
AFTER FIRST 50 HRS OPERATION ONLY:			
Replace hydraulic return filter			
Replace engine oil filter			
Replace engine oil			
Check tightness of all fastenings			
Replace track gearbox oil			
EVERY 50 HRS (Including First):			
Grease all lubrication points			
Check/Adjust Track tension			
Clean agglomerator filter and bowl			
Drain fuel tank contaminants			
Check/Replenish battery electrolyte			
EVERY 250 HRS:			
Carry out 50 Hr servicing			
Change engine oil			
Change engine oil filter			
Clean air filter element			
EVERY 500 HRS:			
Carry out 250 Hr servicing			
Replace hydraulic return filter			
(or sooner if indicated by warning lamp)			
Clean hydraulic suction strainer			
Replace fuel filter			
Clean radiator fins			
Check battery voltage			
Check tightness of all fastenings			
Check/Adjust engine valve clearance			
Check cylinder head bolt torque			
Grease slew ring pinion and teeth			
EVERY 1000 HRS:			
Carry out 500 Hr servicing			
Replace track gearbox oil			
Replace hydraulic oil			
Replace air cleaner element			
(or sooner if indicated by warning lamp)			
Replace engine coolant			

Chapter 2

COOLING SYSTEM

Fuel, Air, and Exhaust

3. Clean the area around the agglomerator filter and unscrew the collar.
4. Remove the bowl, filter and seals.
5. Clean the bowl and filter using clean diesel fuel.
6. Inspect the rubber seals for damage and renew if necessary.
7. Apply a small amount of grease to the seals and refit the seals, filter, and bowl. Secure with the collar.
8. Open the fuel supply tap.
9. Vent air from the fuel system (refer to sub-section 3.2.5).
10. Check for leaks.

3.2.5 Venting air from the fuel system

Vent air from the fuel system as follows:

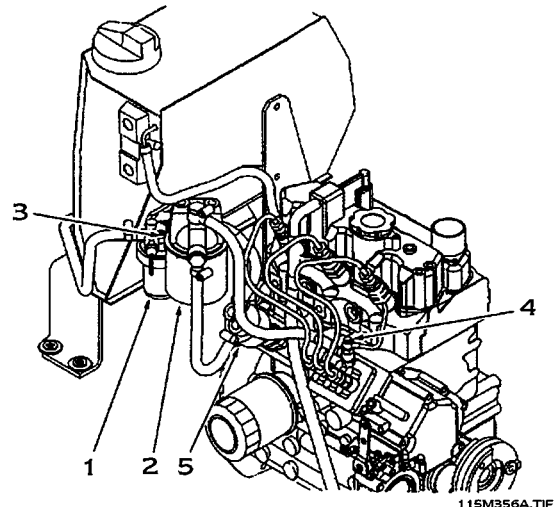
1. Check the level of fuel in the fuel tank is above the level of the agglomerator (1).
2. Loosen the two screws (3) on the fuel line, and with the tap open, wait until bubble-free fuel emerges, then tighten the two screws.
3. Open the vent valve (4) on the fuel injection pump.
4. Operate the hand primer lever on the fuel lift pump (5) until bubble-free fuel emerges.



Note

If no fuel emerges, rotate the engine through 180° to enable the hand primer lever to function (on cam).

5. Close the vent valve (4) on the fuel injection pump.
6. Clean vented fuel from the area of the vent valve (4), agglomerator (1), and filter (2).
7. Start the engine.

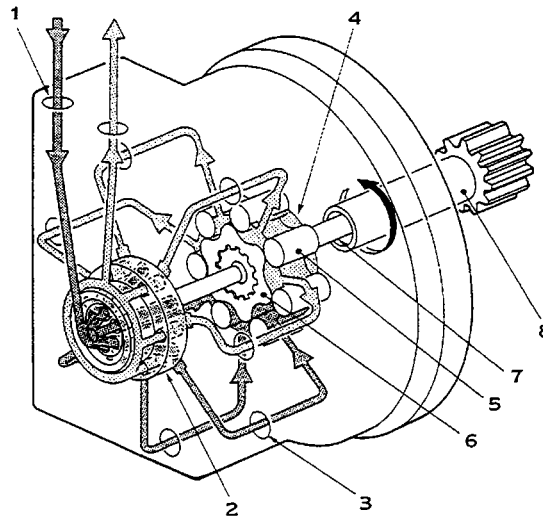


The arrangement of a typical orbit type hydraulic motor is shown below. High pressure hydraulic oil flowing in the main port (1) enters the geroller (4) by way of the valve (2) and valve plate (3). The geroller (4) consists of a stator (5) and rotor (6), and the stator (5) contains seven rollers inside it and is fixed to the housing. The inner rotor has six external gears. For this reason, seven chambers are formed inside the geroller. The rotor (6) is constructed so that it orbits around inside the stator.

On the other hand, there are 12 holes in the valve (2) for hydraulic oil, with high pressure hydraulic oil or returning oil flowing through half of these holes at a time. In the same way, there are oil holes made in the valve plate (3) in seven places. These oil holes connect with the seven chambers in the geroller (4). Thus, since the seven oil holes in the valve plate (3) connect with some of the 12 oil holes in the valve (2) a circuit is formed for oil to flow to the geroller (4).

In this way, orbiting of the rotor (6) of the geroller is started by hydraulic pressure, with only the rotations which take place in the orbiting action being picked up by the drive shaft (7), causing the shaft (8) to rotate. Also, the rotations of the rotor (6) are transmitted by way of the valve drive shaft (7) to the valve (2).

The rotations of the valve (2) cause the oil holes in the valve which connect with the oil holes in the valve plate (3) to shift in sequence. For this reason, high pressure oil flowing in the geroller (4) also flows into sequentially differing chambers. This causes the motor to rotate continuously.



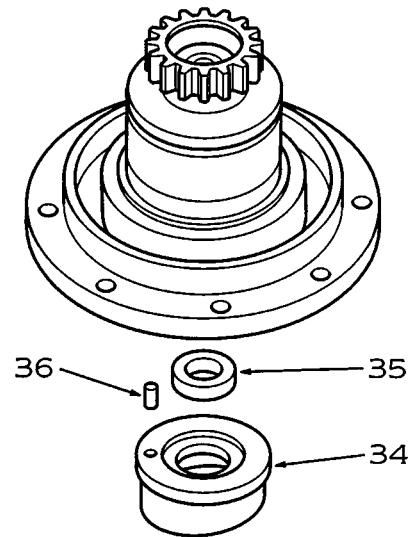
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- (1) Main port
- (2) Valve
- (3) Valve plate
- (4) Geroller

- (5) Stator
- (6) Rotor
- (7) Drive shaft
- (8) Shaft

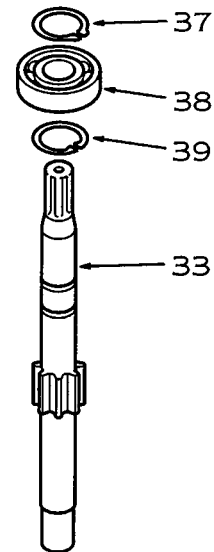
Track Gearbox

22. Remove the angle faced block (34) and the damaged seal ring (35). If necessary, remove the centring pin (36).



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23. Remove the circlip (37), the bearing (38), and the circlip (39) from the bearing and drive shaft (33).



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Inspecting the track gearbox after disassembly

Inspect the track gearbox as follows:

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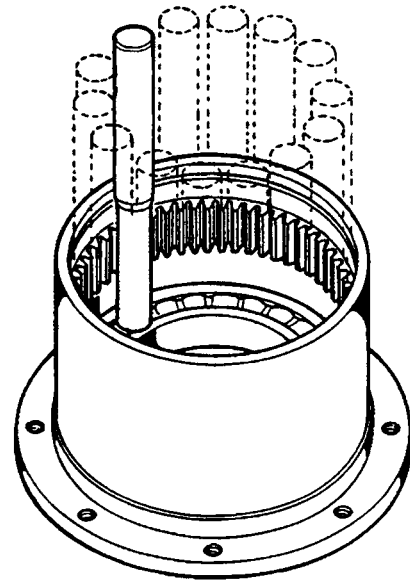
1. Inspect the gears of the first and second stage planetary assemblies. If there is damage to any gear, replace the complete planetary stage including the sun gear.
2. Inspect the components of the brake valve. If you find scratches on the valve sliding surface or if it is rough, replace it. Replace the springs if there is signs of damage or deformity.
3. Inspect the bearing and drive shaft. If it is pitted or worn, replace it.
4. Inspect ball and roller bearings. If there is abnormality in turning, for example noises or not turning smoothly, replace it. If the lapped surface of the lapped bearing shows signs of damage, replace it.
5. Inspect the front seal. If you find scratches or damage, replace it.

15

1. Inspect the gears of the planetary assembly. If there is damage to any gear, replace the complete planetary assembly including the sun gear.
2. Inspect the components of the brake valve. If you find scratches on the valve sliding surface or if it is rough, replace it. Replace the springs if there is signs of damage or deformity.
3. Inspect bearings. If there is abnormality in turning, for example noises or not turning smoothly, replace it. If the lapped surface of the lapped bearing shows signs of damage, replace it.
5. Inspect the front seal. If you find scratches or damage, replace it.

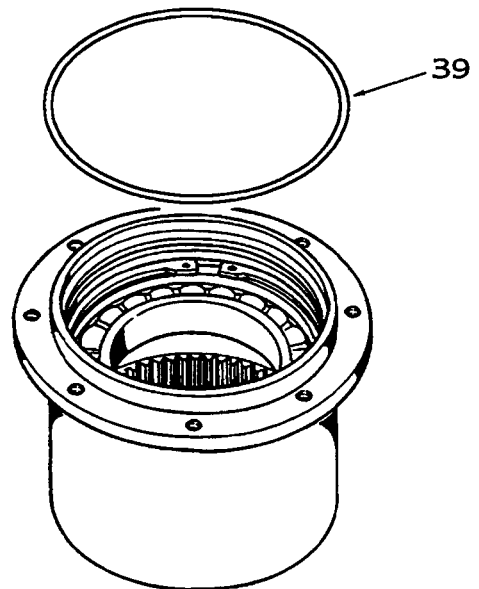
Track Gearbox

3. Reverse the ring gear and push the bearing against the spacer ring.



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4. Install the O-ring (39).



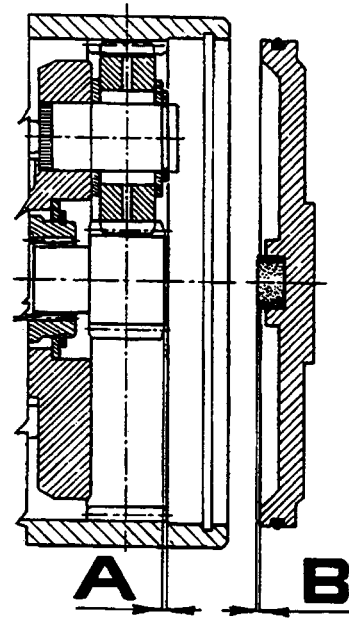
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Track Gearbox

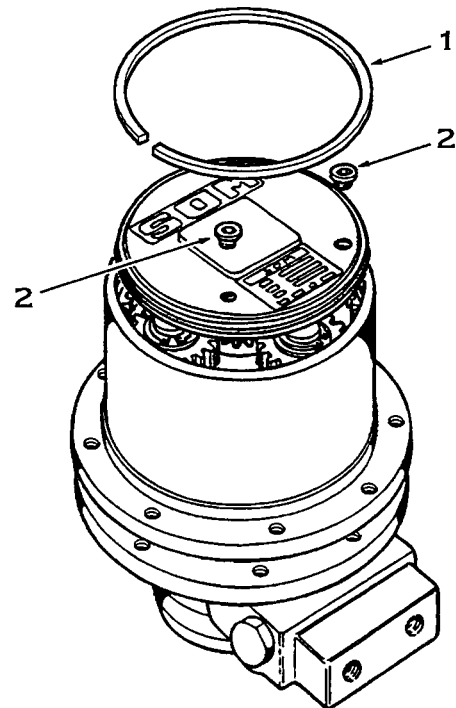
25. Check the following measurements:

- (A) The distance between the cover support face and the sun gear height.
- (B) The distance between the cover face and the pad.

Measurement (A) must be less than measurement (B) by 0.2 to 0.8 mm.



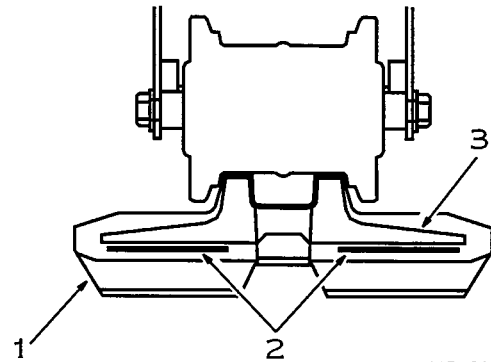
26. Install the end cover on the casing and install the two gas drain plugs (2). Secure the end cover with the internal snap ring (1).



Inspecting rubber track

Inspect the rubber track as follows:

1. Replace the rubber tracks if any of the following are found:
 - The track lugs (1) are worn or the steel cord (2) is exposed.
 - The steel cord (2) is broken.
 - The metal core (3) is worn in one or more places.



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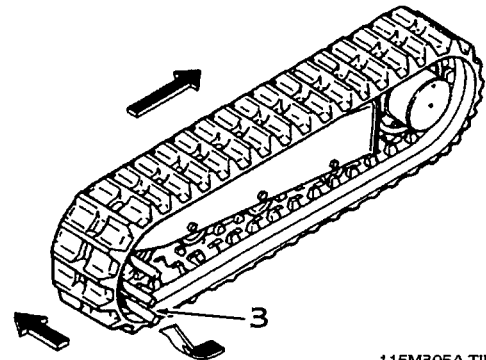


WARNING

Ensure that all persons are clear of the track and especially of the driven sprocket during the following operations. Make sure you have no loose clothing, which could get caught in moving parts.

Install the rubber track as follows:

1. Raise the machine body and set the track (1) on the frame.
 - The track should engage in the sprocket.
2. Engage pieces of iron pipe (3) in the crawler, then rotate the sprockets in the reverse direction.
3. When the iron pipes reach a point just to the side of the idler, stop rotating the sprocket.
4. Slide the track to a position where it will fit snugly with the idler.
5. Remove the iron pipes.
6. Engage the track fully with the sprocket and the idler, then adjust the track tension (refer to sub-section 6.2.5).



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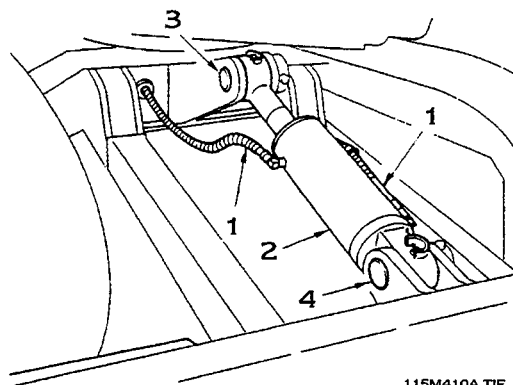
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6.2.11 Removing and installing the dozer blade

Removing the dozer blade

Remove the dozer blade as follows:

1. Disconnect the hydraulic hoses (1) from the dozer blade cylinder (2).
2. Temporarily suspend the dozer blade cylinder (2). Remove the pins (3) and (4) and remove the cylinder.
3. Temporarily suspend the dozer blade (5). Remove the pins (6) and remove the dozer blade.



Installing the dozer blade



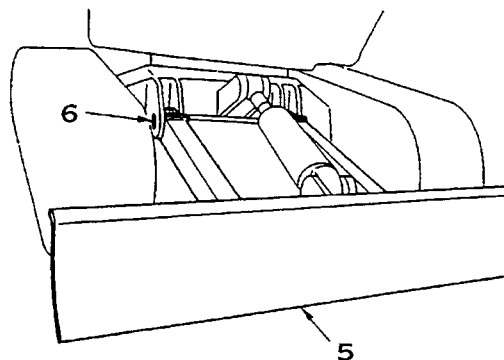
CAUTION

Never put your finger in the hole when lining up. Line up by sight.



Note

Apply a thin coat of grease to the pins before installation. When tightening the two retaining bolt nuts, maintain a clearance of 0.5 to 1 mm between the nuts and bosses.



Install the dozer blade as follows:

1. Position the dozer blade (5) and line up the bores. Install the pins (6) and secure each pin with a bolt and two nuts.
2. Lift the dozer blade cylinder (2) into position and line up the bores. Install pins (3) and (4) and secure each pin with a bolt and two nuts.
3. Connect the hydraulic hoses (1) to the dozer blade cylinder (2).
4. Vent air from the hydraulic system (refer to sub-section 10.2.6).

Chapter 8
SHEET METAL AND COVERS

Key to Electrical Circuit Diagram

- | | |
|--|--|
| (1) Engine oil pressure switch | (19) Battery |
| (1a) Engine oil pressure warning lamp | (20) Starter motor |
| (2) Engine coolant temperature switch | (21) Fuse link (starter motor to alternator) |
| (2a) Engine coolant temperature warning lamp | (22) Warning buzzer |
| (3) Air filter blockage switch | (23) Heater motor switch |
| (3a) Air filter blockage warning lamp | (23a) Heater motor warning lamp |
| (4) Fuel reserve switch | (23b) Heater motor |
| (4a) Fuel reserve warning lamp | (24) Servo isolator switch |
| (5) Fuel tank contents sender | (24a) Servo isolator solenoid |
| (5a) Fuel tank gauge | (25) Fuel shut-off solenoid |
| (6) Engine coolant temperature sender | (26) Ignition switch |
| (6a) Engine coolant temperature gauge | (27) Windscreen wiper enable relay |
| (7) Alternator | (28) Wiper and Washer switch |
| (7a) Charge warning lamp | (28a) Wiper warning lamp |
| (8) Engine glowplugs | (28b) Wiper motor |
| (8a) Engine glowplug warning lamp | (29) Washer motor |
| (9) Hourmeter | (30) Instrument cluster |
| (10) Diodes | |
| (11) Load switching device | |
| (12) Work light switch | |
| (13) Work light relay | |
| (14) Front and Rear work lights | |
| (15) Radio | |
| (16) Interior light | |
| (17) Horn | |
| (18) Beacon switch | |
| (18a) Beacon warning lamp | |
| (18b) Beacon motor | |

Wiring colour code

N - Brown	LTG - Light green
Y - Yellow	O - Orange
U - Blue	W - White
K - Pink	L - Lilac
G - Green	R - Red
B - Black	S - Slate

For example:

Wire number NR1A3:

NR - Wire colour (Brown/Red)
1 - Wire cross section (mm)
A - Type (Harness)
3 - Wire number

Chapter 10
HYDRAULIC SYSTEM (EXCEPT CYLINDERS)

Hydraulic System (Except Cylinders)

Servo controller

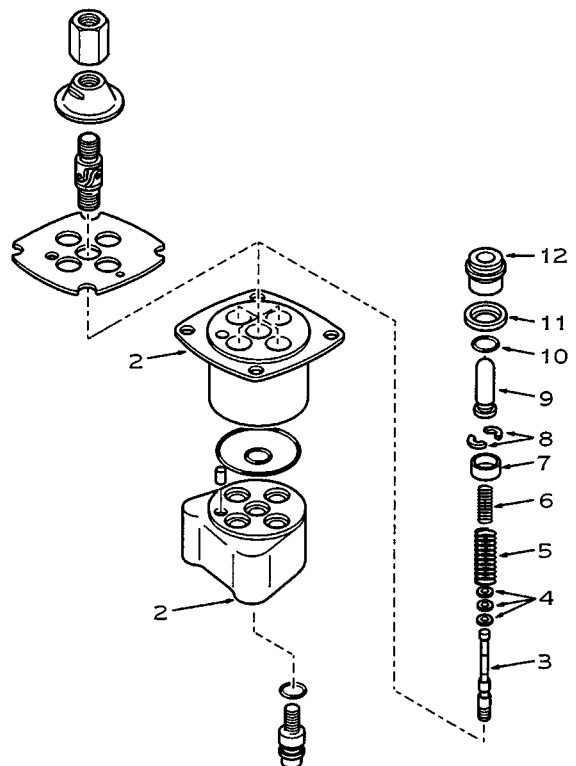
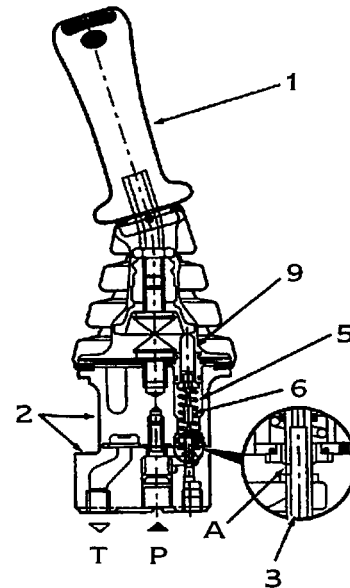
Two identical servo controllers are used, the right-hand operating lever also incorporates the horn switch.

Each servo controller comprises a control lever (1) operating on four pressure reducing valves in housing (2). The pressure reducing valves consist of a control spool (3), shims (4), return spring (5), control spring (6), spring clip (7), clips (8), plunger (9), O-ring (10), seal (11), and guide (12).

When the services are not selected, the control lever (1) is held in the neutral position by the four return springs (5). In this position, control ports 1, 2, 3 and 4 are connected to the tank port 'T' through the boring 'A' (see insert).

When a service is selected by moving the control lever, the plunger (9) pushes against the return spring (5) and the control spring (6). The control spring (6) first moves the control spool (3) downwards and closes the connection between the selected control port and the tank port 'T'. At the same time the selected control port is connected to the supply port 'P' through boring 'A'.

The control phase begins as soon as the control spool (3) has found its balance between the force of the control spring (6) and the resistance offered by the selected control port. Through the co-operation of the control spool (3) and control spring (6), the pressure in the selected control port is proportional to the stroke of the plunger (9) and therefore the control lever (1).



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Hydraulic System (Except Cylinders)

Replace the main hydraulic pump seals as follows:

1. Remove the main hydraulic pump (refer to sub-section 10.2.8).



CAUTION

Do not strip the main pump unless it can be rig-tested before refitting to the machine.

2. Before starting to dismantle the pump, mark the pump sections, flange, and end cover to ensure correct alignment on reassembly.
3. Remove the nuts (1) and washers (2) and remove the tie bolts.

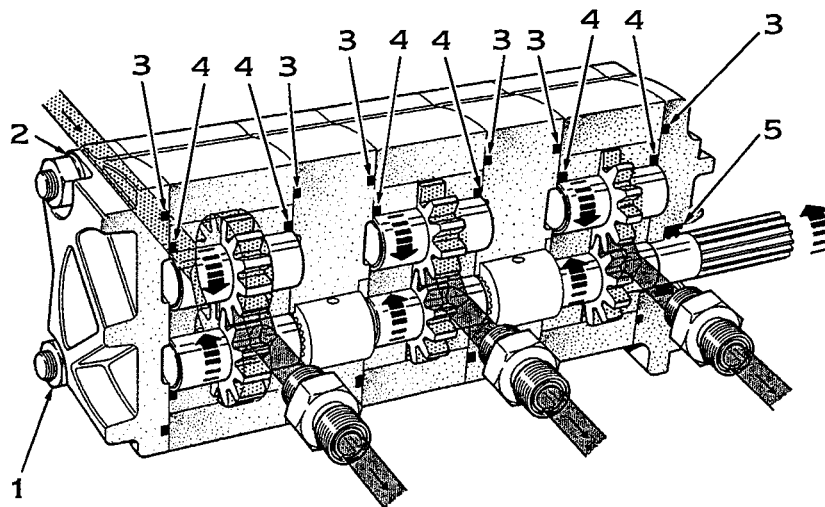


CAUTION

Do not use levers of any kind to separate the pump sections.

4. Using a soft faced hammer, separate the pump sections.
5. Remove the bearing blocks and gears, keeping the components together in their relative positions.
6. Remove the seals (3), (4), and (5).

7. It is normal for the gears to have cut a slight track in the body bore on the inlet side. The gear track cannot be measured accurately but will be related to bearing wear. Examine the bores of the bearing blocks which are coated during manufacture with Polytetrafluoroethylene (PTFE). If the grey PTFE is worn through so that large areas of the bronze bases are visible, the complete pump must be renewed.
8. Renew pump if faces of bearing blocks are scored or if side faces of gears are chipped or damaged. DO NOT use any abrasives on the bearing blocks or gears as this would destroy critical manufacturing dimensions.
9. Install the bearing blocks and gears in their relative pump sections.
10. Install new seals (3), (4), and (5).
11. Assemble the sections of the pump on new tie bolts and secure with new washers (2) and nuts (1). Tighten the nuts to a torque of 5.5 to 6.2 kgf/m.
12. Rig-test the main hydraulic pump (refer to sub-section 10.2.31).
13. Install the main hydraulic pump (refer to sub-section 10.2.8).



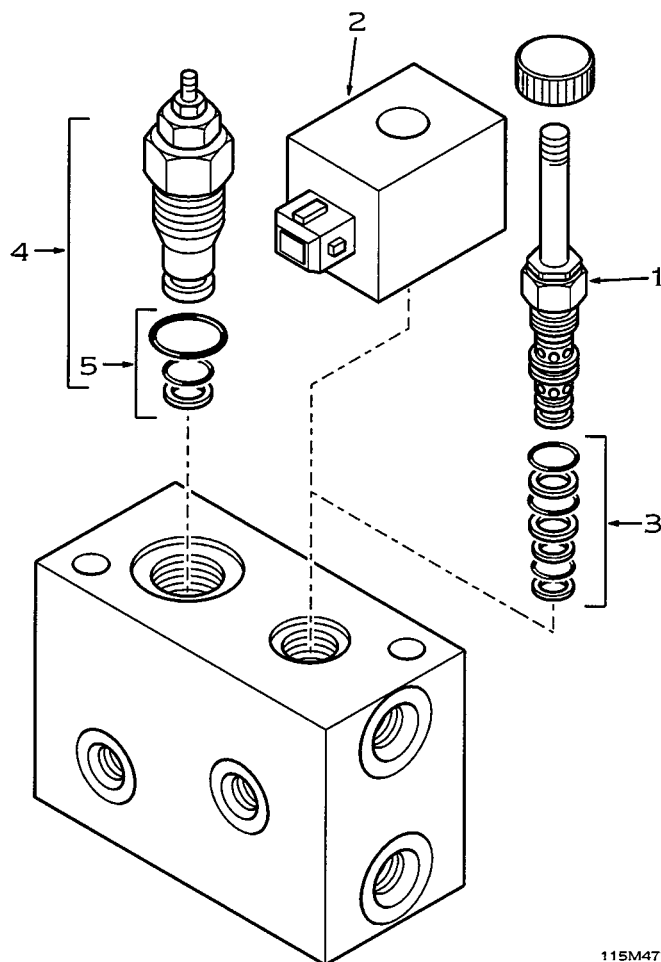
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Hydraulic System (Except Cylinders)

Installing the solenoid valve

To install the solenoid valve, carry out the following steps:

1. Position the solenoid valve and secure from underneath with the two bolts.
2. Connect the hydraulic pipes at the solenoid valve.
3. Connect the electrical connections at the solenoid valve.
4. Connect the battery positive lead.
5. Pressurise the hydraulic tank (refer to sub-section 10.2.5).



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10.2.20 Replacing the solenoid valve seals

Replace the solenoid valve seals as follows:

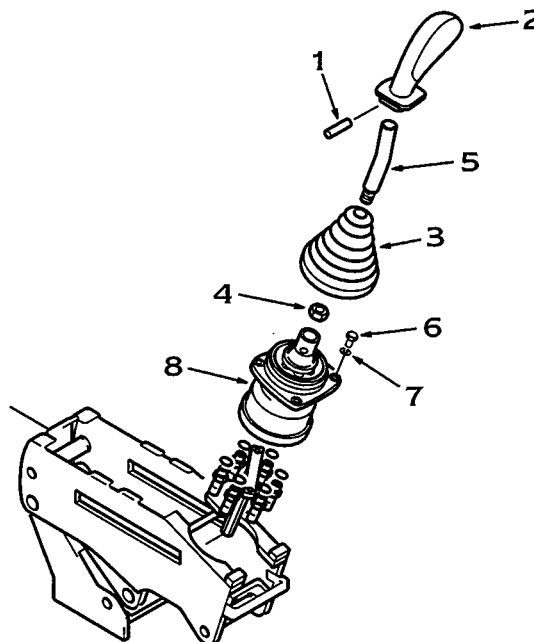
1. Remove the solenoid (2).
2. Remove the solenoid valve (1) and replace the seals (3).
3. Remove the relief valve (4) and replace the seals (5).

10.2.21 Removing and installing the servo controller

Removing the servo controller

To remove the servo controller, proceed as follows:

1. Disconnect the battery positive lead.
2. Depressurise the hydraulic tank by slowly unscrewing the plug on the top of the tank.
3. Raise the control console (left or right).
4. Remove the handle on the left console, or the right console for canopy versions, as applicable.
5. Remove the roll pin (1) and remove the handle (2).
6. Remove the rubber boot (3).
7. Loosen the nut (4) and remove the lever (5).



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10.2.32 Adjusting the Port Relief Valve (PRV) set pressure

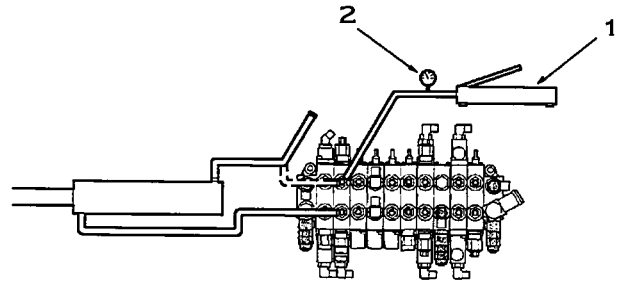
Adjust the PRV set pressure as follows:



CAUTION

Do not test or reset the port relief valve by over pressurising the main relief valve. The port relief valve is not designed to accommodate full pump flow and the aluminium pump will almost certainly be damaged by such action.

1. With the engine stopped, vent any residual pressure between the spool and the affected service.
2. Disconnect the supply hose either at the service or the valve block.
3. Connect in its place a hand pump (1) and a 0-400 bar test gauge (2) either to the selected hose or port and pump back to the spool in neutral.
4. Adjust the PRV to release at 245 bar.
5. Disconnect the test equipment and re-connect the service hose.
6. Start the engine and test for leaks.



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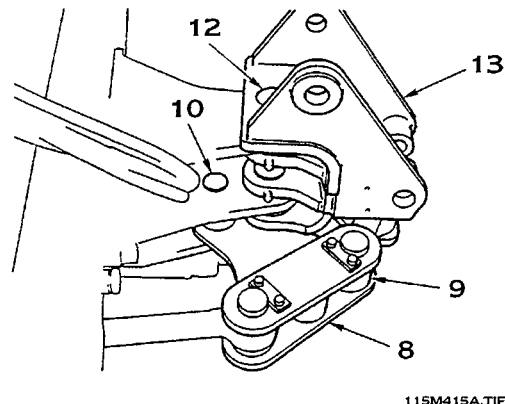
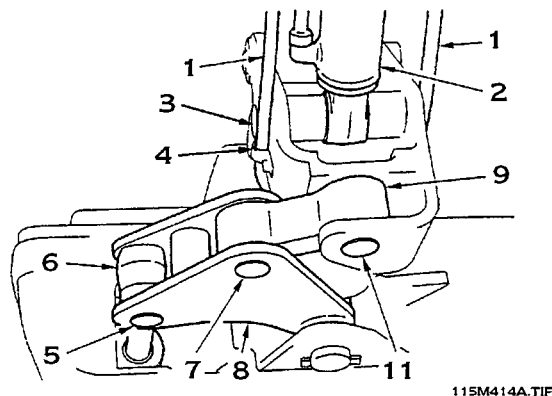
Chapter 12
BOOM, DIPPER, AND LINKAGE

12.2.6 Removing and installing the king post support, off-set arm and linkage

Removing the king post support, off-set arm, and linkage

Remove the king post support, the off-set arm, and the linkage as follows:

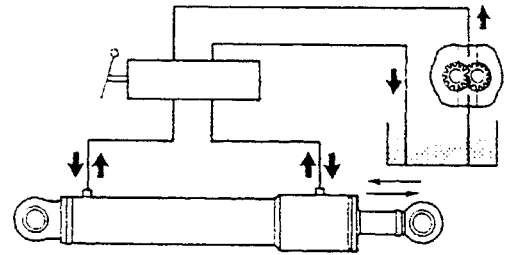
1. Remove the boom (refer to sub-section 12.2.5).
2. Disconnect the hydraulic hoses (1) from the boom cylinder (2).
3. Suspend the boom cylinder (2) and remove the pin (3). Remove the boom cylinder (2).
4. Remove the hose clamps and the plates (4).
5. Remove the pin (5) and disconnect the offset cylinder rod (6).
6. Remove the pin (7), and disconnect the offset arm (8), and the link (9). Collect the dust seals and the spacers.
7. Remove the pin (10) and remove the off-set arm (8). Collect the dust seals and the spacers.
8. Remove the pin (11) and remove the link (9). Collect the spacers.
9. Suspend the king post support (13). Remove the pivot pins (12) and remove the king post support (13). Collect the washers.



Inspecting cylinders after assembly

(No load operation test)

1. Place the cylinder in a horizontal position with no load.
2. Apply gentle pressure alternately to the ports at both sides, operating the piston rod 5 or 6 times.
3. Make sure there is no abnormality in the operating condition.



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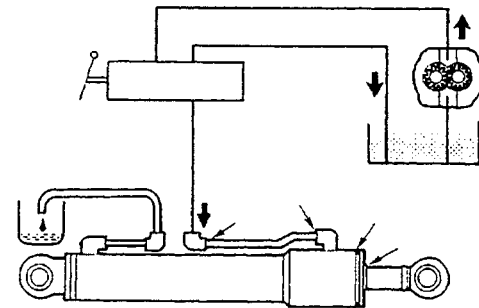
13.2.4 Cylinder leak test

External leakage

1. Apply a test pressure of 190 bar for 3 minutes to each of the retraction and extension sides of the cylinder.
2. Ensure there are no external leaks from the rod seal, the rod cover mount, the connections, or the welded seams.

Internal leakage

1. Disconnect the extension side hose.
2. Apply a test pressure of 190 bar to the retraction side for 3 minutes.
3. Measure the amount of hydraulic oil which leaks from the extension side. The amount should not be more than 1 cc in the 3 minutes.



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Superstructure (Including Slew Motor)

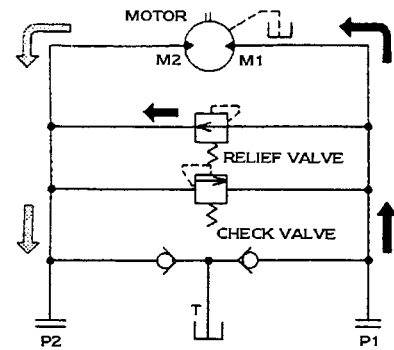
Relief valve

When the motor is started.

When the motor is started, since the inertial load is great, the pressure of the oil required to accelerate it rises. If this pressure reaches the relief valve set pressure, the relief valve operates and oil returns to port M2.

In this way, the motor begins to turn as it relieves the relief valve, and as the rotational speed increases, the amount of relief decreases until it ceases.

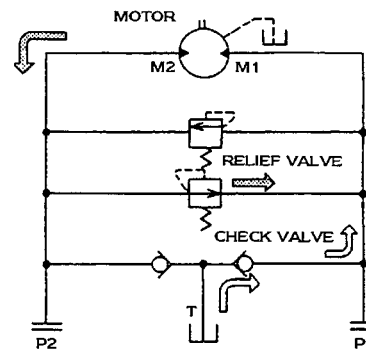
In this way, the shock during starting is absorbed.



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When the motor is stopped.

When the motor is stopped, the return circuit is closed off. However, since the motor is forced to continue rotating due to inertial energy, the pressure in port M2 rises. When this pressure reaches the relief valve's set pressure, the relief valve operates and oil flows to port M1. On the other hand, a vacuum is generated at port M1. For this reason, oil flows into port M1 from the tank (T). In this way, the flow of oil to port M1 prevents cavitation from occurring as it absorbs the shock during stopping.



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14.2.2 Removing and installing the superstructure

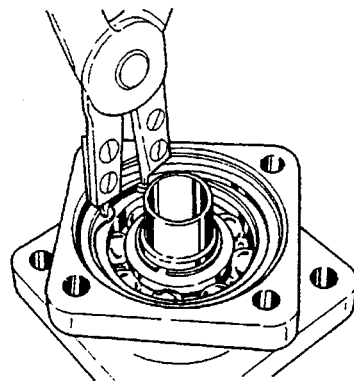
Removing the superstructure

Remove the superstructure as follows:

1. Remove the floor plate (refer to sub-section 8.2.2).

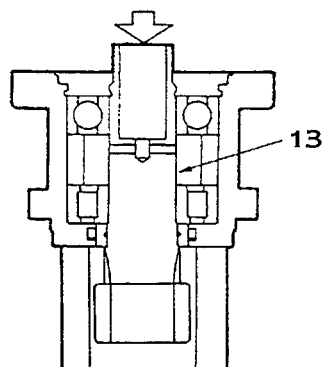
Superstructure (Including Slew Motor)

7. Remove the snap ring and retaining ring.



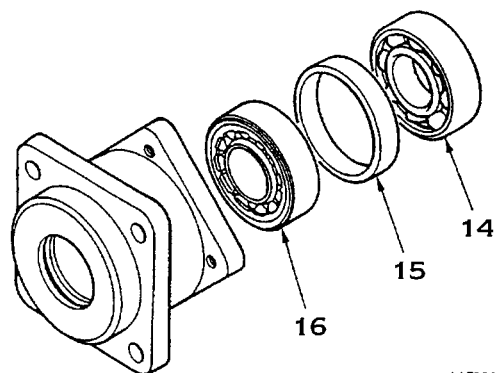
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8. Tap on the shaft (13) with a plastic hammer to remove it from the housing.



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9. Remove the ball bearing (14), spacer (15), and roller bearing (16) from the housing.



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