Section H

Steering

Service Manual - Backhoe Loader

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Notes:

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Service Tools

Numerical List

The tools listed in the table are special tools required for carrying out the procedures described in this section. These tools are available from JCB Service.

Some tools are supplied as kits. Cross references are given to tables showing kit contents.

Note: *Tools other than those listed will be required. It is expected that such general tools will be available in any well equipped workshop or be available locally from any good tool supplier.*

Part Number	Description	Tool Detail Reference
892/00180	Seal Fitting Tool	⇨ *Fig 1. (H-2)*
992/09300	Hexagon Spanner	⇨ *Fig 2. (H-2)*
992/09400	Hexagon Spanner	⇨ *Fig 2. (H-2)*
992/09500	Hexagon Spanner	⇨ *Fig 2. (H-2)*
992/09600	Hexagon Spanner	⇨ *Fig 2. (H-2)*
992/09700	Hexagon Spanner	⇨ *Fig 2. (H-2)*
992/09900	Hexagon Spanner	⇨ *Fig 2. (H-2)*
992/10000	Hexagon Spanner	⇨ *Fig 2. (H-2)*

Tool Detail Reference

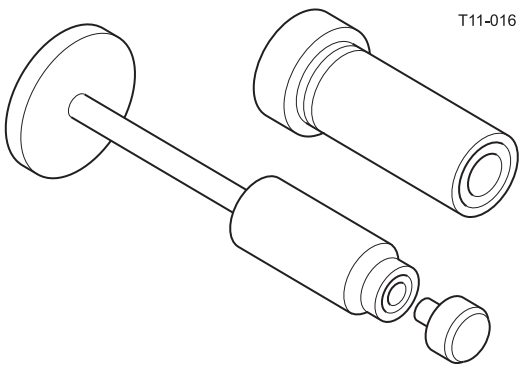

Fig 1. 892/00180 - Seal Fitting Tool

Seal Fitting Tool for fitting 'O' ring and back-up ring to Danfoss Orbitrol Unit.

892/00181 - Replacement Plastic Boss

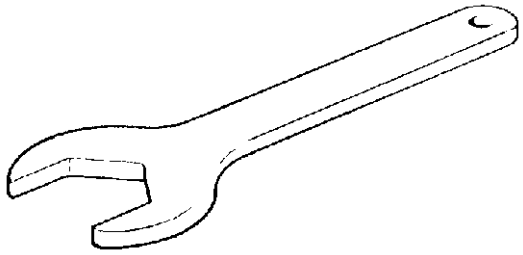

Fig 2. Hexagon Spanners

For ram pistons and end caps

992/09300	55mm A/F
992/09400	65mm A/F
992/09500	75mm A/F
992/09600	85mm A/F
992/09700	95mm A/F
992/09900	115mm A/F
992/10000	125mm A/F

Technical Data

Hydraulic Steer Unit

Steer unit with load sensing, complete with integral relief valve and shock valves.

Model Reference:	200 OSPC
Volumetric Displacement	200 cc/rev
Relief Valve Operating Pressure (at 1500 revs/min)	120 +/- 3 bar (122 +/- 3.5 kgf/cm^2, 1740 +/- 50 lbf/in^2)
Shock Valve Operating Pressure	175 - 190bar (178 - 199 kgf/cm^2, 2538 - 2756 lbf/in^2)

Model Reference:	250 OSPC
Volumetric Displacement	250 cc/rev
Relief Valve Operating Pressure (at 1500 revs/min)	120 +/- 3 bar (122 +/- 3.5 kgf/cm^2, 1740 +/- 50 lbf/in^2)
Shock Valve Operating Pressure	Shock Valve - Not Fitted

Model Reference:	160 OSPC
Volumetric Displacement	160 cc/rev
Relief Valve Operating Pressure (at 1500 revs/min)	120 +/- 3 bar (122 +/- 3.5 kgf/cm^2, 1740 +/- 50 lbf/in^2)
Shock Valve Operating Pressure	175 - 190bar (178 - 199 kgf/cm^2, 2538 - 2756 lbf/in^2)

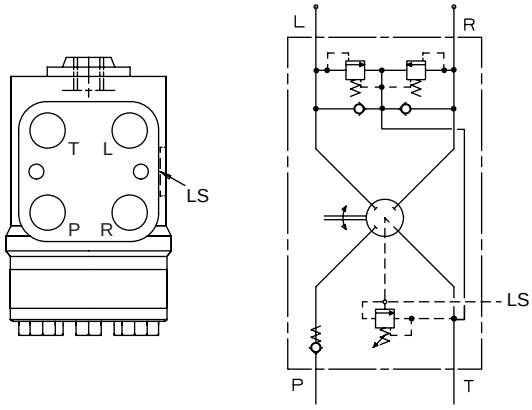

Fig 3.

Priority Valve

Standby Pressure:	7 bar (7.1 kgf/cm^2, 102 lbf/in^2)
	18 bar (1) (18.4 kgf/cm^2, 261 lbf/in^2)

(1) Priority Valve Part No. 35/910066 (if fitted).

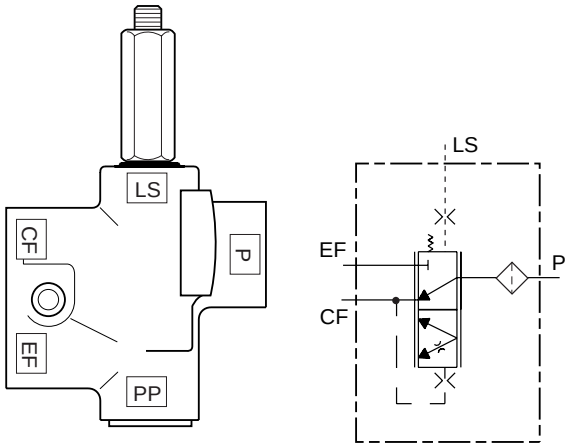

Fig 4.

Priority Valve - 3C Machines (Sideshift)

Standby Pressure: 5.6 bar (5.7 kgf/cm^2, 81.2 lbf/in^2)

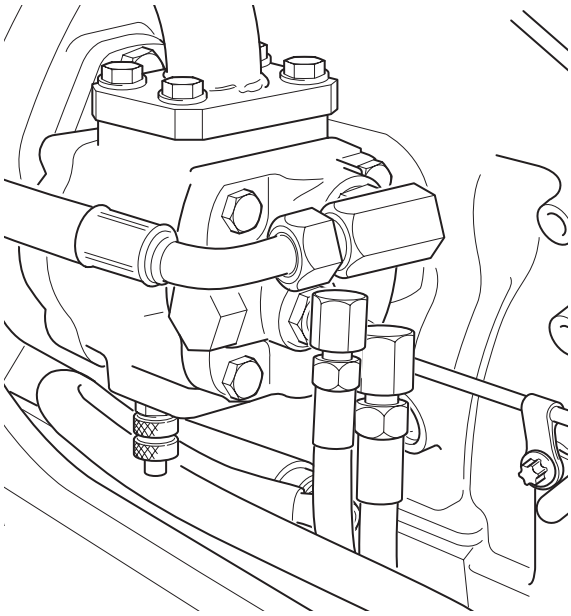

Fig 5.

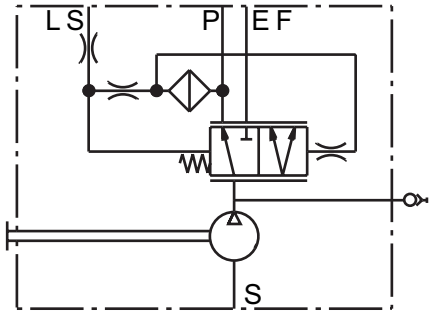

Fig 6.

Basic Operation

General Description

2 Wheel Steer Machines

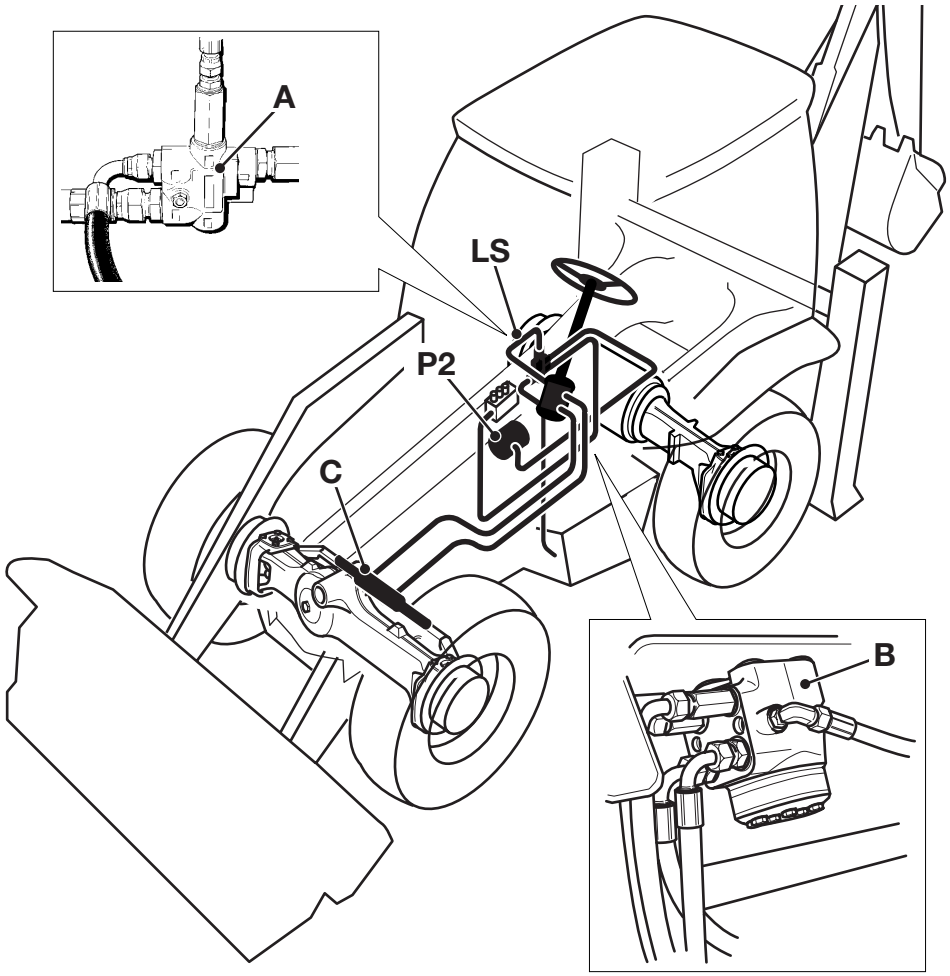

Fig 7.

The main components of the steering system are the priority valve **A**, load sensing steer unit **B** and double acting power track rod ram **C** mounted on the front axle.

When the steering wheel is turned, a pressure signal (demand) is generated in the load sense line **LS** from the steer unit to the priority valve. The priority valve **A** directs oil from the secondary hydraulic pump **P2** to the steer unit **B**, which in turn directs the flow to the power track rod ram until the required steering lock is achieved. ⇨ *Steer Circuit Schematics (H-9)*.

When the steering lock is held, the pressure signal in the load sense line **LS** ceases. The priority valve then directs the oil from the secondary hydraulic pump **P2** into the main hydraulic system for operation of the hydraulic services.

The maximum steering system pressure is set by a relief valve housed inside the steer unit **B**.

4 Wheel Steer Machines

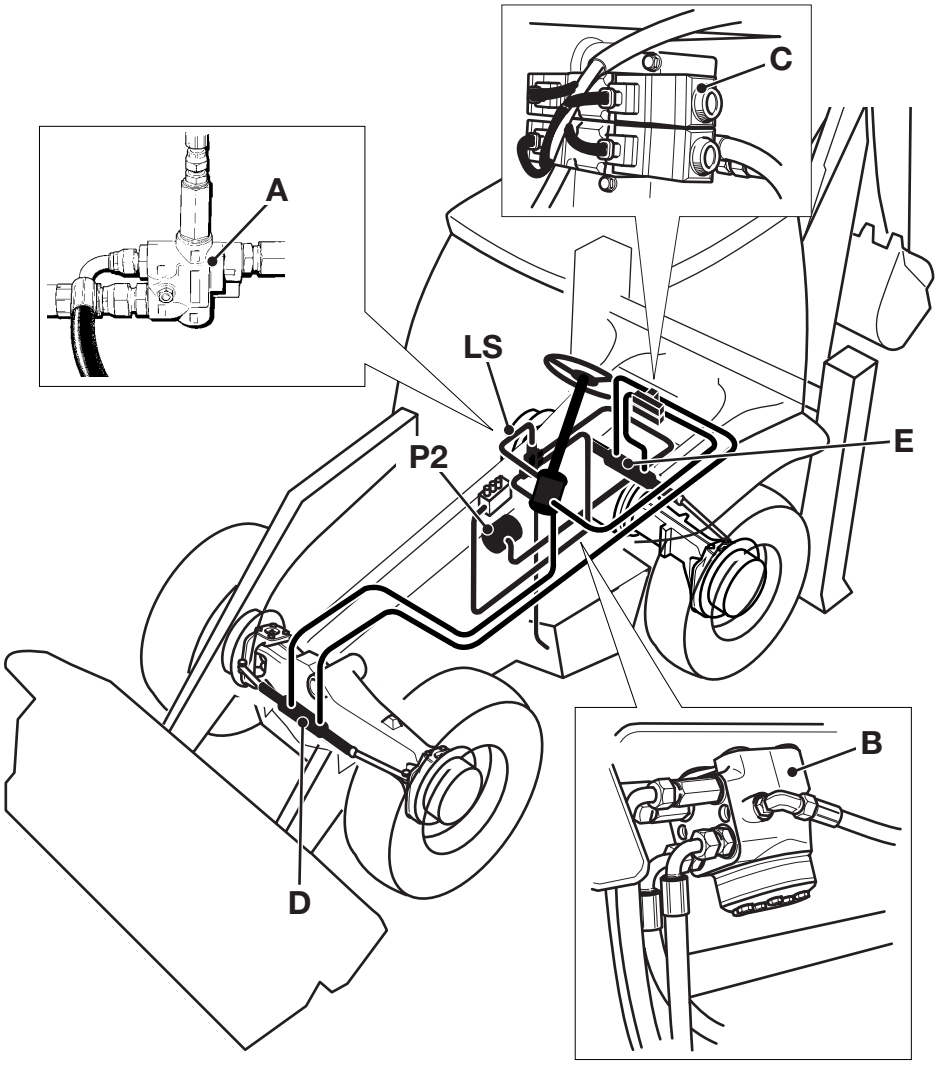

Fig 8.

The main components of the steering system are the priority valve **A**, load sensing steer unit **B**, steer mode control valve **C** and double acting power track rod rams **D** and **E** mounted on the front and rear axles.

When the steering wheel is turned, a pressure signal (demand) is generated in the load sense line **LS** from the steer unit to the priority valve. The priority valve **A** directs oil from the secondary hydraulic pump **P2** to the steer unit **B**. When left turn is selected, the steer unit directs the flow through the steer mode control valve **C** to the rear power track rod ram **E**. When right turn is selected, the steer unit directs the flow to the front power track rod ram **D**. ⇨ ***Steer Circuit Schematics (H-9)***.

When the steering lock is held, the pressure signal in the load sense line **LS** ceases. The priority valve then directs the oil from the secondary hydraulic pump **P2** into the main hydraulic system for operation of the hydraulic services.

The maximum steering system pressure is set by a relief valve housed inside the steer unit **B**.

For details of the different steer modes ⇨ ***Steer Modes (H-8)***.

Steer Modes

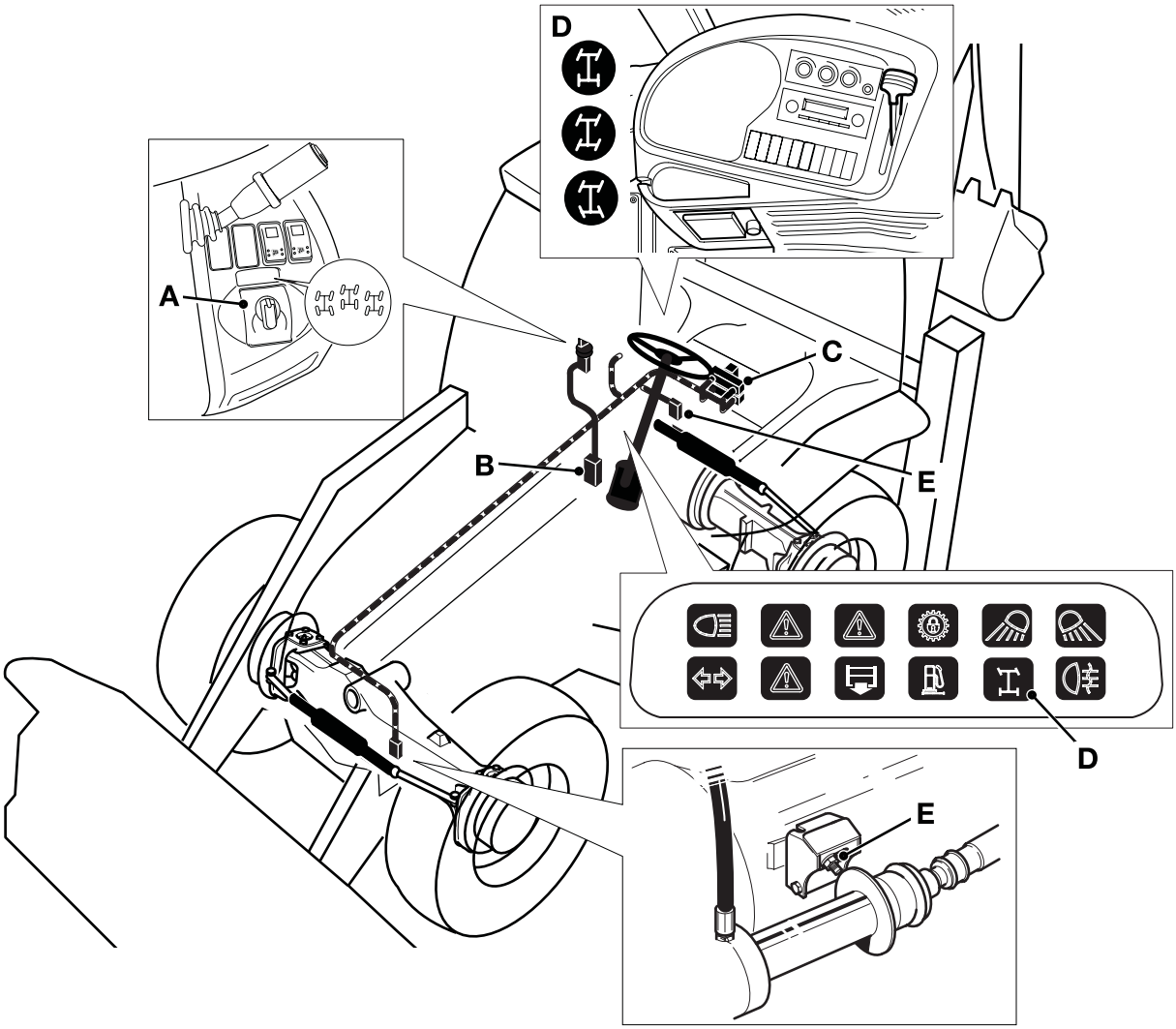

Fig 9.

Three steering modes are available:

- 2-Wheel Steer (front axle only)
- 4-Wheel Steer
- Crab Steer

The steering modes are selected from a three position switch **A**. The switch sends an electrical signal to a control unit **B**, which in turn energises the appropriate steer mode control valve solenoid **C**. Indicator lights **D** on the instrument panel illuminate to show the steer mode currently operative.

In 2-wheel steer mode only the front wheels are steered. In 4-wheel steer mode both axles are steered, giving a smaller turning circle. The crab steer mode allows the machine to be driven diagonally.

The system is prevented from changing mode until all the wheels are in the straight ahead position. This is detected by proximity sensors **E** mounted on the front and rear axles. E.g. If the system is set in 4-wheel steer and 2-wheel steer is then selected, the system will stay in 4-wheel steer until the rear wheels are turned to the straight ahead position. The rear wheels are then hydraulically locked in the straight ahead position.

For details of the electrical circuit and connections, see ***System Operation***.

Steer Circuit Schematics

2 Wheel Steer Machines

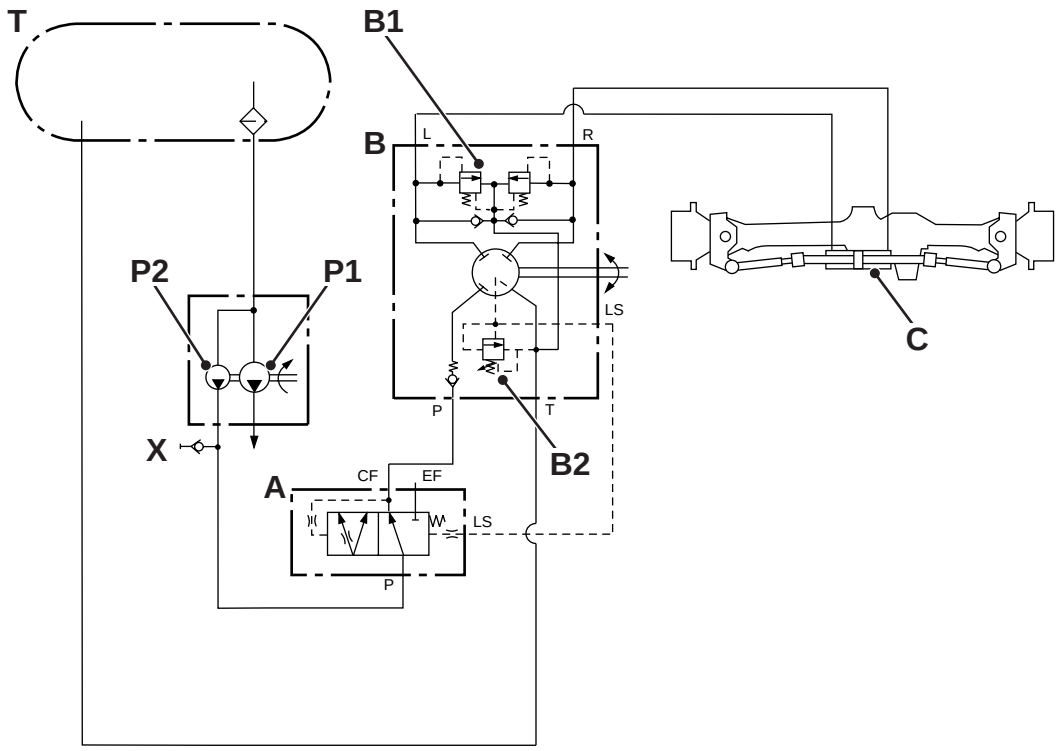

Fig 10.

Component Key:

A Priority valve
B Steer unit
B1 Shock valves
B2 Steering system relief valve
C Power track rod ram (Front axle)
P1 Pump, Main section
P2 Pump, Secondary section
T Hydraulic tank
X Steering pressure test point

4 Wheel Steer Machines (Steer Mode Valve Type 1)

This diagram shows the complete steer circuit. For diagrams of the different steer modes, ⇨ *Steer Mode Valve (Type 1) (H-11)*.

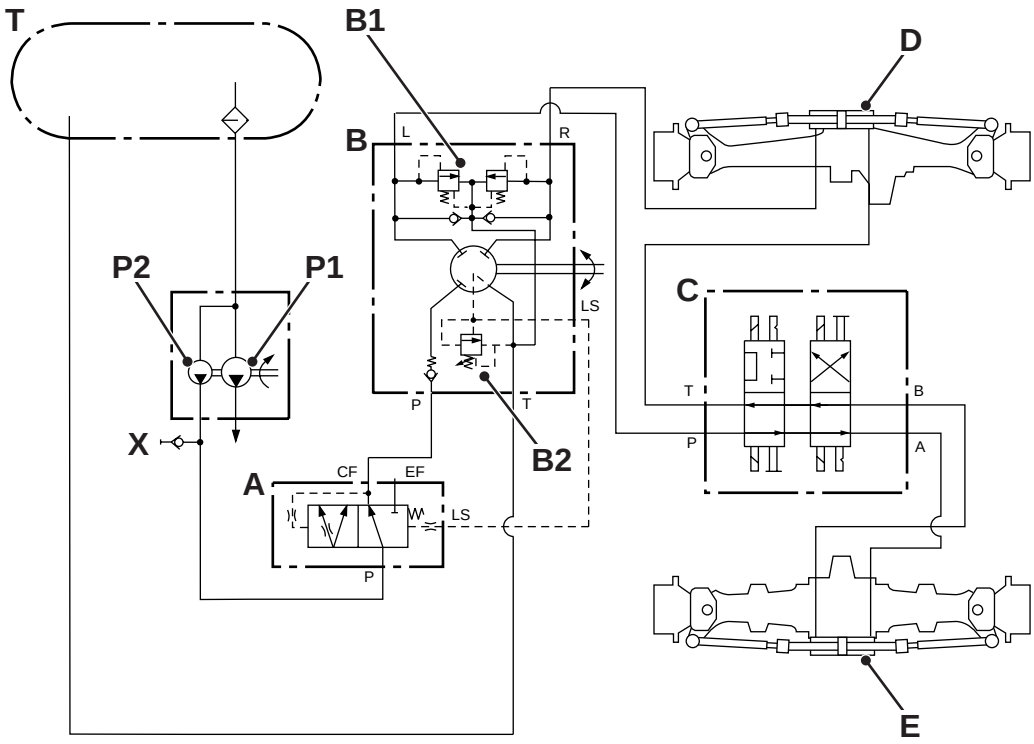

Fig 11.

Component Key:

A	Priority valve
B	Steer unit
B1	Shock valves
B2	Steering system relief valve
C	Steer mode control valve
D	Power track rod ram (Front axle)
E	Power track rod ram (Rear axle)
P1	Pump, Main section
P2	Pump, Secondary section
T	Hydraulic tank
X	Steering pressure test point

Steer Mode Valve (Type 1)

2-Wheel Steer

Solenoids energised: A
Ports internally connected: P, T
Ports internally blocked: A, B

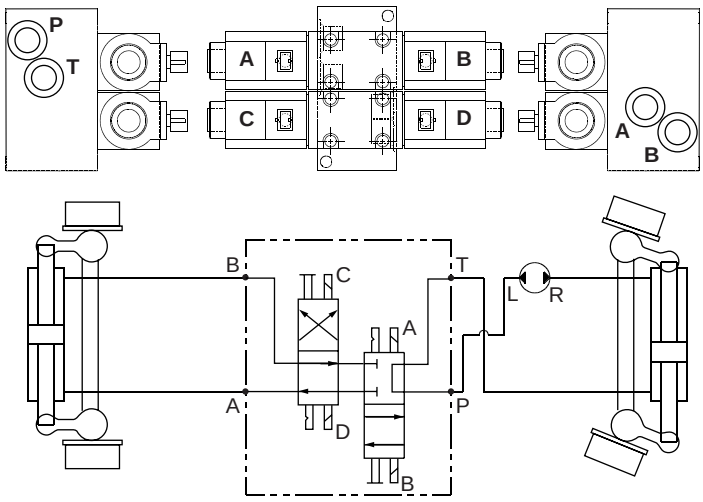

Fig 12.

4-Wheel Steer

Solenoids energised: B, D
Ports internally connected: A, P
B, T
Ports internally blocked: -

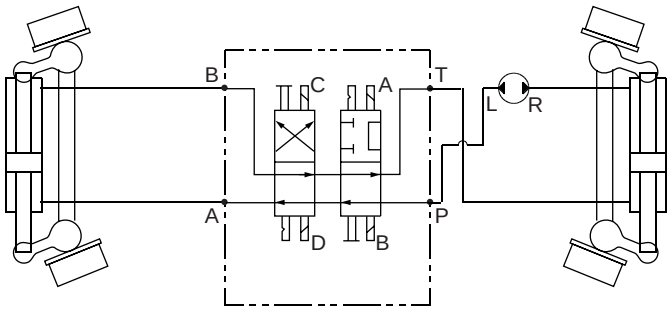

Fig 13.

Crab Steer

Solenoids energised: B, C
Ports internally connected: A, T
B, P
Ports internally blocked: -

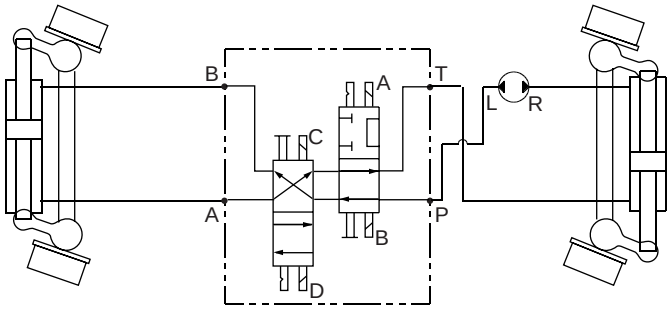

Fig 14.

4 Wheel Steer Machines (Steer Mode Valve Type 2)

This diagram shows the complete steer circuit. For diagrams of the different steer modes, ⇨ *Steer Mode Valve (Type 2) (H-13)*.

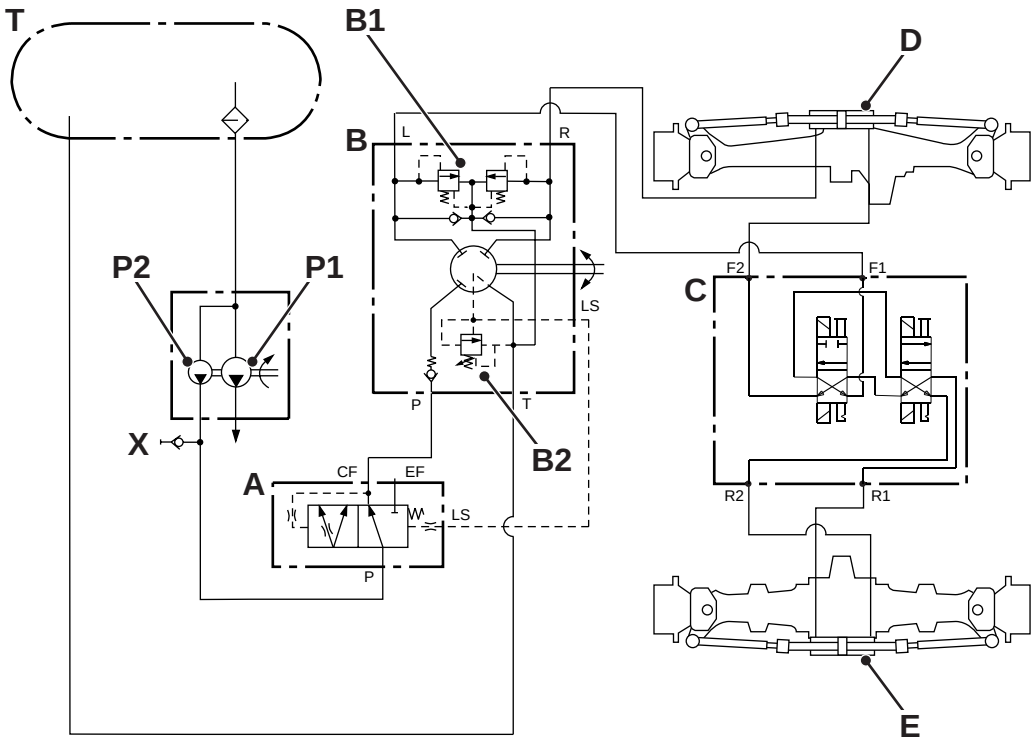

Fig 15.

Component Key:

A	Priority valve
B	Steer unit
B1	Shock valves
B2	Steering system relief valve
C	Steer mode control valve
D	Power track rod ram (Front axle)
E	Power track rod ram (Rear axle)
P1	Pump, Main section
P2	Pump, Secondary section
T	Hydraulic tank
X	Steering pressure test point

Steer Mode Valve (Type 2)

2-Wheel Steer

Solenoids energised: A
Ports internally connected: F1, F2
Ports internally blocked: R1, R2

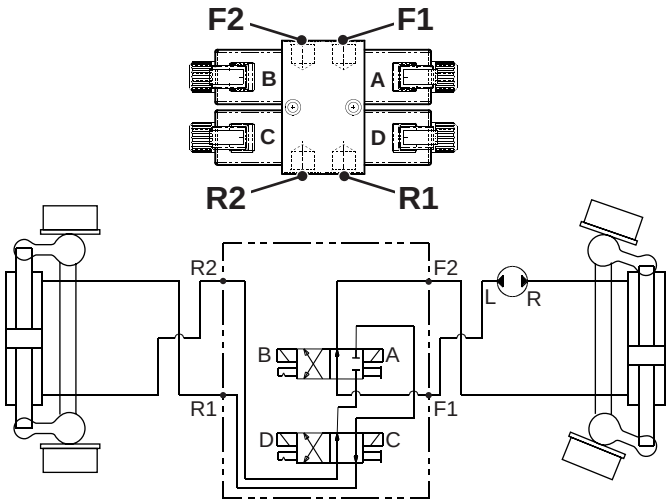

Fig 16.

4-Wheel Steer

Solenoids energised: B, D
Ports internally connected: F1, R2
F2, R1
Ports internally blocked: -

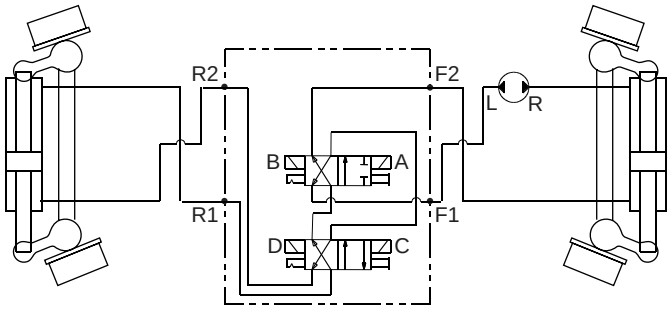

Fig 17.

Crab Steer

Solenoids energised: B, C
Ports internally connected: F1, R1
F2, R2
Ports internally blocked: -

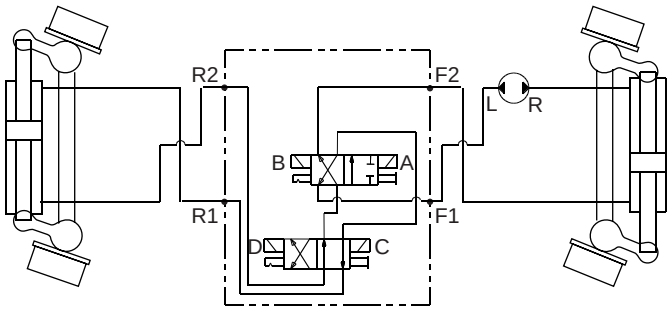

Fig 18.

Circuit Descriptions

Steer Unit Operation

Neutral

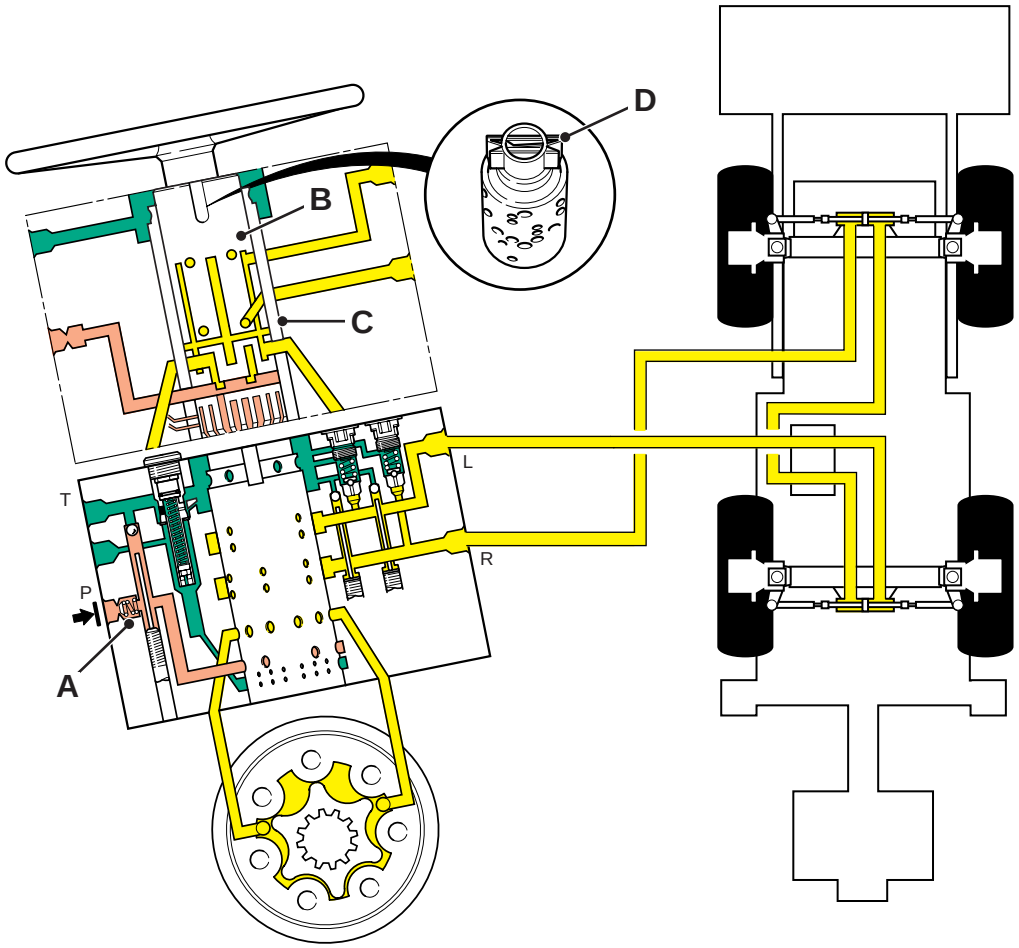

Fig 19. 4 Wheel steer machine shown

Oil from the priority valve enters the steering unit through the inlet port (P), opening the non-return valve **A**. When the steering wheel is stationary, the inner spool **B** and outer sleeve **C** are held in the neutral position by the centring springs **D**. The steering unit is 'closed centre' therefore the flow from the priority valve is dead ended by the steering unit.

2 Wheel Steer Machines: On 2 wheel steer machines the hydraulic steer unit operation is identical to that described for the 4 wheel steer machines, except the unit pumps oil out directly to a power track rod ram fitted on the front axle only. Also, therefore the 2 wheel steer machines do not have a steer mode control valve.

Left Turn

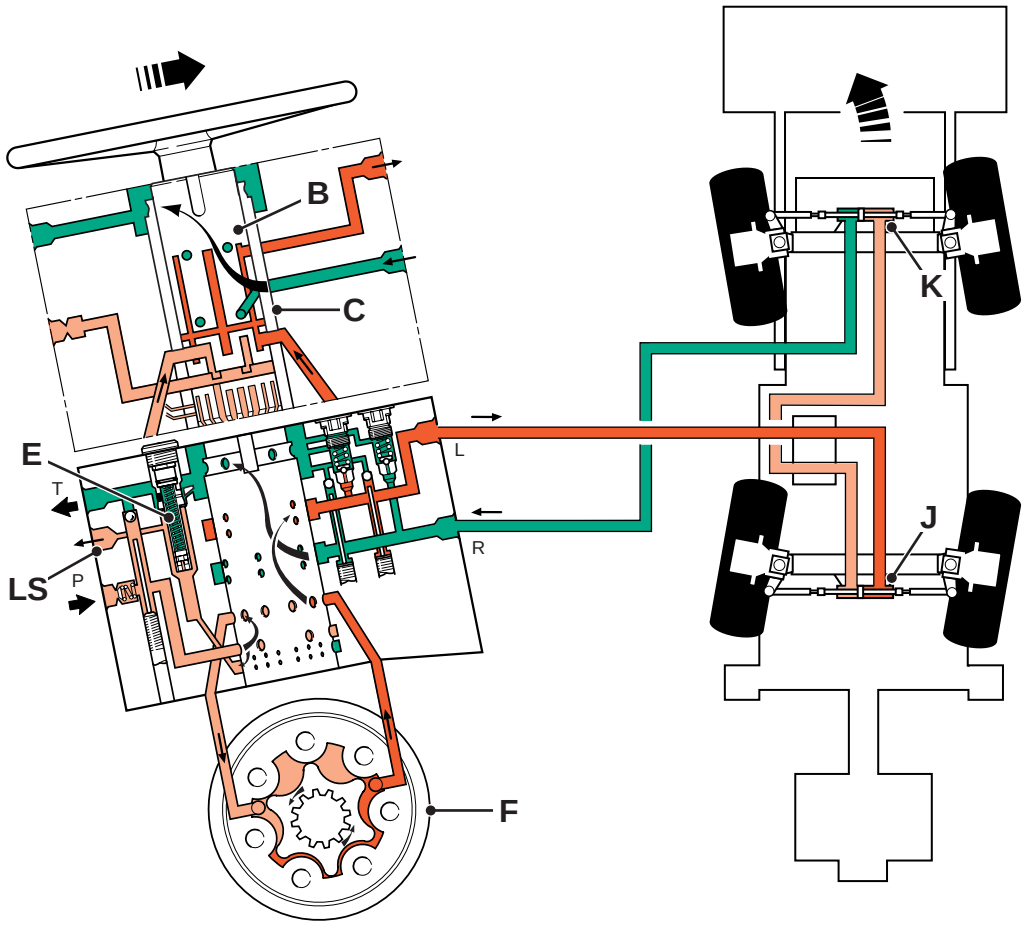

Fig 20.

The illustration shows the flow through the steering unit in a left-hand turn condition. Turning the steering wheel rotates the inner spool **B** a few degrees relative to the outer sleeve **C**, and sends a pressure signal (demand) to relief valve **E**, and through the load sense port **LS** back to the priority valve.

The relative movement between **B** and **C** directs oil pressure through 6 of the 12 holes in the bottom of outer sleeve **C**. The metering unit is linked to the spools by a cross pin. As the steering is operated the oil is diverted by the inner spool **B** into the stator **F**.

The rotor lobes pump the oil out to one side of the rear power track rod ram **J**, turning the rear wheels to the right. At the same time, the oil displaced from the other side of the power track rod ram **J** is directed to the front power track rod ram **K**, hence turning the front wheels the required degree of left turn.

Right Turn

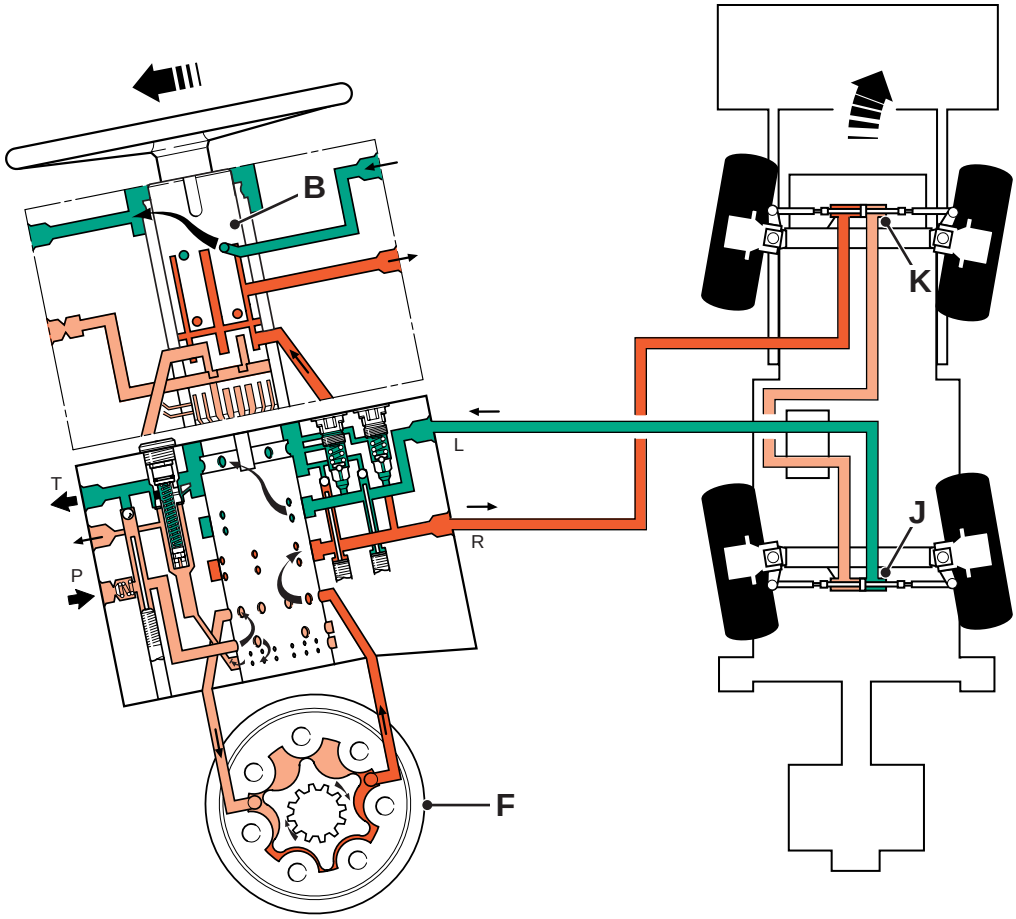

Fig 21.

The illustration shows the flow through the steering unit in a right-hand turn condition. The operation is identical to that described for a left-hand turn, except that the oil is diverted by inner spool **B** to the other side of stator **F** and power track rod rams **J** and **K**.

Right turn, Unassisted

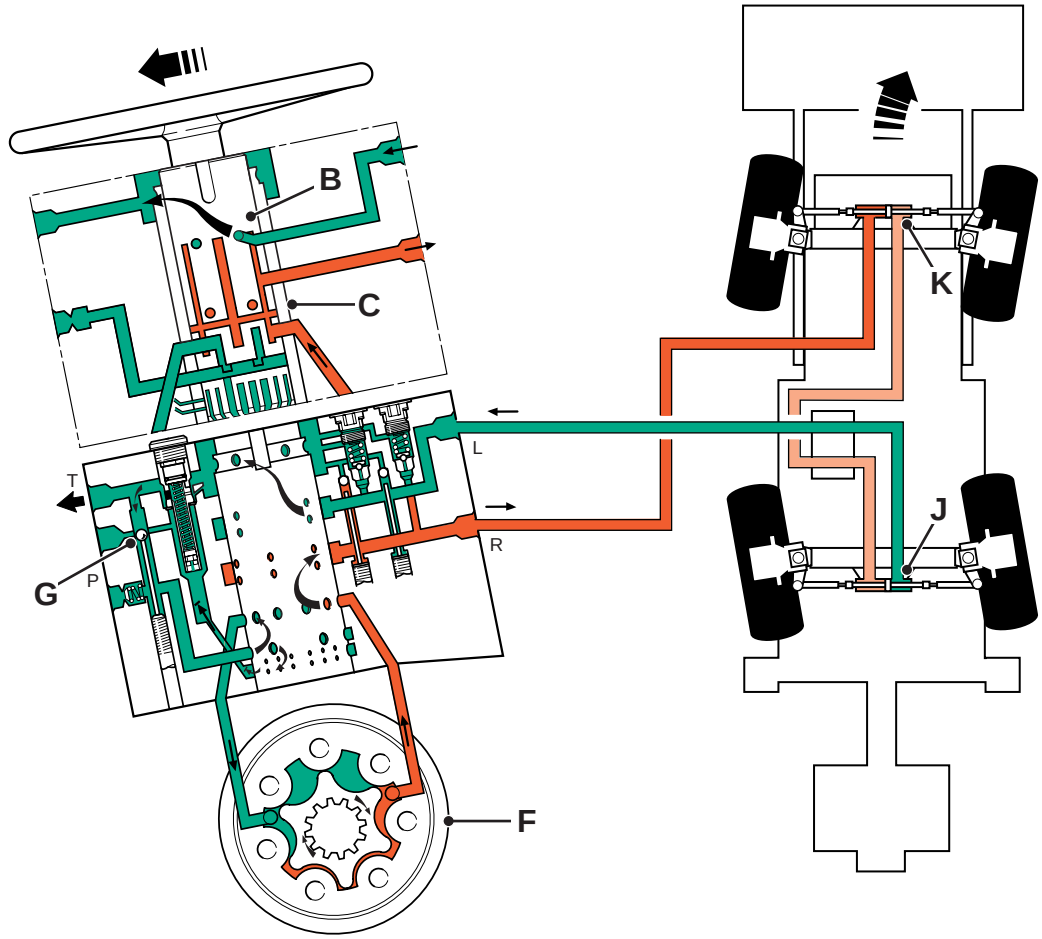

Fig 22.

The illustration shows the circuit operation with the engine stopped. Turning the steering wheel rotates the inner spool **B** until the cross pin engages with and rotates outer sleeve **C**, metering oil to the stator **F**, and pumping it out to power track rod rams **J** and **K** under manual pressure only.

As there is no supply from the pump, oil from one side of the power track rod rams (supplemented by exhaust oil if necessary), is used to feed the other side via non-return valve **G**.

Shock Valve

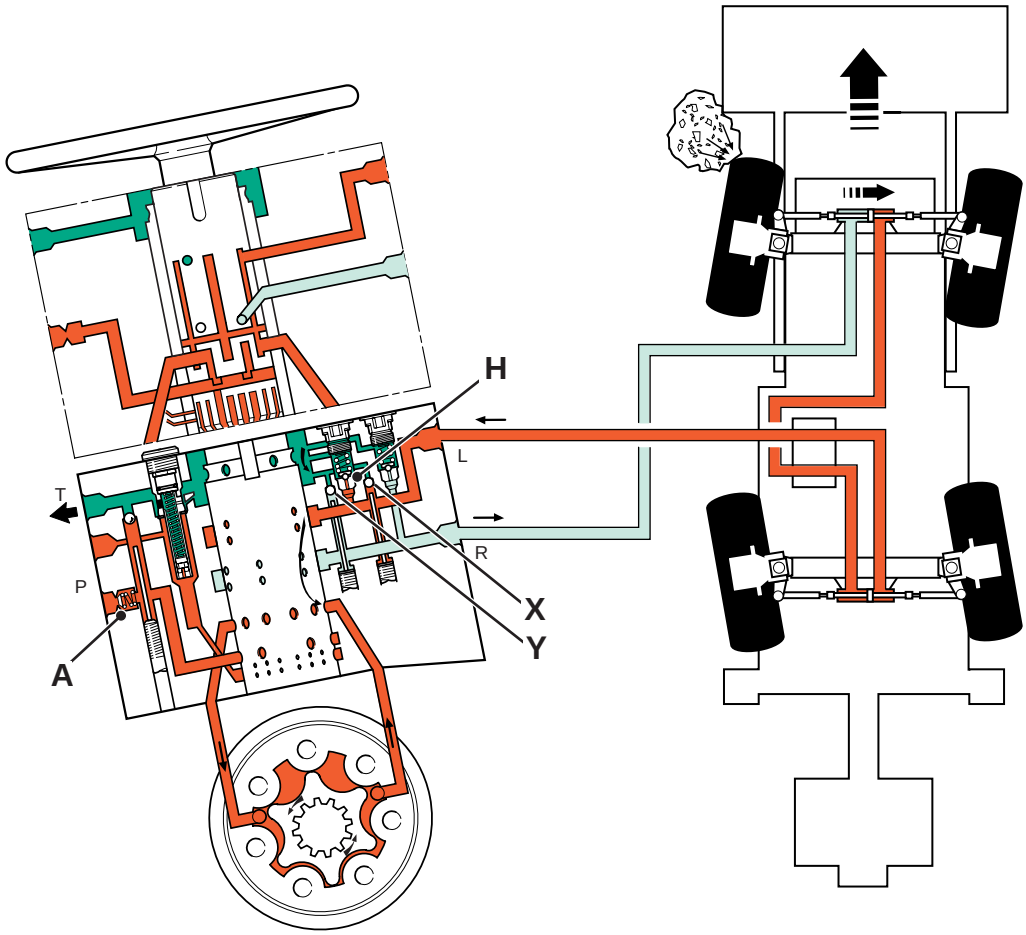

Fig 23.

In normal operation, oil from the priority valve enters the steering unit through the inlet port (P), opening a spring-loaded non-return valve **A**. The flow is directed by the steering unit to achieve the desired turn (right-hand shown).

In the event of a pressure shock wave being generated in the system by an outside force, shock valve **H** vents this pressure to exhaust preventing damage to the steering unit.

Non-return valve **X** is held on its seat by the generated pressure and non-return valve **A** closes to prevent the shock wave being fed back to the pump. Some of the excess flows via non-return valve **Y** to the opposite side of the power track rod ram to prevent cavitation occurring.

2 Wheel Steer Mode - Right Turn

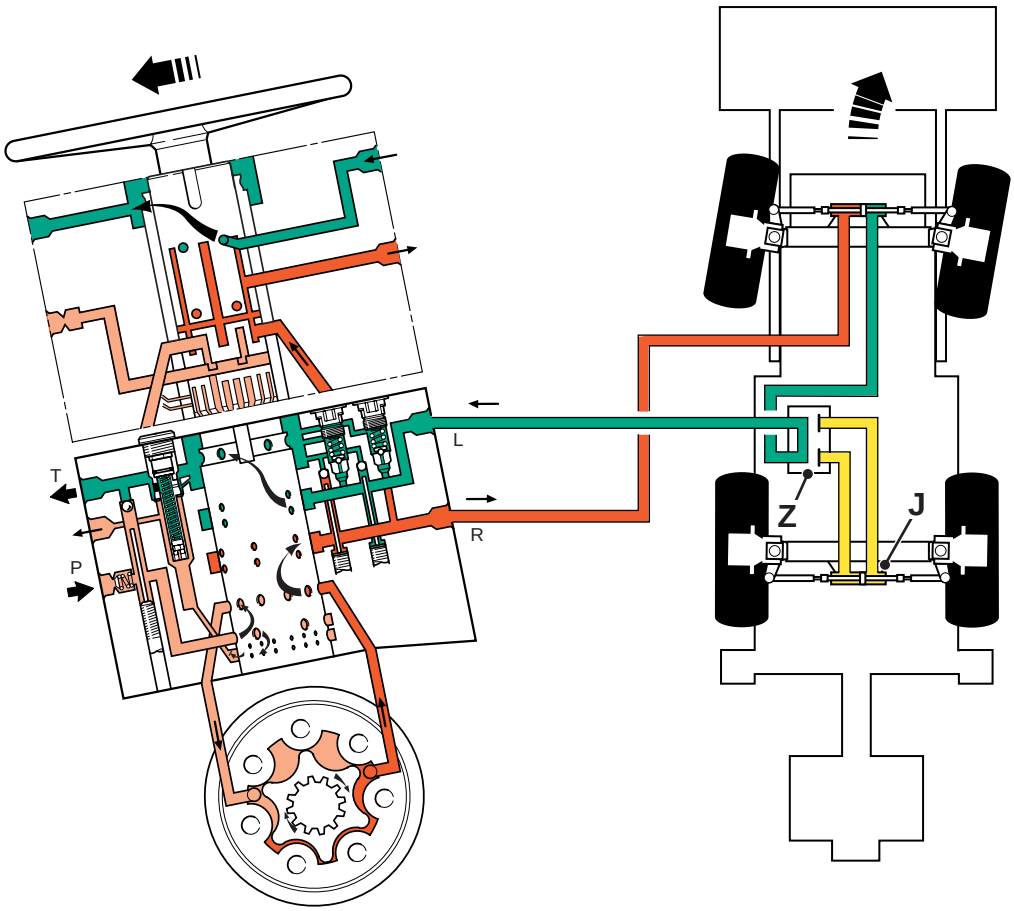

Fig 24.

The illustration shows the flow through the steering unit in a right-hand turn condition. The operation is identical to that described for the 4 wheel steer mode, except the steer mode control valve **Z** isolates the oil flow to the rear power track rod ram **J**, consequently the rotor lobes pump oil out to the front power track rod only. The rear wheels are held in the straight ahead position by the locked-up oil in the rear power track rod ram.

Crab Steer Mode - Right Turn

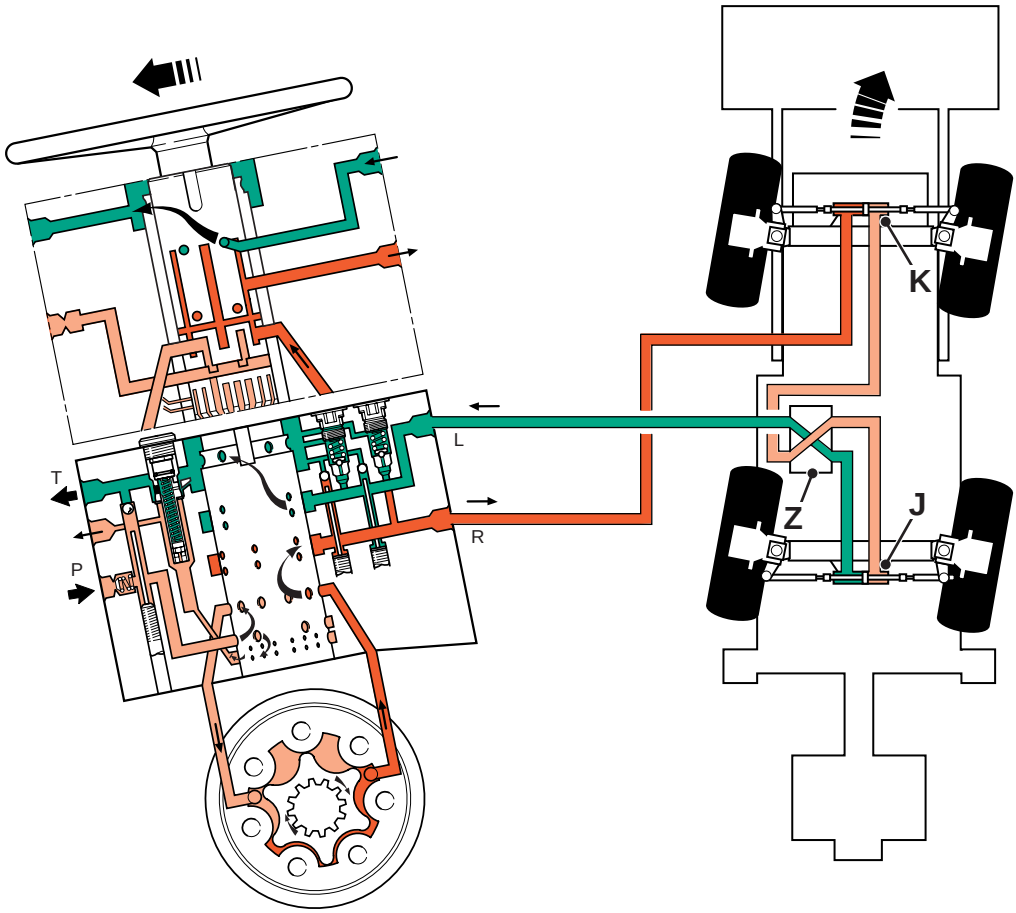

Fig 25.

The illustration shows the flow through the steering unit in a right-hand turn condition. The operation is identical to that described for the 4 wheel steer mode, except the steer mode control valve **Z** directs the oil displaced from the front power track rod ram **K** to the other side of the rear power track rod ram **J**, hence turning the rear wheels in the same direction as the front wheels, causing the machine to crab to the right.

Priority Valve Operation

Neutral

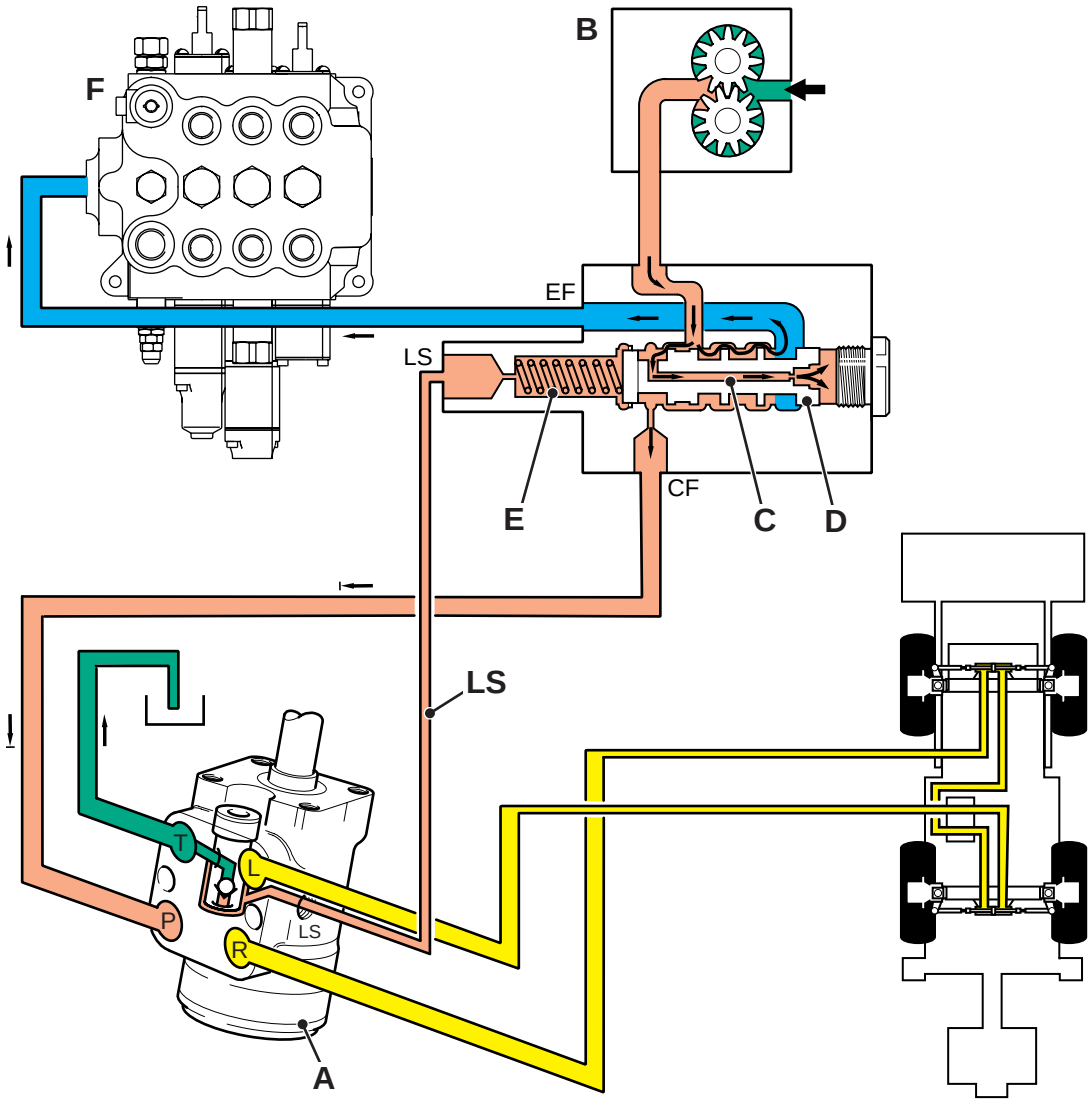

Fig 26.

When the steering is not being operated, flow to the steering circuit is dead ended by the `closed centre' steering unit **A**, and no pressure signal (demand) is generated in the load sense line **LS**.

Pressure from the pump **B** is directed through an internal drilling **C**, onto the end of the priority valve spool **D**. This creates a high pressure differential across the spool, causing it to move to the left against the force of the spring **E**. This allows full pump flow to the loader control valve **F**.

Turning

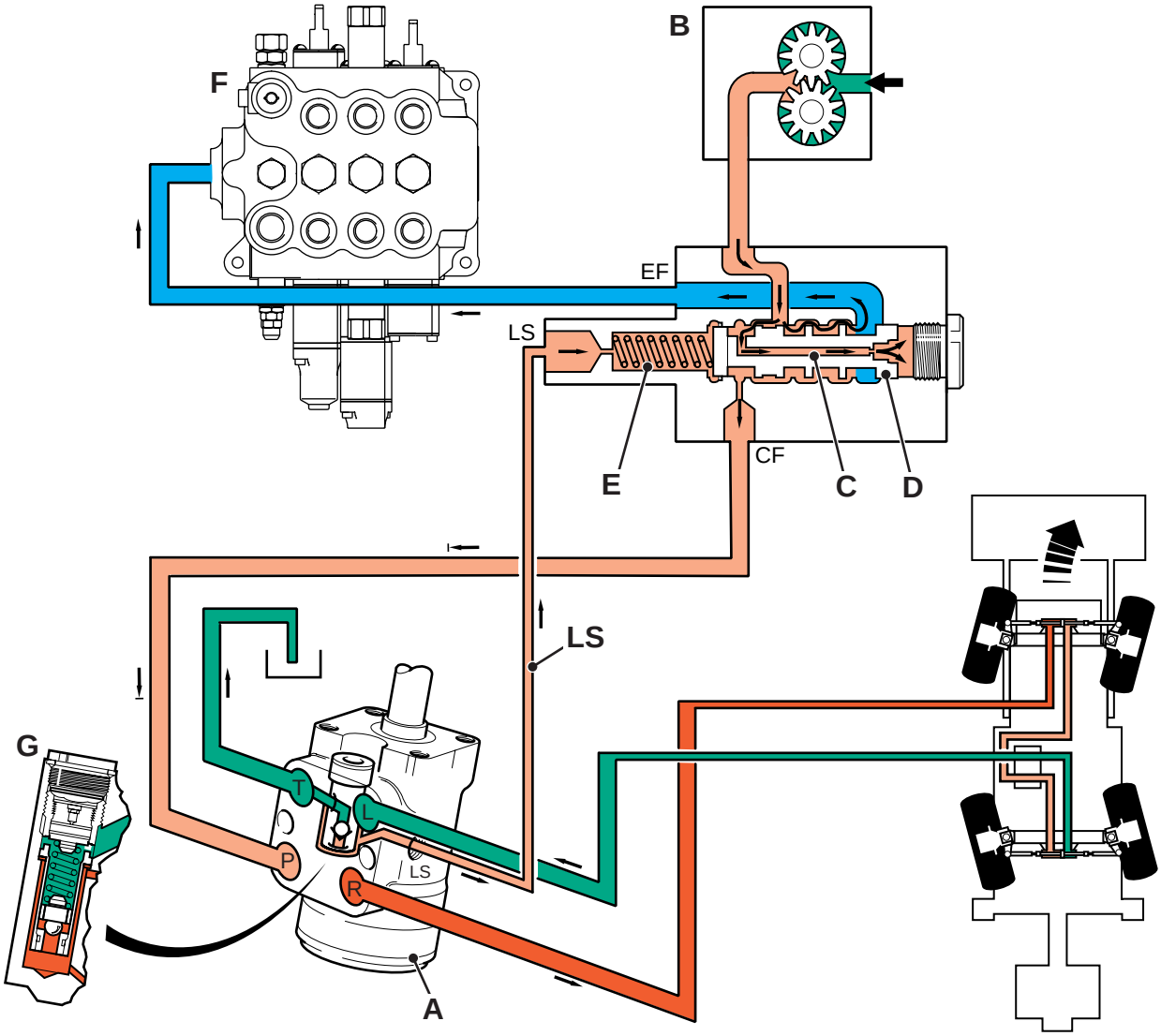

Fig 27.

When the steering wheel is turned, a pressure signal (demand) is generated in the load sense line **LS** from the steering unit **A**.

Pressure is then applied to the spring end of the priority valve spool **D**. This reduces the pressure differential across the spool, causing it to move to the right under spring force. This allows priority valve flow to the steering unit **A**, which in turn directs the flow to the corresponding power track rod ram until the required steering lock is reached.

When the steering lock is reached the pressure signal in the load sense line **LS** from the steering unit ceases, restoring the pressure differential across the spool **D**. The spool moves back to the left, allowing full pump flow to the loader control valve **F**.

The pump output flow available is always greater than the actual flow required to operate the steering system, therefore flow to the loader valve is never completely cut off.

The maximum steering system pressure is set by relief valve **G**, housed inside the steering unit.

PCB (Relay) Controlled Steer Mode

The schematic diagrams in this section show how the electrical circuit works when different functions are operated.

The wire numbers and colours, where appropriate, are shown as an aid to identification while fault finding. The wires coloured red show the electrical live feeds. The wires coloured green show the electrical returns to earth.

Before fault finding make sure that you understand how the electrical circuits work. Most potential faults can be traced using a multimeter to carry out continuity checks on wires, switches and solenoids.

2-Wheel Steer Selected: ⇨ *Fig 28. (H-24)*. The rear wheels must be in the straight ahead position before 2-wheel steer mode is enabled. When the rear wheels are in the straight ahead position, the proximity switch **4** on the rear axle operates and lets current flow to the steer mode selector switch **2**.

Central to the system is the steer mode control unit (PCB) **1**. With the selector switch **2** in the 2-wheel steer position, the current energises the coil of the 2WS micro-relay inside the control unit. The relay switch contacts **1a** operate to complete the return circuit for the 2-wheel steer valve solenoid **8** which then energises. The relay switch contacts **1a** also complete the return circuit for the instrument panel indicator lights which also illuminate.

4-Wheel Steer Selected: ⇨ *Fig 29. (H-24)*. The front wheels must be in the straight ahead position before 4-wheel steer mode is enabled. When the front wheels are in the straight ahead position, the proximity switch **3** on the front axle operates and lets current flow to the steer mode selector switch **2**.

With the selector switch **2** in the 4-wheel steer position, the current energises the 4WS and AWS micro-relays inside the control unit **1**. The relay switch contacts **1a** and **1b** operate to complete the return circuit for the 4-wheel steer valve solenoid **6** and all-wheel steer valve solenoid **5** which both energise. The relay switch contacts **1a** and **1b** also complete the return circuit for the instrument panel indicator light which also illuminates.

Crab Steer Selected: ⇨ *Fig 30. (H-24)*. The front wheels must be in the straight ahead position before crab steer mode is enabled. When the front wheels are in the straight ahead position, the proximity switch **3** on the front axle operates and lets current flow to the steer mode selector switch **2**.

With the selector switch **2** in the crab steer position, the current energises the Crab and AWS micro-relays inside the control unit **1**. The relay switch contacts **1a** and **1b** operate to complete the return circuit for the crab steer valve solenoid **7** and all-wheel steer valve solenoid **5** which both energise. The relay switch contacts **1a** and **1b** also complete the return circuit for the instrument panel indicator light which also illuminates.

Component Key:

1	Steer mode control unit (PCB)
1a	2WS/4WS relay switch contacts
1b	4WS/Crab relay switch contacts
2	Steer mode selector switch - front console
3	Proximity switch - front axle
4	Proximity switch - rear axle
5	All wheel steer mode valve solenoid
6	4-Wheel steer mode valve solenoid
7	Crab steer mode valve solenoid
8	2-Wheel steer mode valve solenoid

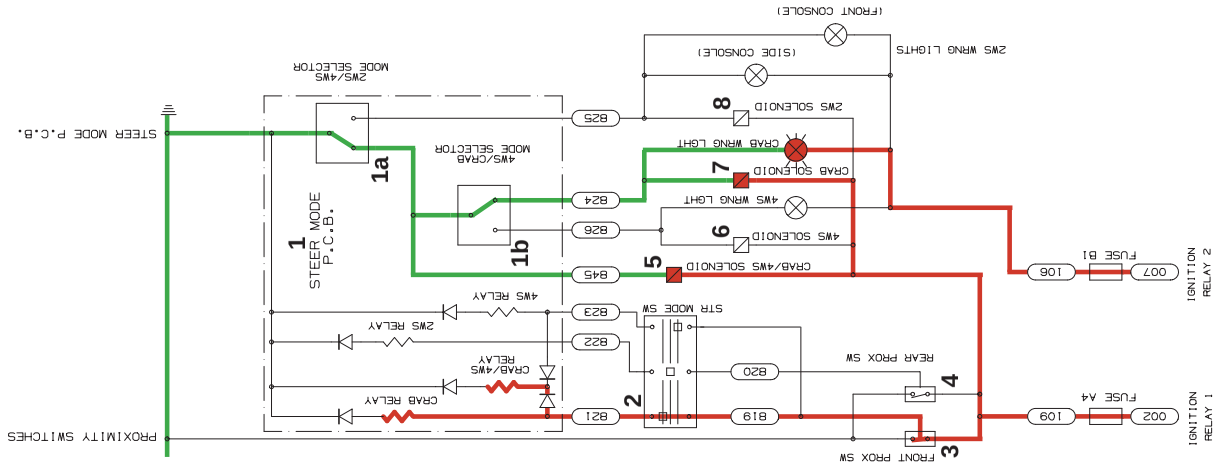

Fig 30. Crab Steer Selected

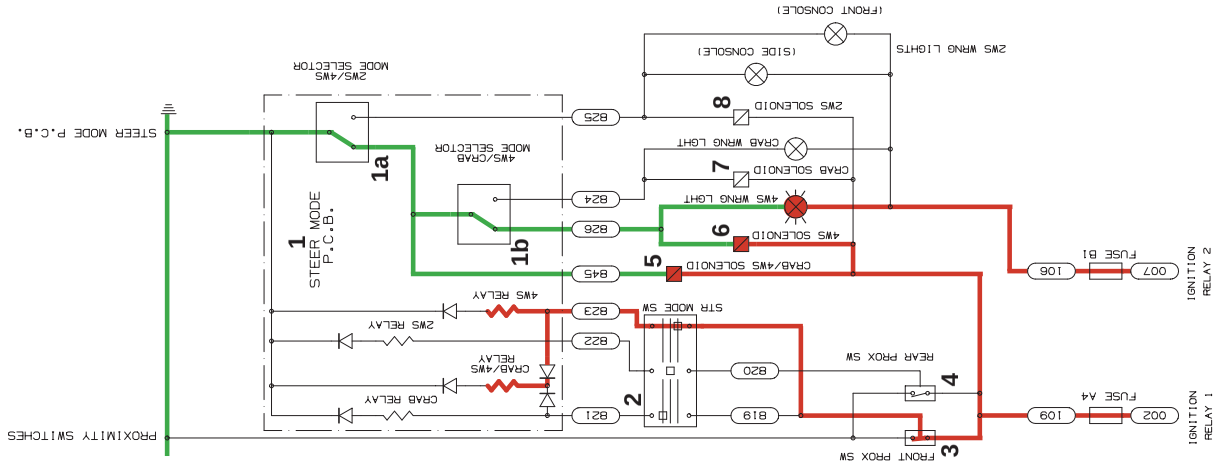

Fig 29. 4-Wheel Steer Selected

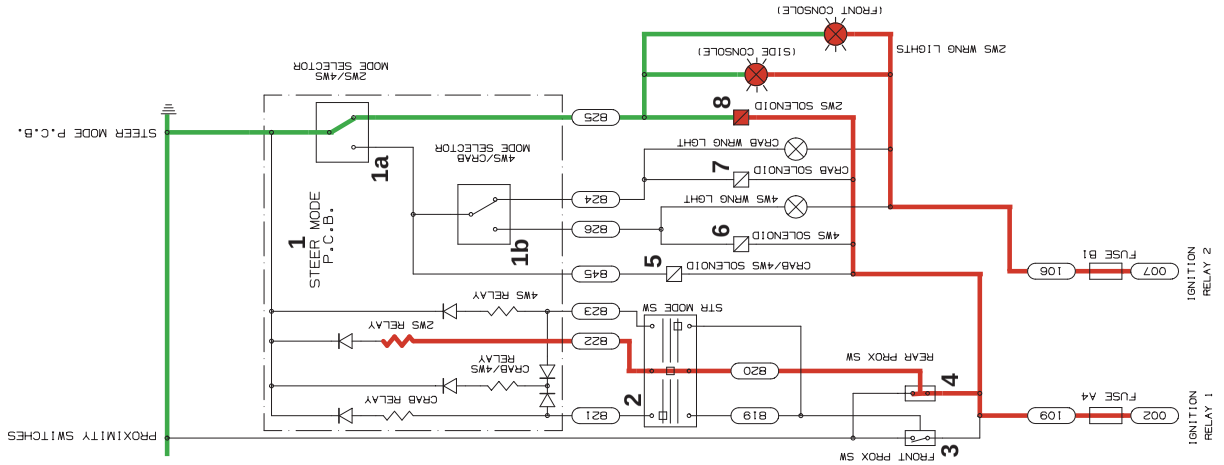

Fig 28. 2-Wheel Steer Selected

ECU Controlled Steer Mode

Applicable to 4WS machines from serial no. 1327630.

The schematic diagrams in this section show how the electrical circuit works when different functions are operated.

The wire numbers and colours, where appropriate, are shown as an aid to identification while fault finding. The wires coloured red show the electrical live feeds. The wires coloured green show the electrical returns to earth.

Before fault finding make sure that you understand how the electrical circuits work. Most potential faults can be traced using a multimeter to carry out continuity checks on wires, switches and solenoids.

Important: *DO NOT use a multimeter on the ECU connector pins. Only test the associated harness wiring. Uncouple the harness from the ECU and then use a multimeter on the pins inside the harness connector as applicable.*

2-Wheel Steer Selected: ⇨ *Fig 31. (H-26)*. The rear wheels must be in the straight ahead position before 2-wheel steer mode is enabled. When the rear wheels are in the straight ahead position, the proximity switch **4** on the rear axle operates and sends an electrical input to the steer mode control unit (ECU) **1** pin 9.

With the steer mode selector switch **2** in the 2-wheel steer position, there is no electrical input to the ECU on pin 7 or pin 8. In this condition, the ECU does not send an output on pin 10 or pin 11, and interrupts the return path on pin 2 so that the steer mode changeover relay **9** is de-energised. The changeover relay contacts connect a live feed to the 2-wheel steer valve solenoid **8** which then energises. When the solenoid is energised, an electrical input is sent to the ECU pin 5. The ECU then sends an output on pin 4 to illuminate the indicator light on the front console.

4-Wheel Steer Selected: ⇨ *Fig 32. (H-26)*. The front wheels must be in the straight ahead position before 4-wheel steer mode is enabled. When the front wheels are in the straight ahead position, the proximity switch **3** on the front axle operates and sends an electrical input to the steer mode control unit (ECU) **1** pin 6.

With the steer mode selector switch **2** in the 4-wheel steer position, there is an electrical input to the ECU pin 8. In this condition, the ECU sends an output on pin 10 to energise the 4-wheel steer valve solenoid **5**. The ECU also completes the return path on pin 2 so that the steer mode changeover relay **9** energises. The changeover relay contacts then connect a live feed to the all-wheel steer valve solenoid **7** which also energises.

Crab Steer Selected: ⇨ *Fig 33. (H-26)*. The front wheels must be in the straight ahead position before crab steer mode is enabled. When the front wheels are in the straight ahead position, the proximity switch **3** on the front axle operates and sends an electrical input to the steer mode control unit (ECU) **1** pin 6.

With the steer mode selector switch **2** in the crab steer position, there is an electrical input to the ECU pin 7. In this condition, the ECU sends an output on pin 11 to energise the crab steer valve solenoid **6**. The ECU also completes the return path on pin 2 so that the steer mode changeover relay **9** energises. The changeover relay contacts then connect a live feed to the all-wheel steer valve solenoid **7** which also energises.

Component Key:

1 Steer mode control unit (ECU)
2 Steer mode selector switch - front console
3 Proximity switch - front axle
4 Proximity switch - rear axle
5 4-Wheel steer mode valve solenoid
6 Crab steer mode valve solenoid
7 All Wheel steer mode valve solenoid
8 2-Wheel steer mode valve solenoid
9 Steer mode changeover relay

Table 1. ECU Connections

ECU Pin	Function:
1	Earth connection
2	Earth connection - Steer mode changeover relay coil
3	Not used
4	Low side output - 2WS indicator light/Front console
5	High side input - 2WS mode valve solenoid energised
6	Proximity switch input - Front wheels straight ahead
7	Switch input - Crab steer mode selected
8	Switch input - 4WS steer mode selected
9	Proximity switch input - Rear wheels straight ahead
10	High side output - 4WS mode valve solenoid
11	High side output - Crab steer mode valve solenoid
12	Power supply

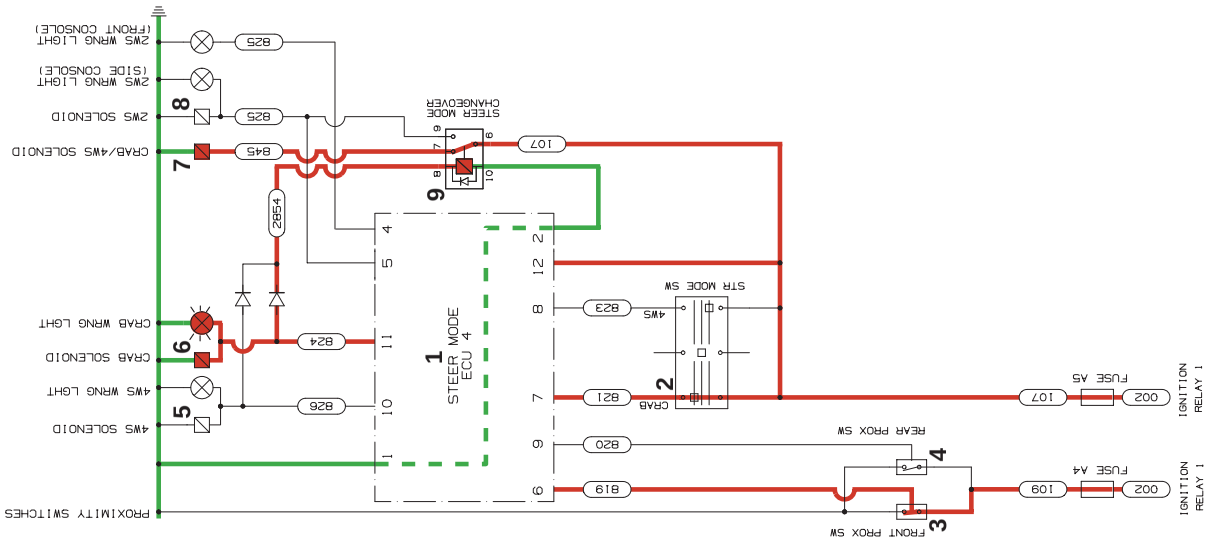

Fig 33. Crab Steer Selected

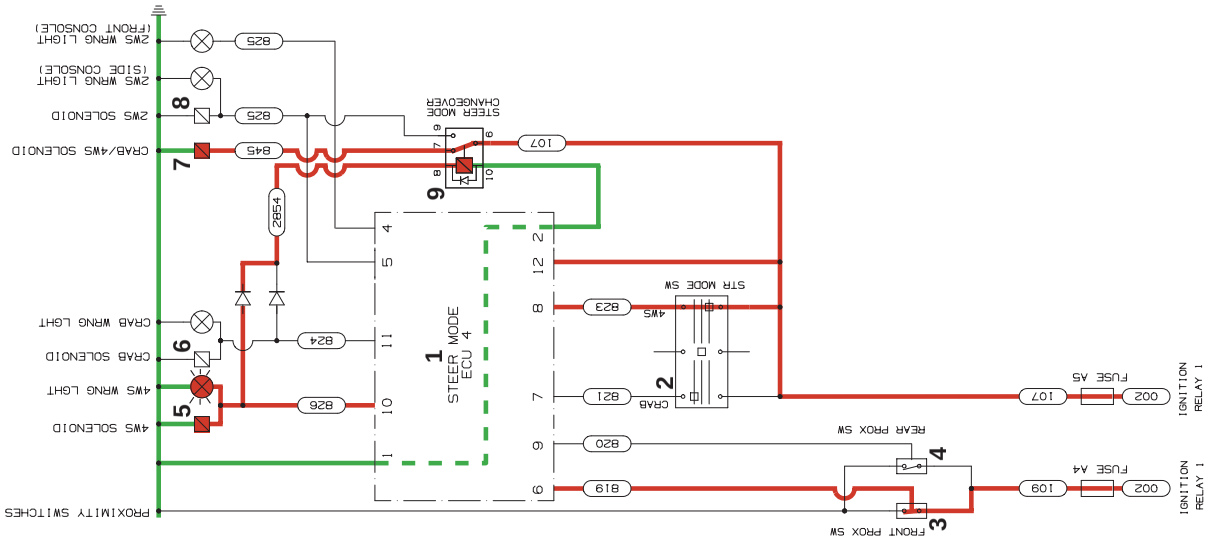

Fig 32. 4-Wheel Steer Selected

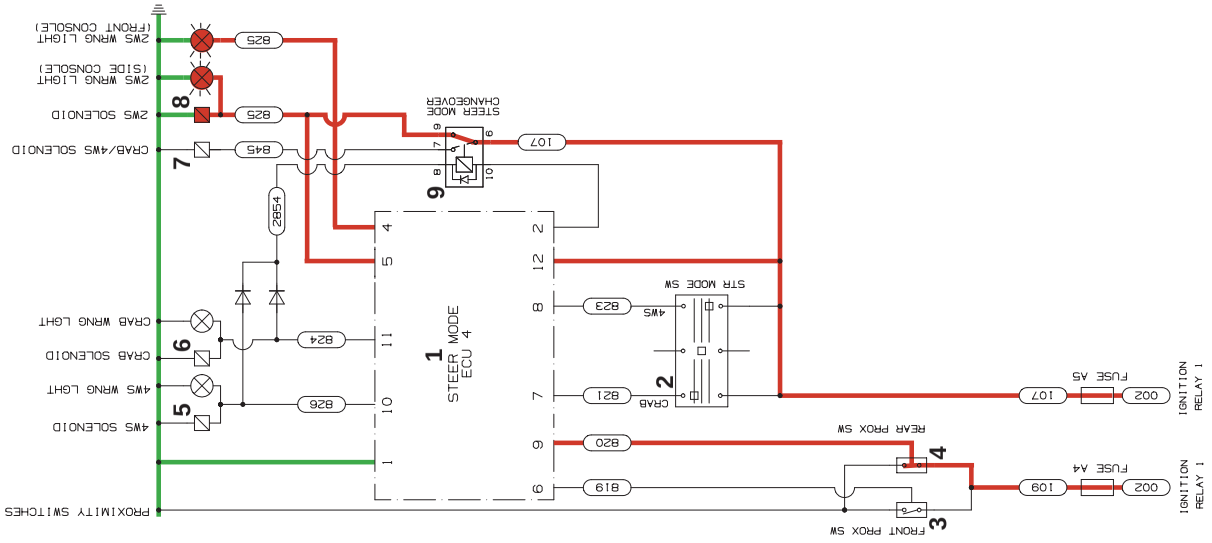

Fig 31. 2-Wheel Steer Selected

Wires and Connectors

PCB (Relay) Controlled Steer Mode

For components and connector locations ⇒ *Fig 34. (H-28)*.

Note: *The steer mode control unit (PCB)* ***A*** *is mounted on the RH side of the front console. Remove the front console to gain access. The steer mode control unit is a non-serviceable part. If it is faulty it must be renewed.*

Wires and connectors ⇒ *Fig 35. (H-29)*. On the electrical diagram the electrical connectors (example, FR) are shown looking on the mating face of each connector when they are disconnected.

Wires coloured red show the electrical live feeds. Wires coloured green show the electrical return to earth.

Earth Points

Faults may be caused by poor earth connections. Although earth connections are shown, it must be remembered that the cab assembly is earthed via further earth strap and cable connections.

Component Key

The following key identifies the component connectors.

h1	Harness - Front Console
h2	Harness - Side Console/Cab
h3	Harness - Engine/Mainframe
h4	Harness - Steer

Note: *For harness drawings see* ***Section C, Electrics****.*

Connectors (h1)

FA	h1 - h2
FB1	Earth point
FC	Steer mode control unit (PCB)
FR	Indicator lights - front console
FS	Speedo - if fitted
FT	Steer mode selector switch

Connectors (h2)

CA	h2 - h3
CB	h2 - h1
CCA	Fusebox A
CCB	Fusebox B
CV	Instrument panel
DR2	Earth point
S	Steering
B	Rear horn, Rear alarm
G	Auxiliary hydraulics
N	Rear lights, Hydraclamp

Connectors (h3)

MB1	Earth point
MC	Proximity switch - front axle
NH	h3 - h2

Connectors (h4)

MA	2-Wheel steer solenoid
MB	All wheel steer solenoid
MC	Crab solenoid
MD	4-Wheel steer solenoid
ME	h4 - h2
MF	Proximity switch - rear axle

Splices (h1)

SA
SB
SD

Splices (h2)

SA
SC
SD
SN
SU
SY

Splices (h3)

SA
SD

Splices (h4)

SA

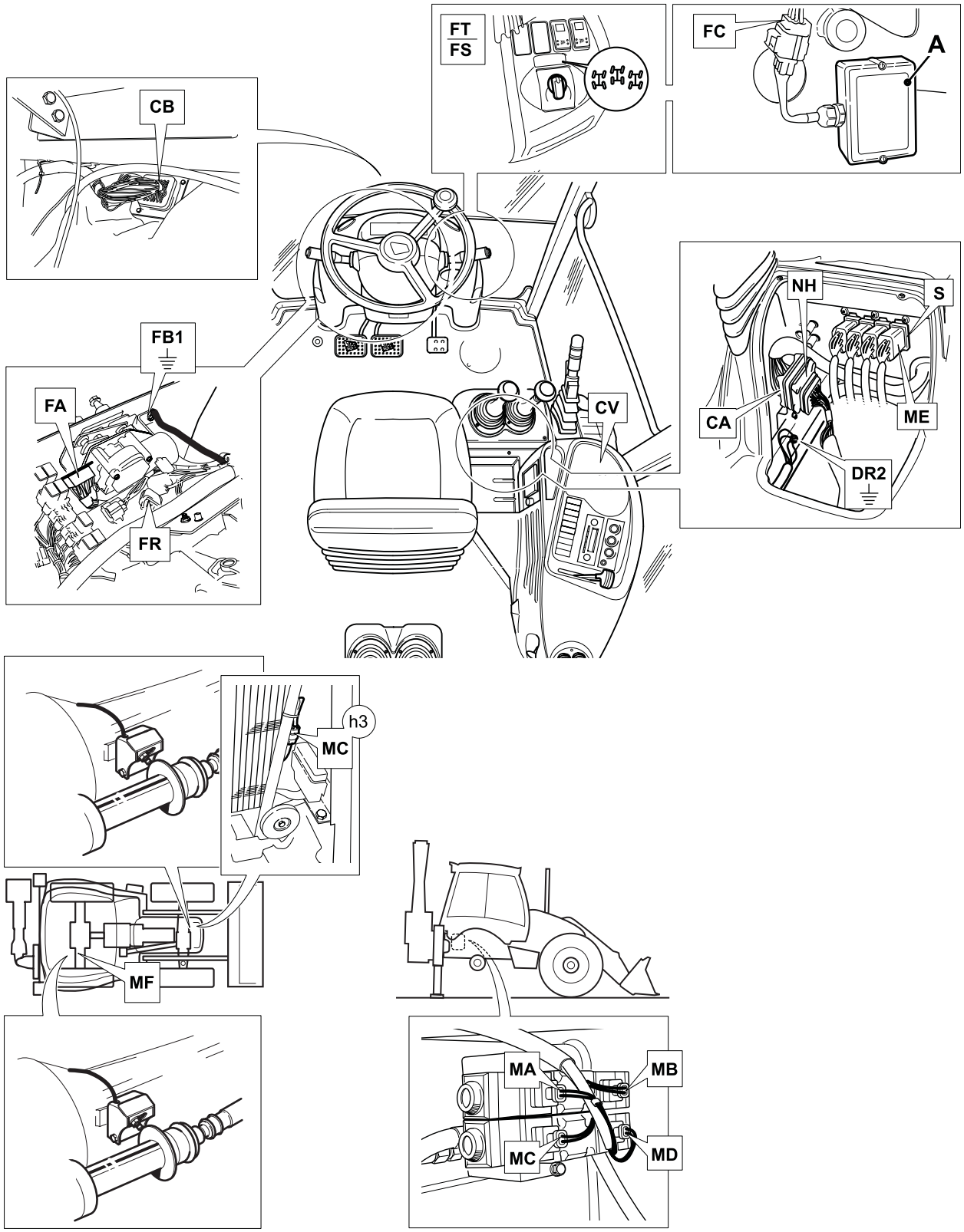

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Fig 34. Component and Connector Locations - PCB (Relay) Controlled Steer Mode

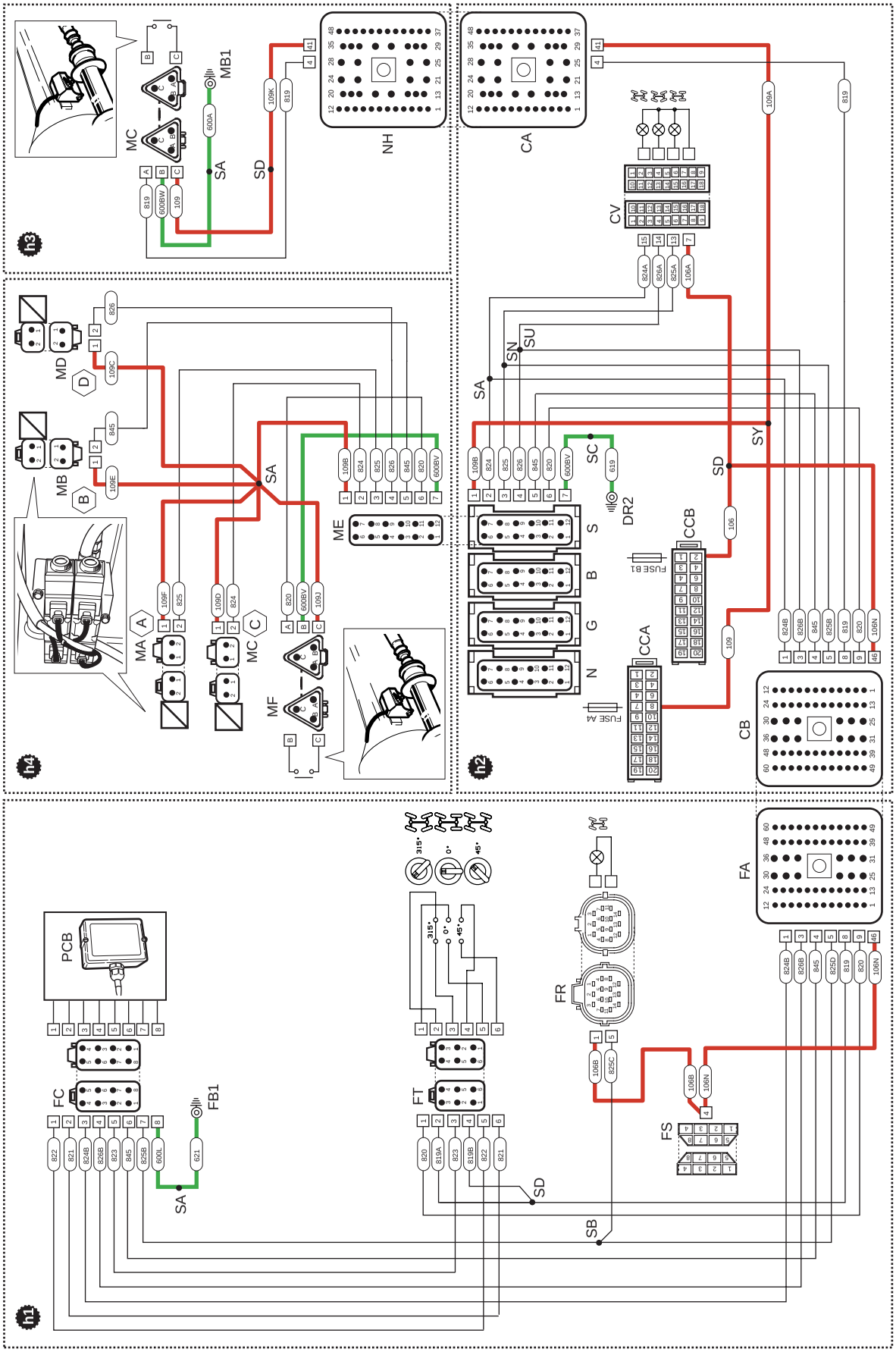

Fig 35. Wires and Connectors - PCB (Relay) Controlled Steer Mode

ECU Controlled Steer Mode

For components and connector locations ⇒ *Fig 36. (H-31)*.

Note: *The steer mode control unit (ECU)* ***A*** *is mounted on the RH side of the front console. Remove the front console to gain access. The steer mode control unit is a non-serviceable part. If it is faulty it must be renewed.*

Wires and connectors ⇒ *Fig 37. (H-32)*. On the electrical diagram the electrical connectors (example, FR) are shown looking on the mating face of each connector when they are disconnected.

Wires coloured red show the electrical live feeds. Wires coloured green show the electrical return to earth.

Earth Points

Faults may be caused by poor earth connections. Although earth connections are shown, it must be remembered that the cab assembly is earthed via further earth strap and cable connections.

Component Key

The following key identifies the component connectors.

h1	Harness - Front Console
h2	Harness - Side Console/Cab
h3	Harness - Engine/Mainframe
h4	Harness - Steer

Note: *For harness drawings see* ***Section C, Electrics****.*

Connectors (h1)

FA	h1 - h2
FB1	Earth point
FC	Steer mode control unit (ECU)
FR	Indicator lights - front console
FS	Speedo - if fitted
FT	Steer mode selector switch
FZ	Steer mode changeover relay
GA	Diode gate

Connectors (h2)

CA	h2 - h3
CB	h2 - h1
CCA	Fusebox A
CCB	Fusebox B
CV	Instrument panel
DR2	Earth point
S	Steering
B	Rear horn, Rear alarm
G	Auxiliary hydraulics
N	Rear lights, Hydraclamp

Connectors (h3)

MB1	Earth point
MC	Proximity switch - front axle
NH	h3 - h2

Connectors (h4)

MA	2-Wheel steer solenoid
MB	All wheel steer solenoid
MC	Crab solenoid
MD	4-Wheel steer solenoid
ME	h4 - h2
MF	Proximity switch - rear axle

Splices (h1)

SA
SB
SS
SZ
TA

Splices (h2)

SA
SC
SD
SN
SU
SY
TF

Splices (h3)

SA
SD

Splices (h4)

SA

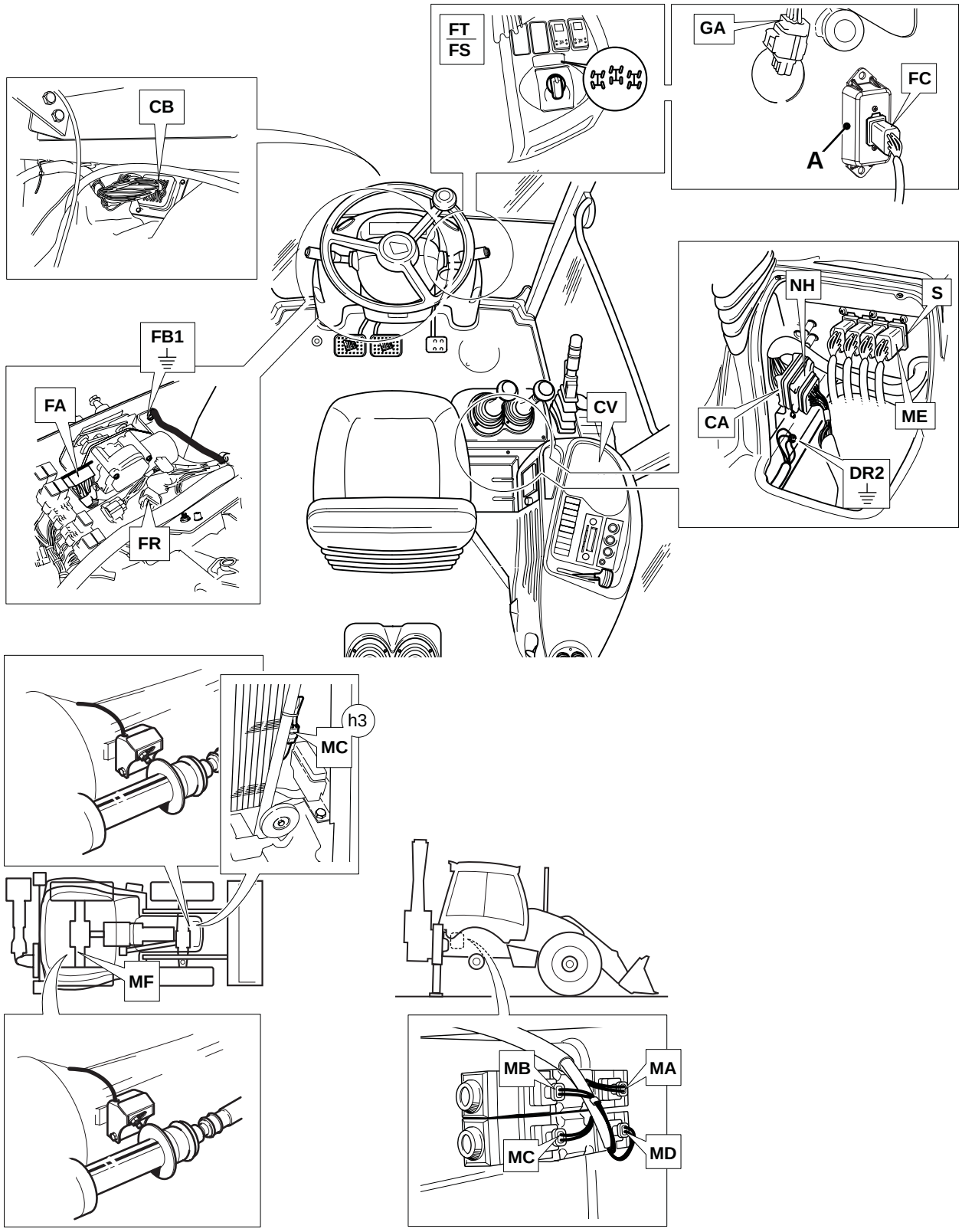

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Fig 36. Component and Connector Locations - ECU Controlled Steer Mode

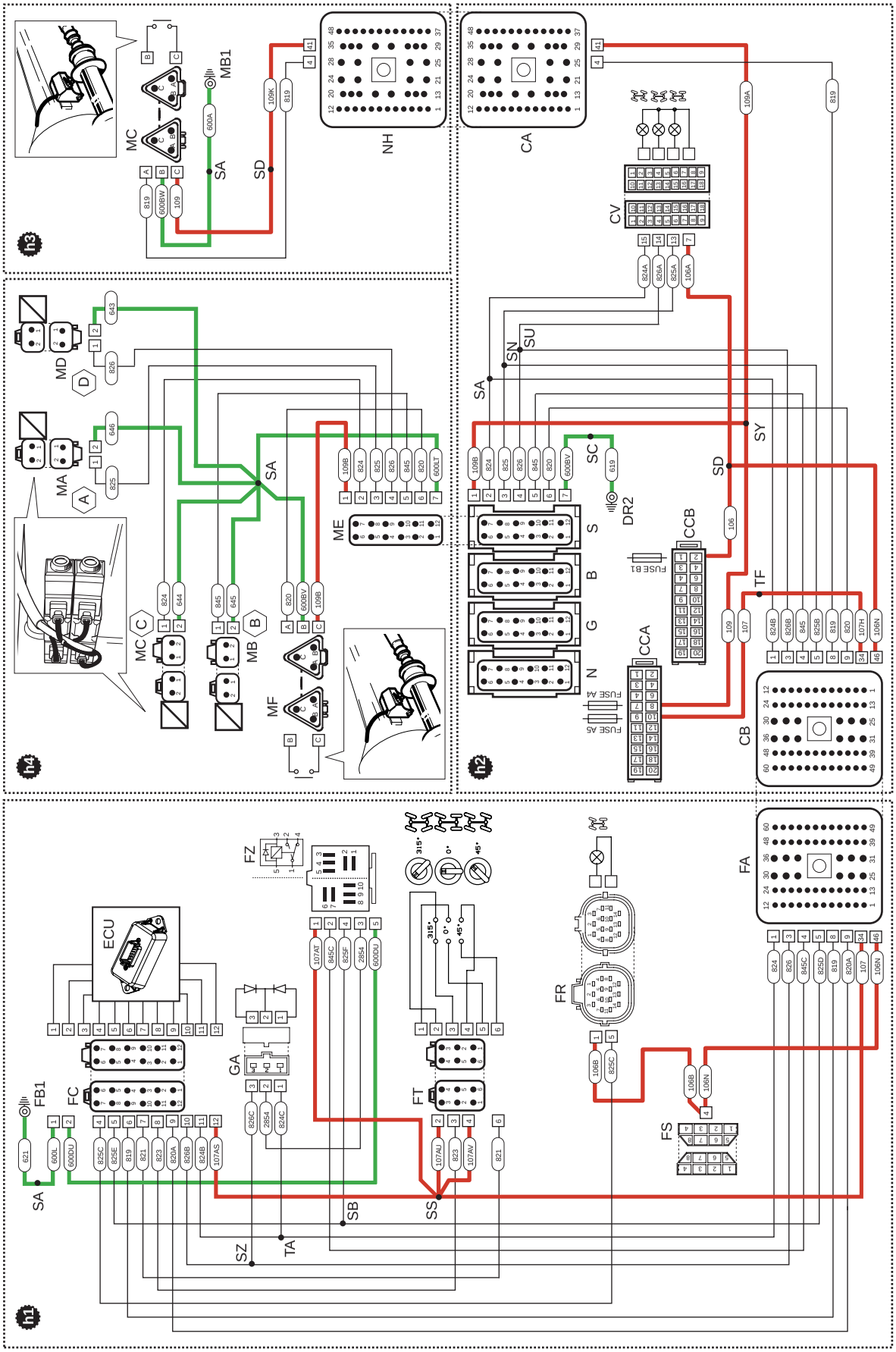

Fig 37. Wires and Connectors - ECU Controlled Steer Mode

Fault Finding

Steering System

The purpose of this section is to help you trace hydraulic faults to a faulty unit (valve, actuator, ram etc). Once you have traced the faulty unit, refer to the appropriate dismantling, inspecting and test instructions given elsewhere in the steering section.

To help identify circuits, valves, rams etc mentioned in the fault finding procedures, refer to the hydraulic schematic diagrams (near the beginning of the Hydraulics Section).

1 Before you begin fault finding, read the Safety information at the beginning of this manual.

2 Make simple checks before say, stripping a major component.

3 Make sure that the hydraulic fluid is at correct working temperature (50 °C, 122 °F).

4 What ever the fault, check the condition of the hydraulic fluid. Drain and replace if necessary.

5 Make any relevant electrical checks before moving on to the hydraulics.

6 Be sure to remove ALL contamination and if possible identify its origin. It may be part of a component from elsewhere in the circuit.

7 Replace any seals such as 'O' rings before re-assembling hydraulic components.

Fault Finding Tables

Fault Descriptions:		
1	Steering wheel difficult to turn.	⇨ *Table 2. (H-34)*.
2	Steering wheel turns on its own.	⇨ *Table 3. (H-35)*.
3	Machine will not turn when the steering wheel turned.	⇨ *Table 4. (H-36)*.
4	Steering fails to respond to selected mode. (4WS Machines only)	⇨ *Table 5. (H-37)*.
5	Steering fails to phase accurately or `drifts' out of phase during operation. (4WS Machines only)	⇨ *Table 6. (H-38)*.

Table 2.

Fault	Probable Cause	Action
Steering wheel difficult to turn.	Tyres not inflated to correct pressure	Inflate tyres to correct pressure
	Insufficient hydraulic fluid.	Check for leaks and top up the hydraulic tank as required.
	Leaks in the relevant hoses or component connections	Check hoses and connections for leaks
	Air in the hydraulic system.	Bleed system - bleed the load sense line.
	Low pump flow.	Check pump flow, if required service or replace pump.
	Steer relief valve set incorrectly	Check pressure setting of steer unit relief valve, adjust as required.
	Worn or damaged parts in the steer control valve.	Remove and inspect.
	Priority valve not operating correctly.	Check if the priority valve is sticking, rectify as required.
		Check the load sense line from the steer unit to the priority valve for signs of leaking or poor connection.
	Steer mode valve not operating correctly (4WS Machines only)	Check if spools sticking, rectify as required
		Check if solenoids operating, replace solenoids as required
	Mechanical failure	Check for damaged axle components, such as rams, trackrods, linkages etc.

⇒ *Fault Finding Tables (H-33)*.

Table 3.

Fault	Probable Cause	Action
Steering wheel turns on its own.	Dirt in the steer control unit (causing sleeves to stick open)	Clean and inspect unit.
	Steer control valve centring springs damaged, broken or missing.	Check steer unit.
	Steer control valve - position of rotor to shaft slot incorrect.	Refer to ***Hydraulic Steer Unit - Dismantle and Assemble***. Correct as required.

⇨ ***Fault Finding Tables (H-33)***.

Table 4.

Fault	Probable Cause	Action
Machine will not turn when the steering wheel turned.	Insufficient hydraulic fluid.	Check for leaks and top up the hydraulic tank as required.
	Leaks in the relevant hoses or component connections	Check hoses and connections for leaks
	Air in the hydraulic system.	Bleed system - bleed the load sense line.
	Low pump flow.	Check pump flow, if required service or replace pump.
	Steer relief valve set incorrectly.	Check pressure setting of steer unit relief valve, adjust as required.
	Worn or damaged parts in the steer control valve.	Remove and inspect.
	Priority valve not operating correctly.	Check if the priority valve is sticking, rectify as required.
		Check the load sense line from the steer unit to the priority valve for signs of leaking or poor connection.
	Steer mode valve not operating correctly (4WS Machines only)	Check if spools sticking, rectify as required
		Check if solenoids operating, replace solenoids as required
	Mechanical failure	Check for damaged axle components, such as rams, trackrods, linkages etc.
	Steer column splined shaft not fully engaged in steer valve.	Check shaft engagement.
	Power track rod failure	Check power track rod for signs of damage, leaks etc.

⇨ *Fault Finding Tables (H-33)*.

Table 5.

Fault	Probable Cause	Action
Steering fails to respond to selected mode (4WS Machines only)	Selector switch faulty.	Check selector switch, replace as required.
Note: *Machines with ECU controlled steer mode will generate a blink code for certain fault conditions,* ***⇨ Diagnostic `Blink' Codes - if applicable (H-39)***.	Proximity switches not operating correctly.	Check setting of Proximity switches, reset or replace switches as required.
	Steer mode valve not operating correctly.	Check if spools sticking, rectify as required.
		Check if solenoids operating, replace solenoids as required.
	Leaks in the relevant hoses or component connections.	Check hoses and connections for leaks
	Electrical failure.	Check relevant electrical connectors, if problem still persists, do a wiring continuity check on relevant circuits.

⇨ Fault Finding Tables (H-33).

Table 6.

Fault	Probable Cause	Action
Steering fails to phase accurately or `drifts' out of phase during operation. (4WS machines only).	Incorrect re-phasing procedure.	Ensure phasing is carried out correctly and at the correct intervals. See ***Service Procedures, Re-phasing the Road Wheels.***
Note: *Where phasing problems are limited to 2WS mode, faults will be related to the rear power track rod system. 4WS mode problems require front and rear track rod systems to be investigated for possible faults.*	Air in steer hydraulic system.	Bleed the system. See ***Service Procedures, Bleeding the System.***
	Incorrectly set proximity switches.	Re-set the proximity switches. See ***Service Procedures, Proximity Switch - Setting***.
	Power track rod internal or external hydraulic leaks, see ***Note.***	Check relevant hose and pipework for leaks. Check track rod seals for leakage. Also see ***Service Procedures, 4WS Machines - Checking for Internal Hydraulic Leakage***.
	Steer mode valve internal or external hydraulic leaks, see ***Note.***	Check relevant hose and pipework for leaks. Also see ***Service Procedures, 4WS Machines - Checking for Internal Hydraulic Leakage.***

⇨ ***Fault Finding Tables (H-33)***.

Diagnostic `Blink' Codes - if applicable

Applicable to 4WS machines from serial no. 1327630.

The blink codes are applicable to machines fitted with ECU controlled steer mode only. The ECU has the facility to detect faults with the steer mode electrical system. These faults are indicated using the 2WS indicator light **A** in the front console. The blink code sequence consists of the light being switched ON for approximately one second followed by a number of flashes (the code). The sequence is repeated until the fault is cleared.

C048691

Fig 38.

Blink Code:	**Fault:**	**Action:**
1 Flash	`C' solenoid coil or circuit fault (open or short circuit).	Check the solenoid coil and related harness wires and connectors.
2 Flashes	`D' solenoid coil or circuit fault (open or short circuit).	Check the solenoid coil and related harness wires and connectors.
3 Flashes	Steer mode changeover relay, diode or circuit fault (open or short circuit).	Check the steer mode changeover relay and related harness wires and connectors.

For details of the wires and connectors, see ***Circuit Descriptions***.

Service Procedures

Hydraulic Pressure Tests

Standby Pressure

⚠ WARNING

Make the machine safe before working underneath it. Park the machine on level ground, lower the attachments to the ground. Apply the park brake, put the transmission in neutral and stop the engine. Block both sides of all four wheels.

Disconnect the battery, to prevent the engine being started while you are beneath the machine.

GEN-4-1_1

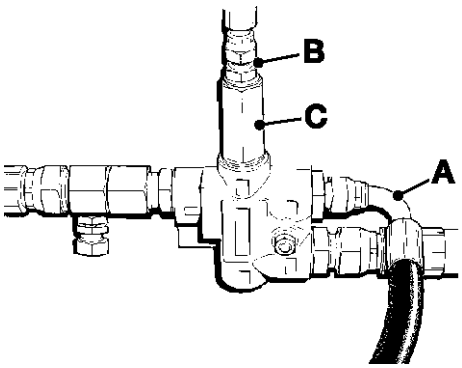

Fig 39.

Make sure that the hydraulic oil is at working temperature, i.e. 50ºC (122ºF).

1 Turn the steering wheel to the left and to the right several times to vent system pressure.

2 Disconnect hose **A** and install a 0 - 40 bar (0 - 580 lbf/in^2) pressure test gauge into the valve port. Position the open end of hose **A** into a clean container in order to collect any oil drainage.

3 Disconnect hose **B** from load sensing port adaptor **C** and blank off.

4 Set the steering to neutral and start the engine. Gradually increase the engine speed to 1000 rpm while checking the maximum pressure gauge reading which should be 5.9 to 8.7 bar (86 to 126 lbf/in^2).

If the pressure is outside the limits try cleaning the priority valve, ⇨ ***Steer Priority Valve - Cleaning (H-42)***.

If cleaning the valve does not rectify, check the hydraulic pump flow rate, see ***Section E, Hydraulics, Service Procedures - Flow and Pressure Testing***.

If the hydraulic pump flow and pressure tests are satisfactory, then the priority valve must be renewed.

Steering Pressure

⚠ WARNING

Make the machine safe before working underneath it. Park the machine on level ground, lower the attachments to the ground. Apply the park brake, put the transmission in neutral and stop the engine. Block both sides of all four wheels.

Disconnect the battery, to prevent the engine being started while you are beneath the machine.

GEN-4-1_1

Make sure that the hydraulic oil is at working temperature, i.e. 50ºC (122ºF).

1 Turn the steering wheel to the left and to the right several times to vent system pressure.

2 Connect a 0 - 400 bar (0 - 6000 lbf/in²) pressure gauge to the hydraulic test point **A** at the outlet from the pump secondary section (P2) as shown.

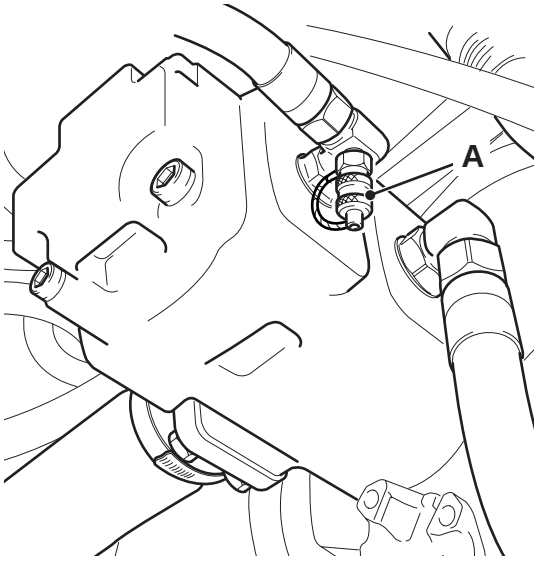

Fig 40.

3 Run the engine at 1500 rpm and turn the steering wheel to full lock. Hold the wheel on full lock and check the gauge reading. This should be equal to the relief valve operating pressure, see ***Technical Data***.

4 If necessary, adjust the pressure setting by removing plug **B**, on the hydraulic steer unit.

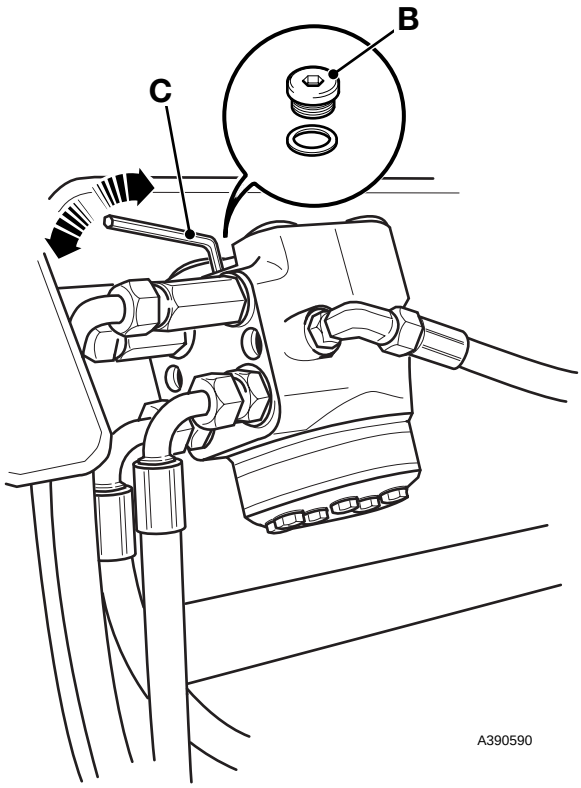

Fig 41.

5 Using an allen key **C**, adjust the valve screw until the correct pressure is shown on the gauge.

6 Refit the plug **B**.

Steer Priority Valve - Cleaning

The priority valve spool and spring may be removed for cleaning.

1 Remove the priority valve from the machine. Refer to ***Priority Valve - Removal and Replacement.***

2 Unscrew adaptor **9** and extract the priority valve spring **11**.

3 Remove the blanking plug **7**. Press out the priority valve spool **12** using a nylon pin. Take care not to damage the bore of the valve.

4 Clean these components in clean paraffin paying particular attention to the orifices at each end of the spool. Dry off and lubricate with clean hydraulic fluid.

5 Refit the priority valve spool **12** making sure that the spring seat end of the spool faces towards the LS port. Refit blanking plug **7** and torque tighten.

6 Refit the priority valve spring **11** and adaptor **9** and torque tighten.

7 Refit the valve onto the machine. Refer to ***Priority Valve - Removal and Replacement***.

8 Bleed the load sensing line LS as described below:

a Start the engine, loosen the connection on the valve, turn and hold the steering wheel fully in either direction. When bubble free oil flows from the joint, tighten the connection.

Table 7. Torque Settings

Item	Nm	kgf m	lbf ft
7	50	5.1	37
9	50	5.1	37

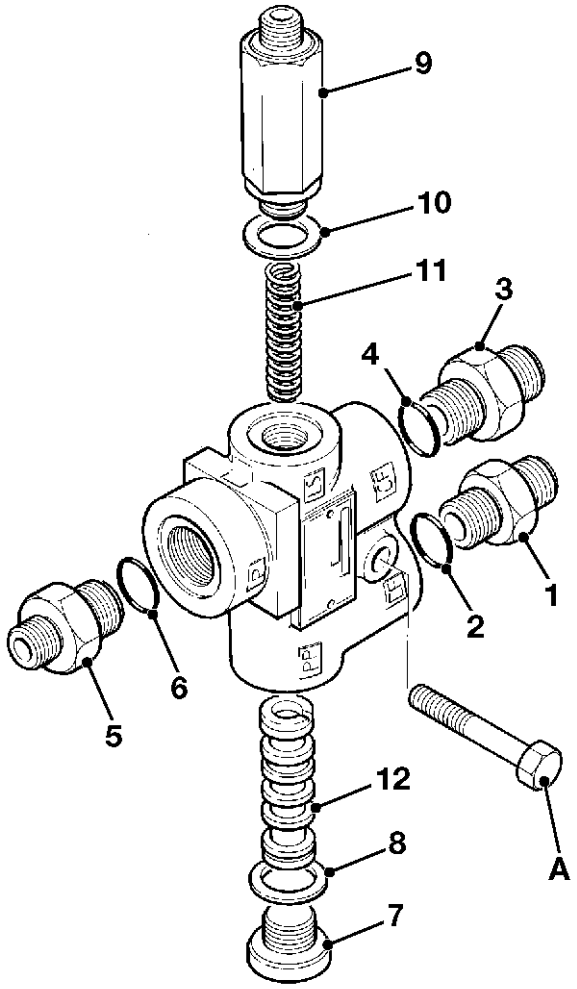

Fig 42.

2 Wheel Steer Machines

Bleeding the System

When any hydraulic steering component is disconnected or removed, the system must be bled before driving the machine.

1 Run the engine at 1500 rpm.

2 Turn and hold the steering wheel fully in both directions:

- **a** Turn the steering wheel to the left, until the front wheels are fully locked to the left.
- **b** Turn the steering wheel to the right, until the front wheels are fully locked to the right.
- **c** Turn the steering wheel to the left, until the front wheels are in the straight ahead position.

3 Stop the engine.

4 Check the hydraulic tank fluid level, and top-up the tank if required.

4 Wheel Steer Machines

Re-phasing the Road Wheels

⚠ WARNING

Over a long period of time, the front and rear axles may get slightly out of phase. At the start of each working period, before travelling on public roads and at least once a day, or if having difficulty in steering, check and, if necessary, re-align the road wheels. Failure to re-align the road wheels at least once per day may mean a reduction in steering effectiveness. This can lead to tyre scuffing and difficulty in steering a straight line.

5-2-6-4

The steering must be re-phased:

- After travelling for 15 miles (24 km) or more on the road (in 2 wheel steer).
- After carrying out service procedures on any part of the steering system.

Follow the procedures below for re-phasing the steer system:

1 Select 2-wheel steer.

Sensors on the axles prevent the steer mode from changing until the wheels straighten up or pass through the `straight ahead' position. Because of this, there will be a short period when the indicator lights do not agree with the switch position.

2 Operate the machine until the rear wheels straighten up.

When the rear wheels straighten up the machine will go into 2-wheel steer. The indicator light will show when 2-wheel steer has engaged.

3 Select 4-wheel steer again.

The front and rear wheels are now back in phase.

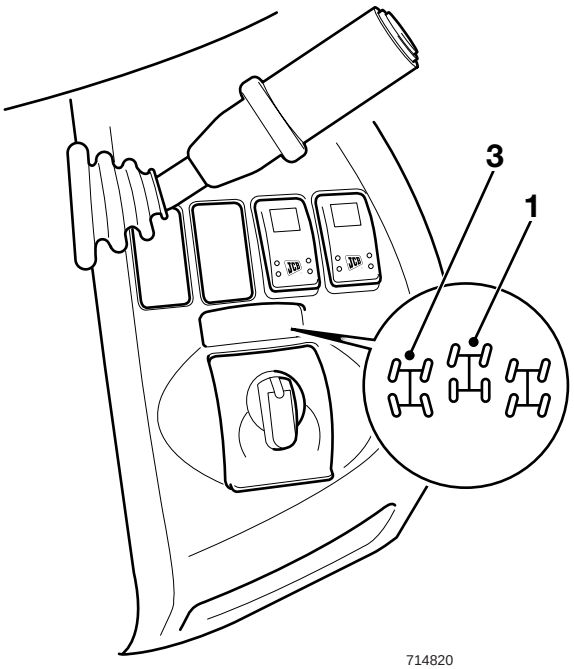

Fig 43.

Bleeding the System

When any hydraulic steering component is disconnected or removed, the system must be bled before driving the machine.

With the engine running, the following procedure must be carried out in the correct order that is laid down. You must not alter the order of selections and operations.

1 Select 2 wheel steer.

a Turn the steering wheel to the left, until the front wheels are fully locked to the left.

b Turn the steering wheel to the right, until the front wheels are fully locked to the right.

2 Select 4 wheel steer.

a Turn the steering wheel to the left, until the front wheels are fully locked to the left.

3 Select 2 wheel steer.

a Turn the steering wheel to full right lock.

b Turn the steering wheel to full left lock.

c Turn the steering wheel to full right lock.

4 Select 4 wheel steer.

a Turn the steering wheel to the left, until the front wheels are fully locked to the left.

5 Select 2 wheel steer.

a Turn the steering wheel to full right lock.

b Turn the steering wheel to full left lock.

c Turn the steering wheel to full right lock.

6 Select 4 wheel steer.

a Turn the steering wheel to the left, until the front wheels are fully locked to the left.

7 Select 2 wheel steer.

a Turn the steering wheel to full right lock.

b Turn the steering wheel to full left lock.

c Turn the steering wheel to full right lock.

8 Select 4 wheel steer.

a Turn the steering wheel to the left, until the front and rear wheels are fully locked.

9 Stop the engine.

10 Check the hydraulic tank fluid level, and top-up the tank if required.

Proximity Switch - Setting

⚠ WARNING

Raised Equipment

Never walk or work under raised equipment unless it is supported by a mechanical device. Equipment which is supported only by a hydraulic device can drop and injure you if the hydraulic system fails or if the control is operated (even with the engine stopped).

13-2-3-7_2

Note: *The proximity switch setting procedure is the same for both the front and rear axles. The illustration shows a typical rear axle.*

1 Align the wheels in the straight ahead position. Check if straight ahead by measuring the steering ram position.

Set the steering so that dimension **X** is equal both sides.

2 Remove the proximity switch cover **C**.

3 With the starter switch on, loosen the proximity switch lock nut **D** and slide the switch in line with the target disc **A**.

4 Loosen the bracket fixing bolts **E** and adjust the assembly up or down to bring the switch to the centre of the target disc. Tighten the fixing bolts **E**.

Make sure the light emitting diode (L.E.D.) is not illuminated (if it is then screw the switch out).

Now screw the proximity switch towards the target disc until the light emitting diode (L.E.D.) on the switch illuminates. Add a further 1 to 1.5 turns of the locknut. Tighten the locknut.

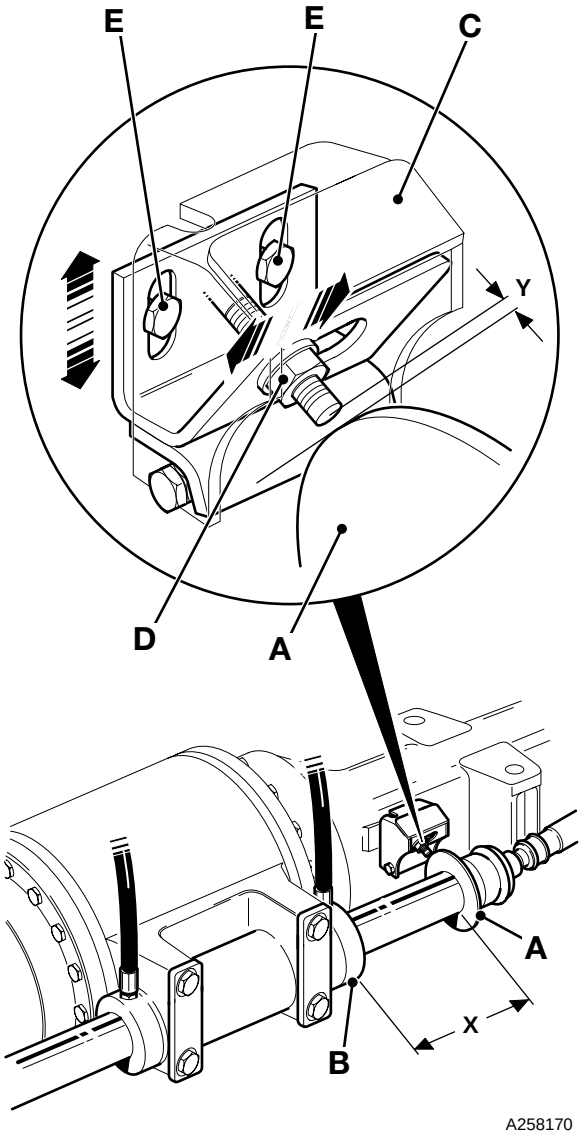

Fig 44.

Steer Mode Valve - Checking Solenoid Operation

The solenoids operate according to the steer mode that is selected.

Mode	Solenoid(s) Energised
2-Wheel steer	**A**
4-Wheel steer	**B, D**
Crab steer	**B, C**

Operation (energisation) of a solenoid can be easily detected by placing a steel object (e.g. screwdriver blade) close to the outer casing. A magnetic attraction of the steel object towards the solenoid indicates energisation.

If a solenoid is not energising carryout the following checks:

1 Check the fuse is intact. If not, renew and then check that all steer mode solenoid combinations function correctly.

2 If the fuse is intact remove the electrical connector from the malfunctioning solenoid(s) and check that the 12V supply is present across the connector pins. If not, check the supply circuit.

3 Check the solenoid coil resistance which should measure a few ohms (if unsure of the value compare with a known good solenoid).

Renew the solenoid if the reading indicates a short circuit (zero ohms) or open circuit (infinite resistance). If a reading somewhere between the two is obtained, reverse the two instrument probes and repeat for a valid check.

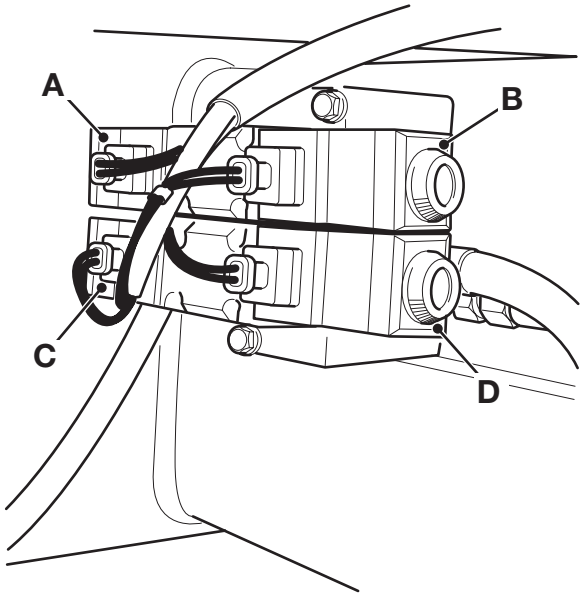

Fig 45. Type 1

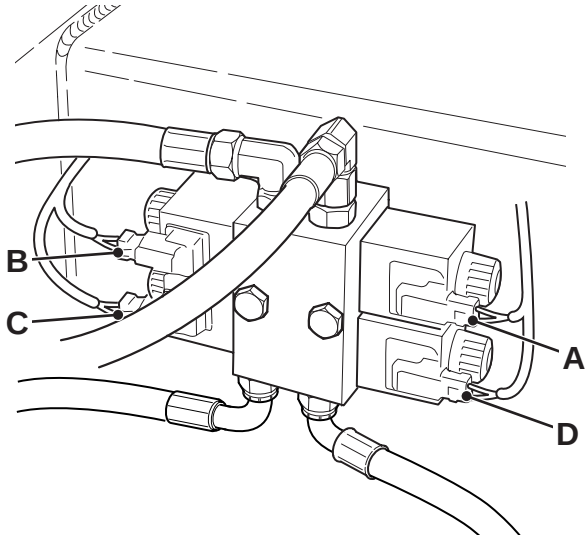

Fig 46. Type 2

Checking Components for Internal Hydraulic Leakage

If hydraulic leaks occur at the steer mode valve or power track rods the steering system will go progressively out of phase, the more the steering is operated the further the front and rear wheels will `drift' out of phase.

Note: *Some drifting out of phase is normal over time and the system must be routinely re-phased,* ⇨ ***Re-phasing the Road Wheels (H-44)***.

If the system goes out of phase over short periods of time it is probable that there is hydraulic leakage. External leakage is obvious and may occur at track rod seals, relevant hoses, pipes and adaptors. Internal leakage can occur across power track rod piston seals or within the steer mode valve.

When identifying internal leakage proceed as follows;

For 4WS mode faults both front and rear track rods and the steer mode valve must be investigated individually for possible leakage. See the relevant procedures under ***Power Track Rod*** and ***Steer Mode Valve*** in this section.

For 2WS mode faults it is possible to identify if internal leakage is at the rear power track rod, or steer mode valve without first removing and dismantling components. Proceed as follows:

1 Stop the engine and remove the starter key. Disconnect the hydraulic hoses **A** at the rear power track rod. Fit an isolating ball valve **B** at each port on the track rod and then reconnect the hoses.

2 Open the ball valves. Start the engine and bleed the system, ⇨ ***Bleeding the System (H-45)***.

3 Set the machine in 2-wheel steer mode and then close the ball valves **B**. Measure the length of one side of the track rod **C** and record the value.

4 Drive the machine, in a circle, in one direction, several times. Stop the machine and re-measure the track rod length. Compare the measurements.

If the track rod has moved then it can be assumed that there is internal leakage across the piston seals in the power track rod. This may be due to worn or damaged seals, or due to a worn or damaged cylinder bore. See the relevant procedures under ***Power Track Rod*** in this section.

If the track rod has not moved it can be assumed there is internal leakage at the steer mode valve See the relevant procedures under ***Steer Mode Valve***.

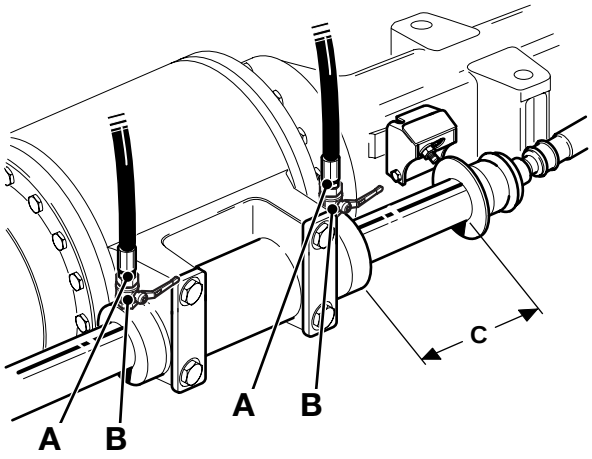

Fig 47.

Service Procedures - 3C Machines (Sideshift)

Hydraulic Pressure Tests

Standby Pressure

Make sure that the hydraulic oil is at working temperature, i.e. 50ºC (122ºF).

1 Park the machine on firm level ground, engage the park brake and set the transmission to neutral. Raise the loader arms and fit the loader arm safety strut. Stop the engine and remove the starter key.

⚠ WARNING

If it is necessary to work with the loader arms raised, then the loader arm safety strut must be fitted.

4-3-2-8

2 Turn the steering wheel to the left and to the right several times to vent system pressure.

3 Working in the engine compartment, disconnect the hose from priority valve outlet port **P**. Install a tee adaptor into the port, then reconnect the hose to the tee adaptor. Connect a 0 to 40 bar (0 to 580 lbf/in^2) pressure test gauge to the other tee adaptor outlet.

4 Disconnect the hose from priority valve load sensing port **LS**, blank off the hose to prevent loss of fluid. In its place connect a suitable hose to enable any leakage from the port to be collected in a clean container. Make sure the end of the hose is in the container before starting the engine.

5 Set the steering to neutral and start the engine. Gradually increase the engine speed to 1000 rpm while checking the maximum pressure gauge reading which should be 5.6 to 8.7 bar (81 to 126 lbf/in^2). A small amount of oil leakage should be evident from load sensing port **LS**.

If the pressure is outside the limits or there is no oil leakage, try cleaning the priority valve. ⇨ *Steer Priority Valve - Cleaning (H-51)*.

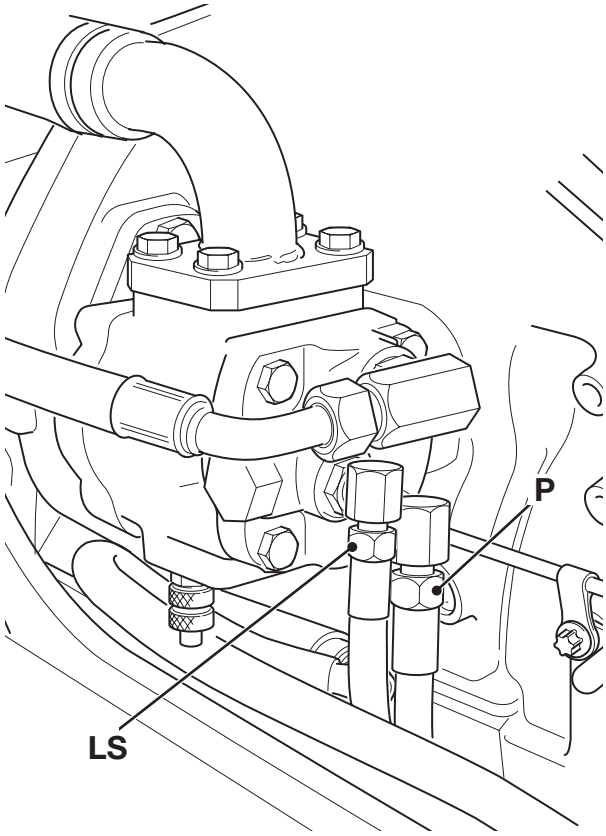

Fig 48.

Steering Pressure

Make sure that the hydraulic oil is at working temperature, i.e. 50ºC (122ºF).

1 Park the machine on firm level ground, engage the park brake and set the transmission to neutral. Raise the loader arms and fit the loader arm safety strut. Stop the engine and remove the starter key.

⚠ WARNING

If it is necessary to work with the loader arms raised, then the loader arm safety strut must be fitted.

4-3-2-8

2 Turn the steering wheel to the left and to the right several times to vent system pressure.

3 Working in the engine compartment, connect a 0 to 400 bar (0 to 6000 lbf/in^2) pressure gauge to the hydraulic test point **X** located on the pump body.

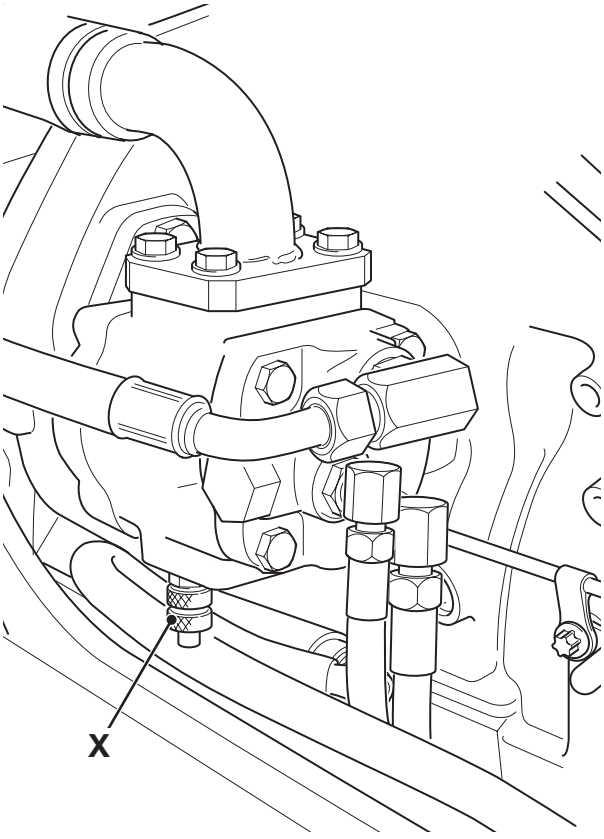

Fig 49.

4 Run the engine at 1500 rpm and turn the steering wheel to full lock. Hold the wheel on full lock and check the gauge reading. This should be equal to the relief valve operating pressure, see ***Technical Data***.

5 If necessary, adjust the pressure setting by removing plug **A**, on the hydraulic steer unit.

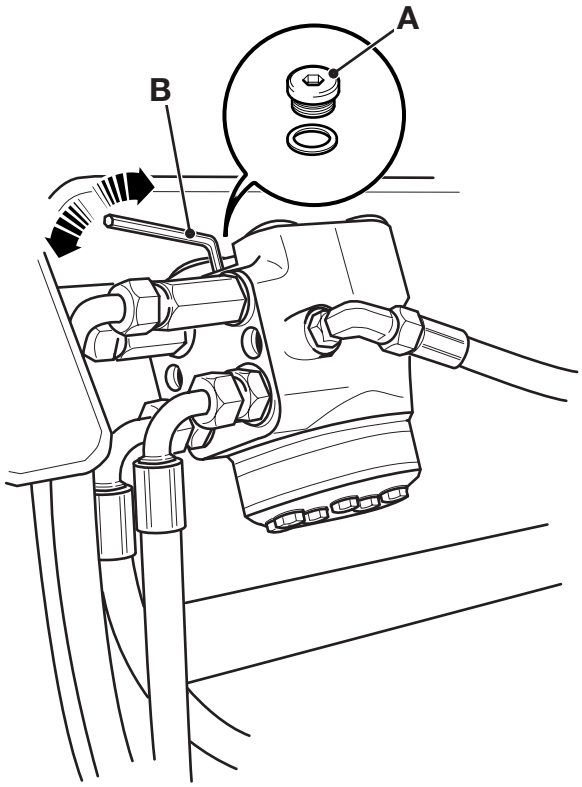

Fig 50.

6 Using an allen key **B**, adjust the valve screw until the correct pressure is shown on the gauge.

7 Refit the plug **A**.

Steer Priority Valve - Cleaning

The priority valve spool and spring may be removed for cleaning with the pump fitted to the engine.

1 Park the machine on firm level ground, engage the parking brake and set the transmission to neutral. Raise the loader arms and fit the loader arm safety strut. Stop the engine and remove the starter key.

⚠ WARNING

Raised Equipment

Never walk or work under raised equipment unless it is supported by a mechanical device. Equipment which is supported only by a hydraulic device can drop and injure you if the hydraulic system fails or if the control is operated (even with the engine stopped).

13-2-3-7_2

2 Turn the steering wheel to the left and to the right several times to vent system pressure.

3 Working in the engine compartment, disconnect the hose from priority valve load sensing port **LS**, blank off the hose to prevent loss of fluid.

4 Unscrew hexagon cap **A** and extract the priority valve spring and spool. Take care not to damage the bore of the valve.

5 Clean these components in clean paraffin paying particular attention to the orifices at each end of the spool. Dry off and lubricate with clean hydraulic fluid.

6 Refit the spool and spring making sure that they are the correct way round.

7 Refit the hexagon cap **A** using a new `O' ring and torque tighten.

8 Reconnect the hose to the priority valve load sensing port **LS**, and bleed the load sense line as described below:

Start the engine, loosen the connection on the valve, then turn and hold the steering wheel fully in either direction. When bubble free oil seeps from the joint, tighten the connection.

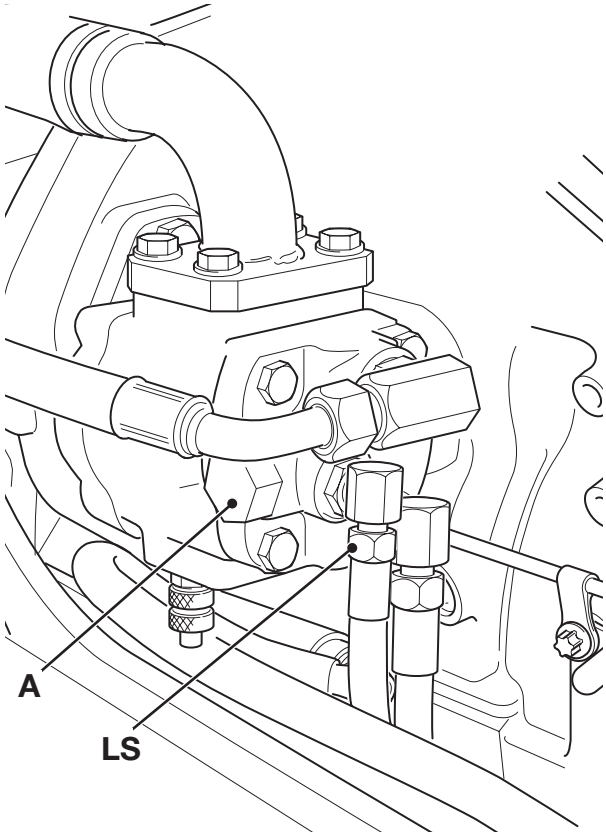

Fig 51.

Table 8. Torque Settings

Item	Nm	kgf m	lbf ft
A	103	10	76

Priority Valve

Removal and Replacement

⚠ WARNING

Make the machine safe before working underneath it. Park the machine on level ground, lower the attachments to the ground. Apply the park brake, put the transmission in neutral and stop the engine. Block both sides of all four wheels.

Disconnect the battery, to prevent the engine being started while you are beneath the machine.

GEN-4-1_1

The priority valve is mounted on the right hand side chassis member, adjacent to the loader valve block. It is attached to the chassis member by one bolt **A**, and is accessible from underneath the machine.

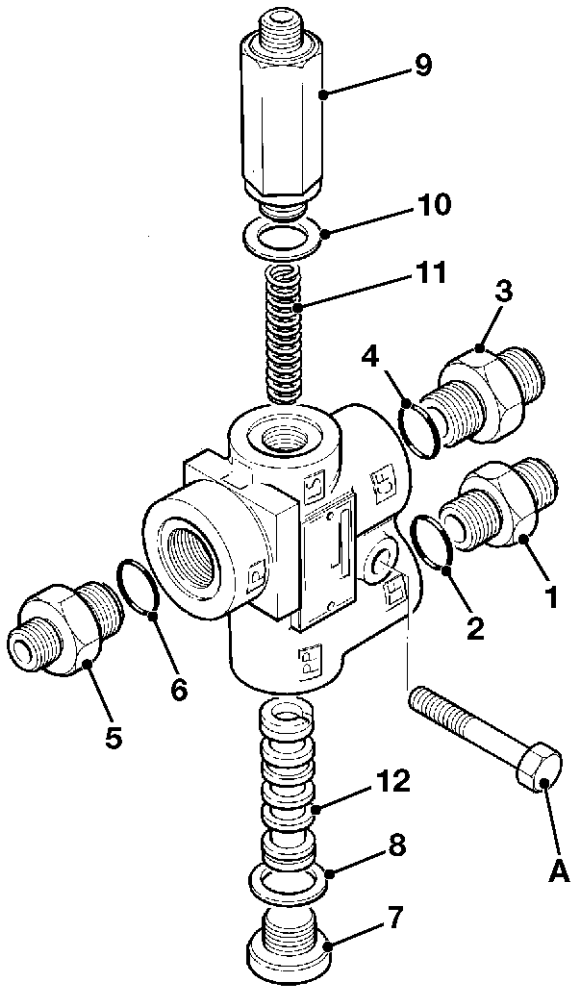

Fig 52.

Dismantle and Assemble

The numerical sequence shown on the illustration, is intended as a guide to dismantling.

For assembly the sequence should be reversed.

Note: *The priority valve is not serviceable beyond the removal of foreign matter (Refer to* ***Service Procedures, Priority Valve - Cleaning****). A faulty unit must be replaced.*

1 Remove the priority valve from the machine.

2 Unscrew adaptor **9** and extract the priority valve spring **11**.

3 Remove the blanking plug **7**. Press out the priority valve spool **12** using a nylon pin. Take care not to damage the bore of the valve.

4 Clean these components in clean paraffin paying particular attention to the orifices at each end of the spool. Dry off and lubricate with clean hydraulic fluid.

5 Refit the priority valve spool **12** making sure that the spring seat end of the spool faces towards the LS port. Renew the aluminium washer **8**, then refit blanking plug **7** and torque tighten, ⇒ ***Table 9. Torque Settings (H-53)***.

6 Refit the priority valve spring **11**. Renew the aluminium washer **10**, then refit adaptor **9** and torque tighten, ⇒ ***Table 9. Torque Settings (H-53)***.

7 Refit the valve onto the machine.

8 Bleed the load sensing line LS as described below:

a Start the engine, loosen the connection on the valve, turn and hold the steering wheel fully in either direction. When bubble free oil flows from the joint, tighten the connection.

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.*

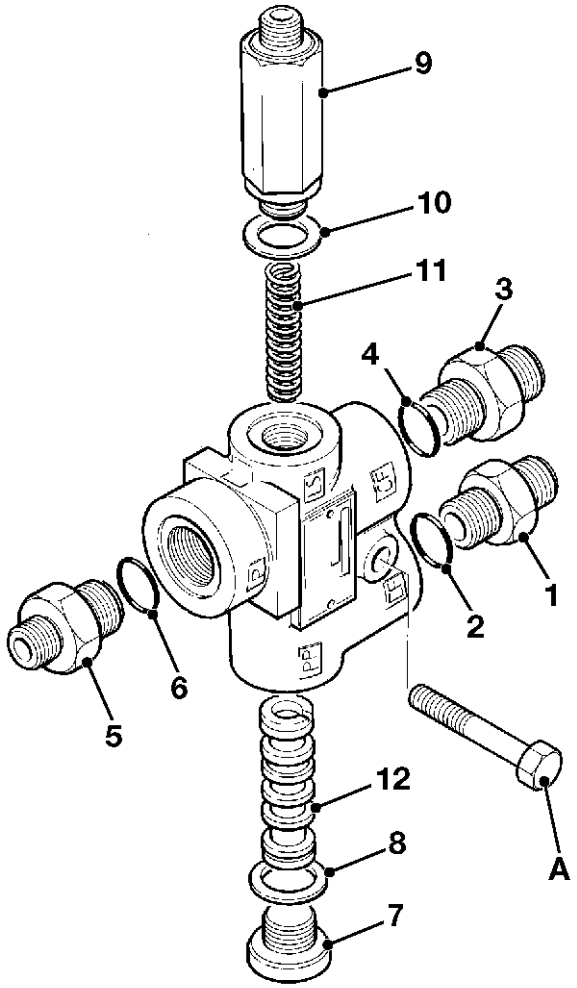

Fig 53.

Table 9. Torque Settings

Item	Nm	kgf m	lbf ft
7	50	5.1	37
9	50	5.1	37

Priority Valve - 3C Machines (Sideshift)

Removal and Replacement

The priority valve housing can be replaced with a new housing which includes the valve. The housing is an integral part of the main hydraulic pump. For dismantling and assembly of the priority valve, see ***Section E, Hydraulics, Main Pump - 3C Machines.***

The priority valve assembly is not serviceable beyond the removal of foreign matter, see ***Service Procedures - 3C Machines, Steer Priority Valve - Cleaning***. A faulty unit must be replaced.

Power Track Rod

Removal and Replacement

This procedure is for a typical power steering track rod removal and replacement.

⚠ WARNING

Make the machine safe before working underneath it. Park the machine on level ground, lower the attachments to the ground. Apply the park brake, put the transmission in neutral and stop the engine. Block both sides of all four wheels.

Disconnect the battery, to prevent the engine being started while you are beneath the machine.

GEN-4-1_1

⚠ WARNING

Raised Equipment

Never walk or work under raised equipment unless it is supported by a mechanical device. Equipment which is supported only by a hydraulic device can drop and injure you if the hydraulic system fails or if the control is operated (even with the engine stopped).

13-2-3-7_2

Removal

1 Disconnect and cap hydraulic hoses to prevent loss of fluid and ingress of dirt. Label hoses for identification and correct refitting.

2 On 4WD machines remove the split pin and nut **54A**. Remove the track rod ball joint from the wheel hub assembly.

On 2WD machines, remove lock assembly **55B** and pin **55C** to remove the track rod pivot from the wheel hub assemblies.

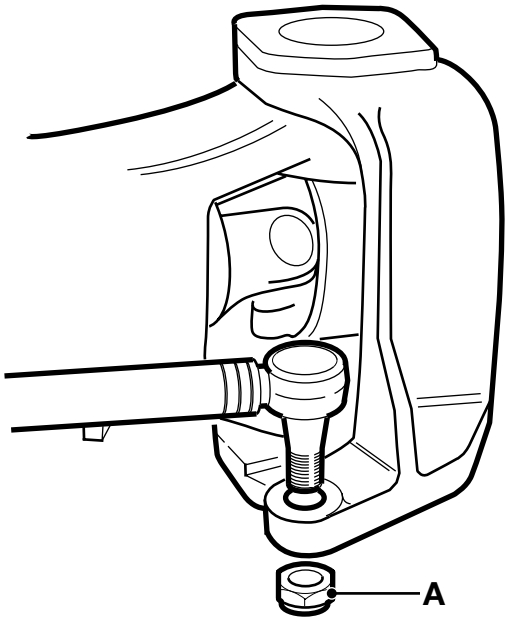

Fig 54.

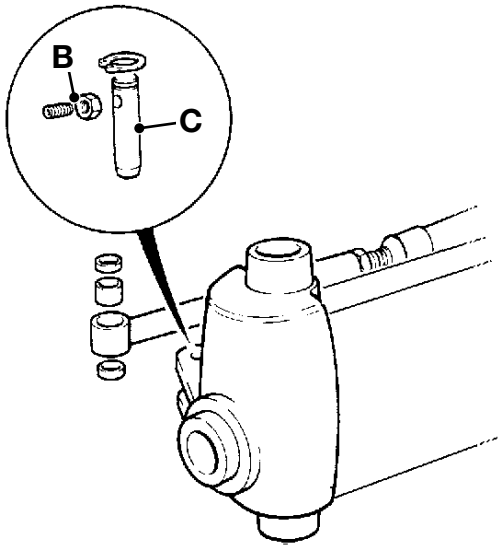

Fig 55.

3 Remove the four fixing bolts **56D**.

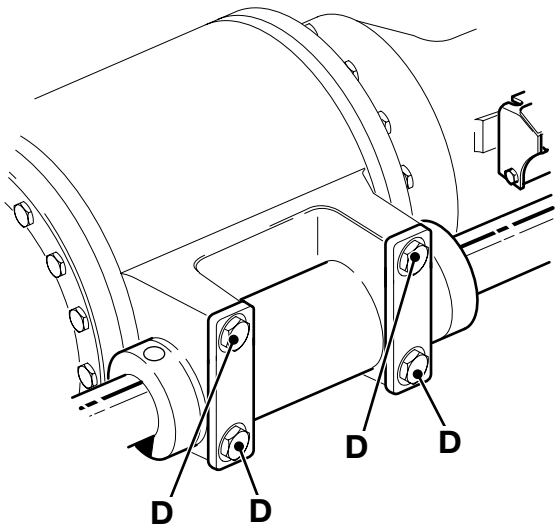

Fig 56.

Replacement

Replace the power track rod by reversing the removal procedure but note the following:

1 On 4WD machines make sure that the split pin is fitted. If the split pin cannot be fitted after torque tightening the nut **54A**, tighten further to a maximum of 150Nm until the pin can be inserted.

2 Note the applicable torque values for the track rod fixing bolts according to axle type, ⇨ ***Table 10. Torque Settings (H-57)***.

Important: ⇨ ***Fig 59. (H-57)****. On 2WS 4WD axles, the washers under the heads of the M20 x 110 mm long bolts **G** are special washers and must be renewed with the correct grade JCB hardened washer.*

3 After connecting hoses check hydraulic fluid level, if necessary top up.

4 Bleed hydraulic steering system, refer to ***Service Procedures, Bleeding the System***.

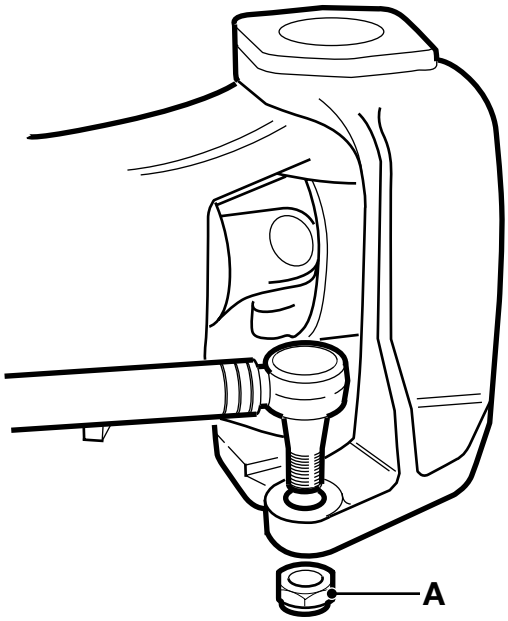

Fig 57. 4WD Axles

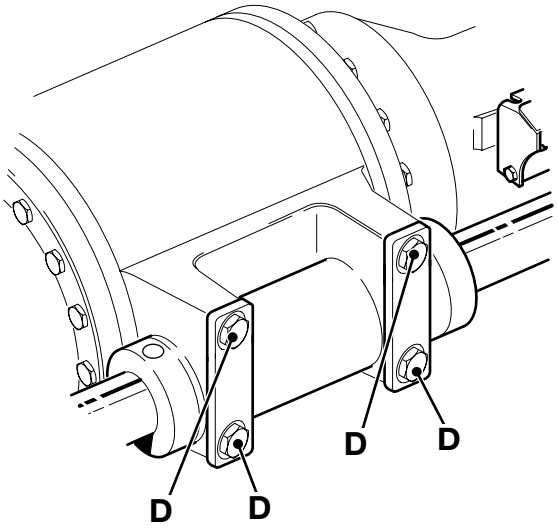

Fig 58. 4WS Rear Axle

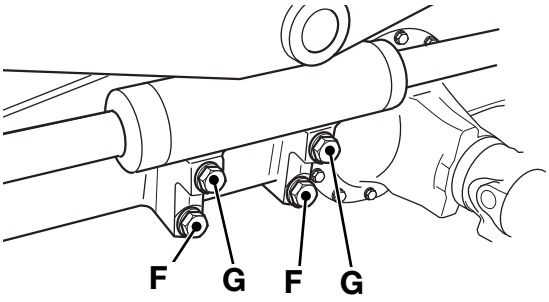

Fig 59. 2WS, 4WD Front Axle

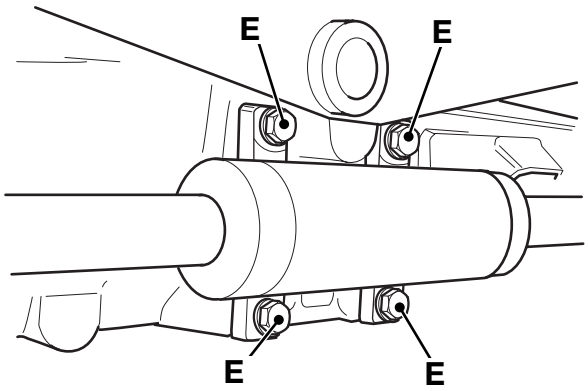

Fig 60. 4WS, 4WD Front Axle

Table 10. Torque Settings

Item	Bolt Grade	Nm	kgf m	lbf ft
A	-	140	14	103
D	-	620	63	457
E, F	-	476	48	351
G	10.9	510	52	376

Note: *The 2WS 2WD front axle is not illustrated. Torque the bolts to the value given for item* ***D*** *in the table.*

Link Arms

Removal and Replacement

Removal

1 Fix the assembly on a locally made strip and rebuild bench as shown in ⇒ *Fig 61. (H-58)*.

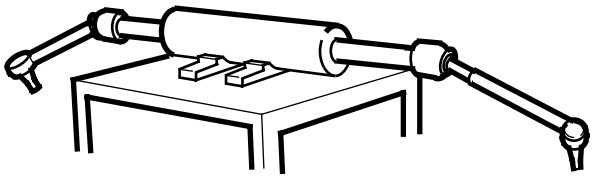

Fig 61.

2 Using two suitable open ended spanners at **62L** and **62M** react against each other until one ball joint unscrews.

3 Unscrew the ball joint **62L** until an open ended spanner can be fitted on the rod **62N**. Screw the ball joint against the spanner to secure the spanner and to prevent damage to the rod.

4 By reacting against the spanner at **62N** and 62**M** undo the other ball joint.

The track rod spanner flats at **63E** are:

2 Wheel drive machines - 32 mm A/F x 4 mm wide.

4 Wheel drive machines - 40 mm A/F x 4 mm wide.

Note: *The piston rod operates at full length, any damage to the surface will cause fluid leaks. DO NOT attempt to grip the rod diameter with pipe grips etc.*

5 Repeat the procedure for the remaining link arm assembly.

6 Where applicable remove the target disc **63G**.

Note: *If the inner or outer ball joints need to be renewed, then a replacement link arm assembly must be fitted.*

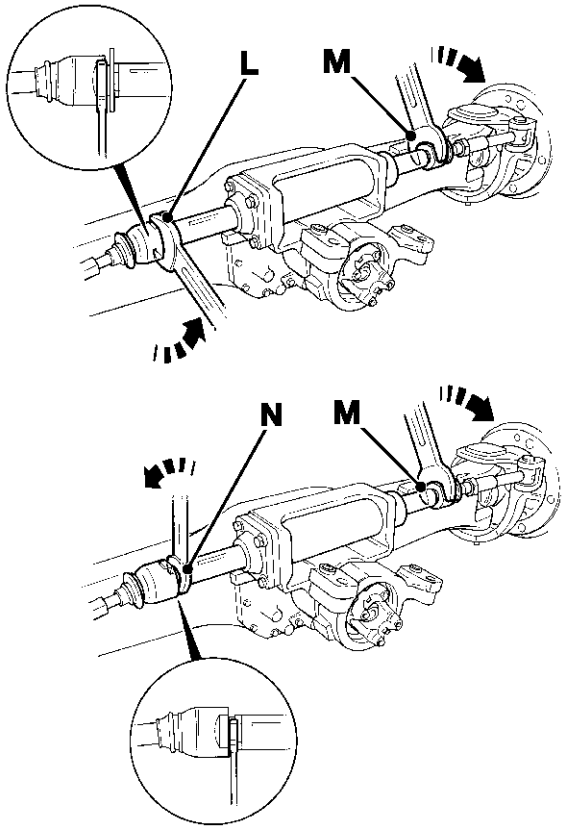

Fig 62.

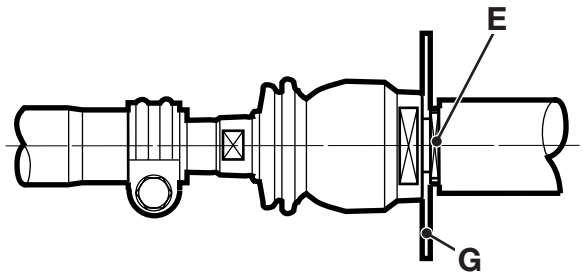

Fig 63.

Replacement

Replacement is the reverse of removal but note the following:

1 Remember to fit the target disc **63G** (where applicable).

2 Use JCB Threadlocker and Sealer on the trackrod link arms.

3 Note the applicable torque values for the link arms according to axle type, ⇨ ***Table 11. Torque Settings (H-60)***.

4 If the link arms have been renewed, the wheel alignment must be checked as follows:

a Set the wheels to the straight ahead position and measure dimensions **64X** and **64Y** (at the outer edge of the wheel hub). Alignment is correct if the difference between **64X** and **64Y** is a maximum of 1 mm.

b To adjust the wheel alignment undo the lock nuts (**65H** or **66K** as applicable). Turn the threaded adjusters **J** equally to obtain the correct alignment. Tighten the lock nuts (**65H** or **66K** as applicable).

5 Check the proximity switch setting (where applicable). Refer to ***Service Procedures, Proximity Switch - Setting***.

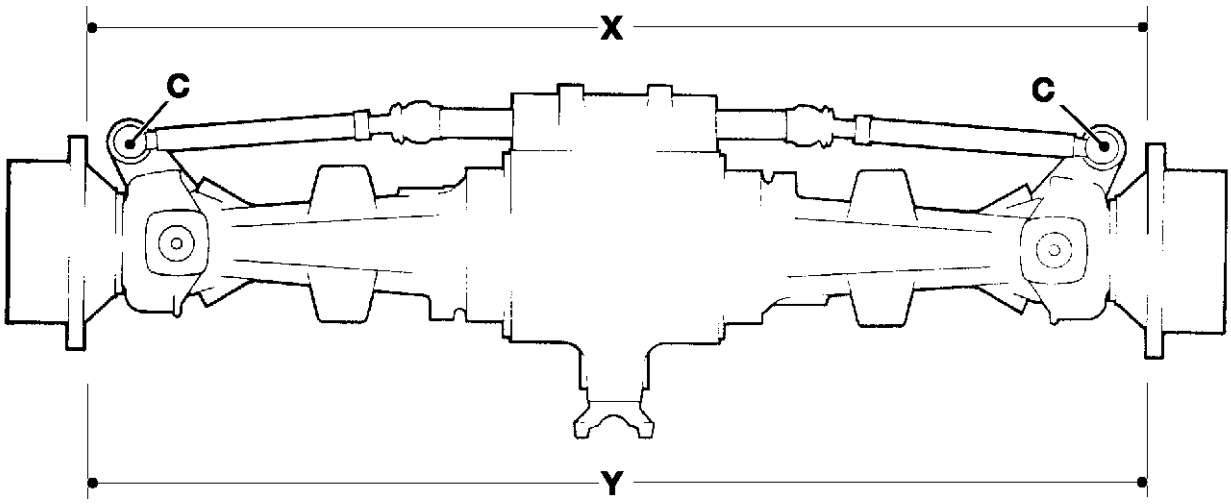

Fig 64.

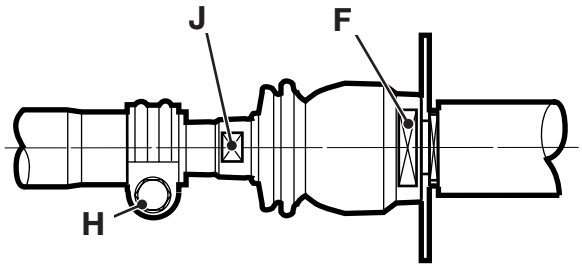

Fig 65. 4 Wheel Steer Machines

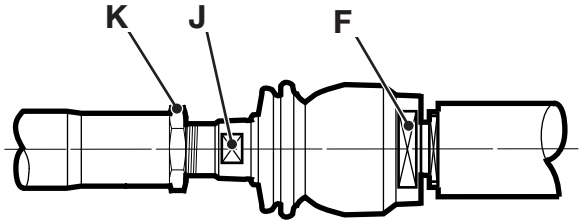

Fig 66. 2 Wheel Steer Machines

Table 11. Torque Settings

2WS, 4WD	**C**	180 Nm (132 lbf ft)	**H**	45-50 Nm (33-36 lbf ft)	**F**	240-260 Nm (177-184 lbf ft)
2WS, 4WD	**C**	140-150 Nm (103-110 lbf ft)	**K**	300 Nm (221 lbf ft)	**F**	240-260 Nm (177-184 lbf ft)
AWS, 4WD	**C**	270-280 Nm (199-206 lbf ft)	**H**	70-85 Nm (51-62 lbf ft)	**F**	450 Nm (331 lbf ft)
AWS, 4WD	**C**	270-280 Nm (199-206 lbf ft)	**K**	390-410 Nm (287-302 lbf ft)	**F**	450 Nm (331 lbf ft)
2WS, 2WD	**C**	N/A	**K**	240-260 Nm (177-184 lbf ft)	**F**	240-260 Nm (177-184 lbf ft)

Rams

Dismantle and Assemble

⇒ *Fig 67. (H-63)*. The numerical sequence shown on the illustration is intended as a guide to dismantling.

For assembly the sequence should be reversed.

Dismantle

1 Fix the ram assembly on a locally manufactured strip and rebuild bench as shown at **A**.

2 Remove both end caps **1**, using a special spanner (refer to ***Service Tools***). Pull the piston rod assembly from the cylinder.

Note: *DO NOT allow the piston rod to come into contact with the cylinder bore. The cylinder bore may be damaged by careless dismantling.*

3 Position the piston rod assembly **2** on a bench in place of the ram cylinder. Remove the seal **4** and wear rings **3** from the piston head.

Note: *The piston head cannot be removed from the rod. If there is damage to the rod or piston head, replace the complete assembly.*

4 Carefully inspect the bore of the cylinder and the piston rod outer diameter for scoring, nicks and burrs. If such damage is visible the components must be renewed.

Note: *If burrs are evident on the ends of the piston rod at positions **C** or **D** remove by careful filing.*

Both end cap assemblies are the same, dismantle as follows:

5 Remove the `O' ring **5**, end cap seal **6** and wiper seal **7**.

6 The bearing bush **8** can be renewed if necessary. However, time will be saved if a complete end cap and bush assembly is obtained.

Assemble

1 Clean the threads of the end caps **1** and cylinder using a wire brush.

2 Use JCB Cleaner and Degreaser to ensure that all threads are free from grease, hydraulic oil and sealant. Allow 15 minutes for solvent to dry before applying JCB Threadlocker and Sealer (High Strength).

Ensure that lubricants used during assembly do not come into contact with the JCB Threadlocker and Sealer (High Strength).

3 Refer to ***Section E, Hydraulics, Rams - JCB Ram Sealing Procedure*** for the correct method of fitting seals to the end cap and piston head.

4 Clamp the cylinder vertically and lower the piston rod assembly in from the top, as shown at **B**. Take care not to allow the piston rod to come into contact with the cylinder bore. Be sure to engage the piston head new wear rings and seal carefully into the cylinder. If the piston head wear rings or seal are damaged during this stage, they must be renewed.

5 Apply JCB Activator to threads of the end caps **1** and cylinder. Allow Activator to dry for 15 minutes before bringing into contact with the JCB Threadlocker and Sealer (High Strength).

Note: *Neither the JCB Threadlocker and Sealer (High Strength) nor Activator must be allowed to contact seals, bearing rings or `O' rings.*

6 Apply JCB Threadlocker and Sealer (High Strength) to threads of the ends caps **1**, fit new `O' ring **5**.

7 Ensure that there are no burrs at the ends of the piston rod, ⇒ *Dismantle (H-61)*, step 4.

8 Fit an end cap **1** over the piston rod. Apply light hand pressure to the cap to engage the gland seal on the piston rod. DO NOT use excessive force. Screw on the first end cap and then fix the assembly on the strip and rebuild bench as shown at **A**. Fit the remaining cap and then torque tighten both caps, ⇒ *Table 12. Torque Settings (H-62)*.

Note: *If hydraulic oil contacts the uncured JCB Threadlocker and Sealer (High Strength) a weakening of the bond will result. Cure times vary according to the ambient temperature. Allow a minimum of 2 hours between assembly and filling the ram with oil.*

Table 12. Torque Settings

Item	Nm	kgf m	lbf ft
1	678	69.2	500

Note: *Cold weather operation. When operating in conditions which are consistently below freezing, it is recommended that the track rod is operated slowly to its full extent in both directions before commencing normal working.*

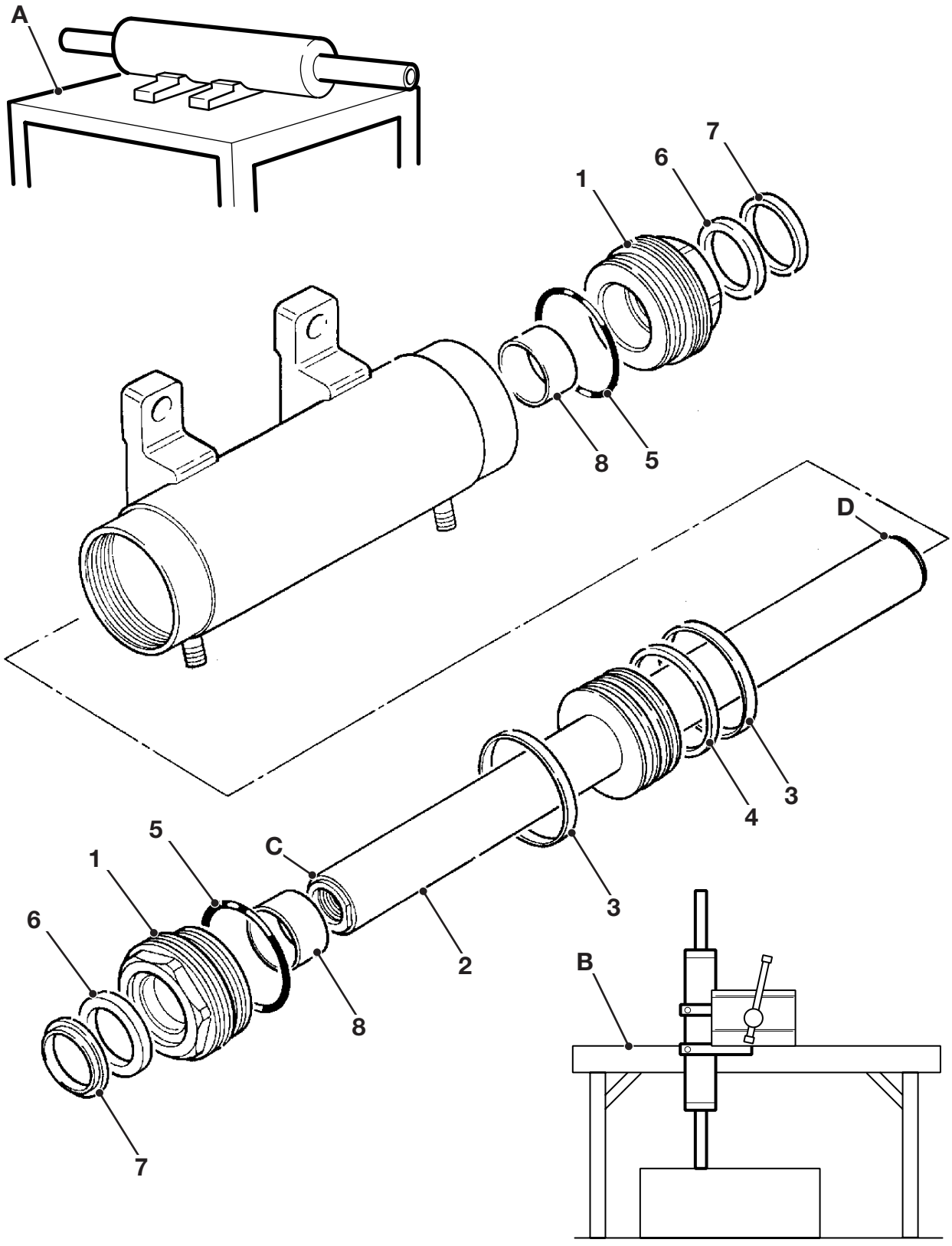

Fig 67. Dismantle and Assemble

Steer Mode Valve (Type 1) - if fitted

Removal and Replacement

⚠ WARNING

Make the machine safe before working underneath it. Park the machine on level ground, lower the attachments to the ground. Apply the park brake, put the transmission in neutral and stop the engine. Block both sides of all four wheels.

Disconnect the battery, to prevent the engine being started while you are beneath the machine.

GEN-4-1_1

⚠ WARNING

Hydraulic Pressure

Hydraulic fluid at system pressure can injure you. Before connecting or removing any hydraulic hose, residual hydraulic pressure trapped in the service hose line must be vented. Make sure the hose service line has been vented before connecting or removing hoses. Make sure the engine cannot be started while the hoses are open.

INT-3-1-11_2

Removal

The steer mode valve assembly is mounted on the right hand side of the machine in front of the rear axle. ⇨ *Fig 68. (H-64)*.

1 Park the machine on level ground, engage the parking brake and set the transmission to neutral. Lower the attachments to the ground. Stop the engine and remove the starter key.

2 Turn the steering wheel to the left and to the right several times to vent system pressure.

3 Uncouple the electrical harness from the solenoids. Label each connector before disconnecting to ensure correct replacement. The connectors may already be identified **A**, **B**, **C** and **D** as shown.

4 Disconnect the hydraulic hoses from the steer mode valve. Label each hose before disconnecting to ensure correct replacement. Cap the hose ends to prevent loss of fluid and ingress of dirt.

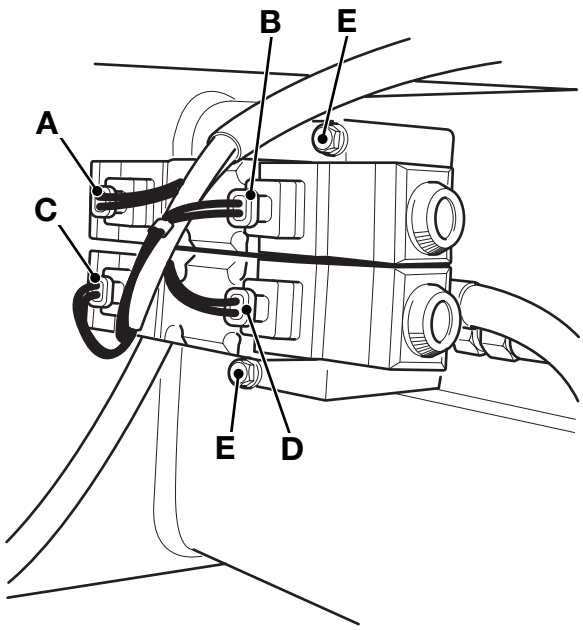

Fig 68.

5 Unscrew bolts **E** and carefully lift the steer mode valve away from the machine.

Replacement

Replacement is a reversal of the removal sequence, but note the following:

Make sure that the electrical harness is reconnected correctly:

- Solenoid **A** = 2-Wheel steer
- Solenoid **B** = 4-Wheel steer
- Solenoid **C** = Crab steer
- Solenoid **D** = All wheel steer

Check that the correct solenoids energise when the steer mode selector switch is operated, see ***Service Procedures, Checking Solenoid Operation***.

Make sure that the hoses are reconnected correctly:

- Port **P** to hydraulic steer unit (L port)
- Port **B** to rear power track rod (left side)
- Port **A** to rear power track rod (right side)
- Port **T** to front power track rod (right side)

Note: *The steer mode valve ports should be stamped 'P', 'B', 'A' and 'T'. Left and right hand are as viewed from the rear of the machine.*

⚠ WARNING

Fluid Under Pressure

Fine jets of fluid at high pressure can penetrate the skin. Keep face and hands well clear of fluid under pressure and wear protective glasses. Hold a piece of cardboard close to suspected leaks and then inspect the cardboard for signs of fluid. If fluid penetrates your skin, get medical help immediately.

INT-3-1-10_2

Before driving the machine, bleed the steering system, see ***Service Procedures, Bleeding the System.***

Dismantle and Assemble

⇨ *Fig 70. (H-67)*. The numerical sequence shown on the illustration is intended as a guide to dismantling. The illustration depicts a complete strip down, but to carry out specific servicing or repair E.g. renewal of one of the solenoids **3** and **6**, it is only necessary to dismantle the relevant components.

For assembly the sequence should be reversed.

Dismantle

1 Before dismantling, match mark the side of the solenoid valves and the manifold block to ensure correct assembly.

Note: *None of the component parts of the CETOPS valve assembly can be renewed individually. The extent of permissible servicing is cleaning and the consequential renewal of 'O' ring seals. If damage to any component or distortion of the spool is evident the complete valve assembly must be renewed.*

Important: *Take care not to lose the detent balls **A** from items **16** and **18**.*

Assemble

1 Renew all 'O' rings.

2 Lubricate parts with JCB Special Hydraulic fluid before assembling.

3 Use the match marks made during the dismantling to ensure that the valves and the manifold block are assembled correctly.

Table 13. Torque Settings

Item	Nm	lbf in
1	7.1 - 9.1	63 - 80

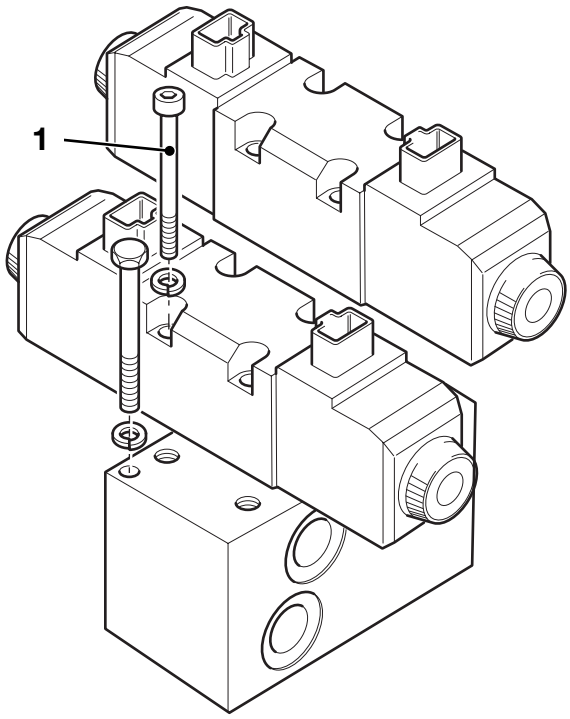

Fig 69.

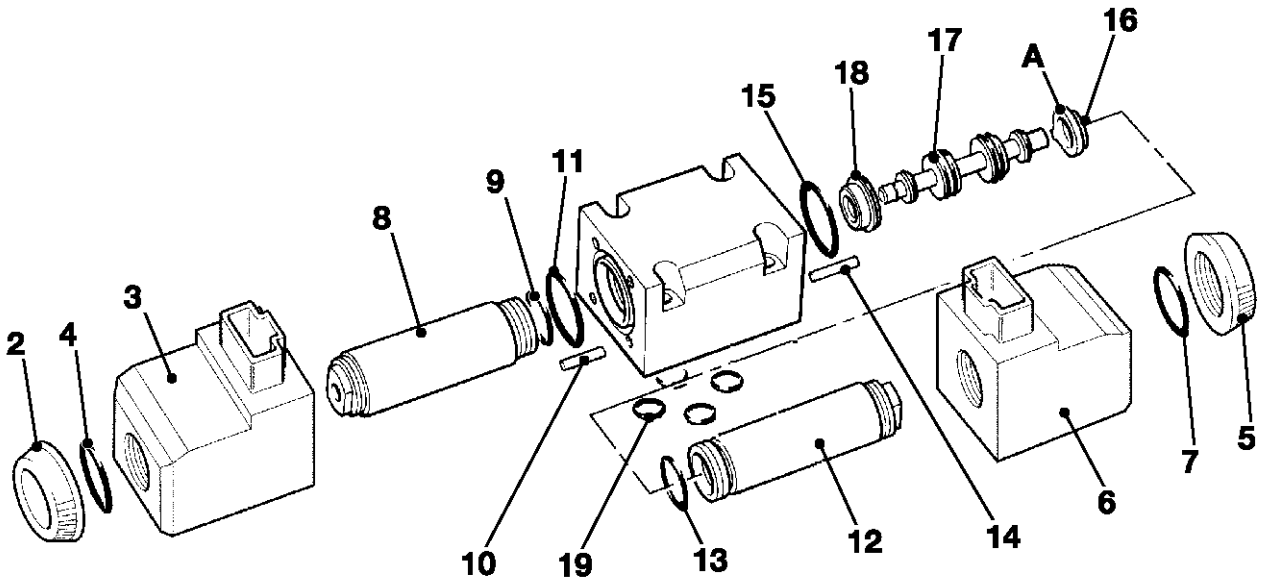

Fig 70. Steer Mode Valve

Steer Mode Valve (Type 2) - if fitted

Removal and Replacement

⚠ WARNING

Make the machine safe before working underneath it. Park the machine on level ground, lower the attachments to the ground. Apply the park brake, put the transmission in neutral and stop the engine. Block both sides of all four wheels.

Disconnect the battery, to prevent the engine being started while you are beneath the machine.

GEN-4-1_1

⚠ WARNING

Hydraulic Pressure

Hydraulic fluid at system pressure can injure you. Before connecting or removing any hydraulic hose, residual hydraulic pressure trapped in the service hose line must be vented. Make sure the hose service line has been vented before connecting or removing hoses. Make sure the engine cannot be started while the hoses are open.

INT-3-1-11_2

Removal

The steer mode valve assembly is mounted on the right hand side of the machine in front of the rear axle. ⇨ *Fig 71. (H-68)*.

1 Park the machine on level ground, engage the parking brake and set the transmission to neutral. Lower the attachments to the ground. Stop the engine and remove the starter key.

2 Turn the steering wheel to the left and to the right several times to vent system pressure.

3 Uncouple the electrical harness from the solenoids. Label each connector before disconnecting to ensure correct replacement. The connectors may already be identified **A**, **B**, **C** and **D** as shown.

4 Disconnect the hydraulic hoses from the steer mode valve. Label each hose before disconnecting to ensure correct replacement. Cap the hose ends to prevent loss of fluid and ingress of dirt.

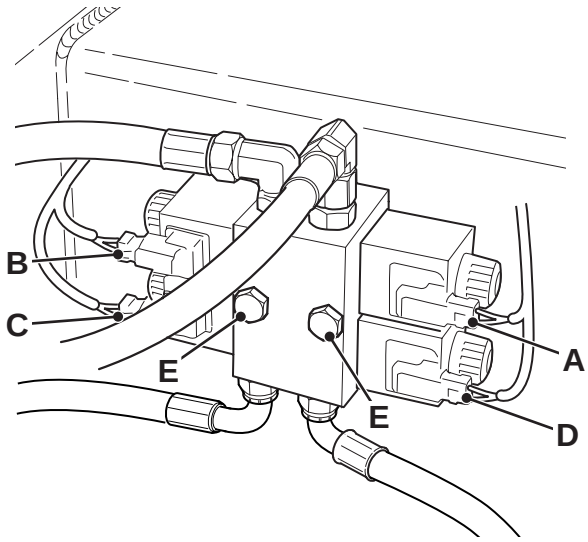

Fig 71.

5 Unscrew bolts **E** and carefully lift the steer mode valve away from the machine.

Replacement

Replacement is a reversal of the removal sequence, but note the following:

Make sure that the electrical harness is reconnected correctly:

- Solenoid **A** = 2-Wheel steer
- Solenoid **B** = 4-Wheel steer
- Solenoid **C** = Crab steer
- Solenoid **D** = All wheel steer

Check that the correct solenoids energise when the steer mode selector switch is operated, see ***Service Procedures, Checking Solenoid Operation***.

Make sure that the hoses are reconnected correctly:

- Port **F1** to hydraulic steer unit (L port)
- Port **R1** to rear power track rod (left side)
- Port **R2** to rear power track rod (right side)
- Port **F2** to front power track rod (right side)

Note: *The steer mode valve ports should be stamped 'F1', 'F2', 'R1' and 'R2'. Left and right hand are as viewed from the rear of the machine.*

⚠ WARNING

Fluid Under Pressure

Fine jets of fluid at high pressure can penetrate the skin. Keep face and hands well clear of fluid under pressure and wear protective glasses. Hold a piece of cardboard close to suspected leaks and then inspect the cardboard for signs of fluid. If fluid penetrates your skin, get medical help immediately.

INT-3-1-10_2

Before driving the machine, bleed the steering system, see ***Service Procedures, Bleeding the System.***

Dismantle and Assemble

Note: *The solenoid valves are non-serviceable parts. Faulty valves must be renewed. The following procedure details removing and replacing a valve fitted at the manifold block. The procedure is identical for all the valves (2 or 4 valve assemblies depending on machine variant). The procedure assumes that the complete valve and manifold block assembly has been removed from the machine.* ⇒ ***Removal and Replacement (H-68)***.

Dismantle

1 Unscrew the knurled cap **B** and pull off the solenoid coil **D**. Retrieve `O' rings **C** and **E**.

2 Using a suitable open ended spanner unscrew the valve stem **F** from the manifold block **A**. Retrieve `O' ring **G**.

Assemble

1 Make sure that all components are perfectly clean. If contamination is suspected make sure that all the oilways in the manifold block **A** are clear of debris.

2 Renew all 'O' rings.

3 Lubricate parts with JCB Special Hydraulic fluid before assembling.

Table 14. Torque Settings

Item	Nm	lbf in
F	TBA	TBA

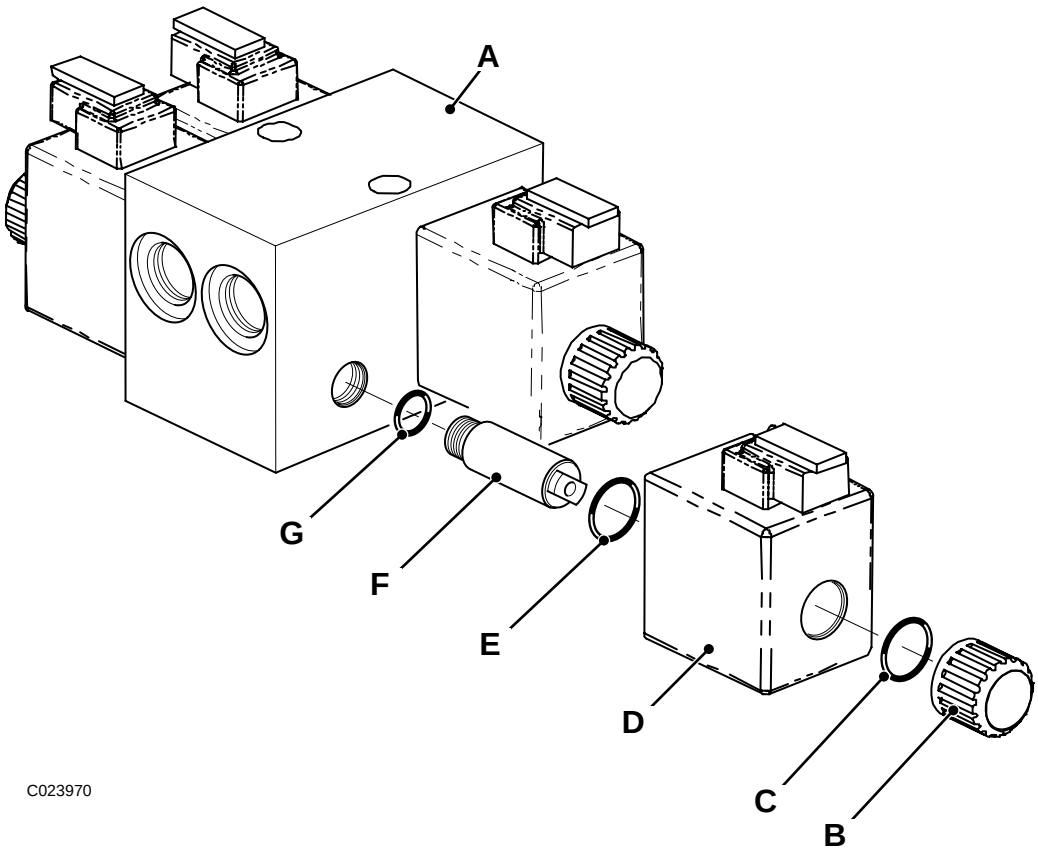

Fig 72.

Hydraulic Steer Unit

Removal and Replacement

⚠ WARNING

Make the machine safe before working underneath it. Park the machine on level ground, lower the attachments to the ground. Apply the park brake, put the transmission in neutral and stop the engine. Block both sides of all four wheels.

Disconnect the battery, to prevent the engine being started while you are beneath the machine.

GEN-4-1_1

⚠ WARNING

Hydraulic Pressure

Hydraulic fluid at system pressure can injure you. Before connecting or removing any hydraulic hose, residual hydraulic pressure trapped in the service hose line must be vented. Make sure the hose service line has been vented before connecting or removing hoses. Make sure the engine cannot be started while the hoses are open.

INT-3-1-11_2

Removal

⇒ *Fig 73. (H-72)*.

1 Park the machine on level ground, engage the parking brake and set the transmission to neutral. Lower the attachments to the ground. Stop the engine and remove the starter key.

2 Turn the steering wheel to the left and to the right several times to vent system pressure.

3 Disconnect and cap all hydraulic hoses from the steering unit as shown at **A**. Label the hoses to ensure correct refitting.

4 Get an assistant to hold the steering unit, and, working inside the cab, loosen and remove 4 bolts **B**. Lift the steering unit from the machine.

Replacement

1 Replacement is a reversal of the removal sequence. Make sure that the hoses are correctly installed.

⚠ WARNING

Fluid Under Pressure

Fine jets of fluid at high pressure can penetrate the skin. Keep face and hands well clear of fluid under pressure and wear protective glasses. Hold a piece of cardboard close to suspected leaks and then inspect the cardboard for signs of fluid. If fluid penetrates your skin, get medical help immediately.

INT-3-1-10_2

2 Bleed the steering system. See ***Service Procedures, 4 Wheel Steer Machines - Bleeding the System.***

3 If a new steering unit has been fitted then the system relief valve must be tested for correct pressure setting. See ***Service Procedures - Testing the System Pressure.***

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

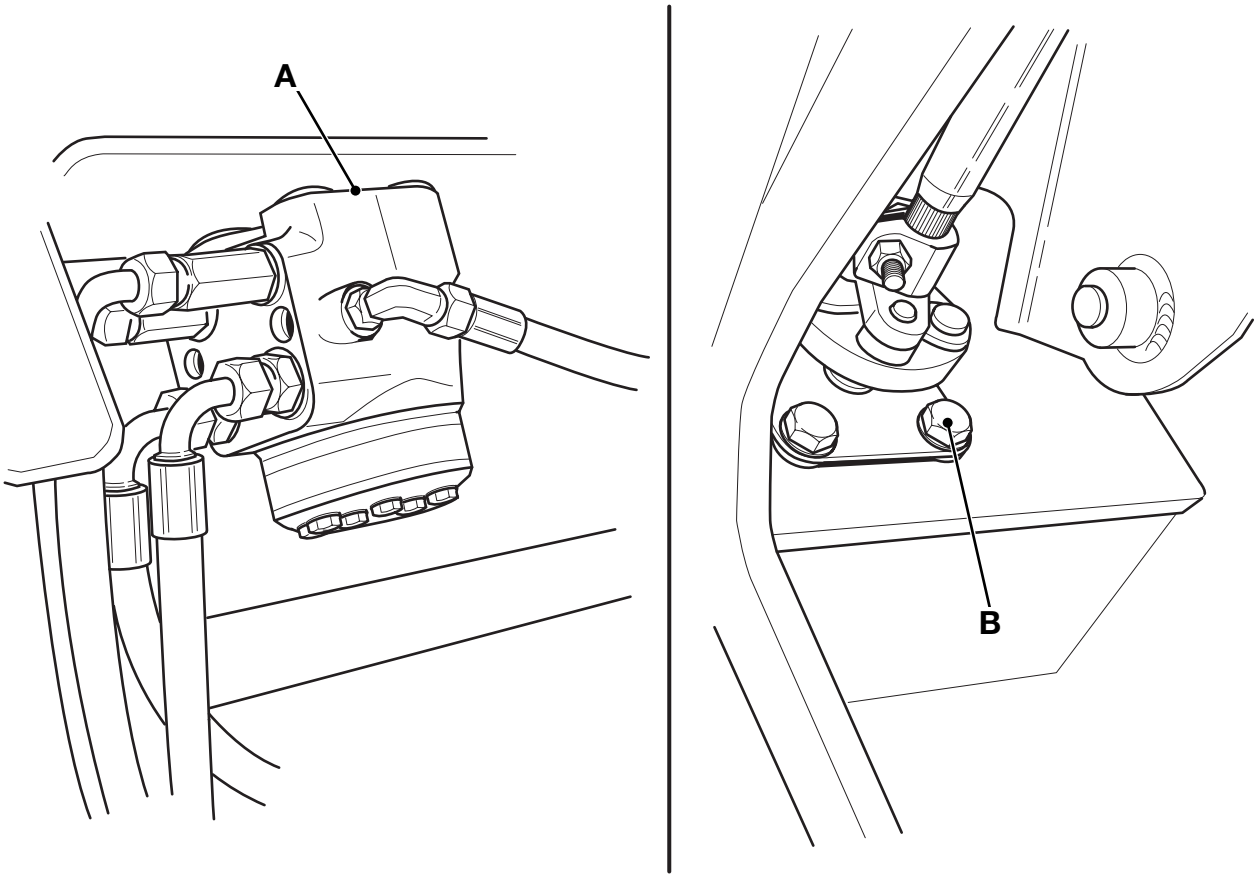

Fig 73. Hydraulic Steer Unit

Dismantle and Assemble

Dismantle

⇨ *Fig 74. (H-74)*. The numerical sequence shown on the illustration is intended as a guide to dismantling.

Note: *During manufacture, a small mark **X** will have been made on sleeve **12** and spool **15**, close to one of the slots for the centring springs **13**. Before removing the centring springs, check that this mark is visible; if not, make a new mark to ensure correct assembly.*

Note: *Shock valves (items **29** to **35**) are pressure set during manufacture and the adjusting screw **31** secured with Loctite. Due to the difficulty of resetting the pressure it is recommended that the valves are not disturbed. If dismantling is unavoidable, however, measure and record the depth of adjusting screw **31** below the top face of the steering unit before removing the screw.*

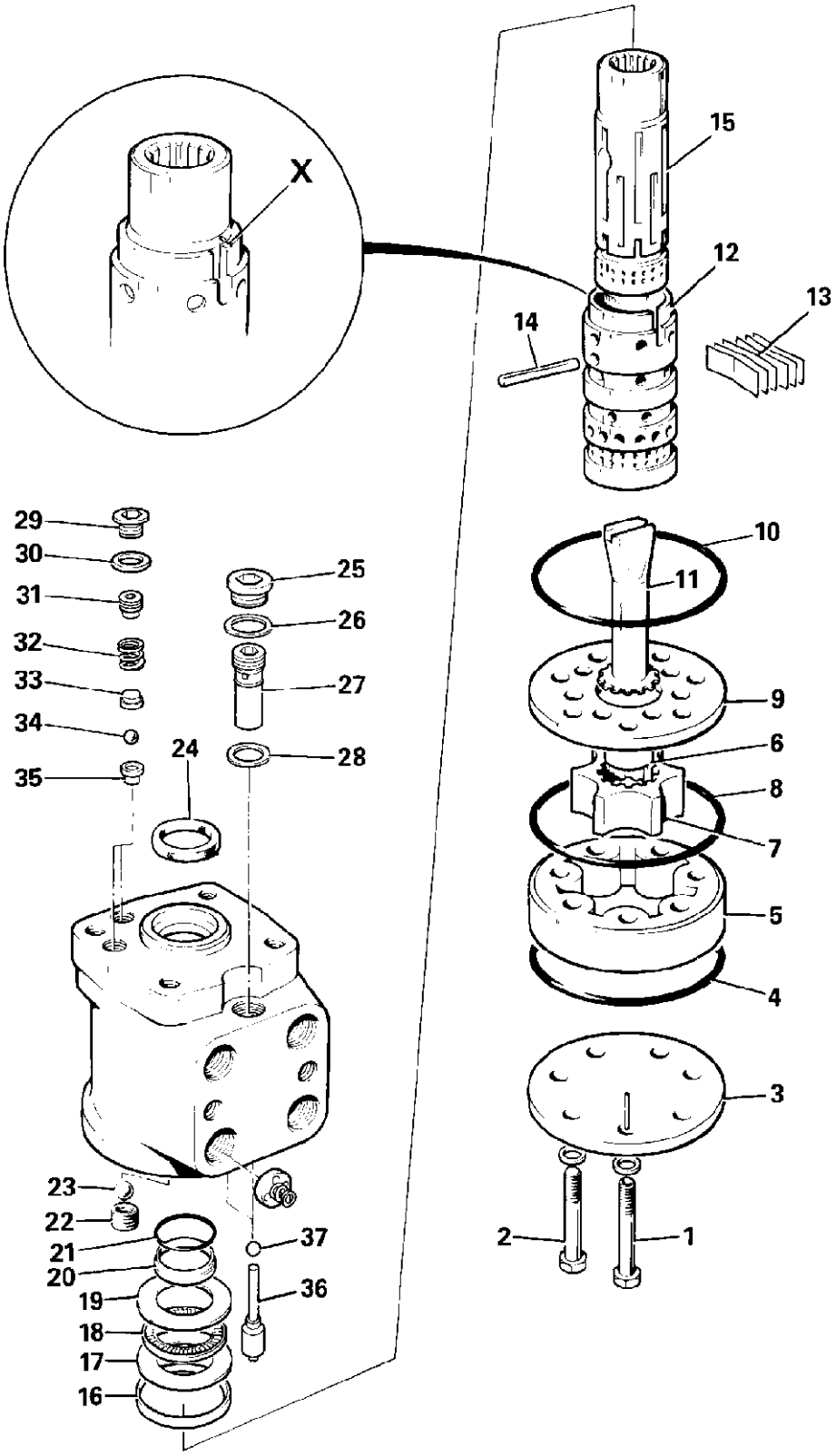

Fig 74. Hydraulic Steer Unit

Assemble

Note: *The unit illustrated in the following sequence represents a typical hydraulic steer valve. The relief valve (items **25** to **28**) and shock valves (items **29** to **35**) are not therefore shown in the following illustrations.*

1 Fit spool **15** into sleeve **12**, aligning slots for centring springs **13** and checking that the small marks **X** are aligned. Ensure that three slots in spool partially uncover three holes in sleeve, as at **A**.

2 Fit two flat centring springs **13** with four curved springs between them, as shown at **B**.

3 Fit seal **24** into steer unit body and insert sleeve of service tool 892/00180. Fit back up ring **20** and seal **21** onto plastic boss, and position on tool spindle, as shown.

4 Lower steering unit body and tool sleeve over tool spindle until plastic bush is flush with end of bore. Assemble sleeves **12** and **15** with cross pin **14** and centring springs **13**. Fit bearing components **16** to **19** with chamfered face of **17** facing away from bearing **18**.

5 Remove body from tool leaving plastic bush in position, and lower body over assembled spool.

6 Apply downward pressure on body until plastic boss is forced out of bore, leaving seals correctly located, ⇨ ***Fig 76. (H-75)***.

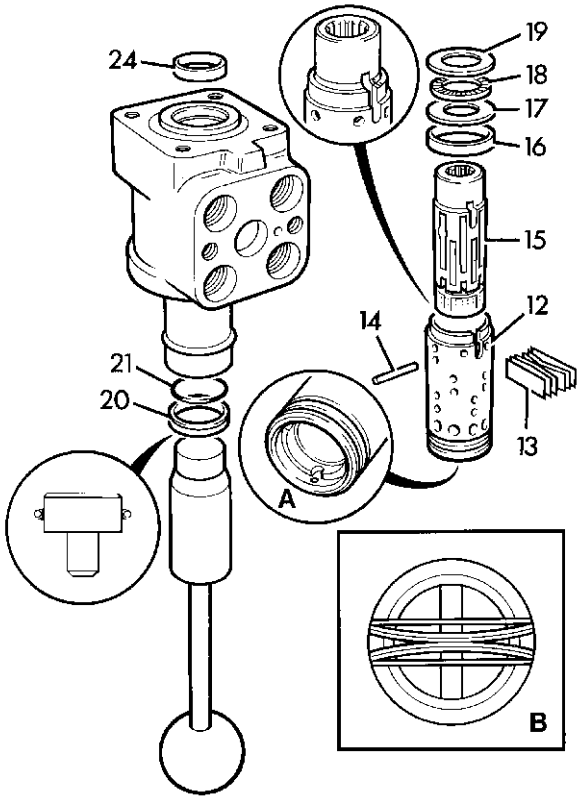

Fig 75.

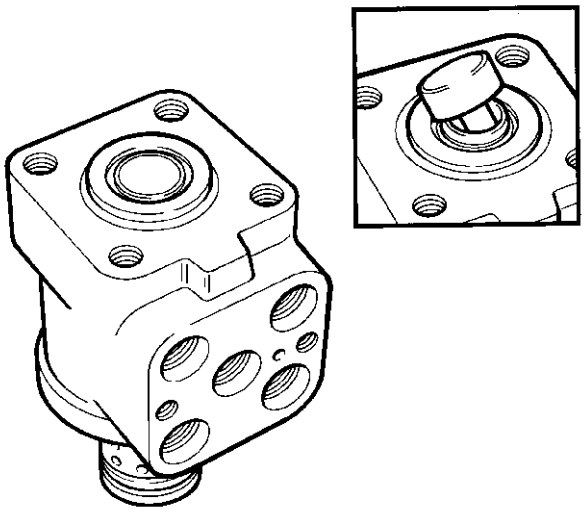

Fig 76.

7 Invert unit and place on a suitable hollow support so that body does not rest on protruding sleeve, thus preventing displacement of the new seals. Place ball **23** into check valve hole and fit bush **22**.

8 Fit new 'O' ring **10**.

9 Fit distributor plate **9** ensuring that holes align. Locate shaft **11** onto cross-pin **14**, noting position of slot **B**. When rotor **7** is fitted, slot must align with hollows of rotor as shown at **C**.

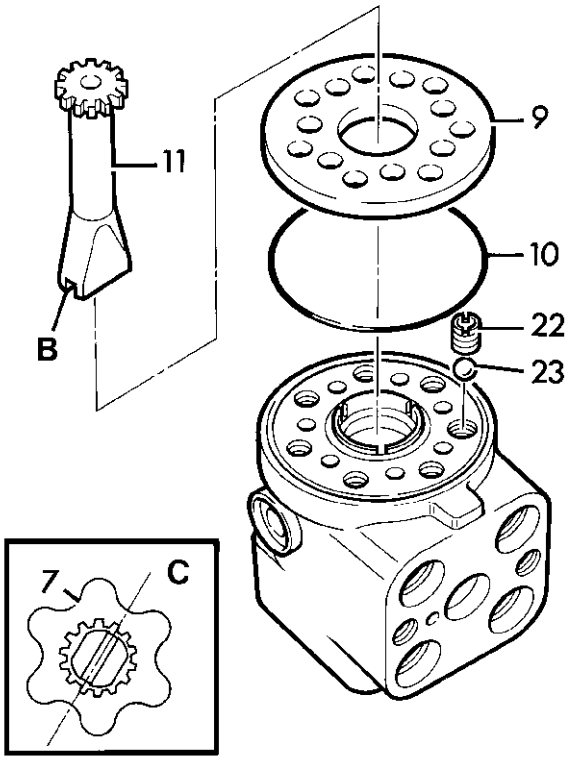

Fig 77.

10 Use a suitable piece of rigid flat material, 0.25mm (0.010 in.) thick, to support the shaft and ensure positive engagement with the splines of rotor **7**.

11 Locate rotor onto shaft, ensuring alignment as at **C**. Fit spacing bush **6** into rotor.

12 Fit 'O' rings **4** and **8** each side of body **5**, then position body over rotor.

13 Refit the end plate and fit at least one bolt **2** before removing support material.

14 Fit remaining bolts, ensuring that special bolt **1** is correctly located. Torque tighten the bolts, ⇨ *Table 15. Torque Settings (H-76)*.

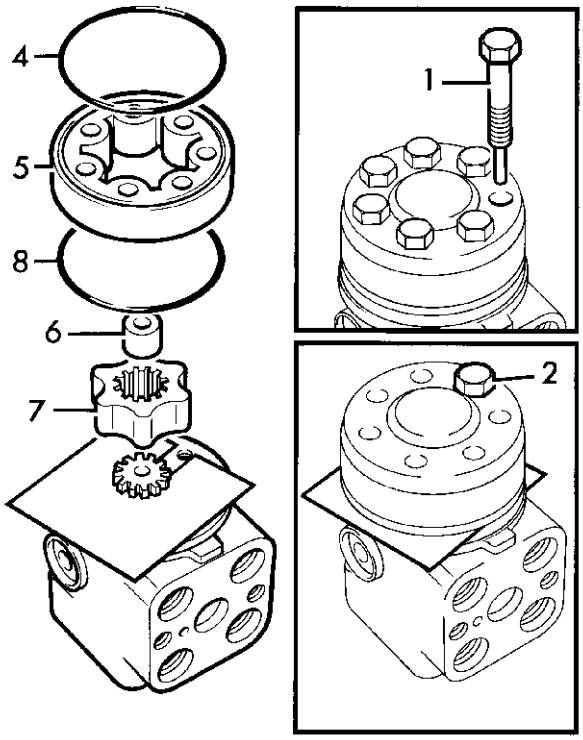

Fig 78.

Table 15. Torque Settings

Item	Nm	kgf m	lbf ft
1	29	3.0	22
2	29	3.0	22

15 **Pressure Relief Valve** (items **25** to **28**), ⇨ *Fig 74. (H-74)*.

a If removed during the dismantling, clean the threads of the adjusting screw **27** and the threads in the bore of the steering unit body.

b Assemble the valve into the steer unit body.

c Check the relief valve setting after fitting the steering unit to the machine. See ***Service Procedures, 2 and 4 Wheel Steer Machines - Testing the System Pressure***.

16 Shock Valves (items **29** to **35**), ⇨ *Fig 74. (H-74)*.

a If removed during the dismantling, clean the threads of the adjusting screw **31** and the threads in the bore of the steering unit body using JCB Cleaner and Degreaser. Allow to dry.

b Assemble seat **35**, ball **34**, cap **33** and spring **32** into the steer unit body.

c Apply JCB Threadlocker and Sealer to the threads of screw **31**. Fit the screw to the depth measured during dismantling.

d Fit plug **29** and washer **30**.

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