Service Manual

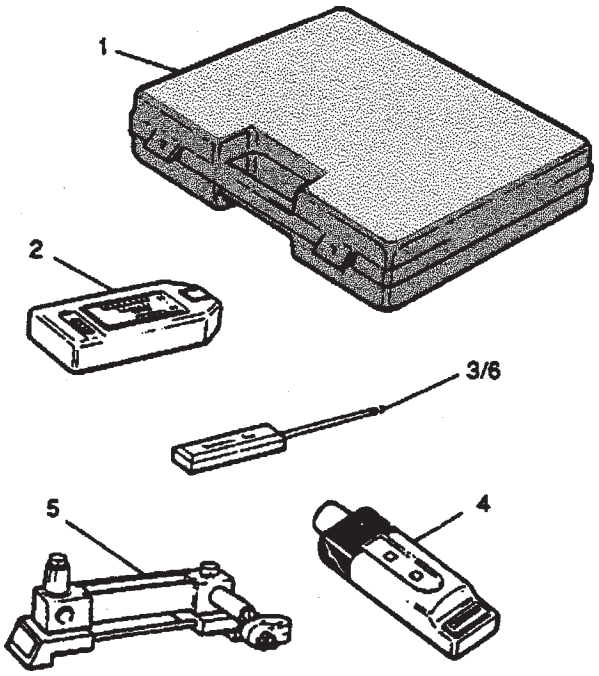
JS 210 LC

110026 On

PUBLISHED BY THE
PRODUCT SUPPORT DEPARTMENT
OF JCB SERVICE :
23/7, MATHURA ROAD,
BALLABHGARH, FARIDABAD
TEL. : 0129-4299000
Part No. : 9803/6510

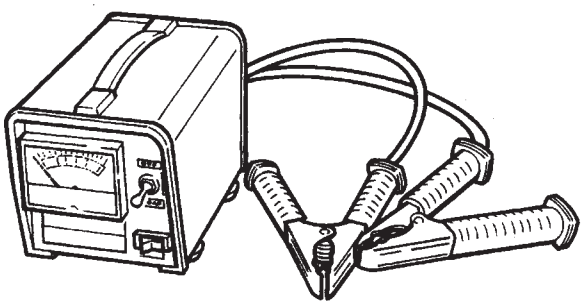
Service Tools

SECTION C - Electrics



Electrical Test Equipment

1	892/00283	Tool Kit Case
2	892/00281	AVO Meter
3	892/00286	Surface Temperature
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

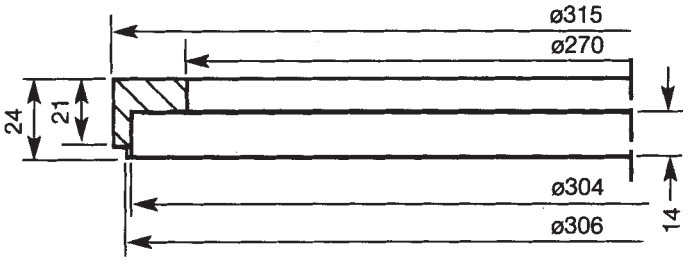
Service Tools (cont'd)

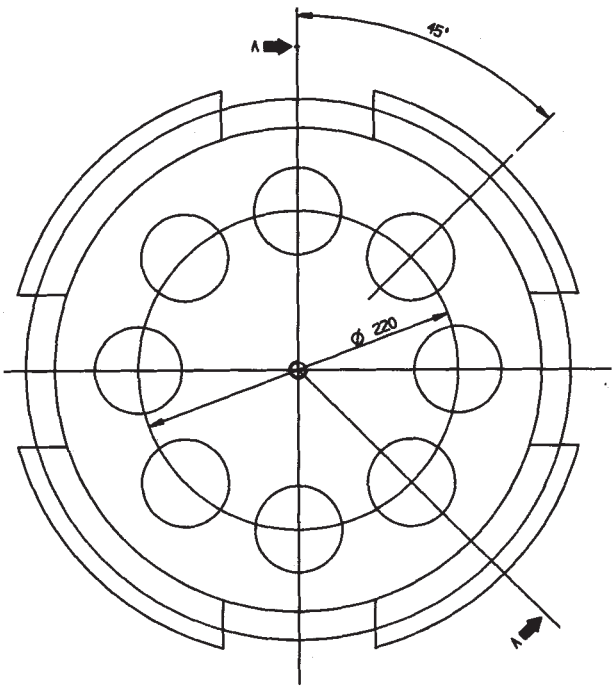
SECTION F - Transmission

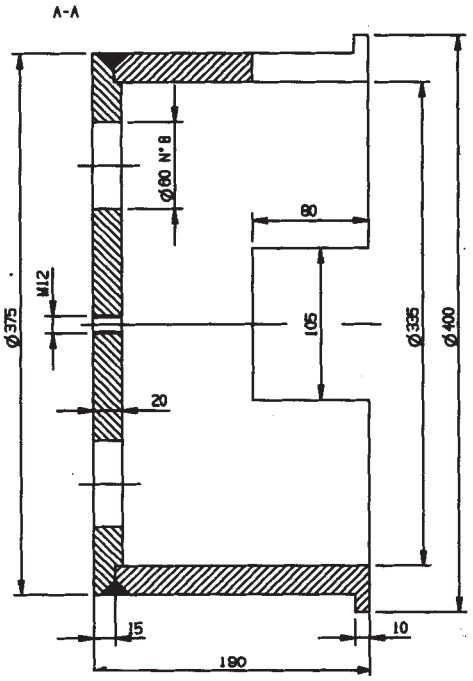
Track Gearbox Jig

STO037 Re-sealing Tool
(All dimensions are in mm.)

SST0037







Stopper for the assembly of Hydraulic motor on track gearbox

A409010

Maintenance Safety (cont'd)

⚠

⚠

⚠

⚠

⚠

⚠

⚠

⚠

⚠

A poorly maintained machine is a hazard. Doing the regular maintenance and lubrication jobs listed in these schedules will help keep the machine in safe running order.

Apart from the daily jobs, the schedules are based on machine running hours. Keep a regular check on the hour meter reading. Do not use a machine which is due for a regular service. Rectify any defects found during regular maintenance before clearing the machine for use.

Types of Fuel

Use good quality diesel fuel to get the correct power and performance from your engine. The recommended fuel specification is given below.

Cetane Number : 45 (minimum)
Viscosity : 2.5/4.5 centistokes at 40°C (104°F)
Density : 0.836/0.866 kg/litre (1.046/1.084 lb/pint)
Sulphur : 0.5% of mass (maximum)

Distillation : 85% at 350°C (662°F)

Cetane Number
Indicates ignition performance. Fuel with a low cetane number can cause cold start problems and affect combustion.

Viscosity
This is the resistance to flow. **If** this is outside limits, the engine performance can be affected.

Density
Lower density will reduce engine power. Higher density will increase both engine power and exhaust smoke.

Sulphur
High sulphur content can cause engine wear. (High sulphur fuel is not normally found in North America, Europe or Australia). If you have to use a high sulphur fuel you must also use a highly alkaline engine lubricating oil; or change the normal oil more frequently.

Distillation
This indicates the mixture of different hydrocarbons in the fuel. A high ratio of lightweight hydrocarbons can affect the combustion characteristics.

Low Temperature Fuels
Special winter fuels may be available for engine operation at temperatures below DoC (32°F). These fuels have a lower viscosity. They also limit wax formation in the fuel at low temperatures. (Wax forming in the fuel can stop the fuel flowing through the filter).
Flow improvers may also be available. These can be added to the fuel to reduce wax formation.

Advice
Consult your fuel supplier or JCB distributor concerning the suitability of any fuel you are not sure about. **If** you have to use non-standard fuels, contact your JCB distributor for advice on engine adjustments and oil change periods.

Fatty Acid Methyl Ester Fuels as a replacement for Diesel Fuels

Fuel resources such as Rape Methyl Ester and Soybean Methyl Ester, collectively known as Fatty Acid Methyl Esters are being used as alternatives and extenders for mineral oil. Fatty Acid Methyl Esters must conform to certain standards to be of acceptable quality, just as mineral oils do at present. Consult your JCB distributor for advice about the use of Fatty Acid Methyl Ester fuels, as improper application may impair engine performance.

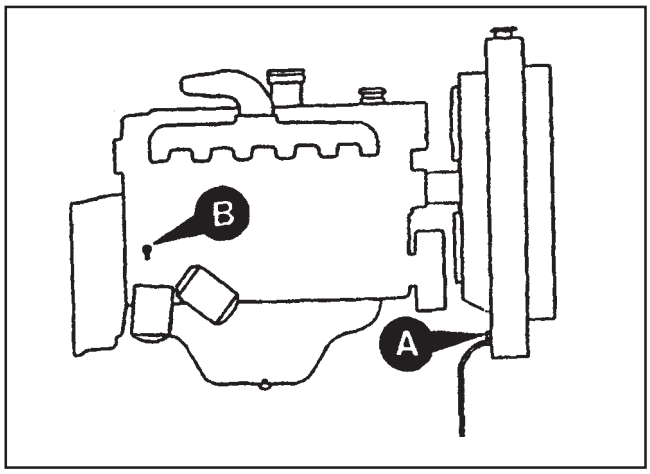
Filling the Tank and Fuel Level Checking
For location of fuel tank refer to Identification of Machine Components at the end of this section

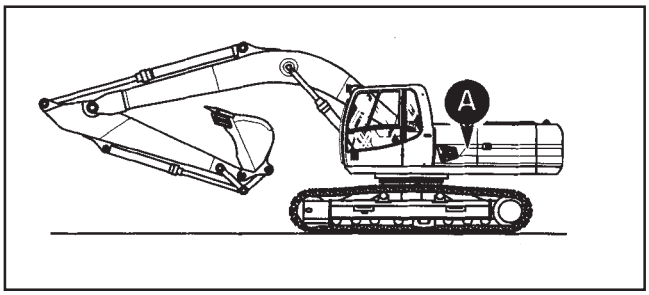
Changing The Coolant

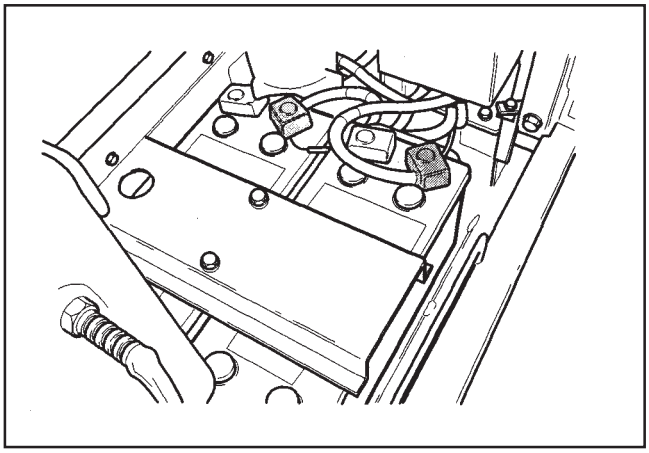
1 Do Steps 1 and 2 of Checking the Coolant Level.

2 Drain the system.

Remove the radiator pressure cap. 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.




A



To extend the service life and improve the operation of the machine, daily inspection and lubrication are necessary as well as immediately isolating any problem found and dealing with it. If the machine is operated with the problem uncorrected, it may lead to larger trouble and possibly to a big accident.

If trouble occurs, search for the cause in the items below and make adjustments, repairs, etc. as necessary.

Engine and Related Area

Problem	Cause	Remedy
Engine does not start	Defective starter switch (Starter does not run) Defective rotation of starter (Starter rotates slowly) Improper viscosity of engine oil Excessive cooling of engine (Cold weather) Possible seizure in engine Incomplete air bleeding of fuel system No fuel in fuel tank Fuel quality unsuitable Fuel filter clogged Low compression Defective fuel injection pump	Connect, repair connection. Discharged battery, starter problems, contaminated or loose wiring connection. Inspect and replace as necessary. Preheat with air heater. Warm up the coolant (add hot water). *Repair. Completely bleed air. Refill. Inspect and replace as necessary. Clean or replace. *Repair *Repair.
Engine stops during operation	No fuel in fuel tank Fuel filter clogged Air is mixed in the fuel system	Refill. Clean and replace. Retighten fuel pipe connections and bleed system.
Low oil pressure	Low oil Defective oil pressure switch Oil filter clogged Low oil viscosity Improper operation of oil pump Oil leakage at connections	Refill. Replace. Replace element. Replace with oil of viscosity matching temperature. *Replace parts. Tighten connections.
Exhaust gas from engine is white or blue	Excessive oil consumption Excessively low oil viscosity Excessive cooling by radiator Improper fuel injection timing Low compression	Disassemble and repair, replace parts. Replace with correct oil. Adjust. *Adjust or replace if necessary. *Disassemble and repair, replace parts.
Exhaust gas from engine is black or dark grey	Improper fuel Improper valve clearance Defective fuel injection pump/injectors Low compression Insufficient air intake (air cleaner clogged)	Replace with correct fuel. Adjust. *Adjust or replace if necessary. *Disassemble and repair, replace parts. Clean or replace the element.
Excessive fuel consumption	Defective fuel injection pump Improper spray from fuel injection nozzle Improper fuel injection timing Improper fuel Low compression Insufficient air intake	*Adjust or replace if necessary. *Adjust or replace if necessary. *Adjust or replace if necessary. Replace with correct fuel. Disassemble and repair, replace parts. Clean or replace element.
Excessive engine oil consumption	Excessive oil Low oil viscosity Oil leakage Worn cylinder piston rings	Drain oil to proper level. Replace with oil of viscosity matching temperature. Retighten and replace parts if necessary. *Disassemble and repair, replace parts.
Abnormal noise.(Fuel or mechanical)	Bad fuel Damage inside muffler	Replace. Replace.

***Refer to Engine Service Manual Publication No. 9803/2210**

Torque Settings

Use only where no torque setting is specified in the test. Values are for dry threads and may be within three per cent of the figures stated. For lubricated threade the values should be REDUCED by one third.

UNF Grade 'S' Bolts

Bolt Size		Hexagon (A/F)		Torque Settings	
In	(mm)	In	Nm	kgf m	lbf ft
1/4	(6.3)	7/16	14	1.4	10
5/18	(7.9)	1/2	28	2.8	20
3/8	(9.5)	9/16	49	5.0	36
7/16	(11.1)	5/8	78	8.0	58
1/2	(12.7)	3/4	117	12.0	87
9/16	(14.3)	13/16	170	17.3	125
5/8	(15.9)	15/16	238	24.3	175
3/4	(19.0)	11/8	407	41.5	300
7/8	(22.2)	15/16	650	66.3	480
1	(25.4)	11/2	970	99.0	715
11/4	(31.7)	17/8	1940	198.0	1430
11/2	(38.1)	21/4	3390	345.0	2500

Metric Grade 8.8 Bolts

Bolt Size		Hexagon (A/F)		Torque Settings	
	(mm)	mm	Nm	kgf m	lbf ft
M5	(5)	8	7	0.7	5
M6	(8)	10	12	1.2	9
M8	(8)	13	28	3.0	21
M10	(10)	17	56	5.7	42
M12	(12)	19	98	10	72
M16	(16)	24	244	25	180
M20	(20)	30	476	48	352
M24	(24)	36	822	84	607
M30	(30)	46	1633	166	1205
M36	(36)	55	2854	291	2105

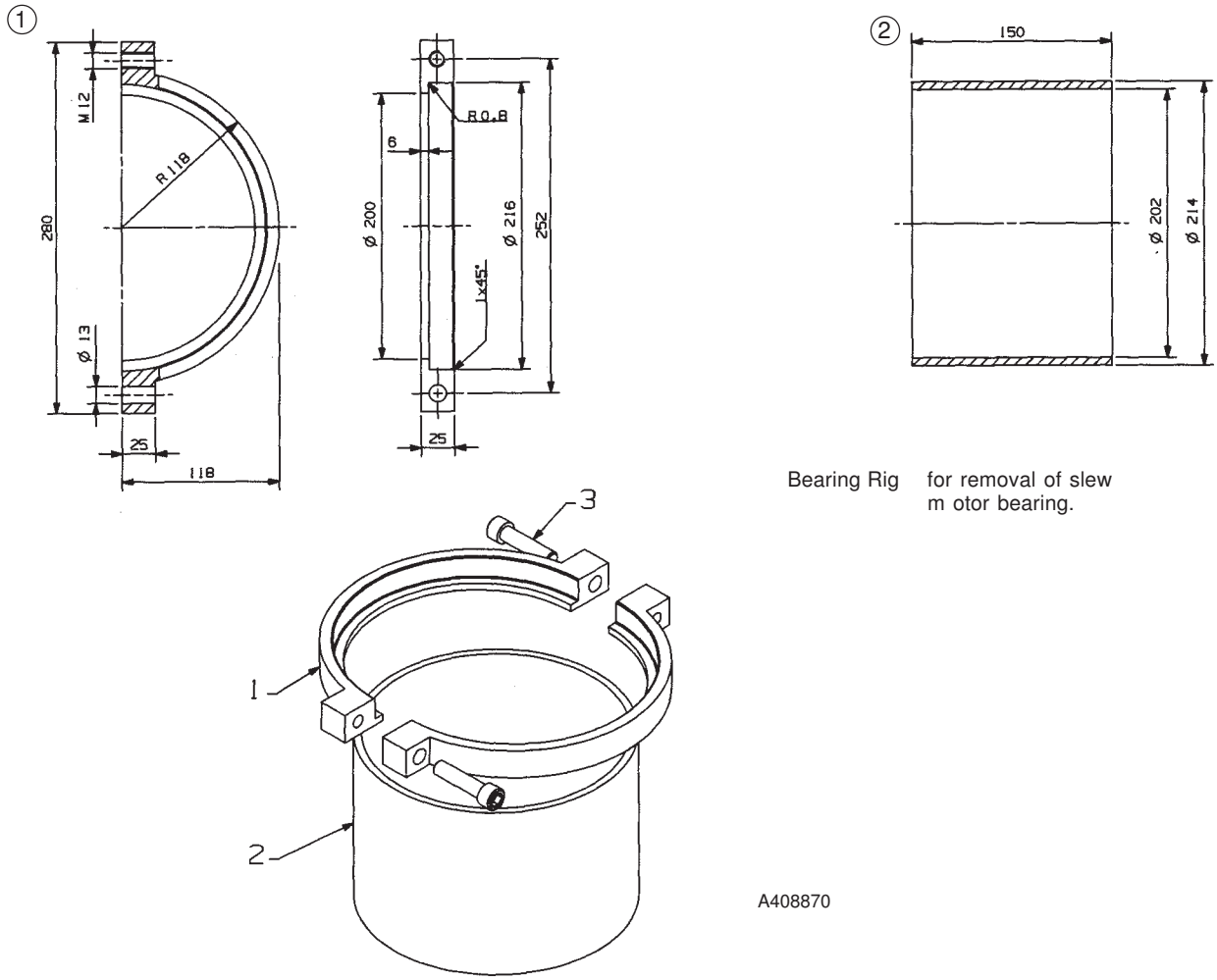
River Nut Bolts/Screws

Bolt Size		Torque Settings (for steel rivet nuts)		
	(mm)	Nm	kgf m	lbf ft
M3	(3)	1.2	0.12	0.9
M4	(4)	3.0	0.3	2.0
M5	(5)	6.0	0.6	4.5
M6	(6)	10.0	1.0	7.5
M8	(8)	24.0	2.5	18.0
M10	(10)	48.0	4.9	35.5
M12	(12)	82.0	8.4	60.5

Note : All bolts used on JCB machines are high tensile and must not be replaced by bolts of a lesser tensile specification.

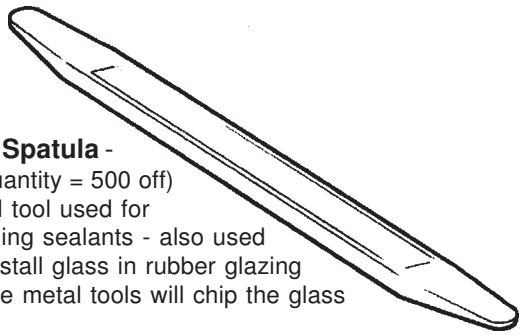
Service Tools (cont'd)

SECTION E - Hydraulics (con'd)



Bearing Rig for removal of slew m otor bearing.

Service Tools



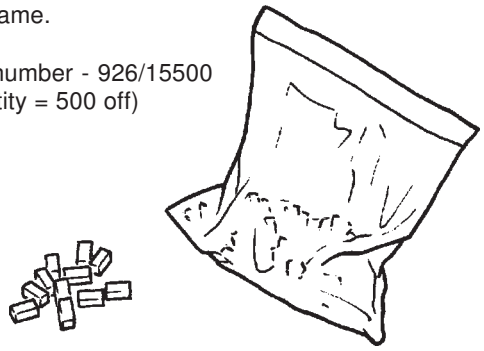
Nylon Spatula -
(unit quantity = 500 off)
general tool used for
smoothing sealants - also used
to re-install glass in rubber glazing
because metal tools will chip the glass
edge.

JCB part number - 892/00847

S186470

Rubber Spacer Blocks - used to provide the correct set clearance between glass edge and cab frame.

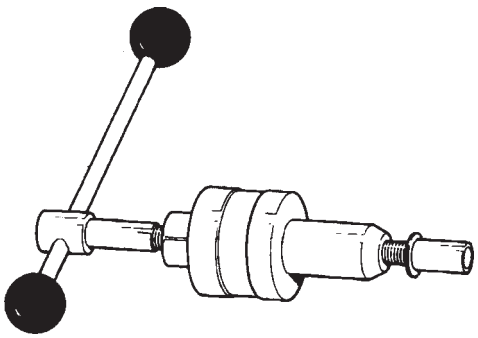
JCB part number - 926/15500
(unit quantity = 500 off)



S186550

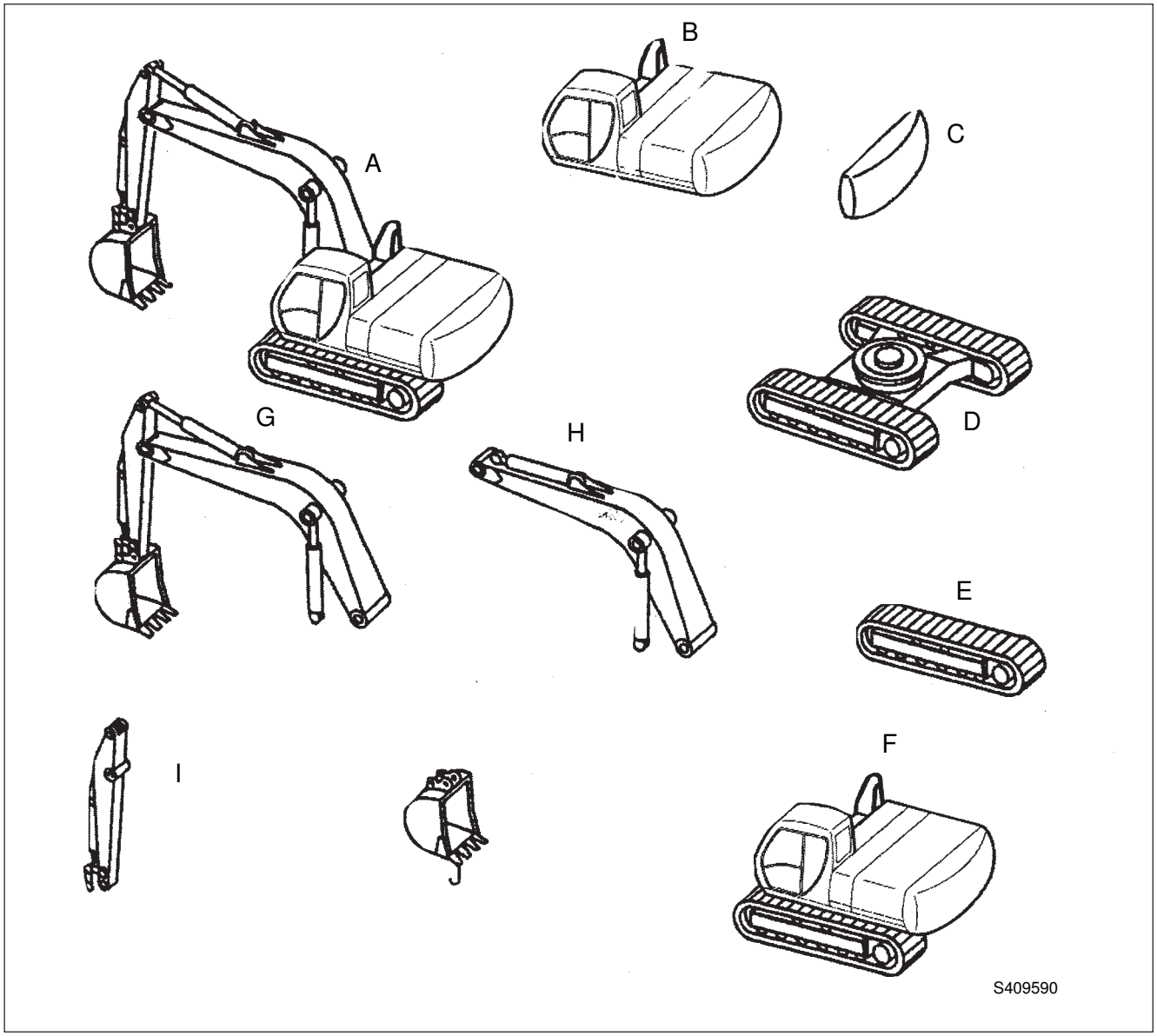
826/01099 M6 x 16mm Rivet Nut
826/01101 M6 x 19mm Rivet Nut
826/01103 M8 x 18mm Rivet Nut
826/01102 M8 x 21 mm Rivet Nut
826/01104 M10 x 23mm Rivet Nut
826/01105 M10 x 26mm Rivet Nut

Installation Tool Available from:
Bollhoff Fastenings Ltd.
Midacre
The Willenhall Estate
Rose Hill
Willenhall
West Midlands, WV13 2JW

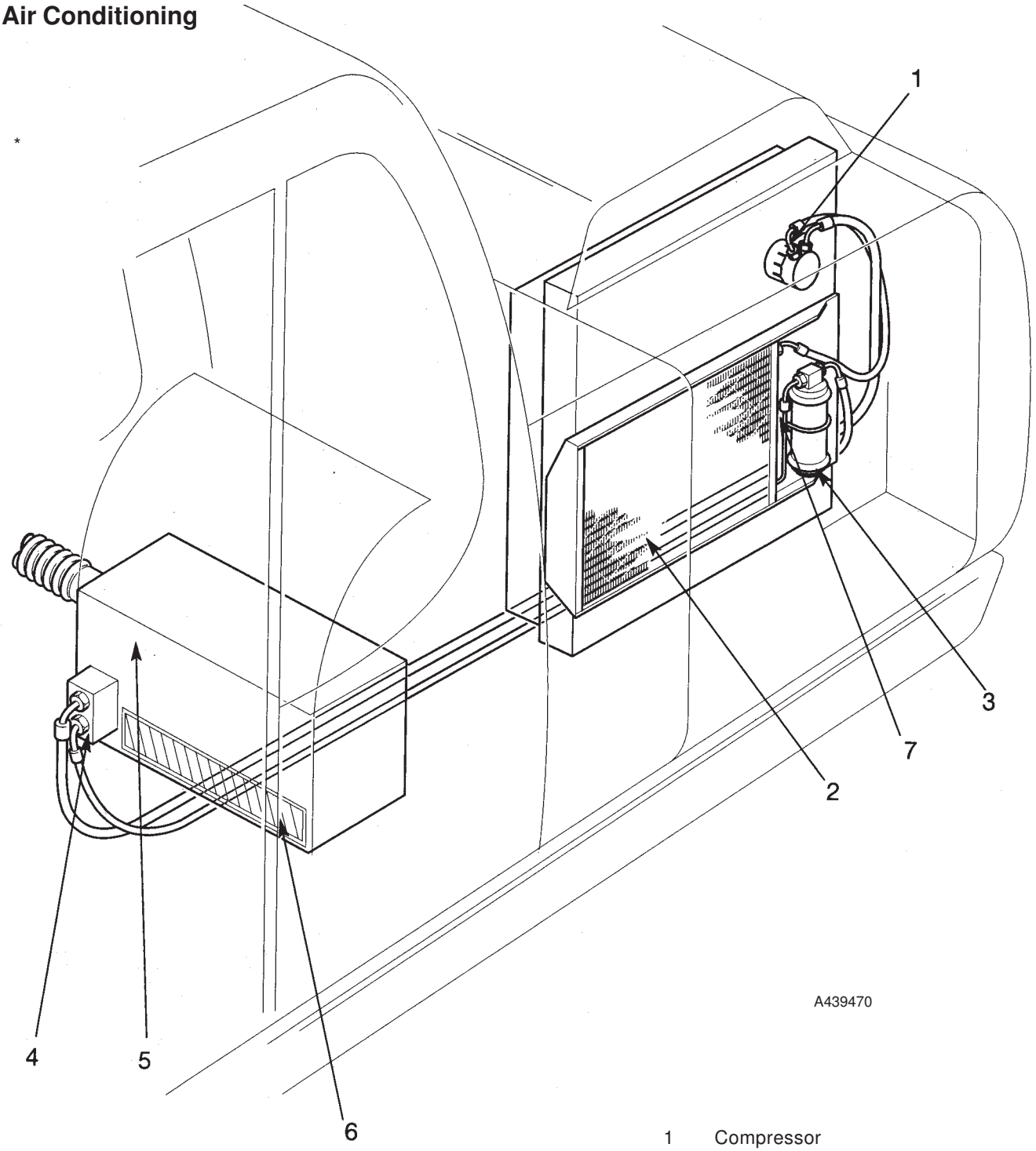


S261210

Weights



Air Conditioning



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

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).

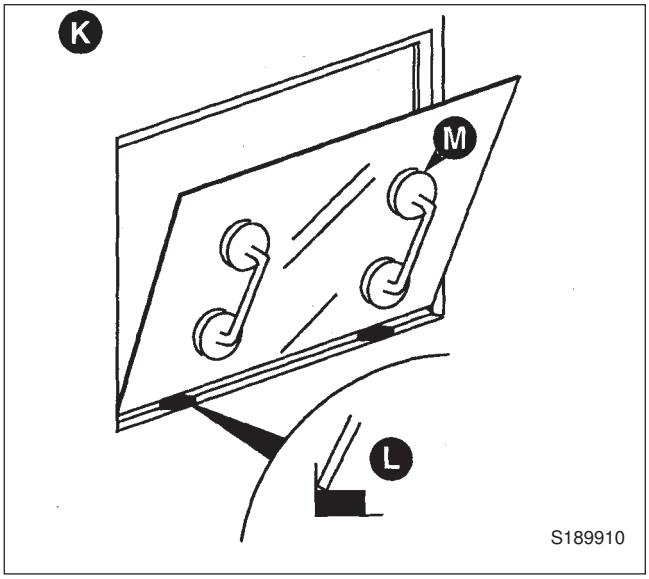
Small panes of glass will need locating on a 600 x 700 mm x 15 to 19 mm thick plywood board **P** (sourced locally to fit the glass stand **N**). It is recommended that an access hole is cut in the board to accommodate the glass lifter, making it easier and safer to handle small panes of glass. The board 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.

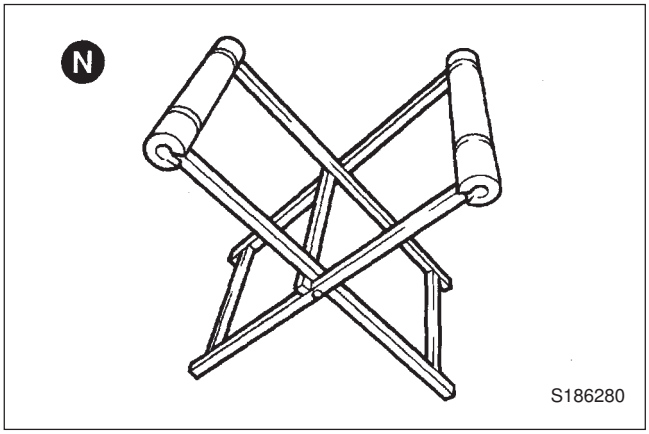
3 Make sure the glass is positioned on the stand the correct way up (i.e. with the black ceramic ink band upwards) ready for application of primer etc.

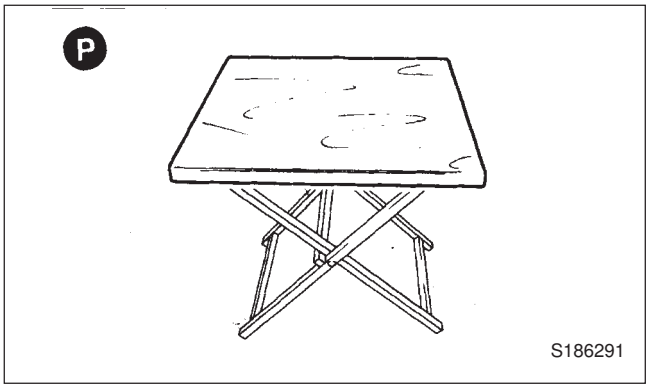
4 a Use 'Active Wipe 205' to thoroughly clean and 'prime' the black ceramic ink band printed on the glass (see Note 1). Use a lint free cloth to apply the 'Active Wipe 205', allow 5 minutes flash off (drying) time.

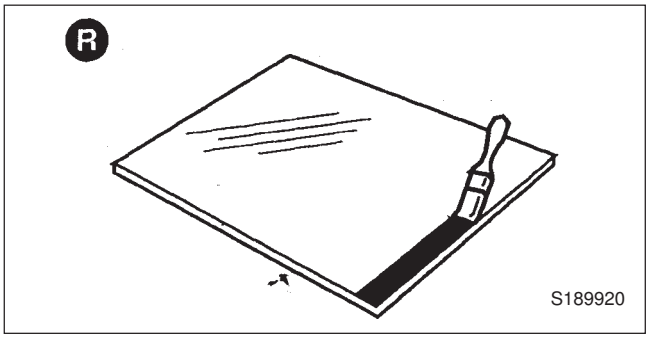
Note 1: Do not touch the glass after cleaning with the 'Active Wipe 205'.

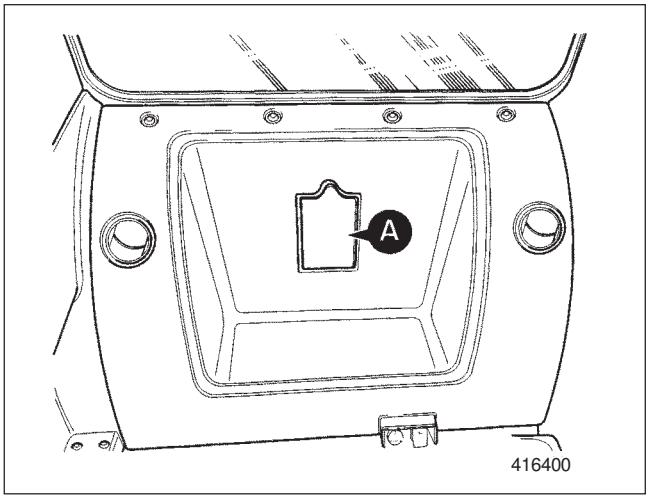
b If the glass does not have a black ceramic ink band, paint a band on the glass using 'Black Primer 206J'. The band should be approximately 25mm (1 in) wide, and the edge should be a neat straight line as shown at **R.**

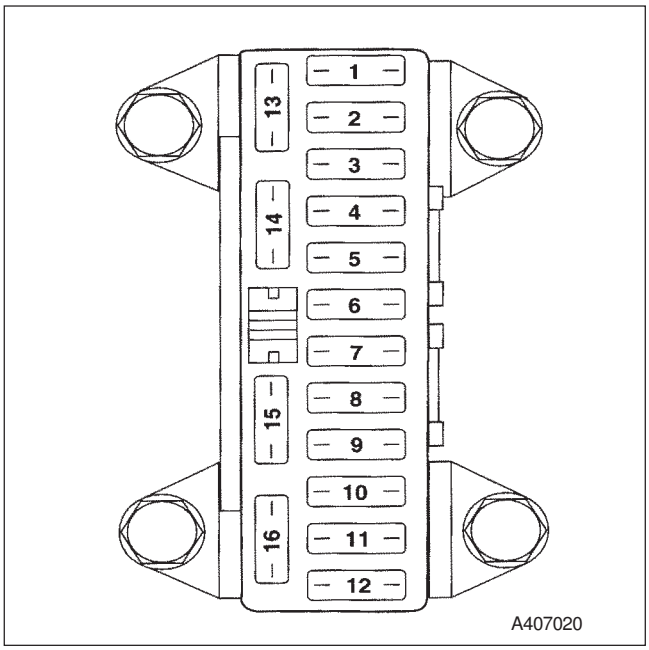


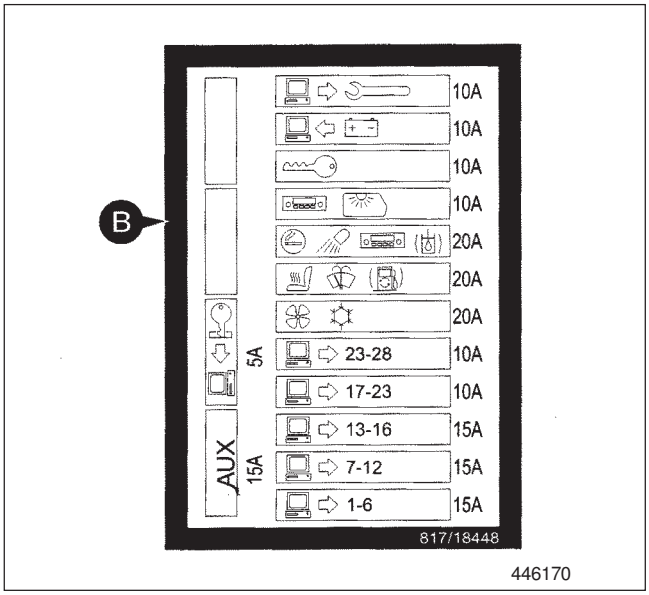







A
416400


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
A407020

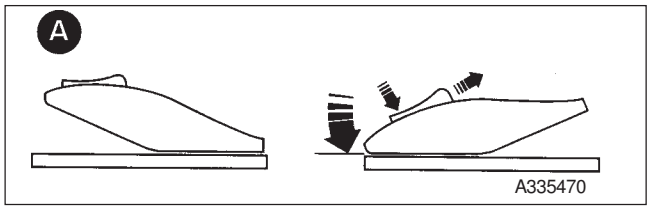

B
10A
10A
10A
10A
20A
20A
20A
10A
10A
15A
15A
15A
5A
AUX
23-28
17-23
13-16
7-12
1-6
817/18448
446170

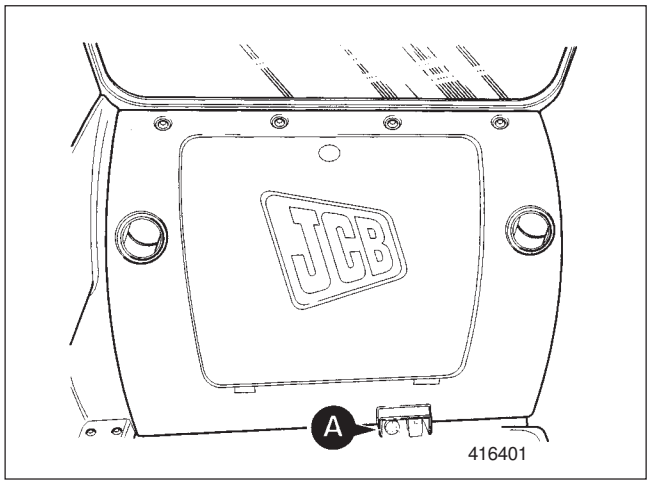
Switches and Controls (cont'd)

Emergency back-up switch

Under normal conditions the switch **A** is OFF. Under emergency conditions it becomes necessary to press the switch ON. The switch has a lock in the cap which must be slid towards the centre of the switch when pressing.

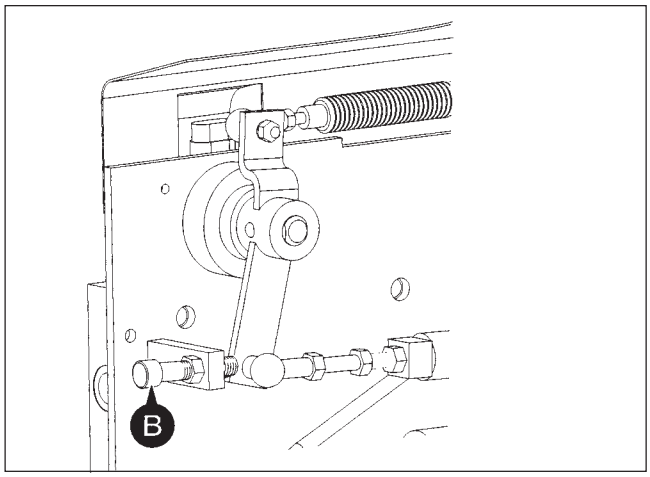
By switching the emergency back -up switch the engine can be started and the hydraulic functions are operating. The engine will run at idle speed, in emergency back up mode the monitor will display "LIMP MODE". The machine should only be operated in this mode to allow the machine to be moved to a safe position





Mechanical Engine RPM Override

To use the machine in redundancy mode, adjust the mechanical engine RPM override screw **B** using a 8mm alien key. Increase the RPM to an intermediate speed sufficient for the machine to operate.

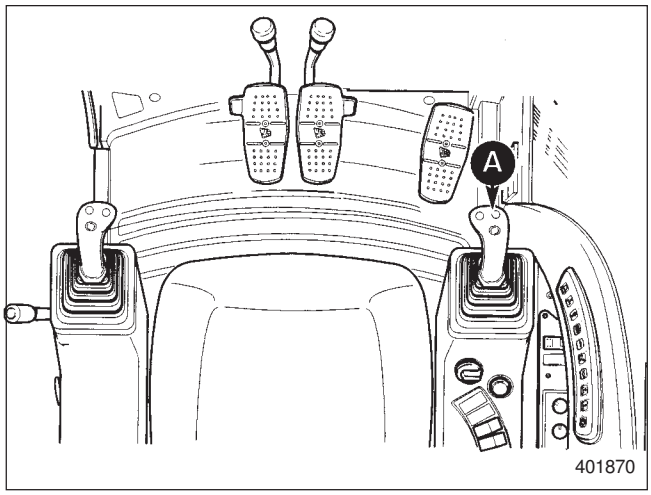


Travel Speed Change Button

The travel speed of the machine can be changed to high, medium and low. (The travel speed is recorded at engine shutdown and the travel speed is re-applied at the next engine start up). Each time the button **A** is pressed, the speed is changed to the next higher speed. (When it is at high speed, it then selects low).

Note: Do not change the mode when travelling. Stop the machine to select different speeds.

Travel Mode	Choice Selected
High Speed	Use when the ground is level. When climbing a slope and the load increases, it automatically changes to medium and when the load reduces, it returns automatically to high.
Medium Speed	
Low Speed	Use when climbing or descending a slope or when the ground is rough. It does not change automatically.



Circuit Concepts

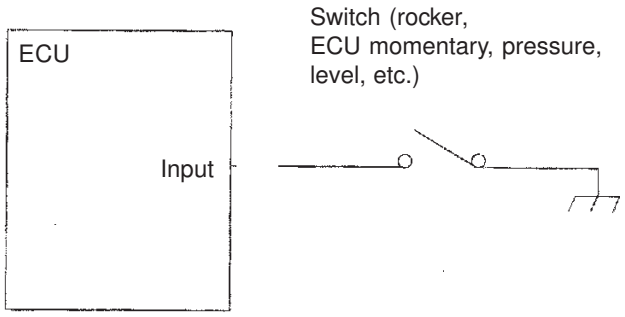
Inputs

There are two main types of input, Digital and Analogue.

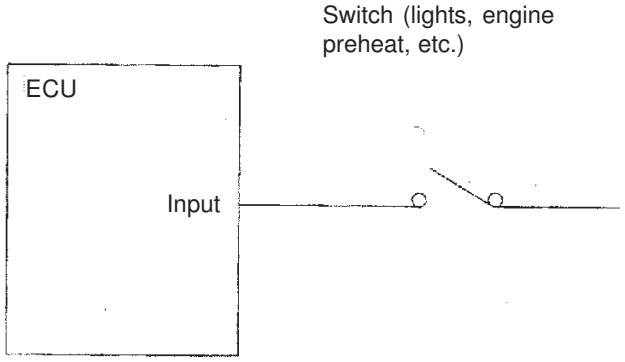
Digital type inputs are on/off type inputs (i.e. switches) and can be Low side inputs or High side inputs. Low side inputs are inputs that provide a ground to the ECU. High side inputs are inputs that provide a positive feed to the ECU.
Analogue Inputs are sensor type inputs that provide a varying type input to the ECU, this input could be a resistance or frequency type input.

Digital inputs (on/off switch type inputs)

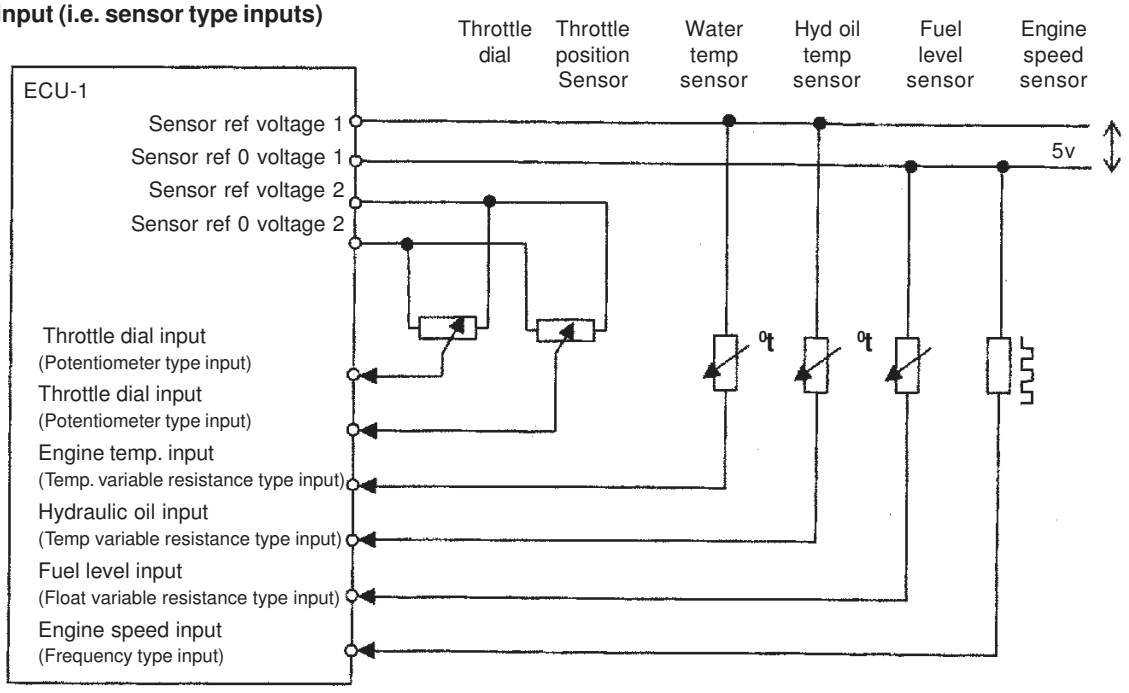
a Low side input
The low side input is the most frequently used input on the A.M.S system. The low side input can be in the form of rocker switches or pressure switches.



b High side input
The high side input is used on circuits that require a positive feed when the ignition is switched off, i.e. sidelights or hazard lights. The high side input is also used on the engine preheat circuit.



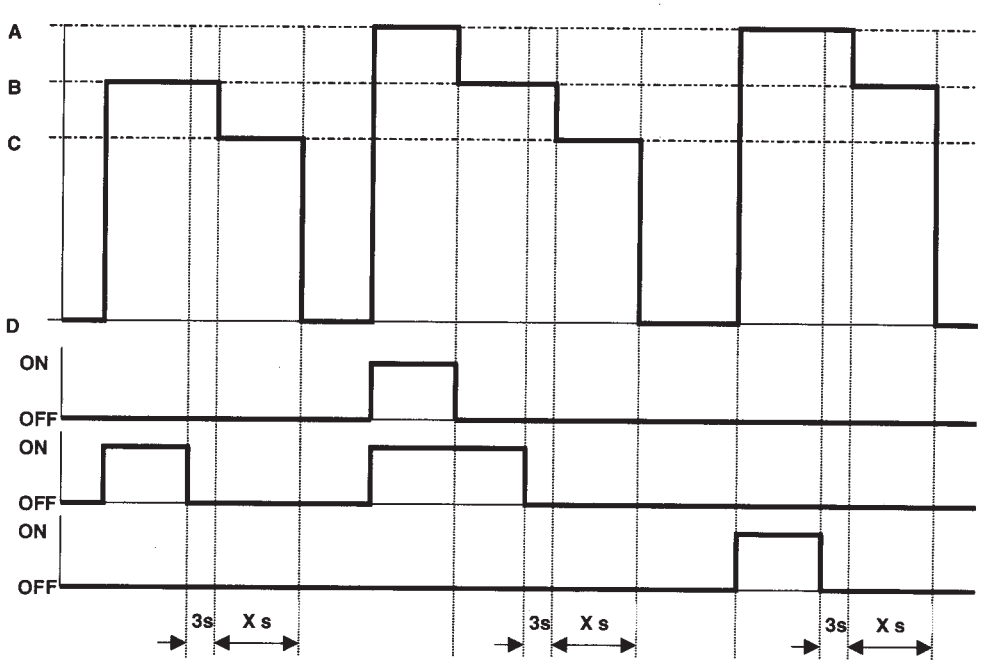
c Analogue input (i.e. sensor type inputs)



Engine Throttle Control for Each Mode (cont'd)

JS2001 210/220 **JS240-260**

Auto mode throttle characteristic

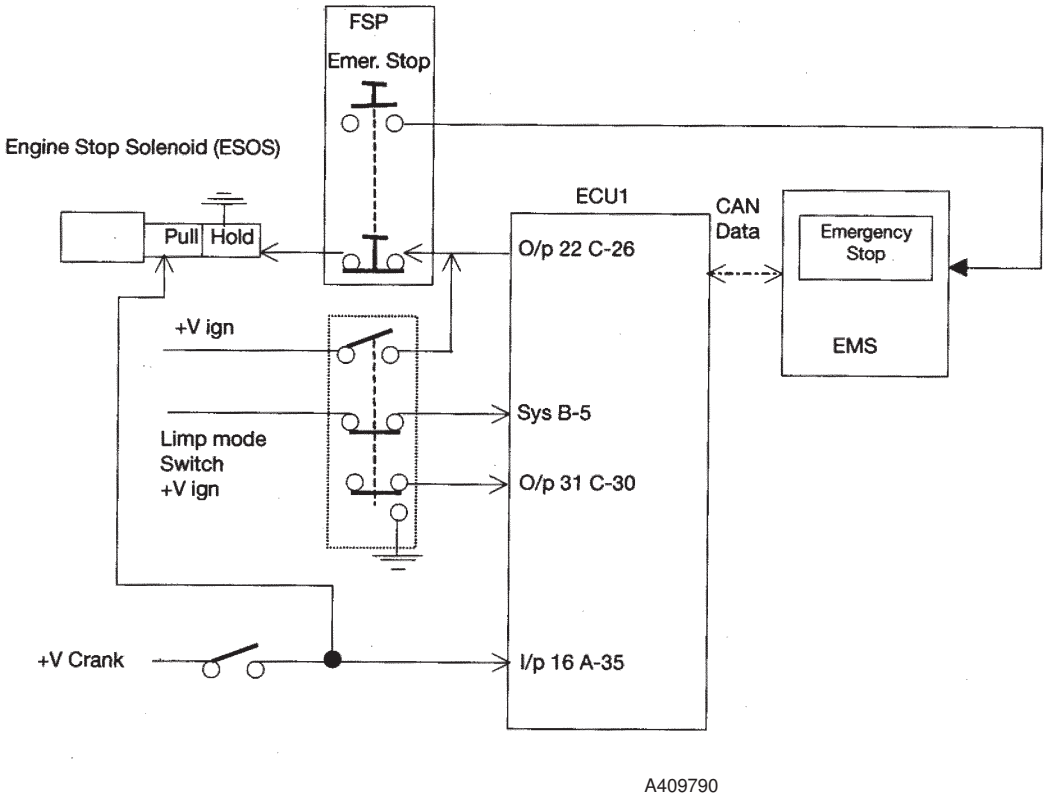


"E" Economy mode.
In standard mode the EMS displays "ECONOMY" and the letter "E" next to the power mode icon. The engine is allowed to operate over its selected rev range as defined by its programmed rev limit and the throttle sense input, (ECU1 lip A 39) in direct proportion to the throttle input. However the maximum rev limit of 100 rpm less than the maximum permissible is imposed. Thus for a full throttle potentiometer setting the engine revolutions is 100 lower than it would be in the Auto mode.

"P" Precision
In Precision mode the EMS displays "PRECISION" and the letter "P" next to the power mode icon. The engine is allowed to operate over its selected rev range as defined by its programmed rev limit and the throttle sense input, (ECU1 lip A 39) in direct proportion to the throttle input. However the maximum rev limit of 200 revlmin less than the maximum permissible is imposed. Thus for a full throttle potentiometer setting the engine revolutions is 200 lower than it would be in the Auto mode, the same as it is for Lifting mode.

"L" Lifting mode
In Lifting mode the EMS displays "LIFTING" and the letter "L" next to the power mode icon. The engine is allowed to operate over its selected rev range as defined by its programmed rev limit and the throttle sense input, (ECU1 lip A 39) in direct proportion to the throttle input. . However the maximum rev limit of 200 rev/min. less than the maximum permissible is imposed. Thus for a full throttle potentiometer setting the engine revolutions is 200 lower than it would be in the Auto mode, the same as it is for Precision mode.

Engine Start/Stop



Operation

Starting I Stopping the engine;
When the ignition key is turned to the crank position, 24v is inputed to the ECU on IIp A-35. The same crank signal is seen at the starter motor relay at position S which will also energise the pull section of the stop solenoid.

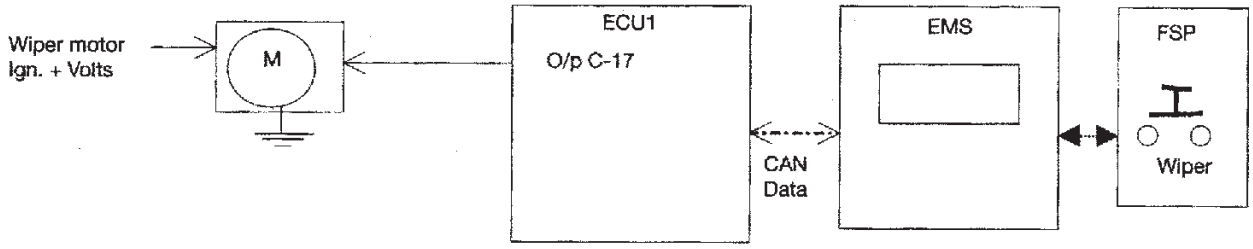
The solenoid will then energise and move the fuel lever on the injection pump to the 'fuel on' position. The ECU provides a24v O/p C-26, through the closed contacts of the emergency stop button on the FSP to the hold section of the stop solenoid, the solenoid will hold the fuel lever in the 'fuel on' position.

When the engine is running, if the ignition key is switched off, the 24v which was holding the stop solenoid energised is lost due to the O/p C-26 being fed from an ignition live fuse. The stop solenoid will de-energise and move the fuel lever to the 'fuel off' position, stopping the engine.

Pressing the emergency stop button;
If the emergency stop button on the FSP is pressed whilst the engine is running the ECU switches off the 24v from O/p C-26 to the hold section of the stop solenoid - the solenoid will de energise and move the fuel lever to the 'fuel off' position and the engine will stop. At the same time the EMS will display the message 'EMER STOP' In this condition the engine can be cranked but will not start due to the hold section not being energised.

If the ignition is switched off and then back on, the system retains the emergency stop function until the emergency stop button on the FSP is pressed again.

Wiper



Operation

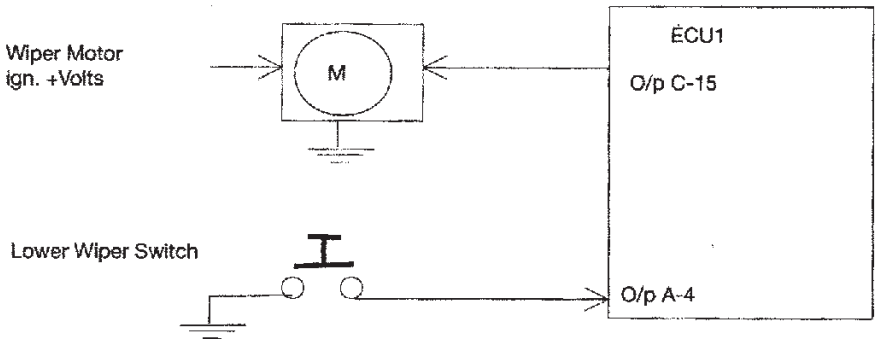
The wiper has three modes of operation, intermittent, permanently on and oft. Timing for the intermittent function is performed by ECU1, and can be varied via the set menu on the EMS.

When the wiper switch on the Facia Switch Panel (FSP) is pressed once alp C 17 on ECU1 is pulsed for 0.5 seconds to start the wiper stroke. A hold on contact within the motor assembly retains power for the return stroke of the blade. A time delay of variable seconds is activated before the output is energised again, thus giving intermittent operation.

A second press of the switch enables the wiper to operate continuously and the output is permanently energised.

A third press of the switch disables wiper operation.

Lower Wiper (option)



Operation

The lower wiper is a customer selected option and is fitted to the lower glass panel at the front of the operator's cab.

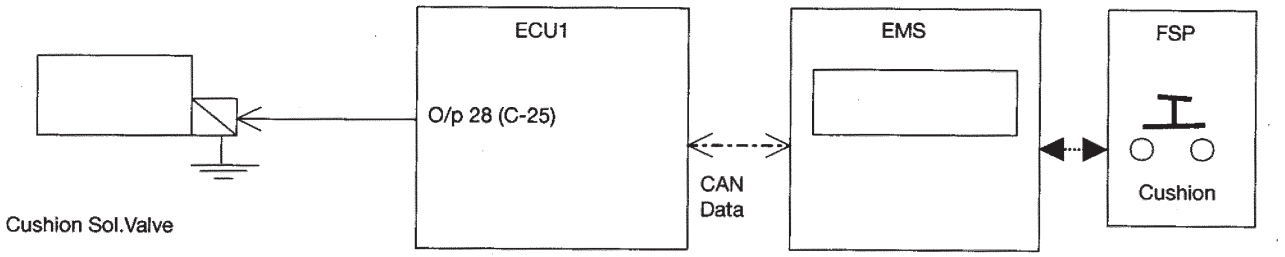
The wiper has three modes of operation intermittent, continuous and oft. Timing for the intermittent function is performed by ECU1. The same timer as utilised for the standard wiper is used to synchronise both wipers together.

When the lower wiper button is operated the ECU1 output number C 15 is energised to start the wiper stroke. A hold on contact within the motor assembly retains power for the return stroke of the blade. A time delay equal to that set for the main wiper is activated before the output is energised again, giving intermittent operation.

A second press of the switch enables the wiper to operate continuously and the output is permanently energised. A third press of the switch disables wiper operation.

Note: If the upper (main) wiper is energised then the lower wiper output is energised at the same time, synchronising both wipers.

Soft/Hard (Cushion)



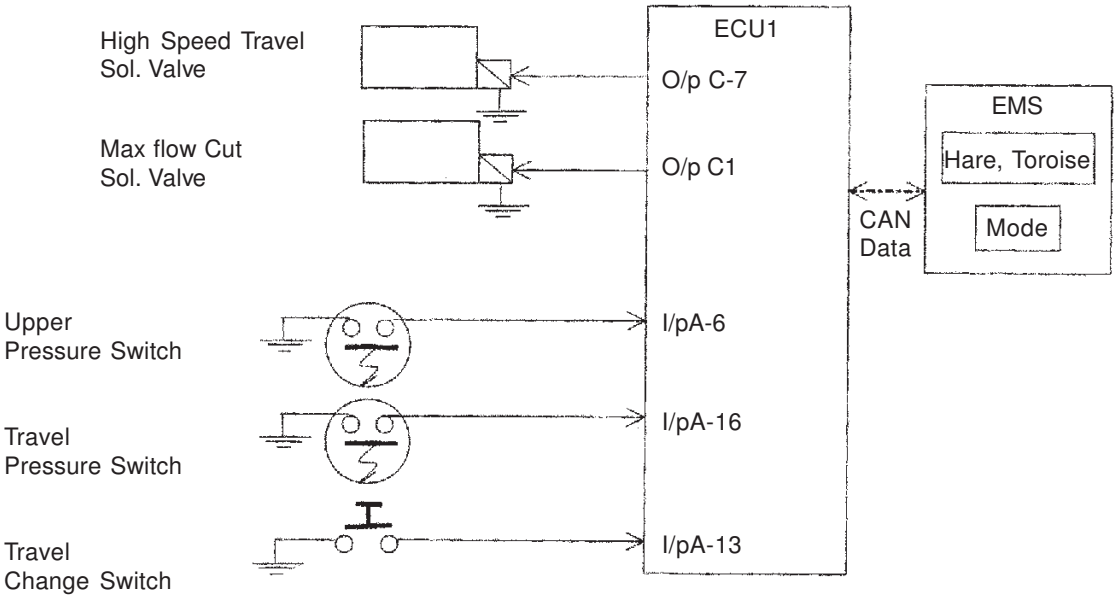
Operation

The soft/hard mode allows the operator to select the response of the hydraulic circuits, soft being controlled and hard being fierce when de-selecting boom and dipper functions. Soft mode is the default setting when starting the machine.

To change to hard mode the operator must select the option by pressing cushion switch on the facia switch panel. Cushion solenoid output ECU O/pC 25 is energised.

The Hard mode is cancelled either by turning the ignition off, or by pressing the cushion switch for a second time.

3-Speed Travel



Operation

Using a combination of two solenoids (high speed travel solenoid and max flow cut solenoid), pump flow and swash plate position of the travel motor are used to give three travel speeds. The selected travel speed is indicated on the EMS as either a Hare (High), double arrow (Middle), or Tortoise (Creep) and is changed by successive presses of the travel change switch. The current operating mode of the machine alters the logic in which the solenoids operate.

Note: The last selected travel speed when machine is stopped is re-instated when the machine is restarted.

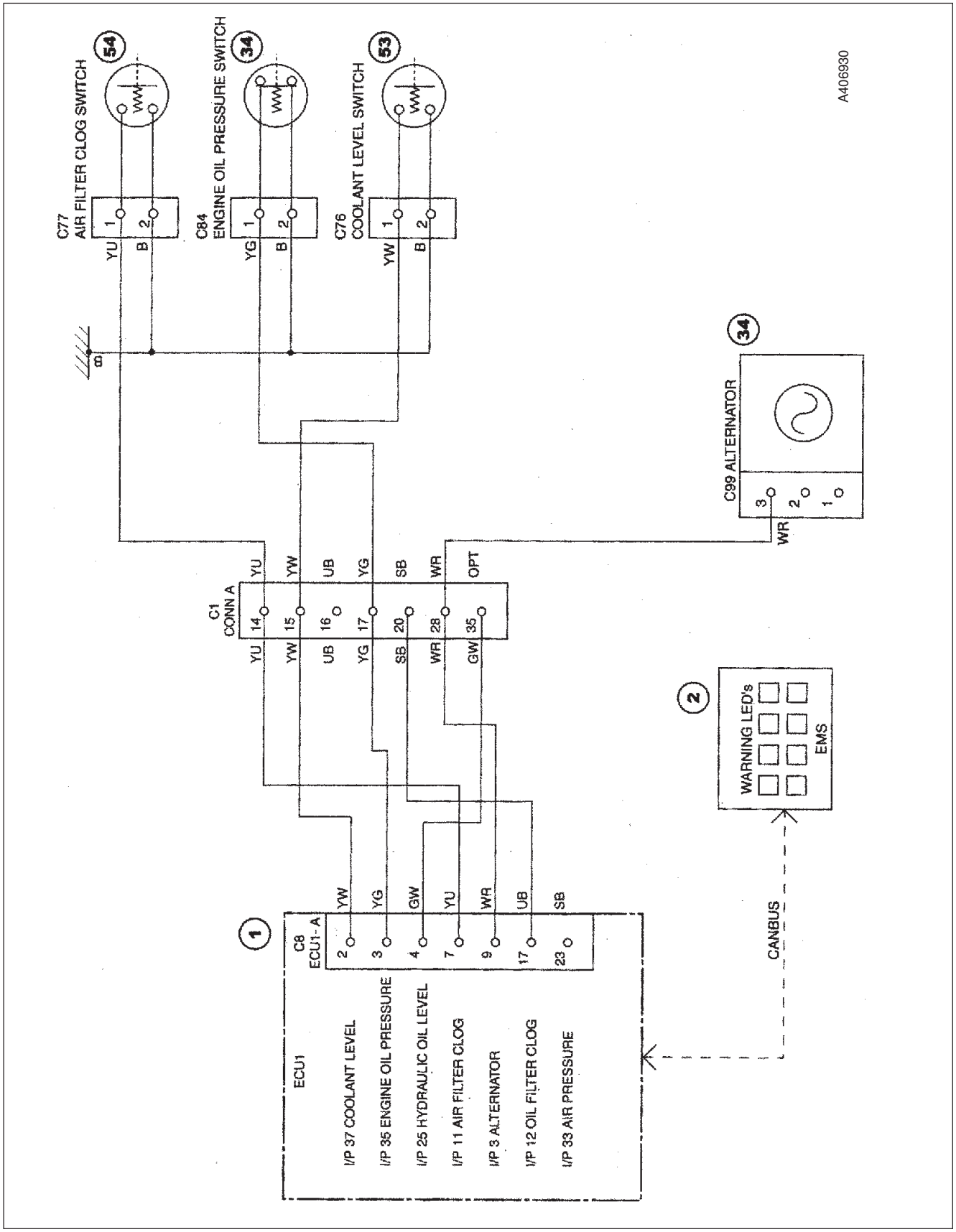
"E" Economy, "P" Precision & "A" Auto Modes.

At the mid travel speed the motor swash plate is in the maximum swash position (low speed) and the pump is at the standard setting. The max flow cut and high speed travel solenoids are de-energised and the statuses of the travel and upper pressure switches are ignored. The EMS displays the "Arrow" gear icon.

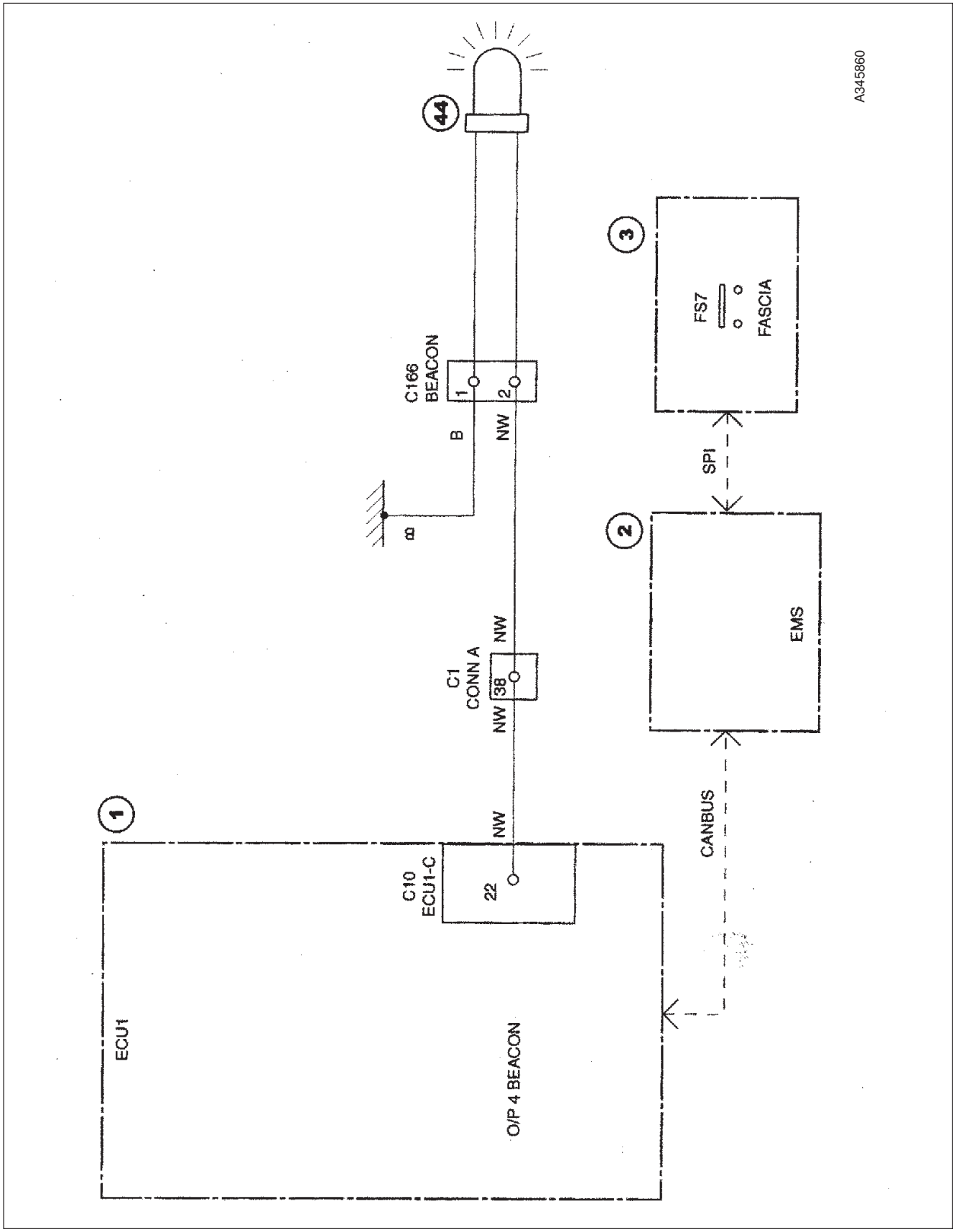
When the travel change switch (ECU1 lip A 13) is pressed the EMS displays the "Hare" gear icon. The high speed travel solenoid is energised (ECU1 alp C 7), thus moving the swash plate to the minimum swash position (high speed). The pressure switch inputs are ignored. The machine is now in the high speed travel mode.

When the travel change switch is pressed again the EMS displays the "Tortoise" gear icon. The machine is now in creep travel speed mode. The high speed travel solenoid (ECU1 alp C 7) is de energised. If the travel pressure switch is activated ie travel selected (ECU1 lip A 16) then the Max flow cut solenoid is energised (ECU1 alp C 1) and the pump is put in "Q cut "mode. The max flow cut solenoid is only energised whilst the travel pressure switch is activated. The input from the upper pressure switch is ignored. The next successive press of the travel change switch (ECU1 lip A 13) selects the mid travel speed and the EMS displays the "Arrow" gear icon.

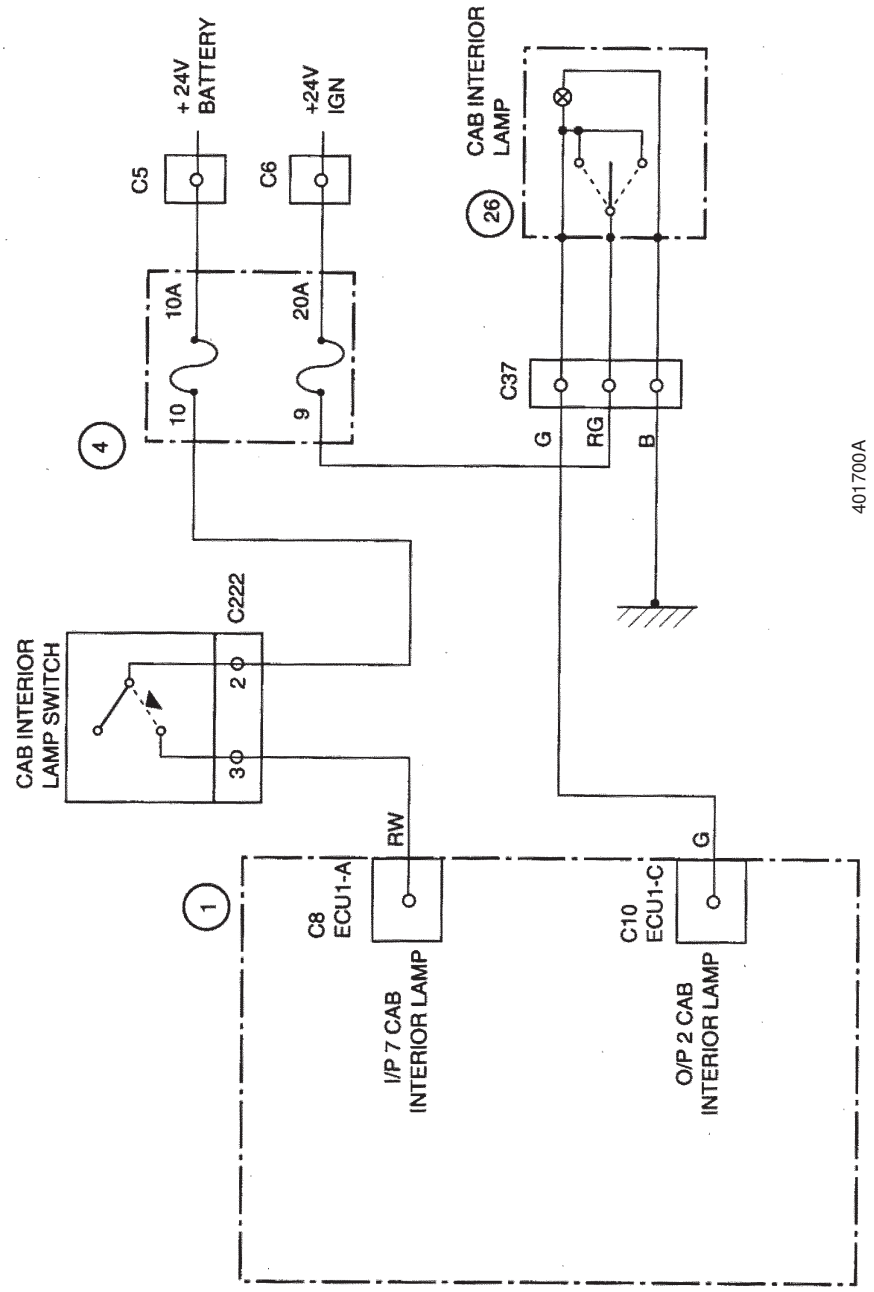
Warning Indicator Lamps



Beacon


A345860
44
C166
BEACON
1
2
B
NW
SPI
3
FS7
FASCIA
2
EMS
C1
CONN A
38
NW
NW
CANBUS
1
C10
ECU1-C
22
NW
ECU1
O/P 4 BEACON

Cab Interior Lamp



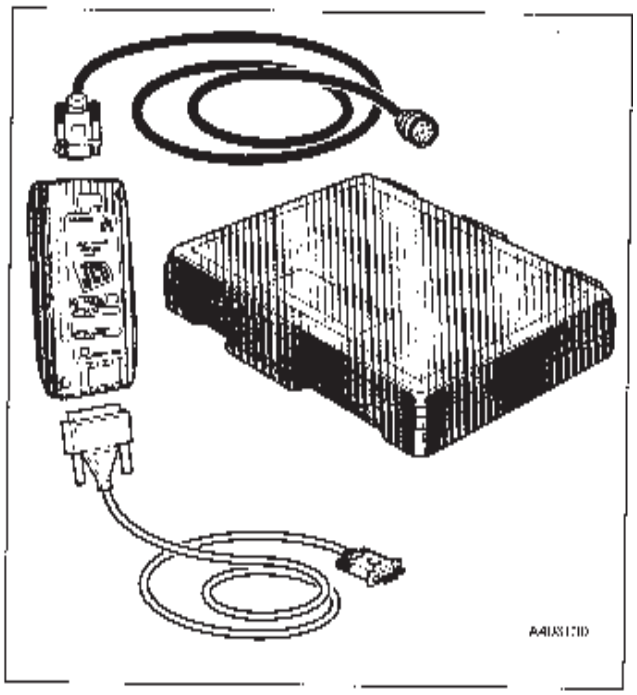
EMS Set+Mode (20 sec) Menu.
When the set and mode buttons on the EMS are pressed together for 20 seconds a sub menu structure appears, enabling JCB trained personnel to cancel the intermediate service warning, calibrate the throttle and override the engine speed sensor input to energise solenoids for testing purposes. The up/down arrows scrolls through the menu and the item is selected by pressing the “Ack” button. Pressing “set” at any time will return the operator to the normal display.
‘,,— Service off.
The intermediate service warning can be cancelled by entering this menu. To enter this menu the following procedure must be followed:
Press and hold the “Set” and “Mode” buttons on the EMS together for 20 seconds, until the “Service off” is displayed.
Press the “Ack” button. You are now in the “service off” routine and four zeros will appear in the display and you will be prompted to enter the JCB dealer code.
“0”000 Will be displayed and the left hand digit will be flashing. The up and down arrows are used to select the digit value and “Ack” to enter/accept the value and move to the next digit. When all digits are entered the final press of “Ack’ “- followed by a press of the “Set” button will extinguish the service indicator and record the service event. (hours, time and dealer code to the service history file).
Note: Information stored in the service history is available via the JCB Diagnostic tool. ~ Throttle calibration. ~
Throttle calibration is obtained via the Set + Mode (20 sec) menu on the EMS. The throttle calibration should be performed on
every new machine, when the throttle linkage parts are replaced or when the “No throttle” warning appears on the EMS. ,..-
To enter throttle calibration the following procedure must be followed:
‘ The engine must be started, and warmed up to normal operating temperatures.
Press and hold the “Set” and “Mode” buttons on the EMS simultaneously for 20 seconds, until the “Service off” message “- is displayed.
Use the scroll arrows until the “Calibrate” message is displayed.
Press the “Ack” button. You are now in the throttle calibration routine and the message “lower Limit” will appear in the display.
Rotate the throttle volume dial to the minimum position.
Press “Ack”. The “Upper Limit” message will then be displayed. ,-
Rotate the throttle volume dial to the maximum position.
Press “Ack”. The message “Working” will then be displayed and the engine will accelerate to maximum speed and slowly - reduce to idle speed. (This will take approximately 3 minutes).
When complete the engine will return to maximum revs and throttle control will be restored to the throttle volume dial. The EMS will revert to the normal display. . “-
Note: If the engine is stopped during the calibration, the “recalibrate” message is displayed and the procedure has to be restarted. If the throttle volume dial minimum and maximum values are the same, or the wrong way round, then “recalibrate” ~ is also displayed.
-..

Data Link Adaptor

The DLA is a universal device for connecting several data communications mediums to the PC via a single piece of hardware. HPSetup uses the J1939 CAN Specification for on vehicle network and communications. Being one of the cheapest methods to connect the PC to the vehicle bus the DLA has proven its ability in applications such as Diagnostics, Data Logging and Vehicle setup procedure tools like HPSetup.

Power for the DLA is taken from the vehicle power supply via the 15 way connector so it requires no internal source of power and is self regulating up to +40V, giving great protection and versatility because it can be connected to most forms of automotive machinery operating between 5 and 40V DC.

Once connected to the PC the DLA is auto detected and initialised by software eliminating any need for the user to determine port settings, data transfer rates.



DLA Trouble Shooting

Failure of the software to initialise the DLA will prevent any read/write operations. This section will help debug the error and get the DLA working. Follow this list of checks to perform to help diagnose the problem.

1 Cables, ensure that the correct cables are used between the PC/DLA/On Vehicle connector.

2 Inspect cables for possible damage, replace if necessary.

3 Check that good firm connections have been made between all devices.

4 Power up the vehicle and make sure the power LED on the DLA is ON, if the LED is not illuminated there may be a problem with the power supplied to the unit or the DLA regulator system is not working. To check the power to the DLA unplug the DLA from the vehicle, use a digital multi-meter to check the voltage between pins 6 and 8. There should be a minimum of 12 V DC (or IGNITION Voltage, see vehicle specifications) between these two pins. Suspect the vehicle power supply if there is not, else the DLA should be replaced because of a problem with it's internal circuitry.

5 With the Vehicle power ON, start HPSetup application and visually observe the CAN activity LED and note the error message displayed by the PC. If the LED does not flash off/ON several times after it has been initialised by the PC then there is probably a hardware problem with the DLA. Replace the DLA. Error messages displayed by the DLA driver software often indicates the origin of the problem. It may help to power down the vehicle, wait a few seconds and then retry establishing connection.

Fault Finding Without using the JCB Service Master Diagnostic Tool

Introduction

The AMS system is designed so that all of the components that are connected to the system are able to communicate with each other. This means not only are the machine hours displayed on the Electronic Monitor (EMS) but also they are recorded in the Electronic Control Unit 1 (ECU-1).

Changing Machine Components

Under such circumstances where fault diagnosis is not possible by using the JCB Service Master Diagnostic Tool then the following actions must be taken in circumstances where a change of the Electronic Control Unit 1 (ECU-1) and/or the Electronic Monitor System (EMS) is unavoidable.

1 If either a new ECU-1 or new EMS. is fitted to either a new or old machine, the machines working hours will pass automatically to the new units and upgrade them when the machines ignition is switched on.

Note: This includes stock machines with over 1 hour recorded by the AMS system.

2 Only under extreme circumstances should either the ECU-1 or the EMS be transferred to a machine with lower working hours than the donor machine. The effect of this would be to automatically transfer the higher hours information to the recipient machine.

Note: This process is not reversible.

3 When either an ECU-1. or EMS is changed on a machine, the machine system must be set up again using the Set Up Service Tool. Without this action some options previously active would not function and the throttle system would not be calibrated.

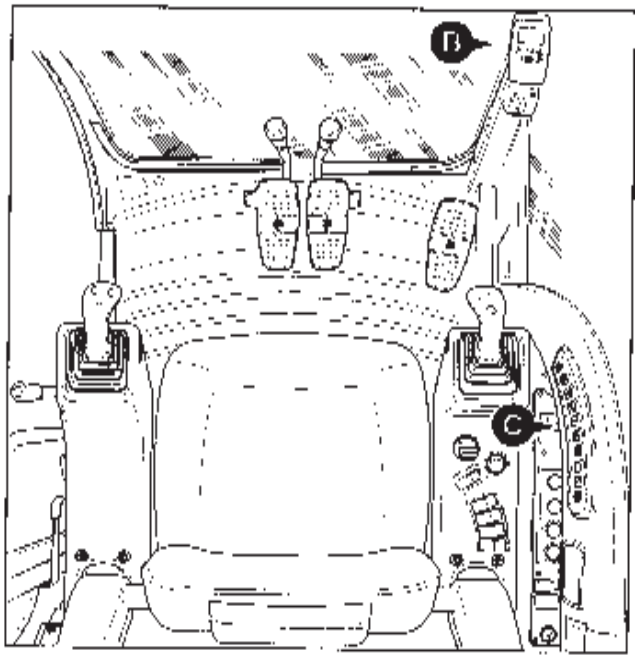
4 To remove the EMS unit, carefully pull the unit away from the facia panel. The unit is held in place by a retaining seal only and is a tight fit, do not attempt to lever the unit out as this could cause damage to the the E.MS and the facia panel. Reassembly is a reversal of this procedure.

5 To access the ECU-1,remove the seven panel screws from the panel behind the seat and remove panel.

6 To remove the ECU-1, remove the three Allen screws which fasten the computers to a frame. To remove the machine harnesses from the computers, undo the Allen screw integral to each connector. Reassembly is a reversal of this procedure.

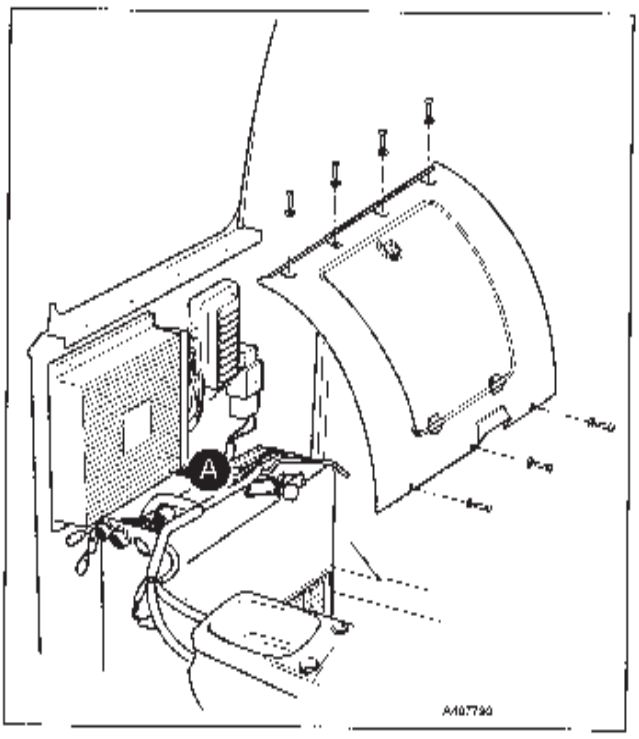
Note: On the ECU-1 the identification letters for the individual harness connectors and the fixed harness connections on the computer itself, are the cast letters (A,B,C) on the body of the computer.This is vital when identifying connectors and pins during fault diagnosis.

7 The Facia Switch Panel (FSP) is not affected by any changes of other components.



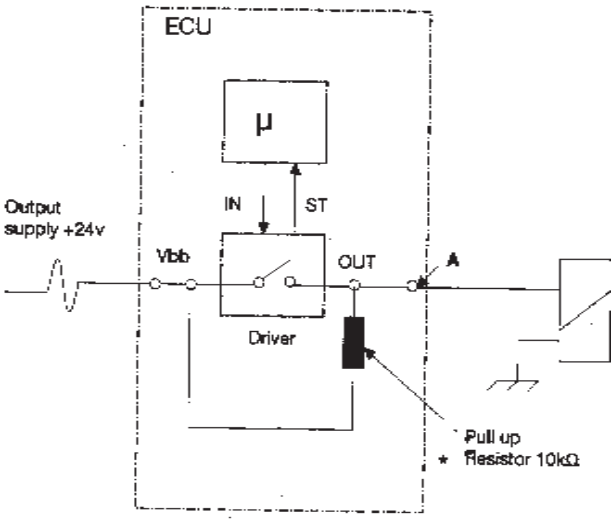
The system comprises of the following main electronic components:

A	Electronic Control Unit -1 (ECU 1)
B	Electronic Monitoring System (EMS)
C	Fascia switch panel (FSP).



Testing high side outputs (cont'd)

The ECU is internally configured to give short circuit protection and detection of short circuit / open circuit, this is done by internal resistors. This internal configuration can give some confusing results when testing the outputs on the ECU.



Voltage at point A:

Solenoid connected output off = 0.1 V approx.

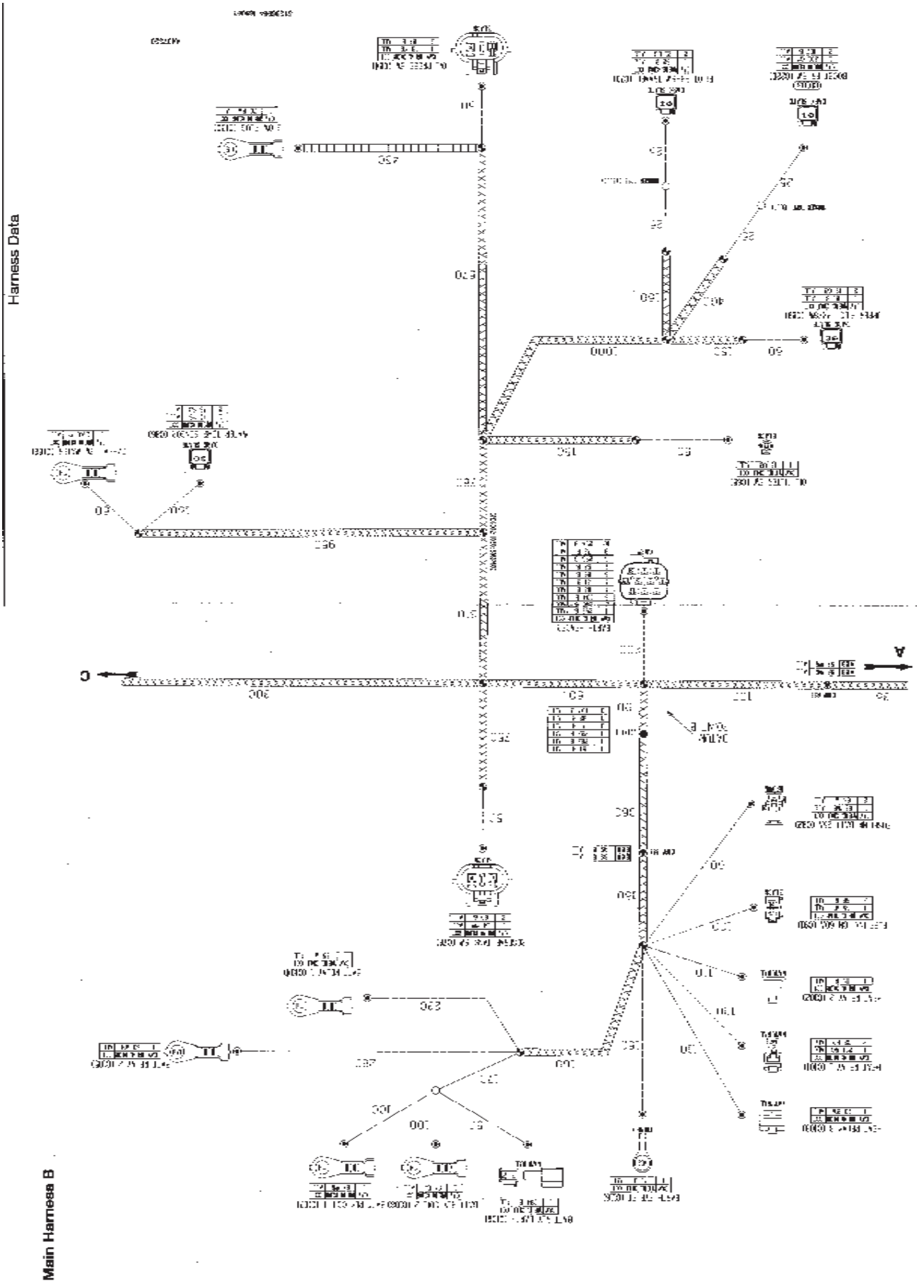
Solenoid connected output on = battery voltages nominal.

Solenoid disconnected output off = reduced voltage (15 V - 22 V).

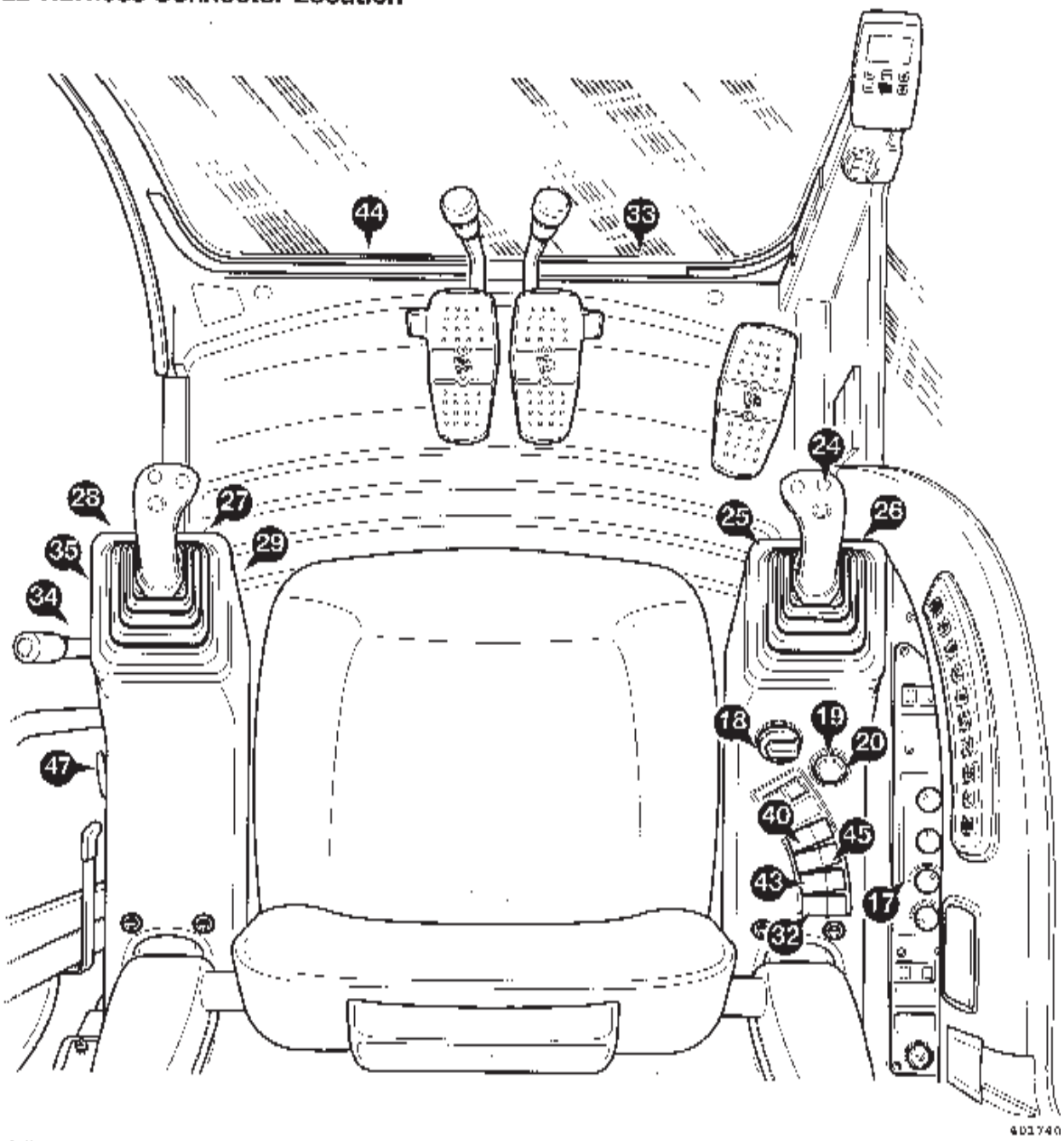
Solenoid disconnected output on = battery voltage nominal.

Shorted to ground = 0 V.

Shorted high (to positive) = battery voltage.


Harness Data
Main Harness B

Cab Harness Connector Location



See following page for the description of the annotations above.

Key To Wire Colours

B	Black
R	Red
U	Blue
LG	Light Green
G	Green
Y	Yellow
P	Purple
W	White
N	Brown
O	Orange
K	Pink
S	Grey
BR	Black with Red

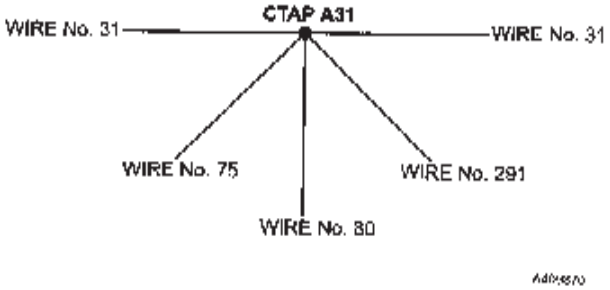
Cab Harness Data (cont'd)

Wire Number	Colour	Connector	Destination
240	BW	CTAP A47	C8
241	BW	C13	Earth Header 3
242	YR	C13	C10
243	-	-	-
244	-	-	-
245	BU	CTAP A165	C226
246	-		-
247	-	-	-
248	-	-	-
249	-	-	-
250	K	C200	C8
251	RW	C222	C8
252	GU	C201	C10
253	-	-	-
254	W	CTAP A259	C25
255	R	S/JOINT 12	C25
256	R	S/JOINT 12	C25
257	R	S/JOINT 12	C25
258	R	S/JOINT 12	C25
259	W	C25	C5
260	W	CTAP A259	C25
261	R	S/JOINT 12	C25
262	GB	S/JOINT 10	C25
263	N	S/JOINT 11	C25
264	RB	S/JOINT 9	C25
265	-	-	-
266	G	CTAP A55	C25
267	RG	CTAP A36	C25
268	LG	CTAP A284	C25
269	SR	S/JOINT 1	C25
270	UY	C11	C25
271	UR	S/JOINT 2	C25
272	P	CTAP A127	C25
273	-	-	-
274	-	-	-
275	R	S/JOINT 12	C6
276	-	-	-
277	-	-	-
278	-	-	-
279	-	-	-
280	RG	CTAP A36	C37
281	RG	CTAP A36	C200
282	RY	C2	C8
283	-	-	-
284	LG	C224	C33
285	GW	C225	C21
286	YR	C180	C21
287	UR	S/JOINT 2	C26
288	UR	S/JOINT 2	C226
289	RY	C225	C37
290	Y	C224	C225
291	R	C224	C37
292	G	CTAP A 55	C201
293	-	-	-
294	Y	C203	C202
295	G	C202	C37
296	-	-	-
297	BO	C224	Earth Header 4

Wire Number	Colour	Connector	Destination
298	BO	C203	Earth Header 4
299	BO	C224	Earth Header 4
300	-	-	-

Splice - Example: CTAP A31

Splice Location	Wire No.	Wire Colour
A31	75	RG
A31	80	RG
A31	291	RG



Joint - Example: S/Joint 13

Joint Location	Wire No.	Wire Colour
13	115	RY
13	150	RY

Service Tools (cont'd)

SECTION E – Hydraulics (cont'd)

Ram Dismantling and Assembly (cont'd)

Jig for inserting and correcting seal ring

WDB 2052	Bucket	120mm Cylinder inner diameter
WDB 2054	Boom	125mm Cylinder inner diameter

Jig for pulling out, press-fitting bushing

WDB 2166	Bucket	80mm Piston Rod diameter
WDB 2167	Boom	85mm Piston Rod diameter
WDB 2170	Arm	100mm Piston Rod diameter

Jig for press-fitting wiper ring

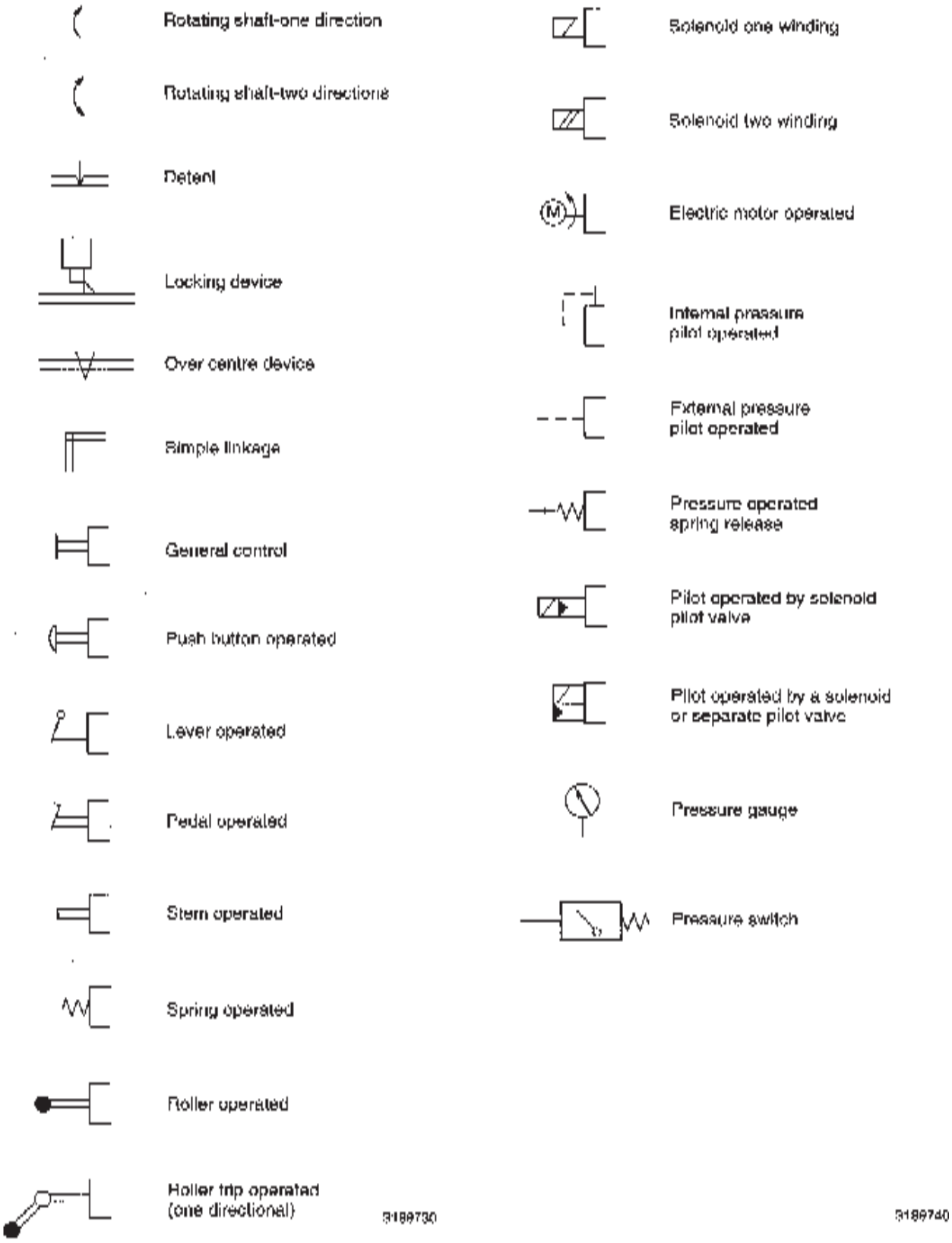
WDB 2166-1	Bucket	80mm Piston Rod diameter
WDB 2167-1	Boom	85mm Piston Rod diameter
WDB 2170-1	Arm	100mm Piston Rod diameter

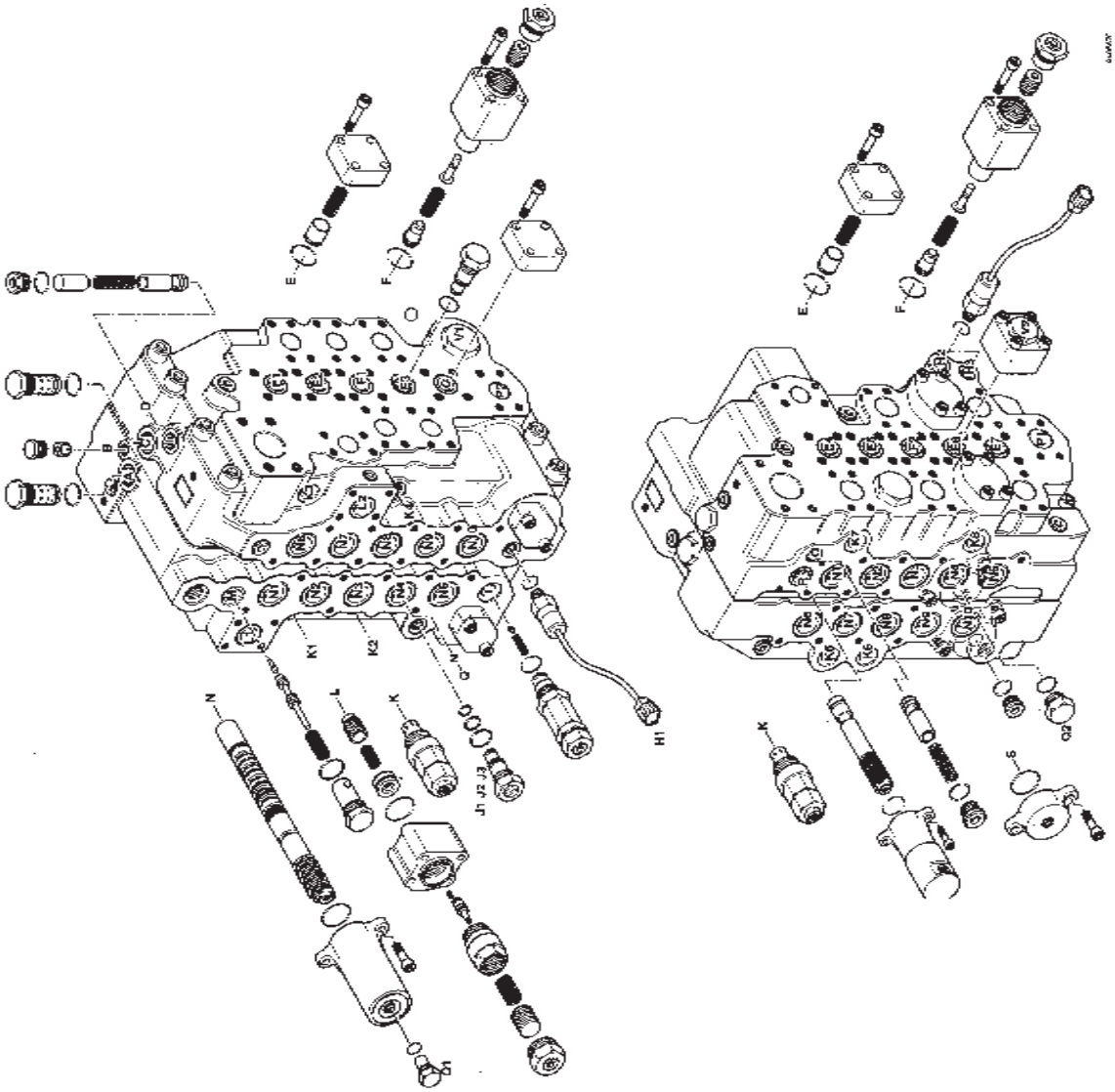
Jig for inserting cylinder head

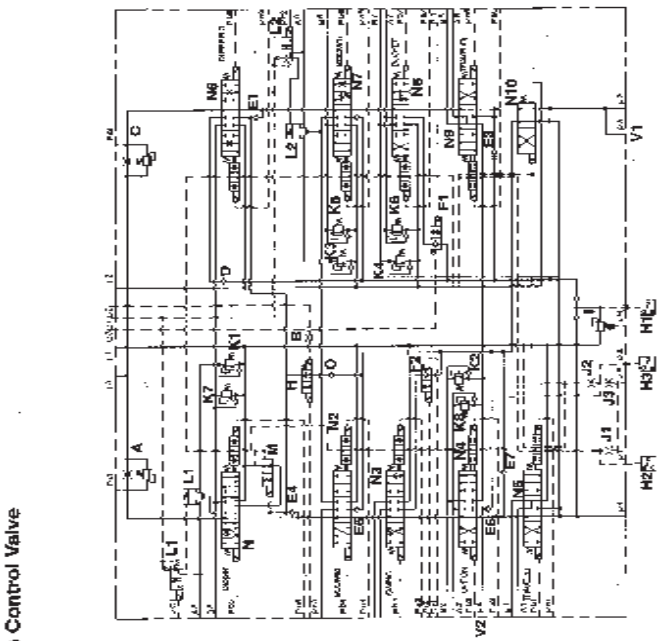
WDB 2174	Bucket	80mm Cylinder rod inner diameter
WDB 2175	Boom	85mm Cylinder rod inner diameter
WDB 2178	Arm	100mm Cylinder rod inner diameter

Introduction to Hydraulic Schematic Symbols (cont'd)

Control Mechanisms







Main Control Valve

KEY

- **A** Negative Control Valve (Ps1)
- **B** Restrictor
- **C** Negative Control Valve (Ps2)
- **D** Shuttle Valve
- **E** Load Hold Check Valves (x 7)
- **F** Priority Valve
- **F1** Room over Bucket, **F2** Room over Slew
- **G** Blank
- **H** Pressure Switch
- **H1** Auto Power Boost, **H2** Travel, **H3** Excavator
- **I** Main Relief Valve (MRV)
- **J** Restrictors - **J1** Travel, **J2** Linear Travel, **J3** Excavator Pressure Switch
- **K** Auxiliary Relief Valves (ARV)
  - **K1** Dipper out, **K2** Option, **K3** Boom Up, **K4** Bucket Open
  - ***K5** Boom Down, **K6** Bucket Close, **K7** Dipper In, **K8** Option
- **L** Load Holding Valve
  - **L1** Dipper, **L2** Room
- **M** Regeneration Valve
- **N** Spool (x 10)
- **O** Shuttle Valve
- **P** **P1** Pump 1 pressure in, **P2** Pump 2 pressure in
- **Q1, Q2** Blank (For option spool only when not used to centralise the option spool)
- **R** Slew over Dipper Priority Valve
- **S** End Cap
- **V** **V1** Merge Out, **V2** Merge In

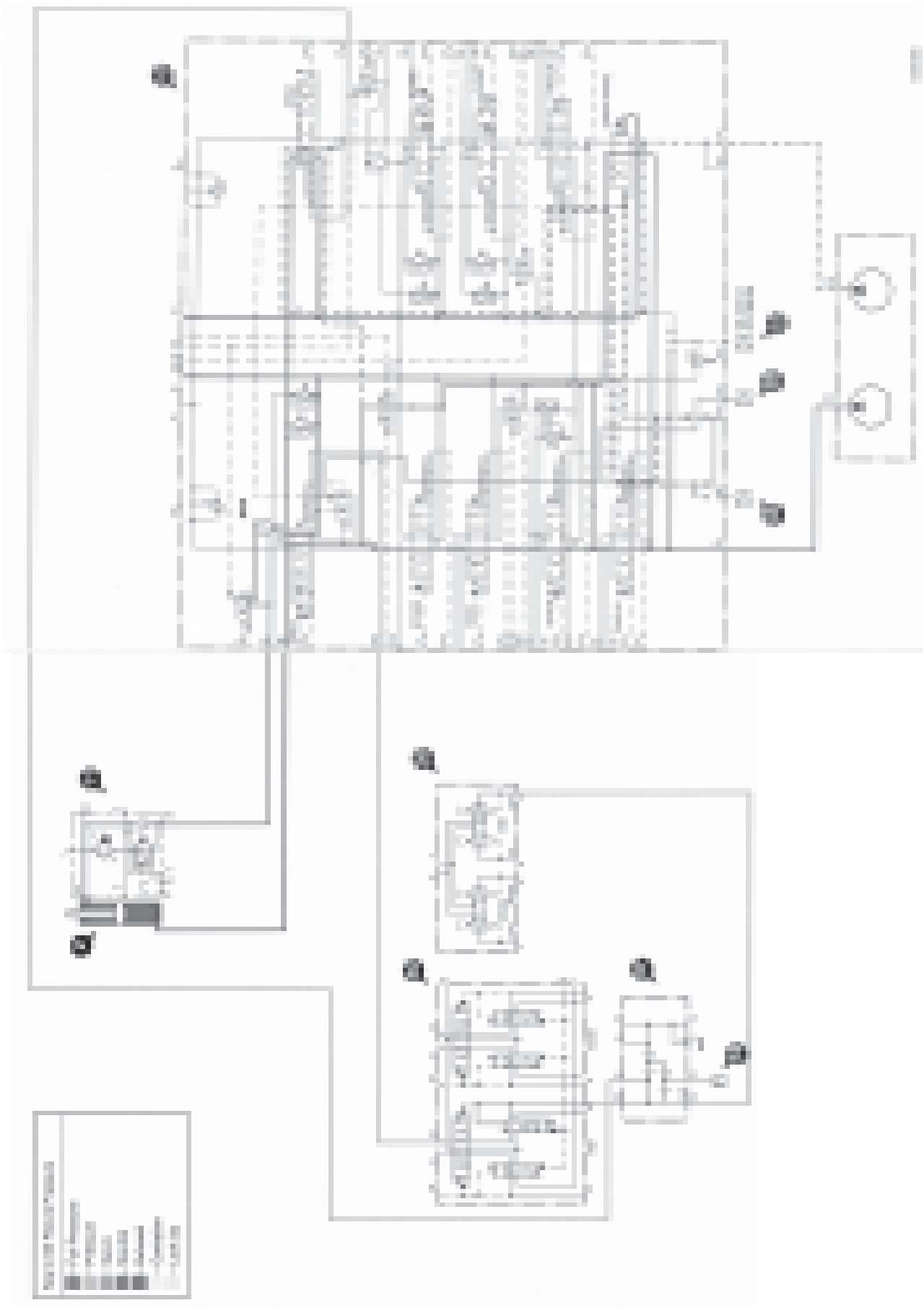
Neutral Circuit

With all the controls in the neutral position, flow from pump **A1** enters the main control valve **10** at port P1 and flow from pump **A2** enters the main control valve **10** at port P2.

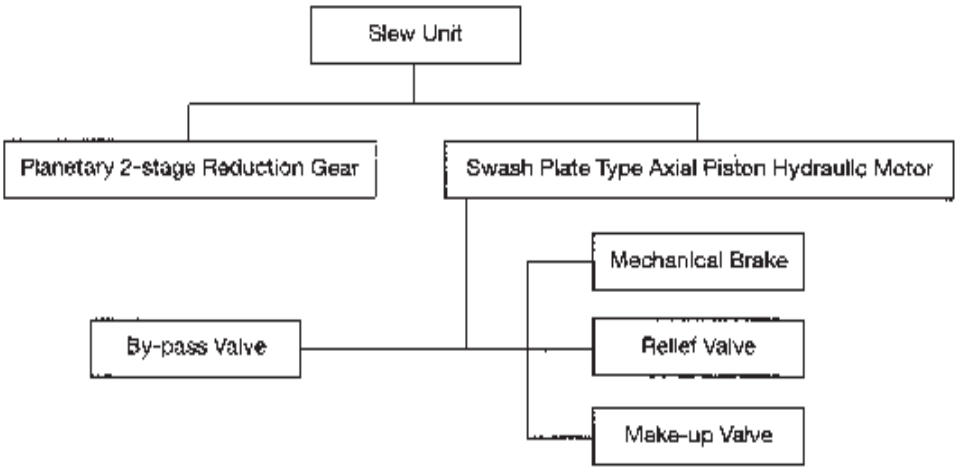
Oil is allowed to flow across all of the spools via the neutral gallery when all controls are in the neutral position. Oil from pump **A1** exits port Ps 1 and oil from pump **A2**, exits port Ps2 at the top of the main control valve. Both flows of oil meet a separate restrictor and relief valve. Some oil will pass through the restrictor and back to tank, creating back pressure in the line. Oil is exhausted across the relief valves at 40 bar (580 lb in^2). The back pressure is sensed at ports Ps1 and Ps2 and ports Pt1 and Pt2 of the pumps, holding the pumps on minimum flow.

Flow from the servo pump enters the valve block at port Pp, where it meets 3 restrictors. These maintains the pressure on the input side at full servo pressure. Oil that crosses the restrictors, is allowed back to tank after passing over the neutral gallery of the spools. No pressure is created in this line whilst all controls are in neutral, allowing all pressure switches to remain in the open position.

a	Dipper (1) spool
b	Boom (2) spool
c	Slew spool
d	Option spool
e	Travel (left) spool
f	Dipper (2) spool
g	Boom (1) spool
h	Bucket spool
i	Travel (right) spool
k	Linear Travel spool



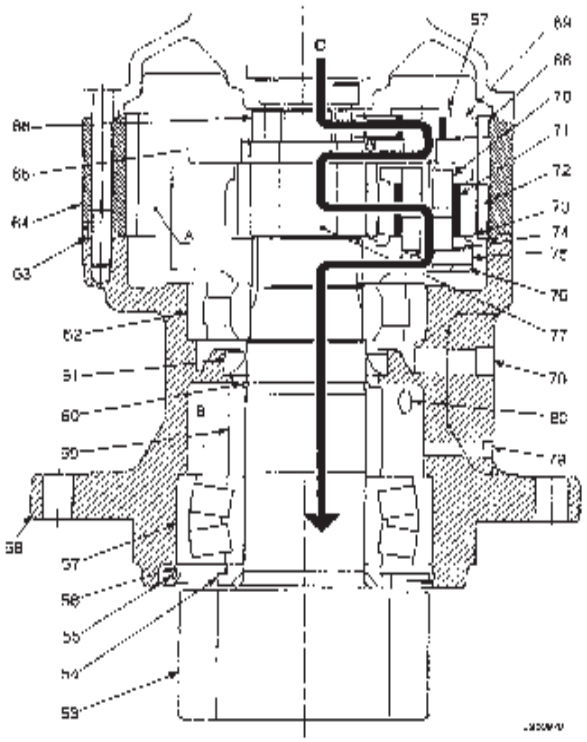
Slew Motor Configuration



Slew Motor Reduction Gear

Key

A A chamber
B B chamber
C Torque path

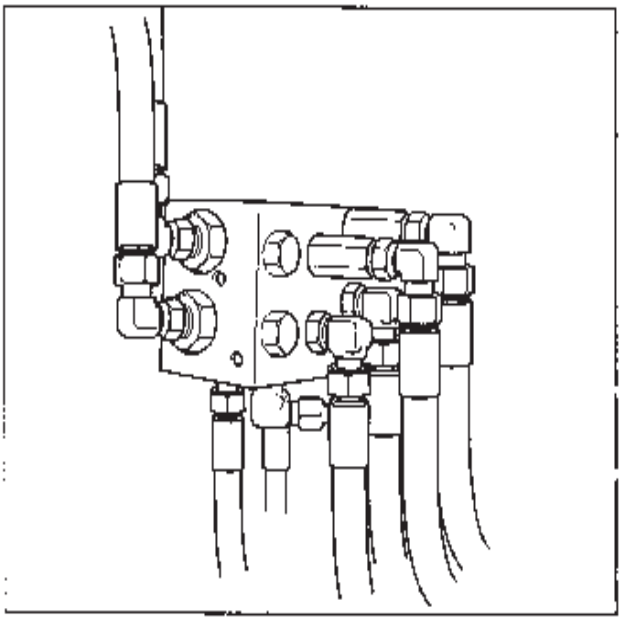


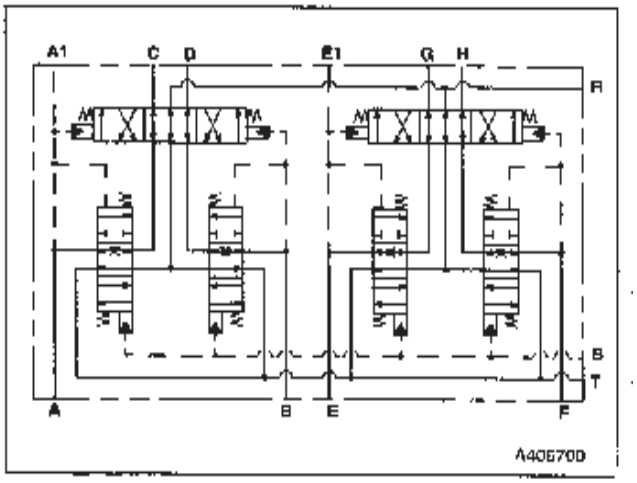
Reduction Gear Structure and Working Principles

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.

Cushion Valve





Operation

The machine defaults to cushioned mode on start up. The following describes only the "Dipper in" function but, Dipper out, Boom in and Boom out circuits all operate in the same way.

1. Cushioned Mode - Hand controller in neutral (Fig 1)

When the Hand control is in Neutral, hot oil is taken from the pressurised oil cooler line, entering port **R** of the cushion valve, through the outer spool and around the inner spool, via the galleries **E** and **F**, around the middle of the outer, via galleries **G** and **H**, returning to the tank via port **T**.

2. Cushioned Mode - Hand controller at Dipper in (Fig 2)

Pilot pressure enters port **A** of cushion valve from the left hand controller. The left-hand inner and outer spools move over to the right. Oil passes from **A** to **C** via gallery **I** and flows on to the dipper spool in the main control valve. Returning oil from the main control valve enters port **D** and passes through gallery **J** to tank via port **T**. The movement to the right, of the left hand inner and outer spool cuts off galleries **E**, **G** and **H**. This allows hot oil from port **R**, to pass through gallery **F**, through the central orifice **Z**, via port **B** to the dipper hand controller, which then warms up.

3. Cushioned Mode - Hand controller moved from dipper in to neutral (Fig 3)

When the hand controller is released, the left hand inner and the outer spools move over to the left, back into the neutral position. Pilot return oil from the control valve enters via port **C**, then passes through the restricted orifice **Z** through the centre of the inner spool. Due to this restrictive effect, the dipper control spool in the main control valve returns slower than normal to the neutral/stop position.

Anticavitation

Anticavitation oil is supplied from the **T** port on the hand controller, through port **B**, through the centre of the right hand spool and gallery **K**, via port **D** to the main control valve.

4. Cushion Control off (Fig 4)

When the cushion switch is illuminated, the cushion solenoid is energised and pilot pressure is fed to port **S** on the cushion valve. The two inner left and right cushion spools are both pushed into the centre of the outer spool, so that the unrestricted galleries **X** and the cushion valve spools are open to allow the pilot outputs from the hand controller to pass through the valve unrestricted, to the main control valve. When the dipper hand controller is operated, pilot pressure from the lever to port **A**, moves the outer spool to the right and pilot pressure is fed to the dipper spool in the control valve, via port **C**. At the conclusion of the hand controller operation, the returning pilot oil, goes straight back to the lever, with no restriction. There is no cushioning effect. Hot oil from port **R** returns to tank via the dipper hand controller, as it does in the warming circuit in the neutral position.

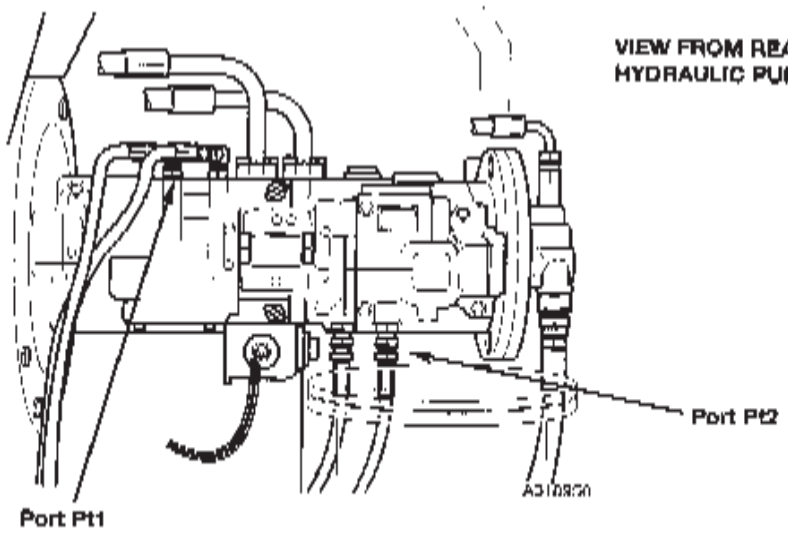
Slew (cont'd)

Symptom	Cause	External Inspection	Countermeasure	Repair
Insufficient torque	Wear or setzure 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	Repair or renew the part
b	Damage to sliding surface of cam plate	Repair the part or renew the motor.
c	Damage to sliding surface of the piston assemblies	Repair the part or renew the motor.
d	External wear to the piston assemblies	Repair the part or renew the motor.
e	Wear to piston bores in cylinder assembly	Renew the motor.
f	Damage to Teflon ring 19 or 'O'-rings	Renew the part.

Test 001: Testing Negative Control Signal



- Fit test gauges (0 - 50 bar, 10 - 1000lb in^2) into hose connections to ports Pt1 + Pt2 with tee piece adapter
- Warm up machine hydraulic temperature to 50 °C (122 °F)

* This pressure will vary with oil temperature and engine speed.

	(Expected Pressures) Port pt1	Port pt2
With max engine rpm's and no services selected record negative control pressure	30 - 35 bar* 435 - 507 lb in^2	(30 - 35 bar*) 435 - 507 lb in^2
Select and stall boom up service record pressure	(0 - 3 bar) 0 - 43.5 lb in^2	(0 - 3 bar) 0 - 43.5 lb in^2
Fully select boom down record pressure when service first selected	(30 - 35 bar) 435 - 507 lb in^2	(15 bar) 217.5 lb in^2
Select and stall bucket open service record pressure	(30 - 35 bar) 435 - 507 lb in^2	(0 - 3 bar) 0 - 43.5 lb in^2
Select and stall bucket close service record pressure	(30 - 35 bar) 435 - 507 lb in^2	(0 - 3 bar) 0 - 43.5 lb in^2
Select and stall dipper open service record pressure	(0 - 3 bar) 0 - 43.5 lb in^2	(0 - 3 bar) 0 - 43.5 lb in^2
Select and stall arm close service record pressure	(0 - 3 bar) 0 - 43.5 lb in^2	(0 - 3 bar) 0 - 43.5 lb in^2
Select and stall swing left service record pressure	(0 - 3 bar) 0 - 43.5 lb in^2	(30 - 35 bar) 435 - 507 lb in^2
Select and stall swing right service record pressure	(0 - 3 bar) 0 - 43.5 lb in^2	(30 - 35 bar) 435 - 507 lb in^2
Select and stall left hand track forward record pressure	(0 - 3 bar) 0 - 43.5 lb in^2	(30 - 35 bar) 435 - 507 lb in^2
Select and stall left hand track backwards record pressure	(0 - 3 bar) 0 - 43.5 lb in^2	(30 - 35 bar) 435 - 507 lb in^2
Select and stall right hand track forwards record pressure	(30 - 35 bar) 435 - 507 lb in^2	(0 - 3 bar) 0 - 43.5 lb in^2
Select and stall right hand track backwards record pressure	(30 - 35 bar) 435 - 507 lb in^2	(0 - 3 bar) 0 - 43.5 lb in^2

9803/6510 Issue 2

Test 008: Testing Machine Cycle Times

- Warm up hydraulic system to 50 °C (122°F).
- Select E mode only
- Operate all services 10 times to ensure warm oil as been circulated through all the services.
- Use a stopwatch to measure the time is takes for the service to complete one cycle with the hand controller fully selected.
- Repeat five times and take the average time.
- If the machine is fitted with HBCVs and any delay is felt when operating dipper in, then the HBCV must be bled of any air and the test repeated.

Service operated	Time. (Seconds)	
	JS200-220	JS240/260
Boom Up	3.0 - 3.7	3.2 - 3.7
Dipper In	3.0 - 3.6	3.4 - 3.9
Dipper Out	2.5 - 3.0	2.5 - 2.9
BucketOpen	2.0 - 2.5	2.2 - 2.5
Bucket Close	2.3 - 2.7	2.2 - 2.4
Slew. (1 revolution)	4.7 - 5.2	5.5 - 6.0

Track motor speed in E mode, max RPM.

- Raise one track off the floor by slewing the machine through 90 degrees and lifting the machine using the boom and dipper.
- Make a mark on the outside edge of the Track Gearbox.
- Operate the track motor in forward and reverse for 5 minutes, changing gear at regular intervals to distribute warm oil through the system.

Speed selected	Expected Gearbox RPM
Creep (Tortoise)	24 +/- 4
Middle	28 +/- 5
High (Rabbit)	46 +/- 6

Test 016: Flow Testing Hydraulic Pumps

- Install flow meter and load valve as close as possible to pump outlet in one of the pump lines.
- Fit pressure test gauges 0 - 600 bar (8700 lb in²) to main pump test points.
- Start engine and warm up hydraulic oil at least 50 °C (122 °F).

To Confirm Minimum Flow Setting

- Set machine to A mode.
- Stall boom up service and record pressure in each pump, flow on flow meter and engine rpm's (record this on sheet attached).
- Repeat this test for E mode, L mode and P mode.

To Confirm Maximum Flow Setting

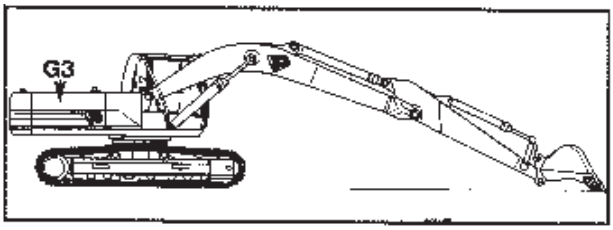
- Disconnect negative control pilot hose from pump which is being tested, plug the hoses and leave ports on pump open to atmosphere.
- Set machine to max engine rpm's in A mode with the Auto Pressure Switch shorted out. Have the load valve the on flow meter fully open and do not operate any services.
- Record the pressure on both pumps, the flow on flow meter and the engine rpm's (record this on sheet attached).
- Repeat this test for E mode, L mode and P mode.

To Confirm Horse Power Control

- Disconnect negative control pilot hoses and max flow cut pilot hoses from both pumps.
- Plug the hoses and leave ports on pump open to atmosphere.
- Start the engine and set the machine to max engine rpm's in A mode, make sure the load valve is fully open.
- Record the pressure on both pumps on the flow on flow meter, engine rpm's and proportional solenoid current (record this on sheet attached).
- **SLOWLY** increase the pressure using the load valve up to approx 100 bar (1450 lb in²).
- Record the pressure on both pumps, flow on flow meter, engine rpm's and proportional solenoid current (record this on sheet attached).
- Increase the pressure in steps of 25 bar (362.5 lb in²)each time recording the pressure on both pumps, flow on the meter, engine rpm's and proportional solenoid current (record this on sheet attached).
- **DO NOT** increase pressure above 350 bar (5075 lb in²).
- Reset the load valve to fully open.
- Repeat test for E mode and P mode (record all results on sheet attached).

Remove flow meter from pump being tested and fit into second pump carry out tests to confirm minimum flow, maximum flow and horsepower control.

Servo Relief Pressure



1 **Prepare the Machine**

Put the operator levers into neutral and lower the gate lock lever. Start the engine and park the machine on level ground. Operate the dipper out and lower the boom to set the bucket on the ground. Stop the engine.

2 Before testing the Pilot Relief valve **C**, connect a 0-100 bar (0-1500 lb/in²) pressure gauge to test point **G3**.

3 Start the engine and confirm that the engine is at its maximum no-load speed and it is in the **E** mode. The pressure gauge reading should be compared to the technical data at the start of this section. If it is outside the limits adjust the pilot relief valve as below.

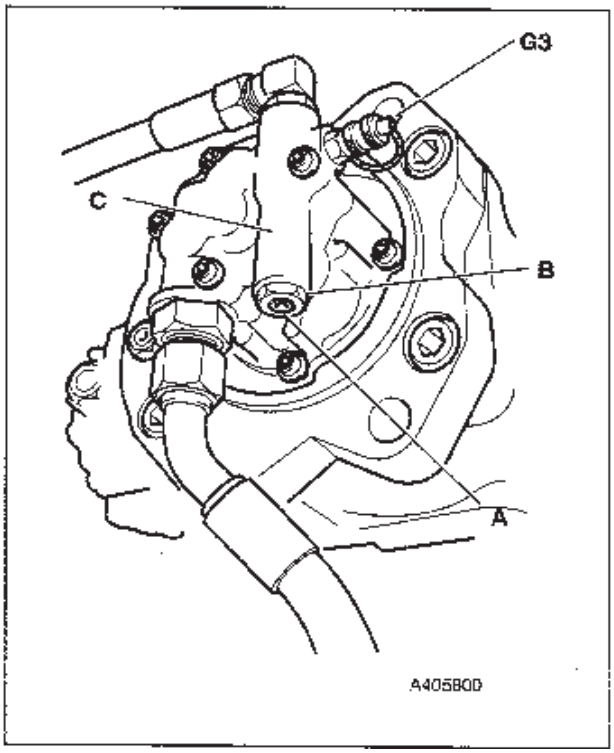
4 **Stop the engine.**

5 Loosen the lock nut **B** of the pilot Relief Valve.

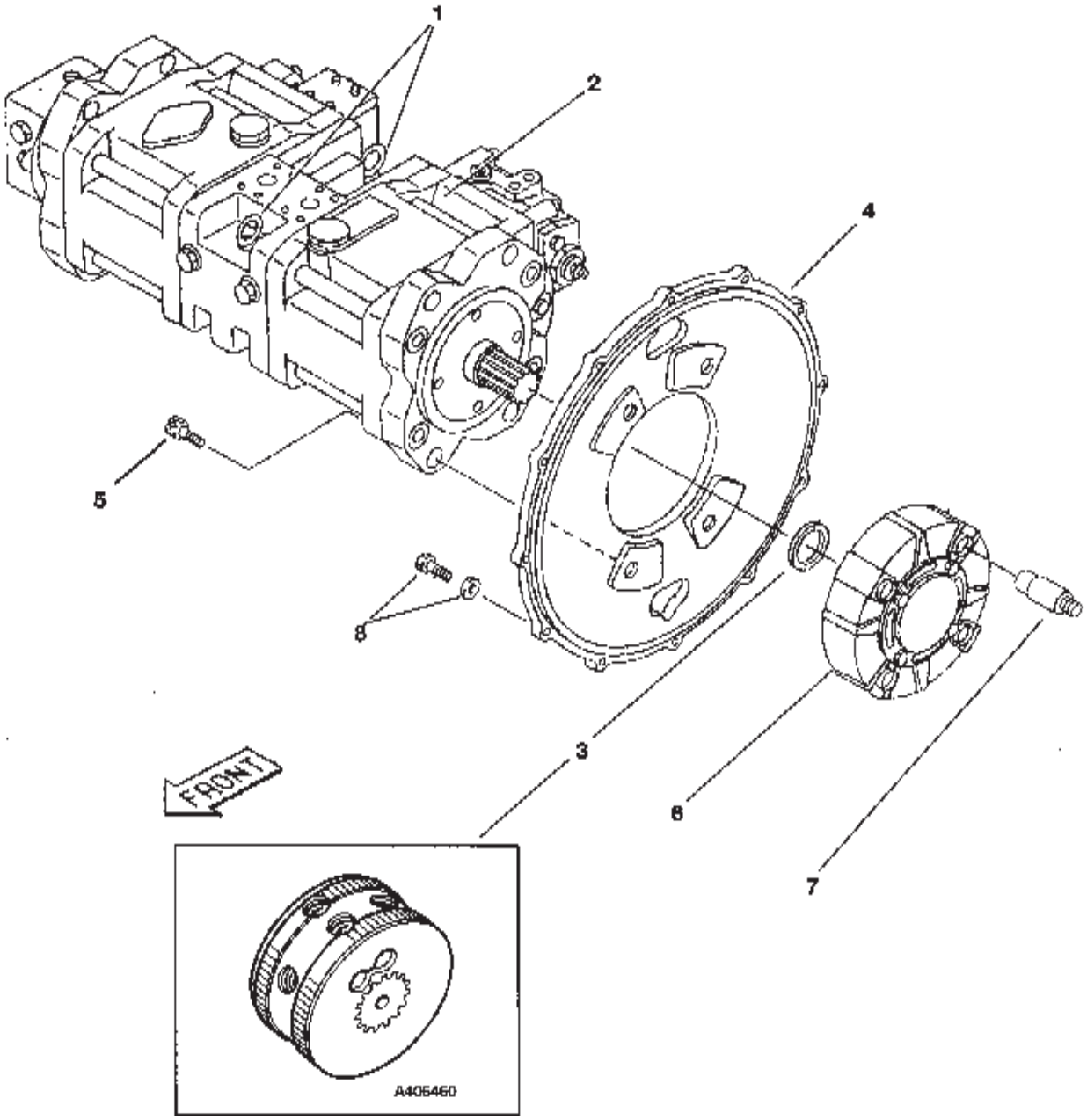
6 The valve is adjusted by turning relief valve adjusting screw **A** (one turn of the adjustment screw equals 39.2 bar, (568.5 lb in²)).

7 Tighten lock nut **B** to 17 Nm (12. lbf ft, 1.7 kgf m), check the relief pressure again.
If it is not within the limits above, perform steps 3 to 6 again.

8 Stop the engine, and then remove the pressure gauge.



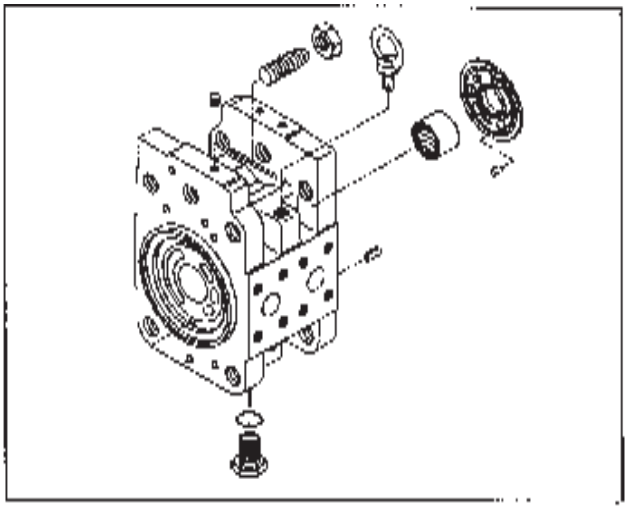
Removal and Replacement



Assembly (cont'd)

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.

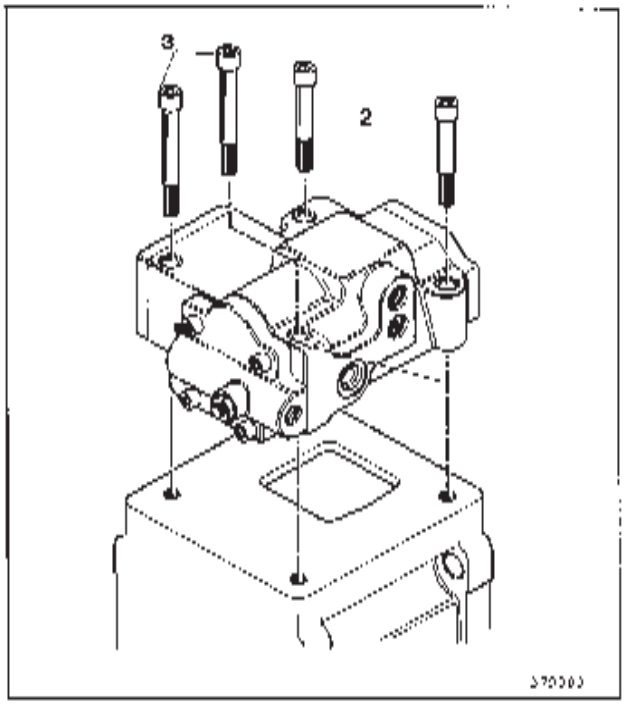


7 Install the valve block **312** to the pump casing **271** and tighten the hexagonal socket head bolt **401**.

Note:

a The work would be easier if the rear of the pump is assembled first.

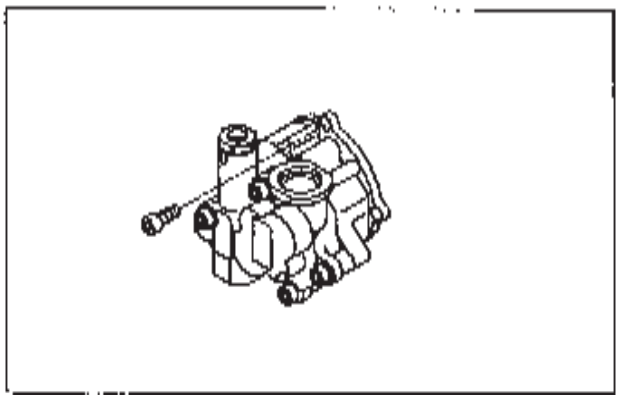
b Take care not to mistake the direction of the valve block. When looking from the front side, the regulator is on the top and the delivery flange is on the left.



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 **2,3**..

Note: Take care not to mistake the front and rear of the regulator.

9 Replace servo pump **4**, and tighten cap screws **436**



Removal and Replacement (cont'd)

⚠ DANGER

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

Removal

1 Lower dipper and place bucket on the ground

2 Turn off engine.

3 Operate both control joysticks back and forth and side to side to vent residual pressure.

Remove the two screws **A** from each side, and loosen screws **B** (one either side of the arm rest) Remove front panel **C**.

Disconnect electrical connection to Remote Control Valve.

Disconnect all hydraulic hoses and pipes from the Remote Control Valve and plug all orifices to prevent ingress of dirt. Label each hose before disconnecting, this will ensure correct position when refitting.

Remove the two screws **D**, two screws **E** and loosen the two screws **F**. Remove panel **G**.

Lift up gaiter **H** and remove the fours bolts holding the valve to the arm rest .

Lift the remote contol valve clear of the arm rest.

Note: Care should be taken when removing right arm rest, remove switches, using a thin flat bladed screw driver and disconect electrical connections.

Replacement

⚠ WARNING

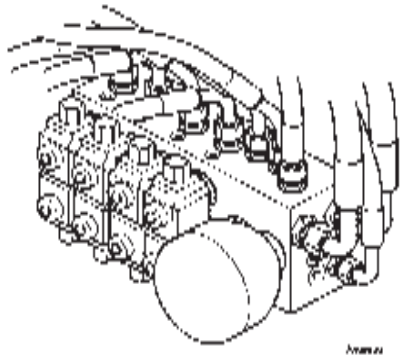
Fine jets of hydraulic fluid at high pressure can penetrate the skin. Do not use your fingers to check for hydraulic fluid leaks. Do not put your face close to suspected leaks. Hold a piece of cardboard close to suspected leaks and then inspect the cardboard for signs of hydraulic fluid. If hydraulic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

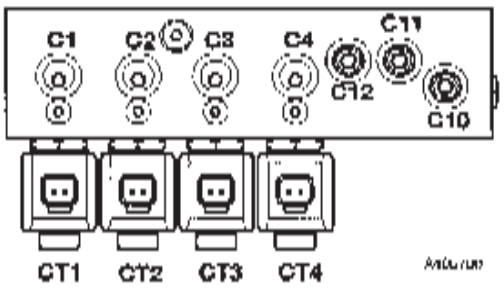
INT-3-1-10/1

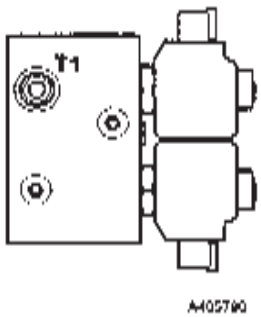
Replacement is the reversal of the removal sequence.

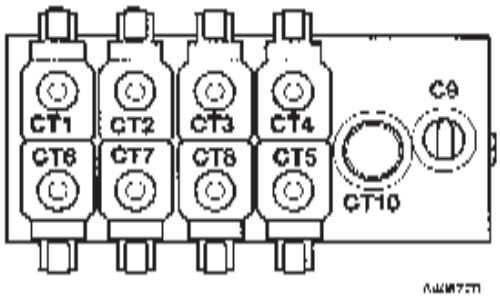
Note: All hydraulic adapters that are installed together with a bonded sealing washer must also have JCB Threadseal applied to the threads of the adapter.

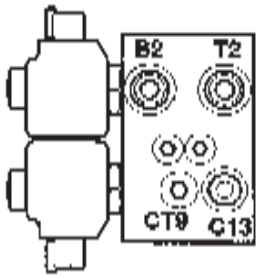
Removal and Replacement

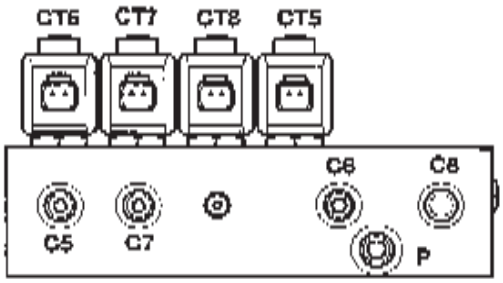




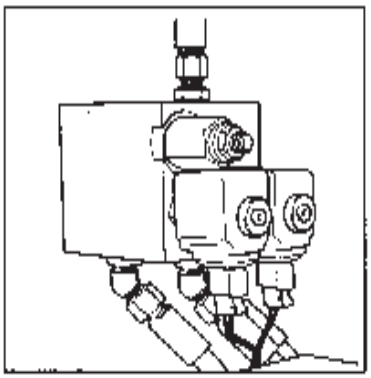


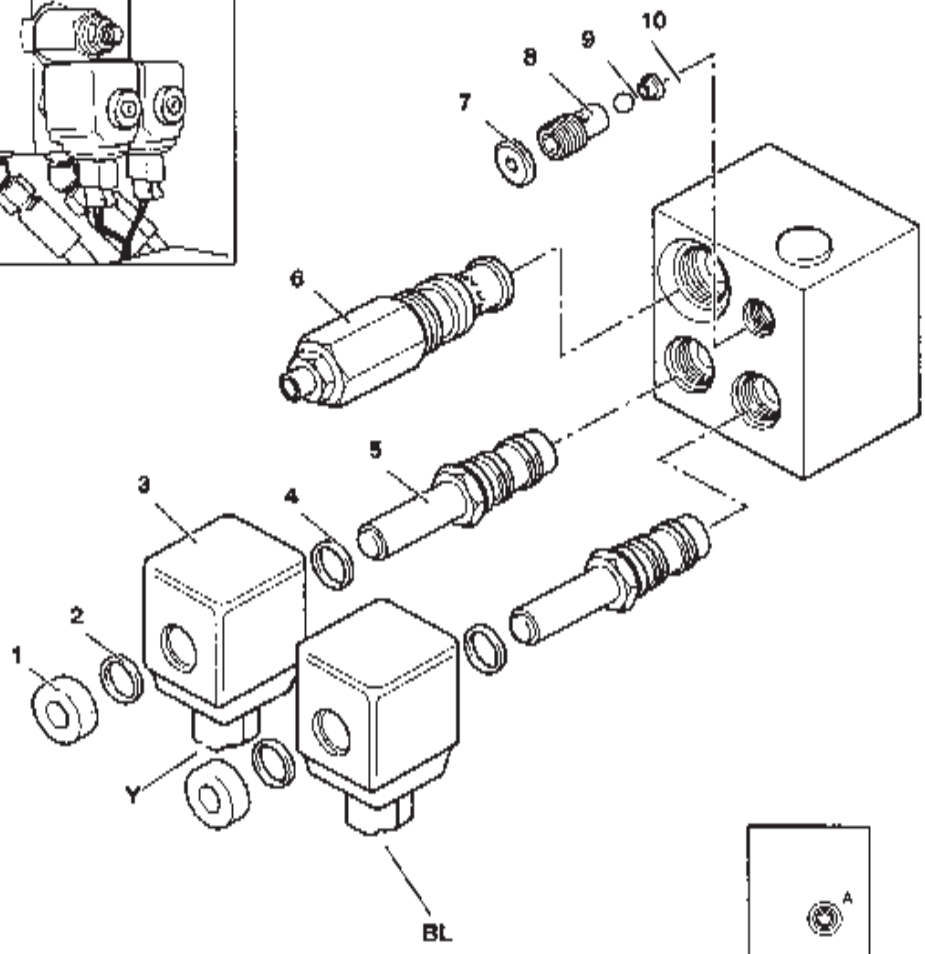




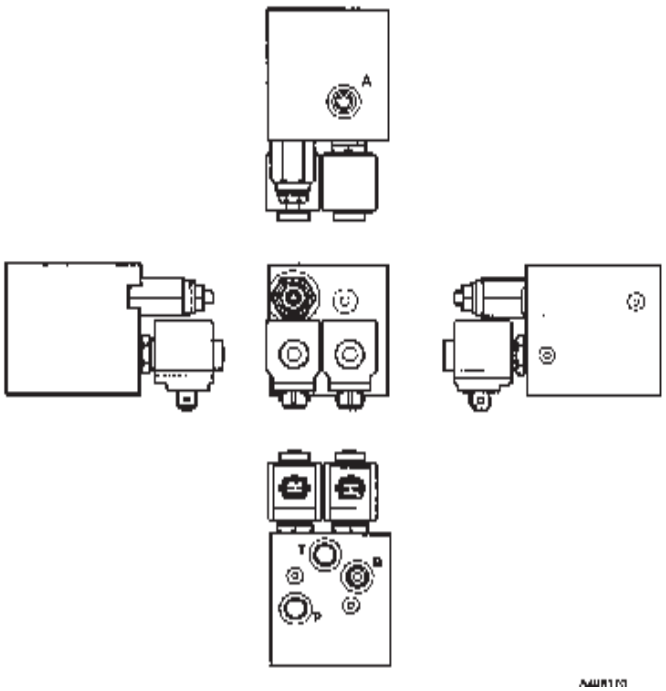


Solenoid	Function	Electrical Harness Tape Colour	Hydraulic hose colour
CT1	2 Stage Travel	Red	Blue / Blue
CT2	Swing Shut Off	Green	Red / Red
CT3	2 Stage Relief	Yellow	Green / Green
CT4	Cushion Control	Light Green	Yellow / Yellow
CT5	Negative Control	White	Violet / Violet
CT6	Boom Priority	Pink	Orange / Orange
CT7	Max Flow Cut	No Tape	Light Blue
CT8	Servo Isolator	Blue	No Hose





Port	Hose Colour
A	-
B	Red/Light Green
P	Gray/Gray
T	White/Yellow



Inspection

1 Clean each part in a suitable solvent and dry using compressed air.

2 Inspect all parts and act in accordance with the following table.

3 Discard all used seals and 'O' rings and fit new ones during assembly.

⚠ 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.

INT 3-1-6/1

⚠ 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

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 **6** 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.

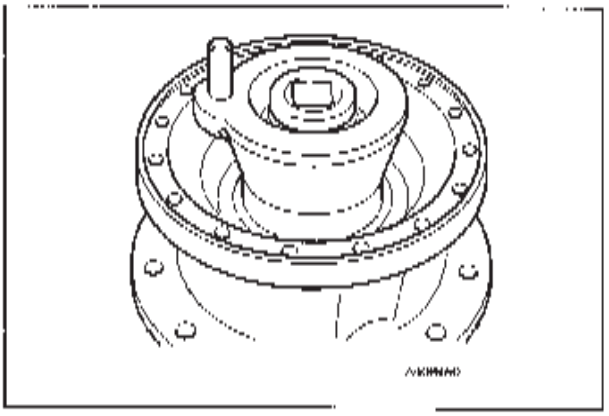
Slew Reduction Gear (cont'd)

Dismantling

Cleanliness is the utmost importance when servicing the gearbox. All precautions to prevent any ingress of dirt, grit etc must be taken

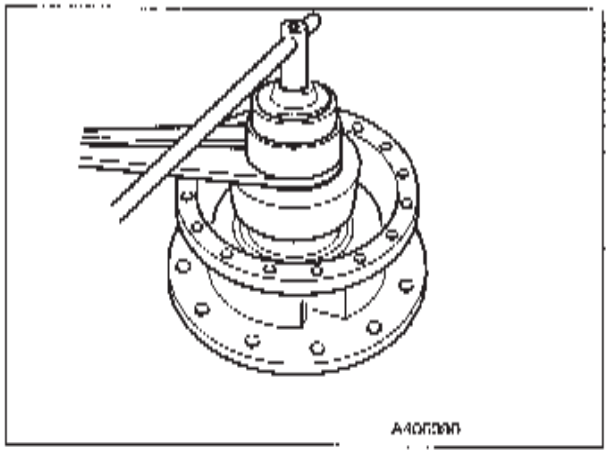
Note: For details of service tools referred to, see **Service Tools** at the front of this section

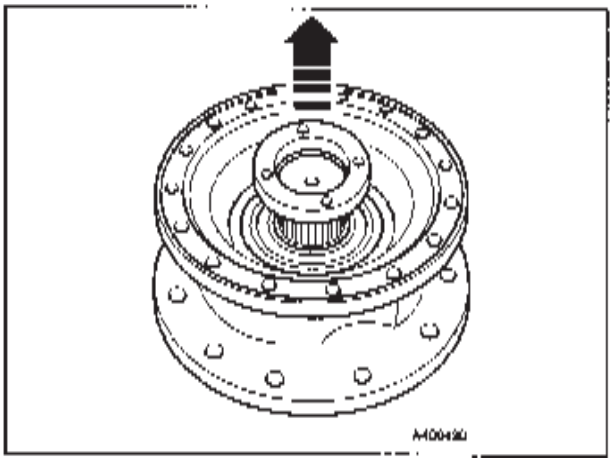
1 Remove bolts 3 which hold the cover 4 to the ring gear and gear box cover 13.
Lift out 1st Reduction Sun Gear 1.
Lift out 1st Reduction Planet gear assembly 2
Lift out 2nd Reduction Sun Gear 5.
Remove cover 4.
Remove O-ring 6 from the ring gear.
Lift out 2nd Reduction Planet gear assembly 9.
Remove ring gear 7.
Remove O-ring 8 from the ring gear.



2 Assemble the Socket Box Wrench and Nut Adapter (see **Services Tools**, Section 1) on the ring nut 10.

By using a torque multiplier (1:25) loosen the ring nut 10.
Remove the ring nut.

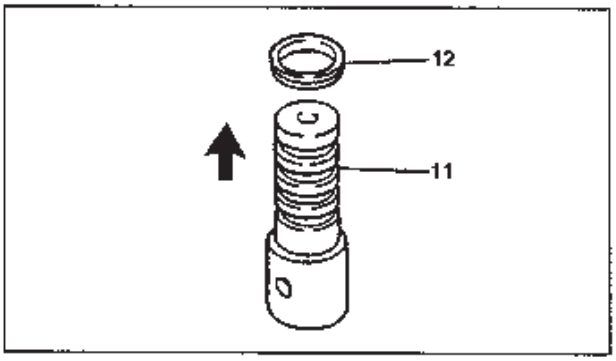




Dismantling (cont'd)

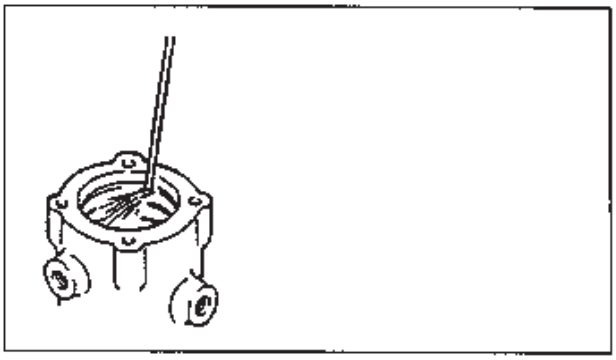
5. Remove the V-ring 12 from the axle 11.

Note: Do not reuse the V-ring 12.



16. Remove the 'O'-ring 14, and packing ring from the rotor 13.

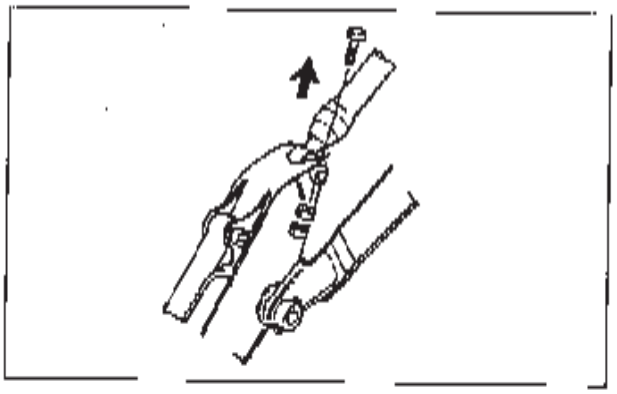
Note: Do not reuse the packing ring 15.



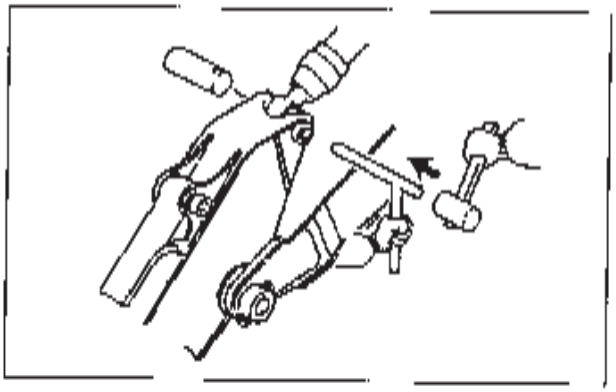
Dipper Ram (cont'd)

Removal (cont'd)

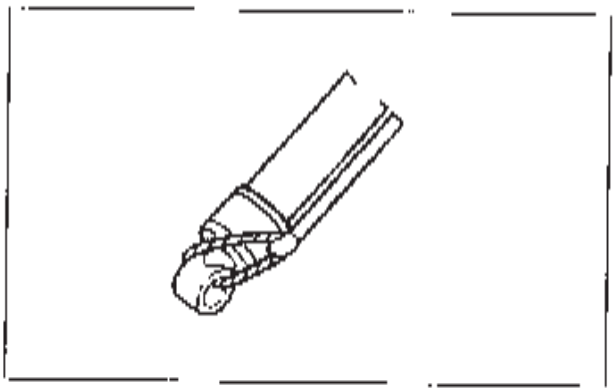
4 Remove the nuts and bolts.



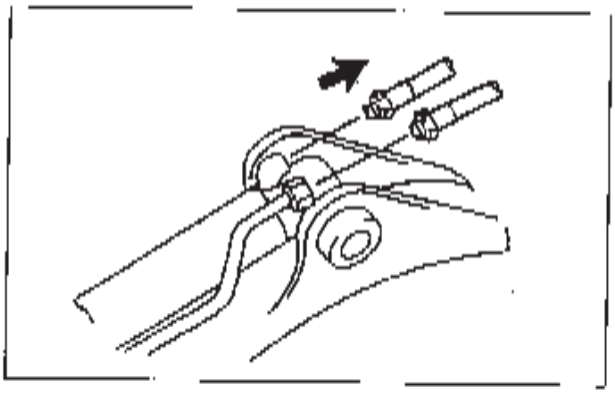
5 Push out the pin, using a bar and hammer.



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.



Dismantling the Piston Rod

Note: protect all the parts from dirt.

1 Secure the piston rod pack on the bench, brace the piston rod head (Fig. 4).

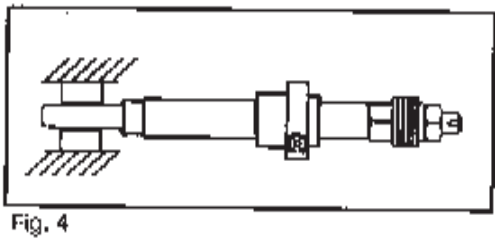


Fig. 4

2 Unfasten and remove the stop screw **X.** Remove the steel ball **Y** (Fig. 5).

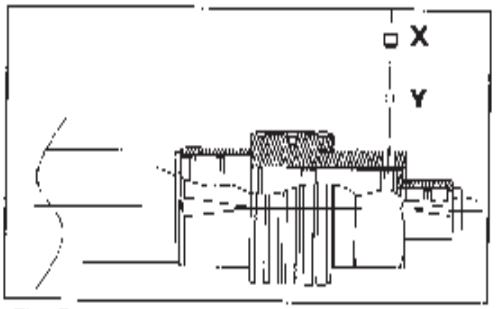


Fig. 5

3 Unfasten the nut (Fig. 6).

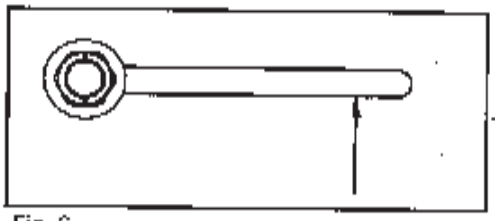


Fig. 6

4 Dismantle the snap ring (Fig 7).

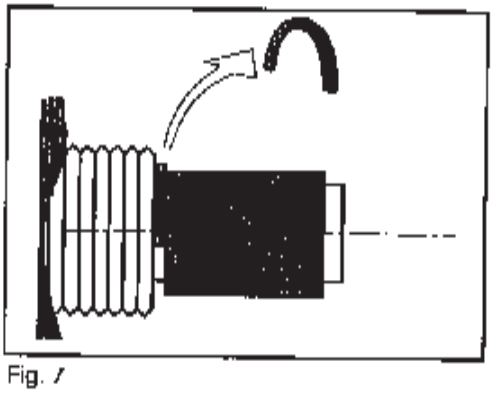


Fig. 7

5 Press the cushion ring against the piston (Fig. 8).

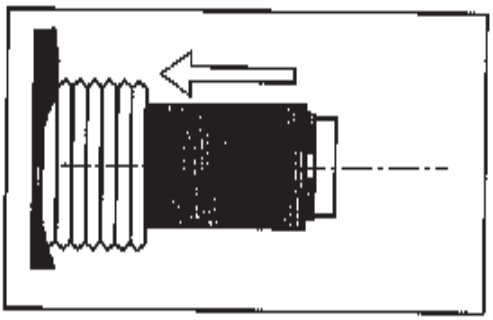


Fig. 8

Assembly of the Piston Rod with Cushion Ring on the Piston Rod Side (cont'd)

1 Fit the cylinder head on (Fig. 19).

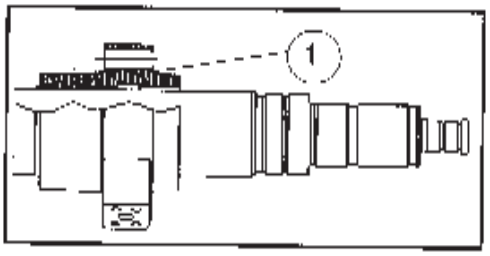


Fig. 19

2 Fit the seal under the cushion ring (Fig. 20).
Please note the direction!

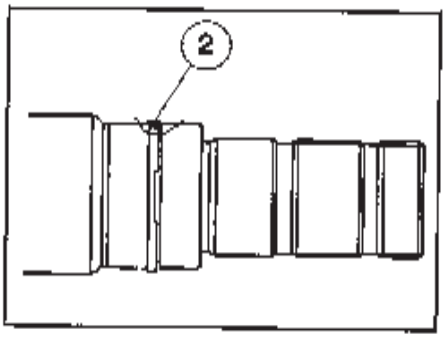


Fig. 20

3 Put the cushion ring on (Fig. 21).
Please note the direction! Turn the arrow point towards the piston.

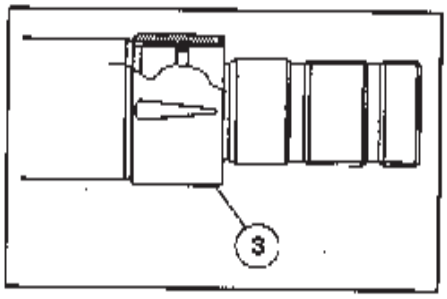


Fig. 21

4 Put the piston on. Please note the direction! (Fig. 22).

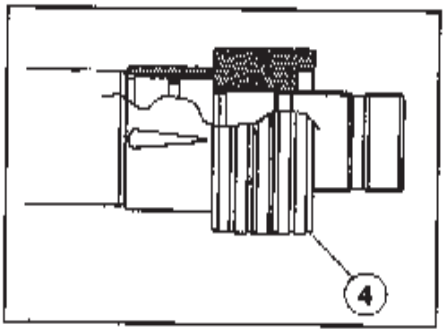


Fig. 22

5 Fit shims (reduction of friction) (Fig. 23).

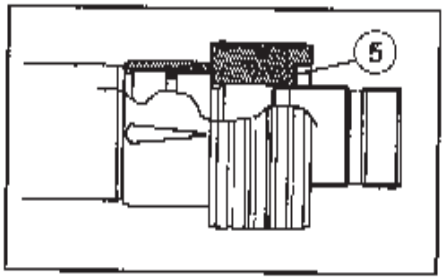


Fig. 23

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

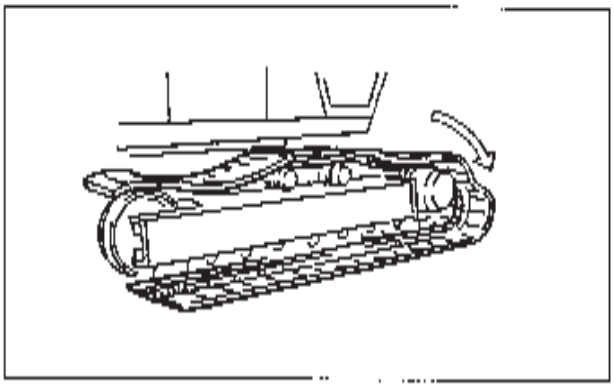
Because the bushing is press-fitted by the hydraulic press at the central part of the cylinder head, it requires a lot of time and work in order to remove the bushing from the cylinder head quickly, easily and accurately without damaging the inside of the cylinder head.

1 1

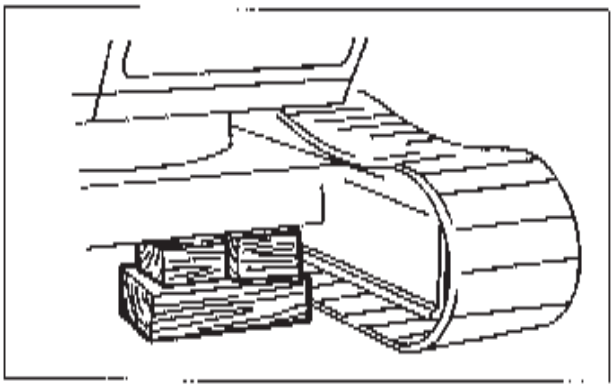
Contents

Removal (cont'd)

4 Operate the traction motor to remove the track.



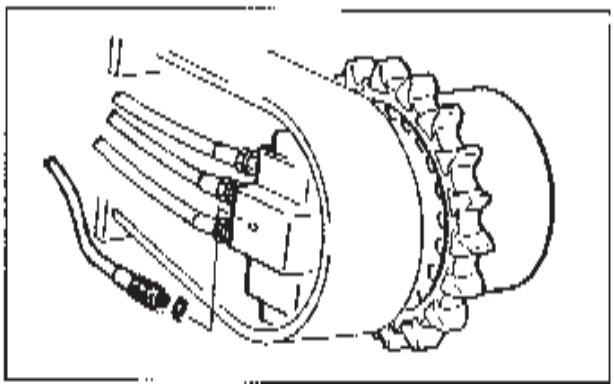
5 Lift the side of the undercarriage high enough to permit drive sprocket removal. Support with wooden blocks.



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, Section 3**).

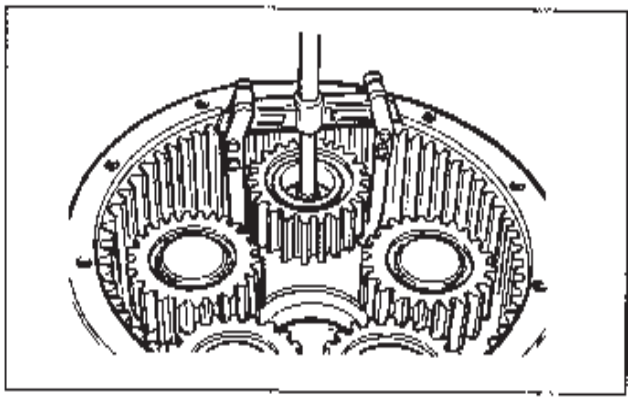
7 Remove the motor cover, attach identification tags to the motor hoses, disconnect the hoses from the motor and install plugs and caps.



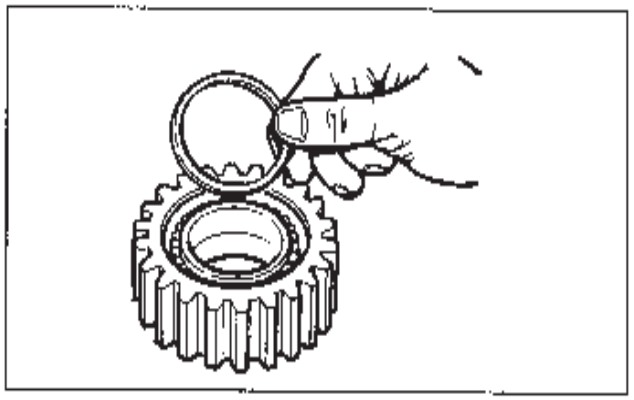
Dismantling and Assembly (cont'd)

Dismantling (cont'd)

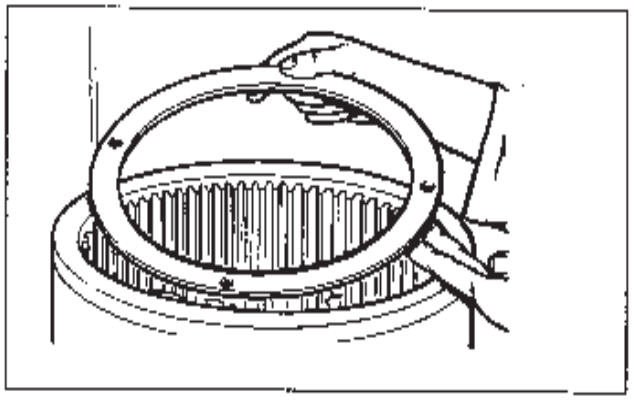
9 Use a puller and remove the five planet gears **11** off the third reduction assembly.



10 Remove the spacers **12,** positioned on the back of the planet gears of the third reduction assembly.

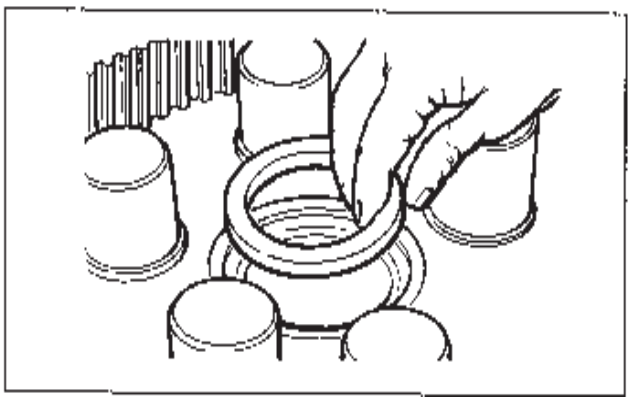


11 Using a drill, remove the two deformed sections of the ring nut **13.** Using Service tool SST0040 and a torque multiplier, unscrew the ring nut **13.**



12 Remove the centring ring **16,** from the hydraulic motor **17.**

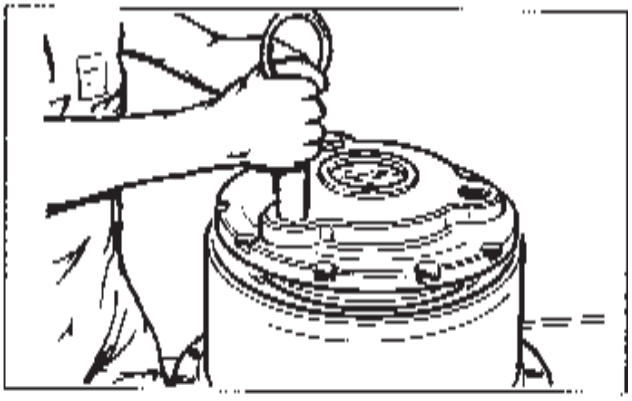
Note: This operation must be carried out only when the hydraulic motor is to be removed.



Dismantling and Assembly (cont'd)

Assembly (cont'd)

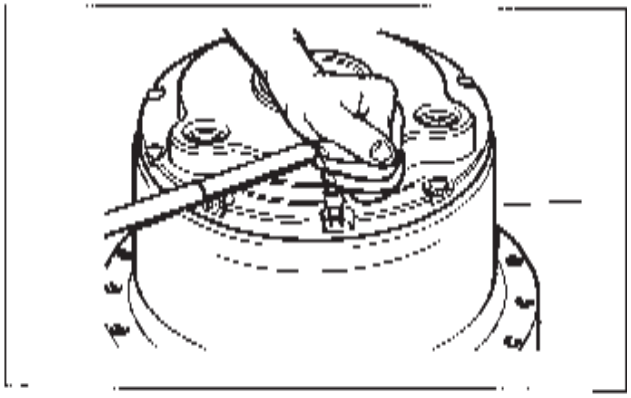
15 Fit the end cover **2**, on the gearbox housing **14**.



17 Fix the end cover **2**, with the socket screws **1**.

Torque Setting

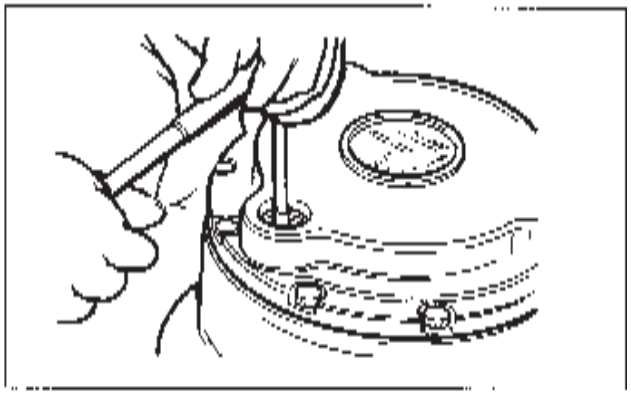
Item	Nm	lbf ft	kgf m
1	75	53	7.5

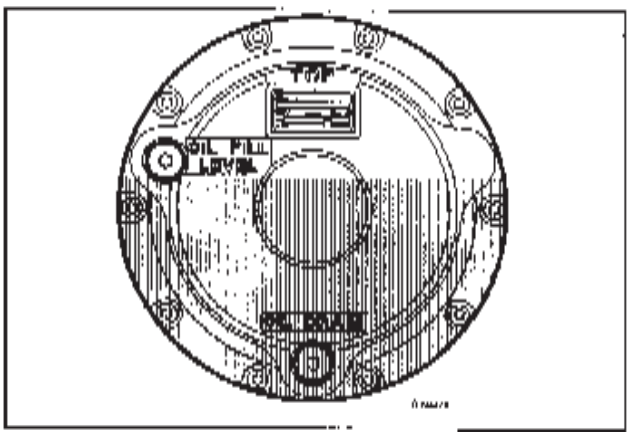


18 Fill the gear box with oil Tighten the two plugs **3** using a hex head torque wrench.

Torque Setting

Item	Nm	lbf ft	kgf m
1	35	26	3.5

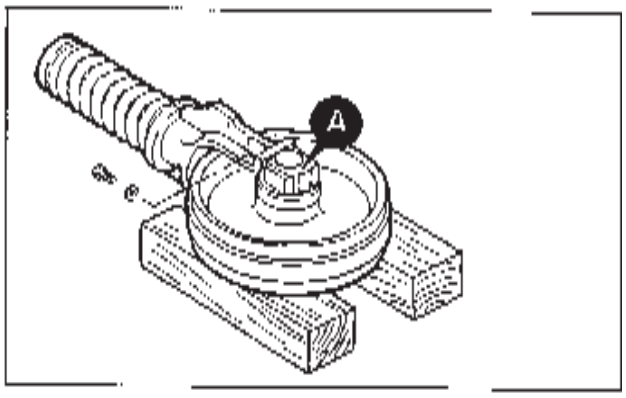




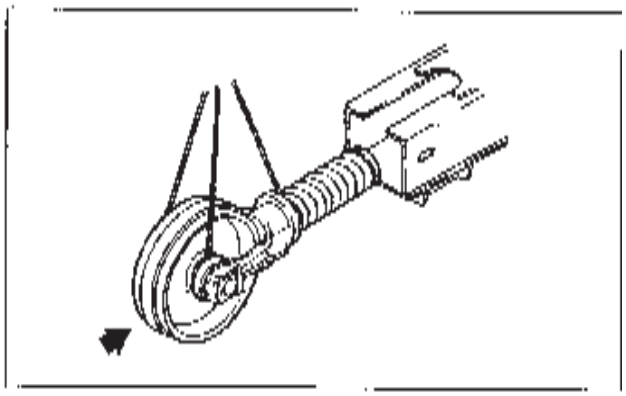
Replacement

1 Before fitting the idler wheel, check the oil level at A. If required, top up with the specified oil (see section 3).

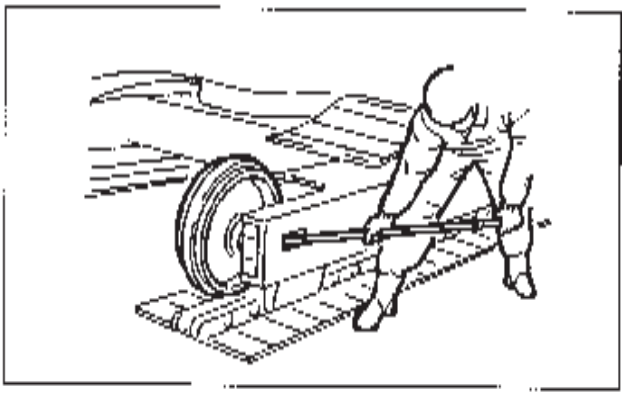
Assemble the idler wheel to the recoil unit and fit the mounting bolts.



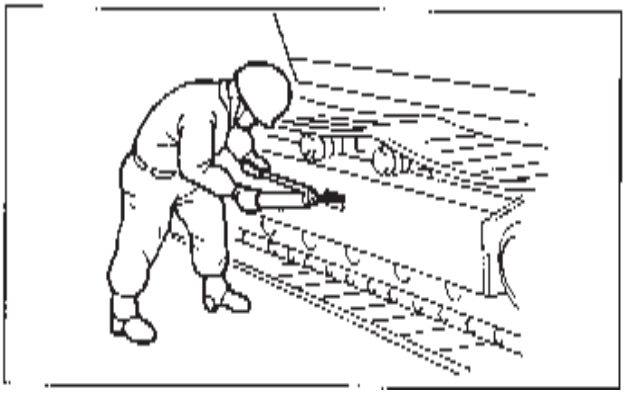
2 Fasten a sling around the idler wheel and recoil assembly and enter it into the undercarriage.



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).

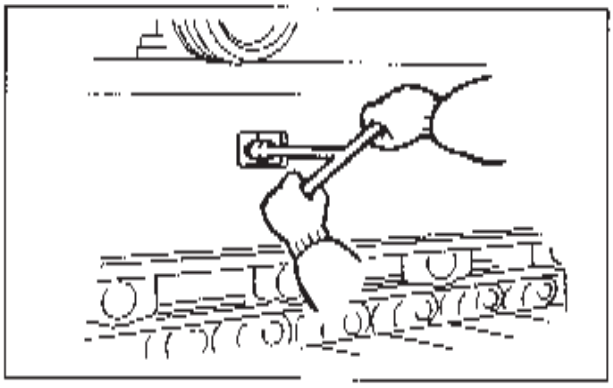


Removal

1 Slacken the check valve to bleed out grease.

⚠ WARNING

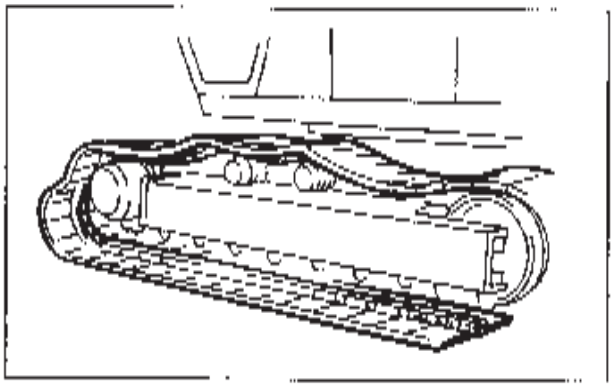
When opening the check valve always stand to one side and loosen a little at a time until grease starts to come out. If you over-loosen, too much grease could spurt out or the valve cover fly out and cause serious injury.



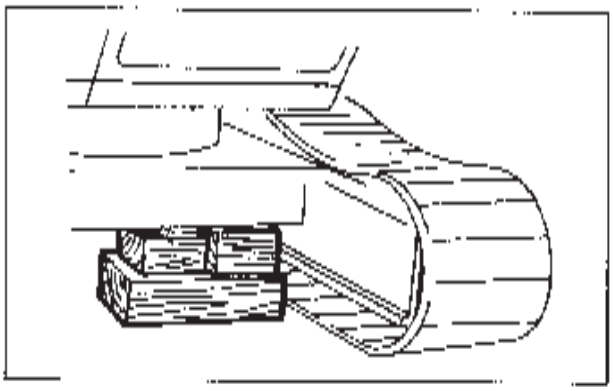
2 Disconnect the track link.

⚠ WARNING

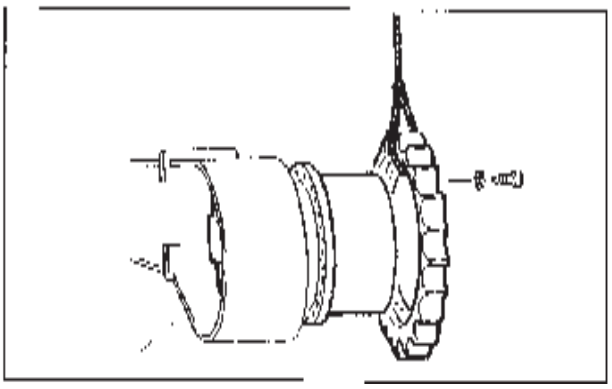
Stand clear and to one side of the track while you remove the master pin. When the master pin is removed, the track could fall forward and injure you.



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.



Wear Limits

	JS200 - 260
Nominal Pitch	190.00mm
	Dimension A (mm)
Wear	Normal Impact
0%	120.00
10%	118.90
20%	117.70
30%	116.60
40%	115.40
50%	114.20
60%	113.10
70%	111.90
80%	110.90
90%	109.00
100%	107.20
110%	105.40
120%	103.50